FESTIVAL CEREALIA | XI EDITION 2021

RICE

a cereal with a long history

Elisabetta **Lupotto,** Valentina **Narducci** e Paola **Sarcina**

CEREALIA

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Festival CEREALIA | XI edition 2021

RICE
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PREFACE

This short, but rich and documented publication, intends to continue the dissemination action on cereals started by the Cerealia festival with the contribution of experts, research partners and promoters. In fact, as early as 2012, the festival started to publish and disseminate to the public small handbooks containing the program of the event and an in-depth sheet each year dedicated to a specific cereal.

Rice, the cereal to which the eleventh edition of the festival is dedicated, is the object of this publication. I wish to thank the Council for Agricultural Research and Economics (CREA), for the scientific and graphic editing, that made available to the public not simply the traditional little handbook, but a more scientific-informative project to celebrate the tenth anniversary of Cerealia.

My first thank goes to Elisabetta Lupotto and Valentina Narducci for their scientific contribution and their exquisite kindness.

I thank ISMEO for the contribution written by prof. Matteo Delle Donne and prof. Lorenzo Costantini; I also thank prof. Giuseppe Nocca and chef Renato Bernardi - ambassador of the Italian taste and of the Mediterranean diet in the world - both members of the scientific committee of the festival.

Finally, I thank the PROMOItalia association and Giovanna Sangiuolo, organizing partner of the Cerealia festival in China, for being so generously available to carry out the Chinese translation of this publication.

I wish everyone a pleasant reading

Paola Sarcina
Founder and director of the Cerealia Festival


essandro Nsomma

INTRODUCTION

CEREALIA. The cereal feast. Ceres and the Mediterranean. An inclusive, participatory, sustainable and transdisciplinary festival

The celebrations of grains in ancient Rome

"Cerealia. The cereal feast" is an annual event dedicated to the history and importance of cereals in the economy and human culture, especially in the Mediterranean.

In ancient Rome grains were celebrated in the rites of the Vestals (*Vestalia*) and in the *Ludi* of the goddess Ceres (*Cerealia*). In the second week of June, between June 7 - when "*Vesta aperitur*" (the temple of Vesta in the Roman Forum was opened, as stated in the calendars) - and June 15, when "*Vesta clauditur*" (the temple was closed), a series of rites connected gave rise to a cycle defined as the "grains cycle" (prof. Romolo Augusto Staccioli).

In May, on the other hand, the ritual of the "*fake harvest*" was celebrated precisely in the critical period in which the flowering of the ears could have been exposed to the risk of a possible last frost.

Three times, every other day, on June 10, 12 and 14 the three older Vestals prematurely picked the ears of farricello, the poorest dressed wheat, and placed them in baskets that would then be used for the harvest: to fill those baskets in advance meant that the cultivation would be successful.

The Vestals prepared the *fake bread* with the addition of a special dose of salt, pounded and baked (the so-called mola salsa) a dough that, transformed in a small part into *focaccia*, was offered to Vesta while the rest was preserved and destined for sacrificial use.

The *fake bread*-making took place on the day of the *Vestalia* (June 9) and not surprisingly on that same day the feast of the *pistores* (bakers) was celebrated; bakers for the occasion decorated the millstones of the mills with wreaths of flowers (prof. A.S. Staccioli).

The blond goddess Ceres - included in the Aventine Triad with Liber and Libera - was

celebrated in a great feast that lasted eight days in April, from 12 to 19: this was the *Cerealia*, a feast of propitiation rather than agricultural work. The white color was the sign of the celebrations for priestesses and devotees.

The opening of the feast was given by a solemn procession followed by the *Ludi* (Games) of Ceres which were distinguished in *Ludi circenses* and *Ludi scaenici*, whose management was the responsibility of the plebeian *edili*. The most spectacular part took place on April 19: the great day of ritual solemnities and spectacular recreational activities, which included the race of the foxes in the Circus Maximus.

