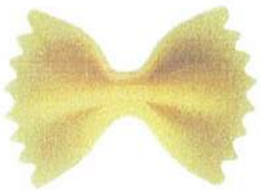
PASTA

History, Technologies and Secrets of Italian Tradition



DIFFERENT TASTES

PASTA

History, Technologies
and Secrets of Italian Tradition

Barilla

PASTA

"Quality" is a noun that any good dictionary more or less defines in the following manner: that which makes something good or bad, large or small, hot or cold, black or white.

When evaluating a product or a service as being of "good" or "bad" quality, we measure the degree to which that product/service corresponds to our expectations. In so doing, we are not, therefore, measuring quality but, rather, we are measuring quality on the basis of a personal opinion, which can evolve and change in time. Consequently, merely producing a good product is insufficient. The product must also be exposed, made known, and its story must be told. Its production and cooking processes must be explained. In our case, this means revealing everything that concerns a simple *spaghetto*.

Our company often uses the metaphor of on iceberg. The "protruding" part of the product is what the mouth experiences, what the customer directly perceives, however, this is but a part of the iceberg. What the cunsumer doesn't see, the part underneath, is enormous, and it is composed of research, verification, studies. It is made of quality.

For us, quality begins with a granule of wheat. Italians are the biggest consumers of semolina in the world, and we need enough of it to produce 7 million plates of pasta per year. Success means having avant-garde production systems, investing in innovation and, especially, spreading the culture that is the foundation of our work, keeping it alive.

In 1877, Barilla was a small shop, operating in Parma, today it is a national and world leader in pasta production. We have been producing pasta for over 130 years. To survive the test of time it is important to be well-rooted and to be knowledgeable of one's product, knowledge that we now wish to share with you.

The Mediterranean Diet was first mentioned in the 70s, when the U.S. Department of Agriculture adopted the pyramid as a symbol, using it to summarize the need to follow a healthy, balanced diet. Forming the base of the pyramid, cereals, recommended for the prevention of the so-called "illnesses of well-being," represent half our daily intake of

energy. The pyramid made healthy cooking a priority. Thanks to science's recognition of the health benefits of the Mediterranean Diet, consumer trends changed.

And so, pasta has become the "queen" of the Mediterranean model of nutrition. Mediterranean, it must be understood, must not be equated with Italian, at least not exclusively; rather, it refers to the habits and customs of an ancient civilization, which has its roots in a gentle and sunny land, rich in cereals. These eating habits were passed down over the centuries, until they became a tradition.

Today, it is no longer necessary to explain the nutritional benefits of pasta. Instead, one might wonder why, in this era of global marketing, such typically Italian food has become so famous the world over. Herein lies the paradox of pasta: the fact that in pasta modernity and innovation coincide with tradition and health. It is true that nothing is more resistant to change than eating habits; however, those of the Italians are so deep-rooted that they cannot be solely dependent on a basal conservatism. We have been eating pasta for too many centuries to say that. Perhaps it is due to the fact that our sensitivity to food has always been grounded in the myth of naturalism. We have inherited this worship of the natural – this wisdom – from our ancestors who lived in the Mediterranean basin.

It is therefore no coincidence that Italy's national dish tallies with current trends and with healtly eating habits.

The increasing popularity of Italian cuisine has led to the need and desire of consumers all over the world to augment their competence in preparing pasta and to learn about the production and preparation processes.

This is why Barilla decided to write this book. It is for all those people who want to master – whether for fun or profession – the culture and techniques of a product which unites nutritional and expedient needs with enjoyment and imagination; a product that owes its eternal youth to its natural simplicity.

Guido Barilla

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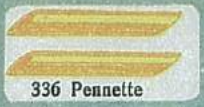
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HISTORY OF AND STORIES ABOUT PASTA

Pasta Becomes an Art

At one time, everything was done manually, with the strength of one's arms, and for this very reason, the sole shape possible for pasta was that of the noodle, known as the *tagliatella*, the *tagliolino*, the *fettuccina*. Just as housewives do today, the pasta was rolled out until it became a thin layer, and cut into strips of varying widths. The strand of spaghetti, at least in the Western World, is really the offspring of a machine, of the act of extruding, and all the other types are offspring of that same machine. Little by little, over time, the varieties of pasta have increased to the point that there are now hundreds of different types, sufficient to satisfy a multitude of tastes.

Initially, pasta was made with a screw-press. The dough was kneaded with bars (kneading-machine with poles)and placed into the press. The energy required for the kneading was provided by human labor or by the humble donkey. Water was not used until later.

Artisans' shops were small pasta "factories," typically located on the outskirts of a town, and on streets which later took their names, such as the Vicolo delle Paste and Via dei Pastini in Rome. Initially, these shops were not considered guilds and were not actually classified as anything in particular, so they were overlooked by the legislator.

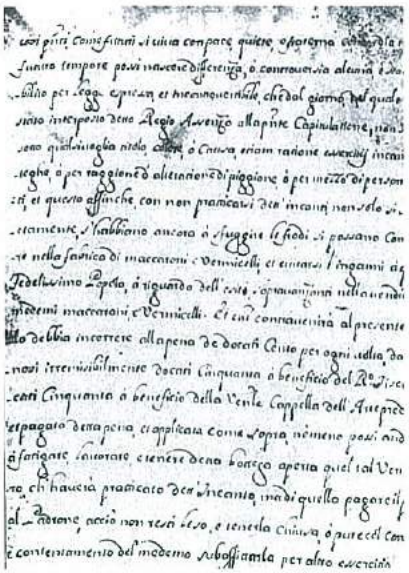
Later, as the profession became more important and the sector developed, the Guild created regulations and drew up specific statutes. In the mid 1600s, the Guild of the Vermicellai, as pasta makers were called at the time, had its statutes approved in Rome. Already a century earlier, however, Roman pasta-makers had gained independence from the *Corporazione degli Ortolani*, the Greengrocers' Guild (a genuine fact!) to protect their own interests in more similar and competitive sectors such as those of the *Fornai* (bakers) and the *Pizzicaroli* (grocers).

During the 17th century, there were so many Vermicellai shops that with a Papal bull dated

Bando Contra Vermicellari (Proclamation against the Vermicellari) *with norms and regulations relative to the sector, issued in Rome in 1702.*

B A N D O
CONTRA VERMICELLARI.

Statute of the Guild of *(Neapolitan)* Vermicellari. (*Codex, Naples, Biblioteca Nazionale*)

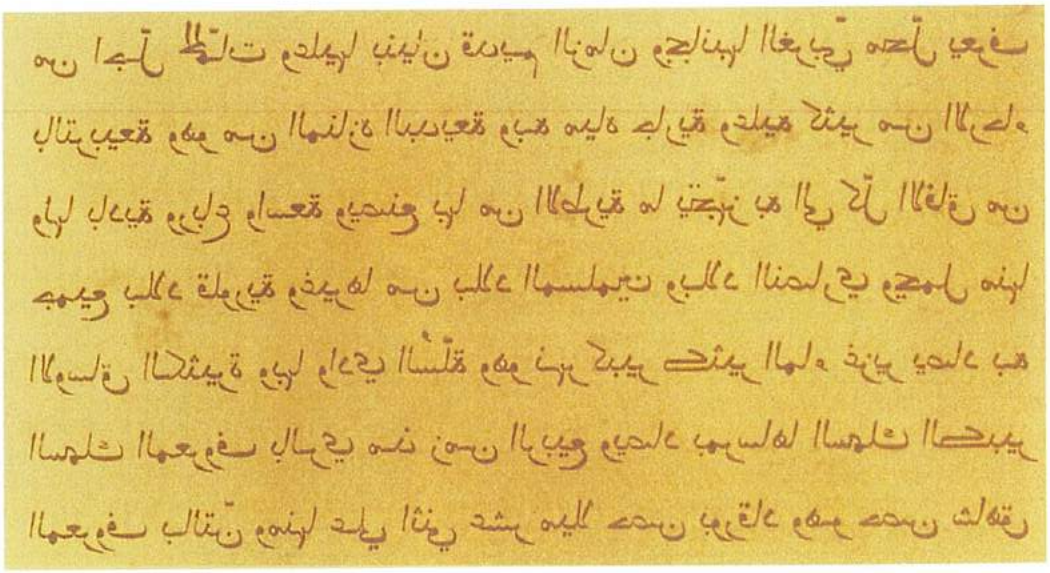


1641, Pope Urban VIII attempted to regulate the sale of pasta by imposing a minimum distance of 24 meters between one shop and another.
In Naples and its surroundings, especially in Gragnano, the true homeland of Neapolitan pasta, taxes for the sale of macaroni are not mentioned until the 18th century; nonetheless, pasta production had began much earlier, in the 16th century.
In truth, thanks to the abundance of water from the many springs that gush forth from the mountains above the city, Gragnano developed commercially thanks to the "white art." First came the windmills and then the numerous pasta factories. Beginning in the mid 16th century, in Liguria, in the province of Savona, the *Fidelari* and the *Formaggiai* (cheese-makers) had formed their own guild.
The Statutes for the *Arti dei Pastai* were approved in Genoa on May 28, 1574, in Savona in 1577, in Naples in 1579, in Palermo in 1605, and in Rome on August 11, 1646.

The dates coincide and it can be confirmed that in Italy the production of pasta (of "maccheroni" in Naples, of "vermicelli" in Rome, and of "fideli" in Liguria) became an "Art," a Guild, between the 16th and 17th centuries.
From a family-run shop, it became first a public store and then a business. When the authorities realized this, they established rules and regulations to govern the new business, determining its statutes, its restrictions in relation to related professions, and, of course, its production limits and sale taxes.
Thus was born a new industrial activity, which, like many others during the course of the 19th century alone, would become a true and proper industry.

Pasta's Place in History

The origin of pasta, however, is deeply rooted in time. In fact, its history begins about 7,000 years ago, when man



Text in Arabic from the geographer Al-Idrisi's The Book of Roger, *written about 1154, which discusses the production of pasta in Trabia, 30 kilometers from Palermo*

abandoned the nomadic life and became a farmer, learning how to sow and to reap. It was then that man's history became one with the history of wheat; and pasta's history begins with wheat. From harvest to harvest, from generation to generation, man learned to improve the way he processed wheat, by grinding it and mixing it with water, by rolling it into a very thin layer of dough and cooking it on burning stones. Many centuries before the birth of Jesus, the Greeks and the Etruscans were already producing and consuming the first types of pasta. The first indication of the existence of anything similar to pasta goes back to the 1st century B.C., to the Greek civilization. The Greek term *laganon* was used to indicate a large flat sheet of pasta cut into strips. The Latin *laganum* derives from *laganon*, which Cicero refers to in his writings. *Lagane* and sheets of pasta conquered the Empire, and, as is often the case, each society adapted the novelty to suit its own traditions.

The Arabs of the desert were the first to dry pasta so that it could be preserved for long periods of time, since during their pilgrimages they did not have sufficient water to prepare fresh pasta daily. They thus created small cylinders of pasta with a hole through them so that they could dry quickly. When did all of this happen? The oldest document is a recipe book written by Ibran' al Mibrad (9th century), which describes a dish that was very popular with the Bedouin and Berber tribes and which is still eaten in Syria and Lebanon today. It is called *rista*, a sort of dried macaroni prepared in a variety of ways, but especially with lentils.

Pasta Capitals: Palermo

Palermo is historically the first, true capital of pasta because the first historical testimonials attesting to the production of dry pasta at an artisan-industrial level go back to the 11th century in Sicily, a region that at that time was profoundly influenced by the Arab culture. Ibran' al Mibrad's descriptions of pasta reveal the wide variety that

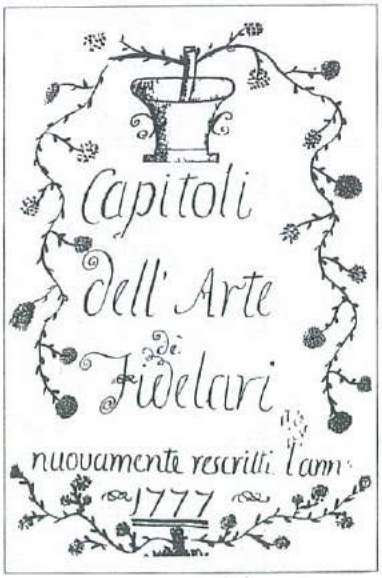
Gaetano Dura,
Mangiatore di maccheroni.
Lithograph, Naples, Gatti and Dura, about 1835

was already in existence in the 9th century. It would appear that knowledge and technology had been transmitted by the Arabs during their occupation of Sicily between the 9th and the 11th centuries. It is certain that in the 12th century, during the Norman domination, Sicily produced dried pasta and propagated its use to the other southern regions. Around 1154, much before the birth of Marco Polo, the Arab geographer Al-Idrisi states that in Trabia, a lovely site, 30 kilometers from Palermo, "much pasta in the shape of strips is made. It is known as *triyan* (from the Arab *itrija*, still used today and derived from the root word *tari*, meaning humid, fresh) and is exported everywhere, to Calabria, and to many Muslim and Christian countries, even by ship." In Sicily today we still find *tria bastarda* and *vermiceddi di tria*; *massa e tria* and *ciceri e tria* in Salento; and *tridde*, a diminutive of *tria* in Bari.

In 1501, as we are informed by the documents published by Major Perni in his volume *La popolazione di Sicilia e di Palermo dal X al XVIII secolo* (Palermo, 1892), the use of pasta was so widespread in the island's capital that its price was among those established by the *meta*, that is, by official price list. In 1548, the *meta* no longer generalized pasta, making a distinction between *virmicelli di simula* and *maccarunj di farina*.

The other region that is historically known for its sale and production of dry pasta throughout the 13th century is Liguria. Presumably, Genoese merchants had imported vermicelli and *tria* from Sicily (the recipes for *tria* found in 14th-century cookbooks are cited as "Genoese"). At the Historical Archives of Genoa, an inventory related to an inheritance drawn up by a notary in 1279 lists "una bariscela (basket) plena di macaronis." Dry pasta, instead, does not appear to have been popular in the north-central region of Italy, where home-made fresh pasta is more the tradition (lasagne, *tagliatelle*, ravioli), as Boccaccio points out.

Maccheroni (at that time, shaped like gnocchi) is



Handwritten title page of the Statutes of the Guild of the Fidelari of Genoa, dating back to 1574 and republished in 1777. (Genoa, State Archives)

first mentioned in a literary work by Boccaccio, the *Decameron* (1348-1353), where Maso del Saggio gives his famous description of Bengodi's country to the foolish Calandrino. He writes, "...and there was a whole mountain of grated Parmesan cheese, above which were people that did nothing else but make *maccheroni* and cook them in capon broth, and then they would toss them down..." Boccaccio had probably heard the term *maccheroni* used in Naples, where he sojourned until 1336.

Pasta Capitals: Genoa

Historical documents attest to the production of dry pasta in Liguria as early as the 13th and 14th centuries. One such document, held at the State Archives of Genoa and dated 1244 is a prescription made by a physician to a Genoese wool-maker, advising him to eliminate "pasta lissa," (i.e. smooth pasta) from his diet. Another document, dated 1316, is a lease on a house owned by Maria Borgogno "quae faciebat

lasagnes" (a lasagne maker).The artisan production of *fidei* (pasta, in the local dialect) became popular in Liguria in the 15th and 16th centuries as demonstrated by the founding in 1574 of the Guild of Pastai with its own statute, the *Capitoli dell'Arte dei Fidelari.* Only three years later the *Regolazione dell'Arte dei Maestri Fidelari* is established in Savona. It is interesting to note that these statutes preceded those of the Vermicellari in Naples (1579) and in Palermo (1605).
What type of technology was used at that time? Vincenzo Agnesi's partially unpublished research mentions a deed of sale dated February 1794 for "a press (in Savona) used for making *fideli,* with all of its required parts and equipment, as detailed in the list."

A decree issued in Savona in 1617 reports that the local pasta was made by machine, "al tornio de' fidelari," while that imported from Sardegna and Sicily was made by hand. The Doria Archive also reveals that in 1592, machine-made *fideli* cost less than hand-made *gnocchetti.* The documents state, "In essence, the semolina was poured into the wooden container of the kneading machine. Using one's hands, a crater was made at the peak of this mountain and lukewarm water was poured into it as the hands began to knead the mixture. A heavy marble grinding wheel was then pushed onto this mixture with a rod, and the dough was worked in a circular motion all around its circumference."
This mixer ("gramola a molazza") was the same machine used in Naples, where it was known as the " gramola a stanga." Typically, the machines were powered by a donkey or a waterfall. Olives cultivated in the area were worked in a similar manner. "When the pasta was well crushed or kneaded, resembling a shiny circular ribbon, it was cut into large pieces and these were placed in the bell or empty cylinder of the press. With the help of a bar and then of a winch, the piston was brought down, compressing the pasta inside bell. Finding no way out except the holes of the copper die, where it was shaped into spaghetti or macaroni, the pasta was extruded and then cut into various lengths."
For one century, this is how pasta was produced in artisan shops. The next phase was drying it out in the open. The technical innovations began in the mid 19th century, especially in Naples, with the first hydraulic press and mixer with blades, used by the Officina Pattison.
Liguria was an active participant of this innovative "revolution," inventing, for example, the "gramola ligure," or the Ligurian mixer. It was made of cast iron and had rotating splined rollers. This type of machine became popular throughout Ligura beginning in 1870. Initially it was known as the "sciancabrasse" (arm tearer) because of the accidents it caused. It became widely used in the South and in Sicily and it underwent many alterations and improvements. With the import of Russian wheat, called "Taganrog," and the advancement of technology, by the end of the 19th century, Liguria, like Naples, had become an important center for the production and export of pasta. In 1890, in the province of Genoa alone, there were 222 pasta factories and 148 in the surrounding area of Savona and Porto Maurizio (Imperia today). Each factory required 5 workers, 2 of which were men, each paid 2 francs and 40 centimes, and 3 women, each paid 79 centimes. Each factory produced about 4 quintals of

Drying of pasta in Amalfi from a Liebig fashion plate (History of Pasta, series no. 1521)

pasta per day, totaling just over 1,000 quintals per year. Pasta produced in Liguria became a specialty of the region so that it was quite common (at least until 1950) to speak of "Genoese pasta" or the "pasta of Naples."

Pasta Capitals: Naples

In the 16th century, the Neapolitans were called "Mangiafoglie" (leaf-eaters) because of their diet based on vegetables (cabbage), bread and meat. In the 18th century, the epithet "Mangiamaccheroni," which in the past had been reserved to refer to the Sicilians, was used in referring to the Neapolitans. Before the 17th century, in most of Southern Italy, pasta was a whim, a luxury, and it could be given up in hard times.

In fact, a Neapolitan proclamation of 1509 prohibited the production of "*taralli, susamelli, maccarune, trii vermicelli*" during periods in which "the price of semolina increased on account of war, famine, or a bad crop season." During the 16th century, Naples was still importing pasta from Sicily.

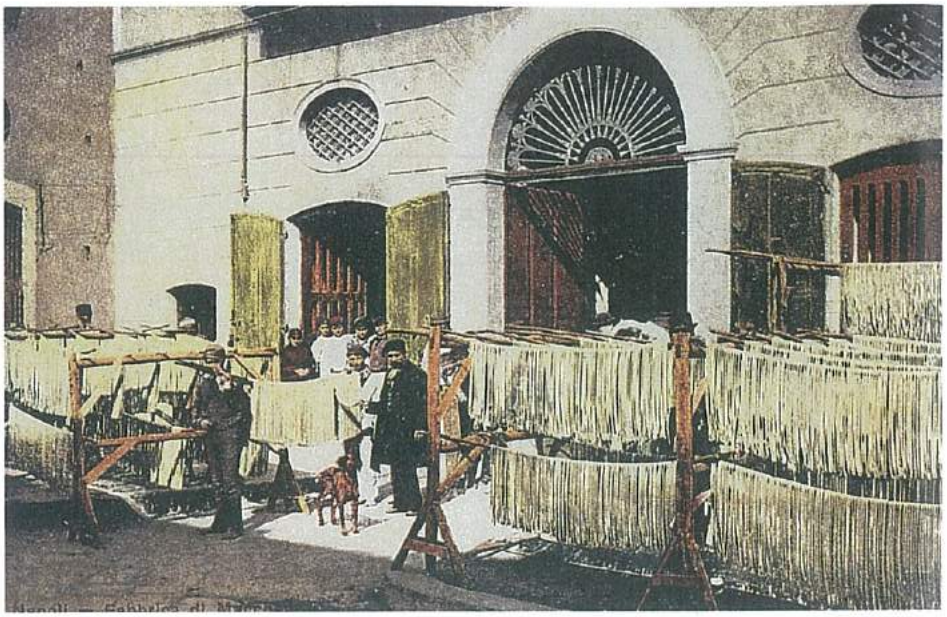
The great Frederick II of Swabia reigned over Palermo and Naples in 1200; therefore, the import and export of pasta was facilitated. Literature made use of this fact, creating fantastical stories such as *Il segreto del mago* (1895) by Matilde Serrao. This legend, set in Naples in the year 1220, under the reign of Frederick II, attributed the invention of spaghetti to Mago (magician) Chico, who was deceived by the beautiful young Jovannella di Canzio.

It was not until the 17th century that, as a consequence of food shortages, pasta in Naples assumed an important nutritional role. With a crisis in the meat industry, and an increasing population, the availability of food became even scarcer. At the same time, a small technological revolution (the diffusion of the mixer and the invention of the mechanical press) was taking place, allowing for the production of pasta at more convenient prices. Pasta and cheese

Pasta shop in Puglia. Late 19th century. (Parma, Barilla Historical Archives)

Open-air drying of pasta in the Neapolitan region from a postcard dated about 1920. (Parma, Barilla Historical Archives)

Drying of pasta in Gragnano in a postcard printed in Naples by E. Ragozino in 1918. (Parma, Barilla Historical Archives)



replaced the traditional meat and cabbage meal. This was a brilliant combination because cheese contains the protein and fat that wheat lacks. This solution kept malnutrition at bay in Naples, unlike those places where the people relied on single nutrients such as corn (*polenta* in Lombardy and Veneto) or potatoes (in Ireland).

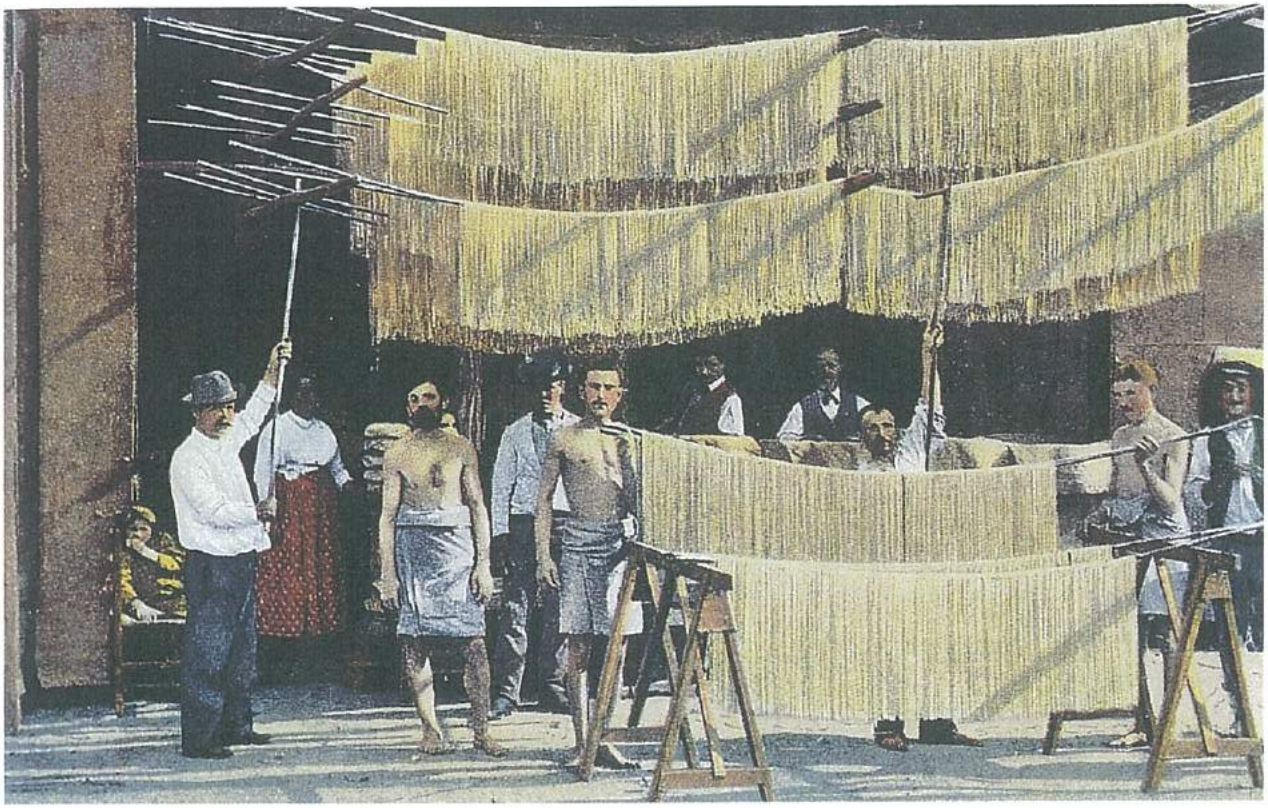
Hurrah for pasta with cheese and...tomatoes

Thus Naples introduced pasta to the Italians for a second time. It become a staple, consumed by the masses, to use modern terminology. Pasta could be bought in kiosks along the road (as illustrated in many prints and paintings of the time), and it could be eaten without utensils or condiment, or with grated white cheese. Pasta was not combined with the tomato until the 19th century. Tomatoes, which had arrived in Europe as a botanical curiosity in the 16th century, with the discovery of America, were not quickly adopted in the kitchen. Later, however, tomatoes triumphed, their success originating in Naples, where they were "married" to pasta. The first documents mentioning the use of the most famous vegetable in the world date to the 17th century.

The *solanum lycopersicum* (belonging to the *Solanaceae* family, like the potato, the pepper, and the eggplant) originated in Peru, where the ancient Aztecs called it "tumatl." It was brought to Europe by the Spanish *conquistadores*. From Spain it then spread to the old continent, finding an ideal climate in the countries of the Mediterranean basin.

Initially, the "Aura Poma" (so called because of its original golden yellow color) was used only as an ornamental plant. It was not until 1778, in his *Cuoco galante*, that Vincenzo Corrado first mentions tomato sauce, without, however, thinking of using it for seasoning pasta.

In any case, the Italians must be credited for having "launched" the tomato. Tomato sauce, boiled in a pot with a pinch of salt and a few leaves of basil, was first used in the early 19th



century by outdoor merchants in the south as a condiment for macaroni.
In Italian cuisine, the tomato became common only at the end of the 19th century, after tomato sauce and mozzarella had been used to make pizza - which dates to the beginnings of human civilization.

Naples and Spaghetti: The Art of Living, The Art of Eating

The binomial Naples and spaghetti influenced literature until it clearly blended the art of living, poetry, and Neapolitan creativity with spaghetti and all that surrounds it. In his book *Napoli: Punto e basta?* Giovanni Artieri writes, "It is a unison filled with life and emotion - the same unison that perhaps suggested combining music and lyrics with panoramic restaurants, as well as with the entire scenery of the gulf and the hills of Naples and the pleasures of eating." Pasta had become a culture. "Certainly," Artieri continues, "it is no longer possible to return to the artisan production of spaghetti, to the 'pasta of the coast,' produced by the myriad of small pasta factories that overlook the divine solar delirium of the Amalfi coast; placed next to each other, distinguished by festoons of spaghetti and *zitoni* and vermicelli drying on canes, they lean against the backs of beautiful straw chairs."
The drying process lay at the core of successful production, and that is why pasta factories were born and prospered along the coast (in Palermo, in Genoa, and in Naples). Giuseppe Prezzolini's *Spaghetti Dinner*, written in the U.S. after World War II, provides interesting information in this regard. He writes, "Naples's role in the history of spaghetti is unquestionable. Although its place of birth and its discovery is still uncertain, we know with certainty where the process used to dry pasta was discovered and perfected. It is a process that allows pasta to be preserved for a long time. Pasquale Barracano, director of the technical journal *Molini d'Italia* has something to say on this matter. He states that 'the problem was not one

of production but, rather, of finding the perfect method of drying pasta, so as to avoid the natural fermentation that would otherwise make it rancid. Such a method was achieved by airing the pasta several times, in a location where changes in temperature, from humid air to dry air, were frequent. At first Amalfi seemed to be the ideal location, then Gragnano was taken into consideration, and finally it was ascertained that the surroundings of Torre Annunziata were in fact better than any other place because the climatic conditions varied up to four times a day.' Much of these cities' success in producing pasta must be attributed to these facts. It is no wonder that there are still many connoisseurs in New York today who would not buy macaroni unless it came from Gragnano or Torre Annunziata. Until the outbreak of World War I, in fact, the most renowned brand-names for macaroni imported in this country came from these two locations." Giovanni Artieri's nostalgia is revealed once more when he writes, "I would not, no, I certainly would not want to witness the disappearance of real spaghetti, of authentic green spaghetti! Green? Yes, from an old Neapolitan expression used to describe a situation or an event occurring in the here and now, on the spur of the moment; something sounding like 'a vierde, a vierde, spavette!' an echo of the cry of the ancient merchants who sold their cooked spaghetti at the corners, in Lavinaio or in Pendino, working-class neighborhoods in Naples [...]." From Neapolitan literature of the 19th century we learn that "maccheroni from Naples are easy to recognize because they are not all rolled up like they are in Genoa. They are completely straight, curved only at the tip because as soon as they come out of the press they are hung from poles and left to dry [...]. Common people eat maccheroni with their hands, lifting them from the cauldron with a wooden fork. They then take them with their right hand, raising them by extending their arms, and bringing the end of the spaghetti to their mouths."

The port of Torre Annunziata , about 1910, with the wharf onto which pasta is loaded in the foreground, from a postcard from the early 1900s. (Parma, Barilla Historical Archives)

Color and technology

Neapolitan pasta was naturally amber in color, that is, translucid yellow, while other kinds of pasta were less shiny and, even if they were yellow, like the Genoese varieties, because they had been enriched with saffron, they were opaque when viewed against the light. Genoa had at its disposal that formidable instrument that is the kneading machine (mixer). Wheat was crushed under its enormous pressure, becoming semolina, but at the same time those tiny diamonds, which constitute semolina, were, at least in part, ground and pulverized, thereby losing their natural glassiness.

Naples relied on a different method. After boiling the granules to soften their exterior, first using the gentle pressure of feet and then with an equally energetic but careful pressure of the rod, Neapolitan pasta makers were able to gradually eliminate the vacuoles between each granule, working on its exterior, all the while respecting its internal structure, as evidenced by the granular consistency of Neapolitan dough. This is the real reason for the shine of Neapolitan *maccheroni*.

The relative precariousness and weakness of the utensils used, press included, was compensated by making very soft dough. In this way, the process was quick, preventing the formation of acid. This made drying the pasta more complicated; however, the skillful Neapolitan pasta makers were able to overcome this obstacle by exposing the pasta to alternate periods of sun and shade. The abundant and rather hot air favored the work of the enzymes living in the semolina and especially in the wheat granule. These enzymes served to make the semolina tastier and render the gluten more elastic, simplifying the mixing process by softening the dough, but possibly weakening the resistance of the macaroni during cooking. This created the need for a protein-rich semolina because proteins coagulate during the boiling phase. Russian Taganrog semolina was valuable in this respect because it had a protein content of up to 19%..

Beyond the Capitals: Pasta Spreads to Italy and Abroad

Although influenced by the climatic conditions that favor or limit the delicate drying phase, local pasta factories were established inland as early as the 18th century, thanks to the initiatives of professional pasta makers and workers who had gained experience in Naples or Genoa. These small factories were often granted privileges, tax exemptions, and franchising rights by the local authorities. Donato Velluti, a Florentine statesman and author of *Cronaca di Firenze*, writes of a Sicilian woman who owned a "bottega di lasagneria" (lasagne shop)from 1367 to 1370.

In 1421, in Milan, an official price-list set the price of lasagne and *pastine*, which was proclaimed by a town crier.

In 1597, Oliviero Minuto successfully obtained permission from the city of Cremona to "produce and sell different kinds of pasta, that is, *maccheroni, tagliatelle, formentini* and the like, as this would certainly be a service to the public since they were an easy and cheap means of survival."

Antonio Frugoli provided the description of a supper held for a group of diplomats in Madrid on February 11, 1625 at which "maccheroni di Sardegna" (Sardinian gnocchi or *malloreddus*) were served.

In 1654, Soliani published Count Francesco de

The Barilla pasta factory in June of 1911, three months after the inauguration of the new plant. The company was active in Parma from 1877. Among the ancestors of its founder, Pietro, is one Ovidius, Mastro dell'Arte dei Fornai" in 1576. (Parma, Barilla Historical Archives)

Lemene's (1634-1704) *Della discendenza e nobilità de' maccheroni* in Modena. The Count, who worked as a magistrate, distracted himself from the business and seriousness of his job by writing poetry.

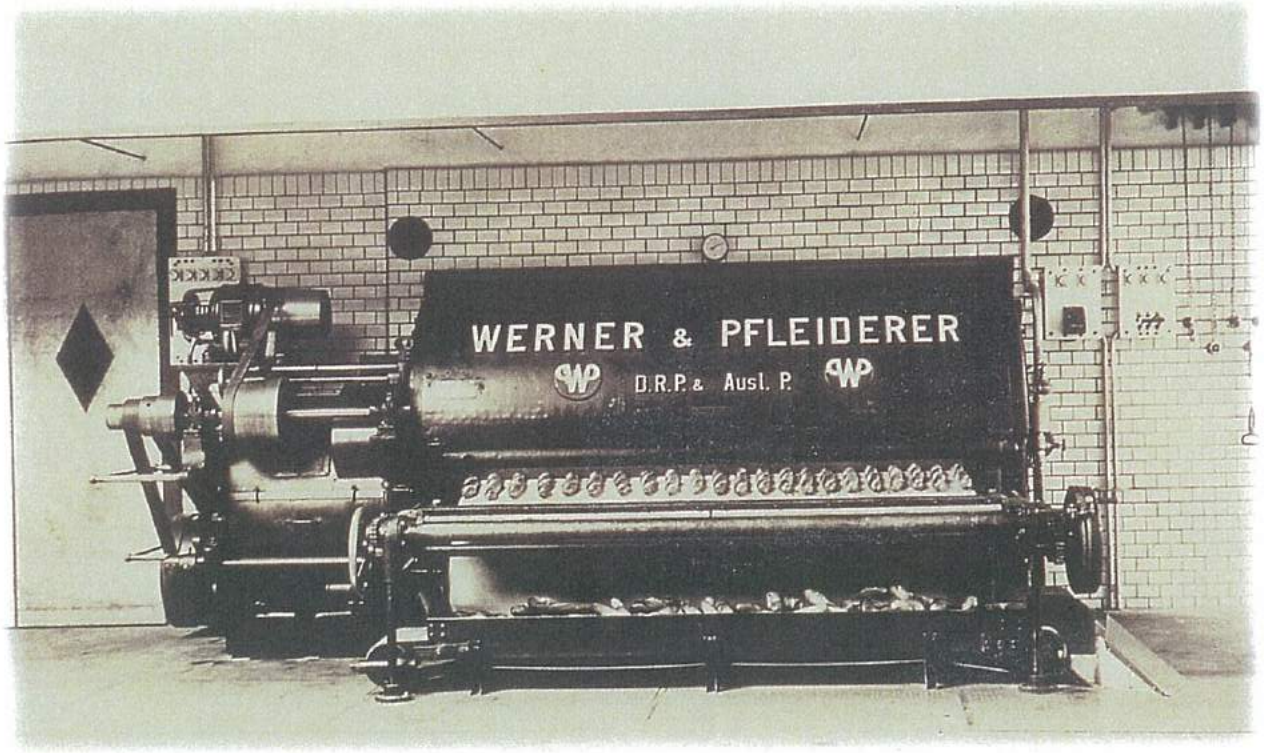
In his poem, Lemene describes the genealogy of his hero Maccarone and narrates how Pasta was born of Flour, prolific mother who, as widow, gave birth to a natural son called Gnocco (who did not have a happy ending), and who had already had other children from her three husbands, Cannella (rolling pin), Kneading-trough and Press. With Cannella, she had generated Polenta and Lasagna (foods prepared with cinnamon or a rolling pin), the latter then becoming the mother of Cake and Raviolo. But the most wondrous offspring, Maccarone, was produced with Press. The descendant of Maccarone is Fidelino, the father of Pestarino. This is the first explicit reference to the two most essential machines in a pasta factory: the mixer and the press.

As early as 1630, Giambattista Basile had cited the die in his *Cunto de li Cunti*.

In 1740 the Republic of Venice had granted the Genoese master, Paolo Adami, the right to "open a factory of fine pastas that are made in Genoa and that the *lasagneri* of this city do not make."

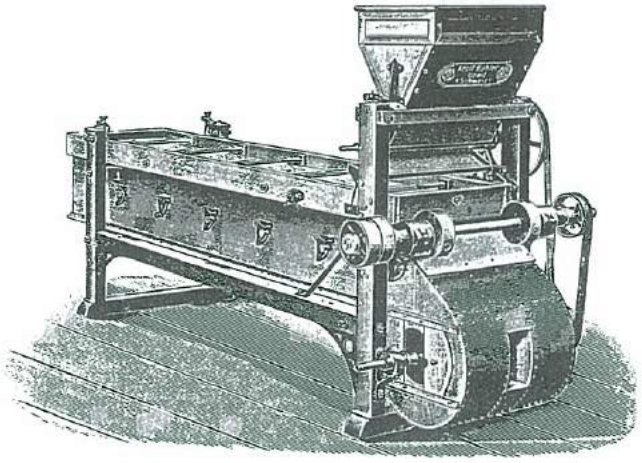
In 1755, in Piacenza, the Bourbon government had authorized Gaetano Verdelli to produce vermicelli and dry pastas. In 1783, the Regulations of the Main Hospital of Santa Maria Nuova in Florence included pasta, lasagne and semolina in three of the seven meals that it provided for its regular patients as well as for convalescents.

In 18th-century Parma, just as in northern Italy in general, dry pastas (long, short or entwined) were mostly imported from Liguria, but also from Naples. Apart from the locally produced home-made dough made with semolina and eggs, which was used for making *tagliatelle, tagliolini, quadretti* and *maltagliati*, artisan products were made in bread bakeries, equipped with a mixer and a press, and were primarily pasta products



The very modern Werner and Pfleiderer oven, installed in 1910 in the bakery of the Barilla brothers. (Parma, Barilla Historical Archives)

to be cooked in meat or vegetable broth.
The semolina was made from local wheat and enriched with eggs. The tradition of *pastasciutta*, dried pasta as we know it today, is more recent. Under Bourbonic rule (1748-1802), Stefano Lucciardi of Sarzana was granted the right in 1763 to produce pasta in Parma to be sold in Genoa. His permit expired in 1799 and was not renewed.
In 1812, in the district of Taro, there were 37 food factories registered, including some that produced pasta.
After Italy was unified, the production of pasta was still limited and produced mostly by artisans. At the 1887 Industrial Exposition of Parma, bakers with annexed pasta "factories" were considered true businesses, having employees and some presses. Bassano Gnecchi, Tullio Cavalli and Guerrino Zucchi were awarded prizes as "producers of pastas for soups." Gnecchi employed 18 workers and had three presses and a gas-run motor; Tullio Cavalli employed 6 workers and had 2 presses with a gas-run motor. Both of them produced bread and pasta.
Barilla also has its origins in a bakery located on Via Vittorio Emanuele in Parma. In 1877 the company began making pasta with a wooden press (50 kg per day). A few years later, with a cast iron press from the Officina Mecchanica Cugini and Mistrali, production increased to 2 quintals per day. In the early 20th century, with the help of the founder's sons, Pietro, Riccardo and Gulatiero, as well as 5 workers, production increased to 25 quintals per day. From there, the company expanded "beyond its walls," becoming a true industry in 1910 when a factory for the production of bread and pasta was established. At that point, Barilla employed 80 workers and produced 80 quintals per day.
Memoirs of the epoch exalt the passion and the courage of the two young entrepreneurs and the advanced level of their technological equipment, which included machinery for producing pasta (mixers, hydraulic presses, drying machines,



A 19th-century image of the "Marsigliese," a machine invented in Marseilles during the second half of the 19th century to clean and refine the semolina before mixing it.

engines) and industrial-size ovens with a continuous flame, manufactured by Werner and Pfleiderer from Stuttgart.
In 1936, Riccardo Barilla bought a total of 6 Braibanti continuous presses. By 1940, the company was producing 800 quintals of pasta and 150 quintals of bread daily, and it employed 700 workers. After the war, under Pietro's guidance, the company became a national business and, under Guido, Luca and Paolo, Barilla entered the international market in the 1990s.

From the Pasta Maker to the Pasta Factory: Industrialization in Naples

Toward the mid 19th century, the industrialization of pasta along the Neapolitan coast became popular. Vincenzo Agnesi recalls that a true pasta industry was introduced in Torre Annunziata in 1840 by pasta makers from Amalfi.
In the areas along the coast, the mills were water-powered. The grinders were made of stone while the semolina was sifted by shaking sieves.
Suddenly, in 1878, a new machine, the purifier, was introduced. It improved the quality of the semolina and, therefore, of Neapolitan pasta. This new purifier was equipped with the same perforated leather sieve used for manually sifting the semolina, except that this one functioned automatically, thanks to an eccentric mechanism that emulated the manual movements.
Particularly important was the jet of air that was blown from the bottom, generated by fans attached to a rotating axis.
This machine had been invented in Marseilles, another important center for the production of pasta, along with Naples and Genoa, and it was appropriately called the "Marsigliese." In essence, where previously five or six were needed to shake the sifters, one operator now sufficed. Oddino Morgari, a trade union organizer, provided the following description, which was published in *Avanti* on April 27, 1904: "A 'revolution' breaks out in Torre Annunziata. Over a five-day period the workers invade and destroy the plants, they

break and burn the 'man-starvers,' destroying every last one of them. They hit the guards, and in one of the conflicts an industrialist is killed. The guards are attacked and one worker is killed in a skirmish. The troops are called in and there are many arrests; fifty of the rebels are sentenced to between 2 and 6 years in prison. The "Marsigliese" are reintroduced everywhere. The struggle of 1878, which condemned the working class, had been so painful that in 1884, when steam-run mills, mixers, kneading machines and mechanical presses were introduced, leaving half of the workers jobless, none of them reacted."
In truth, the first hydraulic press for the extrusion of macaroni dates to 1882. It was made by the Pattison company, the first company in Naples to weld cast iron and work with steel in a significant manner. They fabricated a "pressa a gotto montante," that is, the first hydraulic press with an upright cylinder, in which the bell containing the pasta was pushed toward the fixed piston, positioned above, by hydraulic power. The pasta was then forced to squeeze through the holes of the extruder, where it was shaped and turned into macaroni.
At about the same time, mixers with axles and cams were introduced to replace the foot grinding . A few years later, Pantanella, the most important company in the field of mills and mixers at that time, with factories in Naples and in Rome, sponsored a contest for the construction of a machine that would provide an adequate alternative to the bar. Pattison won the contest by manufacturing a mixer with blades.
The machine worked by placing the pasta on a circular wooden plate, where it was hit by a double bar (the blades), also made of wood, and was rhythmically pushed up and down by two large lateral cams. With each strike of the bar, the plate turned slightly.
All of these machines greatly contributed to improving and expanding production and, in essence, to increasing employment, with the exception of a few periodical regressions. In fact, from the handful of workers employed in 1840, employment gradually increased to the levels required by the union leader Oddino Morgari in 1904. "Torre Annunziata's livelihood is the pasta industry. Wheat arrives there from Russia on two steamers, and 300 dock workers - dockers, packers, boatmen, porters, weighers, etc. - place the wheat on the shore; 500 millers grind it into semolina at 14 large steam-powered mills; 800 pasta-makers turn the semolina into pasta at 54 pasta factories; 200 mechanics, firemen, and carpenters operate and repair the equipment and just as many coal merchants provide them with combustible fuel that arrives from the sea; 300 men from the local corporation of workers perform external duties with hand-drawn carts, and 100 cart-drivers transport the pasta to Naples; 50 porters from the rail-workers' "crew" load them onto trains, 50 fishermen on boats transport small loads by sea; and the aforementioned dock workers, who provided the raw material, that is, the wheat, then receive the finished product, loading it onto large ships, which will take most of the produce to America. Thus, nearly 3,000 people, and, if we count their families, more than 10,000 people in Torre rely directly on the pasta industry for their survival, and they are divided into about 20 different kinds of work, all of them closely connected, however, so that if one of the links in the chain breaks,

The packaging department of the Pastificio Barilla in 1927. (Parma, Barilla Historical Archives)

all of the others must stop. That's when strikes breaks out, life comes to a standstill in the city, and the Italian press must direct its attention to the situation, as it is currently doing."

In truth, Torre Annunziata's golden years were yet to come. In fact, between 1904 and 1914 Torre Annunziata's production of macaroni was limited only by the production capacity of its plants. In practice, the more pasta was produced, the more it found a way of being exported. Every liner that left Naples (and a similar situation was occurring in Genoa) typically transported thousands of crates, made of thin wood, each one containing 20 lbs. of spaghetti or macaroni. The edge of each crate was decorated with blue paper and bore colored labels.

During the same period, the spaghetti industry was rendered richer by new machinery such as the Ligurian mixer. This machine was composed of a rotating, circular cast iron basin, which, cogged under two rotating, splined rollers, their teeth having the same triangular shape of the rod between one spline and the next, pulled the pasta through. Between one roller and another, a spade lifted the dough from a horizontal position to a vertical one.

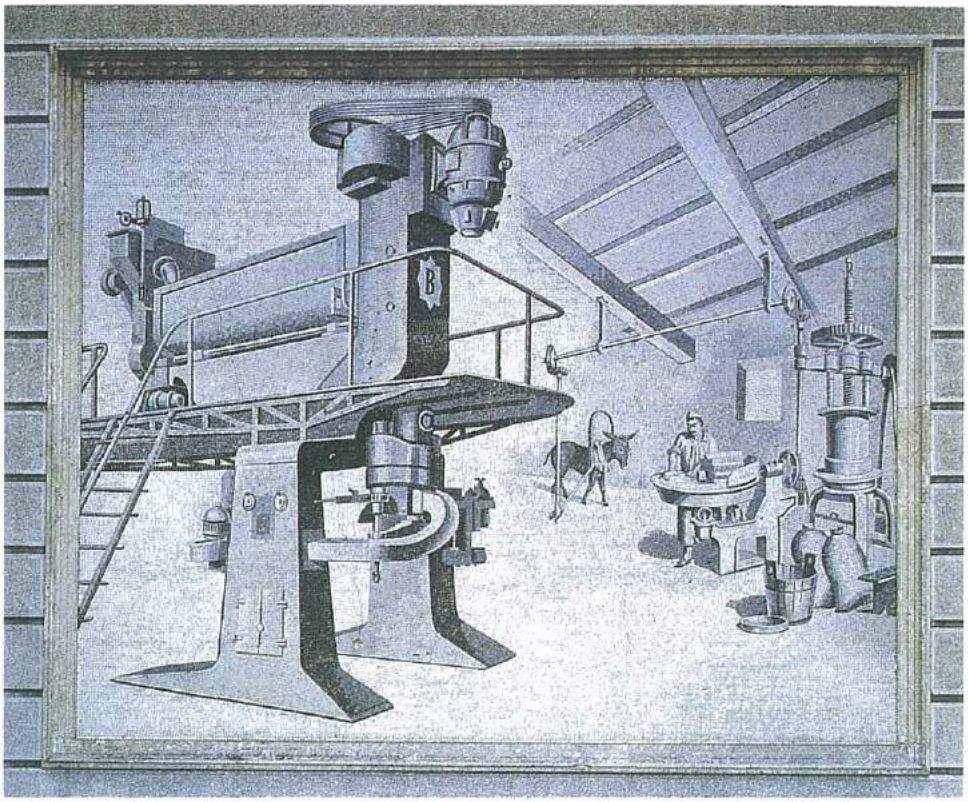
At the same time, other machines were being perfected, and the conditioning of the semolina and its grinding was especially improved, so that the quality of the pasta also improved, reaching quality standards that were probably never equaled again because of the irreparable disappearance of the most famous semolina ever used the world over to make spaghetti.

The Mythical Taganrog, King of Wheat

Along with the wheat produced in Sicily and the region of Puglia in fact, Naples and Genoa both received shipments of the unsurpassed durum wheat known as Taganrog. In Vincenzo Agnesi's words, "The King of wheat used for making pasta was the famous Taganrog, which was lost during Russia's most difficult years. The Black Sea is surmounted by the peninsula of Crimea and,

The shipping department (below) and the finished products warehouse (to the right) of the Pastificio Barilla in 1913. The pasta, which was packaged in large baskets ("corbelli") was shipped by train to the shops where it was sold in bulk. (Parma, Barilla Historical Archives)

therefore, by the Sea of Azof. Where the sea narrows to join the Don, there is Taganrog. From this port was shipped the wheat that Ligurian and Neapolitan pasta-makers preferred. An old label from a Ligurian pasta factory, from a time when half of its production was destined to the State of New York alone, had these words on it: 'Pasta of Taganrog.' The same words are found in the oldest recipe books of Neapolitan pasta makers. What should a good durum wheat be like? The dough obtained from it must have properties opposite those required of common wheat. It must not be elastic, but it must be extensible, resistant and short. It should be easy to tear, but not to be pulled. And this feature is characteristic of Taganrog. In fact, when spaghetti comes out soft from the extruding machine, it is hung from canes for drying, like laundry. The weight of the spaghetti must not cause it to lengthen, because it must be the same thickness throughout. Experience tells us that when the dough is extensible, spaghetti does not cook well. And if the dough is short, it does not produce that stickiness that is so displeasing to the Italian consumer. This is why at the time of the sailboat Italian ships journeyed the long wheat route from their national ports to the Black Sea.
These are the famous black lands of Russia, more ancient than rare, as they are so naturally fertile that they do not require fertilization, not even after many years.
A Russian proverb says, 'Sow stones, wheat will grow.' That is, do not worry about the seed. Even if it is more stone than wheat, the fertility of the Russian land will supply it all it needs.".
With the Bolshevik Revolution in 1917, the export of Russian wheat had ceased, as the land had become the property of the State, and the farmer was forced to turn over all of his wheat to the State, detracting only the part necessary for sowing and for family consumption. The consequences are obvious: the farmer limited his work to sowing only for his family's needs, so that this precious botanical species was lost.

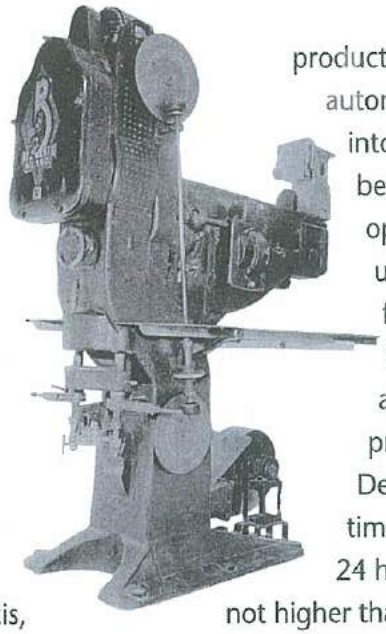


Enrico Bonaretti, La tecnologia del Pastificio. *Mosaic, Parma, former Barbieri factory, about 1938. To the left, the new Braibanti continuous press, destined to replace the traditional vertical press (to the right). (Photo by Giovanni Amoretti)*

Let us conclude with Vincenzo Agnesi's lament: "Taganrog contained no less than 17% gluten in dry and about 20% total nitrate substances. But this was very little compared to the quality of the gluten, which is especially important to good quality pasta. Much to the surprise of those of us who are not initiated: modern researchers of new wheat varieties, despite the extraordinary means available to them, such as select hybridization and cross-breeding, do not know how to provide us with something similar to what nature created in its own time. When we old pasta makers think back with nostalgia to the age-old good that has been lost, we are forced to ask ourselves if Taganrog truly existed, or whether it was an unreal dream, a Blue Fairy destined to dissolve and vanish into nothingness."

Universal Technology

But Naples's "monopoly" on the pasta industry was soon crushed. At the beginning of the 20th century, the focus had shifted to companies' ability to resort to technological innovation, regardless of their dislocation, and logistics; in other words, regardless of a factory's proximity to where the goods were to be consumed.
Technical progress, which had been very slow over the centuries, now accelerated, thanks first to the introduction of the steam engine, and, later, to the invention of electric motors and hydraulic presses. Nonetheless, the innovation that most influenced the propagation of pasta was the artificial drying process, conducted within specially designed environments or cooling systems, transforming an artisan activity into a true industry.
According to Pasquale Barracano, the first attempts at artificial drying were made at Torre Annunziata, and it seems that it was a mechanic named Cirillo who invented the first drier, in which a normal fan acted as a substitute for the sea-breezes of the coast and a simple coal stove replaced the heating function of the sun.
According to Barracano, however, poor Cirillo was

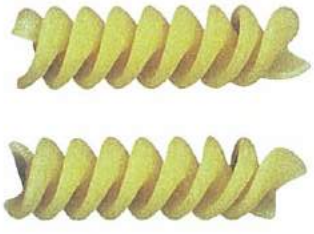


The innovative continuous press invented in 1933 by the engineers from Parma, Mario and Giuseppe Braibanti.

unlucky, and was in fact considered an iconoclast for wanting to use a mechanical process as a substitute for the natural processes of the wind and sun, which were governed by the masters of the profession. Garbuio, a technician from northern Italy, developed a true thermodynamic system for the artificial drying of pasta.
Thus, the first circular driers were invented. Made of wood and shaped like merry-go-rounds, they were arranged around a central, vertical axis, so as to support the framework bearing the short or tangled pasta, or the canes from which the long pasta hung. The merry-go-rounds, moved by straps and pulleys, rotated within rooms specifically heated for the purpose, where the air was broken up by the fans. Static driers, which functioned with forced air, were introduced later.
At the beginning of the century, the production of pasta had gradually been mechanized with tools like the mixing/kneading machine, the press and the extruder; nonetheless, production remained discontinuous and much manual labor was required to transport the dough from one machine to the other, and to unload the extruded product onto the drying apparatus, not to mention all of the scraping and cleaning of the machines after each operation. The true revolution took place in 1933, with the invention of the continuous mechanical press by the brothers Mario and Giuseppe Braibanti of Parma. Delays were eliminated (and the scraps or waste) during mixing, kneading, and extruding procedures, and the quality and hygiene of the product improved. This machine automatically converted the semolina into dough and expelled it, ready to be dried. The only remaining manual operation was the loading-unloading of the pasta onto the frameworks and onto the canes of the drying apparatus. It took another 25 years to connect the press with the drying apparatus.
Despite the improvements, drying times were still very long, exceeding 24 hours, with maximum temperatures not higher than 40∞C. Export was another influential factor in the great development of pasta at the beginning of the century. By 1913, export peaked at 700,000 quintals, most of that going to the U.S.
With World War I, the export of pasta became illegal, ensuring a sufficient supply to the nation. This provoked a crisis in the industry from which Naples never recovered, partially due to the fact that importing countries, and the U.S. in particular, began buying or building their own machines and setting up their own factories. In fact, during those years, the Italian mechanical industry increased because pasta-making machines were in demand worldwide. Due in part to the boom of new machinery and techniques, the manufacturing industry in this sector flourished at a continuous rate, and it began to take root at a constant rate inland as well as in the south, the center and the north of Italy. The first census, taken in 1937, reveals that the nation had a production capacity of 12,500,000 quintals, while actual production was somewhere between the 6 million quintals estimated by the Central

Institute of Statistics in 1936, and the 9,600,000 quintals assessed by the National Federation of Millers and Pasta-Makers in 1940.
Pasta's triumphant success, however, met with some opposition. During the early 30s, the madness of modern innovations made all of Italy tremble. Convinced that for the good of the country it was necessary "to abolish pasta, an absurd Italian gastronomic religion," Marinetti fired a gunshot at a tray of spaghetti, completely destroying it. In 1936, however, he relinquished, and allowed himself to be photographed with a plate of spaghetti; a historical photo, dedicated to his comrades in Bari. Tired of having taken on an absurd battle against pasta, the poet sought reconciliation in Polignano al Mare, albeit in his typical rough style, "It is no use to take it out on me! The pasta of the conspirators of Bari has been liquidated!" (Pasta here intended as protagonist or central figure).
The nutritional value of pasta was once more debated by nutritionists in the 60s only to be completely reevaluated in the 1980s by the Pyramid of Serious Nutrition prepared by the U.S. Ministries of Agriculture and Health, confirming a centuries-old food tradition.
Although the process of production has changed enormously over the years, the product has always remained the same simple mixture of durum wheat semolina and water. While common wheat semolina is also used to prepare fresh pasta, in Italy, durum wheat semolina is used exclusively for making dry pasta.
Durum (hard) wheat and common (soft) wheat are the two most commonly used types of wheat worldwide. In Italy, they are both cultivated though the former is more diffused in the southern regions, particularly in Puglia, and the second is more popular in Lombardy, Veneto and Emilia Romagna. The difference between hard wheat and soft wheat is so important that even Italian law distinguishes the two. Law no. 580, dated 1967, states that only durum wheat semolina and water may be used in the production of dry pasta. This is because durum wheat contains gluten, which makes the pasta more resistant to the cooking process, maintaining the proper texture: al dente.

Very young sellers of straw products in Naples greedily eating a plate of spaghetti. Postcard, 1902. (Parma, Barilla Historical Archives)

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LITERARY PASTA

It is very common to find pasta recipes in cookbooks; however, closer observation reveals that pasta has, over time, carved a niche for itself in the most glorious pages of literary works. Thus it is present in one of Horace's odes, and it appears in the writings of Jacopone and Boccaccio, in Sacchetti's stories, and in Goethe's travel memoirs. Based on Mariaelena Mondelli's in-depth research, we now provide an overview of pasta's role in literature, citing some of the most significant works, knowing that is not an exhaustive list. In fact, we urge readers to inform us of any other such citations.

Horace's Supper (35 B.C.)

In Satire VI of Book I, v. 115, Q. Horace Flaccus (65 A.C.-8 B.C.) describes his frugal dinner, "[...]*inde domum me ad pori et ciceris refero laganique catinum.*" (And so I come home in the evening to eat a bowl of leaks, chick peas and *lagane*. In his *Lexicon totius latinitatis*, Forcellini (1688-1768) explains that *lagane* are "*membranulas ex farina et aqua, quae iure pingui coctae, caseo, pipere, croco et cinnamomo conditur. Illud certum est cibum esse teneriorem et qui nullo lab ore mandi potest.*" That is, *lagane* are thin strips of semolina and water, cooked in a fatty broth and seasoned with cheese, pepper, saffron and cinnamon. This was obviously a very soft (almost mushy) food and chewed easily.

Pulcinella Mangiamaccheroni *in a ceramic figurine manufactured by the Pastificio Voiello in Torre Annunziata. (Parma, Barilla Historical Archives)*

Apicio's lasagne (1st century B.C.)

Several centuries later, in Apicio's *Book IV* of the *De re coquinaria*, *lagane* are mentioned again, this time reworked as a food that was almost symbolic of "rich people's fare." They are in fact layered with various types of meat and fish, boiled and seasoned in an endless variety of ways: "*quotquot posueris, tot trullas impensae desuper adificies*" (as many layers of pasta, as many layers of sauce). Finally, "*unum vero laganum fistula percuties, et superimpones*" (flatten out one of those layers very well and layer it on top,

Pulcinella and Pulcinellino Eating Spaghetti. *Lithograph, 19th century, taken from a painting by Michele Cammarano (1851-1920)*

like a blanket). Apicio's text goes into detailed description of how to prepare the sauce but it does not explain how to make the *lagane*, proof that this type of pasta was well-known at the time and everyone knew how to make it.

Salimbene's Tasty Lasagne (13th century)

Brother Jacopone da Todi (1230-1306) claimed that "granel di pepe vince per virtù la lasagna" (a pinch of pepper enhances lasagne). In describing Giovanni da Ravenna, Brother Salimbene da Parma (1221-1282) described him as a fat and corpulent monk. He stated, "I never saw anyone stuff himself so willingly with lasagne seasoned with cheese." Cecco Angiolieri admonished, "he who uses his flour to make lasagne has a castle with neither a wall nor a moat."

Boccaccio's Maccheroni and the Homini di bona pasta (14th century)

Franco Sacchetti, poet and novelist, described himself as a "rogue and a fat man." In his *Rime*,

Pulcinella and Macaroni

During the 18th and 19th centuries, macaroni could not be dissociated from the character of Pulcinella. "Macaroni are Pulcinella's main attribute," wrote Anton Giulio Bragaglia in his beautiful and carefully documented work on Pulcinella. He continues, "that macaroni, which he carries around even in his pocket, seasoned and piping hot, such as those of the famous Florindo de'Maccheroni, of the 18th century, who had stolen from the Neapolitan theater its most interesting character, using it in the *Don Giovanni*, coupling it with Arlecchino as they await the frightful encounter with Convitato di Pietra. Naples had borrowed these scenes from the Spanish, and Pulcinella adopted them before any of the other masks."

Curious comedies have survived the ages: *Pulcinella maccaronaro*, or *Pulcinella e i maccheroni*. More specifically, plots from these comedies have survived, finding life in the popular tradition, where actors, such as the famous Antonio Petito, Salvatore De Muto, Ernesto Caleca, and the twin talent of the two Scarpettas, embellished the plots, as they improvised, immortalizing the masks.

A very amusing comedy or, rather, a habit of Pulcinella on stage, is played out through lively dialogues between the character and his master, whose portion of pasta Pulcinella always manages to devour with the excuse that he merely wants to taste it. In his role as restaurateur or host, Pulcinella is linked even more closely to macaroni. He nearly always boasts his ability to cook and season macaroni, giving lessons on gastronomy that are very openly Neapolitan. "I am the God of Maccheroni," he claims. And he works purely for the love of it, because his numerous clients, when it comes time to leave, depart without paying the bill ... As he himself admits, though he may not be a god, he is, nonetheless, closely connected to macaroni. Pulcinella's true attribute, however, more than his connection with macaroni, his hunger. Pulcinella is the mask of poverty, the mask of the "proletariat," the grotesque representation of the common person, cowardly, fearful and starving, who defends himself from the great, from the powerful, from the arrogant, and from the sly, with the only weapons he has: cowardliness, deceit, cunning, his jokes, and his comicality. Pulcinella used to say, "I want to eat three times a day for three months, three years, three hundred years." Pulcinella's permanent state of being is hunger, his constant dream, the one that is never fulfilled, is macaroni; that macaroni which in the 17th, 18th, and 19th centuries was already a complete meal, the national dish of the Neapolitans.