Mediterranean and cultural pluralism

These rituals represent the historical inspiration of the Cerealia festival, while its international aspect derives from the emphasis placed each year on the exchange, the cultural enrichment and the focus on a different Mediterranean country: 2011 Egypt;

2012 Turkey; 2013 Greece; 2014 Cyprus; 2015 Croatia; 2016 Morocco; 2017 European Union / 60 years of the Treaty of Rome; 2018 Malta; 2019 Tunisia. Due to covid the 2020 and 2021 editions have temporarily interrupted this tradition, maintaining a diffusion of local and national activities and programming a broader calendar. The 2022 edition is dedicated to the Kingdom of Jordan.

The Mediterranean is the intersection of a myriad of interconnected but essentially different identities and collective societies. Since ancient times cultural pluralism has been a dominant feature of the mare nostrum basin.

The social and economic importance of cereals in human history is also undisputed, as is its essential position in the food pyramid. The Cerealia festival therefore proposes itself as an opportunity for cultural exchange on several levels and seeks to raise public awareness of the value of the land and indigenous cultures; on renewing the links between cereal-producing areas and consumers; on revitalizing traditional practices based on respect for the land and its fruits. The festival promotes the sharing of common challenges at the level of regional clusters among peoples bordering the Mediterranean, stimulating the development of sustainable circular economy models and promoting the 17 SDGs of the United Nations 2030 Agenda, with a bottom-up participatory approach which enhances the needs and skills of civil society, while respecting and safeguarding the Mediterranean ecosystem.

A collective and participatory project

Cerealia is an international festival that takes place in Italy every year in June (9 June is always included as date of the afore mentioned ancient vestal rites and *pistores*' feast). In more recent years, the festival calendar has also extended to the months of July, September and October. The key themes are: culture, society, economy, food and gastronomy, environment, territory and landscape, tourism, collective identity and shared memories. For over a decade Music Theatre International and the festival network have been committed to creating a festival sustainable and with low environmental impact (the first edition of Cerealia was included among the "EcoFests" of the Province of Rome).

The festival's organizational system uses a balanced combination of "glocal model" and "state identity model". According to this model the executive producer of the festival (the association Music Theater International) supports and collaborates with the partners and festival network operating at a local and international level to share

content and to plan activities. The intent is to use a "light" management structure, encouraging partners to work together to achieve common goals in synergy with all the public and private stakeholders of the festival. Both for-profit and not-for-profit organizations that are partners of the festival can thus make available and share their unique know-how, human and material resources, goods and services.

The organizing partners and the members of the festival network are responsible for the activities they organize at the local level; they collaborate with the executive producer M.Th.I., which is responsible for the guidelines, coordination and general communication. This flexible governance structure facilitates the potential development of activities proposed by the different territories. Cerealia is therefore configured as a participatory festival that enhances the shared economy and emphasizes the positive impact of consumption and production models that are more respectful of the ecosystem and human needs.

The calendar of activities, based on the initiatives proposed by the executive producer and the various partners generally includes: seminars, conferences and workshops, live performances, tastings and themed menus, guided tours, video projections, photos and art exhibitions, workshops for adults and children.

Network activities, collaborations and awards

Since 2013, the Cerealia festival has hosted internships in collaboration with the Académie de Grenoble - Lycée Polyvalent Louise Michel (France). The festival was among the supporters of the Milan Charter on Food and Nutrition (http://www.milan-protocol.com), thus being included in the publication of the Barilla Center for Food & Nutrition "*Food People & Planet. Sharing responsibilities for a more sustainable tomorrow*" published for Milan Expo 2015.

The festival is among the promoters of the *Observatory on Dialogue in Agro-food* (ODA) created to promote a process of collective reflection on the relationship between science and society, involving all the actors of the food system (study and research centers, economic operators, mediators of knowledge, decision makers and civil society). More than one hundred stakeholders have joined the ODA, including representatives of public and private entities, as well as ordinary people. The festival promotes the *Biodistretto delle Colline e dei Castelli Romani*, a project that unites producers who carry out rural business activities and citizens and has given life to the experience of the Farmers' Markets of Rome, Castelli Romani and the Metropolitan City, capable of

involving thousands of consumers and hundreds of producers, creating a flywheel for alternative, sustainable and eco-compatible development and at the same time enhancing the resources of the territory.