(from *Storia dei maccheroni* by Alberto Consiglio)

The mountain of parmesan cheese on which macaroni and ravioli are cooked, illustration of the third story of day VIII of the Decameron *by Giovanni Boccaccio, in a popular print of the 16th century*

he mentions "Lombard soups, lasagne with sauce and fritters with Sambuca."

In the *Decameron*, which Giovanni Boccaccio (1313-1375) began writing in Florence during the time of the Plague, the author told of the delights of Bengodi's country, the land where he who sleeps the most earns the most. He described "a mountain of grated Parmesan cheese from which *maccheroni* and ravioli cooked in capon broth roll down."

Describing scenes of country life, Antonio Pucci (1309-1388) tells of women that "sell eggs with cheese used to make vegetable cakes and sweet cakes and ravioli and other similar fare." It is during this century that sayings such as "being of *buona pasta*," meaning being likeable and good-natured, came into use. To be of "*pasta grossa*," instead, meant being uncouth and wretched. Giovanni Sercambi (1347-1424) wrote: " As the fame of Sir Martino spread throughout the county, some men and women of *buona pasta* went to him, saying..." Boccaccio instead described this man as "Frate Puccio [...] an idiot, made of *pasta grossa*."

Franco Sacchetti's Maccheroni (1376)

Franco Sacchetti tells of a certain Giovanni Cascio who, sitting at table with Noddo d'Andrea, a glutton, is capable of swallowing food that is "practically still boiling." When the *maccheroni* were finally served, "Noddo began forking the steaming hot pasta, gulping it down. He had already swallowed six mouthfuls when Giovanni was still at his first."

Teofilo Folengo and Bengodi's Country (16th century)

Teofilio Folengo (1491-1544) invents macaronic poetry, written in a language that blends strictly Latin terms with "latinized" Italian terms or with Latin endings. The Mount Olympus of the macaronic muses that inspired Folenga was a Boccaccio-like land created by Bengodi in which, among many other delights, there were "a hundred boilers sending their steam up into the clouds, filled with *caciottine, maccheroni* and lasagne." For the author, a native of Mantua, who had spent most of his life in the province of Veneto, *maccheroni* are

very much like huge gnocchi made with semolina, cheese and butter. Nor can it be mere coincidence that in many regions of Veneto, gnocchi are still called *maccheroni*.

Like cheese on Macaroni (1584)

In *Lo spaccio de la bestia trionfante*, Giordano Bruno notes the Neapolitan saying, "the *maccarone* has fallen into the cheese," meaning that something/someone is exactly where it/he belongs.

Who Invented Pasta? (1604)

In his *Catalogo degli inventori delle cose che si mangiano*, Ortensio Lando attributes the invention of macaroni to Meluzza.

Gnocchetti at Court (1625)

Frugoli describes a lunch served to a group of diplomats in Madrid on February 11, 1625, which included "*maccheroni* di Sardegna" (Sardinian gnocchi).

Getting Drunk on Tagliatelle (1630)

In his collection of popular Neapolitan fairy tales titled *Cunto de li cunti*, Giambattista Basile (1575-1633) described the mishaps of a certain Jennarello. After going through a die, the protagonist came out looking "like a *maccheroni*." This is one of the first literary references to the "die" intended as a device whose various perforations determined the various types of pasta.

In *La difesa dell'Adone* (Venice 1630), Girolamo Aleandri describes a scene of daily life at court that indirectly illustrates that the term "fettuccia," intended as a type of pasta, was already well-known at the time, as were its synonyms "tagliatelli," "lasagnette" and "tagliolini." The text, loosely translated, states, "As some gentleman had gathered to play *sbaraglino* at the house of the marquis, Pepoli, one of them jokingly said to another that he was drunk on *tagliatelli*, that is on that soup made of tiny strips of pasta, which in many places in Lombardy are called *lasagnette*, while in Rome they are known as tagliolini (if I am not mistaken)."

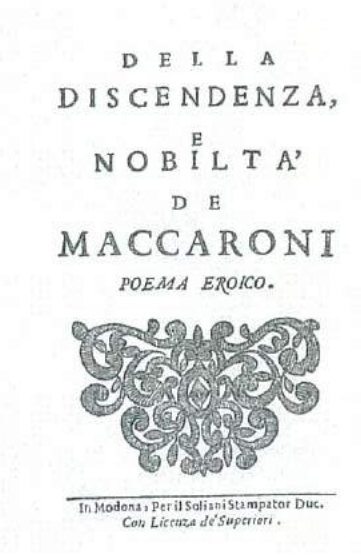
Maccheroni's Genealogical Tree (1654)

Count Francesco de Lemene (1634-1704) publishes his poem, *Della discendenza e della nobilità de maccheroni*, in Modena. In addition to being the first attempt at rationally classifying pasta types, the rhymes also provide one of the earliest testimonials attesting to the two machines whose existence is essential in a discussion on modern pasta factories: the kneading-trough and the press.

Providing a genealogy of the maccherone, the author explains how "Pasta was born of Flour. Prolific mother who, as widow, gave birth to a natural son called Gnocco (who did not have a happy ending), and who had already had other children from her three husbands, Cannella (rolling pin), Kneading-trough and Press. With Cannella, she had generated Polenta and Lasagna, the latter then becoming the mother of Cake and Raviolo. But the most wondrous offspring, *Maccarone*, was produced with Press. The descendant of *Maccarone* is Fidelino, the father of Pestarino."

The count then enters into an ironic narrative on some cities' disputes over who invented the macaroni. In addition to Como (see 1604) "Naples and Bergamo are enemies … They fight and fuss more over *maccheroni* than over taxes."

More than a century later, Camillo Cateni, a Florentine doctor born in 1760, affirmed through a complicated series of "genealogical" sophisms


DELLA
DISCENDENZA,
E
NOBILTA'
DE
MACCARONI
POEMA EROICO.

In Modena, Per il Soliani Stampator Duc.
Con Licenza de' Superiori.


DELLA
DISCENDENZA,
E NOBILTÀ
DE'
MACCARONI.
POEMA EROICO
DI
FRANCESCO DE LEMENE
CANTO PRIMO.
1698.

In 1654 Francesco de Lemene publishes the first edition of the poem Della discendenza e nobiltà dei macaroni *in Modena. It met with much success, and was reprinted in numerous editions. These are versions from the 1698 edition and an 18th-century edition. (Parma, Barilla Historical Archives)*

that "maccheroni are very close relatives of Zeus in both body and soul."

Gnocchi Barocchi (1676)

Lorenzo Lippi's poem, *Il Malmanatile racquistato*, is very interesting from a linguistic point of view because of its rich vocabulary, expressions and phrases, typical of Florentine speech at the time. In the poem he uses the expression "everyone has the right to make gnocchi with his pasta," which means that one can use one's things as he sees best and do as he chooses. "Non so se lo sanno questi sciocchi, / ch'ognun può far della sua pasta gnocchi." (I don't know if these silly people know that anyone can make gnocchi with his pasta.) In his *Annotazioni al Malmantile* (1750), the erudite priest Anton Maria Biscioni specified that "gnocchi are normally made with common flour, but they can be improved by using rice flour and milk."
In *Il Torracchione*, a mock-heroic poem filled with proverbial sayings, written in about 1660 and published posthumously, Bartolomeo Corsini (1606-1673) could not have found a better phrase to describe the ecstasy of the rapture of love when he writes, "Ivi stette ogni altra cura a monte / mandando or da sera or da mattina / a specchiarsi di lei ne' lucidi occhi, / e a far con lei della sua pasta gnocchi." (No other thought in the world but / to go, morning or night / to gaze into her beautiful eyes / and to use her flour to make gnocchi with her.)

Pulcinella and the Pasta Press (1773)

Jacopo Vittorelli writes the humorous poem, *I maccheroni*. In it, he attributes the invention of "that food that makes the soul rejoice" to Pulcinella (character of the Commedia Dell'arte). He explains that though pasta was once hand-made, the various types "are now made by a press, producing more than 12 types..."

Goethe and Maccheroni (1787)

In his diary, *Travels in Italy*, Goethe defines macaroni as a "delicate pasta, made with fine semolina,

The Wizard's Secret

Cicho was a good magician. He worked to give a man happiness and this noble purpose lay before him like a guiding vision. At the end, after many years of work, he could say that he had reached his goal, like others, shouting the word pronounced by the Greek Archimedes, before such a discovery. Then, as all inventors do, he began to flirt with his discovery, to caress it, to give it varied and seductive forms, so that he could say to all men "Here it is! My gift to you, beautiful and complete!"

Next to Cicho the wizard there lived a malicious, sly and spiteful woman. Her name was Jovannella di Canzio and she was the wife of one of the king's kitchen helpers. Mean and slanderous as she was, Jovannella spied on the old wizard day and night, having promised herself that she would discover his secrets, even it meant her death. And try as she might, one day she saw all that was to be seen and understood everything that was to be understood. "Our fortune is made," Jovannella said to her husband Giacomo, and she went to the king to present her discovery. It took her three hours to see to her needs. First she took the best flour, she mixed it with some water, salt and eggs, and then she kneaded the pasta dough for a long time, to refine it and to make it into a thin layer, as thin as a canvas. Then, with a large knife, she cut it into small strips; she rolled the strips like small sticks, and having made a large quantity, and as the sticks were soft and humid, she placed them in the sun to dry. When it came time to eat, she had a pot of boiling water ready, and she threw in the sticks of pasta. While they cooked, she grated a huge quantity of that sweet cheese that takes its name from Parma and is made in Lodi.

When the pasta was perfectly cooked, she separated it from the water and in a ceramic container she added the sauce, little by little, first a tablespoon of cheese, then a tablespoon of sauce. Thus, with the famous dish, she went before the great Frederick, who marveled and was pleased; and he called Jovannella di Canzio to him and asked her how she could possibly have created such a wonderful and stupendous blend. The evil woman said that it had been revealed to her in a dream by an angel. The great king wanted his chef to learn the recipe and he gave Jovannella one hundred gold pieces.

One day, as Chico the wizard was wandering about in a small street in Naples, he was struck by the aroma that was coming from an underground home. He entered the house, saw a pot on the fire, and anxiously asked what it was. And thus he learned of the macaroni that an angel had revealed to a woman, and that had now become known throughout the city. No one every heard speak of him again. Naturally, people said that the devil had taken the wizard away; however, as Jovannella lay on her death bed, after a happy, rich and honored life, the kind of life that the evil usually have the fortune of living, despite maxims to the contrary, in her desperation and anguish, she confessed her sin and died shouting like a damned woman. Justice was never done to Chico the wizard. Only legend adds that in that house in Via dei Cortellari, inside the wizard's small room, on Saturday night Chico the wizard returns to cut his macaroni. Jovannella di Canzio stirs the tomato sauce with a ladle, while the devil grates the cheese with one hand, and keeps the flame alive with the other. Nonetheless, diabolic or angelic that it may be, Chico's discovery has been the happiness of the Neapolitans, and there are no indications that it will not continue to be so for centuries to come.

(Freely interpreted and abridged by Matilde Serao, *Leggende napoletane. Libro di immaginazione e di sogno*, Rome 1895).

Outdoor kitchen and Mangiamaccheroni in a street in Naples. Naples, Edizioni Brogi, about 1910. (Parma, Barilla Historical Archives)

heavily worked, boiled and cut into various shapes." He also describes delightful episodes of Neapolitan life, describing the work of the *maccheronari* who, at the corner of almost every street, "busily make *maccheroni*, especially on days when one must abstain from eating meat, using their pans filled with boiling oil. They sell their product so incredibly well that thousands of people carry their meal away in pieces of paper."

Pasta in a Dream (1820)

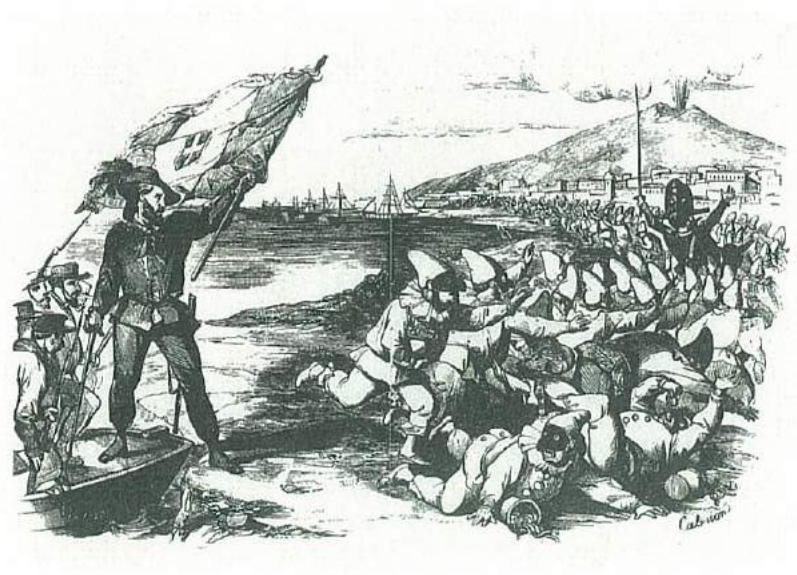
In *L'albergo della fortuna aperto ai giuocatori del Lotto* published in 1820, gnocchi and *maccheroni* pay homage to cabala (an esoteric theosophy and theurgy developed by rabbis). It matters little if one dreams of hunger or of fortune, the important thing is to play the right numbers:
Gnocchi: your cravings will be satisfied, 70.
Macaroni: glutton, parasite, 25, 42, 62.
Pasta, roll out: you will obtain an unexpected supply, 1, 40.
Tagliatelle: a visit from scroungers, 15.

Slanderous Proverbs (1853)

Having abandoned poetry and rhetoric, in 1853 Giuseppe Giusti (1809-1850) publishes *Raccolta de' Proverbi toscani* in which pasta is viewed as an unjust and miserable element: "Lasagne e *maccheroni*, cibo da poltroni," meaning that lasagne and macaroni are food for the lethargic.

Tasty Paintings (about 1850)

Having just returned from the *Grand Tour*, Arrigo Heine (1797-1856) publishes his memoirs in *Quadri di viaggio* in which he provides a passionate vision of Italian cuisine. He writes, "Contemplated from on high, from an ideal point of view, women everywhere resemble the cuisine of their country in some way. Italian cuisine, seasoned with passion, garnished with humor, yet always ideally plaintive, reflects the character of beautiful Italian women. Oh, how often I am filled with desire for Lombard stews, for the *taglierini* and broccoli of lovely Tuscany! Everything swims in oil, lazily and tenderly, and warbles sweet melodies by Rossini,



The flight of the Neapolitan army (the "Pulcinella") before Garibaldi's Army of Thousand in a satirical drawing published in Il Lampione *in Florence on 4 September 1860*

and weeps of the aroma of onion and desire! But *maccheroni* must be eaten with one's fingers, and it is called: Beatrice."

Gastronomic Pilgrimages (about 1850)

Different traveler, different memories. Ferdinand Gregorovius (1821-1891), and his *Peregrinazioni in Italia* are the stimulus for conversation concerning hosts, *maccheroni* and *frittate* (omelettes). He writes, "The voyage to the sea lasts five hours at the foot of the Alban Hills. We stop in Fontana di Papa, an isolated tavern situated amongst the vineyards. It owes its name to a well that was dug upon command of Pope Innocent XII. The Pope makes it a habit to stop there in the month of May on his way to the seaside, where he goes to enjoy the sea breeze in his villa located in Porto d'Anzio. There is much merriment as we sit around tables, eating *maccheroni* or an excellent frittata and drinking terrible wine."

Macaron Politik (1860)

Beyond doubt, following unification, pasta became Italy's national dish. Yet the tale was yet to be told of macaroni's role as a metaphoric ingredient - to use Cavour's ciphered terminology - in Garibaldi's Expedition of the Thousand:

In a letter written by Cavour to Costantino Nigra on June 26, 1860, he states,

"*Nous séconderons pour ce qui regarde le continent, puisque les macaronis ne sont pas encore cuits, mais quant aux oranges qui sont déja sur notre table, nous sommes bien décidés à les manger.*" (We will promote that which concerns the continent, since the macaroni have not been cooked yet, but as to the oranges already on our tables, we are resolute in eating them.)

To understand the allusions, it must be remembered that at the time the letter was written, Garibaldi's campaign in Sicily was nearly over (the oranges are on the table), while the Kingdom of Naples was still to be conquered (the macaroni are not as yet cooked).

The Spaghetti of the Racketeers (from the 16th century to the present)

Racketeers, gangsters and prisoners have their own language, made up of innocent words with cryptic and transverse meanings, in which pasta finds its place.

In their jargon, *tagliatelle* are promissory notes, difficult to digest if they are protested, and *pasta ch'i sardi* refers to a brawl, a fight, and - if in prison - to a revolt. In Palermo, the term *pasta con le sardine* (pasta with sardines) also refers to a fight, but in this case the terminology more accurately describes the motions involved. *Lasagna* (stuffed and layered) alludes to the wallet, and a *lasagnaro* to a purse-snatcher. In prison, instead, the layers of the lasagne are intended as a reference to the hierarchical structure of the prison authorities so that the commissary is known as the *capo lasagna*, and the chief inspector as *tre-lasagne*. This terminology was very popular among the racketeers of the Neapolitan camorra. In Calabria, instead, racketeers use the term *lasagna* to refer to a scar, a knife wound, because of its resemblance to a sheet of pasta.

Yet even the most hardened criminals cannot give up a good plate of "barbed wire," the term used by prisoners to refer to spaghetti.

From E. Ferrero, *I gerghi della malavita dal '500 a oggi*, Milan 1972.

Poetry in the Kitchen (1905)

In his *Canti di Castelvecchio*, Giovanni Pascoli (1855-1912) speaks of the poetry of small things and simple pleasures:

"È l'ora, in cucina, che troppi
due sono, ed un solo non basta:
si cuoce, tra murmuri e scoppi,
la bionda matassa di pasta."

(It is time; in the kitchen, when two are too many, and one is not enough, amidst whispers and outbursts, the blond tangle of pasta is cooked.)

Saba's Rolling-Pin (1944)

Knowing hands, genuine ingredients, the warmth of old things; all of this finds new life in the lyrics of Umberto Saba (1883-1957) in an excerpt from *Ultime cose*. " At the center there was a table where an old woman poured out the ingredients. The rolling-pin lengthened the soft dough, shaping it into a circle."

Tourists and Restaurants (1956)

"Traveling with a guidebook in hand proved to be an exciting experience. It is a grandiose sensation to arrive in an unknown city and to be knowledgeable of one's surroundings and as confident as a native. Following Baedeker's indications, you will easily be able to locate any street in any city, find a particular restaurant (usually one of international fame) on a particular street, enter, and ask for *papà* (literally dad, but used to refer to a friendly and kind boss or owner) Roberto, shake his hand as if he were an old friend, and order his famous *tagliatelle alla bolognese*."

From Georges Mikes, *Italy for Beginners*, London 1956.

Gattopardo's Supper (1958)

Sumptuous magic in the house of the prince flows from Giuseppe Tomasi di Lampedusa's (1896-1957) pen, in a seductive excerpt from *Il Gattopardo (The Leopard)*: "Good manners aside, however, the look of those monumental pies evoked trembling admiration. The browned gold of the exterior and the emanating fragrance of the sugar and cinnamon were but the prelude to the sensation of

Pasta and Futurism

On 28 December 1930, Turin's *Gazzetta del Popolo* published Marinetti's manifesto, which called for a total renewal of the nutrition system, prohibiting pasta, which made heavy the bodies of Italians who, on the contrary, had to be quick and agile "for the new heroic efforts imposed by the race."
"Let us make our bodies agile and suited to the very light aluminum trains that will soon replace the current heavy ones made of iron, wood and steel. Determined that in the probable future conflagration it is the most agile and the quickest who will win, we Futurists, after having liberated world literature with freedom of expression and a simultaneous style, after having emptied the theater of boredom through surprising logical synthesis and dramas with inanimate objects, expanding the plastic with anti-realism, having created geometrical architectural splendor without decoration, having abstract cinematography and photography, we now determine the most suitable diet for an increasingly light and speedy life."
And in the name of the cult of modernity, they decreed that "with its entanglements, pasta binds today's Italians to Penelope's slow looms and to the sleepy sailboats seeking the wind." And they appealed to chemistry proposing "new solutions through the harmony of the flavors and colors of food, the invention of savory, complex moldable food, whose original harmony of shape and color nourishes the eyes and captures the imagination before tantalizing the lips."
They provided various recipes, from *Carneplastico*, created by the painter Fillia, to *Equatore-Polo Nord* by Enrico Prampolini, from aerofood, to meals accompanied by the art of aromas to enhance the flavors, poetry and music its ingredients.
The abolition of pasta, "an absurd gastronomical Italian religion, will free the nation from costly foreign wheat and it will favor the rice industry." Thus, in enumerating his aesthetic, cultural, and hygienic theses, Marinetti did not overlook the economic advantages. In fact, the Futurist polemic, intervening in its own fashion on the control of production, coincided with the inauguration of a national campaign for the consumption of rice.
Following the publication of the Futurist manifesto in the Parisian daily, *Comoedia*, the *querelle* spread throughout France, and from there it soon leaped to the German press, where it was the protagonist of many articles, commentaries, and caricatures. Even the *London Times* repeatedly focused on the subject. From Parma the local *La Fiamma* joined the battle, declaring on 8 June 1931 that it was favorable to macaroni; those very macaroni that were provocatively emphasized and magnified in Barilla's manifesto diffused, with a few variations, by means of a postcard, and hung along the streets of the capital which emphasized the prerogatives through caricature. It portrayed a boy-waiter riding gigantic macaroni, a winking and malicious cupid, rosy and chubby, yet very agile in his movements, ready for take-off aboard that aerodynamic means of transportation. To counter the Futurist criticism of pasta as being "anti-virile," the association to Eros immediately and maliciously triggered a connection between macaroni and male seduction. The subject was dictated by the calendar of 1931, printed by the Industrie Grafiche Ricordi, which Adolfo Busi had designed for Barilla, ironically adopting a sensual and playful expression. Freshness of invention and sharp originality underlie the twelve small illustrations that corresponded to the 12 months of the year. The author extorted the secrets of romantic-symbolist sweetness from the beautiful shapes of pasta, infusing vitality into those cuts, which, presented in such an aesthetic manner in the pages of the sales catalog, they do not fail to make an impact. In a fascinating composition, Busi animates the sky with *stelle* and *stelline*, *farfalle* and *farfalloni*, *ruote* and *sorprese*, gladdening jesters and cherubs. *Conchiglioni* in the style of Botticelli are perfectly suited to an infant Venus, just as an ingenious montage of varying pasta cuts is arranged in the shape of a hairless St. George on horseback, in the style of Depero. Blending with festive irony the secessionist inflections and references to *Decò* with the cylindrical conciseness of the Futurists, the calendar prefigures a tumult of themes, anticipating the poster art that was to follow. The Bolognese illustrator's ironic, playful and fabulous microcosm on one hand, the coeval manifestos that counterpoise chromatic values to the formal consistency of the aggressive tones characterizing the attacks on the consumption of pasta on the other, seem to emphasize the strength of a company that neither economic recession nor the stinging words of the Futurists had been able to weaken. In the end, Marinetti surrendered. In fact, exactly during the days in which the diatribe for and against pasta was at its peak, he was caught eating an enormous plate of spaghetti with the avidity of a threshing-machine at Biffi's. A humorous paper commented the event by publishing the following satirical verses, "Marinetti says, 'Stop, let pasta be banned,' and then he is discovered devouring spaghetti."

(Freely adapted in *Barilla: cento anni di pubblicità e comunicazione*, edited by A.I. Ganapini, G. Gonizzi, Milan , 1994)

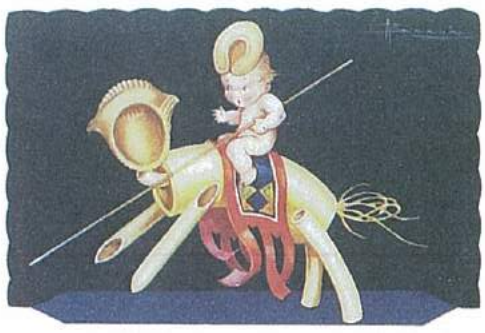
delight, unleashed from within, when the knife tore into the crust. What ensued was an explosion of aromas, followed by the sight of chicken livers, the hard-boiled eggs, the strips of ham, and the chicken and the truffles in the hot, greasy mass of short macaroni; and the meat broth conferred a precious brown color to the whole."

Giuseppe Tomasi di Lampedusa, *Il Gattopardo*, Milan 1958.

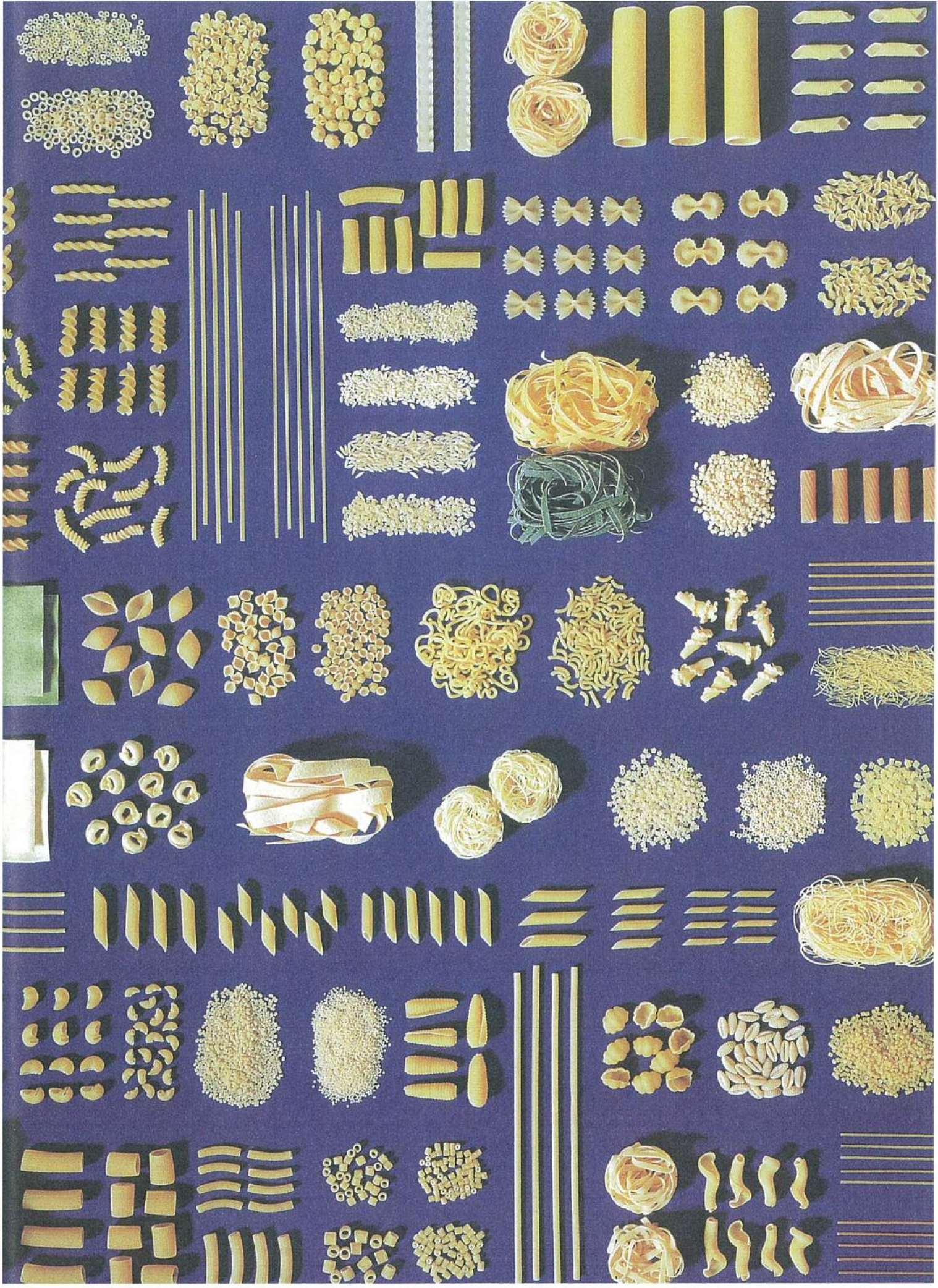
Metaphysical Pasta

Ironic winks, symbology and naturalistic recollections are hidden amongst the various shapes of pasta, in an amusing excerpt from Cesare Marchi's *Quando siamo a tavola* : "Pasta, instead, triggers the thought of a metaphoric waltz: spaghetti, *spaghettini*, penne, *pennoni*, rigatoni, *bucatoni*, *fidelini*, *trenette*, and *tortiglioni*. Some come from zoology, such as *farfalle* (butterflies), *farfalline* (small butterflies), *conchiglie* (shells), *conchigliette* (small shells), *chiocciole* (snails), *creste di gallo* (cock's combs), *code di rondine* (swallows' tails), *occhi di elefante* (elephant eyes), vermicelli, *lumaconi* (large snails), linguine, *orecchiette*(small ears); others have botanical origins: *fiori di sambuco* (elder-tree flowers), *gramigna* (weed), *sedani* (celery); and others still have a religious foundation: *capelli d'angelo* (angel hair), *maniche di frate* (monk's sleeves), *avemaria*, *cappelli da prete* (priest's hats). To these, we add *fusilli*, which are shaped by winding the spaghetti around a knitting needle, and resemble the braids of the soccer player Gullit. In selecting their pasta, Italians are poets, without even knowing it; and then, when they greedily suck on their *bucatino*, they become musicians, making their pasta whistle like a flute in reverse."

From Cesare Marchi, *Quando siamo a tavola*, Milan 1990.



Adolfo Busi, San Giorgio sul cavallo di pasta. *Barilla calendar, 1931. (Parma, Barilla Historical Archives)*



DIFFERENT TASTES

Taste, too, has its rules -ironclad rules - which cannot ignore the tools that nature has given us. Thus, pasta assumes a particular flavor, depending on its ability to bond with a specific sauce. With the help of Peter Kubelka's incisive observations, we will attempt to explore the universe of shapes and flavors.

In culinary art, the most important expressions are obtained with three-dimensional objects, as is the case in architecture.

The mouth is more adept than the eye at analyzing space. In fact, sight helps us to recognize the hardness of stone or the softness of wood, but as children we learned about our surroundings, our world, by touching objects with our mouth and tasting them. Pasta is not judged at a distance from our mouth (unlike the eye); rather, a morsel is evaluated by the tongue and the palate, which, moistening it, become aware of its shape, and dissolve it. Pasta is architecture for the mouth.

The mind receives information concerning not only shape, surface and consistency, but also scent, taste and temperature. Without even seeing them, the mouth can distinguish the various types of pasta; and only in the mouth does each type of pasta develop its particular qualities, which the eye often sees as similarities.

In Italy, there are over 300 types of pasta.

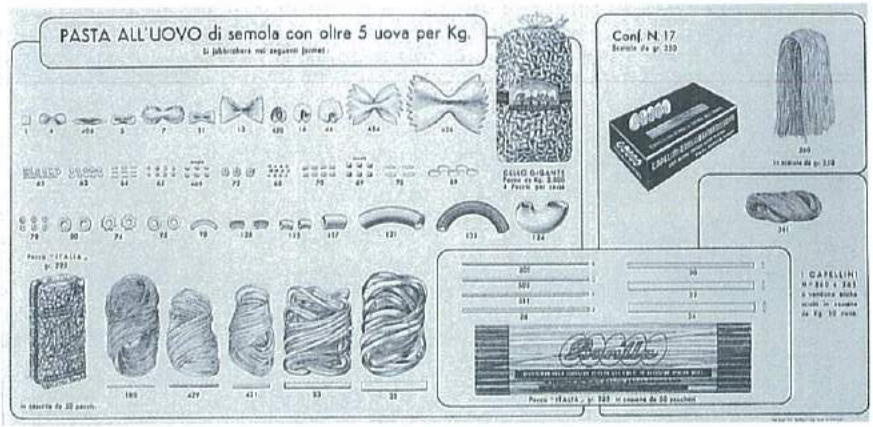
There are categorizes as: fresh pasta (stuffed or perforated); short, thin, rich, smooth, grooved.

The art of pasta, the product of local and regional cultures, has indulged its whims in the many shapes, which are the true foundations of any gastronomical creation based on pasta.

Of all of the dishes that Italy has produced, pasta is undoubtedly the richest in type and specialty. The tiniest locality can be identified by its particular specialty.

It is through this extraordinary variety that the evolution and development of pasta must be traced. Massimo Alberini, historian of gastronomy, has attempted to reconstruct the "history" of pasta, beginning with its shapes.

Egg pasta. Barilla catalog, 1938. Milan, Pizzi e Pizio. (Parma, Barilla State Archives)



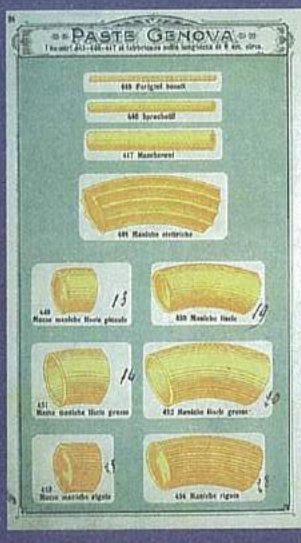
Some of the pages from the Barilla catalog of 1916. Pasta was still categorized according to regional typologies (Pasta Bologna with eggs; Pasta Genoa, made with semolina, short; Pasta Napoli, made with semolina, long). (Parma, Barilla Historical Archives)

The First Shapes

Gnocco was the firstborn, but his brethren were the result of manipulating the water and semolina mixture manually, or with simple tools; and so were born the numerous local variants: *orecchiette*, *trofie*, *cavatieddi di Puglia* and others. Later, it is learned that by subjecting the dough to the pressure and the back-and-forth motion of a smooth and evenly weighted cane, it is possible to obtain a thin layer of dough. Hence the creation of Roman lasagne. At first they were fried, but over the years it became common to boil them. They were followed by the creation of a range of similar shapes, their names originating in two linguistic roots. In Central Europe, where that thin layer of dough had its own origins, separate from those of Italian lasagne, the Latin term *nodellus* was used, becoming *nouilles* in France, *nudeln* in Germany, and *noodles* in the English language. Italians preferred to name their pasta according to the cut (*taglio*) that they were given. Hence, the terms *tagliatelle*, tagliolini, *taglierini* or, considering what the cut produced, fettuccine, *fettucce*, or in the Ligurian dialect, *piccage*: all of them being good things to eat or, rather, to "pappare" (*pappa* is a term used to refer to baby food and is associated with something good). Thus the terms *pappardelle* in Tuscany and *paparelle* in Scaligera and its surroundings. Short pasta also originates from this thin layer of dough: *farfalle* (known as *strichetti* in Emilia), which are rectangles of pasta wrapped around a shagreened stick, thus became *garganelli*. *Corzetti*, which are not only delicious but also pleasing to the eye, originated on the west coast of Liguria. *Corzetti* are made by pressing the dough between two "molds" of engraved wood, so that the pasta takes on the shape of a bas relief medallion decorated with flowers, stars, olive branches and human profiles. It did not take long to progress from a "closed mold" to one with a hole. Thus the modern extruder was born of the simple tool originally used to make home-made *passatelli*.


PASTA ALL'UOVO BARILLA
SENZA COLORANTI
CONFEZIONE N. 10
CONFEZIONE N. 11

PASTE
BOLOGNA
FABBRICATE CON OTTIMI PRODOTTI
leggermente ravvivate
con NAFTHOLS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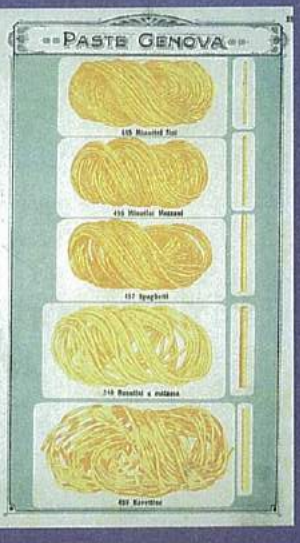
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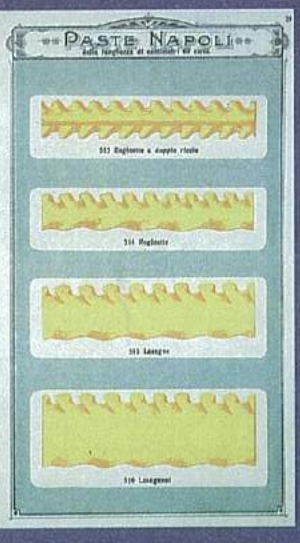
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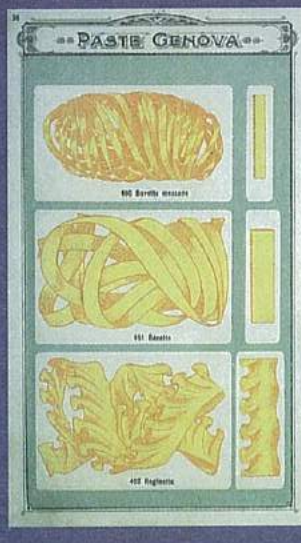

PASTE GENOVA


PASTE
NAPOLI


TORTELLINI


CASA FONDATA NEL 1877
CATALOGO 1916
G.R.Fli BARILLA & C.
PASTIFICIO
PARMA
ITALIA


Condizioni di Vendita.


PASTINA GLUTINATA BARILLA

Barilla catalogue, 1950. (Parma, Barilla Historical Archives)

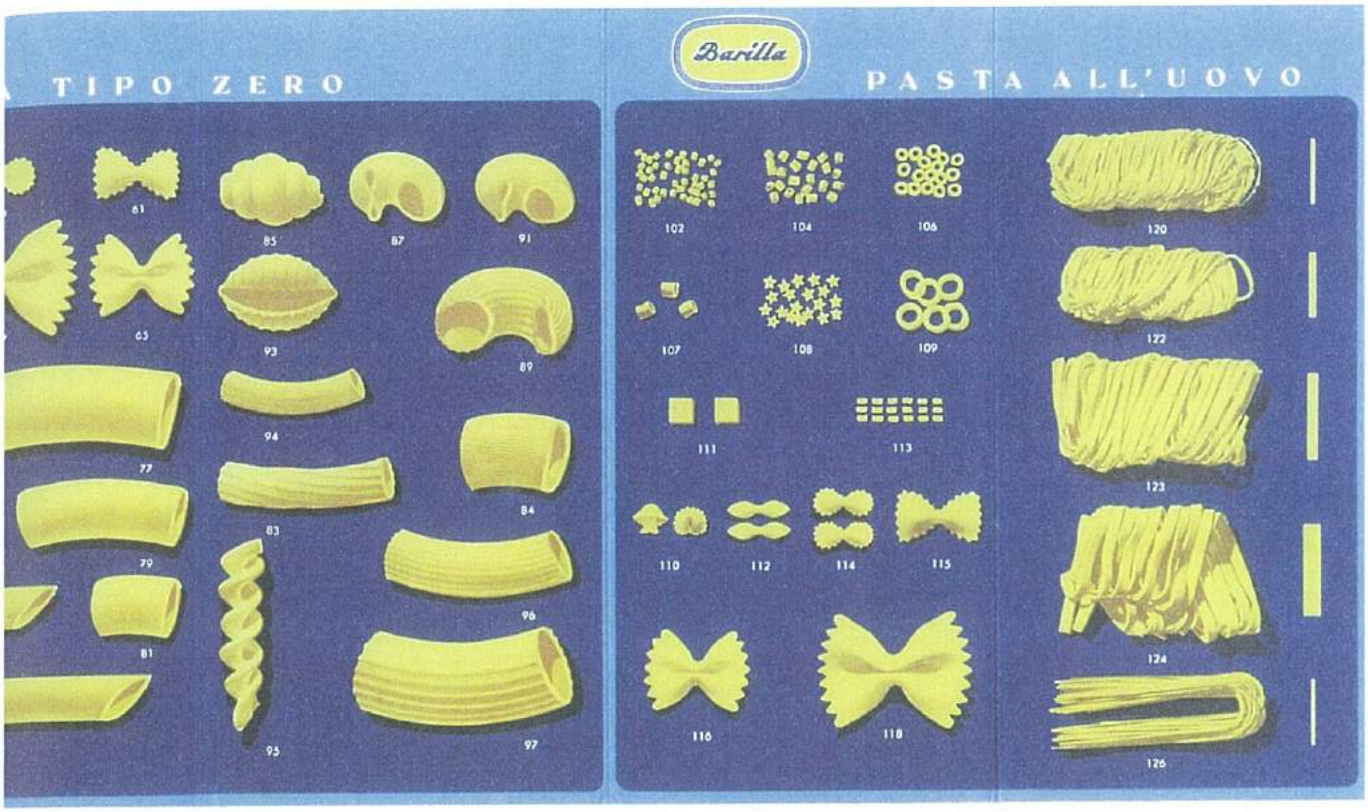
Technique, Skill and Imagination: Pasta Names.

To sell more pasta in a competitive market, it was important to produce good pasta and create new shapes. Artisans known as *trafilai* or extruders, capable of using the bronze disc that covered the press to make holes that were exactly alike, were very skillful and rich in imagination. The pasta factory posed no problems: it was as simple as changing the extruder, and the new shape was ready for drying - with the aid of the air and the Southern or Ligurian sun. The product was then packaged in wooden crates or large baskets containing from 66-110 lbs of pasta each. As the decades passed, technical and scientific progress perfected production, increasing the quality, raising it to standards similar to those in force today. We have said that a great change took place with the introduction of the extruder, but how many types of pasta did the *trafilai* truly invent? Extant lists from many of the pasta factories indicate that there were from 250 to 300 different types of pastas.

The first category is simple and spontaneous: long and short pasta, and *pastine* (for making soup). It had two "parallel" categories: cylindrical pasta, which in the factory corresponded to homemade pasta, and an independent category for stuffed pastas.

Long pasta was divided into two types: cylindrical, with or without a hole, and rectangular or "convex." The former boasts the original pasta, vermicelli and spaghetti, with diminutives such as *spaghettini* and *vermicellini* (alluding to smallness), or the opposite, *spaghettoni* and *vermicelloni*, or with their proper name such as *capelli d'angelo*, *capellini*, *bucatini*, *perciatelli* (perhaps from the Neapolitan "pertusio," meaning hole), *mezzanelli* and, the ancient name, *zita* and *zitoni*, traditionally prepared for weddings (*zita* is the *zitella*, meaning spinster).

"Rectangles" are the commercial adaptation of



the long *tagliatelle*. If they are lenticular, they are known as *linguine*, *bavette*, *tagliarelli* or *lasagnette*. This is where the most famous name of the group comes in, the Ligurian *trenette*, from the same word root for shoe strings. A special shape of the "long" pasta includes *fettucce*, characterized by a wavy border: they were typically known as *lasagne ricche*, but after they were dedicated to the wife of the King of Italy during his visit to Naples, they become known as "*reginette*."

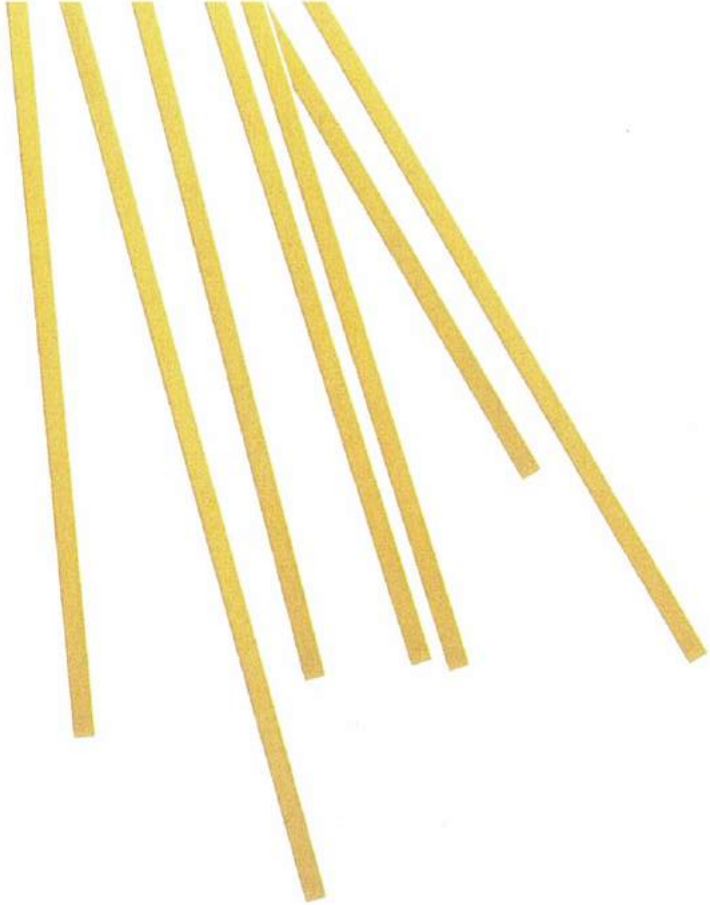
We must limit our list of entwined pastas for the sake of time and space, so we mention only *fusilli*, *eliche* and *riccioli*.

Though formerly vast, the category of *pastine* (used for soups) is now very limited. It includes: *puntine*, *risoni*, *stelline*, smooth and grooved *anellini*, *quadrucci*, the various seeds (melon, apple, chicory), while the alphabet, playing cards, animals and other fantastical creations have disappeared. The *corallini* category still exists but the pastas have almost completely lost their original connection. Inspired by the beads of the rosary, the tiny *avemarie* and *paternostri* were named for the prayers recited by mothers.

Names for Macaroni from Current Events and the Imagination

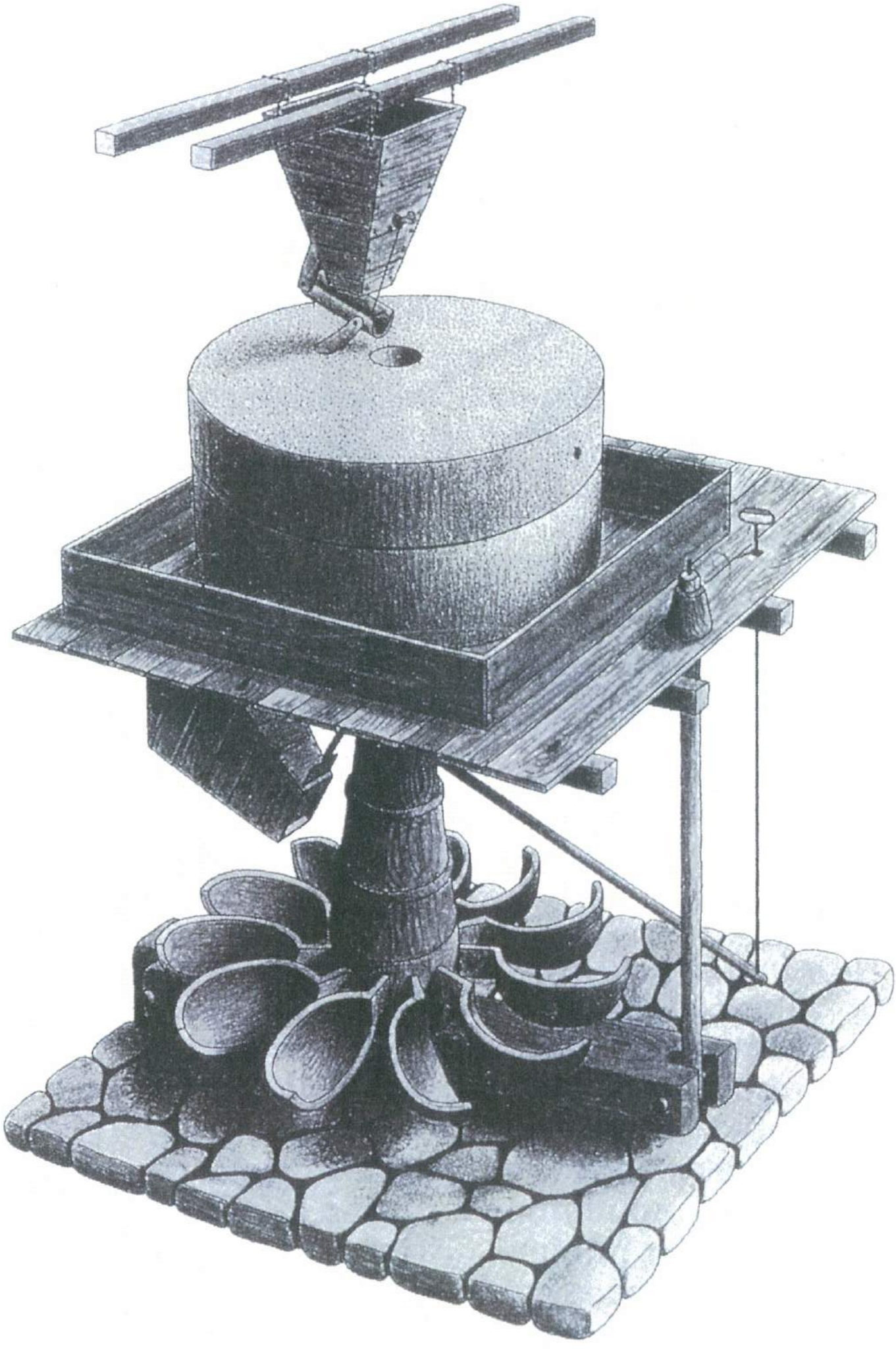
Here we delve into one of the most amusing areas of the history of pasta: giving pastas names attained from current events. At the end of the 19th century, *ditalini rigati* (a vast category, comprised of a variety of sizes) were also called *garibaldini*. Perhaps someone in the Savoia family (or the daughter of a pasta maker) gave *fettuccelle ricche* the name *mafalde* and *mafaldine*, though in Libya they were known as *tripoline* and *bengassine*. In much the same manner, *assabesi* (a type of large shells) were coined when ships landed at the Bay of Aseb, on the Red Sea, in 1882. Soon after they became known as *abissini* while *chinesi* and *chinesini* (shells) had already been in existence for some time.

An attempt to introduce *fasci littori* proved



unsuccessful, not so much for political reasons but mostly because of the way they were cooked. Other attempts at innovative ideas took place after the war. In the 50s, *creste di gallo* (cock's combs), also known as cimiere, found their way onto the lists, as did *ruote* or "wheels" (with spokes), *radiatori*, *gigli* (lilies), and before the acronym UFO was used, *dischi volanti* (flying saucers). They were followed by "floral," erotic, celebratory and illustrated pastas. In 1983, the glorious Voiello pasta factory in Torre Annunziata attempted innovation by entrusting Giorgetto Giuggiaro (a designer from Turin) with the project for a new cut. The result was the *Marille*, which, though very successful with the press, were a fiasco in the cooking pot. In 1987 Barilla introduced a new line: the "exclusives," born of the mind and experience of Carlo Mori, an extruder from Parma. The new line included *Bifore*, using the "B" from Barilla's logo; *Trifogli*, spaghetti with three grooves that made cooking faster; *Nicchiole*, inspired by the shape of mushrooms were skilled ensnarers of sauces; and *Castellane* were refined, grooved shells, ideal for cheese or vegetable sauces.

In the age of electronics and Internet, a pasta factory from the Marche region patented the most recent innovation: a pasta shaped like an "@," best eaten with meat sauce and, preferably at a distance from the computer.



WHEAT AND MILLS

Ubaldo Delsante

The most widely eaten cereals are: wheat, corn, rice, rye, barley and oats. In the past, millet and emmer were also widely used, but currently they are almost exclusively used to feed animals.
It seems that wheat originated in the eastern basin of the Mediterranean.
As it fears neither cold nor hot temperatures, it has spread to every geographical location, even at high altitudes.
In the Middle East, in the high valley of the Jordan River, the remains of a prehistoric village were found. Research on the village, dated to 7000 B.C., reveals that its inhabitants consumed wheat and subsequently cultivated it. In Macedonia, a few kilometers west of Salonika, archeological digs have revealed the remains of a permanent hamlet from 6000 B.C.
The artifacts that were found demonstrate that man had stopped being a nomad in those lands and that he had begun to live in structured communities. He had begun to raise animals, even using them for tilling the land. Perhaps the "discovery" of wheat arrived from Asia Minor via the Aegean Sea, expanding into Greece and from there, to the whole of Europe.
This theory can be substantiated by the discovery of several settlements, dated to about 5000 B.C., along the Danube. Highly civilized and cultured peoples inhabited these villages and their nutritional habits were based on cultivating wheat products such as bran, barley and millet.
Over time, the use of wheat in the Po Valley disappeared. The Italic population mostly cultivated spelt and barley (with which they made *polenta*, adding linseed, coriander and salt), but also millet and wheat.
Strabo's and Polibio's writings indicate that the Romans cultivated wheat. Under the Roman Empire, wheat became a basic food product for the peoples of Western Europe and the Mediterranean basin.

Functional illustration of a mulino "a retricine," *or a mill with a horizontal wheel*

Set of "hourglass" cereal grindstones operated by animals in the bakery shop in Pompeii. (Parma, Barilla Historical Archives)

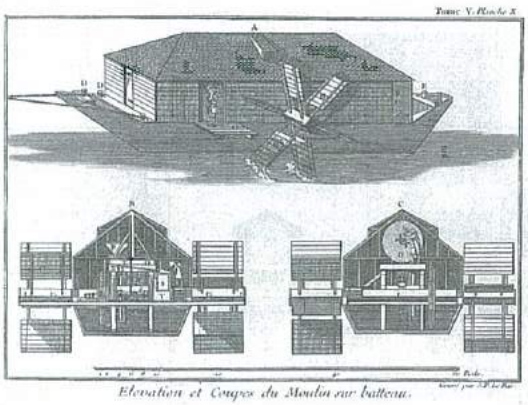
A turbine-operated blade with chestnut wood "spoons." It could also be set in motion by a small jet of pressurized water

Mills and Wheat Grinding

As wheat cannot be eaten in its natural form, man soon discovered how to turn it into semolina by using pestles, mortars, and other manual tools, eventually inventing grindstones, operated by man himself or by animals, and later by the force of the wind or water.
Cereal mills were introduced to Western Europe during the Roman Empire, time at which the water of rivers and torrents became the main source of energy, replacing human force.
It was during the Middle Ages, however, that these mills, which represented a milestone in the economic and social growth of rural populations, underwent a tremendous evolution.
The earliest-known watermills originated in the mountainous regions of the Middle East and were known by the Greek term "a ritrecine" (literally, sweep-net) or, in modern language, turbine. They were horizontal and were introduced in Europe some time during the 1st century B.C.

At that time, the Romans had built a new kind of mill, which, when operated in certain conditions, was more efficient than the imported horizontal one. The vertical mill, also known as the "Vitruvian" mill, was accurately described by the Roman engineer Marcus Vitruvius Pollio (1st century B.C.) in his *Treatise on Architecture*. Floating mills populated perennial and constant streams of water like the Po River. Built on two hulls connected by beams and platforms, and anchored at shore, these mills were powered by the water that set the vanes in motion. In ancient times, the task of manually grinding the wheat with mortars was usually left to the women. As mills evolved, at first operated by animals or slaves who made the grindstones rotate, and then by water power (in certain geographical areas by wind power), grinding became a man's job. This was also due to the technical complexity of the work.
For the most part, women continued to transport the wheat to the mill, while the

Illustration of the functioning of a river mill in a plate taken from the Dizionario delle Arti e Mestieri *by F. Griselini, published in Venice in 1768-1778. (Parma, Barilla Historical Archives)*



Floating mills anchored along the bank of the Adige River in Verone, near the church of Sant'Anastasia in the early 20th century (Parma, Barilla Historical Archives)

preparation and the baking of the bread was their responsibility alone.

Mills did not become widespread in Italy until the 2nd century, when the "medieval industrial revolution" multiplied their activity.

At that time, the different types of mills were located in various areas, depending on the geographical characteristics of the territory.

The history of mills thus paralleled that of the royal rights for using public water.

Control of the waters was passed on from imperial authority to the feudal vassals, to the bishops and to the monasteries, and finally to the free municipalities.

For noble families, the mills represented a definite source of income, a much-wanted royalty associated with aristocratic power, which became a point of reference, both social and economic, for the farmers of the time.

In fact, having control of the mills, their owners and tenant farmers also meant having direct control on the income of each citizen, and, therefore, of knowing the quantity of wheat that each individual brought to be ground in relation to the number of mouths to be fed.

Water and Technology

The architectural structure of the mills and the technology required to operate them are historically known, thanks in part to the extant remains of old buildings.

Whether they have vertical or horizontal wheels, mills are never set in motion directly by the stream of water near which they are located; rather, they receive water by means of a derivation canal, which is artificially dug in the ground. This allows for greater control and more accurate adjusting.

The canal has a rectangular shape with a flat bottom, and its banks are sometimes equipped with secondary lateral water plugs from which irrigation water is obtained. Close to the mill, the canal widens like a funnel, forming a basin from which the water is directed on the wheels via the

The last river mill anchored to the left shore of the Po River in the 1950s

"gutters." A small drainage canal deviates any excess water. The basin is then equipped with as many sluice-valves as there are wheels to be set in motion. Using the light obtained by lifting the sluice-valve, water is poured into one or more of the inclined canals, which are often made of chestnut- wood, coming into contact with the wheels.

In mills with horizontal wheels, each wheel directly moves a single pair of grindstones, without resorting to any kind of gear wheel. The wheels are located inside the mill, in a (usually) vaulted basement. They are positioned parallel to the axis of the building's pavement. The site has two openings, counterpoised to each other, each of them opening directly onto the exterior to allow the inflow and outflow of the water. The axle, which mediates the motion between the wheel and the millstone, located in the upper area, is generally made from a large trunk of oakwood or beechwood. It is 13.12 - 19.6 feet, and 15.6 -19.5 inches wide. Made of superimposed stone discs, the millstones are 3.9 - 7.8 inches high, 31.2 - 50.7 inches in diameter, and they weigh 880 - 1.540 lbs. The fixed grindstone or "lower millstone" and the mobile grindstone or "upper millstone" are separate. The speed of rotation is 90 to 100 revolutions per minute. Located above the grindstones is the feedbox, a wooden box with an inverted pyramidal trunk. The wheat is poured into the feedbox and the grains fragmented, by extrusion, between the splined grindstones, designed to allow the semolina to slide out. Below the framework that protects the millstones, a large crate collects the semolina. Periodically, due to the wear and tear over time, the millstones had to be removed and reshaped with a hammer, to make the surface more rugged. Once the semolina was ground, the bran had to be removed manually, using sieves or sifters. This was usually done directly at the mill, but sometimes it was done by local farmers. Separation of the bran and semolina

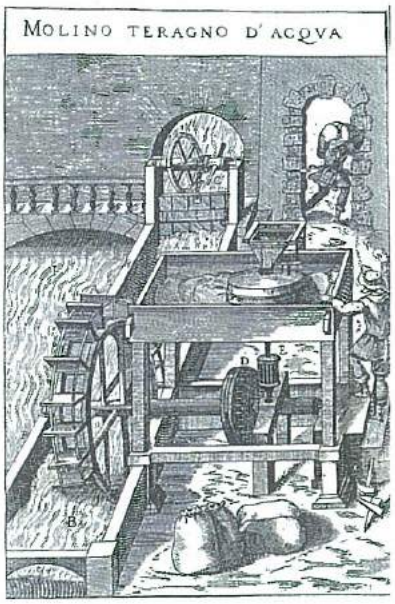
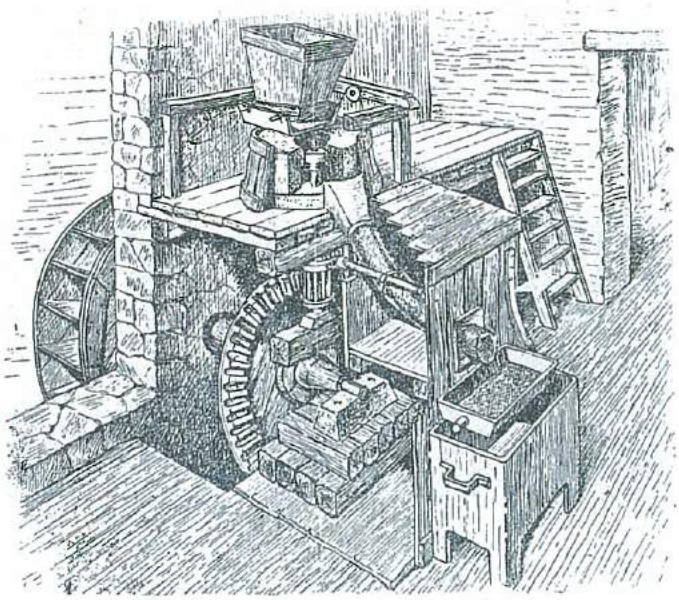


Illustration of the functioning of the vertical-wheel mill with a cross-section of the transmission gears used for moving the grindstone; below, in a technical drawing, and above in a plate from the Theatrum Machinarum Novum.



is now done with machinery.
Often the miller was paid in kind rather than with money, that is, with wheat or semolina. Usually, the mills had two grindstones: the more refined one was used to grind wheat, rye and oats, and, beginning in the 17th century, another one was used for grinding corn. At times, there was a third grindstone. It had a cone-shaped trunk (more accurately, a cone crusher) and it was used to crush grape pomace to produce lamp oil.

The Millers

Millers were classified as "servants," and they hardly ever owned their own mills. In time, however, the miller became a small entrepreneur, rising above the category of farmers, the class from which he almost always originated. In some situations, when the mill was located near a ferry on a potentially torrential stream of water, the jobs of host, miller and boatman were entrusted to a single individual.

"Water-tamer," wrote Piero Camporesi, "an inventor and operator of devices and contrivances which, by harnessing and guiding their force, could stop the savage flow of the liquid element; a massive man, the miller, exerted his power over the waters, bending them to man's will. There was something magic and sacrilegious in he who captured the primordial energy of the flow born in the caverns of the Great Mother, in the swollen breasts and the humid uteruses of the Earth, and channeled them, torturing them with wheels, vanes, nets; a free, fertile being forced into slavery and sterility ....

"Certainly, his was not a dishonorable profession ..., enveloped in prestige. In cultured writings and in the oral tradition is emphasized the miller's confidence with obscure issues and arduous, abstract problems, his familiarity with enigmas and riddles, his sagacity and inspired wisdom, and the subtlety that could embarrass the potent and humiliate the falsely wise.

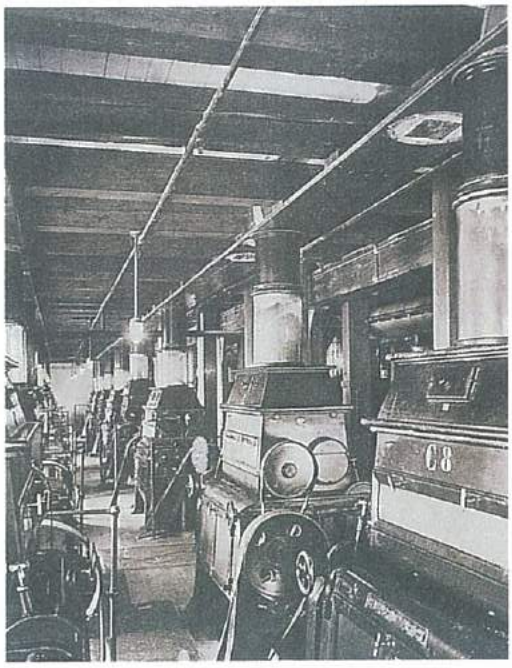
Guido Carmignani,
Interior of a mill on the Po, 1857.
Parma, Lombardi Museum

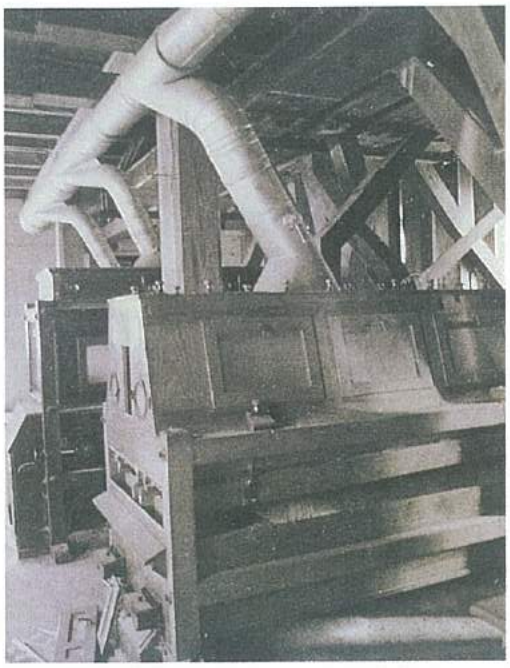
The cylinder mill of the Scalini Co. in Parma. In the early 20th century, thanks to new technologies, the company replaced the cylinder mill with numerous mills with millstones.
An advertising postcard from the early 1920s. (Parma, Barilla Historical Archives)

"A solitary, lonely man, he lived in the humidity of the waters and the wheels, amongst the mountains of semolina and the feedbins, in the workshop of the mill, where the grain of the earth was transformed with his power over the waters as his accomplice into precious edible goods. A man dressed in white (a color associated with sacredness and authority), a figure to which fleeting and tortuous powers were attributed, and perhaps underground canals as well, to communicate with occult realities."
As some historians have recently noted, in the mountains the mill is frequently referred to as "of the devil." It was a meeting place for people coming from different places, a venue for sharing news, exchanging information, and making comments. To pass the time, while the grindstones did their work, people played cards and exchanged ideas, which oftentimes were not pleasing to the authorities.

The Latest Transformations

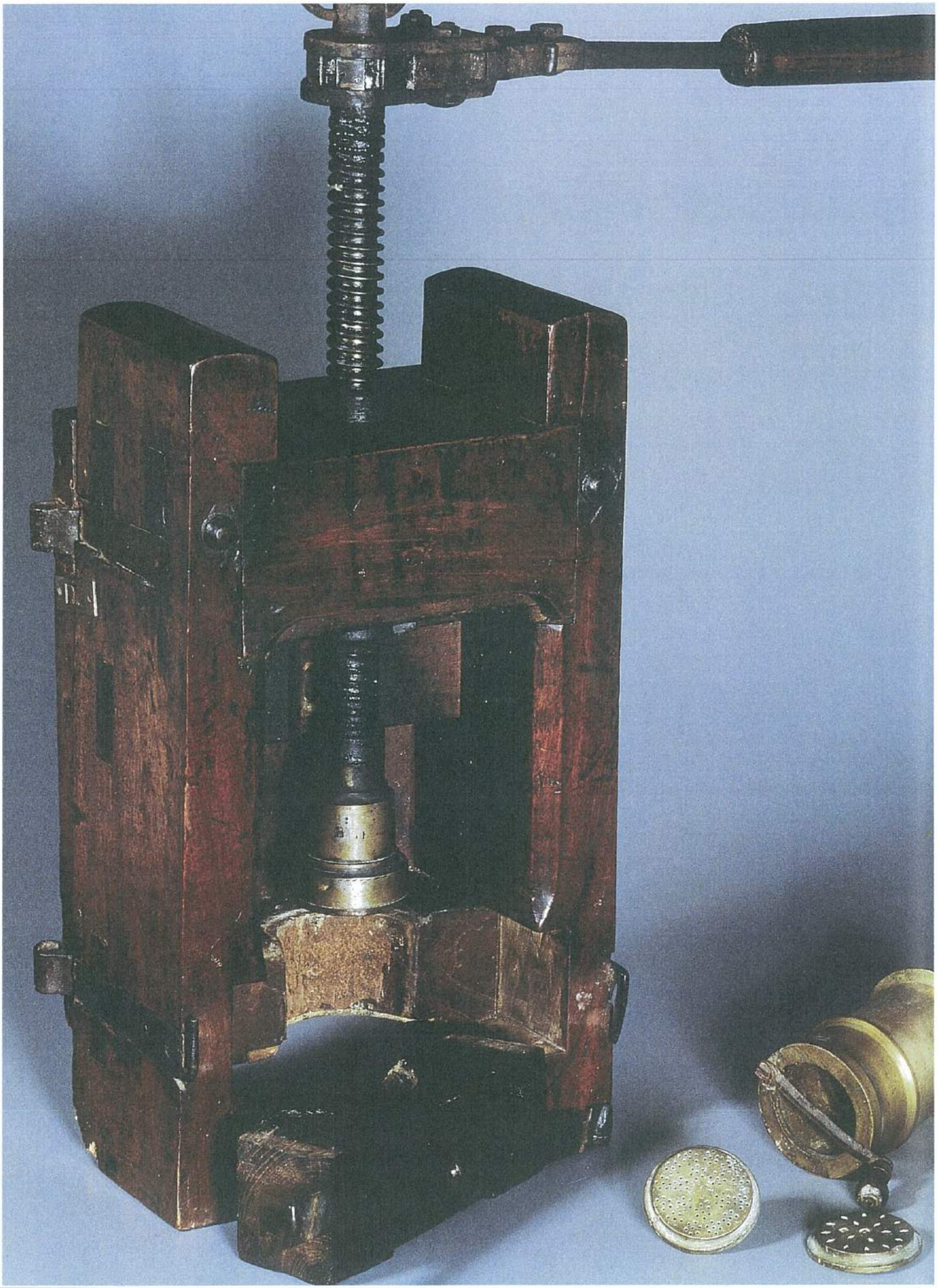
Except for some minor transformations, milling techniques have remained mostly unchanged. Gradually, water mills, particularly those located within the cities, were either transformed into electric mills or shut down because the noise caused the nearby inhabitants much distress. Meanwhile, technology took its first steps toward making millstone grinding obsolete, inventing machines powered with cylindrical blocks, a more effective and hygienic system. The cleaning phase was, in fact, a most important one. Since the procedure took place inside the cylinders themselves, there was no expulsion of dust. A common saying used at the time to advertise the cylinder system was, "You can go to the mill without flouring yourself." From that moment on, the milling business became a true industry, leaving behind its role as a meeting-place as the need for hydro power to operate it decreased. As for the miller, his position in society changed. He went from being a respected social controller





The interior of cylinder mills at the beginning of the 20th century, with rolling-mills and tubes to transport the cereals from the silos.

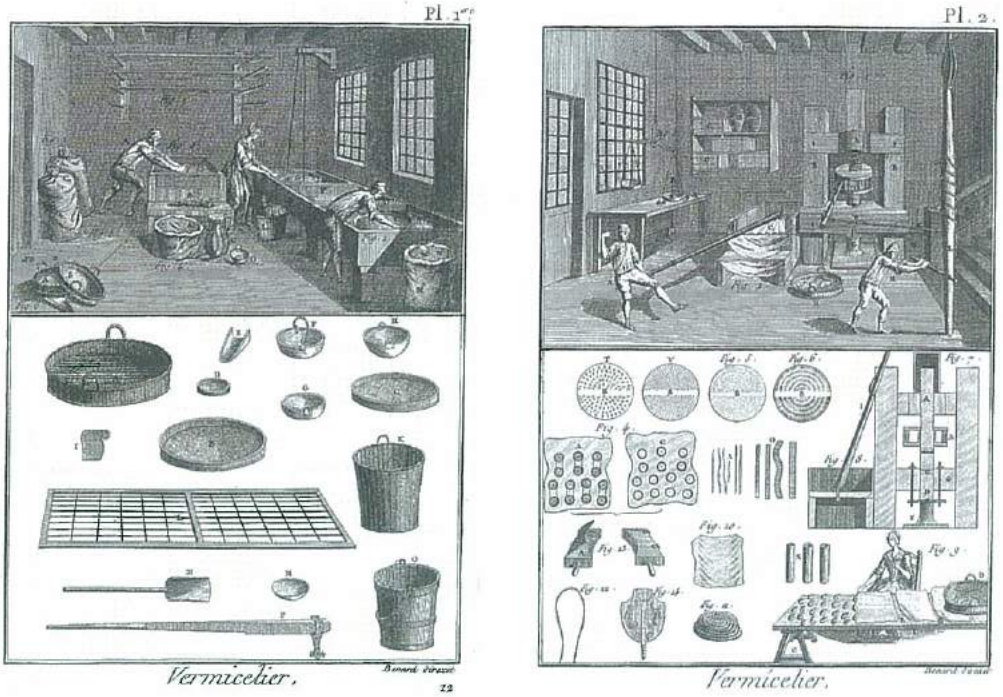
to being a technological expert in the food industry. Still scattered in the countryside are the remains of ancient mills. They stand as romantic monuments of a culture and a society that is no more, relics of an open-air museum that is open to everyone. Hence the mill, its image dissolving into nostalgia, makes its comeback, becoming a symbol and a trademark for the good things of the past (biscuits and snacks, bread for the table and desserts for parties) while modelmakers build miniatures to capture the attention of fair goers. Is it thus so true that "Water that has gone through the mill can grind no more"? (a saying similar to "It's water under the bridge.")



TECHNOLOGY IN THE PASTA FACTORY

It is a well-known fact that for many years, certainly until the 14th century, pasta making was the work of housewives and chefs.
It is not known for certain when pasta making switched from being a domestic task to a flourishing industry; however, it is possible to establish its beginning around the mid 14th century.
Though the technological progress of the pasta industry was very slow through the centuries, it took on more intense rhythms with the introduction of the steam-run engine. This was followed by electric motors and, subsequently, the first hydraulic presses. Furthermore, with the introduction of artificial drying, the pasta making industry began to spread throughout Italy between the end of the 19th and the beginning of the 20th centuries, reaching even those places where environmental conditions would have obstructed that natural drying process practiced in Naples, Genoa, and Palermo. In 1933, thanks to the F.lli Braibanti Co., the continuous press helped the pasta industry make a decisive leap. With this new machine, F.lli Braibanti revolutionized factories, introducing increasingly automatic machinery, which was constantly being perfected. Until the 18th century, the production of pasta had remained an artisan skill, but now it was making its entry into the world of industry and the shop of the vermicellaio and the semi-automatic factory were replaced by a rationally structured and controlled plant. From that moment on, each phase of the production was wholly structured according to the laws of physics, physical chemistry and biological chemistry, which were the result of over 30 years of research.
Before entering into a discussion on modern technology, however, an overview of the single elements that had characterized the production of pasta over the centuries would help facilitate

Artisan wall-press for the production of pasta, with bell and extruders in bronze. Emilia Romagna, mid 19th century. (Parma, Barilla Historical Archives)

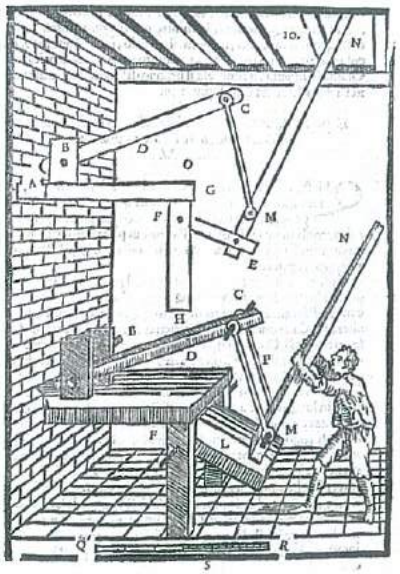


Diderot and D'Alembert, Enciclopédie ou dictionnaire raisonné des sciences, des arts et des métiers. *Vermicellier's shop and equipment. (Parma, Barilla Historical Archives)*

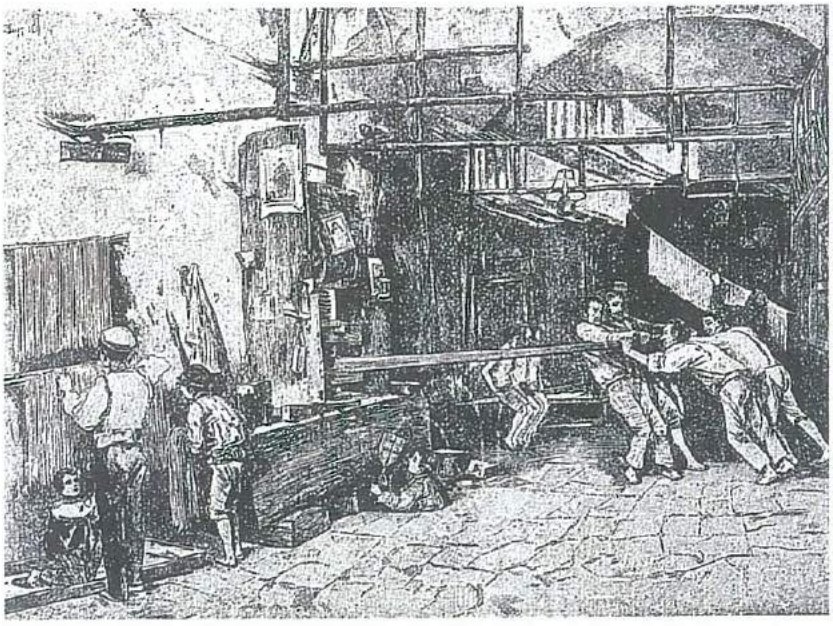
an understanding of the current reality.
In the past, the production process involved four phases: mixing, kneading and refining, shaping, and drying. Each of these processes was done by a separate machine. Before commencing the process, it was necessary to purify the raw material (which often contained threads from the sack, splinters, lumps, etc.) by filtering it, using manual or mechanical sifters.

Mixing

The mixing procedure consists in blending a specific quantity of semolina and water and amalgamating them. Initially this operation was done manually or with the feet, but it was then relegated to a mixer, much like the ones used for making bread but specifically built to reduce the airing of the pasta and to make cleaning easier. Mixing could be done either with cold water (59 °F - 77 °F), or with hot water (104 °F - 212 °F), depending on the quality of the product and the degree to which fermentation was likely to occur during the drying process. Cold mixing was used in Sicily, Liguria and in Abbruzzo, while hot mixing was typical of the Neapolitan region. Mixing lasted from 5 to 20 minutes, depending on whether the dough was soft or hard, cold or hot. If the process took longer, the pasta would break easily after drying, a defect that could not be remedied. From the 20th century, mixing was carried out with one of the following machines:
Manual mixer: used in small pasta factories because they could not install mechanical, thermal or hydraulic motors and therefore had to rely on manual operation. It was entirely built in metal and its production capacity ranged from 11 - 66.15 lbs. At the end of the mixing phase, the tank was capsized and its contents allowed to fall into a kneading trough, directly proceeding to the kneading phase, wasting as little time as possible;
Motor-powered mixer: a machine of great importance because its degree of perfection in mixing the dough influenced the quality of the



Kneading machine to knead the pasta. From A. Capra, La nuova architettura civile e militare. *Cremona, Ricchini, 1717*



Old macaroni factory in Amalfi. The workers are intent on operating a wooden screw press with a pole

pasta, its transparence and its resistance. The machine produced a maximum of 551 - 661 lbs of pasta at a time;

Mixer with blades: some manufacturers had attached special blades to the axle of their machines, enabling the tank to remain clean at the end of each batch. It was, in fact, very important to ensure that not even the slightest bit of the previous batch remain in the tank because this would have produced fermentation, endangering the next batches. Fermentation would have increased in the subsequent kneading, pressing, and drying phases.

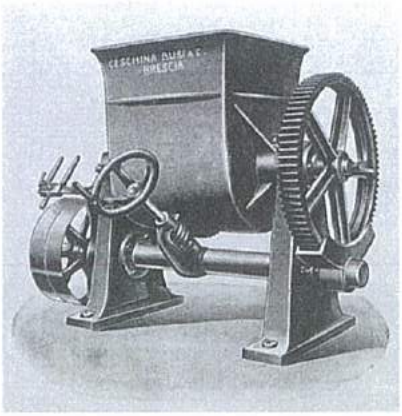
For decades, mixers were the foundation of the pasta industry. They are still used today in artisan shops, along with presses, to produce fresh pasta, egg pasta and stuffed pasta.

Over the years they have been perfected and improved, becoming extremely practical. Tanks are now capsized and straightened automatically, and they are equipped with safety valves, reducing the risk of accidents. With an empty tank between batches not only was the mixing improved but pasta did not stick to the walls, the axle or the blades. Hence, after being emptied, the tank was clean and ready for a new load.

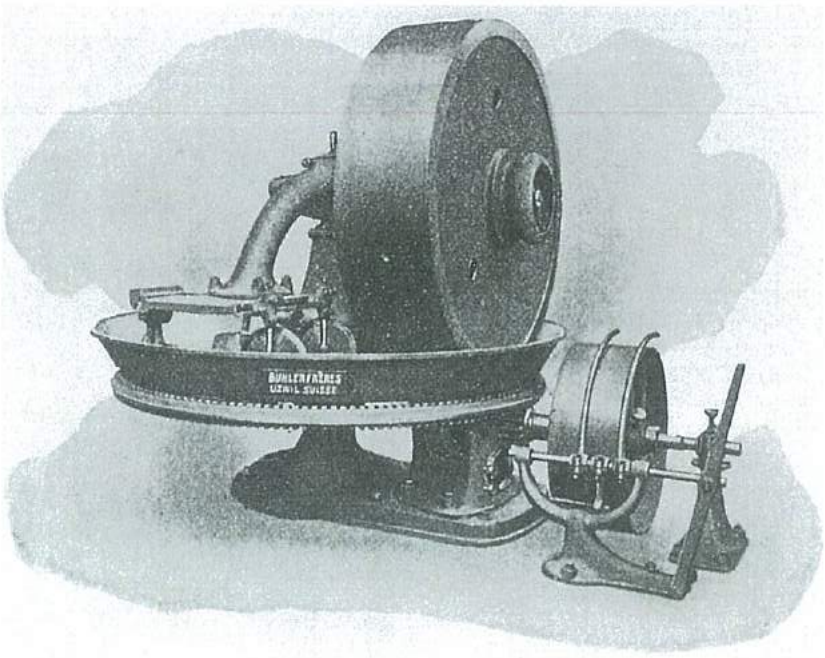
In old pasta factories, the mixer was located above the kneading machine so that the dough could be placed directly onto the kneading plate or tank. This arrangement was known as "a cascata" (like a waterfall). The semolina was either loaded directly into the kneading-machine or it was transported through tubes or sleeves by the operator responsible for manning the machine. It must be noted that the mixing phase had to be synchronized with the kneading phase, impeding the dough from resting too long and thereby running the risk of fermentation or of hardening the dough's surface.

Mixing

The mixer was born of the need to amalgamate, making the dough homogeneous, since the



Mechanical mixer manufactured by Ceschina, Busi and Co. of Brescia at the end of the 19th century

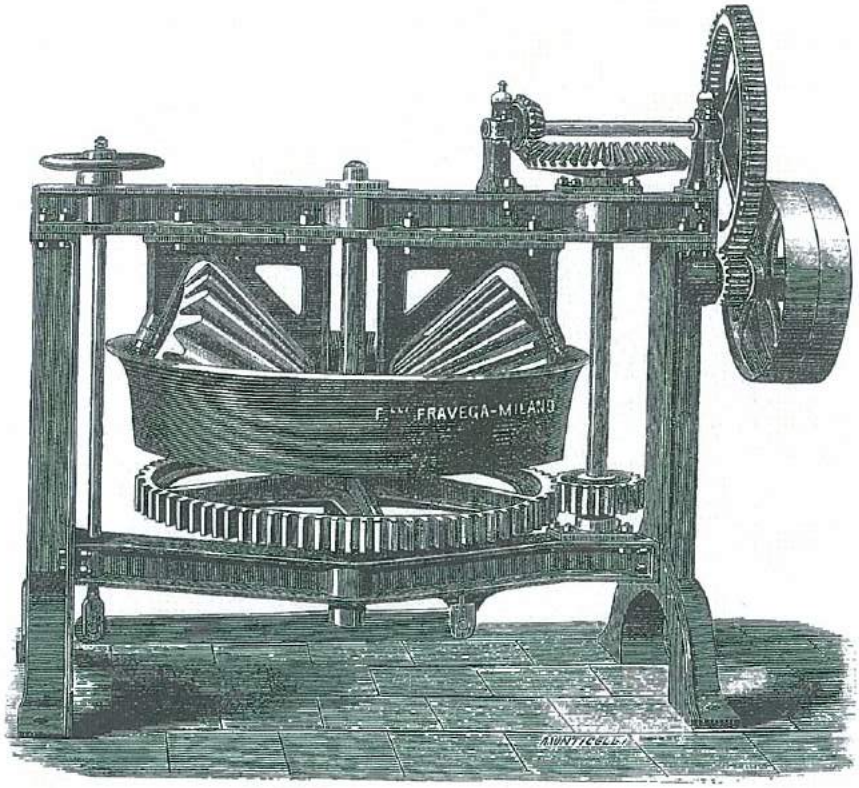


Kneading machine with press from the early 20th century, from the Swiss workshop of the Buhler brothers

kneading machine was not able to do this completely.

Mixing influences the quality of the pasta and its appearance, therefore the mixer must amalgamate the dough, making it compact and homogeneous, without weakening it, safeguarding the tenacity and the resistance of the dough and the uniformity of its color. Furthermore, the kneading machine must prevent the formation of a surface crust, which damages the pasta's quality. This is why the kneading machine's motion must be at once deep, mild and quick, preventing the dough from becoming excessively weak and bleached.

The history of the mixer begins with ... the bar. The bar-operated kneading machine consisted in a smooth wooden table on which the dough was placed. Using the bar, the dough was compressed by turning it over and over. Also made of wood, the bar was shaped like an upside triangle; at one end, it was suspended by cords at the tip of a flexible rod affixed to the wall, while the other end rotated around a fixed fulcrum. The operators stood along the length of the bar, moving it, lifting it and lowering it, aided in their efforts by the elasticized suspension. This kneading machine was particularly suited to soft dough and it required many operators. At precisely the same time, the muller-operated kneading machine was being introduced in Liguria. It was equipped with a marble or stone wheel, similar to the one used in oil mills, and had a tank and a cylindrical muller, which exerted pressure on the dough. Unlike all the other kneading-machines, this one exerted continuous pressure on the dough because the muller was not splined. Furthermore, as a result of the attrition between the tank and the muller, the pasta was stretched, rendering it whitish and quick to cook. To remedy this inconvenience, kneading machines with blades and splined rollers were perfected. The kneading machine with blades more easily emulated the functioning of the bar-operated kneading

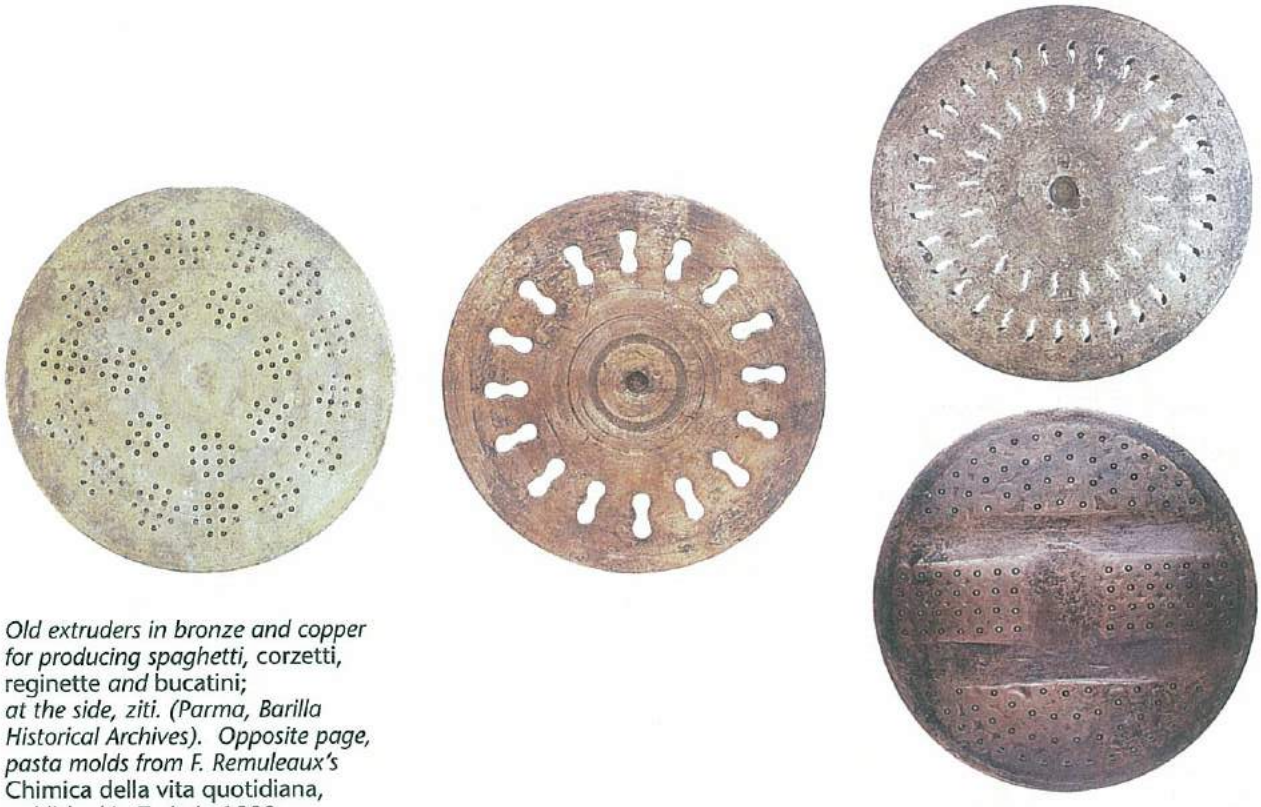


Conical-roller kneading machine from the 19th-century catalog of the F.lli Fravega company in Milan

machine. It consisted in a circular, wooden table, which rotated around the unmoving product, and wooden blades which, arranged in correspondence to the diameter, were raised and lowered, compressing the dough on the table. While the blades were raised, the table moved slightly, and when they were lowered it remained still. Every now and then, the outer edge of the dough was lifted and turned inward, toward the center of the table, until it was kneaded throughout.

There was also the kneading machine with splined rollers. It consisted in a wooden or metallic table and a roller. The dough was placed on the table, and as the table moved in alternating motions, one of the rollers, positioned above it and transversally to it, intermittently exerted pressure on the dough, functioning in a manner similar to that of a bar-operated kneading machine. Finally, there was the kneading machine with conical rollers, which proved to be the most efficient in working the bar delicately enough to reduce the weakening of the dough. It was also suitable for working all the various types of dough: soft, hard, cold water-pressed and warm water-pressed. The kneading-machine with conical rollers consisted in a circular tank, which continuously rotated on its axis, and by two splined conical rollers, which rotated on supports affixed to a frame. The rollers could be raised or lowered by intervening on the handwheels. As the kneading gradually proceeded, the rollers were lowered onto the dough, shaping it into a flat ring. It was then cut into sections, and the central part was turned outward, toward the edge. In many machines this operation was done automatically by a "voltapasta," a "pasta-turner."

The most widely used machine was the one with rollers. The kneading machine with blades was used primarily in Naples and its surroundings, producing excellent results with dough kneaded using warm water while the muller-operated kneading machine was used mostly in Liguria



Old extruders in bronze and copper for producing spaghetti, corzetti, reginette *and* bucatini; *at the side, ziti. (Parma, Barilla Historical Archives). Opposite page, pasta molds from F. Remuleaux's* Chimica della vita quotidiana, *published in Turin in 1889*

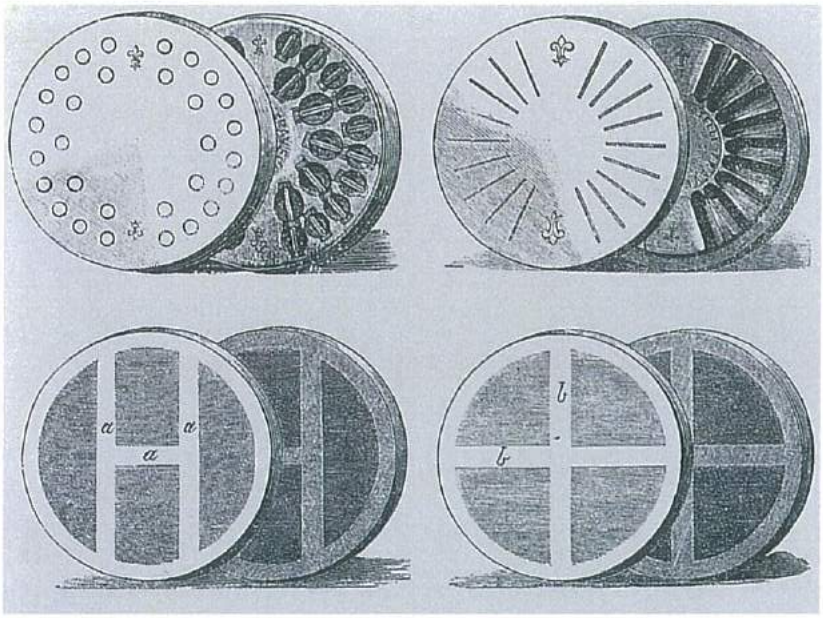
and in some areas of the Veneto region. The kneading machine with a running counter was used only when producing small quantities. These machines were built in different sizes and capacities, and each type was designed to work at both minimum and a maximum capacity, depending on whether the dough to be worked was hard or soft. The time required for kneading depended on the quality of the raw material, the features of the machine, the action of the splined rollers as well as on the functioning of the pasta-turner, which was of prime importance in a properly amalgamated dough, with the right color and lacking a surface crust.

Refining

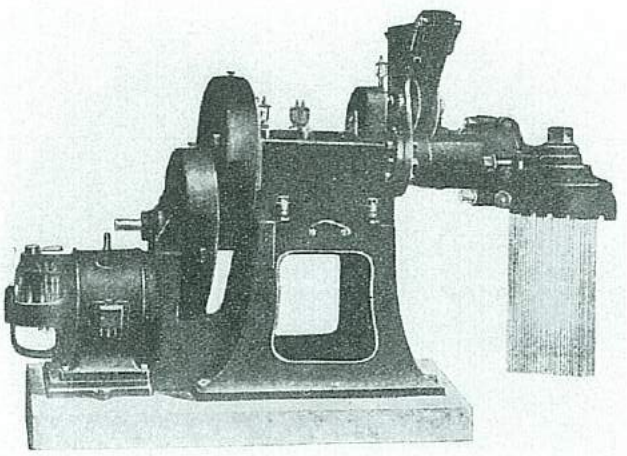
This procedure (normally excluded when making normal pasta) consisted in drawing the pasta dough - after it had been kneaded - through two smooth rollers, making it more homogeneous so that it would yield pasta with a smooth surface. The machine used for this procedure was called the "raffinatrice," (literally, a refiner) or a "laminatoio," a rolling-mill, and it mainly served to stretch thin layers of special pasta, either made with eggs or shaped by hand.

Shaping

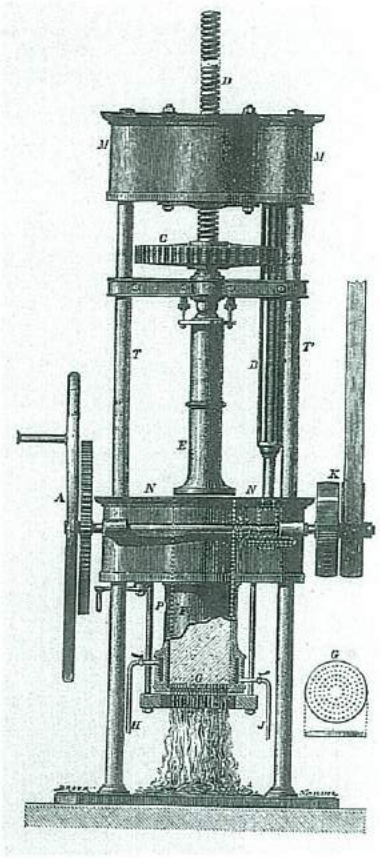
While pasta was originally shaped exclusively by rolling it, that is, by pressing it between a roller and a flat surface or between two rollers, as pasta production became an industry, the extruder became the norm. In extrusion, the pasta is forced through a die and shaped into flowers, strings, tubes or ribbons, which are subsequently cut. In modern pasta factories, the extruder has almost completely replaced the rolling-mill. Initially, screw presses were used for shaping the pasta. They consisted in a plate or a pestle, equipped with a rubber gasket and inserted in a vase or a bell, which compressed the pasta on the extruder. The presses were either vertical or horizontal, the latter equipped with a single-, double- or triple-bladed rotating knife at its



exterior, used for cutting the pasta as it was extruded. If the pasta was to be short, the knife rotated continuously while it rotated intermittently for other formats. Special machines known as "tagliapenne" were used to cut *maltagliati* and penne obliquely.
No longer operated manually but with a piston connected to a pump, the hydraulic press gradually replaced the screw press because it could produce larger quantities, its bell (the same size and capacity as that of the screw press) able to extrude at notably greater speeds. Furthermore, the hydraulic press, although more costly and equipped with more safety and automatic devices, was less complex mechanically and thus less prone to break down or breakages. Pattison built the first hydraulic presses in Naples, in about 1870. Extruders were generally attached to the bells, or mounted on a crosspiece affixed to the frame, where the bells were placed after they had been filled. The soldier Giambattista Basile (Naples, 1575-Giugliano 1632) penned *Cunto de li Cunti*, a collection of popular Neapolitan fairy tales, reminiscent of the *Decameron*. Published in 1630, the book narrates the adventures of Jennarello. In the 9th story of the fourth day, in an excerpt that describes the protagonist's mishaps, the author writes, "Jennarello, ch'essenno passato pe la trafila, mo se ne jeva mbruodo de *maccarone*" (After going through a die, Jennarallo came out looking like a *maccheroni*.) This is one of the first literary references to the die, the "nciegno," which, with its various shapes and holes, gave the pasta its various cuts. Dies were made with materials such as copper, red bronze, manganese bronze, etc., which were resistant to the acids formed during the fermentation process. Some extruders could produce pasta with holes in the middle; for long and thin pastas, thin extruders were used, placing them on steel supports. There were also extruders with short holes, which expanded into chambers inside the bell. The holes of the

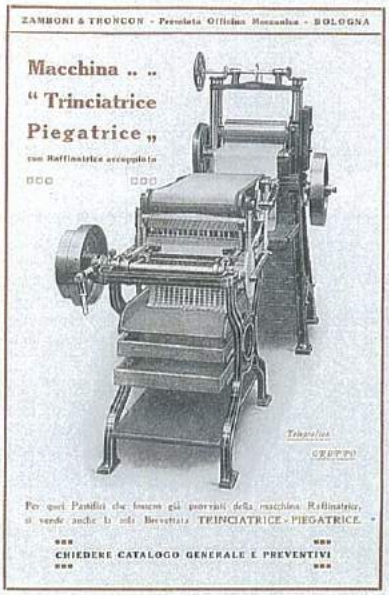


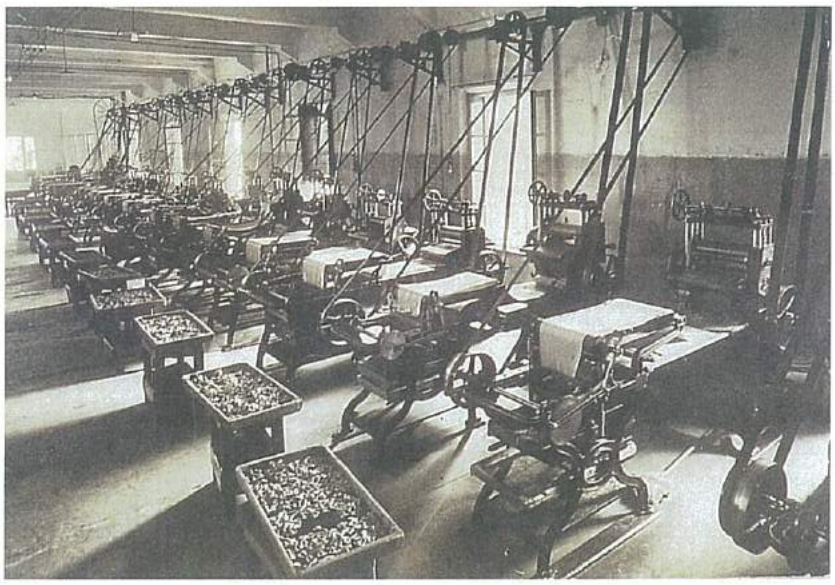
Press with mixing machine. 20th century.



Vertical screw press for the production of long pasta. 19th century.

extruder were 10% larger than the intended size of the pasta, because the pasta would shrink during the drying process.
Extruders were often cleaned by hand with small keys or similar tools; however, since this often ruined the holes, some operators used special tools called "nettaforme" (literally, shape-cleaners), or "lavatrafile" (literally, extruder-washers). The extruder was washed with jets of pressurized water while it was made to rotate on its axis.
In the more advanced models, both screw presses and hydraulic presses had two bells. While one was being used, the operator would prepare the other one by filling it with pasta using a mechanical or hydraulic "pressa pasta" (literally, pasta compressor), which made sure the bell was well-filled, without leaving any vacuums.
Two bells generally required two extruders; nonetheless, large presses with a single extruder and two rotating bells were also manufactured.
In these types of presses, the bells could be loaded (filled) either from the top or the bottom. To ensure that the bell was properly filled and the pasta properly compacted and compressed, without any vacuums, the mouth of the bell was plugged with a device and the pasta from the "pressa pasta" was pressed onto it. Hydraulic presses could work all types of dough (soft, warm, hard), but the yield was highest with soft and warm dough. Pressure could reach 2,133 lbs/in^2, but it was possible to go as high as 200 atmospheres.
Hydraulic presses were powered by hydraulic pumps, which functioned either as part of an independent system or a centralized system. In centralized systems, the pumps were equipped with appropriate accumulators.
In addition to the aforementioned blades, complex machines were also used to cut the pasta as it exited the extruder. These machines, like the "tagliapastelle" and the "trinciatricia-piegatrici" (cutting-folding machine) cut a sheet



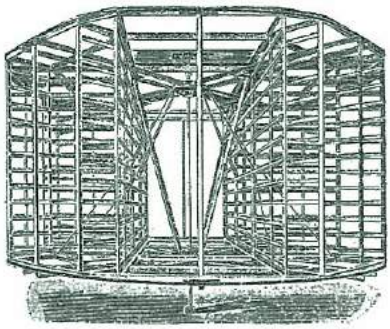


At left, a slicer from the Zamboni and Troncon Co. of Bologna (from the company's catalog), and, above, a set of the same machines at work in the "gallani" room of the Pastificio Barilla in 1913. (Parma, Barilla Historical Archives)

of pasta and folded into elegant shapes such as: *farfalle* (butterflies), *panieri* (baskets), and *stricchetti*. There were also machines that could quickly cut and shape *berrettini* (caps), *conchiglie* (shells) and *cappelli* (hats), which were made from dough that had been loaded in the machine in the form of a sheet. "Tagliapenne" were used to cut the dough obliquely, producing penne, while there were dry-pasta-saws for cutting long pasta as well as machines for ravioli and machines for tortellini. "Tagliasfoglia" machines were used for producing large quantities and for making *tagliatelle*.
When it exited the press, long pasta was extended manually on canes. Instead short pasta, which lost its shape easily and tended to stick to surfaces, was handled with a "trabatto," a rather primitive device, which aired the extruded product, avoiding the risk of amassment and subsequent deformities. From here, the pasta was placed on frames with netted bottoms and dried in the traditional way, out in the open or in rooms equipped with braziers, alternating exposure to air with "rest" periods. For more than four centuries, from the 1500s to the present, pasta factories were equipped with the machinery mentioned here: mixers, kneading machines, presses, and an assortment of accessories, all of which evolved and were perfected with the experience acquired over the years.

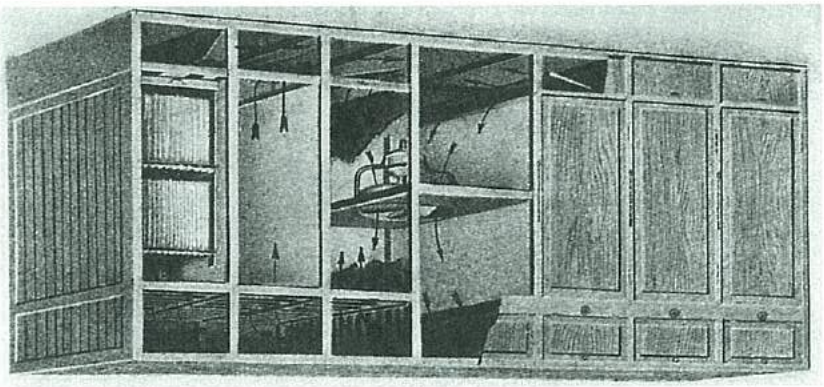
Drying

When artisan shops first began producing pasta, it was nearly always sold fresh by the same shop in which it was produced. As consumption increased and industrial production became centralized, the issues of preservation and shipping became important.
In fact, fresh pastas, whether they are extruded, long or short, rolled or cut, are soft, easily deformed and subject to alteration as a result of the fermentation. Furthermore, the humid surface of the pasta is particularly fertile ground



The molding reel, invented in 1875, for drying long pasta. It was the first attempt at artificially drying pasta

Closet chest with cells for long pasta stretched out on canes, made by the Ori company of Brescia. Early 20th century

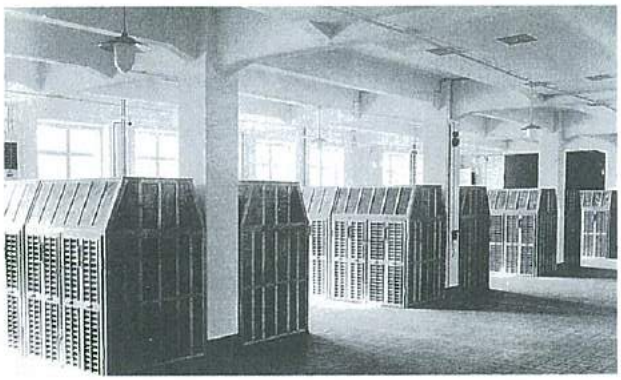


for the reproduction of molds. Already from the beginnings of artisan production it had been noted that pasta, like many other foods, could be preserved unaltered for long periods of time, maintaining and, in some cases, even improving the taste of the fresh pasta after it had been deprived over a short period of time of a high percentage of the water that it contained immediately after shaping. Based on this experience, research was conducted to determine an empirical condition that would allow for accurate drying at the lowest possible costs.

The climate of Genoa, Sicily, and Naples and its surroundings, characterized by constant breezes, was favorable to drying, so that pasta production was soon focused in these regions, and by the end of the last century the industry was exporting a considerable amount of pasta.

The drying of pasta, especially in the Neapolitan region, was more than just a phase in the production process; it was a "rite," attended and followed closely by all the skilled labors. It was a "rite" officiated by the pasta-maker, a veritable wizard and, as such, a person who was obeyed by others. He had to predict and sense the weather, understand the state of the pasta, its degree of dryness, by touching it, so that he could determine what needed to be done next and to prevent the product, the fruit of such arduous endeavors, from fermenting or drying too quickly. And the old man constantly reiterated that his art was...the art of the ignorant! Because it was not necessary to be educated to be a good pasta maker, nor was it important to know how to read or write; one only needed to know how to rely on one's senses, to "feel" the pasta by touching it, to understand, to comprehend changes in the weather, and so on.

Drying could be prolonged for two or three days, and the pasta-maker had to bring it to term without damaging the product, that is, without altering it, but also avoiding the



Above, static pasta dryers (about 1920 circa); to the left, the drying department for pastine *in the Barilla factory in 1932. (Parma, Barilla Historical Archives)*

phenomena of acidity, fermentation and molding. The dangers of acidity and molding was as great as that of altering or burning the product. And on days when humidity was high, the windows and doors were opened wide, and short pasta was placed on frameworks, while for long pasta, the canes were placed father apart. These were true maneuvers, official procedures, which often required three or more days.

From these "rites" was born the professional figure of the "chief pasta-maker," who had to be familiar with hygrometry, despite the lack of technical tools and despite his ignorance of the etymology of hygrometry.

He knew the weather, the winds and the seasons, however, and he felt the changes at the right times, interpreting them, and each time he "invented" the rite of drying. Most important, he invented that which today is the most important phase of pasta's drying cycle. He invented "incartamento," pre-drying and, therefore, recovery or rest, and ventilation. He alternated these procedures and varied their duration and their quantity according to the cut, the type of pasta to be dried, the season, the atmospheric weather, as well as the position of the drying rooms.

This all took place without any technical help, without a manual or books of any kind, only practical experience, often based on disappointments, failures, doubts, apprehension, attentiveness, and especially a tremendous passion for such a difficult and capricious product, one that was reluctant to obey new rules each time it changed shape. What a difference if we compare it with today's continuous assembly lines that swallow quintals of the product on one end, and after a few hours, expel it from the other end, perfectly dried and ready to be packaged, stored and shipped!

The typical Neapolitan drying process involved the following successive phases:

Pre-drying: possibly in the sun, in courtyards or

The rooms where rolled egg pasta and spaghetti were dried in the Barilla factory in 1914. (Parma, Barilla Historical Archives)

on terraces sheltered from the wind; the term "incartamento" derives from the fact that at the end of this first phase of the drying process, the external surface of the pasta is hardened as a result of the intense evaporation that occurs in the meantime. This evaporation, however, protected the pasta from any alternations that could result as the effect of fermentation.
Recovery: in humid and fresh cellars; the purpose of this phase was to uniformly distribute the residual humidity from the pre-drying process throughout the dough, making it moldable again, completing the drying process.
Definitive Drying: This was carried out in large rooms, facing the direction from which the constant winds blew. They were equipped with suitable openings, allowing the pasta to ventilate properly, depending on the winds' velocity, the temperatures and the humidity in the atmosphere. The natural drying process required knowledge of many complex, albeit empirical, notions, so that it was rightly considered an "art."

To resolve the problem of the variable climate, and to be able to also work during the winter, particularly in the northern regions where the weather was less favorable, "artificial" or "thermal-mechanical" systems were built. They were composed of closed chambers with ventilators and radiators that generated hot air used to ventilate the pasta.
The wheel, the oldest system used for artificial drying, dates to 1875. It consisted in a cage with a polygonal base made of iron and wood, which rotated on its own axis while carrying the canes or frames that contained the pasta. Although the rotating motion of this machine dried the pasta, it did so in an imperfect manner because the pasta at the edge dried more quickly - often even breaking - than the one in the center, which stayed relatively fresh and was often moldy because of the difference in the drying times. It was not until 1898 that the system was improved by the inventor Tommasini, who was able to reproduce the traditional method of

natural drying, accelerating, however, the first and last phases by using ventilators to move the air. With this system, long pasta was put inside crates for half an hour to an hour, depending on the cut of the pasta and the humidity in the air, and pre-drying was carried out at temperatures between 86 °F - 95 °F. Subsequently, the product(only in the case of long pasta) was left overnight in the recovery chamber and then brought to the definitive drying room, where ventilation was regulated so that every 4-6 hours mild pre-drying phases were alternated with mild recovery (rest) phases. The definitive drying phase for long pasta required 3-6 days, while cut pasta only needed 24 hours.
Tommasini's system meant savings in time and space, but not labor, because it was still necessary to transport the pasta from the pre-drying crates to the chambers (or to other crates) for the final drying phase.
To eliminate these transportation processes, R. Rovetta (1903)and G. Falchi (between 1907 and 1912)each patented drying methods, both of which were based on the principle of carrying out the drying phases in a closed environment, where the air conditions could be conveniently modified as the drying process ran its course. Falchi subjected the pasta to a series of brief pre-drying phases alternating them with brief recovery periods, simultaneously shifting the position of the air so that the pasta would receive moving air for a while and still air for another while. In the first-built machines, the ventilator was in a fixed position and the pasta, arranged on carts, was moved by repeatedly intersecting the drafts of air.
In subsequent models, the ventilator rotated and the pasta stayed still.
Rovetta's system, instead, functioned by moving the ventilator on longitudinal guides positioned in the drying chambers, causing the air current to shift. Marelli's automatic drying apparatus for cut pasta functioned in a different manner. It was composed of continuous belts, which, loaded with fresh pasta via a feedbox from above, transported the product and discharged it.
While the product was being remixed, a current of air (95 °F) circulated in an opposite direction, airing the pasta.
This system was especially suited to large productions.
The "Ceschina" cell system, used to completely dry pasta, consisted in a large closet composed of disconnected compartments, so that each compartment could receive ventilation, have it removed, or regulated, independently of the others. In this manner, all of the required pre-drying phases could be completed in sequence, within each single compartment, including the alternating phases of ventilation and rest, which are essential to a safe drying process and a good end product.

The Continuous Press

Pasta-makers and machine manufacturers alike had long dreamed of a press that would work continuously; however, the numerous attempts had not been able to produce anything concrete and satisfactory, until Féreol Sandragné made the dream a reality. A native of Provence, Sandragné was a mere laborer who for many years had worked at Mécanique Méridionale in Toulouse. In addition to manufacturing common machines for the pasta-making industry, the company

been the first to manufacture *matassatrici*, skein machines. These machines had replaced the worker, whose nimble hands could so rapidly and perfectly shape the nests of *fidelini* or *tagliatelle*, with an intelligent system of planes, which could be slanted, to receive the pasta, shifted laterally and capsized. Nonetheless, the biggest problem with this machine was that it had to be stopped every 15 minutes, and then immediately started up again. Sandragné, who had retired, had found another job as a custodian in a brick factory, and lo and behold, there he saw how a machine with two rotating screws would grasp the clay and push it into an extruder, from where it exited, shaped like a perforated brick. A metal wire then detached the bricks from each other as they were being extruded.

After studying the necessary modifications, Sandragné manufactured and molded the required pieces himself with wood. He had them smelted and then he invited his former bosses, Sicard and Mansard, to see how pasta was produced continuously in his attic.

Though the machine overheated because of the friction produced by the screws that kneaded the dough, preventing the pasta from being extruded, the problem was resolved by superimposing a wet rag on the rotors (prelude to the cooling chamber).

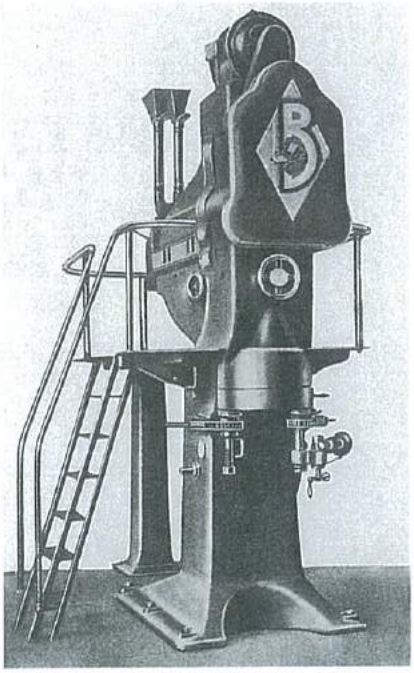
Sandragné's former bosses ensured that he be issued a patent (deposited on October 6, 1917), then receiving a percentage on each machine that was manufactured. The continuous press was an instant success, diffused everywhere. Between 1929 and 1939, Mécanique Méridionale manufactured an average of one machine per day, exporting to it to distant lands. In 1933, the first Italian continuous press/mixer was invented by the engineers Giuseppe and Mario Braibanti of Parma.

Their machine set the stage for the modern automated pasta-making process.

Continuous Production Lines

The road that would eventually lead to modern production lines was long and complex. After World War II, once continuous presses were established, the need to develop a continuous drying process also became an essential goal. For short pasta, this goal was easier to attain. Two modes of transportation replaced the frames: one involved a rotation system while the other employed continuous belts made of metal or nylon. Continuous lines for long pasta spread on canes proved to be more complex. Trolleys, chains, platforms, oval canes with "Z" ends or different models all finally led to the current mechanical transportation of the sticks, which are of two types: racks and chains. For special pastas (especially skeins and nests) two transportation systems are used. The first, which is the most popular, functions with frames while the second uses belts, almost like those used for short pasta. Obviously, this involves an efficient pre-drying phase, carried out on a special belt with plastic containers, ensuring the effectiveness of the treatment and preservation of the nest's shape.

Once the mechanics of transportation had been established, the continuous lines for drying evolved in much the same way as the automatic presses, which, over the years, and through technological advancements began the race



The Braibanti brothers' continuous press. Between 1936 and 1938 Riccardo Barilla installed 2 sets of 12 in his plant, increasing production to 800 quintals of pasta per day

toward increased volumes, largely due to production needs and market demand. From the 220 lbs/per hour produced by Micro presses, larger presses began producing 4.410-6.615 lbs/per hour, currently peaking at 13.230 lbs/hr. Nonetheless, the true consequence of this evolution is not so much the often-surprising increase in the production of these plants as much as it is the definitive affirmation of the continuous production line as a "unit of production." We no longer refer to single machines, mixers, kneading machines, presses, pre-drying or stretching-machines, for example, but to a "line." This line consists of several complementary machines which make it possible to complete the production process from beginning to end, from the raw material to the finished product, packaged, and ready to be shipped, guaranteeing the consumer total quality, in terms of both the production process and the product.

DURUM WHEAT

Cultivating Durum Wheat

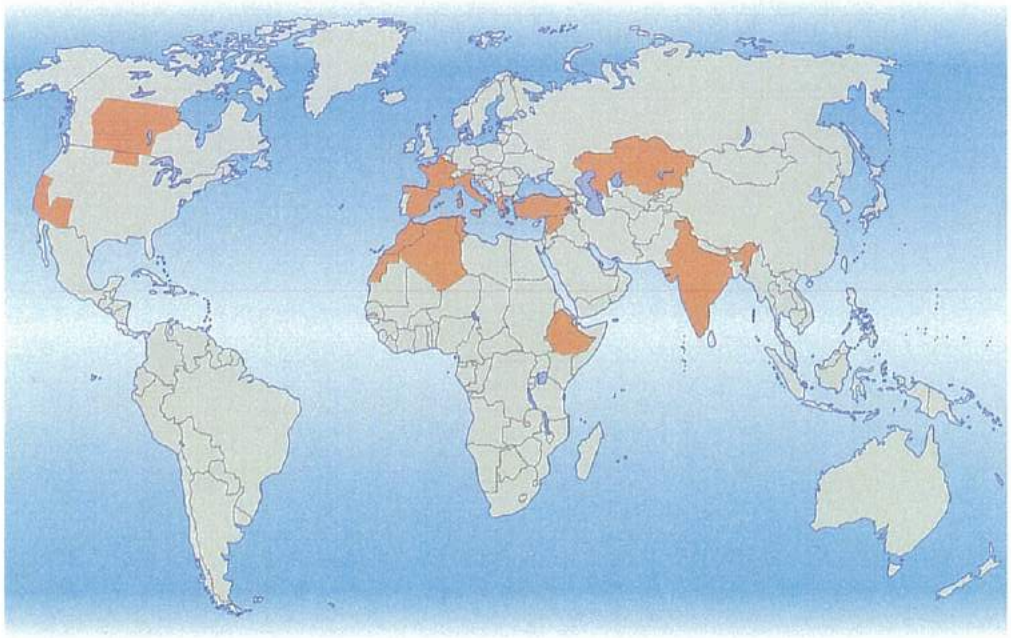
Based on a study of archeological relics found in various countries of the Middle East, it is assumed that wheat was already being cultivated thousands of years before Christ, first in the "fertile crescent" of Palestine and Mesopotamia, later spreading to Western Europe during the Stone Age.

Over the centuries, following the domestication of wild species and the first breeding attempts, various types of wheat evolved, among which were common wheat (*Triticum aestivum L.*) and durum wheat (*Triticum turgidum* var. *durum* Desf.).

The first type spread mainly to cool/moderate areas, which were fertile and had good rainfalls. Durum wheat, due to its tolerance to droughts and shorter cycles (the period between sowing and harvest),grew in and adapted to hot/dry climates, such as those of the Mediterranean. Like other living species, durum wheat comes in a number of "varieties" (class of things with common and uniform features, which are different and distinct from others), and its characteristics (yield, adaptability, quality, etc.) can be selected and gradually improved. New varieties can therefore be developed for higher productivity, better resistance to stresses or parasites and/or adaptability to new cultivation environments. Recently, as a result of the industry of transformation interest, closer attention has been given to the qualitative features of durum wheat, and varieties are also selected for characteristics that can be correlated with pasta-making quality needs.

Currently in the world there are about 230 million hectares of cultivated wheat, of which 90% are common wheat and 10% durum wheat, the latter now incrementing. Though durum wheat is cultivated world wide, it is

Farmers busily harvesting. Detail of an 18th-century Flemish tapestry (Bruxelles) depicting Ceres, the divinity of the messengers, before Trittolemo. (Parma, Collezioni d'Arte Cassa di Risparmio di Parma & Piacenza - Gruppo Intesa)



Principal areas in the world where durum wheat is cultivated and, below, the sowing schedule

concentrated in specific areas of Asia (India, Kazakhstan, Syria, Turkey, Ukraine), Africa (Algeria, Ethiopia, Morocco, Tunisia), North America (Canada, Mexico, U.S.A.) and Europe (France, Greece, Italy and Spain).

On the average, the world produces 30 million tons of durum wheat per year, of which more than 4 million tons are produced in Italy.

With some exceptions, durum wheat is a winter crop. In Italy it is generally sown between November and December and harvested at the end of May in the hotter regions of Southern Italy, and at the end of June or the beginning of July in the cooler, northernmost regions. In Canada and the northern U.S., the situation is different because of an extremely continental climate, with long, hard winters and short, hot summers. There, wheat is sown in April or May,

Table 1. **World Production and Market of Durum Wheat. Averages for 1997 and 1998 Campaigns** (data expressed in millions of tons).

Continents	1997 Campaign			1998 Campaign		
	Production	Import	Export	Production	Import	Export
North America	7,5	0,6	5,9	10,8	0,5	4,9
Europe	7,1	1,5	0,3	9,0	0,5	0,3
Other Mediterranean	6,0	0,1	1,0	6,6	0,1	0,7
North Africa	2,2	3,5	-	4,2	2,7	-
Asia	4,4	0,2	-	2,7	0,3	-
Others	1,0	1,3	-	2,2	1,8	-
Total	28,2	7,2	7,2	35,5	5,9	5,9

Source: integrated data from the International Grain Council and Barilla

The manual beating of grain from Ububchasym de Baldach's Theatrum Sanitatis, codex of the late 14th century (Rome, Biblioteca Casanatense, code 4182)

The wheat cycle in a French lithograph of the 19th century. (Parma, Barilla Historical Archives)

as soon as temperatures are sufficiently mild, and the harvest takes place at the end of July or the beginning of August.

For the most part, wheat cultivation does not require irrigation, hence rainfall plays an essential role in the growth of the plants and the yield at harvest time. Average yield, in fact, varies considerably, depending on the areas of cultivation, and ranges from about 1.5 tons/hectare (Canada, North Dakota, some areas of Southern Italy, etc.) to about 6.0 tons/hectare (central and northern Italy, France, etc.). In some areas of the South-West U.S., production can reach 7-8 tons of durum what per hectare thanks to climatic conditions and the availability of water for irrigation. Canada and the United States are the major exporters of durum wheat, mostly supplying the European and North African market (Table 1), areas in which the demand for this cereal, used almost exclusively for human consumption, is always very high.

Common Wheat and Durum Wheat: the Difference

Genetics

First of all, common wheat and durum wheat are two different plant "species" (meaning class of things species a with similar characteristics that can be interbred to produce fertile seed). Botanically, they both belong to the *Gramineae* family, and to the *Triticum* genus, of which numerous wild or cultivated species are a part. The scientific names of durum wheat and common wheat are, respectively, *Triticum turgidum* var. *durum* Desf. and *Triticum aestivum L.*

From an evolutionary standpoint, it would appear that common wheat derives from an interspecific cross (a cross between different species) between *T. turgidum* and a similar wild graminaceous plant, the *Aegilops squarrosa*, which has provided common wheat with a set of chromosomes that are absent in durum wheat. Thus, the two species present very distinct

Varieties of common wheat

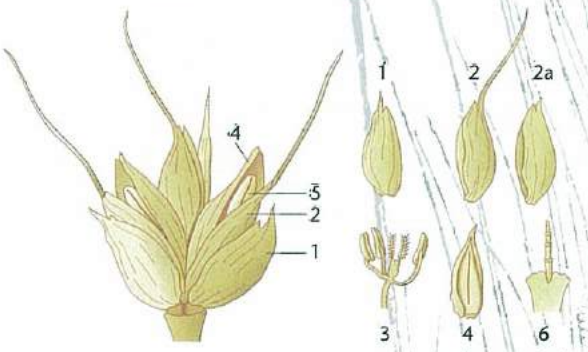
Golia *Mec* *Manital* *Mieti*

Flour obtained by grinding soft wheat is white and powdery

genetic features, the most evident being the number of chromosomes: 28 in durum wheat and 42 in common wheat.

Morphology

Morphologically, the two species are similar, although they do have numerous differences.
1) Ears of wheat are composed of numerous spikelets, which in durum wheat are awned. The awns can grow as high as 7.8 inches and in a full-grown plant they are straw-colored, reddish or black. In common wheat, the ears can be beardless (lacking awns) or awned. In the awned variety, the awns measure 1.17 - 3.12 inches and they are more or less divaricated from the plant's axis.
2) In common wheat, the last internode of the culm (the portion of the stalk that is nearest to the ear) is empty, while in durum wheat it is full.
3) There is fundamental difference in the structure of the grain. In common wheat it has a floury texture when it is fractured while in durum wheat it is glassy.



Drawing of an ear of wheat and its components: 1=glume; 2=lower awned glumette (can be beardless, as indicated in 2a); 3=flower; 4=upper glumette; 5=caryopses; 6=rhachis

Consequently, the products obtained from each variety differ greatly. Common wheat produces "flour," which is white and dusty, and ground durum wheat produces semolina. It has rougher granules and pointed (sharp) particles. The color is yellow amber, its intensity varying depending on the variety.
Although both types are primarily used for human consumption, the technologies employed and the end products are very different. Already in the grinding phase, the production process depends greatly on the

Varieties of durum wheat








Flour obtained by grinding durum wheat has a large granulometry and a yellow amber color

Appio *Grazia* *Simeto* *Svevo*

COMMON WHEAT	DURUM WHEAT
Flour	Semolina
• white color	• yellow amber color
• Powdery	• particles with sharp ears

characteristics of the caryopsis and on the product that one wishes to obtain from it, so that the mill must be configured to suit the raw material.