In January 2020 the executive producer of the festival, the association Music Theater International, signed a collaboration protocol with UNPLI (Unione Nazionale Pro Loco Italiane) to promote cultural activities to be carried out in synergy within the Cerealia festival. Finally, several twinning agreements have been formalized with other Italian events and festivals: Days of the Ancient Mediterranean - of The Phoenicians' Route, Fai la differenza - Sustainability Festival, the Genzano di Roma Bread Festival, ViniCibando and many others.

Since 2015 the Cerealia festival was awarded by the EFFE - Europe for Festivals, Festivals for Europe Label, a brand granted by the EFA (European Festival Association) to European festivals of excellence. In 2016 and 2020 Cerealia was selected by the Lazio Region among the "Good Cultural Practices" and among the "Good Cultural Practices of Excellence". Since 2018 the festival has been a member of the MAECI (Ministry of Foreign Affairs and International Cooperation) coordination table for the Week of Italian Cuisine in the World - Italian Taste. Since 2017 the festival was awarded by 5 medals of the Presidency of the Italian Republic.

The Cerealia Festival Network and the data of its 11 editions (2011-2021)

The not-for-profit cultural association Music Theater International - M.Th.I. ETS is the executive producer of the Cerealia festival. The following not-for-profit organizations and enterprises are members of the festival network: Agroalimentare in rosa, Aisu verso Itaca, Archeoclub d'Italia sezione Etruria Meridionale, Baicr Cultura della Relazione scarl, Cibele srl, ComeUnaMarea Onlus, Associazione Km0 - Consorzio Agroalimentare di Filiera Corta e dei Mercati Agricoli, Federazione Italiana Dottori Agronomi e Forestali - FIDAF, Gi&Mi, Istituto Nazionale di Sociologia Rurale - INSOR, L'Albero Verde della Vita, associazione La Lestra Tarquinia, La Rotta dei Fenici – Itinerario d'Europa, PROMOItalia, Symbiotiqya srl.

Since 2011, 412 events have been organized as part of the Cerealia festival for 240 days of programming, involving 878 civil society organizations, enterprises and public institutions. The activities took place in 12 regions and 36 cities in Italy and in 4 foreign countries. The festival was attended by over 52,000 people. The festival and its promoters participated as a partner or case study in 57 dissemination events in Italy and abroad.

CONTRIBUTIONS

Rice cultivation in Italy: a short story[1]

The origin and history of rice cultivation in Italy can be traced back with the names of the many rice strains and varieties and the names of the growers who selected them. Some names became milestones in the Italian rice breeding, also known and cultivated in the Mediterranean region and later in the world (e.g. Carnaroli).

In the following pages a short history of the rice cultivation in Italy is summarized, based on the rice names. The reader will certainly recognize some of them, and he will be astonished knowing that they have been selected or bred many years ago, and still actually grown and consumed as rice known for its quality excellence.

The origin of rice cultivation in Italy

Cultivated rice (*Oryza sativa* L.) was known since Greeks and Romans, when its use was limited in medicine, sold by apothecary as sugar, pepper and other exotic spices. Greeks and Romans gave a common name of Oryza to cereals coming from the Indian region of Orissa. However, various hypotheses recognize that the root *-riz* is common to various languages of the near Orient (44). Plinius in the *Naturalis hystoria*, describes rice plants and makes comparison with other grasses, also reporting rice as food with nutritional characteristics.