The varying compositional structure of the storage proteins is fundamental in determining the typology of the product that can be obtained with one or the other of the raw materials. The dough obtained with common wheat, in fact, is generally very extensible, and of medium/low tenacity, while that obtained with durum wheat is generally characterized by high tenacity and minor extensibility.

Common wheat is thus particularly suited to the production of bread or leavened products, while durum wheat presents features that are perfectly suited to the production of pasta.

A good gluten tenacity permits to keep starch granules inside the pasta structure, reducing stickiness. It also allows the modulation of the absorption of water during cooking, preventing excessive expansion of the pasta, giving it the right firmness.

Wheat Caryopsis

The edible portion of durum wheat, like other cereals, consists in the kernel, (the botanic term is "caryopsis") in which reserve substances such as carbohydrates (starch) and proteins are

COMMON WHEAT	DURUM WHEAT
• good extensibility • medium/low tenacity	• medium extensibility of the dough • high tenacity of the dough
suitable for making bread or products requiring yeast	suitable for making of pasta

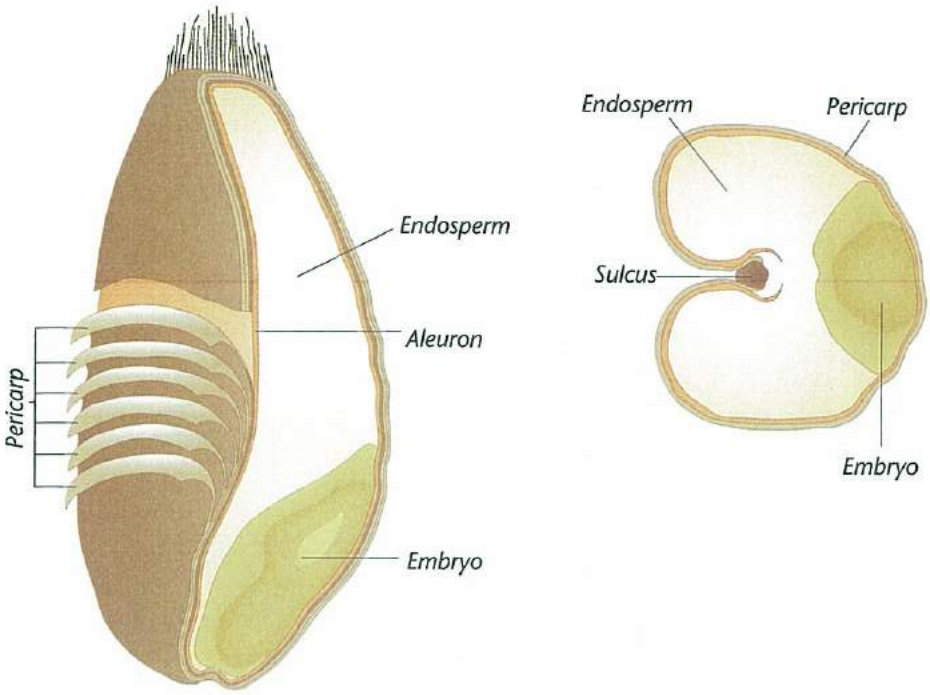


Illustration of wheat caryoposis

accumulated. The caryopsis, which is normally considered a seed, is actually a dry fruit; in other terms, it does not spontaneously open when it is ripe to expel the seed. Externally, it has 2 main parts: the pericarp (bran) and the embryo. Internally, it is instead divided into: the aleuronic layer and the endosperm.

Embryo or Germ

It represents 1-2% of the wheat grain.
It is comprised of the organs (roots, stem, and leaves), already distinct even if only in the embryonic stage, which will give origin to the new plant.
The embryo is particularly rich in proteins, fats, and mineral salts.

Table 2. Average chemical composition of a granule of durum wheat

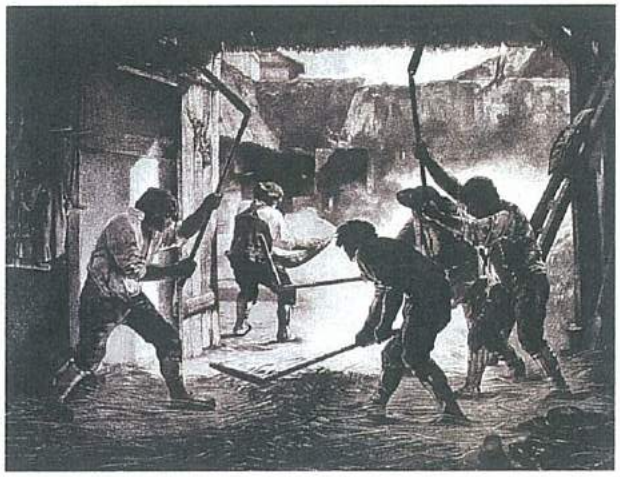
CHEMICAL COMPONENTS	WHEAT (%)
proteins (N x 5,7)	14,0
ash	1,9
fats (lipids)	1,7
humidity	12,0
starch and simple sugars	67,0
cellulose	3,4

The Pericarp (bran)

It represents 10-18% of the wheat kernel. It is the whole set of tissues that surround and protect the caryopsis, excluding the embryo. It varies in color, depending on its variety, and has a range of different shades, from white to straw-colored, to light yellow, amber, reddish, and even dark red. It has a higher content of fibers and mineral salts than the endosperm, and, combined with a portion of the aleuronic layer, it forms the bran.

The Aleurone Layer

It is a single-cell layer located between the pericarp and the endosperm. The cells of the aleurone are particularly rich in mineral salts and proteins which, during germination, perform a



Manual threshing of grain in a French lithograph from the 19th century. (Parma, Collezione d'Arte della Cassa di Risparmio di Parma & Piacenza - Gruppo Intesa)

very important enzymatic function. They stimulate different chemical reactions in the reserve substances, making them available to the embryo, giving it the energy it needs to originate a new plant.

The Endosperm

It is the largest mass in the entire caryopsis grain (80-85% of the granule. In durum wheat it has a glassy structure and a yellow amber color, while it has a less floury consistency and a whitish color in common wheat. In durum wheat, the presence of floury zones is considered a defect known as "yellow berries." Such defect is caused by the nutritional and physiological imbalances of the plant.

The endosperm constitutes the reserve tissue of the seed, and it is prevalently made up of starch (about 70%) and proteins (about 12-14%). Moreover, it contains less quantities of fats, fibers and mineral salts (ashes).

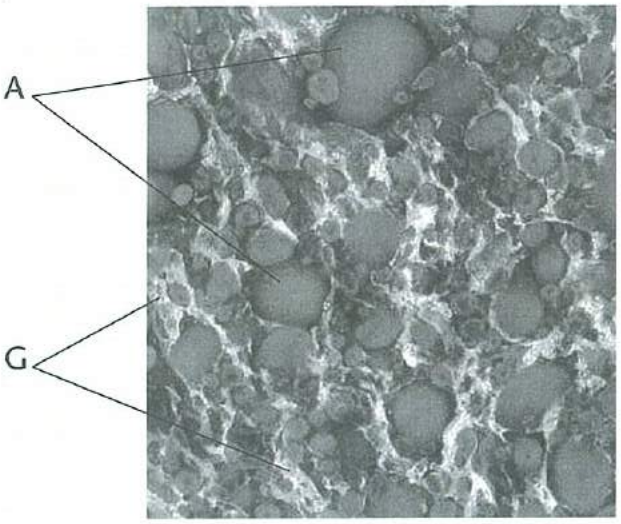
Semolina, which is the ground product of durum wheat and is used to make pasta, comes from the endosperm

Durum Wheat Semolina

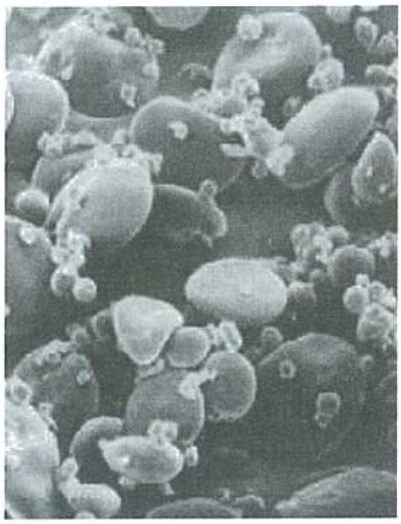
Durum wheat, freed of impurities and subjected to successive grinding, produces semolina. Italian law (No. 580 dated 1967) defines durum wheat semolina as follows: "A sharp granular product obtained from grinding and subsequently sieving durum wheat, which has freed of extraneous substances and impurities."

Law No. 440 dated 1971 stipulates the principle requisites that must be respected in producing semolina for: humidity (maximum 14.5%), ashes (ranging from 0.7 to 0.9% of dry matter), cellulose (ranging from 0.2 to 0.45% of dry matter) and proteins (minimum 10.5%).

Semolina is characterized by its vitreous, crystalline and yellow particles. The color varies depending on the amount of carotene pigments in the wheat. The chemical composition of semolina is similar to that of wheat, but with a



Microscopic image of a cross-section of spaghetti. The translucent gluten matrix (G) is evident. It completely surrounds the starch granules (A), blocking them within the structure of the pasta



Granules of wheat starch observed under a microscope

lower content of ashes, fibers, and lipids (Table 3). In fact, layers of bran and the embryo, which contain the largest portion of these compounds, are eliminated in the grinding process.

Starch

Starch is a complex molecule composed of long linear or ramified chains of glucose. It accumulates in the endosperm of the durum wheat in the form of granules, in varying sizes and shapes.

Starch is fundamental to nutrition as it is the main source of carbohydrates and, therefore, of energy for the organism.

Table 3

Average chemical composition of semolina

CHEMICAL COMPONENTS	SEMOLINA (%)
proteins (N x 5,7)	13,0
ashes	0,90
fats (lipids)	1,15
humidity	14,5
starch and simple sugars	70,0
cellulose	0,45

Proteins

Proteins are molecules composed of a sequence of units represented by amino acids. The proteins of the caryopsis of durum wheat lack essential amino acids (amino acids that the human organism cannot synthesize) such as lysine, methionine and tryptophan. They may be grouped into four principal families, depending on their chemical characteristics and functions:

- albumins
- globulins
- gliadins
- glutenins

From a technological point of view, gliadins and glutenins are characterized by fundamental feature: When water is added, they are capable of intertwining each other in long chains, giving origin to a proteinic reticule (gluten),which trapping the starch in its nets, makes the formation of dough possible. In other words, this

matrix functions as a sort of "cement," which enables the creation of pasta, whose starch granules represent "bricks."
The composition of the reserve proteins of semolina can differ from one variety to the next; therefore, the gluten's characteristics of elasticity and tenacity vary depending on the type of gliadine and glutenin present and their aptitude to form this reticule. The greater the size and the number of chains formed, the more compact and tenacious the gluten is.

GLIADINE	GLUTENIN
↓	↓
influences the dough's characteristics of extensibility	influences the dough's characteristics of tenacity

In terms of gliadin, which influences the characteristics of extensibility, and glutenins, which influence tenacity, the composition thus constitutes an essential element in defining the technological properties of semolina.

Lipids

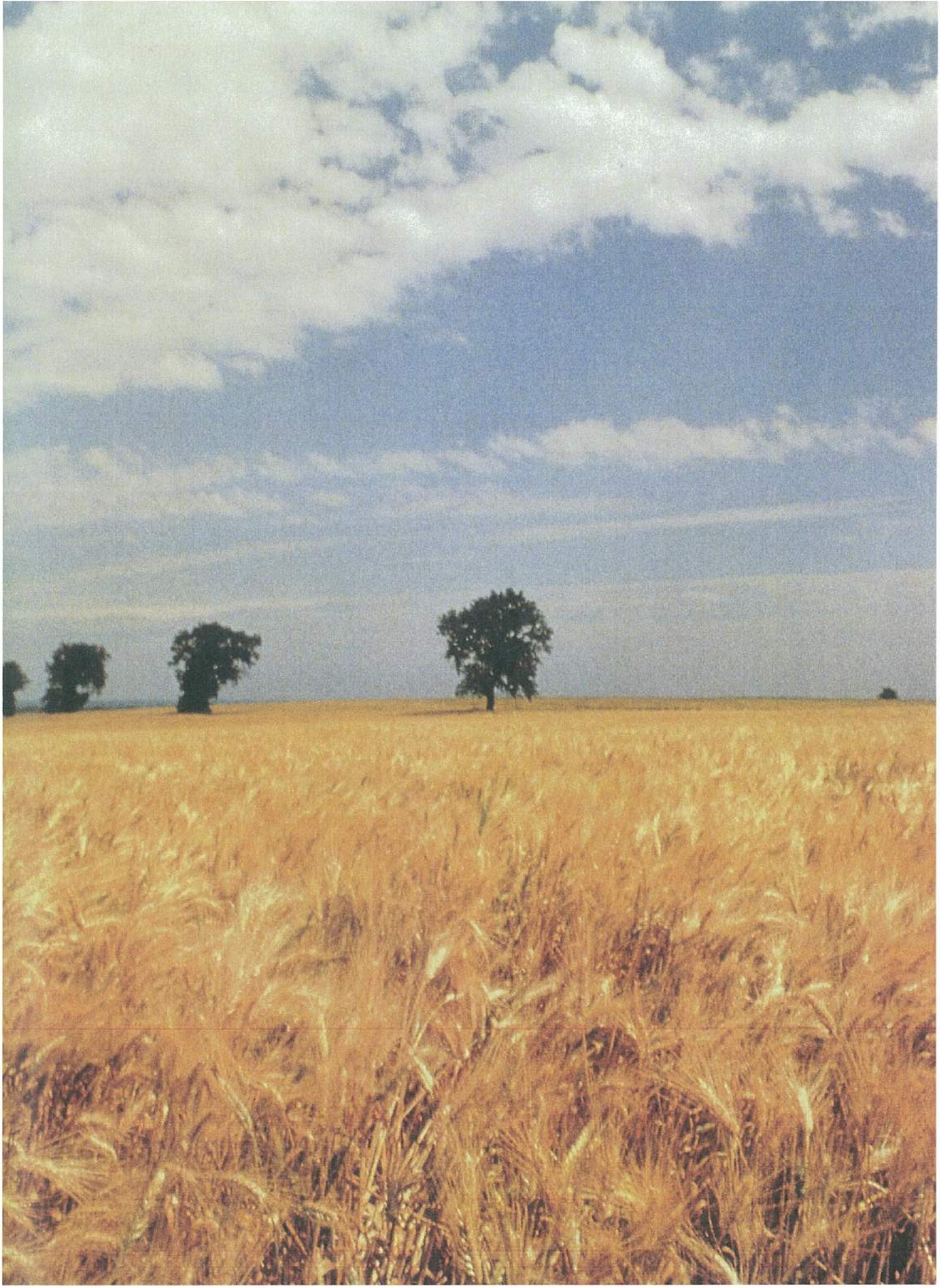
The concentration of lipids in semolina is extremely low. According to some researchers, it would appear that they interact with the starch and/or proteins molecules, improving the quality (decreasing stickiness) of the end product.

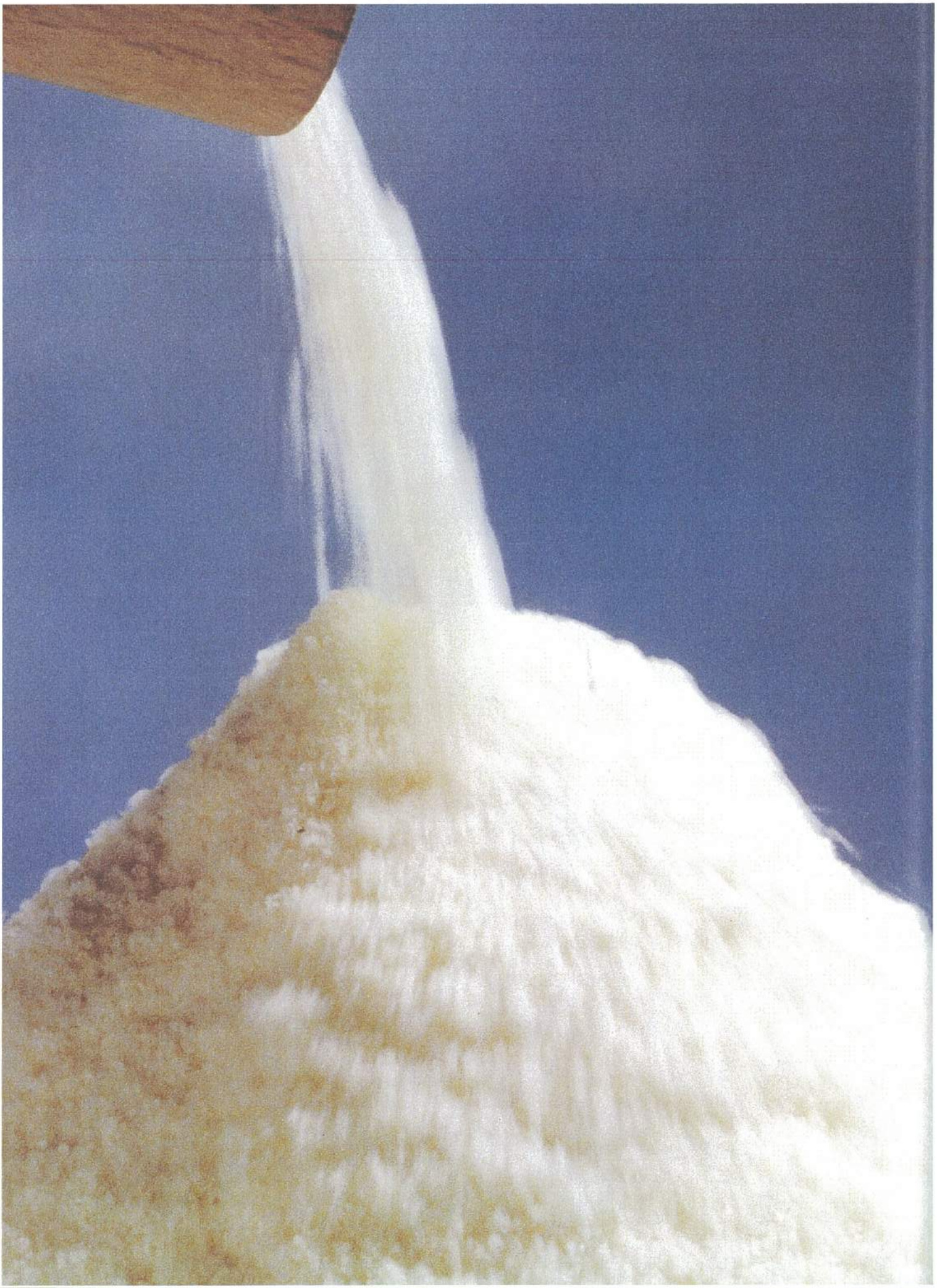
Mineral Substances (ashes)

They constitute the inorganic part of semolina. Italian law (No. 580 of 1968, integrated with Law No. 440 of 1971) prescribes a maximum allowable percentage of 0.90% of these substances on dry pasta.
This amount is intended to limit the addition of bran parts with a high content of ash and fiber considered less valuable, especially in the past to semolina.

Moisture

In semolina, water is present in varying quantities, depending on the type of grinding, on movement, and on subsequent storage. In any case, the legal level of humidity must never exceed 14.5%.





THE QUALITY OF THE RAW MATERIAL: THE SEMOLINA

The quality of a product can be determined by the characteristics which, as a whole, make it possible to meet all of the consumer's expectations. Since pasta is made exclusively with water and semolina (eggs are added only in specific end products), the quality of the durum wheat and, therefore, of the semolina, is very important.

Evaluation of Semolina's Quality

There is no better method for evaluating the quality of durum wheat than by grinding it and making pasta with it. This is a complex and expensive procedure, however, and should therefore only be conducted in specific situations.

Consequently, various laboratory methods have been developed to evaluate the features that are related to the quality of the finished product (see Appendix 1).

For this purpose, the following are commonly measured: the protein content of the grain or semolina; the quantity and quality of the gluten; the quality of the dough; the contents in yellow pigments.

- Proteic contents: measurement of the percentage of storage proteins compared to the dry weight of the sample.
- Gluten quantity: measurement of the percentage of dry gluten contained in the semolina.
- Quality of the gluten: the rheological characteristics of the gluten are analyzed, i.e. tenacity, elasticity, extensibility. Texture, stickiness and resistance to cooking, which are the components of pasta cooking value, depend on the gluten's characteristics. The tool most often used for this purpose is the Brabender glutograph
- Quality of the dough: for some specific types of pasta it is useful to evaluate the semolina's ability to absorb water as well as the overall elasticity and strength of the dough, which includes the influence of starch.

A variety of procedures are used in the laboratory to evaluate the characteristics correlated with the quality of the finished product

The Chopin alveograph is used only in these specific cases.

- Color: measurement of the intensity of semolina's yellow color.
- Specks: measurement of the number of black specks (deriving from extraneous seeds or diseased kernels of wheat attacked by fungi) or branny spots in the semolina.

In addition to these analyses, other parameters are commonly measured in the pasta plant. These include:

- humidity
- granulometry: the size of the particles of semolina must respect specific standards to guarantee perfect hydration during mixing, and to avoid the formation of any defects in the pasta;
- ashes: these are determined by burning the semolina at 1.112 °F;
- filth test: measurement of the presence of insect fragments in the semolina. These insects can develop during grain storage;
- other hygiene aspects: from the harvesting of the wheat to the processing of the semolina, measures are taken with the aim of limiting the multiplication of microorganisms in the product. The number and type of microorganisms and the toxic substances they may produce (e.g. mycotoxins) are periodically monitored.

Appendix 1

Methodologies used to evaluate the quality of durum wheat and semolina

There are a number of methods available to measure the characteristics of the material that are correlated to the quality of the finished product.

1. PROTEIN CONTENT

The amount of proteins contained in durum wheat and in semolina are normally measured with chemicals, using the official Kjeldahl method. This method involves the mineralization of the sample, which must be burnt at high temperatures with sulfuric acid, followed by the distillation of the nitrate, which is then measured. The method is a complex one, requiring long periods of time and expert operators. For this reason, instruments with infra-red rays (NIR) have been developed recently. These instruments are capable of rapidly and automatically measuring the protein contents of the semolina or of the wheat.

2. QUANTITY AND QUALITY OF GLUTEN

Today, gluten is analyzed by using automatic equipment, which makes it possible to extract gluten from the dough, eliminating the starch with a flush of water, to determine its quantity in the semolina, and its quality. The Brabender glutograph is used to measure the qualitative characteristics of gluten. This instrument measures gluten's resistance to constant stress exerted by appropriately shaped and sized torsion gear. The instrument expresses resistance in seconds or in units of deformation, which are transformed into decimals by using a specific formula. Scores above 7.5 indicate high-quality gluten, while scores below 5.5 indicate poor quality.

3. QUALITY OF THE DOUGH

The characteristics of extensibility, elasticity, and tenacity of the dough in its complexity can be measured using a Chopin alveograph. This instrument was designed to estimate the bread-making characteristics of common wheat; however, with appropriate modifications in the method of analysis, it can provide information on the rheological characteristics of durum wheat, which is to be used to make specific types of pasta. The main indexes obtained by using the alveograph are:

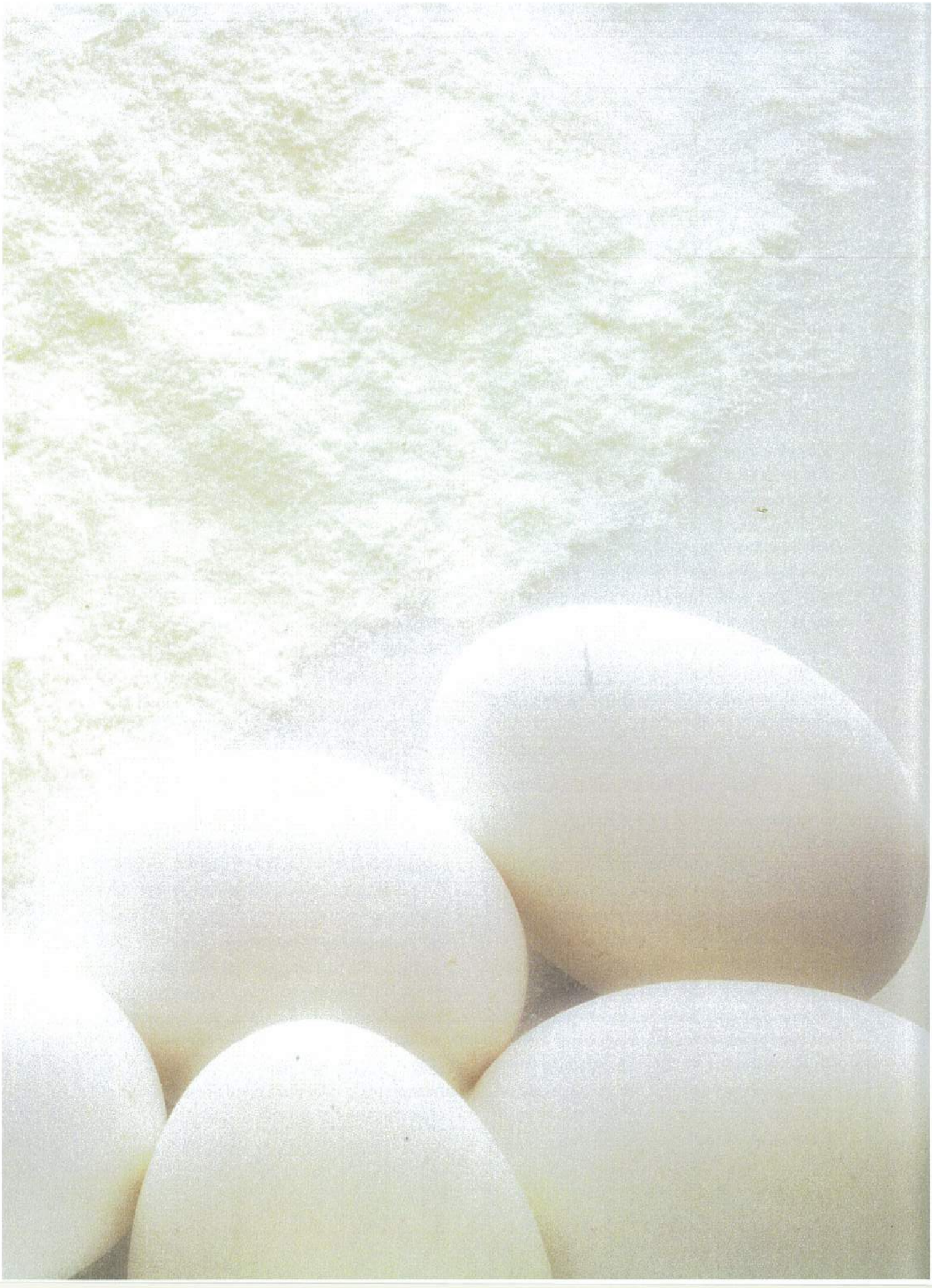
- "P/L": represents the relationship between tenacity and extensibility of the dough;
- "W": energy required for deformation until the sample breaks.

4. COLOR

the analysis of semolina's yellow color is carried out using a colorimeter that quickly and easily evaluates the intensity of the sample's yellowness. To eliminate the influence of particle size, a fraction of the semolina with constant granulometry is isolated so that it can be measured with the colorimeter.

5. SPECKS

Specks are caused by the presence of bran fragments, which were not eliminated during grinding, or of semolina particles deriving from dark caryopses caused by physiological imbalances. The evaluation is done by visually counting, or using digital instrumentation to count the number of specks (black and bran) present in a square decimeter of semolina.



RAW MATERIAL: THE EGG

The Production of Eggs

World production of eggs is mainly concentrated in Europe, the United States, and China. On the average Europe produces about 85 billion eggs year, equal to the work of 285 million chickens. Italy produces 12 billion eggs yearly, of which 4 billion are used by the pasta and sweets industries. The United States produces about 75 billion eggs yearly, and China more than 250 million.

The mission of European egg producers is based on the well-being of the animals. This means having a set of ironclad rules that specify the conditions under which chickens can be raised, such as the amount of minimal space for each chicken in a cage.

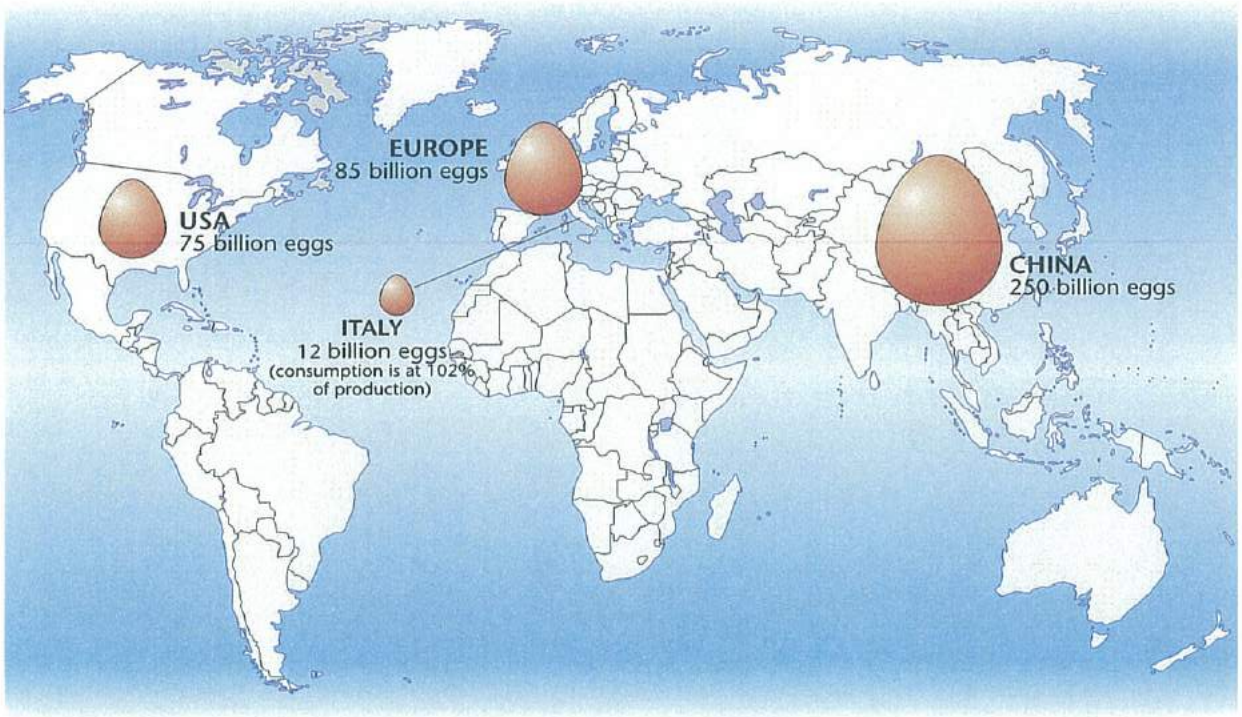
When measuring the index quality of an egg, "freshness" is the most significant factor. Since most chemical analyses normally used in quality control require a long period of time before results are obtained, egg quality is guaranteed on the basis of preventative actions, that is, on the proper breeding of egg-producing chickens (phase A) on one hand, and on the care taken during the preparation phase of the unfinished product for the industry (phase B) on the other.

Included in the first phase of intervention (phase A) are:

- correct weaning of the young chicks;
- guarantee of excellent hygienic conditions of the breeding farm;
- caring for the chicken's nutrition, which means selecting the raw materials for feed and paying particular attention to its preparation, as well as carrying out balanced formulations.

Included in the second phase of intervention (phase B) are:

- care in the transformation process of the egg for the purposes of the industry (phases of peeling, homogenization, pasteurization, transportation, etc.).



The world's production of eggs is concentrated in China, Europe and the U.S.

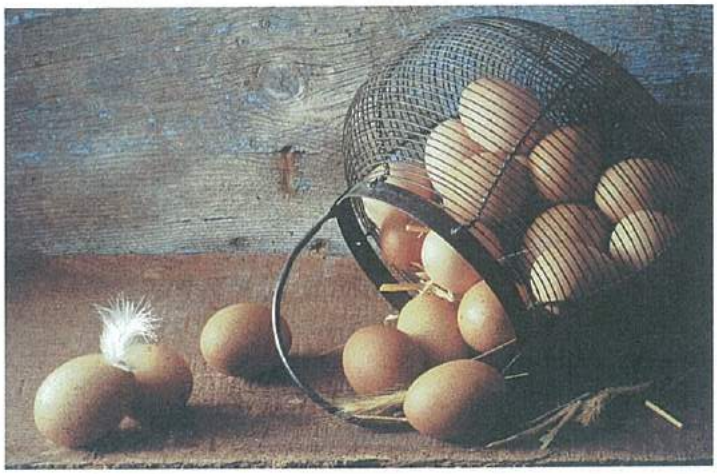
The best guarantees of quality come from the producers, who have direct control of all the aforementioned phases. Italy boasts many high-quality farms.

Italy is a major producer of eggs, with a self-supply index of 102%, that is, it is completely self-sufficient. Traditionally, the Italian pasta industry has a predilection for superior-quality eggs, that is, eggs obtained from chickens raised with feed and raw materials that are particularly prestigious and that contain natural carriers of colored pigments (beta-carotenes) such as corn, broom grass flour and corn gluten. Conversely, other European countries use white chicken-feed, adding natural or artificial colors separately, which greatly reduces costs.

Egg

Generally, when speaking of eggs, we refer to chicken eggs, which are the ones most commonly consumed. On the average, a chicken lays 150 eggs per year; chickens belonging to more prestigious breeds can produce up to 200 eggs per year, or more. The average egg weighs 1.91.93 oz, the albumen about 1.12 oz, the yolk .63 oz, and the shell .17 oz.

The eggshell and its membrane act as a protective barrier between the egg and the outside world. Nonetheless, over time, and especially in unsuitable climatic and humid conditions, the egg loses water and carbon dioxide through the pores of the shell. This allows air to penetrate, resulting in the deterioration of the egg. The shells of fresh eggs vary in color, which has a velvety quality, and when viewed against the light they seem to have a pinkish tint, which darkens at the center. Their air chamber has an indefinite outline and their diameter usually measures less than 1 cm. The albumen is nearly colorless and rather consistent, especially in the interior; the yolk is spherical since it is contained within a membrane rich in ovovitellin.



In this state, eggs can be preserved for about 8-10 days. Old eggs have a shiny and smooth albumen, and, if looked at against the light, they have an opaque dark red tint. Depending on the age of the egg, the air chamber is quite large, measuring to .78 - 1.17 inches in diameter. The albumen appears yellowish and fluidized while the yolk is nearly flat, and has the typical taste and smell of an old egg. There may even be an advanced state of alteration, which causes the yolk to mix with the albumen. Fresh eggs have a density that ranges from 1.0784 to 1.0942 while the density of old eggs varies from 1.020 to 1.040. There is a test which can determine when the egg was laid, by relying on the figures of the egg's density. When immersed in a solution of 10% sodium chloride (NaCl d=1.066, the fresh egg sinks to the bottom, while the bad one continues to float. Hence, the closer it stays to the surface, the older it is. Composed primarily of lipids and lipoproteins, the yolk is a source of food for the embryo, which develops in the fertilized egg.

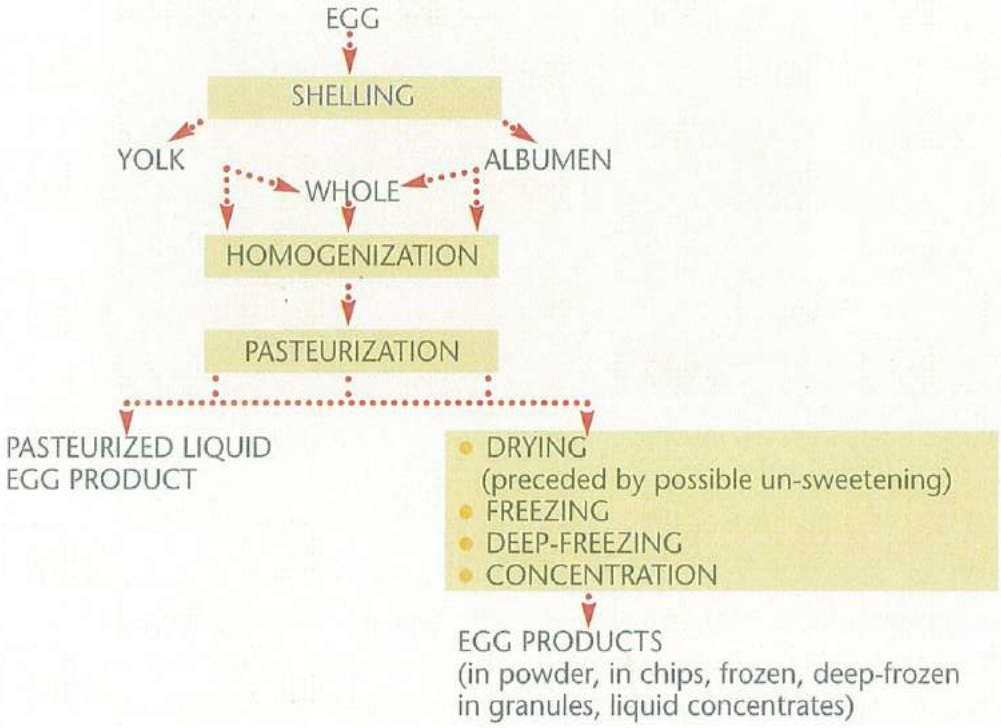
The egg white functions simultaneously as a protector and as a source of protein and water. Studies have been conducted on egg proteins, especially those contained in the albumen, from which different proteins have been isolated in a state of purity, most of them of particular biological interest. Ovoalbumina is the most abundant,

Average Percentages of the Composition of the Shelled Chicken Egg	
water	73,67
nitrates	12,55
lipids	12,11
carbohydrates	1,09
ashes containing calcium, potassium, iron, phosphates	1,12

The yolk and the albumen each contain:

	yolk	albumen
water	49,0	86,6
ashes	1,5	0,8
proteins	16,7	11,6
lipids	81,6	0,2

General diagram of how eggs are obtained



Classification and use of main egg products

Egg Product	Use
WHOLE	
• liquid	egg pasta, baked and bakery products, ice- cream
• salty	mayonnaise, sauces
• dried	baked and bakery products, egg pasta (as per regulations), pasta fillings, mayonnaise, pre-mixes for sweets and ice-cream shop
YOLK	
• liquid	baked and bakery products, egg pasta, ice-cream
• sweetened	baked and bakery products, ice-cream shop
• frozen,deep-freeze	bakery and ice-cream shop
• dried	baked and bakery products, pre-mixes for sweets and ice-cream shop
ALBUMEN	
• Liquid	ice cream shop, bakery, sweet products with a sugar base (meringues, nougats)
• Dried, *powder*	pre-mixes for ice-cream shop, bakery, soups and breads
• Crystallized,*chips*	sugar-based sweet products (meringues, nougats)

Price-marker for a package of Barilla pasta dated 1927. The old trade-mark is enclosed in a large egg

constituting 54% of the albumen's total proteins. It coagulates easily when heated, denaturalizing. Ovoalbumina makes it possible for the egg white to entrap air when it is beaten. It is aided by globulins and ovovitellin, which function as stabilizers for the foam. Conalbumin, which constitutes 13% of proteins, plays an important role in protecting the egg from bacteria that rely on this element for reproduction.

The ovomucoid is a glucoprotein that comprises 11% of the albumen's proteins and does not coagulate when heated.

Lysozyme, one of the three globulins isolated from the egg, has been the subject of in-depth studies because of its antibiotic properties. It is quite constant under heat, and constitutes 3.5% of the albumen's proteins of the albumen.

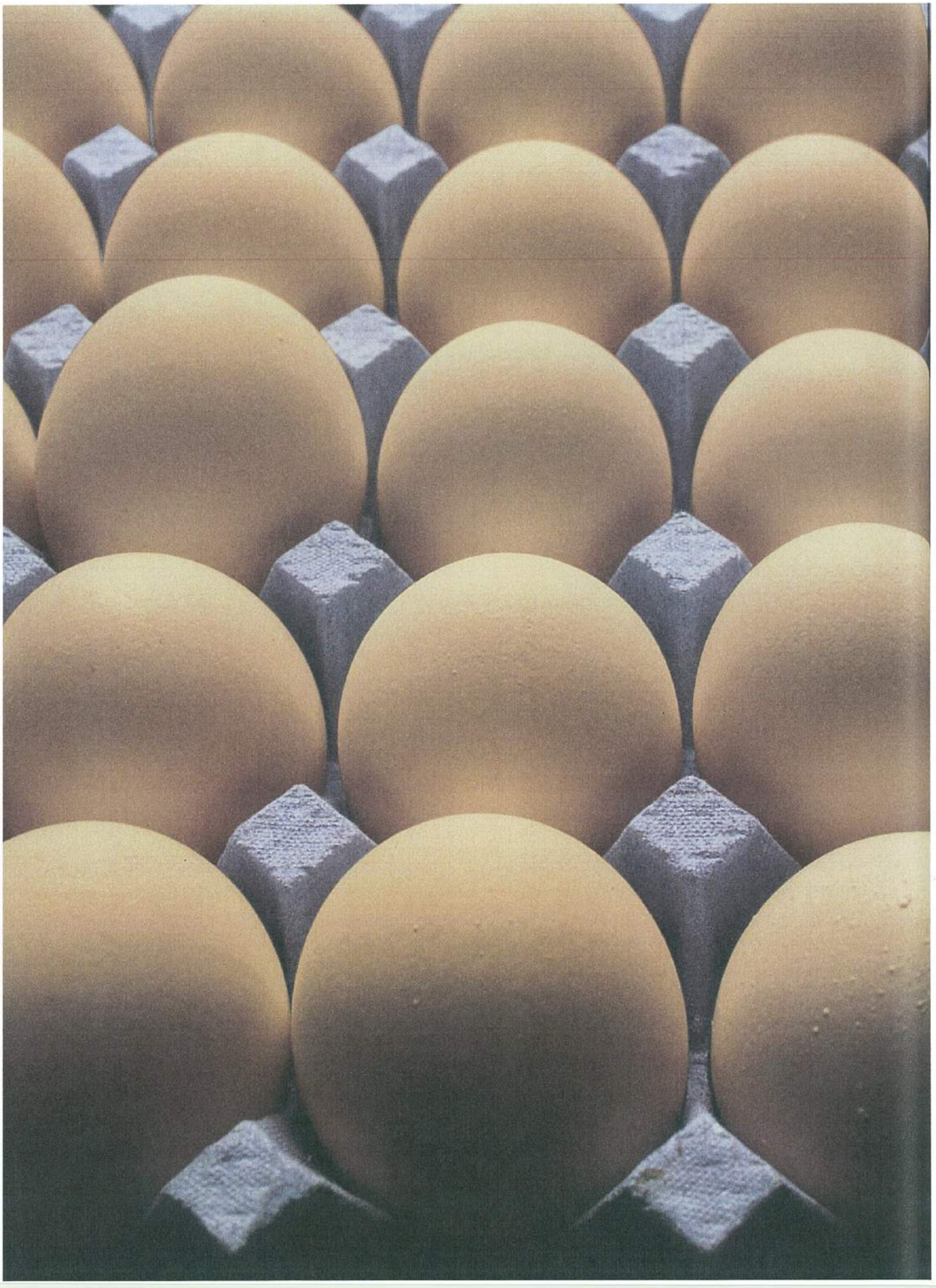
Ovomucin and avidin are proteins that exist in lesser quantities.

The egg yolk is composed primarily of lipids, which are often bound to proteins. In fact, in a dry state, it is made up of: 42% glycerides, 20% phospholipids (3/4 lecithin, and 1/4 cephalin), 2% sterols, especially cholesterol, 21% lipoproteins, 12% various water-soluble proteins, and the rest by sugars, salts and vitamins.

The lipoproteins are lipovitellin and lipovitellenin, the simple proteins which are called vitellin and vitellenin and pertain to phosphoproteins.

Their emulsifying properties make it possible, for example, to prepare mayonnaise.

The yolk contains vitamins A, D, E, K and those in the B group. The yellow substance in the yolk is called lutein.



THE QUALITY OF THE RAW MATERIAL: THE EGG

In 1975, the European Community issued a new regulation regarding the commercialization of eggs. The regulation classifies eggs into three categories, based on quality:

- CATEGORY A or "fresh eggs";
- CATEGORY B or "secondary quality or preserved eggs";
- CATEGORY C or "declassed eggs intended for the food industry."

This document also provides the organoleptic features relative to categories A and B, which are then classified further on the basis of weight.
For example, the height of the air chamber in category A eggs must not exceed 6 mm, increasing to 9 mm for category B.
The sale of spoiled or modified eggs, or of eggs artificially colored with toxic substances is prohibited. Imported eggs must have the country of origin printed on the shell.

Eggs are subjected to numerous controls because they are a delicate product, and can be preserved for a very limited amount of time. In truth, the eggshell is permeable, allowing oxygenated air to permeate its surface, causing visible alterations to the egg.
For this reason, the systems used to preserve eggs are based on the principle that prolonged exposure to oxygenated air must be avoided. Eggs are therefore sprayed with adhesive substances (paraffin, rubber, wax, fat), or covered with a powdery substance (bran, sawdust, ash, chalk, talcum powder) or immersed in a solution of various substances (sodium silicate, limewater, sodium chloride). Though assuring the egg's edibility, these systems slightly modify its scent and flavor.
Refrigeration is the best method for preserving eggs. It consists in maintaining them at constant temperatures of 33.8 °F -39.2 °F. In this manner, eggs maintain their natural qualities of freshness rather well, even over relatively long

Cover page for Barilla's 1938 general catalog. Photographic collage created by Pizzi e Pizio.

Average level of egg yolk pigmentation requested by European and American consumers

Nation	Roche Scale
Germany	13-14
Italy	12-14
Portugal	12-14
Belgium	12-13
Greece	12-13
France	11-12
Spain	11-12
England	10-11
Finland	9-12
Sweden	8-12
Ireland	7-11
Holland	7-9
U.S.A.	7-10

periods of time. Freezing, however, damages them because the yolk gels and is transformed into a gummy mass because the lipoproteins are denaturalized by both heating and cooling.

Qualitative Analytical Evaluations of the Egg

Typically, this raw material is subjected to chemical and microbiological analyses as well as to technological analyses of marketable goods. Analyses are done on:

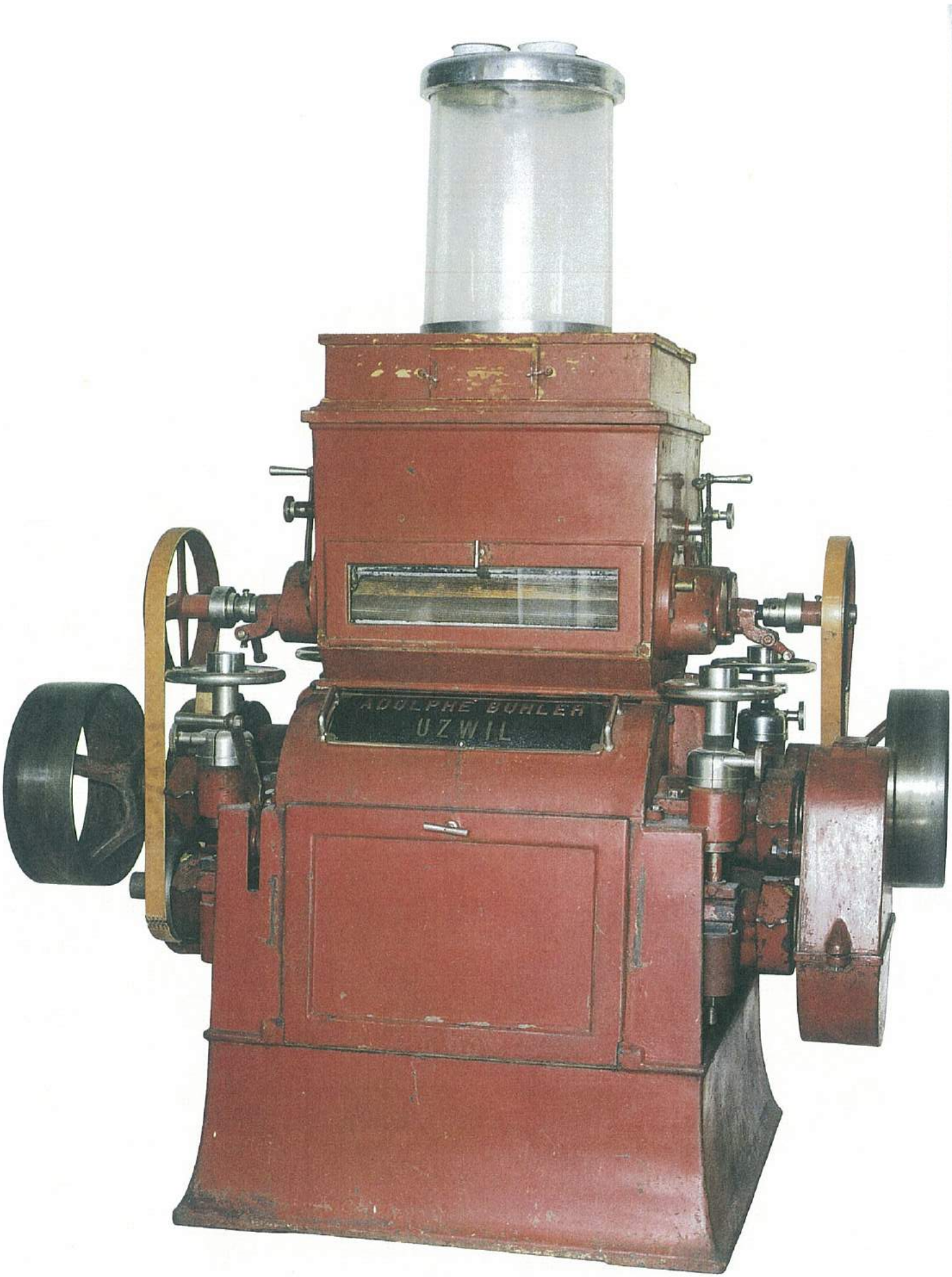
- dry residue generally measured by drying a weighted quantity of the product, which is mixed with fossil flour, in a stove;
- fat content, determined by continually extracting the product, blended with an anhydrite agent, using ethyl ether (to hold back water);
- nitrates are determined using the traditional Kjeldahl method, previously mentioned in relation to semolina.
- cholesterol is determined by saponifying the sample with potassium hydroxide, and subjecting it to by high-speed liquid chromatography (HPLC), using the pure substance as a reference. A more traditional method involves weighing the total that it

Industry's principal uses of the various types of eggs	
Egg pasta	• *eggs with an elevated content of synthetic yellows, 50-60 ppm* • *eggs with natural yellow pigments (20ppm or 35-40 ppm)*
Tortellini, tortelloni	• *eggs with an elevated content of synthetic yellow pigments (50-60 ppm)*
Mayonnaise and sauces	• *eggs with synthetic red pigments* • *eggs with very low content of pigments*
Ice-creams	• *eggs with synthetic red pigments* • *eggs with natural yellow pigments (20ppm or 35-40 ppm)*
Sweet factories	• *eggs with synthetic red pigments* • *eggs with natural yellow pigments (20ppm or 35-40 ppm)*
Restaurant and catering	• *eggs with synthetic red pigments*

forms with a chemical substance (digitonin). These four characteristics can be simultaneously determined in a matter of minutes by using spectroscopy in nearby infrared rays (NIR), which allow quick sighting of a spectrum that is, of a curve in which the absorption of the specific radiation (in ordinals) is configured on the basis of the length of its wave (in x-coordinates) which can then be automatically compared with a set of spectra belonging to other true samples with a known content (because the content had been determined previously).

• Ashes, like other raw materials, are determined by completely burning a known quantity of a portion of the sample and then weighing the residue.

• Total pigment are determined by extraction, using a mixture of solvents, and by measuring the yellow's absorption of the luminous radiation. Instead, to determine the presence of pigments of synthesis, the pigments are separated on a slab covered with silica (chromatography on a thin layer). By using opportune and pure substances for reference, it is possible to verify whether or not colors were added.


ADOLPHE BÜHLER
UZWIL

GRINDING

Grinding is a process of a physical nature. Its objective is to produce semolina (from durum wheat) and flour (from common wheat) by separating the caryopses from the parts considered to be extraneous, such as germs, bran and impurities.
The grinding of cereals occurs through the action performed by a set of treatments that have undergone substantial modifications over time, to adapt to technical progress and consumer needs. In the past, grinding was more a chopping process than a grinding process. The bran was fragmented along with the endosperm of the caryopsis, yielding a product from which only a part of the bran could be separated, specifically, those parts of bran that remained larger than the flour (bran
has a different consistency and elasticity compared to the starchy endosperm).

One of the first rolling mills with cylinders built in 1890 in the workshop of Adolphe Buhler, founder of the homonymous company and current world leader in the sector.

Flour

Caryopses of cereals become fit for human consumption once they have been deprived of the indigestible or irritating parts, such as the lignin and cellulose of the peripheral layers, as well as the fattier parts, and those that are more easily altered like the germ seed. Consequently, it is the endosperm that is used for nutrition purposes.
In Italy, wheat is the principal ingredient of the foods that constitute the basis of nutritional intake. Bread is made with common wheat flour and pasta is made with semolina or from milled and ground flours of soft wheat, which obviously produce lower-quality pasta.
While flour has a tiny granulometry, milled flour, obtained from soft wheat, has a larger granulometry, as does semolina obtained from durum wheat.
Ground durum wheat produces primarily large granules, with sharp-edged (bran)and finer particles, which are always rather rough because

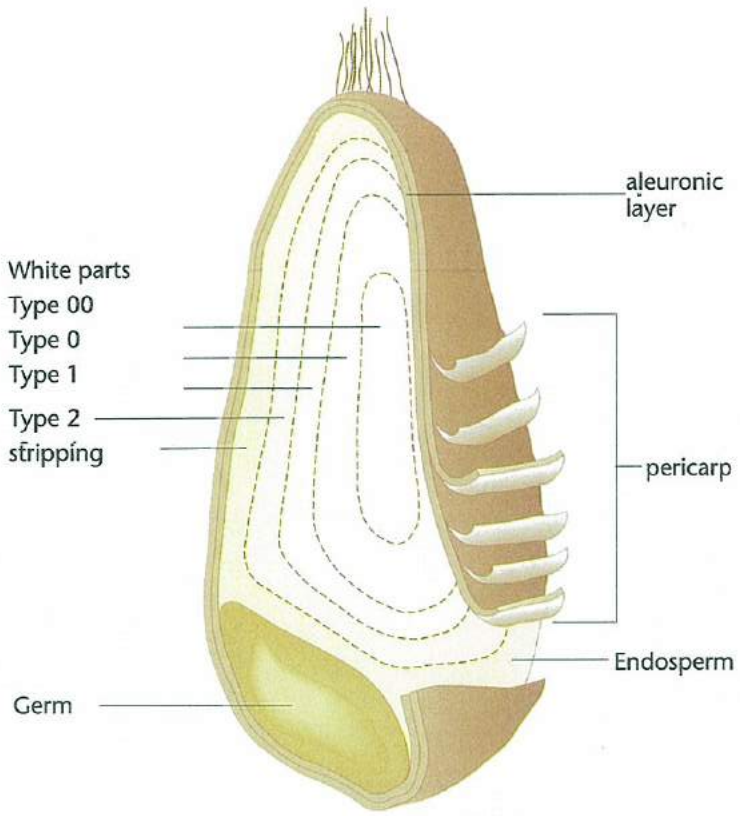


Figure 1: Commercial types of flour and by-products relative to the area of the granule from which they are extracted.

of their essentially polyhedric structure.

Flours are categorized into two groups for commercial purposes: (Fig. 1)

• flour types	00, 0, 1, 2,
• semolina and "semolette"	00, 0, 1, 2, 3

The grinding phases (Fig. 2)

Pre-cleaning and cleaning

Following the receiving procedures, the granules that arrive at the mill are subjected to pre-cleaning and cleaning procedures.

The purpose of pre-cleaning and cleaning is to separate any extraneous substances such as dust, small stones, straw, and extraneous seeds such as vetch, oats and others, from the mass of cereals that will be sent to be ground.

Pre-cleaning takes place when the wheat is received at the mill. Cleaning takes place before the wheat is ground.

The machines that separate the wheat from the extraneous bodies are categorized according to the principles that make them work. The table below lists the most commonly used machines.

Other machines used for cleaning are:

- sterilizers:

they neutralize the insects present in the granule

- rubbing machines:

MACHINES	SEPARATION PRINCIPLES
Stone rakes Densimetric tables Air separators	Specific weight difference
Shelling machine with cylinders Separator	Difference in size
Spiraled shelling machines	Difference in shape

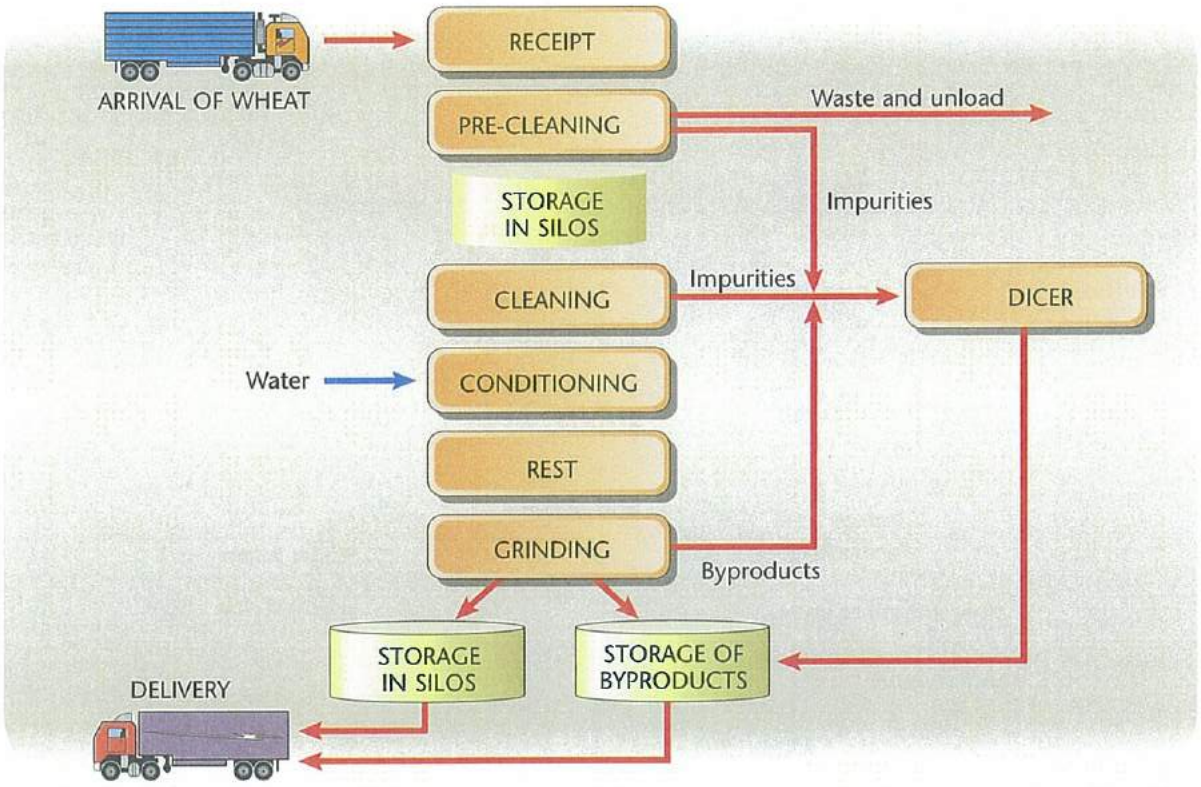


Figure 2: Diagram of a milling plant

they allow the branny parts of the most external part of the granule to be separated.

- deferization machines:

they eliminate the ferrous material through magnetization.

After the cleaning operations, the wheat is subjected to a "conditioning" treatment, which makes it possible to increase the natural humidity levels (about 11%) to about 16.5% prior to the grinding process. This is done by adding water to the mass of wheat to be ground, letting it settle in opportune silos for a period ranging from 8 to 12 hours. This period of rest is necessary to allow the added water to penetrate the caryopses in a uniform manner.

Grinding

After conditioning, the wheat goes through the actual grinding process, which consists of a series of successive and progressive fragmenting procedures, carried out with machines known as rolling-mills. These mills are composed of a twin set of rollers that rotate at a set speed and with suitably grooved surfaces. Rotating in opposite directions and at different speeds, these rollers cause the fragmentation of the endosperm and the stretching of the external cortical parts, which are subsequently separated as a consequence of the resulting size differences.

Rolling-mills

There are three types of rolling-mills:

- breaking-down mills: open the wheat granule by compressing, cutting, and stretching it between the rollers, which function at different peripheral speeds.
- stripping- mills: strip the semolina of the bran particles that adhere to it
- re-grinding mills: reduce the granulometry of the semolina

In large mills, there are rows of several groups of

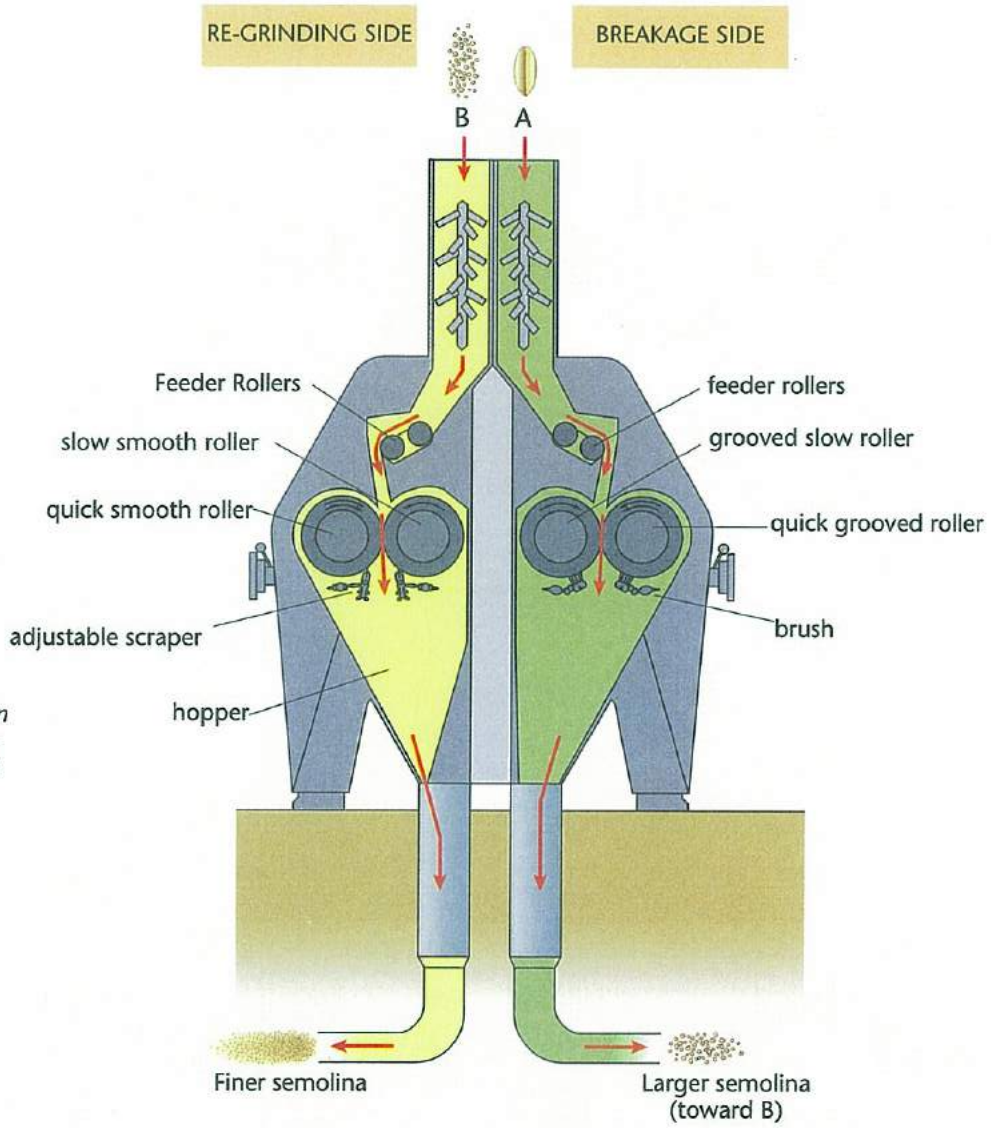


Figure 3: Scheme of a twin rolling-mill after it has been used for grinding wheat.

rolling-mills, that is, various stages of breaking-down. Typically, the stages are 6, each of them assigned a number, indicating their position in the sequence, after the letter "B," (B1, B2, B3, B4, B5, B6), which stands for *broyage*, the French word for grinding.

A rolling-mill is composed of a twin set of large cast iron cylinders fused into a shell.

Generally, two rolling-mills are joined in a single case, forming a double rolling-mill (Fig. 3).

In modern machines, the cylinders are arranged horizontally.

Breaking-down, stripping and re-grinding are the three phases carried out by the rolling-mills. The cylinders of a single pair rotate at different speeds: the upper one is quicker, the lower one is slower. The distance between them is adjustable. The length of the cylinders varies from 1000 to 1500 mm; the diameter is generally 250 mm. The splines are inclined at degrees of 6 to 12.

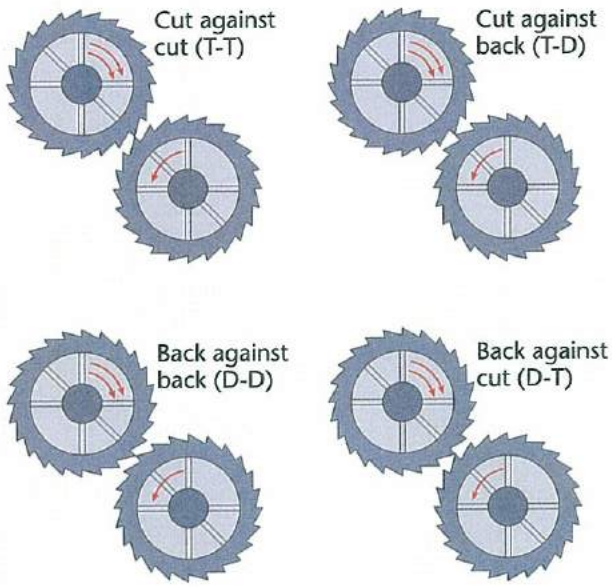


Figure 4: Toothing and functioning of the cylinders

The number of lines per centimeter vary from 3.5 for the first breakages to 12-13 for the last ones, while the depth ranges from 1 mm to 0.15 mm.
The pairs of cylinders work in a variety of ways: cut against cut (T-T), cut against back (T-D), back against back (D-D), back against cut (D-T). Toothing and operating procedures are represented in the following figure (Fig. 4).

Sieving and Separating the Grains

After the breakage phase, the flours are classified according to the size of the granules by means of a machine called the Plansichter, which is composed of a set of sieves. In fact, during the grinding phase, the endosperm tends to fragment and pulverize easily, while the bran parts tend to widen into the shape of scales. This phase is followed by the separation procedure of the pure endosperm granules(heavier) from the "coated" (lighter) granules, that is, granules with more bran particles. This operation is carried out by a machine called the purifier.

The grinding procedures therefore produce semolina and the byproducts fine bran, "farinetta, and "farinaccio," which are used in zootechny as fodder for animals.
Flours and byproducts are then ensiled and shipped to destination.

THE PRODUCTION PROCESS

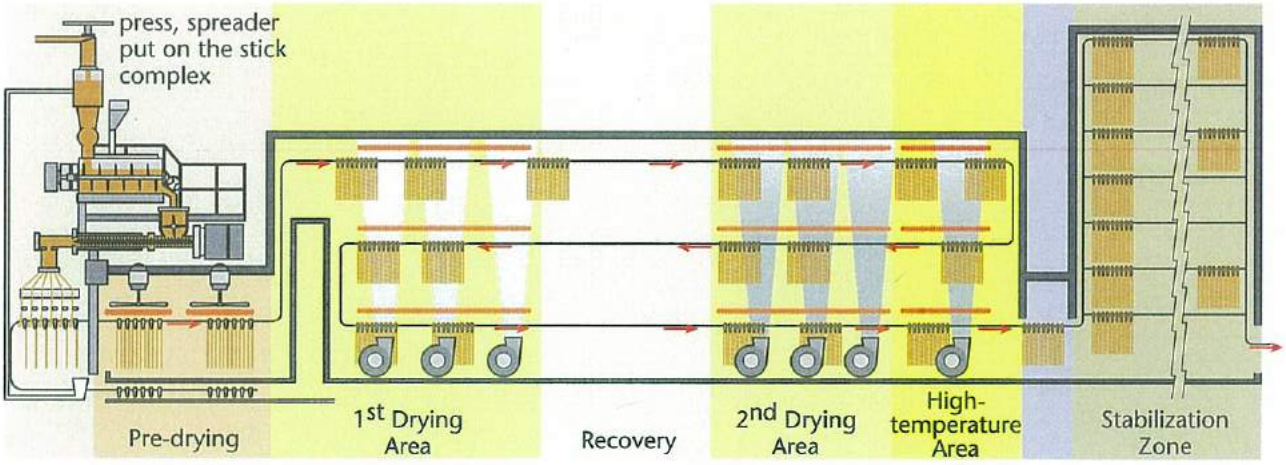
The ground semolina, which has been certified by the supply mill, arrives at the factory where it will be converted into pasta.
Immediately after it has arrived, the semolina is checked by quality control to ensure that the product meets the required standards of the mill that supplies it. It is then stored in the proper silos. Depending on the type of pasta to be produced, each silo is specifically sized to store more than one type of semolina. The warehouse is designed in a way that enables each different type of semolina to be sent to a specific production system.

Sifting the Semolina

Before it can be kneaded, the semolina must be sieved, in order to remove any impurities. Throughout this process larger grains of semolina are also eliminated. This is important because they cannot be efficiently hydrated and could therefore turn up as white specks in the finished product.

Dosing the Ingredients

The sole ingredients used in making the pasta are semolina and water.
A constant and continuous dosage is an indispensable prerequisite to a good final product.
In fact, the quantity of semolina and water that the automatic doser introduces into the mixer must be maintained at constant levels. This eliminates the risk of imbalances or irregularities, which could hamper the quality of the final product during the final dough mixing phase.
The quantity and capacity of the doser is proportionate to the production capacity of the production line. Furthermore, to produce pasta with the proper degree of humidity and an optimal dough mixing temperature, it is important to be able to regulate the water temperature. Semolina is very sensitive to seasonal changes and to the geographical climate in which the factory is located.



Drawing of a production line for pasta

Premixing and Dough Mixing

Dough mixing is done by the mixer. Before the actual dough mixing cycle begins, semolina and water are placed in a premixing machine called the high-speed mixer, which helps to distribute the water onto the semolina grains in a homogeneous manner.

The high-speed mixer is composed of a cylinder with two sections which, placed side by side, form a flatwise eight.

Each of the two cylinders contains an arm with rotating blades. These intersecting arms rotate counterclockwise at extremely high speeds (900 revolutions/min) and they cause the semolina and water to hit the inside walls of the cylinder. As a consequence of the speed and the power of the centrifugal force, the water and the semolina come into contact with each other and are homogenized.

The blades can be placed in a manner that either keeps the product inside the mixer, extending its permanence, or favors its exit, diminishing holding time. When the semolina comes into contact with the water, initiating the hydrating phase of the starch and proteins contained in it, the gluten network phase begins.

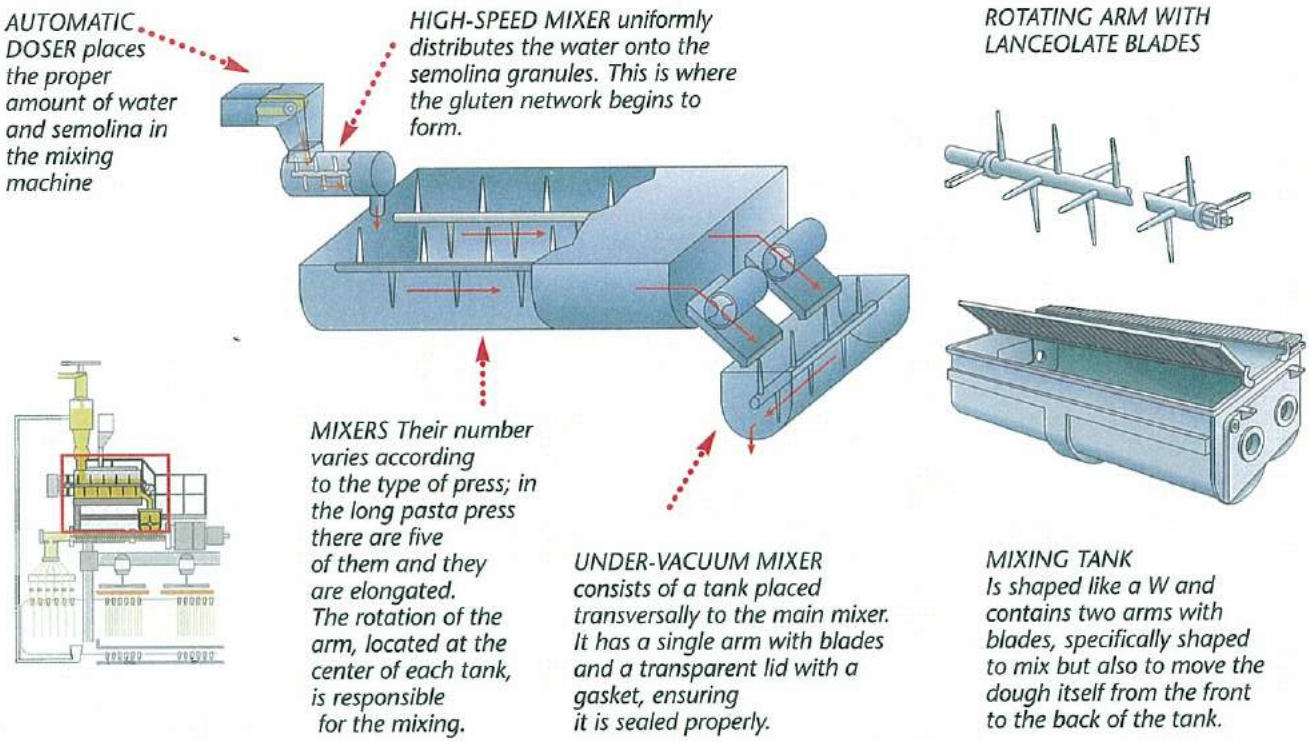
The gluten network is formed by many very thin filaments, braided together. These filaments form a thick net that constitutes the base of the dough, locking the expanded particles of hydrated starch in its web.

Gluten is in dire need of water and, in general, it can absorb up to 200% of its weight.

Elasticity (as well as quantity) is one of the most important elements that the gluten of semolina must have; in fact, thanks to elasticity, the gluten network is able to maintain and control all of the starch, even when it expands in response to water absorption.

Proper hydration of the semolina is, as we have said, essential for obtaining a good final quality product. The semolina's ability to absorb water fundamentally depends on:

1. proper size of the semolina particles



A big granule will have difficulty absorbing the water, even if a large granule has a greater power of retention once it has been hydrated;

2. content and elasticity of the gluten

Since proteins that come into contact with the water expand, the granules, which are rich in proteins, absorb more water;

3. water temperature of the dough

When the semolina is mixed at cold temperatures, the granules absorb the water slowly. Since mixing time is constant, the granules are wet only at the surface, and are therefore insufficiently softened and expanded. This results in hard and floury dough. By using warm water (approx. 95 °F), the granules expand more quickly, producing dough that is the right consistency.

The true mixing process, which follows the premixing phase, perfects the homogenization of the semolina/water mixture, blending the smaller semolina particles (that have excess water) with the larger ones (that need the water).

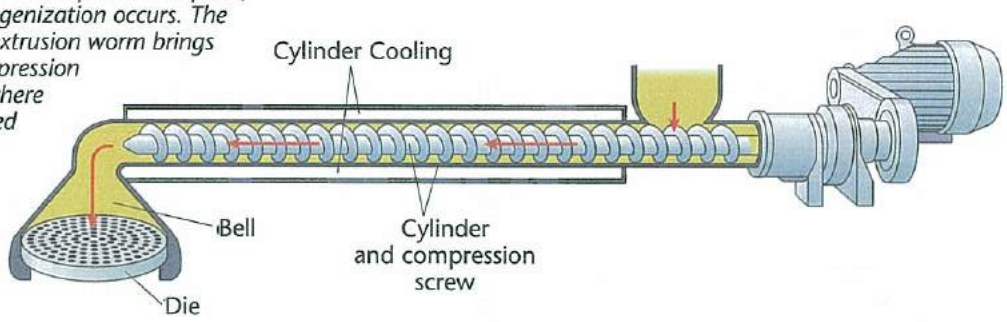
The machine that mechanically produces the dough is called the main mixer. It consists in a W-shaped tank composed of two arms with lanceolate blades, their shape is important to proper mixing as well as to the transportation of the dough itself from the front to the back of the tank.

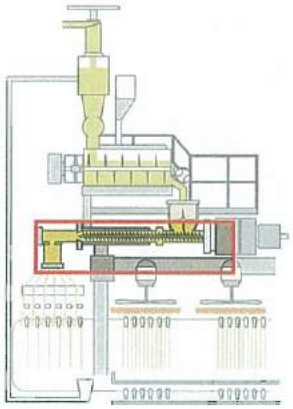
The positioning of the blades enables the dough's optimal consistency; that is, a perfect blend of moisture and medium granulation. It should be neither too floury nor too lumpy as this would create problems in the transfer to the next phase.

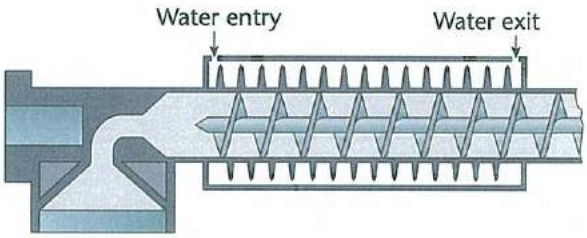
Certain chemical/physical modifications occur during the homogenization produced by the blades and the semolina's absorption of water. These changes are:

- expansion of the starch due to water absorption
- partial formation of gluten

CYLINDER AND EXTRUSION WORM
"Dough mixing" occurs in this part of the press; that is, complete homogenization occurs. The endless motion of the extrusion worm brings the mixture to the compression area of the machine, where it is uniformly distributed on the die.







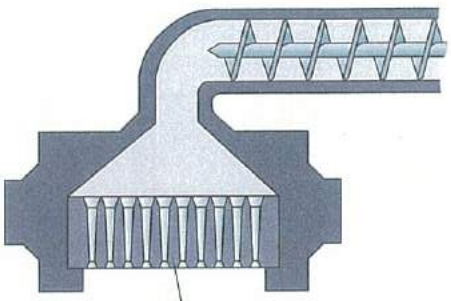
DETAIL OF THE WATER-COOLING SYSTEM IN THE COMPRESSION CYLINDER. This is very important because too much heat would compromise the quality of the pasta.

The last mixing tank differs from the others in that it functions under vacuum. It is comprised of a tank placed transversally to the main mixer. It has a single arm with blades and is closed by a thick and transparent Plexiglas lid with a gasket, ensuring a perfect seal.
The dough level in the vacuum tank is kept constant through a level indicator that intervenes when the phase is reaching its threshold or sets off an alarm when the level is too low.
In addition to furthering the mixing phase, the technological function of this next phase is to remove air from the dough, improving the color and appearance of the drawn pasta's surface. When there is air in the mixture, the surface of the product forms small white bubbles, it appears gray and it lacks shine.

Compression

Once the mixing is completed, the mixture, which is still floury and forming the gluten network, moves from the mixing machine to a compression area (the head).
At the end of this phase, the dough is compressed in the die so that it can be shaped into the various types of pasta.
"Dough mixing" occurs during this transportation phase to the die; that is, the dough is completely homogenized as a result of the pressure exerted by the extrusion worm.
Compression is carried out by an extruder composed of a cylinder containing a constantly rotating extrusion worm.
The compression area is located at the end of the worm, which serves to uniformly distribute the dough onto the die, so it can be shaped.
The internal surface of the cylinder is characterized by rectangular, longitudinal grooves, whose function is to impede the dough from rotating with the worm.

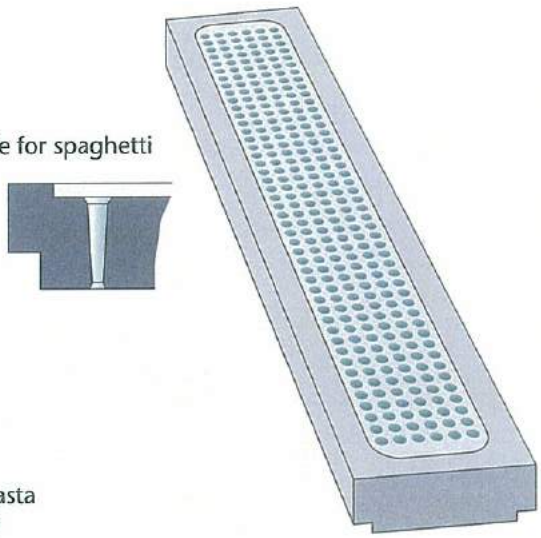
Naturally, the compression and transportation phase generates heat. This must not be allowed to happen or else the mixture will reach critical

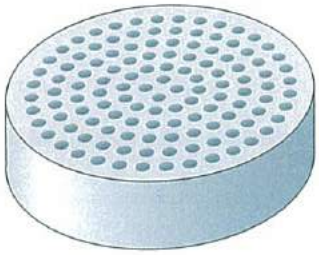


DIE. The machine that "brands" the product. The mixture that has been compressed by the extrusion worm passes through a filter and goes into the die to be given its final shape.

RECTANGULAR DIE
Used or making long pasta
die for spaghetti

Die for spaghetti





The CIRCULAR DIE is used for making short pasta.

Die for short pasta
(*pipe rigate*)

temperatures, which would cause proteins to coagulate, creating bad quality pasta in the cooking phase.

Heat is therefore removed through a thermostat-controlled water cooling system in the compression cylinder.

Die drawing

Now a very viscous fluid, the mixture, which is perfectly homogenized and compact, passes through a steel or drilled foil netting that blocks any impurities, which may not have been noticed in previous phases. The netting also serves to stop the "lumps" that could form in the mixers and to adjust the speed of entry and exit into the die so that the pasta is shaped according to its intended shape.

Each die is suited to the particular shape of the pasta being produced.

There are dies specifically designed for long pasta and dies for short pasta.

Long pasta dies

For long pasta cuts the dies are usually rectangular and measure from 3.28 - 42.64 ft in width. They are built in Bral (bronze/aluminum) and they are perforated, allowing the die inserts, which give the pasta its shape, to be inserted. The spaghetti gets its shape by merely compressing the mixture through the holes of the inserts, the size of each hole determining the intended cut.

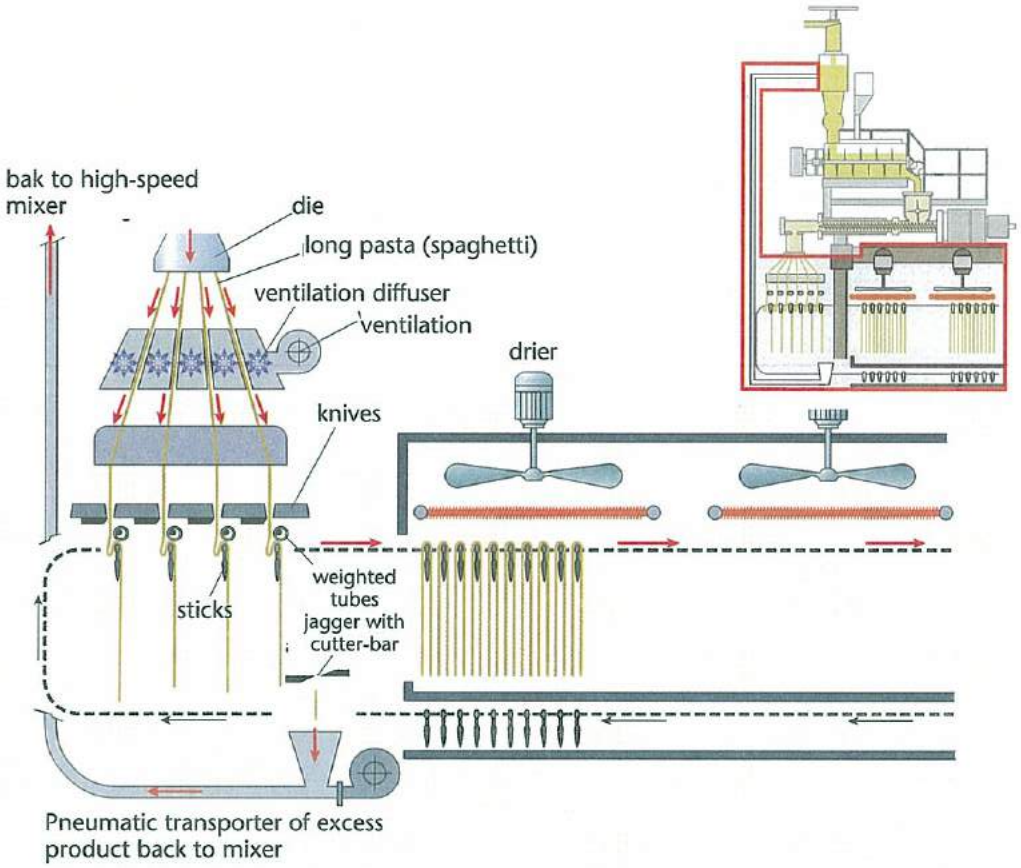
The holes containing the inserts can be perforated into the block of the die in two ways:

- with a small hole for each strand of pasta
- with larger holes in which die rosette inserts are inserted with several die holes

The holes of the die inserts can have:

- an original bronze surface that will give the product a rough, pale yellow surface
- a surface covered in Teflon that will give the product a smooth, bright yellow surface

SPREADING AND PUTTING LONG PASTA ON THE STICK (SPAGHETTI) Lowered onto a parceling machine from the die, the spaghetti receives a jet of warm air from the air fans. Positioned below the parceling machine, the spreader places the spaghetti onto the sticks and cuts them to size. Once they are on the sticks, chains pull them onto a jagger where a cutter-bar cuts the excess product, which will in turn be sent back to the mixer to be reused.



Short Pasta Dies

For short pasta cuts the dies are usually circular and their diameter varies, depending on what will be produced by the press into which they are inserted. For short pasta cuts the dies are usually circular and have a diameter that varies according to what the press into which they are inserted produces.

The diameter of the dies most often used in newer plants is 520 mm.

Even in these cases, the dies are made of Bral.

The various cuts of short pasta are usually formed by compressing the mixture into holes of varying shapes and sizes, depending on the shape.

Again, the surface of the holes can be in bronze, producing a rough surface, or it can be covered in Teflon, producing a smooth surface. While the technology for the construction of the dies used for long pasta is extremely simple, the one for short pasta is more complex and, since the tooling process of the inserts is longer, costs are also higher.

Spreading and Putting on the Stick

While still warm (118.4 °F - 122 °F) and soft (29-33% of moisture) and in order to maintain the shape given to it by the die, the dough is exposed to a jet of warm air that produces a very thin crust on the surface. This procedure also serves to impede the strands from coming into contact with each other and to commence the dehydration of the product.

Sheet Dough

It exits the die through the "gauging rollers," becoming thinner, and enters into a machine called the "cutting-folding" machine, which cuts the pasta and folds it into the desired shape before sending it to be dehydrated. This procedure results in a high percentage of scrap material. Almost 50% of the material has to be crumbled and sent back to the mixer, which mixes it with other dough.

Long pasta

Once it has gone through the die, long pasta descends along the parceling machine, which is composed of planes of perforated plate that are arranged obliquely under the dies, allowing the strands of pasta to slide and be set down. Behind these planes are some open tubes into which warm air is pushed through air fans. These tubes lie inside the edge facing the veil of pasta being emitted from the die.

The spreader is located below the parceling machine, which places the spaghetti onto the sticks and cuts them to the proper length. Located in a waiting position at the front of each strand of spaghetti, these sticks, which are adequately heated, are pulled by belts. Once the spaghetti has reached the required length, the sticks push against the relative sheet of spaghetti, compressing them against foam rubber tubes. This causes the strands to continue their descent on the other side of the stick. The sticks will remain in this position long enough to bring the spaghetti to the required length on the other side of the stick as well. Subsequently, a knife will cut the entire sheet, completing the "placing on the stick" procedure. Pulled by the chains, the sticks carrying the spaghetti are then brought to a jogger where a cutter bar cuts off the excess product, sending it back to the mixer to be blended with the mixture being kneaded.

Short pasta

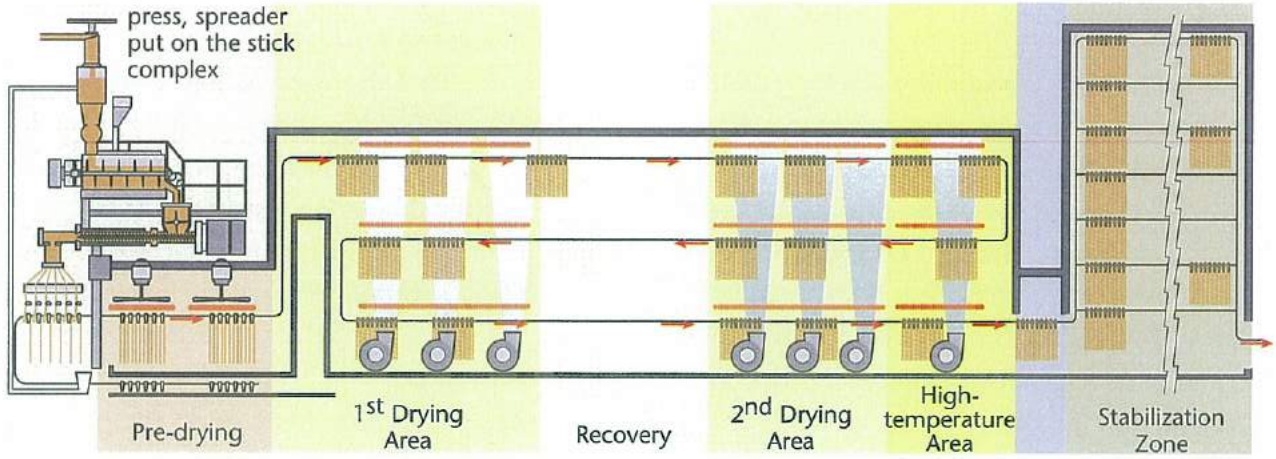
When making short pasta, the parceling machine is equipped with a circular "guard" through which a powerful jet of warm air is pushed. The air is blown onto the recently extruded pasta while it is being measured and cut. In addition, the air functions as a mode of transportation, pushing the pasta to the pre-drying process. Shaped like a steel box, the guard functions as a support to the knife, which cuts the pasta down to size. Since dehydration results in a 10% reduction of the product, at this stage of production the product is not yet at its final size.

Dehydration

The drying process consists in eliminating excess water. This process must not cause any alterations on the composition of the pasta itself. When the product exits the die, it has a degree of moisture that varies from 29-33%. By the end of the drying process, this moisture must be reduced to 12.5%. This percentage is required by law and it ensures a reduction of biological activity that would otherwise alter the product. The biggest problem in this process is ensuring that the pasta dries uniformly on the interior and the exterior. This is a condition that could easily occur given the complex dynamics involved in heat transfer within the product. In fact, the exterior of the pasta tends to dry more quickly than the interior.

When this happens, pressure from the water remaining inside the pasta can create checking or veins on the surface of the pasta. Whether they expand a little or a lot, checking is in any case a serious defect.

Consequently, techniques used for extracting the water from the pasta must ensure sufficient porosity in the upper surfaces, favoring the escape of moisture still present in the product. For this reason, the drying process is divided into two basic stages: a pre-drying phase and a drying phase. The first stage relates to the fresh



The drying phase is one of the most delicate phases of the production process. To ensure that excess water is eliminated uniformly, the drying phases are alternated with periods of rest called "recovery" periods, in which the water molecules are redistributed inside the product.

product, containing a percentage of moisture between approximately 30 and 18% while the second is relative to the reduction of moisture until the product is completely dehydrated and that is, when the remaining humidity is no greater than 12.5%.

Several "recovery" breaks are programmed into these two phases. These breaks consist in a series of technological interruptions of the equipment to allow the redistribution of the water molecules present in the product.

The "recovery" breaks are absolutely essential and can be repeated several times throughout the drying process, according to the thickness, the shape and the relationship between mass of the product itself and its surface.

Each manufacturer adopts a particular technical solution, all the while ensuring a speedy process without sacrificing the product's proper dehydration.

Technology for the dehydration of pasta has made significant progress, especially in the last few years, making it possible to notably reduce treatment times by using higher temperatures and improving both the quality and the costs of the finished product.

Obviously, changes in temperature have been progressive and have included intermediary stages that have evolved from natural dehydration on terraces to HHT cycles that require temperatures higher than 100°C.

There are three fundamental stages in this process and they are:

- LOW TEMPERATURE CYCLES (LT)
- HIGH TEMPERATURE CYCLES (HT)
- VERY HIGH TEMPERATURE CYCLES (HHT)

The development of these cycles has led to

- VERY HIGH TEMPERATURES IN SHORT TIME (HHT/ST)

LOW TEMPERATURE CYCLES (LT)

This is the drying process used in the past but which continues to be employed in the present. It involves static or continuous driers with very long cycles and very low drying temperatures. The low temperature cycle is typically divided into three parts:

- pre-drying
- drying
- dehydration (which also includes the long stabilization phase).

Total duration of the cycle varies from 20 to 40 hours or more. One third of the time is used in the first phases and the remaining time for the actual dehydration. Long pasta requires longer cycles than short pasta because the latter is more easily treated and, therefore, more easily dried. All of the phases require long recovery breaks to allow the pasta to redistribute the water at the interior.

Obviously, this kind of process does not guarantee pasteurization of the product, which can be easily contaminated by various microorganisms.

Even at temperatures between 113 °F - 122 °F, the drying process is based on a relatively quick dehydration in the pre-drying and drying phases where the water is only slightly attached, and on a very slow dehydration at temperatures between 122 °F - 131 °F. The LT dehydration process influences the cooking quality of the pasta only slightly. Aside from some enzymatic reaction, the components do not undergo any particular alteration. In fact, the starch's gelatinization phase and the coagulation of proteins are postponed to the cooking phase; consequently, the quality of the pasta depends almost exclusively on the quality of the raw material.

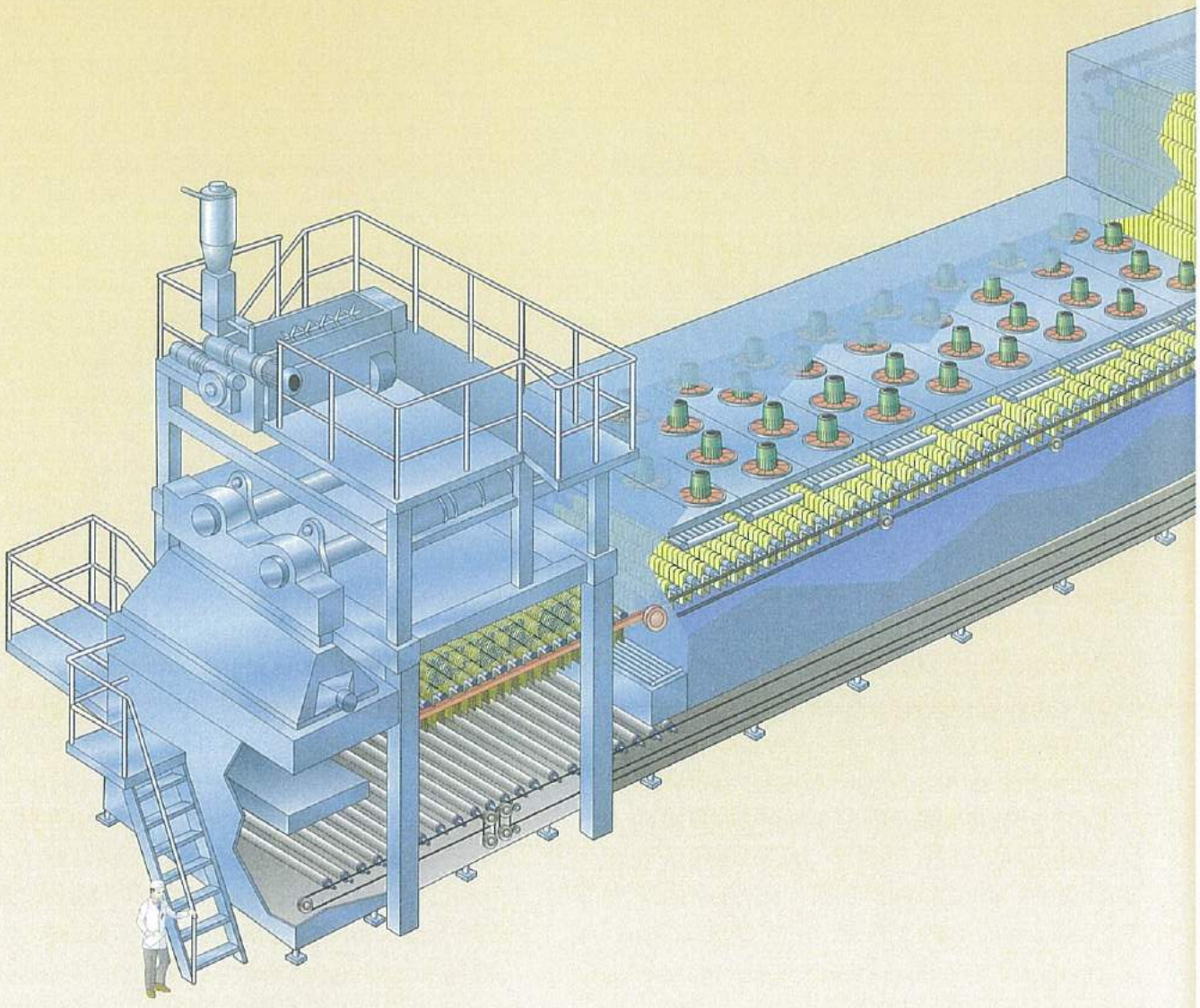
High Temperature Cycles (HT)

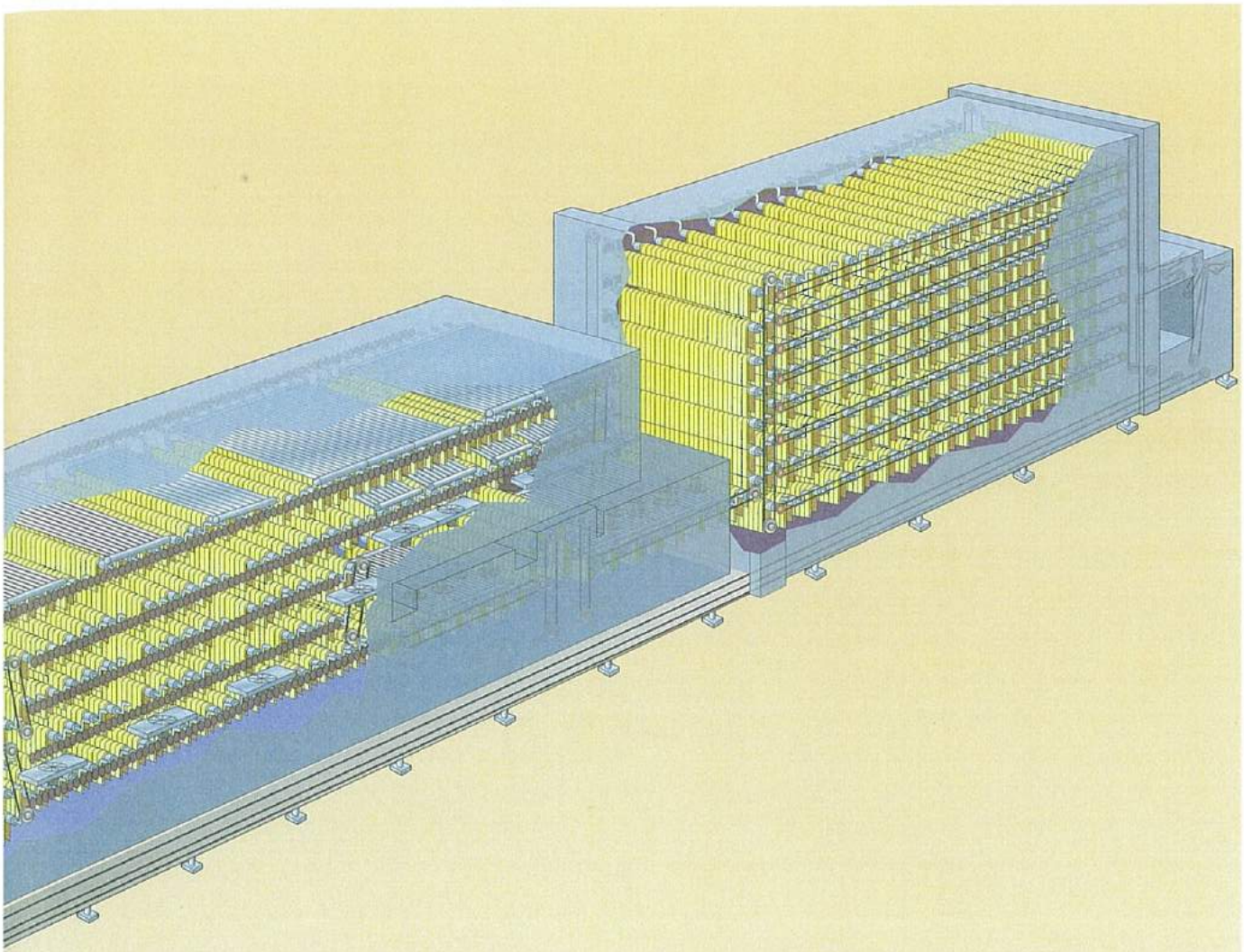
In technologically advanced countries, HT technology has been consolidated. Such technology takes advantage of the physical/chemical properties of the pasta that enable it to retain its moldable qualities during dehydration at air temperatures exceeding 167 °F with a moisture content of the finished product at close to 12%

HT technology also makes it possible to increase the diffusion of water. This means that dehydration can be carried out more quickly because the internal pressure, generated through drying, is released without risks of physically damaging the product.

This type of process requires temperatures that exceed 113 °F in the pre-drying phase, essential for maintaining the shape of the pasta. In the actual drying phase, temperatures rise to approximately 167 °F. In this phase, the pasta is dehydrated and its heating continued. Finally, the drying phase, which also includes the stabilization phase, is carried out at constant temperatures equal to 167 °F. This phase is altered by long pauses intended to allow the water inside the pasta to be redistributed. Complete cycles typically require 7-8 hours for short pasta and 8-10 hours for long pasta. Cooling of the pasta is also essential to ensure its physical integrity.

The industrial pasta production line consist of several machines in a sequence that follows a complete production cycle, from raw material to finished product.
A modern line is 87.52/109.40 yards long, wide, 4.37 yds in hight in the drying area and 10.94/14.22 yds in the press area.





Very High Temperature Cycles (HHT and HHT/ST)

The advantages introduced by HT technology have made it possible to conduct further research to determine how to take advantage of the thermal effects on pasta during the drying phase in a complete and reasoned manner. The objective of such research is to reduce processing time as well as the size of the driers themselves. At first, the driers being used were composed of two or three drying elements. They functioned at very high temperatures (HHT) with the objective of reducing drying times. Subsequently, HHT/ST driers were used. These logically distribute the drying temperatures in a way that improves the cooking quality of the pasta and safeguards the nutritional value of its components.

All of this presupposes a great deal of knowledge of all the chemical-enzymatic reactions of the pasta's principal elements (starch and protein) that occur in the drying phase.

This information makes it possible to determine the proper drying schedule, selecting temperatures that are as hot as necessary and administering them at the right place, at the right moment for the proper amount of time, thereby improving the performance of the raw material being used.

An incorrect process may spoil the use of even the most prestigious raw materials.

This cycle requires the use of driers within a number of different areas at varying hygrothermal conditions, which can be controlled, and without interruptions in the drying process. In order to provide the most versatile thermal functioning possible, the plant requires up to nine areas. The cycle is thereby reduced: 4-5 hours for long pasta and 3-4 hours for short pasta.

QUALITY CONTROL

It is a known fact that the quality of a product (meaning its ability to satisfy the implicit and explicit needs of the consumer) is an important factor, which becomes a part of all company processes, from planning all the way down to delivery of the product to the consumer.
In particular, it is the ability to manage the selection and use of the raw material as well as the ability to manage the execution of the product's transformation in the factory that makes it possible to consistently produce a quality product.
Consequently, the greatest effort must be placed on the "supplier-productive process" binomial.
Nonetheless, even the finished product is subjected to a set of controls and evaluations that ascertain its conformity (both in terms of content and packaging) to the client's expectations.
These evaluations are collected and distributed within the company through a document (Product Standard), which unequivocally defines the chemical, physical, hygienic and organoleptic characteristics of the product.

Evaluation of the Finished Product

Managers' Responsibilities

Typically, Quality Control and Quality Assurance are the sectors within a company that are responsible for guaranteeing that the product conforms to standards. The first operates within the production plant, conducting the required checks in real time, while the latter is responsible for determining the rules, ensuring that they are constantly and correctly applied, verifying the obtained results.

Mechanisms Used

SAMPLING PLAN: Quality Control is responsible for applying procedures aimed at guaranteeing that the collected samples represent a specific batch. Such procedures are applied on all batches subsequently sent to the warehouse.
ANALYSES PLAN: distributed by Quality Assurance and constantly applied by Quality Control within the factory, they guarantee that all the characteristics required by the standard are checked.

Certificate of Conformity

For each sample analyzed, representative of a batch, Quality Control issues a Certificate of Conformity that attests that the finished product meets all the required standards.
In so doing, Quality Control guarantees the consistency of quality, which is the first requisite upon which the customer must be able to rely.

Obviously, these mechanisms as well as all those used in the "supplier-client" chain, are not born extraneously; rather, they coherently reflect the "guidelines" determined by policies for quality and are, therefore, an integral part of the company's quality system.

DRYING AT HIGH AND LOW TEMPERATURE CYCLES

Trasformation of the pasta components

To identify the relationship between drying cycle and the quality of the finished product, it is important to understand the type of changes that occur to the components (starch, proteins and water) of the extruded pasta during the drying phase.

During the drying process, starch undergoes the following phenomena:

- expansion
- gelatinization
- solubilization
- and subsequent retrogradation.

Proteins are subjected to:

- hydration
- polymerization
- aggregation
- coagulation.
- Water evaporates

Starch

The simplest phenomenon that occurs to the granule of starch is expansion; that is, an increase in size (volume) and viscosity.

Expansion occurs at temperatures greater than 122 °F in the presence of water.

No drying process can avoid the expansion of starch.

The second state of modification is gelatinization a phenomenon that gives rise to the desegregation and partial solubilization of the starch in water.

In order for this to occur, the temperature must be at 176 °F, even if the phenomenon can begin at 140 °F - 158 °F, and at a moisture level above 23%. Not all drying cycles result in the gelling of starch although gelatinization undoubtedly occurs when the pasta is cooking.

Gelatinization also involves solubilization whereby the granules of starch detach from each other. This is a threat to the organoleptic qualities of the cooked pasta because the particles can exit the pasta, causing stickiness.

The fourth state of modification is known as retrograding. At this stage, the granules of

Principal phenomena that occur during the cooking of pasta as temperatures increase

WATER:	progressive penetration in the pasta	⋯⋯▸	increase in size Activation of phenomena caused by starch and proteins	
STARCH:	progressive expansion, gelatinization, solubilization	⋯⋯▸	Dispersion of starchy material at the exterior of the starch granules and in the cooking water	⋯⋯▸ Stickiness Loss of elasticity
PROTEINS:	progressive interaction until complete coagulation, formation of the gluten network	⋯⋯▸	Containment of starchy material inside the starch granules and in the pasta	⋯⋯▸ Absence of stickiness

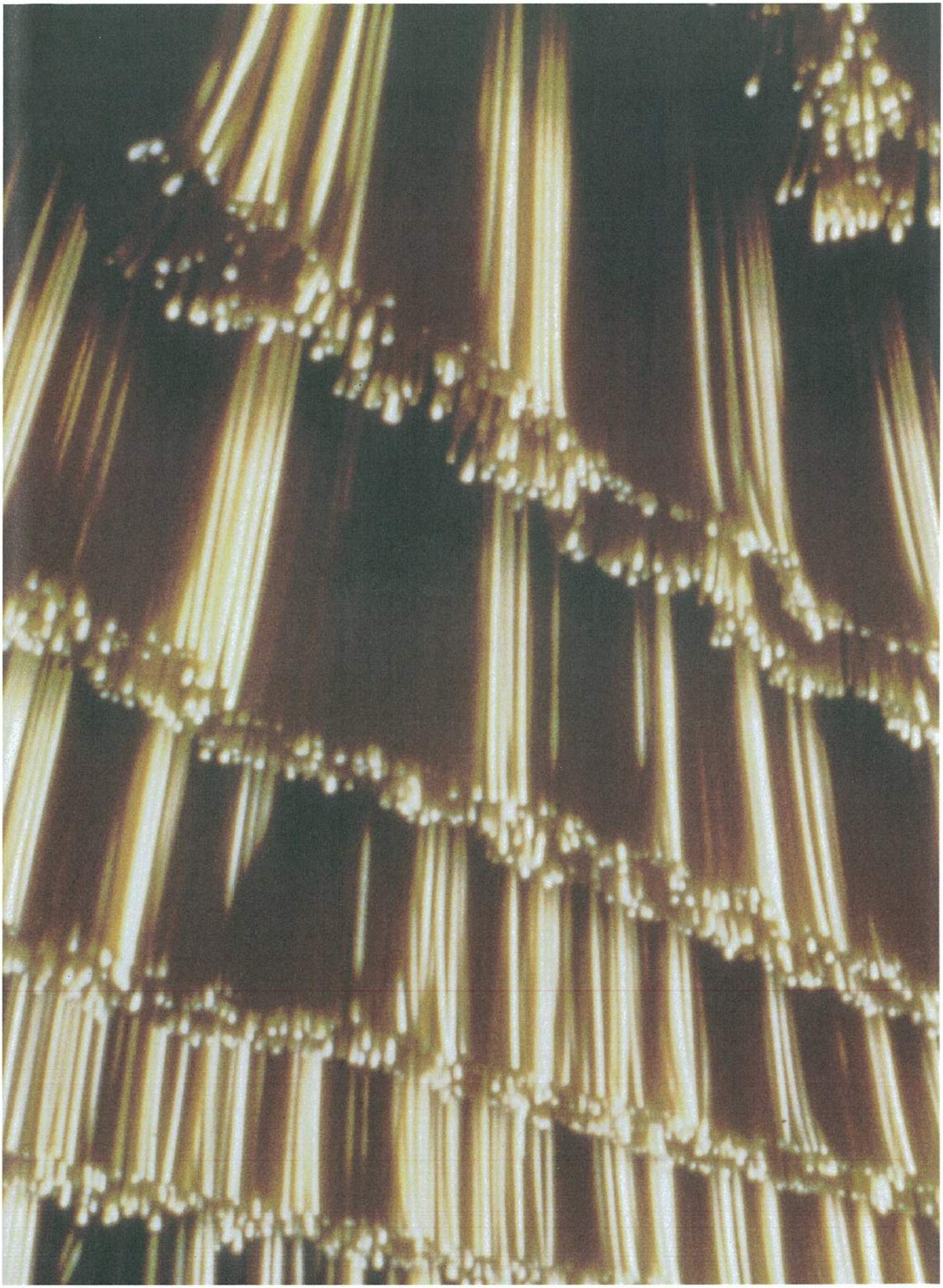
starch are restructured and re-crystallized, acquiring the glassy appearance that is typical of retrograded starch. For this to happen, it is necessary to cool the gelatinized starch.
The more energetic the gelatinization treatment, the stronger the retrograding.
Retrograding is a positive modification for the pasta because it keeps the pasta's stickiness at low levels. In fact, the larger the amount of retrograded starch, the less the starch that enters the solution (promoter of stickiness).

Proteins

Proteins, especially those of gluten, undergo reciprocal interactions and coagulation and they could interact with starch.
As a result, masses of proteins may form and, if coagulation and the union of more proteins occurred uniformly within the spaces between the granules of starch, a gluten network may also form. Any drying treatment at temperatures greater than 158 °F results in the coagulation of gluten's proteins.
Finally, it must be remembered reciprocal interactions may occur between starch and proteins, depending on the intensity of the thermic process to which they are exposed.

Effects of the drying cycles on the pasta's components

In a traditional drying process, temperatures do not exceed 131 °F. Pasta that is manufactured this way has an almost identical composition to that of semolina; that is, starch is perfectly integral because it has not been exposed to temperatures that could cause it to gel. It does not present any type of interaction between starch and protein nor does it show any signs of union between the gluten proteins (polymerization).
During cooking, the water progressively penetrates the pasta and, therefore, there is an increase in volume. In addition, the following phenomena occur as a result of starch processes: expansion, gelitinazation and solubilization.



Some characteristics of dry pasta that favor the gelatinization of starch and the gluten network during cooking

GELITINAZTION OF STARCH	Quality of the starch Low gelitinization temperature Large diameter of the granules Low protein content Lack of preventative polymerization of the gluten Unequal distribution of the proteins Presence of coagulated masses of protein
GLUTEN NETWORK	High protein content Quality of the gluten Low coagulation temperatures for the proteins Presence of thermally unstable soluble proteins Uniform distribution of the proteins High gelatinization temperatures for the starch

These phenomena are profoundly negative in that they result in the formation of small particles that can then penetrate the gluten network, causing the starchy material outside the granules of starch and in the cooking water to disperse. This creates stickiness and loss of elasticity in the pasta.

Fortunately, the opposite phenomenon also occurs during cooking: the proteins progressively interact until coagulation is complete, forming the gluten network, which aids in keeping the starchy material inside the granule.

What are the factors that lead to either one or the other of these opposing phenomena?

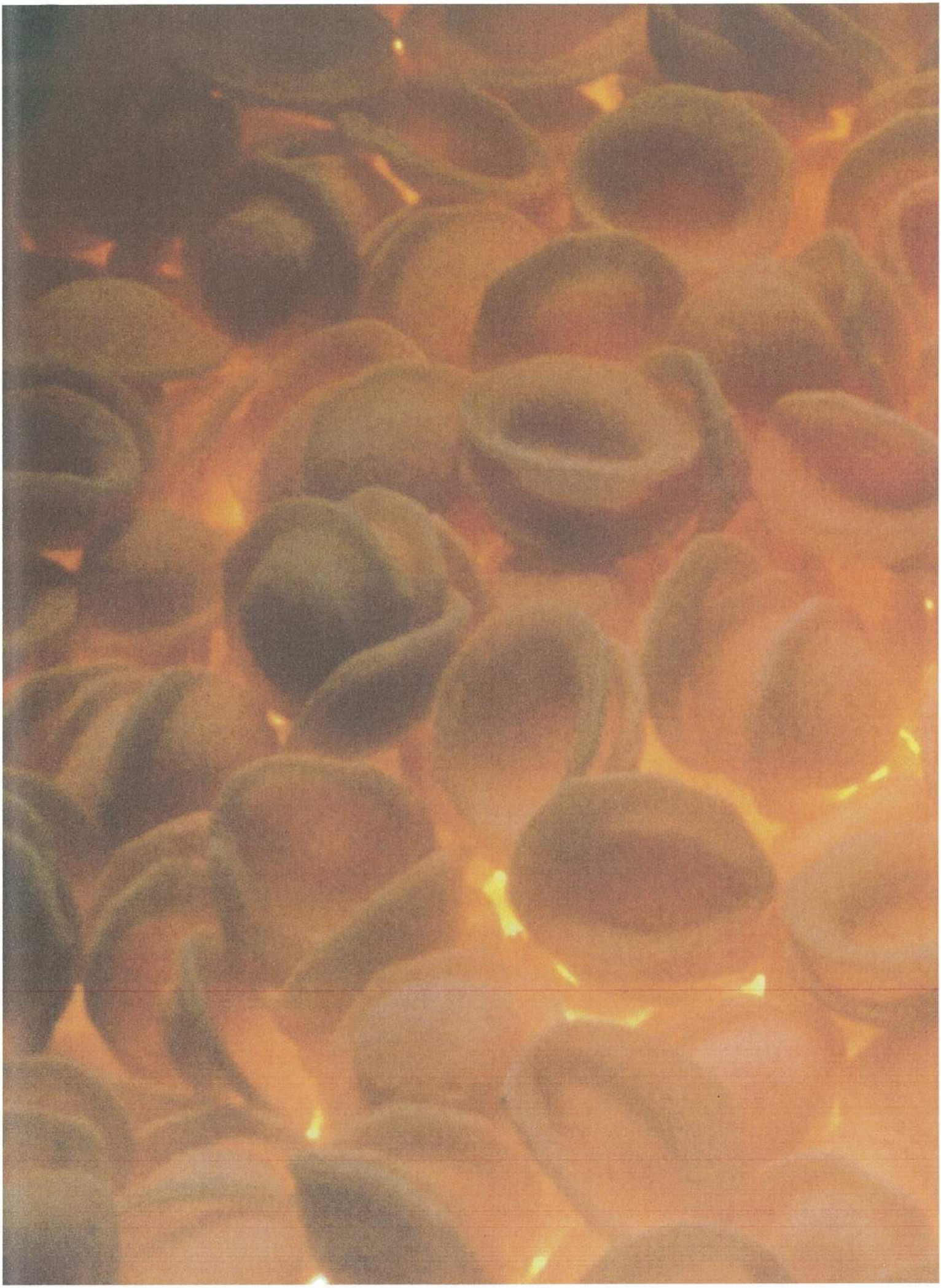
We will take a look at the characteristics of dry pasta that favor the gelatinization of starch and hence worsen the quality, and which are the ones that favor the gluten network.

First of all, the quality of the starch, which suffers the effects of genetic influences, is the most influential factor. There are other factors that influence gelatinization. Among them are:

- low gelatinization temperature
  the lower the gelatinization temperature, the more difficult it is for the semolina to become dough.
- size of starch granule
  larger granules gel at lower temperatures.
- the semolina's low protein content and, therefore, the protein content of the pasta, since it does properly filter the water that penetrates it during the cooking phase.
- the lack of unity between the gluten's proteins, the unequal distribution of proteins and the presence of masses of coagulated proteins.

The gluten network poses an opposing condition, favored by:

- 4the high level of protein
- the relative quality of the gluten
- the low coagulating temperature of the proteins



Images of the drying cycle for long pasta, above, and for short pasta, below.

- the presence of soluble proteins
- the uniform distribution of the proteins
- the high gelatinization temperature of the starch.

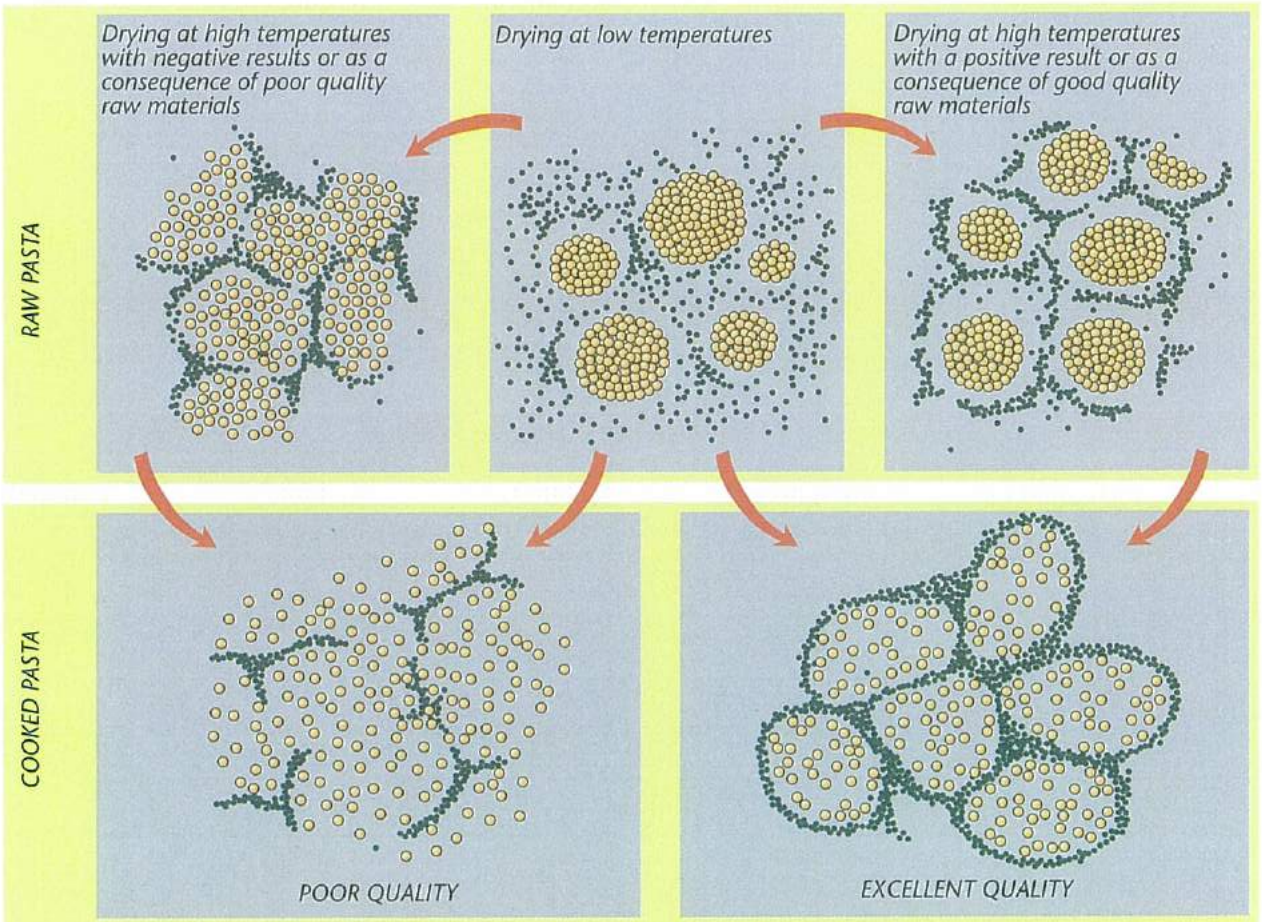
The lower the gelatinization temperature of the starch, the quicker the expansion of the granules, so that gelatinization occurs more quickly than the gluten network.

It must be remembered that gelatinization of starch and the gluten network occur at very similar temperatures; therefore, it does not take much for one to prevail over the other.

Hence, in the case of cooked pasta, which is dried using traditional methods, if the original characteristics of the semolina are very good, the result is a structure in which the gelled starch is completely contained within the gluten network; the pasta is tenacious, elastic and not very sticky. When the semolina is of poor quality, coagulation of the proteins may occur but the protein will coagulate in masses because it is of poor quality. The starch granules will be uniformly distributed and the starchy product will flow into the cooking water, resulting in stickiness.

To summarize, the components are not significantly modified when traditional drying methods are used. Gelatinization and coagulation of the proteins are postponed to the cooking phase; consequently, the characteristics of the prime material are very important.

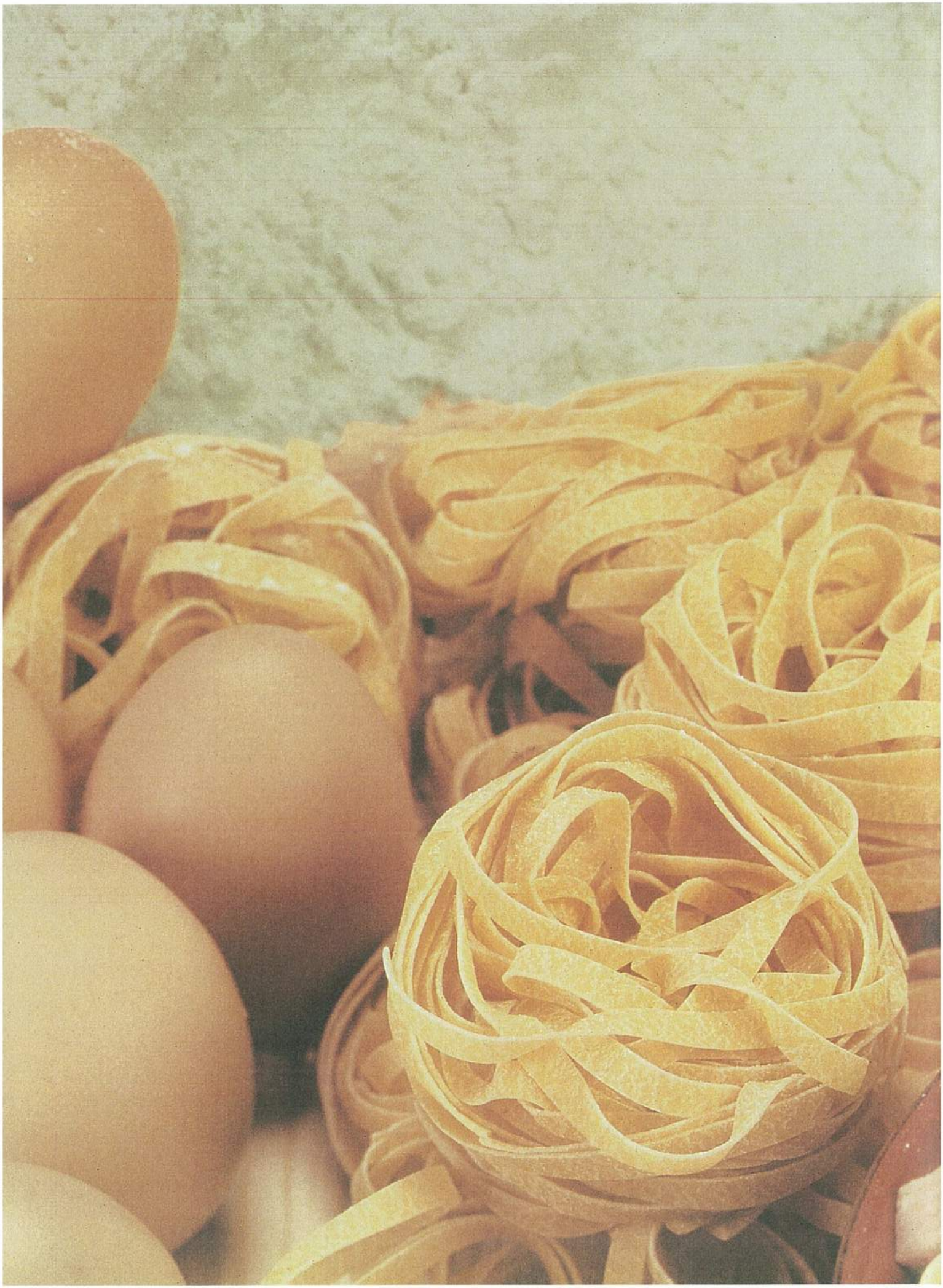
To illustrate, let's take a cycle requiring very high drying temperatures and a low percentage of moisture (16-17%). At such a low level of humidity, the starch will not gel (because in order for gelling to occur, humidity must exceed 20-23%) and the proteins will coagulate. Under these conditions, the starch granule remains perfectly compact and the protein becomes a gluten network; however, there will be no competition between the granule's expansion and the formation of the network because under such drying conditions gelatinization cannot occur.