Very likely, rice cultivation started in Italy around the XIII century (22, 45), but documents attesting rice fields date later, between 1450 and 1500. Rice cultivation diffused at the time of Sforza dinasty domination in the Po valley around Milan, Novara and Pavia. Around Mantova and Ferrara, in the east part of the Po plane, rice was introduced by the potent families of Gonzaga and Este, as dominant cereal in difficult soils, where other cereals were not productive. Moving of rice cultivation to the east of the Po plane is documented by two letters from Galeazzo Maria Sforza addressed in 1475 to Niccolò de Roberti, correspondent of Ercole[1st], Earl of Ferrara,

1 Elisabetta Lupotto, Luigi Tamborini, Valentina Narducci - Council for Agricultural Research and Economics (CREA)

and to Giuliano Guascono, his farm manager, gaving permission to send twelve rice seed bags to Ferrara (32).

Some other documents attest rice cultivation in other regions, such as around Pisa in the mid of XV century, with rice called "*Massarosa rice*", in 1495 around Vigevano (32), around Bologna in the beginning of XVI century (12), Verona in 1522 (4, 13) and in Piemonte before 1523 (18). Tradition wants that around Novara rice was introduced by Spanish in 1521, when Charles V travelled to Milano (16). However, a stronger tradition wants that rice cultivation was introduced before, in XIII-XIV century, by Cistercenses monks, coming from La Fertè in France. According to their law "*ora et labora*" they made the areas around Vercelli in the south till the Monferrato hills, free from woods. The region was rich in water, coming from the Alps and they established and managed rice fields with great experience, holding the main headquarter in Lucedio with minor farms around (the "grange"). The agricultural system was so successful that it spread later in a vast area including the actual Lomellina and south of Lombardy, Veneto till the Adriatic see in the Po delta.

There are no documents attesting the origin of the actual rice cultivation system as irrigated culture in submersion. Various hypotheses are currently considered: it could be introduced by Arabs in Sicily, or by Venecians from China and far East, or by Aragonenses during their domination of Naples, having they learned it from Spain. This latter hypothesis seems the most reliable (16). From South Italy, rice came to the north region in the Po Plane, rich of water; it was called "treasure of swamps" (Pier Crescenzio, 33). Starting from XVI century, rice spread in many areas, but no documents attest what type of rice was cultivated (23, 29, 30). In 1635, a religious Mons. Francesco Agostino della Chiesa, in his work "Report on the actual status of Piedmont" write that this region "….*do not need foreign import of cereals*…", as Piemonte was self-sufficient with its rice production, even export of rice was possible to other areas of the Duke of Savoia (17).

Wars and famine occurred during XVII century, but in mid XVIII century rice cultivation started to expand: about 7345 hectars around Vercelli, in Lomellina and around Novara. In 1758 Gian Battista Spolverini, a Marquis from Verona, wrote a complete poem on rice, dedicated to the Spanish king Philip V "*Rice cultivation*" (39). From the XVIII century, rice becomes the most cultivated cereal in northern Italy, followed by maize, staple food for the population mixed with vegetables, freshwater fish and legumes.

However, no indications on the rice types cultivated appear in the various doc-

uments; rice was indicated with the generic name *Nostrale*, as specified in 1807 by Biroli in his monograph on rice "….*I know only one rice type*" (5). Nostrale represented a mixed rice population characterized by high size, around 120 cm tall, thin stems prone to lodging, light green leaves, panicles with awned spikelets and large grains of good quality. Nostrale was sensitive to blast, the fungal pathogen *Magnaporthe grisea* (*Pyricularia oryzae*) (36), the most important driver during European rice breeding history

Rice blast and its importance in rice breeding

The causal agent of rice blasti is the fungus *Magnaporthe grisea* (*Pyricularia oryzae*). The pathogen attacks rice in two different phases of the plant life: at the seedling stage, with evident and characteristic necrotic spots, and later, during panicle maturation, with the "*neck blast*" more dangerous and in some cases causing complete crop destruction. Rice blast appeared in Italy from the beginning together with rice introduction, already described in XV century (23). In the years 1823-1827 blast epidemics heavily damaged rice fields in Piemonte, Lombardia and Veneto (27). The cultivated rice Nostrale was very sensitive to blast (26) and therefore it was abandoned, though considered a very good quality rice (9). It was therefore necessary to introduce new germplasm from the far East, from the northern temperate regions of China and Japan, in order to preserve the cultivation of this cereal in Italy. The frequent introduction of rice seed from far East were necessary to refresh the germplasm bank and provide new source of resistance. The main traits searched for this scope were: resistance to rice blast and adaptation to our environment.