Ultrastructural changes that can be observed in pasta prior to and following cooking, depending on the raw materials and the technology used.

Pasta with a pre-formed network undoubtedly improves in the cooking phase because, although the starch gels quickly, it is enclosed in the protein network.

Modern, high temperature cycles coagulate the proteins in the drying stage.



DRY EGG PASTA

Egg pasta is part of the domestic tradition of north central Italy as well of central European countries (Switzerland, France and Germany). Since time immemorial these areas have been cultivated with soft wheat while durum wheat was primarily grown in the south. Furthermore, the wheat was of a decidedly inferior quality compared to present-day wheat. Consequently, in the past, wheat was blended with eggs in an attempt to raise the quality to an acceptable standard.

In 1967, a law was established (law no. 580 July 4th), governing the commercial production of pasta for both the semolina and egg varieties. The law, which imposes the use of durum wheat, is still in force today, and it made an impact not only on semolina pasta made with hard wheat, but also on egg pasta, which was traditionally prepared with soft wheat.

The law reads: "Egg pasta must be made exclusively with durum wheat pasta and must contain at least 4 whole chicken eggs, unshelled. The total weight of the eggs must not be less than 7.04 oz." More eggs are permitted.

There are no major differences in the extrusion or drying processes of hard wheat pasta compared with egg pasta in commercial production. Nonetheless, the use of a delicate ingredient like the egg necessitates particular attention and care. Such attentiveness implies the need to have trained personnel; it requires the use of machinery that is specially designed for the production of egg pasta and it must remain consistent throughout all the phases of production.

The shelling of the eggs must be entrusted to factories with a proven record and ones in which all the work phases (cleaning, breakage, homogenization, pasteurization, refrigeration and transportation) are hygienically sound. This same care must be taken in the pasta factory, where the eggs are delivered in refrigerated tankers and then transported to the storage bins via pumps. The eggs must be stored at

temperatures that must never, for any reason, exceed 39.2 °F and that must never go below 32 °F. Bins must be cleaned automatically every day and their state of cleanliness must be ascertained through a microbiological analysis of each cargo. All of the tubing and all of the equipment used in transporting the raw material (shelled, refrigerated egg) must also be properly washed and cleaned.

In terms of the production process, we will emphasize only those procedures that differ from the production process of semolina pasta.

Water dosage: in commercial manufacturing of egg pasta, refrigerated water or, at most, room temperature water, is used. This is done to avoid an excessive increase in the dough's temperature, which would lead to an increase in the formation of bacteria.

Dough mixing: does not differ greatly from the production of semolina pasta in terms of the systems and how they are used. The greatest difference concerns the cleaning of the mixers, which must be done at least every three days. This of course requires the machinery to be stopped. Proper cleaning involves manually removing the remains of the mixture and carefully cleaning the surface that comes into contact with the product.

Compression/Die: Here, too, it is necessary to remove the worm screws that serve to compress the mixture to avoid the formation of deposits. This procedure must be carried out every week. It is important to understand that this procedure requires physical strength and it implies a greater cost compared to semolina pasta.

Shaping: When manufacturing *tagliatelle*, the shaping of the nests or "skeins" is of extreme importance as these nests must appear "vaporous," light and must in no way look amassed.

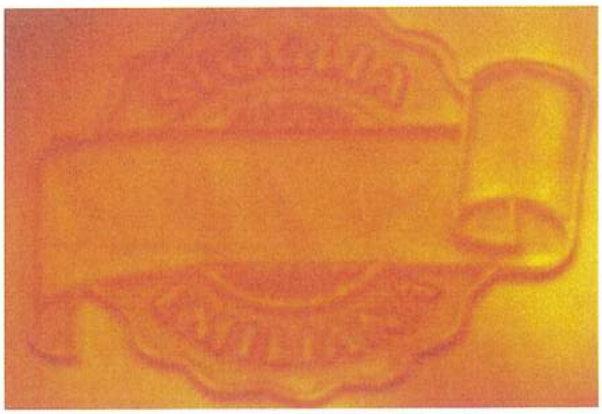
The first step is to cut the sheet of pastry longitudinally into many strands, the width varying according to the format to be produced. These strands are then grouped, and each group is placed into shaping (molding) tubes where they are subjected to a strong jet of compressed air, which reaches them tangentially, folding the strands into nests. The duration of the jet of air, which must occur at exactly the same time as the transversal cut, and the amount of air pressure are all extremely important factors since they determine the aesthetic quality of the finished product. Finally, before the product can be placed in the drier, the nests are placed on frames with netted bottoms, where they are immediately subjected to warm air that "secures" their three-dimensional shape.

Drying: the humidity level to which the product is exposed during the drying process and the duration of the drying process are similar to those of semolina pasta. Nonetheless, to avoid a "reddening" of the pasta, the egg product is dried at temperatures that are 50 °F - 59 °F lower than the temperatures used in drying semolina pasta.

Special care must be taken in handling the product because it is generally very fragile and delicate.

Dry and Filled Egg Pasta

Over the centuries, the genius of housewives,



especially those working in north central Italy, has given rise to an enormous variety of filled pastas. Through a continuous process of inventiveness, manual production of the product, convivial tasting and reworking, these pastas have evolved and been perfected, their traditional forms and fillings passed down orally, from mother to daughter. These recipes for tortellini, originating in Emilia, for ravioli from Piedmont, for *cappelletti*, *anolini* and many other varieties of pasta have become widespread and appreciated, each one with its own particular filling: from beef to ham, cheese and even the fish fillings typical of the Liguria region or the ricotta and spinach ones from Parma and Piacenza.

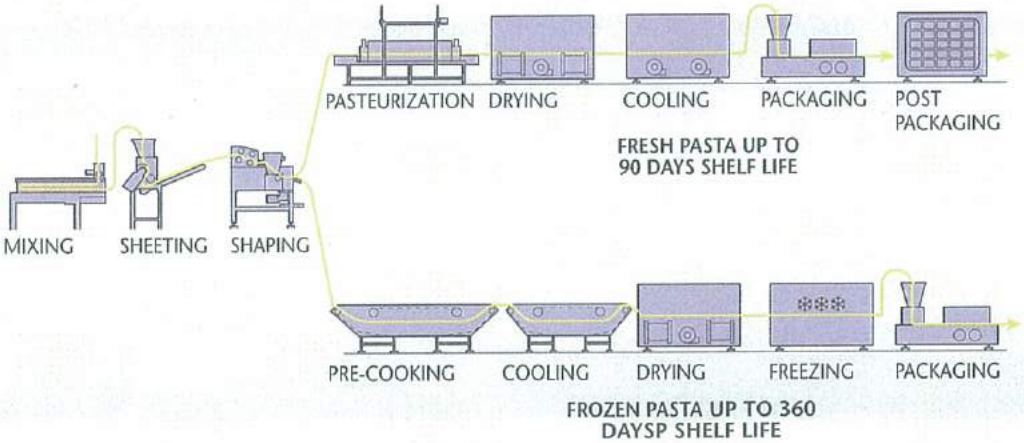
The taste of the product owes much to the balance of ingredients that give the product a certain "roundness" of well-blended flavors. Furthermore, from a nutritional viewpoint, the filling contributes to the ennoblement of the pasta, providing the proper balance of starches, fats and proteins. In this way, filled pastas not only restore tradition and its charm, but they also become part of the modern world, surpassing the ephemeral quality of a fad. Having understood all this, industry has done nothing more than treasure these traditional recipes, refining them and reproducing them in massive quantities, as though they were signed copies of works of art. Basically, mass production simply imitated the work of the housewife, producing the product on a larger scale, and emulating the domestic processes of production, beginning with the selection of the raw materials all the way to the preparation of the dough, finally "marrying" the latter to the filling.

We will simply touch on some of the phases of the industrial production process that deviate slightly from domestic production. For example, the filling, which is obtained from select ingredients, is mixed and then placed on large stainless steel trolleys. It is then transported into large refrigerated cells where it is preserved at

temperatures of 39.2 °F for approximately 24 hours, allowing the flavors to amalgamate.

Meanwhile, in another area of the factory, the pasta dough is prepared on a continuous cycle, 24 hours a day. Obtained by grinding the best quality durum wheat, the semolina is mixed with unshelled, homogenized and pasteurized chicken eggs and water for approximately 20 minutes. The mixture is then run through a set of rollers, placed in parallel to each other. Essentially functioning as rolling pins, they bring the sheet of pastry to its proper thickness (.60 mm). At this point, the sheet of pastry must be "married' to the filling. This is done using special machines, called *tortellinatrici*, which, aided by tiny "hands," reproduce the technique used at home. The filling is dosed, wrapped inside a piece of dough and the tortellini are then sent to be pasteurized. They are placed on a conveyor belt made of stainless steel mesh, which travels into a chamber with flowing steam. The process takes approximately two minutes at temperatures of 212 °F. In addition to being hygienically sound, the pasteurized tortellini are better prepared for the next stage, the drying phase. Subjected to appropriate temperatures and levels of humidity which, on the one hand, allow a consistent reduction of humidity (from 30 to 12%) and on the other, make it possible to maintain the organoleptic qualities of the fresh product unaltered, the tortellini are dried.
In this way, the product is hygienically safe, free of conservatives and has maintained its traditional organoleptic qualities. Furthermore, it can be preserved at room temperature for a reasonable period of time (about 4 months), without having to be subjected to stresses such as freezing and defrosting.

Other Types of Pasta



Frozen pasta

The latest type of pasta to have hit the market is the frozen variety. Freezing is a type of technology that permits a product to maintain its qualities almost unaltered by conserving at low temperatures (-18°C). On the other hand, freezing is a rather costly technology in terms of energy and it requires that the cooling chain be perfectly managed. It avoids the quality product from decaying by creating large crystals of ice. Filled pasta is the type of pasta that is most often kept frozen since it is the organoleptic qualities of the filling that best benefit from this type of preservation.

The technology involves:

- dosing the ingredients for the dough and mixing
- sheeting or dieing
- calibrating the sheet of pasta and, in the case of filled pasta, dosing the filling (shaping)
- pre-cooking and cooling
- partial drying
- freezing
- packaging
- storage at -0.4 °F

There are two types of freezing: with air and with cryogenic gas.
The first is based on cooling the air to which the product is then subjected, lowering its temperature. Air cooling systems are very expensive and can be justified only for big production volumes. The second uses liquid gases (nitrogen or carbon dioxide) which, expanding to return to their original state, detract a large amount of heat from the product. Plants for this system can be much smaller and economical, but there is a higher cost associated resulting from the use of gas.

Pre-cooked Pasta

Over time, customer request for more serviceable products has increased, and industry has responded by introducing fast-cooking pasta. These pastas are partially or fully cooked. Obviously, in this case, there is an elevated cost due to the complexity of the required technology. Preparing a pre-cooked pasta dish may involve completing the cooking of the pasta directly in the sauce.
The technology involves:

- dieing the dough
- cooking in water or steam
- drying using high speed air jets (to remove the substantial amount of water)
- packaging

Alternatives on the market include pre-cooked pastas that maintain all the water that is absorbed in the cooking phase, so that it can then be heated in a microwave oven in just a couple of minutes.
The technology involves:

- the use of either fresh or dried pasta
- cooking in water or steam
- water cooling (which also eliminates the surface starch)
- oiling (optional)
- packaging

pasteurization or sterilization (if the product is pasteurized it must be kept in the refrigerator)


1848

FRESH PASTA

Women preparing fresh pasta, from Ububchasym de Baldach's Theatrum Sanitatis, *a codex issued at the end of the 14th century (Rome, Biblioteca casanatense, code 4182)*

The term "fresh pasta" refers to a set of products made primarily with semolina or with semolina and eggs, having relatively limited shelf-life, and that are traditionally eaten soon after they have been made or else are preserved in a refrigerator.

In Italy, every region, city or town has its own way of making home-made pasta, not only in terms of shape or condiment but also in terms of the filling and even the dough itself. Hence the difference between pasta made with semolina and water and pasta made with semolina and eggs.

In the plains in northern Italy, around the Po River, where the wheat tends to be soft, more eggs are used in preparing the pasta dough. In central Italy, where the wheat tends to be a little harder, eggs are not used as much while in Puglia, Basilicata and Calabria, eggs are almost never used since the wheat is quite hard.

Given the extreme simplicity of the ingredients (semolina, eggs and, if it can be considered an ingredient, water) a good quality pasta depends not only on the ingredients but also on a number of factors such as the way in which the dough is worked and the temperature of the hands, which affects the drying of the dough while it is being worked.

Some regions in Italy keep the tradition of home-made pasta alive (i.e. preparing it by hand and not with machines). These regions are: Emilia-Romagna, Tuscany, Liguria and Lombardy. In Emilia, the weight of the pasta still refers to the number of eggs used rather than on the actual weight of the ingredients. Chefs in that region claim that pasta must be made using 1 egg for every 3.52 oz of semolina, while *garganelli romagnoli* require 8 eggs for every kilo of semolina, in addition to grated parmesan cheese and a pinch of nutmeg for flavor.

Fresh pasta can also be - and usually is - filled. There are many varying and even bizarre theories on the origins of this type of pasta; however, one fact remains: it evolved in parallel to the dough used for *tagliatelle* and lasagne. In fact, until just a few years

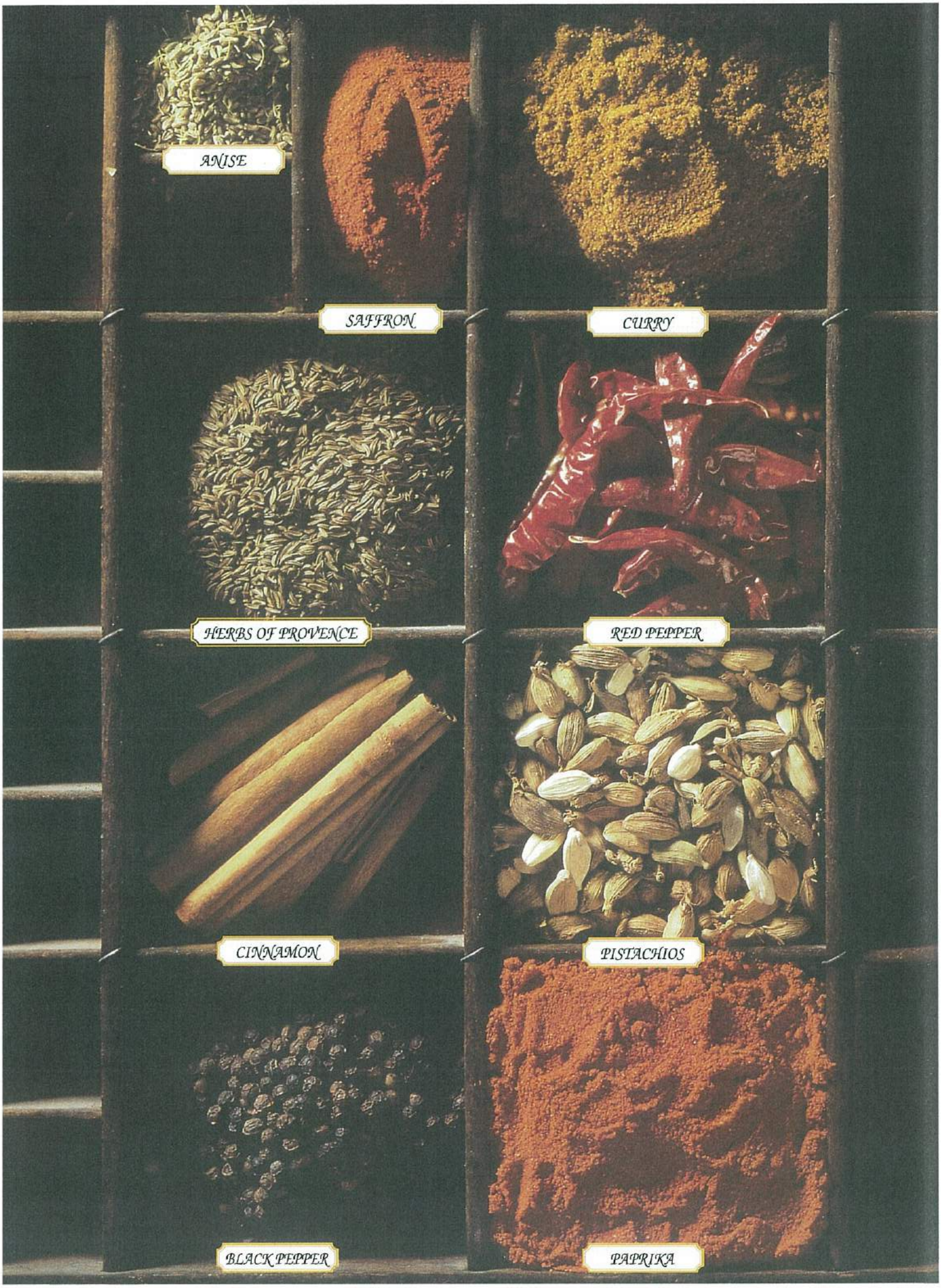
19th and 20th century pastry cutters. (Parma, Museo Guatelli)

Tools used by artisans to work the dough. Press used in the countryside of Emilia for making passatelli. *They were produced by placing the tool onto the semolina and egg mixture and applying pressure. The "vermicelli" were collected in the basin. Small 19th-century press "with arms" with bronze die (Parma, Barilla Historical Archives)*

ago, it was classified in the same category.
Agnolini are a typical fresh filled pasta of Lombardy while *agnolotti* originate in Piedmont and *anolini* are an old and famous type of pasta originating in Parma and Piacenza. Instead, Modena and Bologna both stake a claim over tortellini.
Over time, the rolling pin used for sheeting out pasta dough, was replaced first by machines with handles, and later by electric machines. It was also discovered that food lasted longer when pasteurized and could therefore be stored longer and, hence, sold in more distant places. It was later packaged for easy transportation. Industry and, therefore, the evolution of production technology and product conservation techniques, made it possible to introduce pasta to other regions, eventually popularizing it at a national level. The industrial production process, not so different from the original one, substantially consists in the following:

- dosing the ingredients for the dough
- mixing
- sheeting or dieing
- determining the thickness of the pasta and dosing the filling, if it is filled pasta
- pasteurizing the product
- partially drying the product
- cooling
- packaging
- pasteurizing the packaged product
- conserving it in the refrigerator

It might seem redundant to pasteurize the product twice, before and after it is packaged, but the air araund us is filled with millions of microorganisms, which, once entering into contact with the product, can cause it to deteriorate quickly. Consequently, factories' packaging rooms are equipped with a series of very thin filters that block most of the microbes and dust particles contained in the air. As a result, the product does not require a second pasteurization, to the advantage of the product's quality. Nonetheless, the product must be refrigerated. Fresh pasta is also subject to the regulations of Law no. 580, issued in 1967, and to its subsequent revisions.


ANISE
SAFFRON
CURRY
HERBS OF PROVENCE
RED PEPPER
CINNAMON
PISTACHIOS
BLACK PEPPER
PAPRIKA

SPECIAL PASTAS AND OTHER INGREDIENTS USED IN MAKING PASTA

Pasta today is more than just the traditional semolina and egg type; it can be enriched with a variety of ingredients. To meet the increasing demand for innovative types of pasta, which include variations in color and shape as well as in flavor, the industry has diversified over the years, so that the current market provides a vast selection of pasta products. Law no. 580 of July 1967 governs the production and sale of cereals, flour, bread and pasta. In a set of governmental decrees (September 27, 1967; March 20, 1981; May 24, 1990; March 21, 1991), pasta manufactured with these ingredients must be classified as special pasta, and it must be labeled, " durum wheat pasta," specifying the added ingredients.

Special pastas are those that fit into the following categories:

- pastas containing malt and gluten (fresh and dried)
- pasta containing wheat germ (minimum 3%)
- pasta containing water-soluble milk proteins
- pasta containing vegetables:
  spinach (fresh and/or dehydrated);
  dehydrated spinach powder;
  double or triple tomato paste (concentrate);
  dehydrated tomato powder;
  nutmeg

Whole wheat pasta or pasta containing other cereal products is manufactured in accordance with governmental decree no. 111 of January 27, 1992 ("Actuation of directive 89/398/EEC relative to food products produced for specific consumption"). The products can be produced only with governmental approval and must have a label indicating the contents, that is, the fibers, vitamins and minerals and their relative nutritional value.

Recently, the governmental decree of April 27, 1998 ("ingredients allowed in the production of special, dry and fresh pastas"), expanded the list of ingredients to include:

fruits and vegetables and derivatives;

edible mushrooms, truffles;
natural flavors, spices, plants or parts of edible aromatic plants.

Salt (sodium chloride) is also allowed, but it must not exceed 4% of the total quantity of the dried product. These ingredients are all added for a purpose:

- to improve the pasta's cooking performance by adding proteins to the ones that are already present in the semolina. Such is the case with gluten, or milk proteins which, when added to the semolina, increase the protein content, thereby strengthening the structure of the pasta. Consequently, the pasta increases its resistance to the cooking process, improving its texture, making it more pleasurable to chew. This particular additive was particularly popular in the 60s, when the drying process was conducted at low temperatures and did not, therefore, contribute to increasing the cooking quality of the pasta;
- to improve the nutritional value of the pasta through the milk proteins, the wheat germ and the legumes. Pasta is mostly a source of carbohydrates, and by adding certain raw materials, especially legumes, the quality and the quantity of proteins increases, making pasta nutritionally valuable in terms of protein content;
- to differentiate the product by its taste and/or color through flavors, vegetables or malt. Colored and/or flavored pasta belong to this category. They vary from the traditional spinach or tomato pasta to the more recent types of pasta that have been enhanced with flavors such as mushrooms, truffles, etc.

In terms of the technological process, the addition of ingredients such as the ones specified above does not require any great modifications. The only main difference is the dosing of the additional ingredients which are added to the semolina before the mixing phase. Especially in the case of flavors and/or spices or ingredients whose quantities are determined by law, the amounts must be very precise and constant so as not to cause any significant differences in the various productions. It is very important to properly dose the water with these types of pasta since the amount of water required will vary according to the functional characteristics of the ingredients. Another delicate phase of production requiring particular attention is shaping because of the risks of squashing and sticking.

Ingredients that characterize special pasta

Quality at Cooking	Nutritional Values	Taste/Color
Gluten	Proteins	Vegetables (spinach, tomatoes, etc)
milk protein	Legumes	Spices
Wheat germ	Wheat germ (Vitamin E content)	Malt
	Vitamins	Flavors
	Minerals	
	Fiber	

Finally, drying must be conducted in an appropriate manner to avoid defects in the finished product resulting from ingredients that cause structural tensions in the pasta.

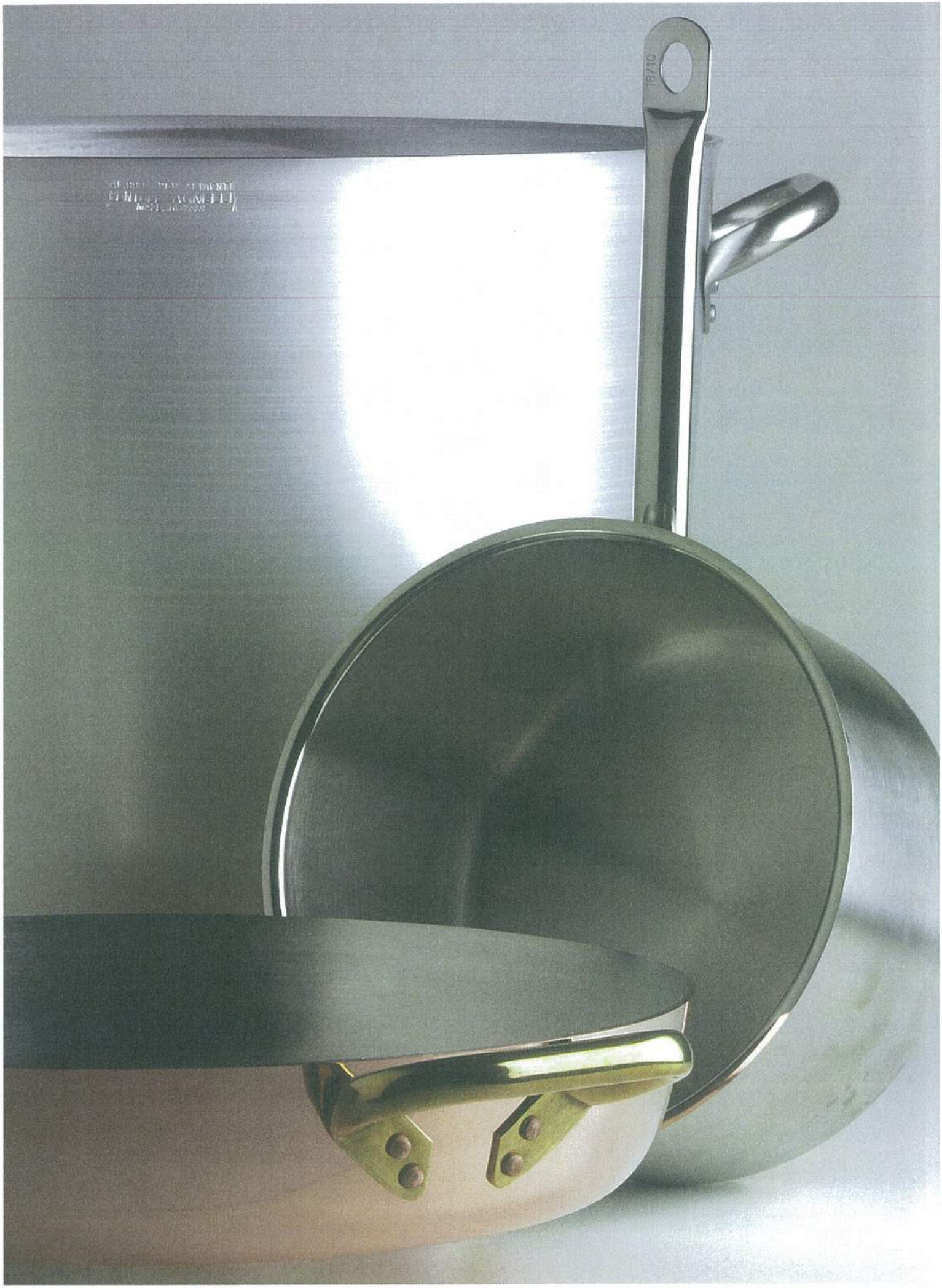
Asparagus and mushrooms are two ingredients used to enhance the flavor of pasta

Special products: "like pasta"

It is necessary to mention certain special products that are made with different kind of cereals, such as corn flour or rice flour. For the purpose of comparing and contrasting the technologies used in producing these types of pasta, we have categorized them into two groups:

- flour containing gluten (e.g. soft wheat, rye)
- flour lacking gluten (e.g. rice, corn, barley, oats)

It is possible to produce soft wheat flour pasta without significantly modifying the technology used; however, the quality of the pasta is poor. It does not have good texture and it has a high level of stickiness. Gluten-free flour, on the other hand, proves to be a technological burden. The dough is sticky, difficult to extrude and to shape, and it has a low texture. Naturally, the technological process must compensate for the missing gluten by forming a particular starch structure that serves the same function as the gluten.



TECHNOLOGY IN THE KITCHEN

Pans

Pans today are still widely used for cooking pasta and they can be made of aluminum, stainless steel and copper. Undoubtedly, the most widely used pans are in aluminum, given their convenient price and durability. In addition, aluminum pans weigh very little and they conduct heat easily, which means that they reach the proper cooking temperatures quickly. On the other hand, it is easy to burn food with these pans.

Steel pans are used less than aluminum pans despite the fact that they are better able to preserve the product without any danger of altering its nutritional value.

They can be cleaned easily, do not lose their shape and, since they have a thermal bottom, they maintain heat, reducing energy consumption.

Copper is mostly used for cooking without a lid. It is the best conductor of heat but it is also more expensive than the other two. Pans come in many different shapes: cylindrical, oval, square and rectangular, each shape relevant to the food to be cooked. When braising, for example, it is important to use a wide, shallow saucepan while soups need tall and narrow pans. In any case, the most widespread type is the cylindrical one.

Of particular importance is the thermal bottom (typical of steel pans), which is ideal for long and elaborate cooking. Instead, the normal bottom is ideal for quick cooking, because the flame must be high and the heat immediate.

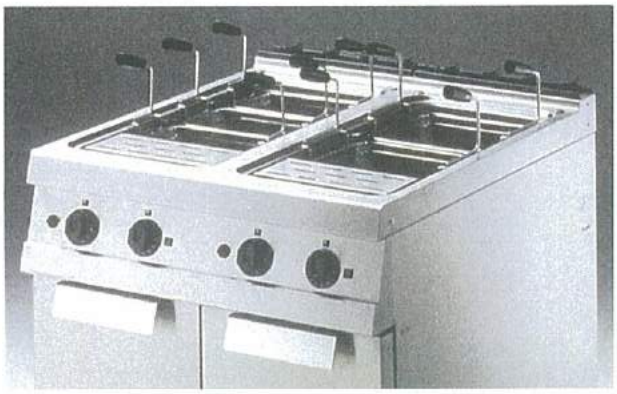
Pasta Cookers

These are machines that are specifically designed for cooking pasta but that must obviously also have more extended uses such as for boiling meat, fish or vegetables. This is of particular importance in the large formats of these types of pans.

The pasta cooker was invented in Italy about

Pasta cooker with automatic tilt.
Ideal for large quantities

Pasta cooker with baskets for small to mid-size production



30 years ago in response to the need for a speedier cooking method and to meet the need to cook larger quantities of pasta, Italy's most famous food. Since then, the tool has evolved enormously and is now available in so many varieties that it easily satisfies the needs of any professional kitchen, from the smallest to the largest, and from the smallest of restaurants to the largest cooking center.
Various tests on different kinds of pasta have been conducted to improve the cooking process. In addition to the results obtained by this research, attention has focused on clients' specific needs: the amount of pasta to be produced each hour, the water boiling time, the type of controls required for heating and cooking, security systems, ease of cleaning, obstructions and general maintenance.
Typically, the pasta cooker consists in a vat with a washout valve and one or more baskets, which allow the pasta to be extruded quickly once it is cooked. Cooking equipment for pasta can function with gas, electricity or steam. It is therefore possible to choose the machine best suited to one's needs in terms of location – in a basement, semi-basement or on a first floor – and the size of the location or the number of windows that will guarantee proper air circulation.
In general, these criteria are governed by Law No. 74, a ministerial decree issued on April 12, 1996. In Italy, the most common type of machine is the one that functions with gas, given the high cost of electric energy. In other countries, where electric energy is cheaper, the situation is different.
Some pasta cookers are equipped with Rapid System; that is, the addition of an electric boiler that preheats the water and can assure a constant temperature of 158 °F. This enables and guarantees a more stable cooking process because the addition of cooking water during boiling does not lower the water temperature (refilling the pan with water is usually done

between the cooking of one batch and the next).
Larger machines do not need to be constantly checked by the operator because they are equipped with a timer that controls the cooking time, activating the automatic device that lifts the basket when cooking has been completed. This mechanism has a linear engine and actuators, allowing a more fluid motion and reducing risks to the operator. This extremely reliable solution also facilitates ordinary maintenance procedures. All pasta cookers are equipped with an overflow system for the foam that develops as a result of impurities and starches released by pasta, rice or gnocchi during cooking. This foam tends to increase when several batches are cooked in the same water.
Eliminating the foam helps to keep the vat clean by eliminating the substances that most quickly and tenaciously dirty it, thereby lengthening the equipment's life. In addition, the use of steel and the lack of fissures and sharp edges make it possible to clean all of the machine's parts.

Static Oven

Now obsolete, this machine lies at the origin of traditional Italian cooking and it is still widely used today in more traditional restaurants as well as in smaller ones. The professional static oven was born of the domestic oven, its power and size adapted to its commercial use. It is a simple machine. Once the temperature has been set and the proper temperature reached, the product is placed in the oven. The food must be checked often while it is cooking because it tends not to cook uniformly and to dry out.
Furthermore, this type of oven is not very ergonomic; the cook needs to constantly bend over to check the product or place it in the oven. Since it is a very simple and inexpensive machine, it does have some disadvantages:

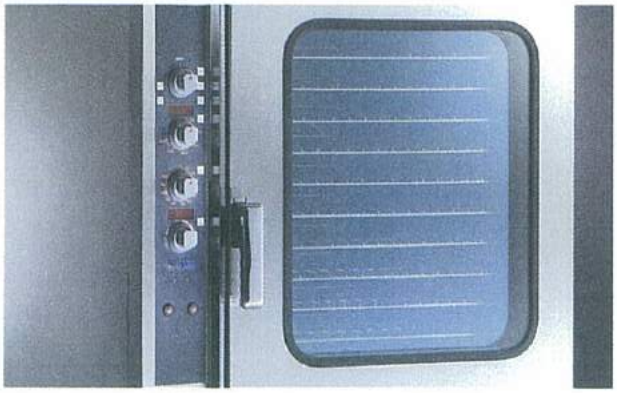
1. absence of a timer to warn that cooking has been completed.
2. imprecision temperature maintenance because of a non-digital probe.
3. inability to bake more than one GN 2/1 pan at a time.
4. inability of inserting the vent rod in the center of the product because it operates only at very high temperatures (482 °F - 572 °F).

Convection Steam Ovens

Convection ovens came into existence at the end of the 1970s. In recent years they have proven to be reliable, easy to use, energy saving and versatile and, compared to other cooking methods, they cause the product the least shrinkage. They provide many other benefits that traditional machines certainly cannot provide. This type of machine is ideal for cooking pasta that requires baking such as cannelloni and any gratinated kind of pasta. These types of oven can be gas or electric (with no difference in performance). Optimal temperatures for these ovens are between 302 °F - 428 °F but they can be used at temperatures up to 572 °F. The most suitable cooking cycle for oven-baked pastas and similar products is the convection cycle at 338 °F.

Professional static oven mostly used in traditional and smaller restaurants.

Convection steam oven. Introduced in the late 1970s, it is characterized by its reliability, ease of use, energy saving features and versatility. It causes the product a minimal reduction in weight.



When baked pasta is placed inside the chamber, the leap in temperature causes an immediate release of humidity. The product subsequently heats to boiling. At this stage, there is an additional transfer of water vapor and it is indispensable to eliminate the vapor so that the product can dry and gratinate. A "steam valve" carries the steam to the upper portion of the chamber. The chamber must be waterproof to impede the vapor formed by the boiler to escape, thereby damaging the electrical circuits.

Prior to cooking, the machine must always be preheated (i.e. brought to cooking temperature without the product inside), allowing the product to reach the ideal cooking temperature as soon as possible, impeding any thermal stress that would hamper the product's quality. The oven must always be preheated to a temperature that is higher than the actual cooking temperature because, when opening the door to insert the product, the chamber tends to cool. There is no need to evidence the practicality of working in a vertical position rather than having to lower oneself continuously, as is necessary with static ovens.

The installation of this kind of machine requires an electric input, a gas connection (except in the case of completely electric machines) and a water connection. Electrical connections are monophase at 230V for machines that function on gas or three-phase at 400V with a neutral wire for completely electric machines. Machines that function on gas also need an electric feeder, albeit minimal, for the "electronic logic" circuit and for the rotor.

Potency, both electric and gas, can vary, depending on the size and, therefore, on the loading capacity of the oven. Another ideal and very important function of this machine is regeneration. This is a cycle that permits previously cooked foods to be heated without

to dehydrating or oxidizing the product, safeguarding its high quality. In this cycle, the machine works on convection and humidifies on the basis of the load because, through a probe, it perceives the quantity of the product in the oven and how much moisture it releases. Suggested temperatures vary from 176 °F - 266 °F and the machine is made of 100% stainless steel 304.
There is also the possibility of installing an HACCP control through the printer, which is connected directly to the machine or an advanced system, connecting a single computer to 115 separate machines.
In terms of cleaning this machine, nothing could be easier. One merely presses the "clean" button and the semiautomatic cleaning cycle begins. At the end of the first phase, the machine rings to alert the user that it is possible to spray the degreaser. Once the door is closed again, the cycle restarts and after two minutes goes into the steam cycle, helping the degreaser to melt the grease. At the end of this cycle, it is possible to clean and rinse the inner chamber with a spout (optional). An important factor in the machine's maintenance is the programmed descaling of the boiler. Limestone deposits must be removed using vinegar or an industrial descaler.

Four burners (pyroceram) and electric plates

These are the traditional machines par excellence used for international cuisine. All of the machines are easy to use and provide similar cooking results. They differ, however, in their waiting times and bringing to boil of the product, obviously depending on the burner's power (gas machines) or on the intensity of the ideal energy (electrically powered ones).

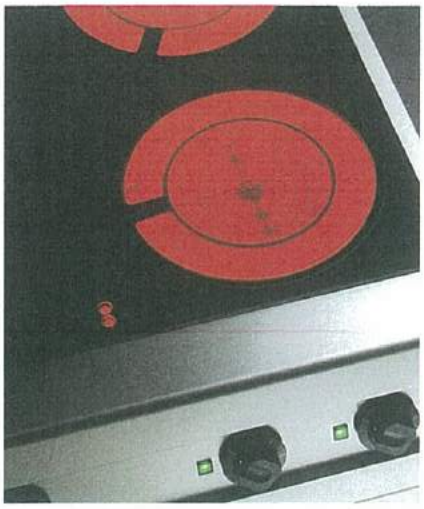
Induction

Induction equipment provides a meaningful and valid alternative to the aforementioned machines. It is characterized by its speed in reaching heating temperatures (indisputably the fastest to date) and its low emission of heat (these machines only heat the surface area covered by the pan). This makes it possible for the product, which might overflow, not to dry out or adhere to the cooking surface. The plate temperature goes from 32 °F - 752 °F in only 10-15 seconds.

Fast Coolers

These were especially developed to decrease the food temperature quickly, bringing it to a level that would not cause it exposure to bacterial infection (+50 °F), as per international norms.
Fast coolers belong to two main families: quick, single-stage coolers for high temperatures, and quick two-stage freezers. This type of equipment was born of the need to store the cooked product for longer periods, without exposing it to bacteria, and safeguarding its nutritional values, including quality, consistency, color, smell, vitamins, etc. To obtain these objectives it is necessary to decrease the temperatures in the least amount of time possible, keeping a temperature range

Four burners in pyriceram.



Electric plate with four burners (below at right). Traditional machines used in internationally.

between +149 °F and +50 °F. The fast cool process is very simple. After it has been cooked, the food is placed in the fast cooler and vacuum cooled.
To attain a good cycle, it is important that the product not "freeze" on the surface during the fast cool. All of this must obviously respect the fast cool times within established intervals. To obtain excellent results for all product types, it is indispensable for the equipment to activate the cycle in the SOFT mode (delicate food) or the HARD mode (large pieces); that is, it must be able to work over time or use the vent rod that measures the temperature at the center of the product.
The quick freezing cycle (chamber temperature equal to -36.4 °F - 104 °F) must operate very quickly, forming micro crystals. The formation of macro crystals of ice must be avoided because they can scale the body of the product, deteriorating it in the subsequent defrosting phase and causing loss of liquids.
Even in this case there is the option of functioning with either time or with the vent rod. Laws governing the functioning of these machines state that the product must be brought to between +149 °F and +50 °F within two hours in the case of fast cooling, or from +149 °F to - 0.4 °F (measured at the center of the product) within four hours in the case of quick freezing. This machine is also equipped with a germicide lamp, which can be used to lower the risk of spreading bacteria. It emits UV rays that guarantee that the chamber will be completely disinfected.

Microwave Ovens

In these machines, the magnetic waves created by the macrom cause the water particles that live in the food product to move, creating friction and, therefore, heat, thereby cooking or heating the product. It is common knowledge that only plastic or glass can be used in these ovens.

The refrigerator allows food products longer life. To guarantee greater uniformity of temperature, the traditional models have been almost completely replaced by ventilated models.

Fast Cooler.
Allows the food temperature to decrease slowly, below the critical level (10°C), impeding the formation of bacteria

Refrigerators

Refrigerators are machines that allow food products to last longer. The product must be kept at well-controlled temperatures and levels of humidity. Refrigerators' high level of humidity favors the creation of mold while low levels of humidity cause the product to dehydrate. A refrigerator must also be able to function at high room temperatures (up to +109.4 °F) with reduced energy consumption. This can be obtained through suitable compressors and very thick insulation (for example, 75 mm).

To safeguard the environment (the Greenhouse Effect and the ozone layer), refrigerators must be CFC- and HCFC-free.

Ideal temperatures for specific products are as follows:

From 32 °F to +35.6 °F for fish

From +35 °F to +39.2 °F for meat

From +39.2 °F to +46.4 °F for fruits and vegetables

From -0.4 °F to -7.6 °F for frozen products.

COOKING METHODS

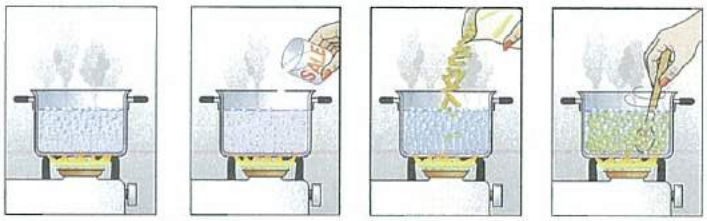
In the restaurant business there are many ways of cooking pasta, and they depend on the size of the restaurant (number of places), the quality of service offered and the number of meals to be served within a specific time limit. The typical cooking methods are: express cooking, the double cooking method, and cooking with subsequent heated transportation of the product.

Express Cooking

Express cooking is carried out in a single phase and is primarily used when the quality of the served pasta is the priority. Nonetheless, this type of cooking functions best only when the number of places (about 40) and the number of people to serve in a limited amount of time is low.
To achieve optimal quality, the pasta must be cooked according to the following procedures:

- Bring the water to boil in a pot or cooker.
- Once the water has reached boiling temperature, add salt (.325 oz of salt for every liter of water).
- As soon as the water starts boiling again, place the pasta in the pot or cooker (3.52 oz of pasta for every liter of water).
- Stir the pasta constantly, at least for the first 4 minutes, to prevent it from sticking or amassing.
- During cooking foam will form, likely spilling over the sides of the pot or cooker. Should it become necessary to reduce the amount of foam, reduce the flame, but do not allow the water to stop boiling. When the water stops boiling, its motion decreases, causing the product to release patina, which in turn produces foam. As a general rule, good quality pastas tend to produce less foam than poor quality pastas because they tend to release less substances during cooking.
- Once the optimal cooking time has been reached, add cold water to the cooking water (7 oz of cold water for every 35 oz of cooking water) and then drain the pasta for at least 10 seconds to prevent

Express Cooking



1. water at boiling *2. add salt* *3. add pasta* *4. stir often*

5. when cooking is complete, add cold water *6. strain* *7. season* *8. apportion and serve*

excess water from touching the product.

- Stir-fry or sauté* in a pan and/or season
- Apportion
- Serve

Double Cooking

The double cooking method occurs in two separate phases, with a pause of several hours between cooking. This type of cooking is generally used when there is a large number of people to serve in a limited amount of time. It allows the more time-consuming preparation phase to be carried out well in advance of the serving time. Though the quality of this product is inferior to that of the product prepared with the express method, using high-quality pastas, especially made to resist to high-stress processes, will gap this difference in quality.

* When sauting, strain the pasta 1 minute prior to the time indicated on the pachet, complete the cooking with the sauce over a high flame

The Procedure:

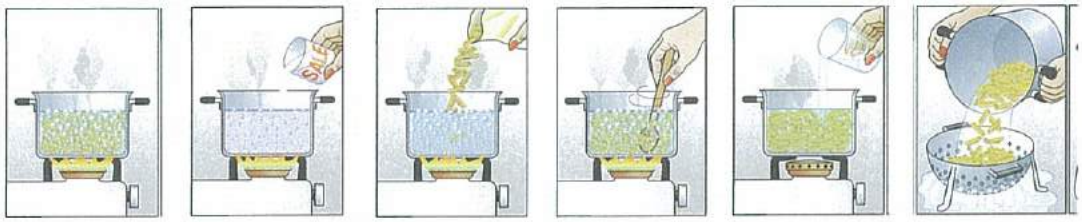
1. Stage: PRECOOKING

Bring the water to boil, add salt, and as soon as the water starts boiling again, add the pasta, respecting the optimal ratio of salt/pasta/water:10/100/1000. In this first phase, cooking time is typically 50% of the time estimated for express cooking (the uninterrupted "animella" method, see page 161). Cooking must be interrupted by adding cold water to the cooking water (7 oz for every 35 oz of cooking water), and then draining the pasta carefully, ensuring that no excess water come into contact with the pasta.

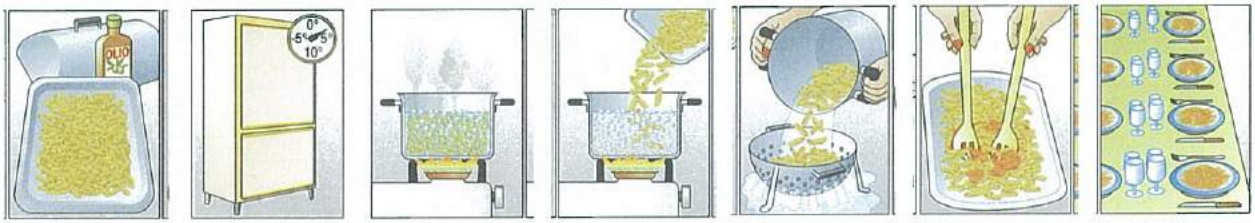
2. Stage: REST

The strained product is placed in a "gastronorm" (a steel tray with a lid), and 3 ml of oil for every 3.52 oz of pasta are added to it (olive oil or sunflower oil). Everything is stirred, uniformly arranged on the gastronorm and COVERED. The product must be allowed to rest in a refrigerated

Double Cooking



1. water at boiling *2. add salt* *3. add pasta* *4. stir often* *5. mid-cooking halt, cold water added* *6. strain*



7. place pasta in "gastronorm" *8. place in cool environment at temperature of 39. °F (maximum)* *9. bring water to boil again* *10. finish cooking for about 1 minute* *11. strain* *12. season* *13. apportion and serve*

environment at 4C (maximum) to guarantee the product's resistance to microbiological contamination (a legal requirement in Italy). Though a refrigerator can be used, coolers are recommended because they ensure faster cooling times and they do not react to steam. In addition, coolers preserve the pasta's surface starch, which helps the condiment to bond. Other cooling methods are also used. Among them are:

- rest at room temperature
- washing the pasta in cool running water

When deciding on which cooling method to use, it is important to remember that the first method is not permitted by law because pasta contains water and has an ideal temperature for the growth of microorganisms, which are a threat to human health. On the other hand, when using the second method, the running water washes away the pasta's surface starch. The starch is useful because it helps the condiment to bond. Typical rest time varies from 1 to 4 hours (and can be extended to 12 hours).

3. Stage: RECOVERY

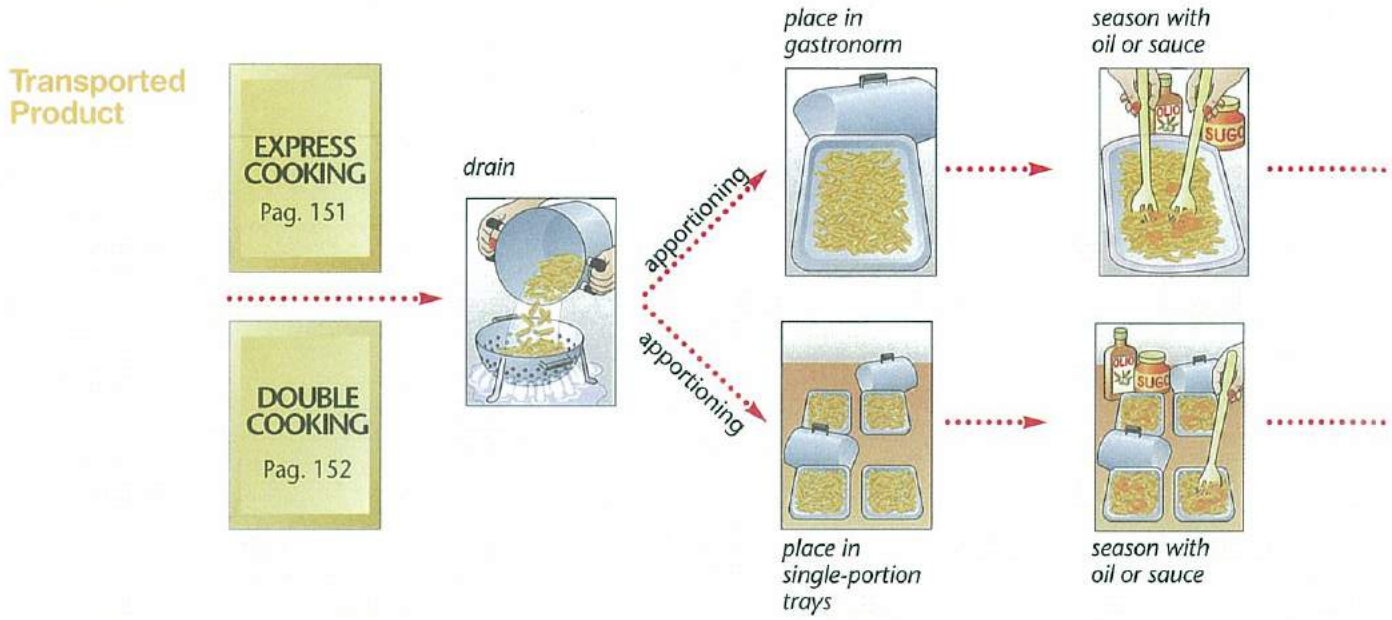
After the product has rested, bring the water back to boiling and soak the precooked pasta for about 40-60 seconds.

- Drain carefully
- Sauté with sauce and/or season
- Apportion
- Serve

Cooking and Heated Transportation of the Product

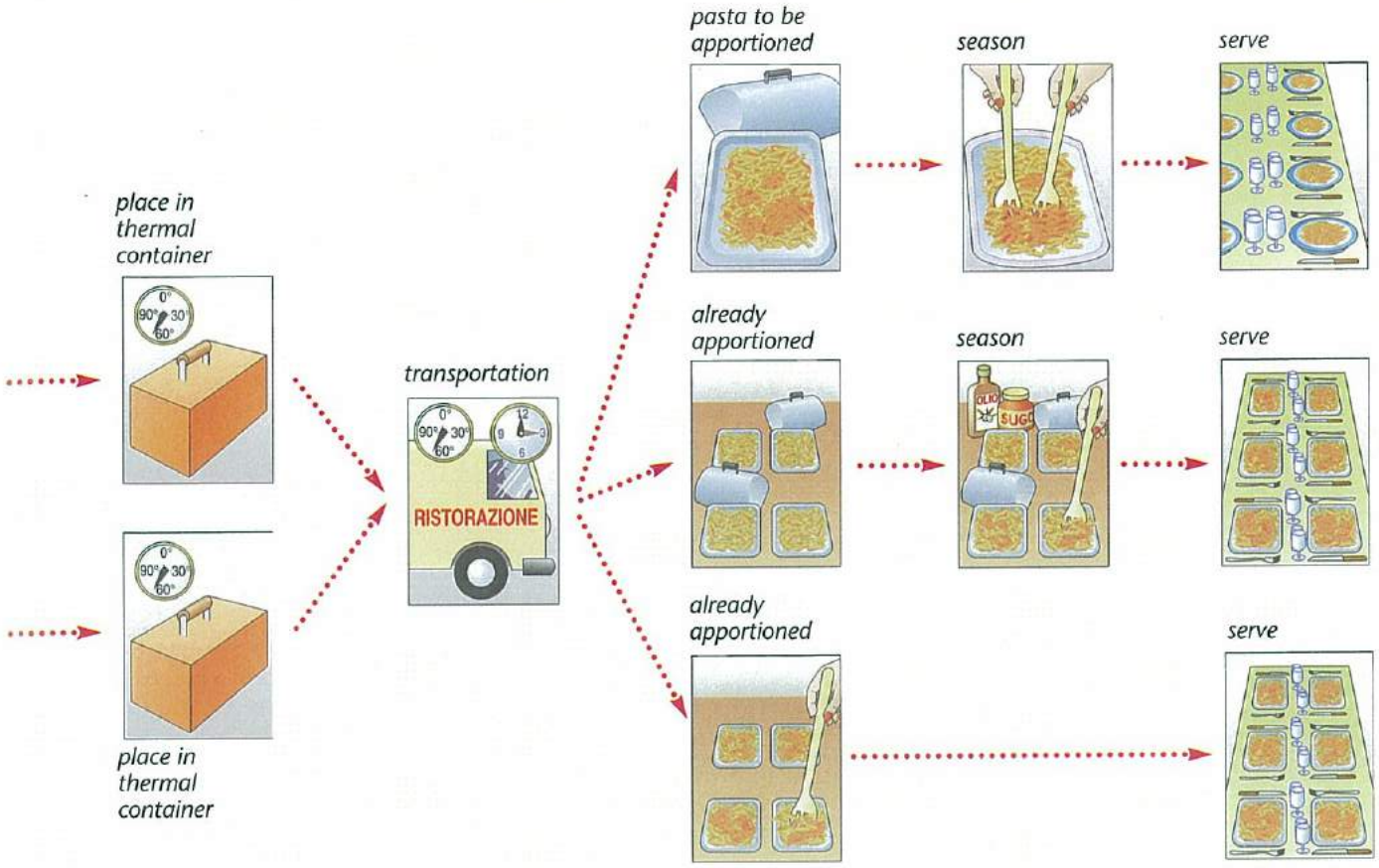
Cooking and heated transportation of the product is a quickly evolving method. The pasta is generally prepared in a "cooking center" using either the express method or the double cooking method (see above). The product is then packaged in single-serving containers (a sealed plate) or, if it is to be apportioned at the time of consumption, it is placed in a steel tray (gastronorm).

The pasta, which can be seasoned or covered



with a very small amount of olive oil to prevent it from amassing, is then put to rest in thermal containers at 149 °F, and transported with a vehicle to the place where it is to be consumed. Transportation time can vary from 30 minutes to 4 hours or more. Once it reaches destination, the pasta can be served immediately, if it has already been apportioned, or it can be apportioned on location, seasoned and served. It is not easy to obtain good quality pasta using this method because the product is subjected to various stresses.; therefore, it is necessary to use high quality pasta, which can endure these types of stresses. In preparing cooked meals that must be transported elsewhere, the cooking method is essentially the same, with a sole variation after draining:

- The product is placed in the gastronorm tray or in the single-portion plates, adding 3 ml of extra virgin olive oil for every 3.52 oz of pasta;
- The tray/single-portion plate is covered and placed in a thermal container at a temperature of 149 °F.
- The product is served at arrival. We recommend that transportation not exceed 3 hours.
- The product is stirred again and, when required, it is apportioned and served.


place in thermal container
transportation
RISTORAZIONE
pasta to be apportioned
season
serve
already apportioned
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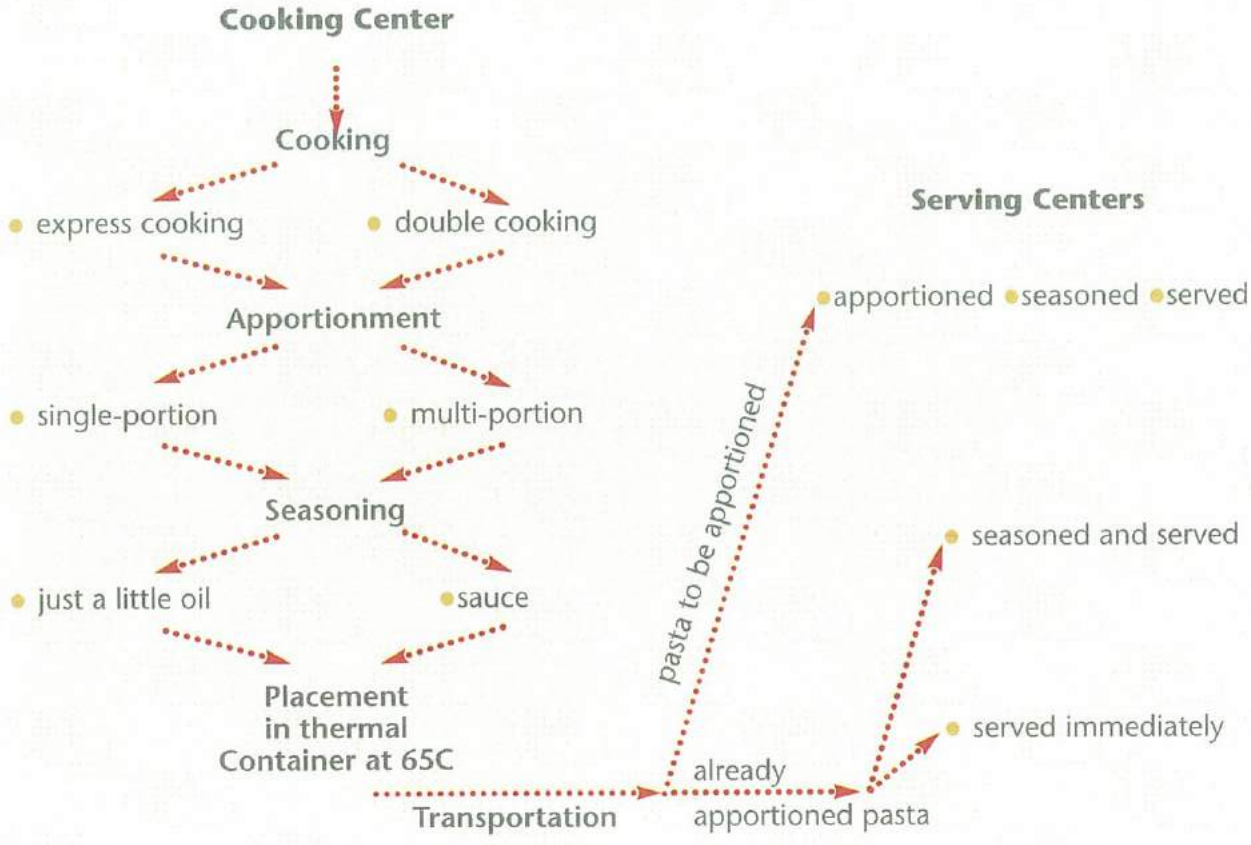
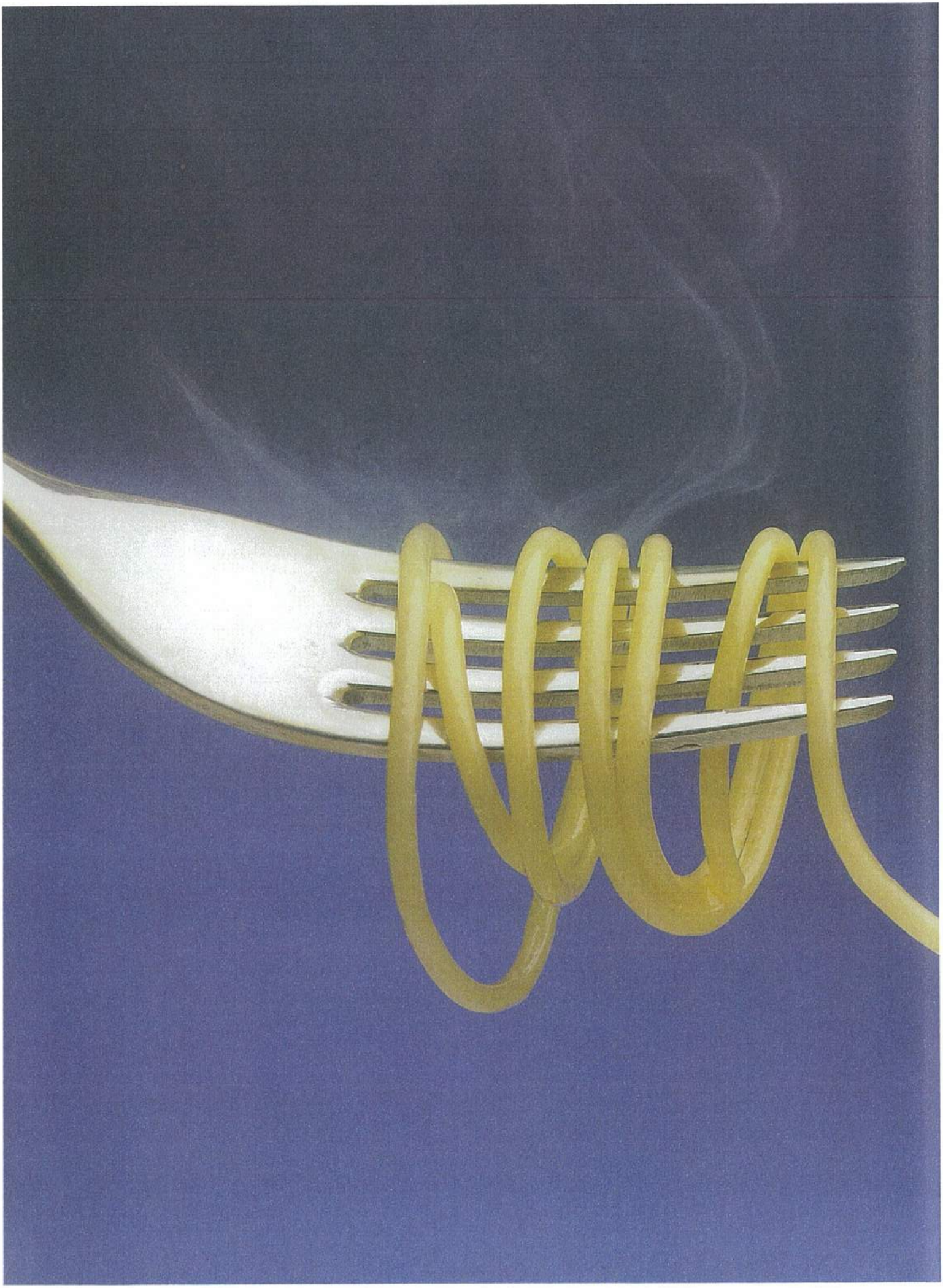

Cooking Center
Cooking
express cooking
double cooking
Apportionment
single-portion
multi-portion
Seasoning
just a little oil
sauce
Placement in thermal Container at 65C
Transportation
Serving Centers
apportioned seasoned served
pasta to be apportioned
seasoned and served
served immediately
already apportioned pasta

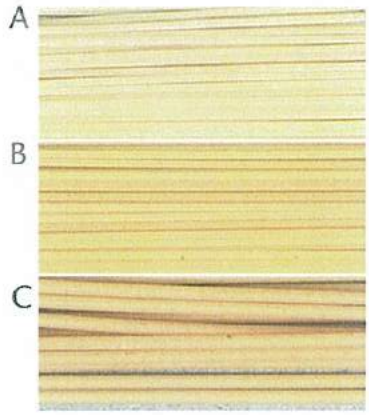


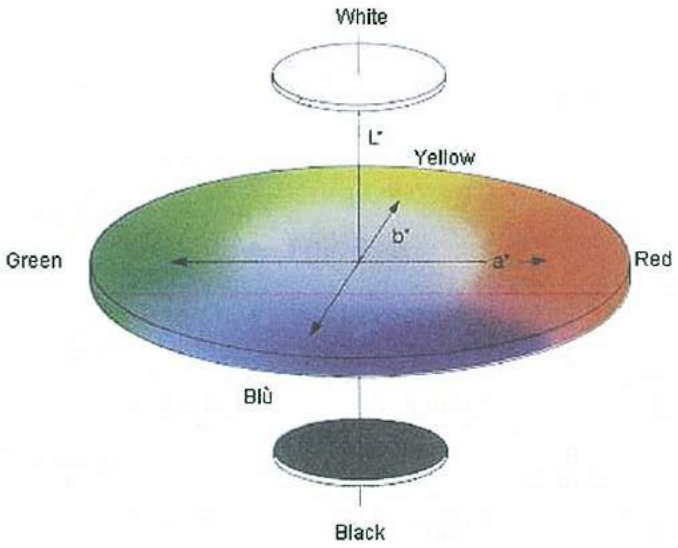
QUALITY OF THE PASTA

The qualities of both the raw product and the cooked product must be measured using specific instruments that allow the product's compliance with qualitative standards to be evaluated objectively. The following table provides a brief description of the evaluation criteria currently being used.

Table 1: **Instruments used in analyzing raw and cooked pasta**

Dry Pasta	Instrument	Parameter Being Evaluated
color	colorimeter	gray index – L* brown index – a* yellow index – b*
size	caliper	diameter or thickness
specks	image analysis	no. of black specks no. of white specks
cooked pasta		
texture	dynamometer	medium load
elasticity	dynamometer	Energy load/energy retrieved
homogeneity	dynamometer	cutting curve
amount of patina	spectrophotometer	absorbance at 600 nm
absorption of sauce	scale	increase in weight
color	colorimeter	brown index – a* yellow index – b*
yield at cooking	scale	increase in weight
yield in plate	scale	increase in weight
Smell	pH-meter	acidity





Representation of the "Space Color CIE Lab," where the functions of the three indices are identified with the purpose of arriving at an objective definition of the pasta's color:
L = Luminosity, which begins at 0 in dark samples and at 100 for lighter samples*
a = red index quantifies the red content (positive values)/ green (negative values) of the sample*
b = yellow index quantifies the yellow content (positive values) / blue (negative values) of the sample*

A. pale yellow pasta
A. bright yellow pasta
A. red pasta

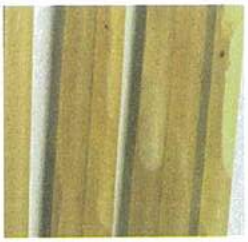
1. Evaluation of the Dry Product

1.1 Color:

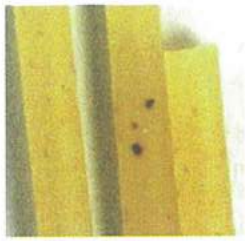
As previously mentioned, the yellow color of the pasta derives from the natural pigments of the wheat. Synthetic colorants are not permitted by law. During the technological phases, possible variations in color occur as the result of two circumstances; the first involves oxidizing enzymes, which can become active and thereby reduce the natural content of carotene by 50%, while the second is an incorrect drying process that can lead to the formation of reddish-brown substances (Maillard compounds). In addition to compromising the appearance of the product, these factors can, in extreme situations, lead to an undesirable "cooked" taste. Though less frequent, another aspect is the "graying" of the product. The pure yellow base diminishes and the product assumes a dull color and a poor overall appearance. Since this phenomenon depends on the type of wheat and how much it has assimilated during its development, it also depends on the type of soil used in cultivating it. A colorimeter is used to objectively measure the aforementioned parameters. This instrument illuminates the product in a homogenous manner, reading the reflected light spectrum. By using algorithms based on standards proposed by the CIE (Commission International de l'Eclairage), the colorimeter can provide the required information, that is, L*, a*, b*. (See Table 1.)

1.2 Size:

The diameter of a single strand of spaghetti or the thickness of a short pasta format determines the correct cooking time, which must respect the specific established tolerance levels. In fact, during cooking, water slowly penetrates the structure, hydrating and gelling the starch (this is because pasta becomes increasingly soft). Obviously, it takes time (usually a matter of minutes) for the water to reach the center of the



Checking. White streaks caused by an imperfect drying process.



Black and brown specks originating in the raw material.

White specks caused by an imperfect hydration of the semolina particles.

product. If the thickness were not homogeneous, the central zones would risk being perfectly hydrated in some areas and not sufficiently hydrated in others. The less hydrated parts remain dry and hard, leaving an unpleasant sensation in the mouth.

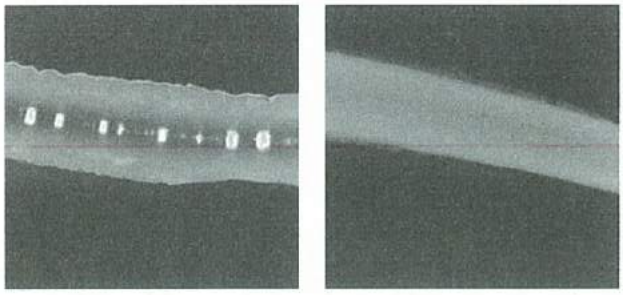
Measurements must be taken several times before they can be considered representative of a sample's true size. The process can be simplified by connecting a micrometer caliper to a small processor, automatically calculating the average and standard deviations. The resulting data is read as a degree of acidity on the dry product, which corresponds to the amount of milliliters of sodium carbonate required to neutralize 3.52 oz of dry product. Since the scent of the product is very slight, it can easily be altered by external factors such as packaging or by an extensive and unsuitable storage (close to scented detergents, for example). The most serious alteration in scent is primarily connected to problems that occur throughout the distribution chain; therefore, they cannot be controlled by Quality Control within the manufacturing plant.

1.3 Specks

As has already been explained, the black and brown specks that appear in the product in varying amounts derive from the raw material. Pasta may also contain "white specks" that are, in essence, associated to an imperfect hydration of the semolina granules (usually because the larger ones soak more). At times, whitish streaks that penetrate the surface may also appear (checking). They form as a result of an imperfect drying process, which leads to uneven tensions in the structure, creating very small internal fissures or weak points. These, in turn, may cause the product to break during cooking.

In long pasta cuts, the number of points or specks can be determined visually by arranging them on a belt and defining the specific area to be evaluated. In so doing, it is possible to determine the amount of specks on the basis of

"Animella" or hardish center refers to the innermost part of the product which, after cooking, has not yet been completely hydrated and is therefore still white. "Animella" can be seen in the cooked product by "squeezing" a strand of spaghetti between two pieces of clear plastic or by cutting one of the penne, exposing a section of it.



The sequence of photos illustrates a strand of spaghetti at two stages of cooking.
On the left is a properly cooked strand with interspersed evidence of "animella" on the right is a section overcooked strand lacking "animella."

specks per 39 inches sq. On short pasta cuts, the procedure becomes more complicated because of the various shapes of the pasta.

1.4 Smell

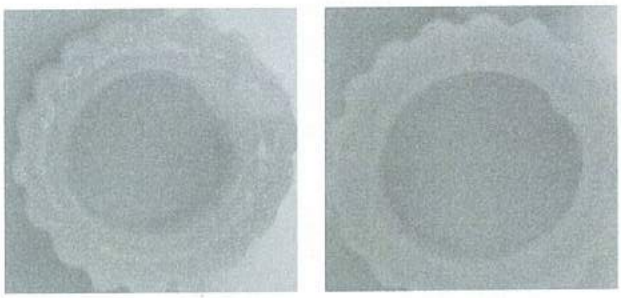
If the wheat or the semolina used in making the product is stored in unsuitable environments, fermentation may occur and the product may smell acidic/fermented. This phenomenon is governed by specific regulations and it can be monitored by extracting the ground product with 50% ethanol and titrating it with NaOH N/50, a clear filtrate.
The resulting datum is read as a degree of acidity on the dry product, which corresponds to the amount of milliliters of sodium carbonate required to neutralize 3.52 oz of dry product.
Since the scent of the product is very slight, it can easily be altered by external factors such as packaging or by an extensive and unsuitable storage (close to scented detergents, for example). The most serious alteration in scent is primarily connected to problems that occur throughout the distribution chain; therefore, they cannot be controlled by Quality Control within the manufacturing plant.

2. Cooking Process – Cooking Value and Hold

If cooking modalities are altered, the various performance analyses can produce a variety of results on a single product.

2.1 Cooking Time

When cooking time is increased, all the quality indexes decrease, especially those related to the product's texture. It is therefore essential to devise an objective system that will determine the Optimal Cooking Time (OCT). One of the most widely used procedures is evaluating the "animella" content inside the thickness, selecting the time at which this element appears partially interrupted (see photo). Another method, derived from the first, is more suitable for normal



The sequence of photos illustrates a strand of a penna at two different stages of cooking.
On the left is a properly cooked strand with interspersed evidence of "animella" on the right is a section overcooked strand lacking "animella."

cooking. It consists in correlating cooking time with the diameter or thickness of the pasta sample to be cooked.

For long pasta, Cooking Value is defined on the basis of the linear combination of the texture, patina and lumping parameters while for short pasta it is determined on a combination of the first two alone. These parameters are normally evaluated five minutes after the pasta has been drained.

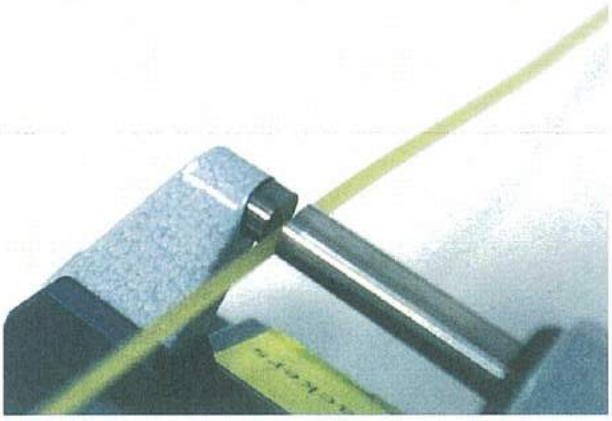
In the manual/organoleptic evaluation, an opportune evaluation scale is used and the sample is compared with well-known pastas. To better understand the influence of cooking time on the intrinsic quality of the product, two techniques are used: "overcooking" and "cooking hold."

2.1.1 In overcooking, the product has surpassed its TOC by 25%. Evaluation involves measuring the decrease of texture by comparing the results and the corresponding values relative to TOC. Good quality pastas tolerate these stresses better than poor quality pastas. The test also serves to determine the pasta's ability to endure the chef's "cooking errors."

2.1.2 While the cooking value is measured 5 minutes after draining, the hold is evaluated after the product has been on the plate more than 10 minutes. Once again, comparisons are made on data collected at 5 and at 10 minutes, using the same logic as described above.
This test serves to evaluate the pasta's ability to remain on the plate or tray for an extended period of time before it is consumed.
This, therefore, becomes one of the most important parameters of evaluation in the restaurant business.

2.2 Acidity:

When using a slightly acidic water, having a pH of 4-5 (e.g. with a vinegar additive), turbidness and patina are diminished. This occurs probably



Instrument used to determine long pasta's dimensions (micrometer).

because the protein's solubility decreases so the gluten network becomes more resistant.

2.3 Softness of the Water:

If the pasta is cooked in distilled water rather than in common tap water, the pasta's thickness is reduced. It is difficult to explain the phenomenon. Perhaps the cause can be attributed to the calcium ions that typically tend to form bridges between two chains of polymer ions.

2.4 Speed at which the water boils:

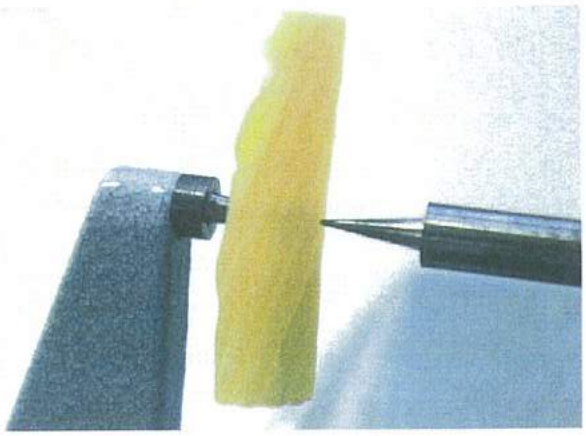
When the water's boiling speed increases but the cooking time remains the same, the firmness diminishes. This is because water penetrates the product more quickly, leading to increased hydration and, therefore, an increase in the gelling of the starch.

3.Evaluation of Cooked Pasta

3.1 Texture of the Product

Texture constitutes the product's principal characteristic. It is noticed when the product is being chewed and it becomes evident in a series of characteristics that can, in part, be measured by using particular tools. These characteristics are: firmness, elasticity, homogeneity, amount of patina, sauce holding capacity, non-stickiness. All of these characteristics can be evaluated by using organoleptic or manual (subjective) methods, but only some of them can be evaluated using objective procedures based on the use of dynamometric measures. The latter involve the use of an instrument (the dynamometer), which is able to measure the strength required to perform a certain mechanical action (compression, cut, extension, etc.) on a sample.

In this case it is necessary to point out that during the preparation and analyses phases, it is



Instrument used to determine pasta's dimensions.

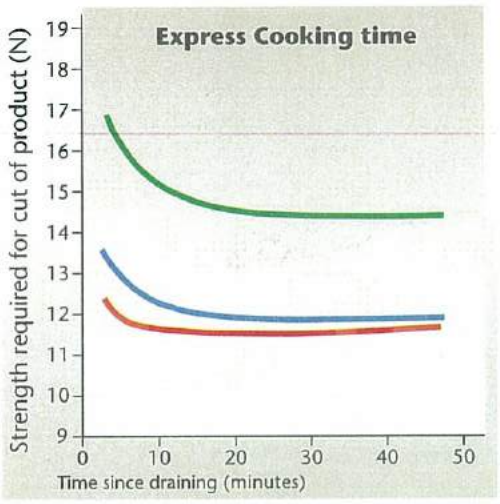
important to use methods that can be very easily reproduced. This guarantees that the result does in effect depend on the quality of the sample and not on the methods used in preparing it or the procedures used in evaluating it. The single most important factor is to establish the TOC for each cut objectively and univocally. Furthermore, after it has been cooked, pasta tends to alter quickly in time; therefore, it is always necessary to determine after how many minutes the evaluation will occur.

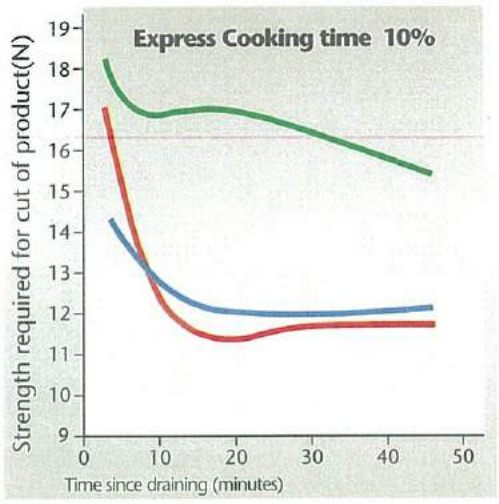
3.1.1 Firmness

Firmness is related to the strength needed to cut the pasta with one's teeth. One way of measuring this on all cuts is by using a metallic camera (Ottawa Cell) composed of a perforated bottom and an upper piston inserted into the head of the dynamometer. A standardized amount of product is placed inside the container and the dynamometer lowers the piston, which extrudes the pasta from the perforated bottom of the cell, at a constant speed. The instrument can measure the strength (in grams) required to perform this action, which depends on the consistency of the sample.

3.1.2 Elasticity, Homogeneity and Cut

Elasticity refers to the ability of the structure to return to its original shape. This characteristic is related to the quality of the gluten, its degree of hydration and on the homogeneity of the latter. Homogeneity means that the gradient of hydration, in passing from the exterior to the interior of the product, is very low; therefore, in chewing, there are no soft areas (exterior) and hard (interior) contemporaneously.
The product's resistance to the cut is well correlated to the sensation that is averted in cutting into the product with one's teeth and it can be compared to the concept of texture. These factors are evaluated by exposing a layer of cooked pasta to a specifically designed "artificial tooth" connected to a dynamometer.





The artificial tooth tests the texture of the sample, cutting it, while the instrument continuously registers the strength required to perform the action. The required information is derived from the movement of the strength's curve.

In terms of elasticity, good texture is the ability to maintain these performance levels under stressful conditions (overcooking, waiting time, etc.). This is fundamental in good quality pasta.

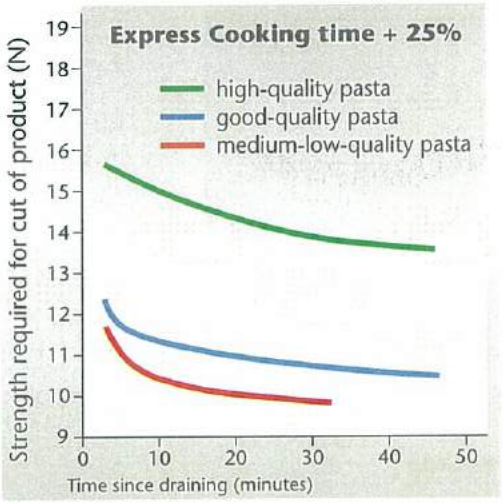
The following pictures illustrate the test results conducted on spaghetti of varying quality (products manufactured with different raw materials, technologies and dies) and cooked with TOC, overcooked (TOC + 25%) and reduced cooking time (TOC-10%).

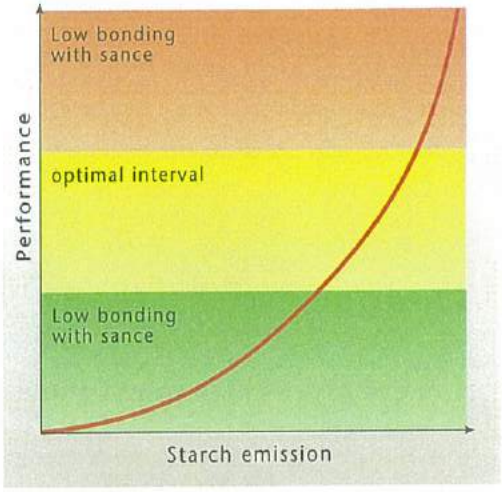
The "Strength of Cut" obtained with the "artificial tooth" was measured immediately after draining and in succession, simulating waiting times.

The product obtained with high quality semolina, dried at high temperatures and cut with Teflon dies offers better resistance, considering all the evaluation conditions mentioned above.

3.1.3 Ability to bond with sauce.

The surface of the pasta must interact with the sauce so that they bond in the best possible way, blending in the mouth and emphasizing the taste. The geometry of a certain cut is often specifically designed to maximize this characteristic; however, certain "smoother" shapes can hold the sauce only if a thin patina of starch forms on the surface. Currently, the only semi-empirical system known for quantifying the product's ability to hold the sauce is to season a weighed quantity of product with a constant quantity of sauce, to allow the sample to rest for a while, and then weigh everything again, recording the increase in weight resulting from the sauce that remains attached to the pasta.





Characterisics of pasta related to emission levels of starch

3.1.4 Patina

Once the pasta has been drained and placed on a plate, it tends to dry within minutes, forming a gluey patina — composed mostly of starch — on the surface. If, on the one hand, a small quantity of this patina favors the sauce's adhesion to the pasta, an excessive amount favors the formation of another unwanted factor, lumping. Lumping is the tendency of each single piece of pasta to attach to each other, forming a mass in the plate. This phenomenon is particularly obvious in long cuts to the point that in extreme cases it becomes very problematic to roll the pasta on the fork. Patina levels are measured using an instrument, placing a standardized amount of pasta into a moving container so that the patina can be washed and removed as it forms on the surface. The patina is therefore determined by measuring the amount present in the water by using reactants and instruments. (Determining the color of the iodine-amylose complex and a solution of iodine and iodide.)

Literature also describes procedures that involve the use of a dynamometer to measure the pasta's ability to adhere to a surface. Currently, however, this method has not produced convincing results.

3.2 Appearance

3.2.1 Color: It is important that the characteristic yellow tint of the product be maintained as much as possible, also keeping in mind that the pigments are diluted by the large quantity of water that the pasta absorbs during cooking. Generally, good natural pigmentation is preserved (the cooking water might be turbid, but whitish) but artificial coloration is not. In addition to the visual proof, it is possible to carry out evaluations using a colorimeter, placing the pasta in a suitable container equipped with a press so that the pasta can be compressed against the transparent bottom. By pressing the instrument against this window, the CIE Lab (L+, a*, b*) indexes can be measured directly.

Instrument used to objectively determine the product's color

3.2.2 Shine: Once the pasta is put on the plate, it might be shiny to a greater or lesser degree; that is, it is more or less able to reflect the visible light and this is due to the varying quantity of starch that is present on the surface. Using an instrument to measure shine is quite difficult because of the irregular essence of this feature and its continuous modifications over time. A suggested method currently being researched consists in taking pictures with a digital video camera at specified intervals and then subjecting them in sequence to the image analysis, using suitable software.

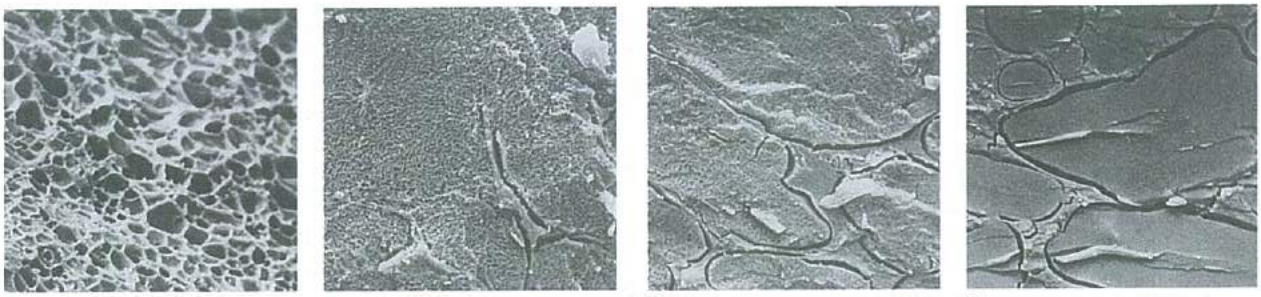
3.3 Other Qualities:

To conclude this particular discussion, we would like to mention other important characteristics of the product, which are of particular relevance to the restaurant industry. These are: yield in cooking, yield in the plate, the turbidity of the cooking water and the formation of foam.

3.3.1 Cooking yield refers to the increase in the product's weight following its absorption of water. It can be measured very simply by weighing the product before and after cooking.

3.3.2 Yield in the plate refers to the full weight of the product as it is presented in the plate after all the broken, lumped up and overcooked pieces have been eliminated. To determine the yield, the pasta must once again be weighed before cooking and after it has been placed in the plate. Generally, this amount is less than the amount measured in the cooking yield due to the wastage of the aforementioned pieces. The more similar the data of these two characteristics, the better the quality of the product.

3.3.3 During cooking, the water becomes increasingly turbid because once the gluten network is hydrated, instead of reacquiring its original elasticity, it becomes thinner or more lax and is therefore not able to hold the starch grains



1 2 3 4

Photos of cooked pasta samples taken with a Scanning Electron Microscope (SEM): The images illustrate the exterior surface of the sample(1), progressively moving toward the interior (4). The picture of the gluten network in the first photo appears to be completely starch-free and is badly damaged by the violent outpouring of the starch.

that are gelled. This causes an increase in the level of patina, lumping and minimal elasticity

A nephelometer quickly measures the level of turbidity. It is a fiber optics system that is able to emit a bright radiation and to measure the intensity of the radiation reflected by the liquid. If the cooking conditions are not standardized to the ultimate degree, it is difficult to reproduce the data obtained because the speed at which the water boils and the formation of small particles of pasta greatly influence the procedure.

3.3.4 The formation of foam during cooking is a fastidious problem and one that cannot be eliminated. It can cause the water to overflow, causing the chef notable irritation. Though the cause of the problem has not been sufficiently researched, it is presumed that the principal cause is connected to the release of a part of the soluble proteins, which act as emulsifiers thereby causing the foam. A smaller (lighter) product tends to stay at the surface, favoring the formation of foam and its subsequent overflow. All pastas demonstrate this problem, albeit in varying degrees. Currently, there are no instruments available to evaluate it.

THE CHARACTERISTICS OF PASTA

Relationship between raw materials, techniques of production, and processes of preparation.

		CHARACTERISTICS	PROCESSING PHASE IN WHICH THE CHARACTERISTIC ORIGINATES	PREPARATION PHASE IN THE KITCHEN IN WHICH THE CHARACTERISTIC ORIGINATES	POSSIBLE CAUSES–NOTES
APPEARANCE OF RAW PRODUCT	**DRIED DURUM WHEAT PASTA**	Black and branny specks	Raw material (semolina)		The presence of black and branny specks is not to be equated with lack of hygiene and cleanliness in the production process. Branny specks are dark particles that come from the tegument of the grain.
					The tegument is formed by layers of cells rich in cellulose, and lignin and is dark colored. The aim of grinding is to eliminate as many of these particles as possible.
		Pale yellow color	Die cutting		The pasta was cut with a bronze die.
			LT Drying*		A low drying cycle was used (T<149 °F and t>9 hours) during which small "brown" composites formed as a consequence of a reaction between amino acids of the protein and simple sugars naturally found in the semolina.
		Bright yellow color	Raw material (semolina)		Semolina containing a high level of yellow pigment was used.
			Die		A Teflon die was used, generating a smooth and shiny surface.
			HT Drying**		The pasta was dried at a high temperature cycle (T>167 °F and t<9 hours) during which small "brown" composites formed as a consequence of a reaction between amino acids of the protein and simple sugars naturally found in the semolina. For this reason the pasta appears more pigmented (Maillard Reaction).
	DRIED EGG PASTA	Dark yellow color	Raw materials (eggs)		Eggs with a high level of pigment (yellow/red) or a large number of eggs were used for the dough.
			Die		The pasta was made with a die.
		Pale yellow color	Raw materials (eggs)		Eggs with a low level of pigment (yellow/red) or only a few eggs were used for the dough.
			Die		The pasta was made using "foil" technology (similar to homemade pasta).
	FRESH EGG PASTA	Dark yellow color	Raw materials (eggs)		Eggs with a high level of pigment (yellow/red) or a large number of eggs were used for the dough.
			Die		The pasta was made using "foil" technology (similar to homemade pasta).
		Opaque	Die		Caused by the rough and porous quality of the pasta. After it has been cooked, pasta tends to absorb the water remaining on the surface, causing opaqueness.
				Rest prior to service	The pasta rested too long prior to the procedure.
APPEARANCE OF COOKED PRODUCT	**COOKED, DRIED EGG PASTA**	Non shiny appearance	Die		Caused by the rough and porous quality of the pasta.
				Rest prior to service	The pasta rested too long prior to the procedure.
	COOKED, FRESH EGG PASTA	Shiny	Die		A Teflon die was used. The pasta was spread manually.
	COOKED DUROUM WHEAT PASTA	Breakage, cracks and fissures	Cooking time		The pasta was overcooked and therefore caused scaling of the cooked pasta's surface and breakage.

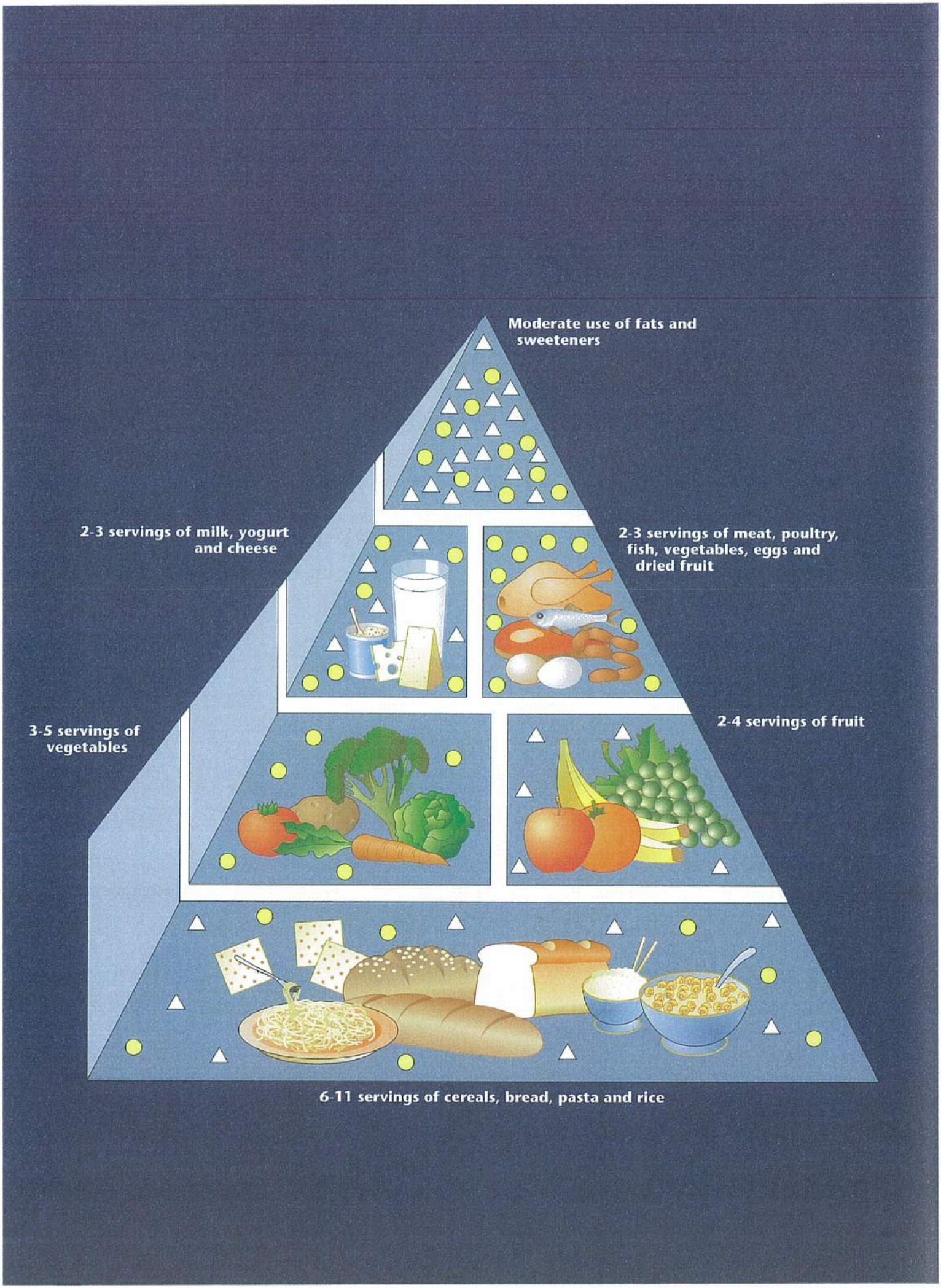
Note: *LT Drying: drying using low temperatures; **HT Drying: drying using high temperatures T= temperatur, t= time

APPEARANCE OF COOKED PRODUCT

	CHARACTERISTICS	PROCESSING PHASE IN WHICH THE CHARACTERISTIC ORIGINATES	PREPARATION PHASE IN THE KITCHEN IN WHICH THE CHARACTERISTIC ORIGINATES	POSSIBLE CAUSES–NOTES
COOKED DUROUM WHEAT PASTA			Water to pasta ratio	The optimal ratio (2.2 lbs of pasta to 2.6 gallons (USA) of water and 3.52 oz of salt) was not respected
			Mixing	Mixing was done manually with excessive force, causing superficial, mechanical lesions.
			Draining	The pasta was drained violently.
	Presence of cooking water in the plate		Shape	Molds used tend to naturally retain water.
			Draining	Pasta was insufficiently drained after cooking.
	Minimal presence of patina	Raw materials (semolina)		The semolina used had high protein levels and high quality gluten content.
		Die		A Teflon die was used. This type of die generates a smooth surface, which limits the existence of starch particles on the pasta's surface.
	Excessive patina on the pasta's surface	Raw materials (semolina)		The semolina used had low protein levels or poor quality gluten content.
			Water temperature	The uncooked pasta was put into the pan before the water started boiling. Water temperature is of extreme importance. In the first few minutes of cooking, significant changes occur in starch and protein. If the water temperature is too low in the first minutes of cooking, patina forms easily. The flame was lowered, causing a decrease in water motion, resulting in an increase of surface patina, which generates amassment.
			Cooking time	The pasta was overcooked, causing surface breakage of the cooked pasta, resulting in the expulsion of starch particles and subsequent opaqueness.
			Water to pasta ratio	The optimal ratio (2.2 lbs of pasta to 2.6 gallons (USA) of water and 3.52 oz of salt) was not respected
			Mixing	Mixing was done manually with excessive force, causing superficial, mechanical lesions.
			Repeated cooking	Several batches were cooked in the same water, causing of starchy substances, which are present in great quantities in the water, to form on the pasta.
			Rest prior to service	The pasta rested too long prior to procedure.
	Deformations a nd Squeezing	Raw materials (semolina)		The semolina used had low protein levels or poor quality gluten content.
			Water to pasta ratio	The optimal ratio (2.2 lbs of pasta to 2.6 gallons (USA) of water and 3.52 oz of salt) was not respected
			Draining	The pasta was drained violently.
	Loss of grooving	Raw materials (semolina)		The semolina used had low protein levels or poor quality gluten content.
			Mixing	Mixing was done manually or excessively induced by operator, causing superficial, mechanical lesions.
	Inability to properly bonds with sauce	Raw materials (semolina)		The semolina used had low protein levels or poor quality gluten content.
			Draining	Pasta was not drained enough. Excess water. Pasta was seasoned with a sauce that was either too liquid or too greasy.

		CHARACTERISTICS	PROCESSING PHASE IN WHICH THE CHARACTERISTIC ORIGINATES	PREPARATION PHASE IN THE KITCHEN IN WHICH THE CHARACTERISTIC ORIGINATES	POSSIBLE CAUSES–NOTES
APPEARANCE OF COOKED PRODUCT	**COOKED DUROUM WHEAT PASTA**	Amassed pasta	Raw materials (semolina)		The semolina used had low protein levels or poor quality gluten content.
					The semolina used had low protein levels or poor quality gluten content.
				Water temperature	The uncooked pasta was put into the pan before the water started boiling. Water temperature is of extreme importance.
					In the first few minutes of cooking, significant changes occur in starch and protein. If the water temperature is too low in the first minutes of cooking, patina forms easily, causing amassment.
					The flame was lowered, causing a decrease in water motion, resulting in an increase of surface patina, which generates amassment.
				Cooking time	The pasta was overcooked, causing surface breakage of the cooked pasta, resulting in the expulsion of starch particles and subsequent amassment.
				Water to pasta ratio	The optimal ratio (2.2 lbs of pasta to 2.6 gallons (USA) of water and 3.52 oz of salt) was not respected
				Mixing	Mixing was done with excessive force, causing superficial, mechanical lesions, resulting in the expulsion of starch particles and subsequent amassment.
					Mixing was not carried out properly.
				Repeated cooking	Several batches were cooked in the same water, causing formation of starchy substances, which are present in great quantities in the water, resulting in amassment.
				Rest prior to service	The pasta rested too long prior to procedure.
TASTING AFTER COOKING		Excessive absorption of water during cooking	Raw materials (semolina)		The semolina used had low protein levels or poor quality gluten content.
			Shape		Pasta is too thick.
				Cooking time	The pasta cooked for too long.
		Low yield		Cooking time	The pasta did not cook for the required amount of time.
				Mixing	Mixing was not carried out properly.
		Does not cook well	Raw materials (semolina)		The semolina used had low protein levels or poor quality gluten content.
				Cooking time	The pasta cooked for too long.
				Water to pasta ratio	The optimal ratio (2.2 lbs of pasta to 2.6 gallons (USA) of water and 3.52 oz of salt) was not respected
				Rest prior to service	The pasta rested too long prior to procedure. The pasta was cooked in pre-used cooking water and low quality pasta was used.
					The pasta was transported at warm temperatures (149 °F) for too long prior to service.
		Too sticky	Raw materials (semolina)		The semolina used had low protein levels or poor quality gluten content.
				Water temperature	The uncooked pasta was put into the pan before the water started boiling. Water temperature is of extreme importance. In the first few minutes of cooking, significant changes occur in starch and protein.

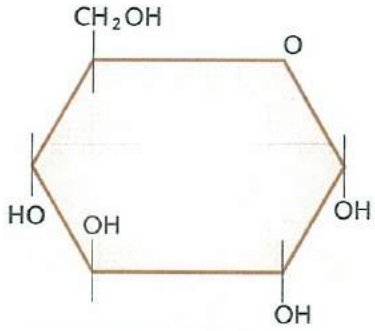
CHARACTERISTICS	PROCESSING PHASE IN WHICH THE CHARACTERISTIC ORIGINATES	PREPARATION PHASE IN THE KITCHEN IN WHICH THE CHARACTERISTIC ORIGINATES	POSSIBLE CAUSES–NOTES
		Water temperature	If the water temperature is too low in the first minutes of cooking, patina will form.
			The flame was lowered, provoking a decrease in motion in the water, thereby causing an increase in surface patina
		Cooking time	The pasta was overcooked and therefore caused scaling of the cooked pasta's surface and breakage.
		Water to pasta ratio	The optimal ratio (2.2 lbs of pasta to 2.6 gallons (USA) of water and 3.52 oz of salt) was not respected
		Mixing	Mixing was done manually with excessive force, causing superficial, mechanical lesions, resulting in the expulsion of starch particles.
		Repeated cooking	Several batches were cooked in the same water, causing of starchy substances, which are present in great quantities in the water, to form on the pasta.
		Rest prior to service	The pasta rested too long prior to procedure.
Is gummy	Raw materials (semolina)		The semolina used had low protein levels or poor quality gluten content.
		Rest prior to service	The pasta rested too long prior to service.
			The pasta was cooked in pre-used cooking water and low quality pasta was used.
Has an acidic taste	Drying		The pasta was dried naturally (static air and drying at room temperature)
Uneven cooking	Shape		Specific geometric molds that tend to exhibit such qualities naturally (e.g. *farfalle*).
		Water to pasta ratio	The optimal ratio (2.2 lbs of pasta to 2.6 gallons (USA) of water and 3.52 oz of salt) was not respected
		Mixing	Mixing was not carried out properly. Several batches were cooked in the same water without adding salt
			Pasta cooked with the double cooking method was rinsed with water to block cooking.
			A mistake was made in dosing salt the first time.
Lacks flavor			Several batches were cooked in the same water without adding salt
			Pasta cooked with the double cooking method was rinsed with water to block cooking.
			A mistake was made in dosing salt the first time.
Inability to properly bond with sauce	Raw materials (semolina)		The semolina used had low protein levels or poor quality gluten content.
		Draining	Pasta was not drained enough. Excess water.
			Pasta was seasoned with a sauce that was either too liquid or too greasy


Moderate use of fats and sweeteners
2-3 servings of milk, yogurt and cheese
2-3 servings of meat, poultry, fish, vegetables, eggs and dried fruit
3-5 servings of vegetables
2-4 servings of fruit
6-11 servings of cereals, bread, pasta and rice

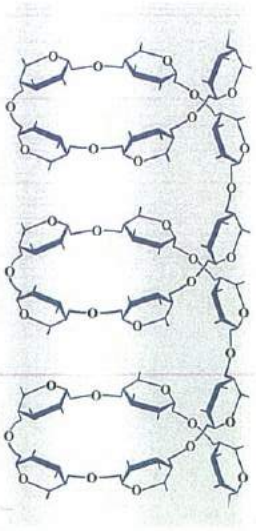
THE NUTRITIONAL VALUE OF PASTA

Before entering into a discussion on the nutritional value of pasta, it would be best to provide the definitions of some of the terms that will be used. From a nutritional point of view, food is composed of:

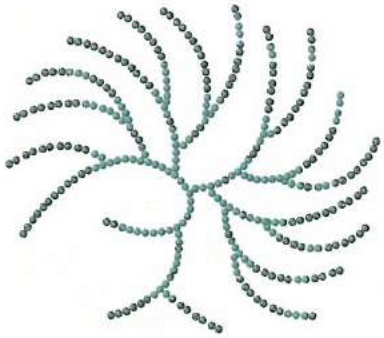
- proteins, which are organic molecules composed of long chains of elements called amino acids. They are fundamental for all aspects of the cells' structure and function, both in terms of the cells' make-up, in that cells are the molecular instruments that carry genetic information, and the organs, since hormones, enzymes, transportation proteins like hemoglobin, myoglobin, etc. are all proteins. One gram of protein produces 4 kilocalories (kcal) of energy. Semolina, milk and eggs have a high protein content.
- carbohydrates, which are simple sugars (e.g. glucose and fructose), and all of their polymers beginning with disaccharide (e.g. sucrose, lactose) and moving on to starch, a very long chain composed of glucose residues. Their main function is to provide energy to all of the cells' processes and, in some cases, they are also structural components of the cell walls. One gram of carbohydrates also provides 4 kcal. Sugars are included in recipes as such (i.e. sucrose, glucose syrups, etc.) but they can also be carried there from ingredients such as milk or chocolate. Dietary fiber also belongs to this family. It is a composite of polysaccharides, which are not digested by the organism and do not, therefore, provide energy.
- Fats are a family of various types of molecular species; in food, the most popular is the triglyceride species, composed of glycerin and fatty acids. The latter are molecules composed of a varying number of carbon atoms that can have a "single" or a "double" bond. If all of the bonds of a fatty acid are single, then they are known as saturated fatty acids; if they



1. simple sugar: glucose



2. spiral formation of amylose



3. amylopectin particle

have a double bond then they are known as monounstaurated and if they have two or more bonds then they are polyunsaturated. While it would seem that the first two do not increase cholesterol levels – on the contrary, polyunsaturated even decrease it – saturated fats tend to increase cholesterol levels and are therefore considered dangerous in that they can provoke cardio-circulatory problems. In all three cases, fats carry 9 kcal/g. They are usually added in the form of margarine, butter, vegetable oils or case, carried in other ingredients.

- micronutrients, which are vitamins, minerals and traces of various other substances having different functions (e.g. flavones). They are only present in extremely small amounts and do not provide energy; but they have important functions within the cell.

General Nutrition Guidelines

General nutrition guidelines issued by the governing bodies of various countries over the past few years have agreed that our diet should consist primarily of carbohydrates. The now famous pyramid created by the United States Departmenbased on carbohydrate-rich products such as bread, pasta, cereals and rice.

Naturally, these are not strict prescriptions but merely general guidelines aimed at properly balancing one's diet (e.g. a varied diet without excessive calorie consumption). Though it was originally designed to meet the dietary needs of the American population, the pyramid was widely used in other countries (e.g. Barilla printed it on its packaging for a while). Later, these same concepts, though slightly modified, were also adopted by the Italian LARN (Livelli Giornalieri Raccomandati di Nutrienti, ed.

Table 1: Average values for 3.52 oz of durum wheat pasta (dried raw product)*

Water	.380 oz			sodium	mg	4
Protein	.383 oz	13.4% kcal tot.	potassium	mg	192	
Fats	.049 oz	3.9% kcal tot.	iron	mg	1.4	10% RDA
Carbohydrates	2.30 oz	81% kcal tot.	calcium	mg	22	3% RDA
Of which			phosphorus	mg	189	24% RDA
Starch	2.16 oz					
Sugars	.147 oz					
Dietary Fibers	0950 oz					
Energy	Kcal	325				

(* From the Tabella di composizione degli alimenti, INN 1997)

1996), equivalent of the Recommended Daily Allowance (RDA), suggesting that at least 55-60% of daily caloric intake derive from carbohydrates, 10-15% from proteins and 25-30% from fats).

Nutritional Value of Pasta

On the premise that the values mentioned by the guidelines relate to a dietary regime in all its complexity, it would therefore be incorrect to expect a single food to satisfy all these requisites. Nonetheless, considering pasta's nutritional values as reported in Table 1, pasta fits this scheme very well.

As stated, the guidelines referred to in the table are based on average values. Durum wheat pasta sold on the market can have significantly varying quantities of protein content (from 11 to 14.5%), depending on the quality of the raw material. The percentage of calories provided by each nutrient is included to emphasize how pasta is well in line with nutritional dictates, keeping in mind, again, that no single food can provide all the necessary nutrients.
In addition, the table also reports the percentage of vitamins and minerals contained in the product as recommended by the RDA. Since these elements also have specific requirements, specified in legal document pertaining to nutritional labeling, it is therefore customary to list their quantities as well. We will now look at each single nutritional component.

Proteins

Protein quantity is not to be disregarded since traditional sources of protein come from other foods (meat, eggs, milk, etc.). They are mostly composed of gluten, a mixture of proteins known as gliadine and glutenin, which is extremely important in the structural composition of pasta.

Table 2: **Amino acid composition (in g / 100 g protein) of pasta and egg proteins**

	SEMOLINA PASTA	EGG PASTA	WHOLE EGG
lysine	2.01	7.1	2.72
histidine	2.07	2.4	1.89
arginine	3.62	6.18	3.95
aspartic acid	4.67	9.75	4.87
threonine	2.88	5.03	3.02
serin	5.21	6.79	5.3
glutamic acid	32.22	12.16	31.71
proline	10.91	4	9.78
glycine	3.25	3.35	2.82
alanine	3.29	5.8	3.19
cystine	2.34	2.61	2.19
valine	4.99	6.63	4.52
methionine	1.68	3.53	1.84
isoleucine	4.17	5.3	3.77
leucine	7.65	8.4	6.9
tyrosine	2.84	4.06	2.61
phenylalanine	4.97	5.34	4.56
tryptophan	0.96	1.59	0.97

(* from the Tabella di composizione degli alimenti, INN 1997)

Table 2 compares the amount of grams of amino acids (which are the basic element of proteins) per 3.52 oz of protein contained in semolina pasta compared to egg pasta. Egg protein is in fact considered more balanced and complete in terms of its amino acid content. Essential amino acids (that is, those which the body cannot produce through other elements) are reported in bold type. Proteins contained in cereals, which, as has already been mentioned, have interesting structural characteristics, do not, however, have high biological worth in that they lack certain essential amino acids, especially lysine. From a nutritional standpoint, this is not an extremely important factor since pasta is usually seasoned with cheese, meat, fish and other sources of protein and is, therefore, complete in terms of amino acids. In addition, as can be seen in Table 1, pasta is not to be considered an elective source of protein, but its principal component is carbohydrates.

Please note that a discussion of egg pasta and its constituents is found in the next section.

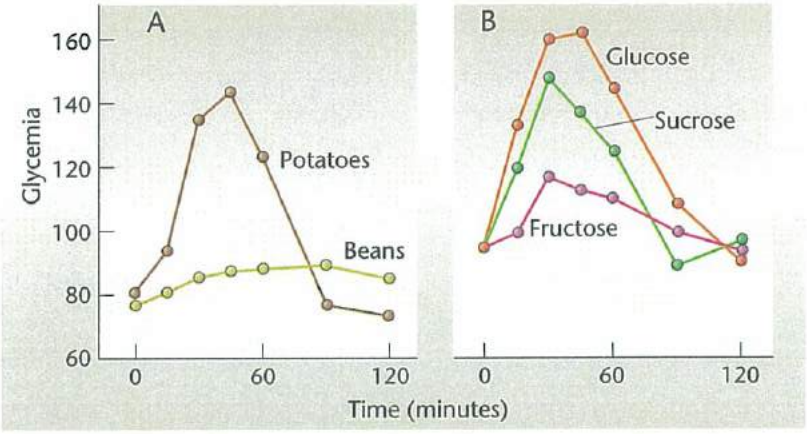


Figure 3: Healthy individual's glycemic response to 1.76 oz of carbohydrates obtained from the cited sources

Fats

Since no fats are added to the pasta dough, the amount of total fats is minimal; furthermore, 80% of fats are polyunsaturate and are therefore positive. Semolina pasta contains no cholesterol.

Carbohydrates

In pasta, this component is present in the largest quantity, especially as a starch and, therefore, as a polymer of glucose. Simple sugars are scarce, hower. The consumption of any kind of carbohydrate, simple or complex, increases glycemia to varying degrees and within varying speeds, depending on the type of carbohydrate. Pasta starch typically takes on the form of grains entrapped in the gluten network which are, therefore, practically inaccessible. This is one of the reasons why the digestion of this starch is slower compared to those of other starches, such as bread, and why glycemia increases less intensely and more slowly after pasta has been ingested.

Since it is common knowledge today that the risk of diabetes is not exclusively connected to the consumption of carbohydrates, but it involves the simultaneous presence of many other factors, it is very important for diabetics to avoid an increase in glycemia after eating in order to avoid complications over time. The most objective and the easiest way to determine the metabolism's reactions to various sources of carbohydrates is the Glycemic Index, though the Index has raised some objections and it is currently being studied.

The Glycemic Index was born of a mathematical equation involving the relationship between the area subtended to the curve of glycemic values, resulting from the same individual's ingestion of 1.76 oz of

Table 3: **Glycemic Index of some common foods**

oatmeal	49	watermelon	72	white bread	69
muesli	66	boiled potato	70	whole wheat bread	72
cornflakes	80	baked potato	98	beans (dry)	31
apple	39	carrot	92	beans (in a can)	40
orange juice	37	pasta	42-50	yogurt	36
grapes	44	rice	70	sausages	28

Table taken from Jenkins et. al. (1984) and Brand et. al. (1990a).

carbohydrates from the food being tested, and the same quantity of carbohydrates derived from a standard food (glucose or white bread).

The Glycemic Index of several products considered to be sources of carbohydrates (Table 3) has been elaborated. As a result, it can be seen that pasta has a rather low value; therefore, it is a product that can be used in the diet of a diabetic, albeit moderately. Dietary fiber, that is, the whole of those components that are not digested by the human organism, also belongs to the family of carbohydrates. This substance is plentiful on the exterior shell of wheat grains and is therefore largely lost in the milling process. Fiber levels in durum wheat pasta are not, in fact, significant. Nonetheless, pasta does contain a good portion of the recommended daily requirement (0.88 - 10.5 oz). To increase one's daily intake of fiber through pasta, whole wheat pasta is recommended as it contains a small percentage of tegument or, in some cases, purified fiber, and therefore has a dietary fiber content equal to at least 6%.

Energy

As has already been stated, pasta is not normally eaten on its own but is seasoned with a variety of ingredients. It is therefore not very useful to calculate the caloric content of pasta itself but rather, the caloric content of a complete pasta meal. Pasta's culinary versatility extends to its caloric content. Pasta with a plain tomato sauce contains about 400 kcal, making it an ideal dish for individuals on low-calorie diets, while a plate of meat lasagne (*lasagne alla Bolognese*) easily contains 700 kcal per portion. The nutritional quality of pasta, therefore, must be calculated on the basis of the quality and quantity of the other components used in preparing the pasta meal. Merely as a way

Table 4: **Energy in KCAL for prepared dishes**

	3.52 oz tomato sauce	3.52 oz meat sauce	3.52 oz clam sauce	1.76 oz pesto	4.22 oz cream, ham and peas
3.52 oz semolina pasta	432	482	462	632	662
2.81 oz egg pasta	368	418	398	568	598
2.81 oz dry tortellini	386	436	416	586	616

of simplifying the discussion, we provide the caloric content of some of the simpler and more traditional pasta recipes, taking into consideration portions and the relationship between "classic" ingredients:
The caloric differences are mostly due to the different fat contents deriving from the various seasonings (Table 4).

Minerals

Like fiber, minerals are also found on the exterior of the grain and are partially lost; therefore, durum wheat pasta must not be considered a good source of minerals, which, in western diets is not lacking, with a few minor exceptions.
The low content of sodium is positive. In fact all nutritional guidelines emphasize the need to control the ingestion of this mineral because it is related to problems of pressure. Instead, phosphorous and potassium are plentiful and important; the first is essential for bones and teeth and the second for energy and muscular efficiency.

Warnings

Only those who suffer from celiac disease should be careful about eating pasta.
Celiacsprue is characterized by a grave intolerance to gluten, which, if ingested, can provoke an inflammation of the intestinal mucous membrane, leading to malabsorption, stunted growth and hemorrhaging. The simplicity and wholesomeness of pasta make it an alimentary staple that can be ingested even by individuals with food allergies (to milk, for example) or, as mentioned earlier, by diabetics.

Concluding Remarks

In view of what has been said and analyzed, it is safe to conclude, as many scientists today have almost unanimously done, that pasta is

Table 5: Average values for 3.52 oz of raw, dried egg pasta*

Water	g	12.5		sodium	mg	17	
Proteins	g	13	14 %Kcal tot.	potassiium	mg	164	
Fats	g	2.4	5.9 %Kcal tot.	ferro	mg	2.1	15 % RDA
Carbohydrates	g	71	77.5 %Kcal tot.	calcium	mg	22	3% RDA
Of which:				Phosphorous	mg	199	25 % RDA
Starch	g	69					
Sugars	g	2					
Dietary Fibers	g	3.2					
Energy	Kcal	366					

(* from the Tabella di composizione degli alimenti, INN 1997)

a healthy, simple, nutritionally balanced and versatile food. It is just as correct to consider it merely as part of a diet characterized by the same qualities.

Other ways of eating pasta: egg pasta, filled pasta

Even though semolina pasta remains the most common, other delicious alternatives - in terms of both gastronomy and nutrition - are pastas enriched with other ingredients.

Egg Pasta

Traditionally, mass-produced egg pasta was made with at least 4 eggs/kg, while today's egg pasta is available in varying quantities of eggs and, therefore, with varying characteristics. Table 5 illustrates the nutritional values of typical egg pasta. Compared to Table 1, it can be seen that the fundamental difference between this pasta and semolina pasta lies in the protein content, which is significantly higher in egg pasta. In comparing the relative column in Table 2, it becomes apparent that lysine content is higher in egg pasta, providing the added benefit of making this limiting amino more abundant.

Another difference can be found in fat content, which, though slightly higher in egg pasta, nonetheless remains at very low levels and always within the unsaturated fat category. Obviously, egg pasta also has a higher cholesterol level (94mg/100g of pasta). Besides this, however, there are no truly significant differences in the nutritional value of the two pastas.

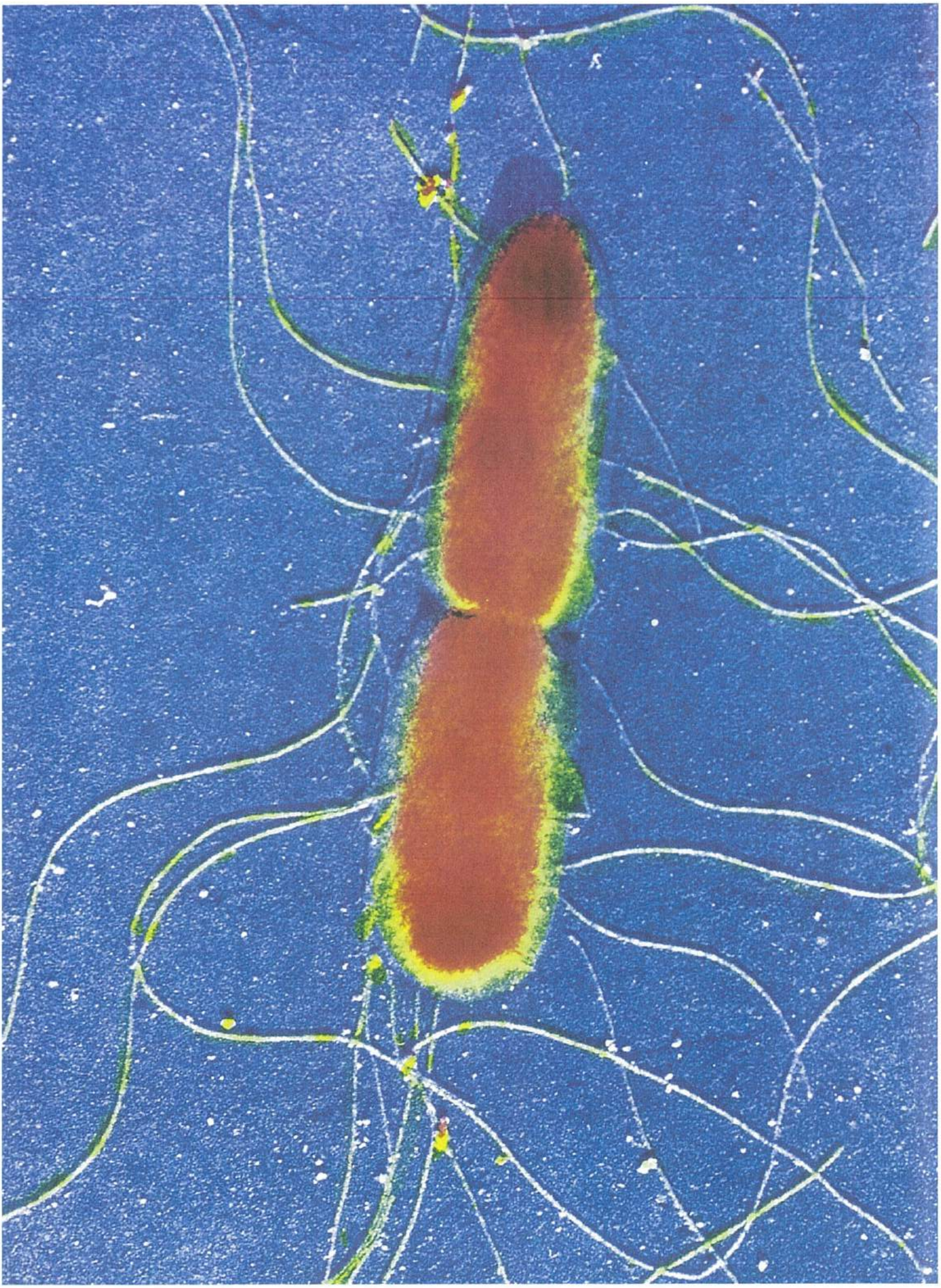
Filled Pastas

This includes all types of pasta that are stuffed with some kind of filling and which therefore have varying nutritional values, depending on the ingredients used for the

Table 6: Average values for 3.52 oz of dried filled

PRODUCT	Kcal	Fat	Kcal	Protein %	Kcal	Carbohydrate	Kcal	
		%		%	%	(n x 6.25)	%	%	%
ham tortellino		408		13,5	30	15,5	15	56,2	55
cheese tortellino		395		14,5	33	14,5	15	51,6	52
meat tortellino	421	16,0		34	16,0	15	53,2	50	
ricotta/spinach tortelloni		388		15,0	35	14,0	14	49,3	51
asparagus tortelloni		379		15,0	36	13,0	14	48,0	51
mushroom tortelloni		378		15,0	36	13,0	14	47,8	51

filling. In this case, therefore, in contrast to the preceding types of pasta, it is not possible to list typical nutritional values.
In any case, filled pasta involves rather rich products, considering that the dough is usually made with eggs, and the stuffing is based on meat, cheese, eggs and vegetables. Compared to semolina pasta, therefore, filled pasta has a higher protein content but, most particularly, it has a higher fat content and, consequently, fewer carbohydrates. Depending on the ingredients used in the stuffing, filled pasta might also have elevated mineral contents (e.g. calcium).
From a nutritional standpoint as well as from a gastronomic one, therefore, filled pasta is more of a "meal in itself," where the various nutrients contribute to a balanced diet.



RISK OF CONTAMINATION AND RELATIVE CAUSES

Contamination may occur during any of the phases of processing, transportation, sales or distribution of the food products.
This may take place if certain preventive measures and control processes are not put into effect, and if the staff responsible for the operation, maintenance and cleaning of the equipment and environment does not follow specific hygienic and behavioral norms.
Contaminants may be subdivided into four categories: chemical, biological, microbiological, and particle.
A contaminated product could be severely harmful to the health we are of the consumer (and let us not forget that all of us are consumers). It could also compromise the image of the company with possibly grave economic consequences.

Risk of microbiological contamination and relative causes

The risks of microbiological contamination are due to the unwanted presence of harmful microorganisms in food. Microorganisms are extremely small living beings that are invisible to the naked eye. They are present everywhere, in water, in the air, in the ground, in vegetables, on animals and on humans. In fact, there are many types of micro-organisms; fortunately, only some of them are harmful to humans.
Micro-organisms may be subdivided into bacteria, molds, and yeasts.
Bacteria are the most widespread and those most responsible for food infections and poisoning. In specific circumstances some bacteria may, in fact, jeopardize health severely, at times. These bacteria are known as pathogens and may be divided into two categories: those that provoke infection directly, and those that are dangerous because

they produce toxic chemical substances known as toxins; these bacteria are thus defined toxinogens.
The first category includes salmonella, which provokes vomiting and gastroenteritis, which can be very severe. Staphylococcus Aureus is a toxinogen bacterium that often resides in the nose and throat of humans and may cause gastroenteric disorders. Clostridium Botulinum, another toxinogen bacterium, normally lives in the ground in the form of innocuous spores; however, in specific circumstances, if it is present in food, it can cause severe damage to the nervous system through the production of a toxin, which, in many cases, even leads to death. Spores are an inactive form of bacteria which have a very resistant protective sheath, allowing for survival even in particularly unfavorable environmental conditions, such as starvation. Like plant seeds, spores are, however, ready to germinate as soon as environmental conditions favorable to life are restored. Bacteria such as Clostridium Botulinum, capable of developing spores, are known as sporogens. Nearly all harmful bacteria can be eliminated at high temperatures, such as those obtained in ovens.

Molds are fungi that often produce organoleptic changes in food products, altering their taste, scent, and aspect. Some molds in foods are, however, very dangerous for humans: in certain conditions they produce very harmful substances called microtoxins.
Yeasts are microscopic fungi that may cause changes in products, such as the formation of gas in packaged food and unpleasant organoleptic alterations in products (color, taste, scent and aspect of food). In general, yeasts are not harmful to human health.

The main factors that influence and condition the survival and multiplication of microorganisms are time, humidity, nutrition, the presence of oxygen and pH, and the temperature.

Time

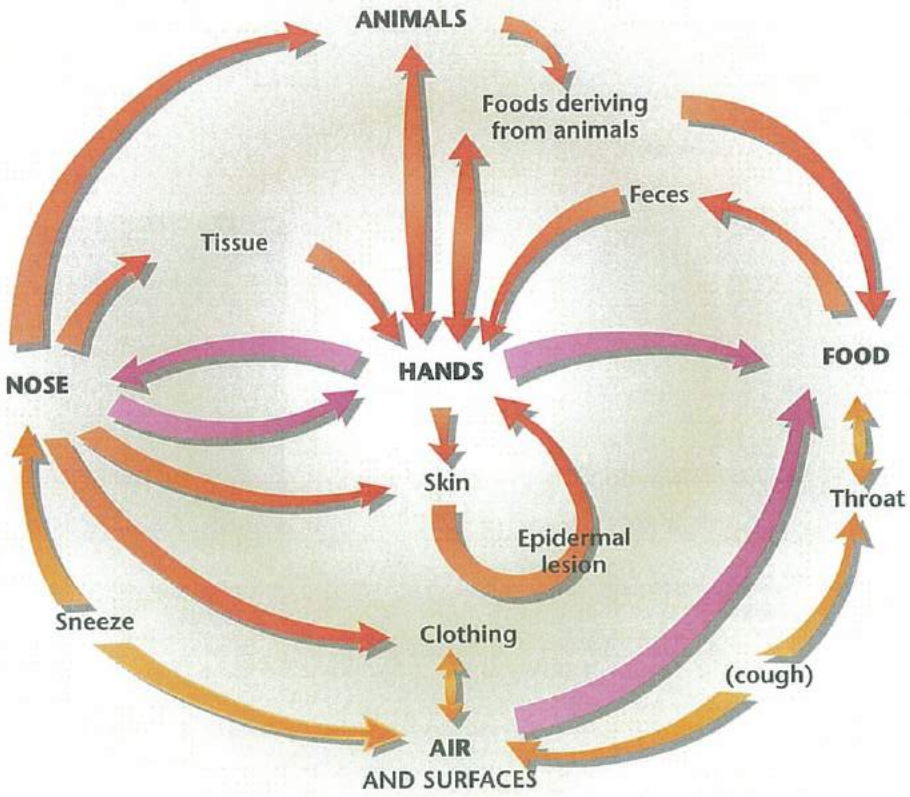
When environmental conditions are favorable, micro-organisms can grow and multiply very quickly: bacteria, for example, reproduce by binary scission, that is, by dividing in half. As reproduction time is about 20-30 minutes, a few hours are sufficient for a single organism to generate millions of identical organisms.

Nourishment

The presence of nutritional substances are an essential condition for the development and proliferation of micro-organisms. Hence, food products constitute an excellent substratum because they contain all the substances, such as sugar, water and minerals, required for the growth of microbes.

Humidity

Water, present in food, is an essential factor for the survival of microorganisms; in fact, the higher the humidity, the faster they grow. The degree of humidity required for the growth of microbes is 13%; below this level most of them are unable to survive.



This diagram illustrates the ways in which microorganisms can come into contact with the food during manipulation. The most critical points are the air, the hands and the nose.

Oxygen

The presence of oxygen may favor or inhibit the growth of microorganisms. They are, in fact, divided into two categories: aerobes, that live and reproduce in the presence of air and, consequently, oxygen, and anaerobes which, on the contrary, are inhibited by oxygen.

pH

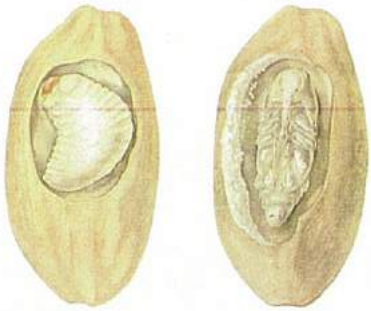
The pH is the unit of measure of acidity. A neutral environment (pH 7) is generally optimal for the growth of microorganisms, although some are capable of adapting to acid environments (pH < 7) and alkalines (pH > 7).

Temperature

Temperature also considerably influences the possible development of microorganisms. For most of them, known as mesophiles, the ideal temperature for growth ranges from 86 °F to 98 °F. There are, however microorganisms known as psycrophiles, whose vital functions achieve optimal levels at temperatures ranging from 32 °F - 41 °F, as well as bacteria known as thermophiles, capable of living at temperatures exceeding 140 °F.

Generally, microbic contamination of food products may derive from: incorrect hygiene procedures when preparing the food, personnel carrying harmful germs, the presence of insects or animals acting as a transmission vehicle, the preparation or preservation of food in an unhygienic environment, or the use of unclean utensils.

Insects in food products



weevil larva *in its development stage inside a wheat granule*

weevil

granule damaged by a weevil

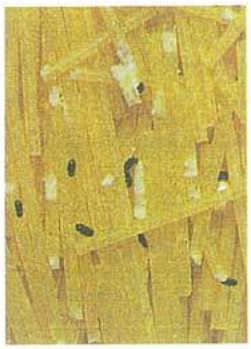
anobe larva *in its developmental stage*

Risk of biological contamination and relative causes

The risks of biological contamination mostly derive from insects, rats, and mice. Insects abound, and many species can accidentally exist in places where food is handled. Insects are subdivided into two categories: those present in food products, such as the anobe, weevil and red flour beetle, which, among other things, attack all products with a semolina or flour base, and those that infest the environment, such as flies, and cockroaches. Since the latter often come into contact with waste products, filth and putrescent substances, they can spread pathogenic microorganisms; that is, organisms that are harmful to health.

Rats and mice seek food and shelter in places where food is processed. They are dangerous because they are dirty and they eat not only the food products but also the packaging, sometimes seriously damaging certain structures such as electrical installations. They may contaminate products with hairs and excrement that are frequently the vehicle of pathogenic microorganisms, such as salmonella. Mice and insects easily enter premises where doors are left open, where windows do not have screens, or where raw materials are not first adequately checked at reception. Once inside, they easily find food and hiding places, especially if the environment is dirty and disorderly, if all residual food is not systematically collected and placed in appropriate containers, or if material and equipment is stacked up against the walls, providing easy hiding places. Unless their presence is immediately observed and measures rapidly taken to eliminate them, mice and insects easily find a home in open food containers, and unfinished products, feeding on scraps.

anobe



spaghetti damaged by anobe

eggs and larva of weevil of red flour beetle

red flour beetle *in later developmental stages*

cereals damaged by red flour beetle

Risk of particle contamination and relative causes

Particle contaminants include foreign objects such as rust, nails, rings, pieces of glass, buttons, hair, crumbs, and scotch tape made of metal and other materials, which may accidentally come into contact with products. One source of this type of contamination may be certain raw materials, particularly those in bulk.

Equipment may also be a source of particle contamination if hygiene regulations are not observed and maintenance is not carried out properly. Frequently, however, the most common cause of particle contamination are the very workers responsible for maintenance and cleaning.

For example, if the product is not adequately protected during maintenance and cleaning, and if, at the end of these procedures, all the equipment used is not collected, and the area is not carefully cleaned, a foreign object may contaminate the product. Inadequate cleaning procedures, or those that are carried out with unsuitable equipment, such as compressed air, constitute a risk of contamination from dust, filth, and foreign objects of various kinds. Other incorrect behavior may also cause accidental contamination. The consumption of food or drink near the work area, for example, could cause crumbs, pieces of paper, plastic or glass to fall into the product. Even chewing gum could accidentally contaminate the product.

Personal objects, such as rings, necklaces, bracelets, earrings, watches and hairclips may also constitute a risk of contamination, and, in some cases, a danger for the safety of the workers.

Particle contamination of a biological nature, such as human hair, may infect the product. For this reason it is important that employees wear suitable head coverings.

Risk of chemical contamination and relative causes

The risk of chemical contamination is mainly caused by pesticides, pharmaceuticals used for animals, detergents and disinfectants.
Pesticides are toxic chemical substances that are used to kill parasites. They include herbicides, fungicides and insecticides. These products are principally used in agriculture, but insecticides are also used in the phases of processing, sale and administration of food. When used incorrectly (not respecting the doses and correct procedures), they may leave residues.
Zoochemicals include antibiotics and other medicinal products used in animal breeding care. If not used correctly, they may leave residues on raw materials from products derived from animals (eggs, milk and meat).
Detergents and disinfectants are chemical substances used to clean and sanitize environments and equipment. To make sure they do not become a source of contamination, it is of prime importance to store them separately, in a closed and ventilated place, accessible only to authorized staff. Furthermore, it is absolutely necessary to respect the doses prescribed on the labels and to rinse *all* cleaned surfaces with *clean* water in order to eliminate chemical residues.

Prevention Tools

Process Management and Control use a variety of tools to prevent contamination risks. The most important are: GMP, HACCP and ethological techniques.
GMP is a set of general norms and regulations, encompassing personnel behavior, which seeks to optimize hygiene during food production processes.
HACCP is a method which was developed through an in-depth analysis of all potential contamination risks. It detects risks related to specific products or processes, making prevention procedures possible.
Ethological techniques are used to facilitate the entrapment of insects by intervening their natural behavior and habits.
The combined application of GMP, HACCP and ethological techniques aims to prevent any type of product contamination, guaranteeing its wholesomeness and safety in compliance with the laws governing food hygiene.

GMP

Good Manufacturing Practice (GMP) means good work practices.
The GMP manual includes a set of general norms and regulations aimed at optimizing hygiene during food production processes and at preventing contamination, which is common to all products. GMP is composed of planning and management rules. The planning rules describe how premises and equipment are to be planned and built in order to be hygienically suitable. For example, they prescribe that the floors and walls of the workplace should not have any holes, cracks or windows so as to prevent the accumulation of dirt and facilitate cleaning processes.
Management norms aim to improve the production and cleaning processes as well as manage the behavior and hygiene of each employee. The following are few examples:

- Raw materials and finished products may only be transported by vehicles that conform to specific requirements.
- Waste and scraps must be collected separately and removed from the work sites at least once daily. They must never come into contact with raw materials or with unfinished and finished products.
- Drinking water and water used for technological purposes must always comply with potability requirements.
- Every department must have specific and formalized cleaning protocol for the premises, installations and equipment.

HACCP

Hazard Analysis Critical Control Point (HACCP), refers to the analysis of risks and the control of the critical points. By correctly analyzing all the possible risks of contamination, HACCP makes it possible to identify those risks specifically related to a particular product or process, thereby defining the measures required to prevent them.

It is essential to identify the Critical Control Points (CCP) with precision. CCP are points, phases or areas of the work process that must be controlled and managed, according to precise procedures, with the purpose of preventing the specific identified risk.

The logical sequence for the application of HACCP is as follows (Codex Alimentarius):

1. To form an HACCP group.
2. To describe the product.
3. To identify its purpose/use.
4. To design a flow chart.
5. To check the flow chart.
6. To identify and list all the biological, chemical and physical dangers and to examine the preventive measures taken to reduce or eliminate any related risks at each phase.
7. To determine the critical points to be kept under control (CCP)for each identified danger.
8. To establish the parameters to be kept under control and the relative critical limits for each CCP.
9. To establish a monitoring system for each CCP.
10. To establish protocol in situations where the established limits are not respected.
11. To establish procedures to check the effectiveness of the system.
12. To establish a system to record data and documentation.

The following is a list of some CCPs that must be kept under control.

- The metal detector makes it possible to detect the presence of any foreign metal objects in the product so that the contaminated product can be removed.
- By correctly controlling the storage temperature of the refrigerator cells, molds or bacteria which have contaminated eggs, milk or yogurt, and which could alter the product or intoxicate the consumer, can be avoided.
- Contamination by microorganisms may also be controlled during the cooking phase; the use of high temperatures inside the ovens eliminates most of the microorganisms that could subsequently form.

Ethological Techniques

Every area in which food is handled is subject to the risk of infestation, particularly by insects present in the raw material, or insects which enter the environment directly from the outside through open windows and doors, finding conditions that favor their development.

The battle against these infestations must be carried out using techniques that are defined as ethological because they interfere with the normal behavior and habits of insect, making it possible to entrap them or to obstruct their reproduction. The most common traps used are of three types:

Pheromone traps capture insects by using aromatized substances known as pheromones, which are naturally emitted by the insects to communicate. Food traps that are made up of food bait, which is particularly attractive to insects, are treated with insecticides.

Lighted traps, that serve to capture flying insects attracted by light, such as flies.

To optimize the effectiveness of ethological techniques, it is necessary to combine them with other preventive measures, such as:

- to refuse infested raw material;
- to keep doors closed and to install insect-proof window screens;
- to clean premises and installations carefully;
- to remove scraps and waste systematically;
- to carry out maintenance procedures in the premises and on equipment to eliminate any cracks or cavities.

To avoid infestations, periodical and scrupulous monitoring is also essential, using on-the-spot controls, ethological traps and the invaluable collaboration of workers who should immediately report any findings of infestations or traces of them.

Hygiene and Individual Behavior

It was previously made clear that GMP prescribes a set of rules for good work practices aimed at keeping the highest possible hygiene and safety standards. A lengthy chapter of GMP is devoted to the behavior and personal hygiene of those who work in production, processing, sales and product distribution. All personnel, including temporary workers, must scrupulously observe several simple but essential rules for proper behavior and correct personal hygiene and work norms. By applying these simple norms it is possible to produce products that fully satisfy the consumer's expectations, safeguarding his or her health.

Clothing

Work clothes, a uniform, overall, head covering and shoes must meet specific requirements. The uniform and hat should be light-colored. The uniform should not have buttons or outside pockets above the belt, and any other pockets should have an adhesive strip closing, for example in velcro. These features are necessary to prevent foreign objects such as buttons, pencils, pens, and pieces of paper from inadvertently falling into the product.

The head covering, which must be worn correctly, covering all of the hair, serves to control the risk of contamination caused by hair falling into the product.

Hands quickly transmit microbes; therefore, it is essential to take good care of them, keeping them clean, trimming the nails and not using nail polish or wearing rings

Finally, the shoes must be accident-proof, with a reinforced toe and anti-slip sole to safeguard the workers' health and safety.

Furthermore, during the work activity:

- all work clothing should be worn correctly;
- rings, earrings, bracelets, hair pins, watches and any other personal objects should not be worn; not only could they accidentally fall into the product but they put the worker's safety at risk.
- In cases where protective gloves are essential, they must cover the entire hand and be made of materials that do not release fibers or similar materials in the product.

Personal Hygiene

It was previously mentioned that individuals are bearers of numerous microorganisms, some of which, in particular circumstances, may be harmful. Personal grooming, therefore, and hygiene are extremely important in preventing the risk of microbiological contamination caused by humans. For this reason, several norms have been established that all personnel must respect. Work clothing should always be clean. Potentially harmful microorganisms find shelter in dirty clothing. Work clothing must only be worn where the product is handled. The work place must have appropriately equipped changing rooms with small closets where it is possible to undress, change and deposit personal objects before entering the work areas.

Hair, protected by a correctly worn head covering, must always be kept clean and tidy. It is very important to carefully wash hands

and dry them with throwaway towels each time on entering the area where the product is being processed and especially after using the bathroom, touching dirty materials and raw substances, cleaning the nose or mouth after sneezing or coughing, and after any interruption at work.
When required, hands must be disinfected before touching the product. It is a good rule to keep nails short and, above all, clean, as millions of dangerous bacteria, which may accidentally contaminate the product, reside there. Nail polish must not be used. Any small wounds must be adequately protected since they are a breeding ground for dangerous bacteria, which it easily multiply.

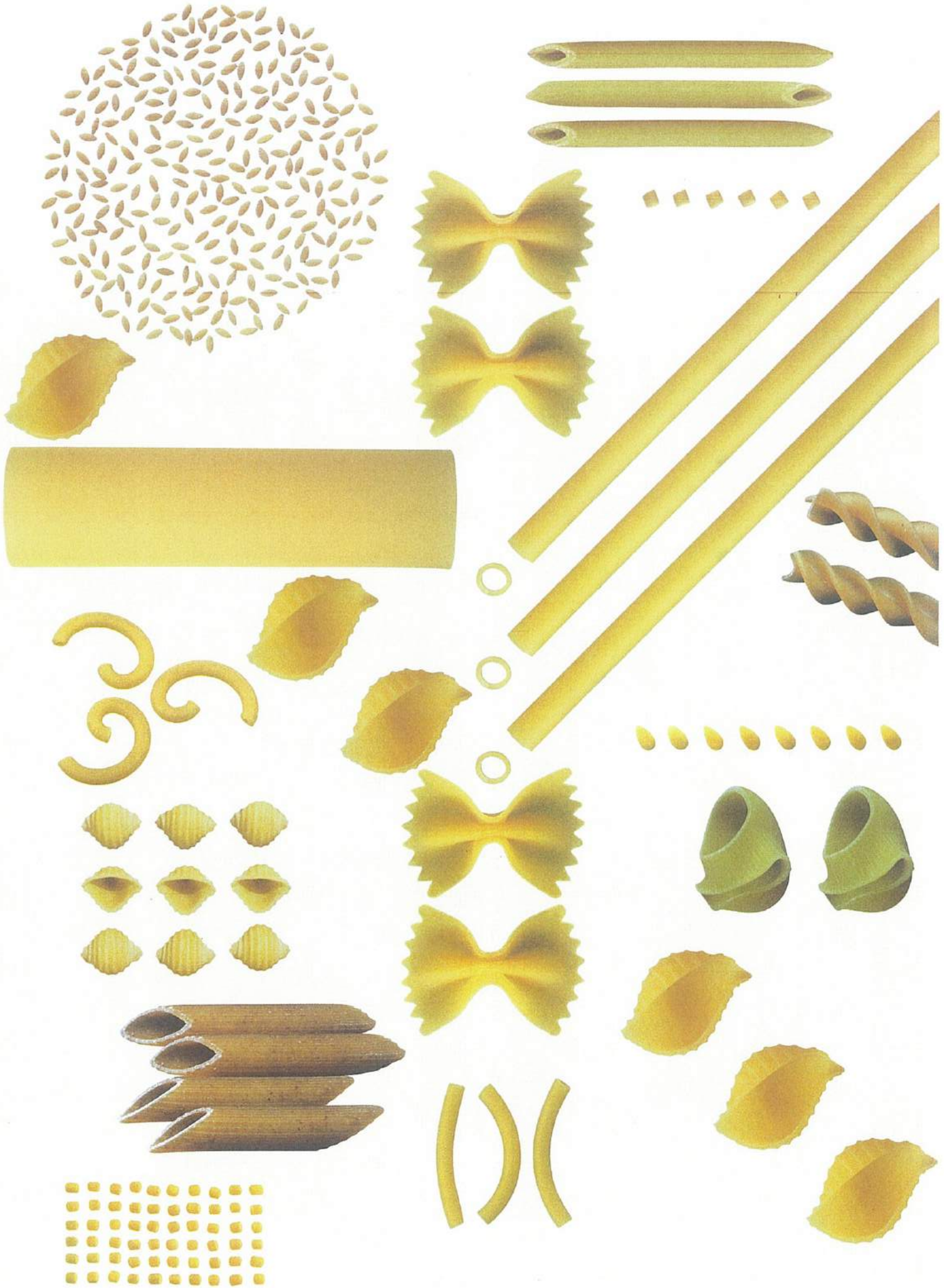
Individual Behavior

Correct individual behavior is extremely important in preventing and controlling contamination risks to the product; therefore, each production and maintenance operator must be alert and attentive on the job. It is prohibited to bring unrelated objects into the work place, and any objects and materials that have been used should not be left on the equipment. It is important not to use dirty utensils and containers that could contain dangerous microorganisms and which could, consequently, contaminate the product. It is important to remember, however, that humans may be the source of contamination. A sneeze or a cough spreads millions of microbes in the air; therefore, when hands are used to cover a sneeze or a cough, it is necessary to wash them before handling the product again. Consequently, adequate protection must be enforced. Food, beverages and chewing gum must not be consumed during work, and smoking is prohibited in all of the work areas. Waste and cigarette butts must be thrown into the bins in the rest rooms and changing rooms.
To prevent insects, mice and birds who are looking for food from entering the work area, doors must be kept closed. This means both the doors leading to the outside as well as those that lead from one area of the building to another.
Finally, it is very important to keep the workplace clean and tidy.

Additional Rules for Maintenance and Cleaning Activities

Maintenance and cleaning activities should be carried out meticulously. Carelessness may lead to serious contamination of the product, especially contamination caused by metallic and non-metallic foreign objects.
Consequently, personnel responsible for maintenance and cleaning in the work area must also observe a set of additional rules.
Before beginning specific maintenance or cleaning procedures, it is important to remove the food product from the area, or, if this is not possible, to protect it adequately, with a sheet for example. When working on parts that come into direct contact with the product, hands must be clean and, when necessary, suitable gloves should be worn.
Transit areas where the product is being worked must always be kept clean; therefore, those areas must not be trodden on or dirtied. Moreover, objects should not be left in these

areas, particularly if the object is small, because it could accidentally be forgotten. Materials remaining from maintenance and cleaning activities must never be left on the work site and, above all, must not be thrown into ingredient containers, unfinished products and recycled waste. At the end of the procedure it is important to scrupulously clean the work area and check that any tools and materials used have not been forgotten.



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THE HISTORY

Mariaelena Mondelli

Freely adapted from Antico e vero come la pasta.
An annotated study of the historical and documentary resources, in Pasta e pastai, *Parma 1998*

THE ORIGINS: THE DISCOVERY OF WHEAT CULTIVATION

Ten Thousand Years Ago

Middle East, upper valley of the Jordan. In 1958, in the town called Malaha, Jean Perrot discovers the remains of a prehistoric village which, according to carbon dating studies, can be dated to the year 8,000 B.C. On the basis of this discovery, the hypothesis is that having settled in that fertile valley of the Jordan, man discovered the secret of cultivating wheat. Urged by the need to find increasingly fertile soil, man followed the river's path, descended into the Jordan valley, and founded one of the first cities ever, Jericho, situated close to the Dead Sea.

Eight Thousand Years Ago

Macedonia, a few kilometers west of Salonika: archaeological digs initiated by Robert Rodden lead to the discovery of artifacts produced earlier than 6,000 B.C. These artifacts demonstrate that man had stopped being a nomad in those lands and that he had begun to live in communities, within structured villages governed by laws. He had begun to raise animals, even using them for tilling the land. Perhaps the "discovery" of wheat arrived from Asia Minor via the Aegean Sea, expanding into the whole of Europe.

Seven Thousand Years Ago

Yugoslavia, along the Danube: artifacts demonstrate that villages were established along the river where highly civilized and cultured peoples built large rectangular houses made of wood. Their nutritional habits were based on cultivating wheat products such as bran, barley and millet.

SEPARATING FLOUR AND COOKING WHEAT PRODUCTS

Four Thousand Years Ago

Egypt: the tomb of Mehenkuetre, chancellor and royal minister to the pharaoh Mentuhotip. Reproduction of a granary and a bakery. In the granary, while the slaves filled the measuring bowls and then emptied them, creating mounds of flour, the scribes recorded quantities and amounts. The bakery was divided into two sections: in one area, the female slaves ground the flour, removing the bran by using perforated sieves made of papyrus. This can perhaps be considered the first attested practice of wheat purification. Sieves made of papyrus, which could only have come from the Nile regions, stayed in existence even in the Latin world until it became difficult, expensive and risky (papyrus is highly inflammable) to export them.
In the year 200 B.C. the Romans replaced the papyrus sieves with appropriately worked and napped leather sieves. Until about seventy years ago, leather sieves were used for purifiers known as "Marsigliese." In the bakery, reproduced in the grave of the Egyptian chancellor, the semolina was kneaded and shaped into round loaves that were then baked in ovens.

Four Thousand Years Ago

Genesis 18: 6-7: "And then Abraham rushed into Sarah's tent and told her, 'Quick, take three bushels made from the best wheat, knead it and make some bread.' "

IX C. B.C.

The Italic population mostly cultivated spelt and barley (with which they made *polenta*, adding linseed, coriander and salt), but also millet and wheat. Before being made into *polenta*, the wheat products were roasted, probably to disinfect them from the various parasites, thereby notably extending their storage period. This method, which was also used by the Greeks, remained part of the Roman tradition for a long period, as attested by Plinius, who died in 79 A.D. during the eruption of Mt. Vesuvius (see further on).

850 B.C.

Bread was cooked on stones: from the Bible, the first Book of Kings 19: 6-7: "He looked and next to his head he saw a loaf of bread that had been cooked on hot stones and a pitcher of water. He ate and drank and then lay down again." Today it is common knowledge that the custom of baking Azim bread between two previously heated stones dates to prehistoric man. In fact, various tools apparently used to cook several bread loaves contemporaneously have been found in various caves. These were small stones, perforated at the center and held together by a stick of wood. It is easy to assume that the dough was inserted between the two stones and cooked, and that it would keep for several days after cooking.

SOURCES FORM CLASSIC LITERATURE

490 B.C.

Date in which the first wheat cultivation has been historically ascertained. During a tremendous famine the Roman Senate decided to introduce the first official price lists, purchasing a large quantity of wheat from Italy to distribute gratuitously or semi-gratuitously to the people. These stores of wheat had to be kept for long periods of time and, therefore, had to be kept away from possible parasites. In addition to toasting the grains, the Romans used to cook hard wheat in water. Once it was worked and dried, pasta could then be stored for long periods of time. These *pastilli* (see below) could then be eaten as such, depending on degree of re-cooking, or used as flour, once they were "restructured" by boiling them in water.

1st Century B.C.

In *De lingua latina*, Marco Terenzio Varrone speaks of *lixulae*, a sort of dumpling (gnocco)which at one time (i.e. prior to the century in which Varrone lived), were considered the food of the poor, belonging to that category of food that was worked, preserved and cooked by the lower classes, being completely reliant on gratuitous wheat donations. Pasta was, therefore, a remedy in emergency situations, a response of the lower classes to the increasing food crises. In his *Dictionarium interpretamenta* (1502), brother Ambrogio da Caleppio confirms this when he emphasises that *lixulae* were at one time considered *inter viliosa cibaria*, that is, the vilest and poorest of foods.

35 B.C.

In his *Satire VI, Book I*, vol. 15, Q. Horace Flaccus (65 B.C. to 8 A.D.) describes his own frugal supper: "[...]*inde domum me ad pori et ciceris refero laganique catinum.*" (And so I come home in the evening to eat a bowl of leaks, chick peas and *lagane*. In his *Lexicon totius latinitatis*, Forcellini (1688-1768) explains that *lagane* are "*membranulas ex farina et aqua, quae iure pingui coctae, caseo, pipere, croco et cinnamomo conditur. Illud certum est cibum esse teneriorem et qui nullo lab ore mandi potest.*" That is, *lagane* are thin strips of semolina and water, cooked in a fatty broth and seasoned with cheese, pepper, saffron and cinnamon. This was obviously a very soft (almost mushy) food and chewed easily .

Several centuries later, in Apicio's *Book IV* of the *De re coquinaria*, *lagane* are mentioned again, this time reworked as a food that was almost symbolic of "rich people's fare." They are in fact layered with various types of meat and fish, boiled and seasoned in an endless variety of ways: "*quotquot posueris, tot trullas impensae desuper adificies*" (as many layers of pasta, as many layers of sauce). Finally, "*unum vero laganum fistula percuties, et superimpones*" (flatten out one of those layers very well and layer it on top, like a blanket). Apicio's text goes into detailed description of how to prepare the sauce but it does not explain how to make the *lagane*, proof that this type of pasta was well-known at the time and everyone knew how to make it. Still in Book IV, the author provides important information regarding pasta, particularly dried pasta. He suggests using *tractae* as an densifier, especially for broth: "*cum furberit, tractam confriges, obligas*" (when it boils, break a sheet of pasta and use it to thicken). *Tractae* were made by working the semolina and water mixture so that it would compress, facilitating the rising of the dough. That it was a sheet to be broken is uncontested. Since it was dry pasta it was obviously breakable; however, another deduction can be made. That is, it was made of hard wheat semolina since the term *tracta* implies great manual force that would certainly not be necessary if the semolina were softer. So perhaps these *tractae*, which were indirectly (so to speak) mentioned by Apicio, were enriched and ennobled by other ingredients and are nothing more than an impoverished version of lasagne, or better, of those same *lagane* that Orazio ate with leaks and chick peas.

3rd Century A.D.

Like Orazio before him, Settimo Severo, in his *Moretum*, a bucolic poem translated by Giacomo Leopardi in 1816, praises simple food and country life. He describes the typical day of an old man who wakes at dawn and, aided by an old female slave, prepares a sort of oven-baked pizza garnished with ground herbs, oil, vinegar and some spices.

850 A.D.

The Arab musician Ziryab, who is known in history by his pseudonym Petronio Arabo, brought the art of cooking and the elegantly-set table to the Spain of Abd-ar -Rahman II. He introduced a variety of foods, presenting them in a very aesthetically pleasing manner, included certain mixtures of dough that resembled pasta.

Medieval Sources

1041

The *Cortex Diplomaticus Cavensis* (*Cava dei Tirreni*, Salerno) mentions a certain "*mari qui dicitur mackarone.*" This document is important in the history of pasta because, even though the term pasta is translated to mean "silly," it stands as testimony to the fact that pasta was already widespread.

1154

In *Il diletto di chi è appasionato per le peregrinazioni attraverso il mondo* the Arabic geographer Al-Idrisi certified that in Sicily there is an enchanting town called Trabia with perennial waters and windmills. He describes a certain food that is made there from semolina shaped into strands, and manufactured in quantities that could feed not only the population of Calabria but also all of the Muslim and Christian lands as well. In the text, the pasta is referred to as *itriyah*, which in Arabic means "bread cut into strips."(Still today, vermicelli known as *tria* are manufactured in Sicily and the outlying areas.)

13th Century

Italian pasta becomes popular abroad. Frederic II, supporting Walter von der Vogelweide, a poet who lauded the beauties of Italy at the time of the Nibelunghi, particularly liked "*maccheroni* with sweet sauce," that is, seasoned with sugar, as was typical at that time.

Brother Jacopone da Todi (1230-1306) claimed that "granel di pepe vince per virtù la lasagna" (a pinch of pepper enhances lasagne). In describing Giovanni da Ravenna, Brother Salimbene da Parma (1221-1282) described him as a large and corpulent friar. He stated, "I never saw anyone stuff himself so willingly with lasagne seasoned with cheese." Cecco Angiolieri admonished, "he who uses his flour to make lasagne has a castle with neither a wall nor a moat."

1244, August 2

Through a deed drawn up by the notary Giannino de Bredono, Dr. Ruggero di Bruca (of Bergamo) cures the dental ailment of the wool-maker Bosso in return for a payment of 7 Genoese lire.

Before a group of witnesses, the patient promises not to eat certain foods, including *pasta lissa.*

1279, February 4
The notary Ugolino Scarpa draws up an act attesting that the soldier Ponzo Bastone's heredity includes, among other minor property, a "barisella plena de macaronis," referring to dry pasta, which likely resembled small dumplings (gnocchi), very similar to the modern-day Sicilian variety.

1295
Marco Polo returns from his trip to China. Among the many wonders that he has seen he cites lasagne made with "tree flour, which are very good." To dispel the myth that pasta originates in China, we add that he also wrote that the lasagne were "as good as the ones that he had tasted many times in Italy." In other words, in *Milione,* lasagne are considered one of the wonders of the world, probably only because a food so similar to the one eaten in Marco Polo's native land was popular in a country so different and distant as China was.

1295, September 20
Naples, Angevin Court: Queen Mary, mother of Carlo Martello of Angiò, made her debtors pay "four ounces for *maccheroni* and other."

FROM THE SHOPS OF THE COURTS

14th Century
Franco Sacchetti, poet and novelist, described himself as a "rogue and a fat man." In his *Rime,* he mentions "Lombard soups, lasagne with sauce and fritters with Sambuca."
In the *Decameron,* which Giovanni Boccaccio (1313-1375) began writing in Florence during the time of the Plague, the author told of the delights of Bengodi's country, the land where he who sleeps the most earns the most. He described "a mountain of grated Parmesan cheese from which *maccheroni* and ravioli cooked in capon broth roll down."
Describing scenes of country life, Antonio Pucci (1309-1388) tells of women that "sell eggs with cheese used to make vegetable cakes and sweet cakes and ravioli and other similar fare."
It is during this century that sayings such as "being of *buona pasta,*" meaning being likeable and good-natured, came into use. To be of "*pasta grossa,*" instead, meant being uncouth and wretched. Giovanni Sercambi (1347-1424) wrote: " As the fame of Sir Martino spread throughout the county, some men and women of *buona pasta* went to him, saying..." Boccaccio instead described this man as "Frate Puccio [...] an idiot, made of *pasta grossa.*"

1316, January 7
The notary Gacomo Napitello of Genoa draws up a lease for the rental of the house of Maria Borgogno, a "lasagne-maker."

1329, January 14
A Genoese deed mentions "Gualiterius Lasagniarius," (lasagne-maker) resident in the county of Prione, Genoa.

1338
Regarding the various names given to pasta, Barnaba da Reatinis from Reggio Emilia notes that Tuscan "vermicelli" are called "orati" in Bologna, "minutelli" in Venice, "fermentini" in Reggio and "pancardelle" in Mantua.

1351
On May 31 and the following day, Pitero Embriaco and Giovanni Bartolotto, two *lasagnari* (makers of lasagne) from Fegino embark on Paganino Doria's ship. Their duty was to cook fresh pasta for the crew during the trip.

1367
In his *Cronica Domestica,* Donato Velluti, a Florentine statesman, tells of a man who was "the son of a baker or, rather, of a *lasagnaia* (lasagne maker)." The woman was of Sicilian origin but she lived in Florence, where she owned her own shop.

1371, October 17
An official price list for pasta is issued in Palermo, differentiating pasta *axutta* (dry pasta) from pasta *bagnata* (literally, wet pasta) and setting different prices for white flour lasagne and *maccheroni,* sold at 30 coins per roll, and semolina *maccheroni* and lasagne, sold at 20 coins DENARI per roll.

1376
In Italy macaroni were eaten with a fork when this tool was still relatively unknown and certainly not yet used at the banquets of the French and English courts.
Franco Sacchetti tells of a certain Giovanni Cascio who, sitting at table with Noddo d'Andrea, a glutton, is capable of swallowing food that is "practically still boiling." When the *maccheroni* were finally served, "Noddo began forking the steaming hot pasta, gulping it down. He had already swallowed six mouthfuls when Giovanni was still at his first."
Centuries later, at the beginning of the 16th century, a Frenchman, Jacques de Saige, attended a banquet and was surprised by the fact that "the guests, when they wanted to eat, would put their food on a silver fork."

15th Century
In Rome, at the house of the "most reverend Monsignor Camerlengo, patriarch of Aquilea," the chef is Maestro Martino, unequalled in his field at the time. If, as Sacchi wrote in his *De honesta voluptate et valitudine,* most of his recipes came from this great chef, the author was much indebted to him. In Martino's *Libro de arte coquinaria,* there are several recipes for what he calls *maccaroni,* which can all be compared to our lasagne (*maccaroni romaneschi*), tagliatelle (a different kind of *maccaroni*) *maccheroni chi fir* (Sicilian *maccaroni*) and *vermicelli,* which, when they are sun-dried, last two or three years. Several years later, toward the end of the century, Bartolomeo Sacchi, a.k.a. Platina, will emulate these same recipes, eliminating the term *maccherone* (perhaps because it was too folkloric), replacing it with the more illustrious *esicio.* It is in Platina's *De honesta voluptate ac valetudine: vei de obsonis: et arte coquinaria, libri decem,"* that the recipe for "*esicium ex carne*" appears. This type of pasta, the size of a huge chestnut (*castanae magnitudinem*), is the forerunner of ravioli.

1421
In Milan it becomes necessary to establish an official price list for pasta. "The food minister must set the price of lasagne and *formentini* (*precium lasagnarum et formentinorum*) as required. He must have the town-crier proclaim the price and force all the sellers and retailers to comply, condemning those who do not obey..."

16th Century
Teofilio Folengo (1491-1544) invents macaronic poetry, written in a language that blends strictly Latin terms with "latinized" Italian terms or with Latin endings. The Mount Olympus of the macaronic muses that inspired Folenga was a Boccaccio-like land created by Bengodi in which, among many other delights, there were "a hundred boilers sending their steam up into the clouds, filled with *caciottine, maccheroni* and lasagne." For the author, a native of Mantua, who had spent most of his life in the province of Veneto, *maccheroni* are very much like huge gnocchi made with semolina, cheese and butter. Nor can it be mere coincidence that in many regions of Veneto, gnocchi are still called *maccheroni.*

1509, January 23
The Vice King of the Kingdom of Naples proclaimed "that when flour must be rationed for war, famine and other such circumstances," retailers must not bake sweets nor must they manufacture "*maccarune, trii* or *vermicelli* except in extreme cases or in the event of illness." The penalty for those breaking the law could be as serious as losing one's license to operate.

1537
The Eremite Guglielmo Cuffitella is beatified by Pope Paul III. In the documents considered during the beatification process, there were two that made reference to performed miracles concerning pasta. One account tells the story of a woman who tried to make fun of the friar in every possible way. One time, she handed him a plate of "maccheroni or, rather, lasagne with sauce," stuffed with bran, which miraculously turned into ricotta. On another occasion, on the first day of Lent, she had a servant boy bring Guglielmo a bowl of lasagne. She ordered the boy not to deliver the plate directly to the saint, however, but to hide it in the closet. At the end of Lent, the husband of the horrid woman sent the boy to retrieve the empty bowl, but another miracle had occurred: the bowl had remained in the closet and the lasagne that had originally been put into it were still there, steaming hot.

1546
A decree is issued in Naples, similar to the one issued in 1509. This one, however, was not addressed to bakers in general who produced vermicelli, susamelli and taralli but more specifically to the bakers specialized in making each of these types of pasta. Prior to the proclamation, therefore, the bakers' guild must have separated into three different groups or, rather, into three different guilds. Of these the vermicellari aspired to monopolize production of all three varieties of pasta.

1548
Printed in Ferrara, Cristoforo Messisburgo's *Libro de arte coquinaria* is published for the first time. The author lived in Ferrara and worked as a chef at the court of the cardinal Ippolito d'Este. His cuisine was characterized by its richness and extreme attention to detail. In short, it was able to satisfy the expectations of the banquet-shows held at court. Messisbugo differed from Maestro Martino and Platina more in the ingredients that he used than in the methods he employed. His recipe for *maccheroni romanaeschi* called for whole eggs, the soft part of the bread (*mollica*) and sugar, in addition to the usual flour and water. There are also particularly rich recipes such as that for *tortelli grassi*, which were the size of a large hazelnut and stuffed with a blend of meats (capon breast and bacon), cheeses (grated hard cheese and fat cheese), eggs, herbs and flavors, all cooked "in a good fat broth."

1548
A proclamation intended to exert some control over Neapolitan wheat is issued in Naples, banning the flour weighers from selling flour that would not be used for making bread. Likely, the Guild of Vermicellari was by this time already distinct from that of the Maccaronari (see 1699). The proclamation spoke of "Flour weighers who do not weigh flour for vermicellari, maccaronari, sosamellari, zeppolari, tarallari and bakers ..."

THE GENIUS OF PASTAS

1548
In speaking of essential objects that every household must have to keep kitchens functioning properly, Messisburgo also mentions the "genius of *maccheroni*;" that is, the press used in making the pasta. He speaks of the need for any good Neapolitan kitchen to have macaroni and vermicelli (in addition to apples, oranges, rice, spelt, etc.), indirectly illustrating how dried pasta was already considered an essential product, to have on hand at all times.

1570
Michele Tramezzino publishes Bartolomeo Scappi's *Opera* in Venice. Secret chef of Pope Pius V, Scappi's recipes include *mille fanti*, made with a mixture of semolina and warm water and worked until it became like "many small grains of millet-seed, which, after being sun-dried, are preserved in small bags. *Maccheroni a ferro* are shaped by rolling them onto an iron and the rather solid stuffing is sweetened with sugar and colored with saffron, placed onto a sheet of pasta as thick as the back of a knife and cut into large strips, wide like half a finger and as long as four." Finally, the *maccheroni* known as gnocchi are shaped by applying pressure with a finger onto the back of the grater, a tradition that is still in practice today, especially in the province of Veneto.
There were also rich recipes like "*tortelli* with ground capon meat, *tortelletti* with bacon and others, deriving from the popular tradition, such as *anolini* and soup made with tortellini stuffed with herbs (beets and spinach) in the Lombard fashion."

1570
According to Scappi, a kitchen "must, above all else, have a kneading-trough to knead several kinds of pasta." If in the 16th century the kneading -trough was considered an indispensable tool for the proper functioning of a kitchen at court, it only follows that such a machine must also be present in local shops. Its protagonist role was shared by the press, the mechanism devised for making pasta.
Scappi also used a tin *siringa* (syringe) with various tiles used for preparing butter vermicelli and other foods. Also considered an indispensable tool, this device was very similar to a modern die. Furthermore, if the *siringa* was used to fashion butter vermicelli and other things, one could safely assume that already in the 16th century there must have been some connection between the term "vermicello" and the *siringa*, regardless of the raw material used. It is of little consequence to speak of butter or pasta and more so of the use of an instrument that was already so widespread and highly influential in the history of pasta.

1571
The year in which the most ancient statute in our possession regarding the Guild of Vermicellari in Naples was issued. This, despite the fact that the Proclamation of 1546, date in which the first constitution of the guild was established, had occurred several years earlier.

1574, May 28
The Senators of the Republic of Genoa approve the oldest statute in favor of the Guild of the Fidelari. From this document it can be deduced that at that time pasta was made of wheat semolina. With the aim of safeguarding the collective interests of the Guild, the statute also specifies regulations for the "purchase of grains, wheat and its allotment." Masters of the guild were not allowed to board English ships or any other sailing vessel to buy grains or wheat .... ; these could be bought only nationally. " Each pasta maker who bought high quality grain or wheat had to make two thirds of his purchase available to his colleagues.

1577
The Guild of the Fidelari Masters, associated with cheese-makers, is governed by a law issued in Savona.

1579
In the articles of the Guild of the Vermicellari in the loyal city of Naples, the law reads, "Each shop must perforce have its own work tools. It is agreed that said profession customarily use bronze screws to assure that the work be carried out perfectly, to satisfy the customer."

1584

In *Lo spaccio de la bestia trionfante*, Giordano Bruno notes the Neapolitan saying, "the maccarone has fallen into the cheese," meaning that something/someone is exactly where it/he belongs.

1592

Documents kept at the Archivio Doria attest to the use of a die for long pasta. Such documents state that machine-made *fidelli* were cheaper than hand-made gnocchi.

PASTA, PROLIFIC MOTHER
17th Century

1602, October 14

A proclamation against the vermicellari is issued in Rome. According to the proclamation, pasta makers must respect the official price list related to, among other things, lasagne, yellow vermicelli, vermicelli, *tagliolini* and white *maccheroni*. Furthermore, vermicellari must also commit to "displaying their products at all times, especially vermicelli and white tagliolini." Penalties for those who break venial regulations is very steep while the punishment for those who break corporal regulations is very cruel.

1602

Giovanni del Turco (1557-1647), a much respected musician who "lived at the large courts of the virtuous princes," begins to collect the material that will be used in his book, which "will talk about how to cook meat, fish and eggs. The book will be divided into three parts. The first deals with cooking meat, the second with fish and eggs and the third with sweets, pastries and other."

Included in this collection, there are some very interesting ones concerning stuffed pasta. The author describes them in great detail, listing not only the ingredients and explaining how to prepare the food, but also describing how to shape the pasta. Agnellotti in broth and *tortelli* stuffed with meat, which are as large as a walnut, must be wrapped in a sheet of pasta that is as thin as the one used for lasagne, and they must be cut with a spur. "Then they must be pushed up with the fingers ...: that is, all the pasta that extends here and there must be pushed upward, leaving a *fragoletto* (small box) in the center.
In making meatless *tortelli*, the pasta dough "must be made with one egg for every pound of high-quality semolina." They are cut into half-moons, like white ravioli, stuffed with ricotta, Parmesan cheese, eggs, salt, pepper and flavors.

1604

In his *Catalogo degli inventori delle cose che si mangiano*, Ortensio Lando attributes the invention of *maccheroni* to Meluzza.

1605, March 31

The articles of the constitution of the Skilled Vermicellari Workers of Palermo are issued.

1608

A Roman law establishes that bakers who intend to sell vermicelli must belong to the Guild of Vermicellari.

1617

An ordinance issued in Savona reveals that the Fidelari manufactured local pastas with a press while those imported from Sardegna and Sicily were packaged by hand.

1625

Frugoli describes a lunch served to a group of diplomats in Madrid on February 11, 1625, which included "maccheroni di Sardegna" (Sardinian gnocchi).

1628

In Naples, people ate pasta that was imported from other areas of kingdom, especially from Cagliari, and that was sold by manual grocers, who, however, were not allowed to sell "maccaroni, vermicelli and tagliolini."

1630

In his collection of popular Neapolitan fairy tales titled *Cunto de li cunti*, Giambattista Basile (1575-1633) described the mishaps of a certain Jennarello. After going through a die, the protagonist came out looking "like a maccheroni." This is one of the first literary references to the "die", intended as a device whose various perforations determined the various pasta shapes.
In *La difesa dell'Adone* (Venice 1630), Girolamo Aleandri describes a scene of daily life at court that indirectly illustrates that the term "fettuccia," intended as a type of pasta, was already well-known at the time, as were its synonyms "tagliatelli," "lasagnette" and "tagliolini." The text, loosely translated, states, "As some gentleman had gathered to play *sbaraglino* at the house of the marquis, Pepoli, one of them jokingly said to another that he was drunk on *tagliatelli*, that is on that soup made of tiny strips of pasta, which in many places in Lombardy are called *lasagnette*, while in Rome they are known as *tagliolini* (if I am not mistaken)."

1639

Vermicellari in Rome win the right to prohibit bakers from making vermicelli.

1642, January 17

In Rome, the Guild of Pasta Makers draws up its own statute titled *Universitas et Ars Vermicellarorium*.

1649

From the minutes taken at a meeting of the Fidelari of Genoa, held on May 1, 1649, it can be deduced that the raw material used in making Genoese pasta was hard wheat semolina since the members speak only of "purchases of hard wheat."

1654, February 13

Genoese censors intervene in the dispute between the Fidelari and the Rebaioli (merchants of chestnut and corn flour, among other things). They issued an order to the Fidelari, whose practice often coincided with that of the Rebaioli, stating that "whoever practices the profession of the Rebaioli cannot and will not practice the profession in the same shop but in another shop, distant from the one in which 30 Fidelari have already established a shop."

1654

Count Francesco de Lemene (1634-1704) publishes his poem, *Della discendenza e della nobilità de maccheroni*, in Modena. In addition to being the first attempt at rationally classifying pasta types, the rhymes also provide one of the earliest testimonials attesting to the two machines whose existence is essential in a discussion on modern pasta factories: the kneading-trough and the press.
Providing a genealogy of the *maccherone*, the author explains how "Pasta was born of Flour. Prolific mother who, as widow, gave birth to a natural son called Gnocco (who did not have a happy ending), and who had already had other children from her three husbands, Cannella (rolling pin), Kneading-trough and Press. With Cannella, she had generated Polenta and Lasagna, the latter then becoming the mother of Cake and Raviolo. But the most wondrous offspring, Maccarone, was produced with Press. The descendant of Maccarone is Fidelino, the father of Pestarino."
The count then enters into an ironic narrative on some cities' disputes over who invented the macaroni. In addition to Como (see 1604) "Naples and Bergamo are enemies ... They fight and fuss

more over *maccheroni* than over taxes."
More than a century later, Camillo Cateni, Florentine doctor born in 1760, affirmed through a complicates series of "genealogical" sophisms that "*maccheroni* are very close relatives of Zeus in both body and soul."

1665
In an optics manual, the Jesuit professor Francesco Maria Grimaldi describes the essence and properties of gluten in a chapter entitled *Index rerum nobilium*. He claims that gluten, which comes from semolina, is gluey and viscous when it is wet but after the liquid particles have evaporated, it becomes unbreakable (*durum ac inflexibile*).

1666
From the bookkeeping records of the Guild of Lasagneri of Venice, it is evident that the pastas produced at the time were: lasagne, *maccheroni, nenelli* and *rapioli*.

1699
Naples: the Guild of Vermicellerai changes name, becoming the Guild of Maccaronari, with its own statute. This demonstrates that as of 1700 the term *maccherone* refers to practically all types of pasta, including those worked with a press and a die as well as those made by hand.

1676
Lorenzo Lippi's poem, *Il Malmanatile racquistato*, is very interesting from a linguistic point of view because of its rich vocabulary, expressions and phrases, typical of Florentine speech at the time. In the poem he uses the expression "everyone has the right to make gnocchi with his pasta," which means that one can use one's things as he sees best and do as he chooses. "Non so se lo sanno questi sciocchi, / ch'ognun può far della sua pasta gnocchi." (I don't know if these silly people know that anyone can make gnocchi with his pasta.) In his *Annotazioni al Malmantile* (1750), the erudite priest Anton Maria Biscioni specified that "gnocchi are normally made with common flour, but they can be improved by using rice flour and milk."
In *Il Torracchione*, a mock-heroic poem filled with proverbial sayings, written in about 1660 and published posthumously, Bartolomeo Corsini (1606-1673) could not have found a better phrase to describe the ecstasy of the rapture of love when he writes, "Ivi stette ogni altra cura a monte / mandando or da sera or da mattina / a specchiarsi di lei ne' lucidi occhi, / e a far con lei della sua pasta gnocchi." (No other thought in the world but / to go, morning or night / to gaze into her beautiful eyes / and to use her flour to make gnocchi with her.)

THE ENLIGHTENMENT OF PASTA

18th Century
In England, macaroni are considered symbolic of Italy, without any negative connotations. On the contrary; the term *macarone* was used to refer to fine and elegant individuals who could afford exotic foods, expressing a hint of snobbery. It was no coincidence that in eighteenth-century London there was a "Macaroni Club," which welcomed "young, educated gentlemen with long locks and spectacles," and who appreciated good food. The popular play, *The Macaroni* toured London's finest theatres.

1740
The Genoese Paolo Adami is granted permission by the Deputies of the Regulations of Commerce of Venice to open a factory of "fine pasta that is made in Genoa but not by the Lasagneri of this city." He was prepared to teach "any master pasta maker or son of any master pasta maker who was willing to learn the art and methods of making such fine pasta, the likes of which were known all the way to Genoa."

1745
Bartolomeo Baccari's (1682-1766) *De scientiarum et artium Instituto atque Academia Commentari* is published. In his treatise, the Bolognese chemist undertakes a scientific study of wheat, demonstrating that wheat contains two essential elements: gluten and starch.

1765
Saverio Manetti's *De specie diverse di frumento e di pane e della panificazione* is published in Florence. In the treatise, the author attempts to classify the various types of wheat used in making pasta. He writes, "The aforementioned type is also used to make the better and the white varieties of pasta, like fine vermicelli, fine *maccheroni*, thin *tagliatelli, foratini and semini."*

1766
The body of St. Stephen is found in a kneading-trough in which he had been buried. For this reason he becomes the protector saint of pasta-makers.

1773
Jacopo Vittorelli writes the humorous poem, *I maccheroni*. In it, he attributes the invention of "that food that makes the soul rejoice" to Pulcinella (character of the Commedia Dell'arte). He explains that though pasta was once hand-made, the various types "are now made by a press, producing more than 12 types..."

1779
M. Diderot and M. D'Alambert publish the new *Enciclopédie* in Geneva. *Vermicilier* is defined as he who turns the pasta into tiny strands that resemble worms by using a perforated instrument. Under that same entry, the authors describe in detail how the pasta is worked and they specify that there are two types of presses: one with a vertical screw for long pasta, and with a horizontal screw for short pasta. They are cut with a knife that is positioned inside the die, at its center.

1787
In his diary, *Travels in Italy*, Goethe defines maccheroni as a "delicate pasta, made with fine semolina, heavily worked, boiled and cut into various shapes." He also describes delightful episodes of Neapolitan life, describing the work of the maccheronari who, at the corner of almost every street, "busily make maccheroni, especially on days when one must abstain from eating meat, using their pans filled with boiling oil. They sell their product so incredibly well that thousands of people carry their meal away in pieces of paper."

1789
Delegated by Thomas Jefferson to purchase a pasta-making machine, William Short, while in Naples, writes a letter to the statesman in which he explains that he has bought the requested die and he includes the relative prices and information. Nonetheless, the idea of introducing pasta and the proper way to cook it was not successful overseas until many years later, when Italian workers emigrated to America.

1794
A deed of sale issued in Savona describes two machines used in the shops of old: the kneading-trough and the press. Both of these machines were, as we have seen, already being used in the kitchens at court in 16th-century shops. The semolina was poured in a hardwood basin in the kneading-machine. A hole was made in the semolina, warm water poured into it and the kneading was then done by hand. A very heavy marble millstone was then pressed onto the dough and pushed with a small bar (*stanghetta*). When the dough was well kneaded, it was cut into large pieces, which were then placed in the bell of the press. They were then compressed by the piston and pushed out a single exit where the die would cut them and shape them.

PATENTED PASTA

19th Century

1806

From London, M. Bonaiuti writes in *Italian Scenery*, "Maccheroni from Naples are easily recognized. They are not rolled on a hank like the ones in Genoa. They are completely straight and are curved only at one end because as soon as they come out of the press they are hung on sticks to dry so that they acquire the intended length. The hole that goes through them is executed perfectly [...]. They are characterized by their golden yellow color. The dough has a granular consistency and when you look at them through the light, they are true Neapolitan maccheroni."

1812

Count Chabrol De Volvic, prefect of Naples between 1806 and 1812 published a statistical report in 1824, after the fall of the empire. Based on information that he had scrupulously collected during his years in the administrative offices in Savona, his publication sheds some light on the situation at the beginning of the 19th century. Among the various activities reported, there is one related to pasta factories: "The outskirts of Savona and Porto Maurizio have 148 pasta factories. Great quantities are exported to Provence and Piedmont. [...] One hundred kilos of wheat produce 50 kilos of fine pasta, 30 of ordinary pasta and 20 of *farinette* and bran. Each factory must have 5 workers: 2 men and 3 women. The women (who are paid less than the men) are responsible for washing and preparing the wheat and they also dry the pasta [...]. Each factory produces 280 tons of pasta per year (about 18 kilos per worker per day).
Several years later, in his *Travels to Liguria Marittima*, published in 1834, Davide Bertolotti confirms that Genoa has 250 factories that produce vermicelli and it "exports by sea to Constantinople, Cyprus, Egypt, France, England, Spain and the two Americas, as well as by land to Lombardy, Tuscany, Switzerland and Germany."

1819

In the *Dizionario della Lingua Italiana* by Nicolò Tommaseo and Bernardo Bellini, the term *spaghetto* is defined as "masculine, singular diminutive of SPAGO" and it includes the entry, "spaghetti soup: pasta the thickness of a small twine and long."

1830

A competition is proclaimed for the creation of a mechanical kneading-trough. The Pattinson company of Naples wins the contest and uses the award money to build a kneading-trough in which the dough, kept in a circular wooden plate, is repeatedly hit by a double shaft of wood which is mechanically lowered and raised. At each blow, the plate rotates slightly so that the dough is kneaded gradually.

1833

Ferdinand II, ruler of Naples from 1830 to 1850 visits a pasta factory in the kingdom and is horrified to see that human feet are used to knead the dough in making maccheroni. He delegates the knight Cesare Spadaccini, an illustrious engineer, to invent a more "hygienic" system. After a year of research, a new and large pasta factory was established. Here, human feet were replaced by a man of bronze, built by Spadaccini at his house on Strada di Campo di Marte in Naples. His majesty greatly approved the idea of substituting human feet with those of a man in bronze and so he initiated the construction of a modern pasta factory. It was located in an enormous building with large wheat deposits, a grinding section and spacious, perfectly aired environments for drying the pasta. There was still much to be done when, once the initial enthusiasm and fervor subsided, Ferdinando cut the funding and decreed the project closed.

1839

In Ippolito Cavalcanti's, Duke of Buonvicino, *Cucina teorico-pratica*, pasta is combined with tomatoes for the first time. The secret in making good vermicelli with tomato sauce lies in making the sauce. Reduce carefully, cooking the pasta al dente then stir-frying everything in the pan, stirring occasionally to perfection.

1845

In *Journey from Naples to Castellamare*, Francesco Alvino deems it important to tell his readers, anticipating the testimonial of De Boucard (see below) that "Nicola Fenizio, famous entrepreneur (in Gragnano) has constructed four hydraulic presses in his factory and they work wondrously."

1846

On the occasion of fair held in Genoa, Giuseppe Dogli is awarded a silver medal for his pasta presses. The uniqueness of his "mechanism," as reported by the lawyer Michele Giuseppe Canale in his *Storia dell'esposizione fatta a Fenova nel settembre del 1846*, lies in the fact that "the parts that are typically made of wood are made of bronze and smelted iron [...]. Furthermore, the introduction of steam to heat the basin or the bell of the press is an improvement. It allows the use of any combustible through a burner or boiler positioned in a separate section of the machine. It also makes it possible to regulate the heat, within limits. This is only slightly possible with current heaters."

1858

Francesco de Boucard publishes the collection *Usi e costumi di Napoli e contorni descritti e dipinti*. This is a collection of essays that describe Neapolitan life. One of these essays states, "maccheroni, who doesn't know it? To foreigners, they are the symbol of the Neapolitan people. [...] In addition to the common way of making this type of pasta, today there is the hydraulic machine and already there is much excitement over which method is the best." This is the first attestation of the use of the hydraulic press, as described by Carlo Tita Dal Bono in *La Taverna*. In this essay, the author goes beyond describing the typical *maccheronaro* (maker of maccheroni), a skilled laborer, often plump and rubicund, rounded from the belly button down. He also provides information of a "technical" nature, including a list of places that, due to their ideal climate, produce some of the best pasta. In addition, he describes the new hydraulic press which works with pressurized water from a pump, pushing the piston of the hydraulic cylinder. This piston then puts pressure on the pasta, which is enclosed in the bell and will come out from the perforated die, cut into maccheroni.

1862

The Chamber of Commerce of Porto Maurizio is established by royal proclamation. Statistics obtained from the inauguration show that the city had 26 pasta factories, producing about 47,470 quintals of pasta. Of this, 19,000 quintals were exported.

1877

A mid-sized shop is opened in Parma. It has an annexed oven for the sale of bread and fresh pasta. The owner's name is Pietro Barilla.

1878

The so-called "Marsigliese" is introduced. It was a purifier that not only mechanically activated the sieve but, through a jet of air projected under the sieve, it also layered the products according to their weight. While previously 5 workers were required, now only a single operator could do the work. This machine causes such unrest in Naples that not even the police can control it and there are several victims. Years later, when steam mills, mixers, kneading-troughs and mechanical presses are introduced, half of the operators are left jobless. They do not put up a fight since "the struggle of 1878, which condemned the working class, had been so painful." (Oddino Morgari in *Avanti*, April 27, 1904).

1882
In Naples, Pattinson builds the first hydraulic presses with an upright cylinder, in which the bell containing the pasta is pushed toward the fixed piston. This system will then be replaced by one with a descending cylinder and piston. This increased production to 1 quintal of pasta every 20 minutes.

1892
In *Province di Genova and Porto Maurizio*, Gustavo Strafforello describes the state of the pasta industry in Liguria at the end of the century. "Production levels are at about 159,000 quintals of pasta per year. Pasta is distributed within the kingdom and exported to other countries, especially to the U.S., Brazil and other South American countries, Gibraltar and Constantinople." In terms of the grinding of wheat products in Porto Maurizio, "the largest and most important factory in the province is the one of the Agnesi Brothers in Oneglia. They import grain from within the country and abroad and they often use their own cargo."

20TH CENTURY

1904
The Ligurian kneading-machine with rollers is invented.

1908
In *L'industria del pastificio*, Renato Sandragné disconsolately states, "various constructors have attempted the unification of this machine (mixer and press), or at the continual work of each of them, but none of them have been successful to date. A good mixer-kneading machine and a continuous press would, for the most part, resolve the problem; however, given the status of the current situation, this reality seems a long way off."

1917
Fèreol Sandragné patents a machine that is the hope and dream of all the pasta makers of the time; that is, a machine that combines in a congruent and continuous manner the work of both the kneading-machine and the press. The history of the unified machine is interesting and deserves mention. The idea flickers in the mind of a retired laborer who had worked in a factory in Toulouse that manufactured pasta machines. Following his retirement, he finds work as a custodian in a brick factory. While there, he discovers that brick-makers used a machine that would be extremely useful to pasta makers. The clay mixture used for manufacturing bricks was pushed into a die by two rotating screws, which were immersed in the clay itself, and came out in the shape of a perforated brick. After making the proper modifications and adjustments, Sandragné built the required pieces himself with wood. He had them smelted and then presented his machine to his former employers at the Mécanique Méridionale. The machine works splendidly; there is only one problem: the machine overheats because of the friction produced by the screws that knead the dough. This is resolved by superimposing a wet rag on the rotors (a very humble but practical archetype of the cooling chamber).

1933
The first truly "continuous," fully automatic press is put into action. It was designed and built by two engineers from Parma, Mario and Giuseppe Braibanti.

1934
Documents of the National Fascist Federation for Industrial Millers, Pasta Makers and Rice Makers state that "we do not feel it is necessary to mention continuous presses since their function is very limited and debatable."

1957
The BBC televises a short film titled, *Spaghetti Picking in the Spring*, illustrating country life in the countryside outside of Lugano. A very serious speaker describes the trees from which dozens of kilos of spaghetti hang. The speaker goes on to explain that thanks to the farmers' skill and expertise, acquired over generations, these trees grow spaghetti of equal length, an element which, among other things, facilitates picking. It is said that the following morning the BBC studios received numerous phone calls from people who were interested in buying the spaghetti trees and they wanted the phone numbers of the retailers.

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