New rice varieties from massive selection

An intense activity, dedicated to the new introductions and to the development of new agricultural practices, characterized the XIX century. New experimental field management was tried, for example, in 1823 with the "*dry rice from China*", adapted to grow in dry soil, obtained by Count Leonardi from Novara with a 84 seeds sample, cultivated in his fields. These new introductions were challenged also for blast resistance during years 1823-1829, as described in the Georgico Calendar by Marquis Arborio from Gattinara of Breme (1,2), and other authors (19. 37). From these experimental fields, it became evident that the "*dry rice from China*" yielded better when cultivated in irrigated soil, had a short cycle and was resistant to blast (25). No

Fig.1 - Cascina Boraso farm – the historical site – with the experimental fields

name of other rice varieties appears in the Calendar till 1833, when a new variety named Bertone was reported, apparently not related with the germplasm before (34). It might however be possible, that Bertone was a selection from the dry rice as its name can be found in documents reporting its cultivation in Piemonte and Lombardia before 1830. Bertone also had a short cycle, not awned spikelets with black apex, resistant to blast (20). However its origini is still uncertain.

From mid XIX century a new pulse in innovation of the agricultural practices was made, with the introduction of fertilizers. Italy at the end of the century had about 232.000 hectars cultivated with rice but in this wide area only five rice cultivars were grown, although in the Congress in Vienna in 1872, Malinverni represented that more than 200 rice strains were cultivated in the world. New blast epidemics in the years 1877 and 1878 promoted, at the end of the XIX century, new germplasm introductions from Japan, China and India (6). In 1880, a first description of the rice strains cultivated in Italy was officially done, accounting 14 different strains (9). Later, in 1903, at the Rice Congress held in Mortara, the number of Italian rice strains were 41, catalogued in 44 in 1905 (24). In this latter list appears, for the first time, the rice strain named *Chinese originario*, a milestone of the Italian rice breeding development.

Chinese originario was shorter in size, 90-100 cm tall, thin stalk and leaves, not-awned spikelets, had very good yield and was resistant to blast. All these traits together contributed to give a strong pulse to the Italian rice production that almost doubled, from 24 q/ha to 40 q/ha in 1915, still rising to 49 q/ha as a mean in 1929 and reaching 55-60 q/ha in optimal management conditions (15, 24).

During the following years, several new varieties were selected out of Chinese originario, such as Balilla, Allorio, Pierrot and Maratelli (28). Also pure line-derived varieties started to be cultivated, such as Novarese and Ostiglia, and additional varieties derived in this way were also produced in addition to breeding performed by intervarietal crossing. As an example, in 1961 Ente Nazionale Risi released S.Andrea,

as a selection from Rizzotto, still today grown and appreciated, present among the D.O.P. (Protected Origin Label) Rice Baraggia vercellese.

At the Experimental Rice Station in Vercelli, taking advantage from its genome instability, several new varieties from the American variety Lady Wright were derived (14). In 1931, Roma was selected, followed by Sesia, Senator Novelli, Adelaide Chiappelli, Stirpe 136, Rinaldo Bersani etc. Because of its large translucent grain, Lady Wright is considered the be the progenitor of the Long A grain Italian risotto rice.

It must be mentioned that in those years, two actors were fundamental for the Italian rice breeding activity: the public reference institution – the Experimental Station for rice cultivation in Vercelli, funded in 1908 – and private farmers, who often maintained strict relationships with the institution, familiarly called "the Station". The "Station" was a reference point for genetic materials, but also teaching, support to agricultural practices and disease control. Researchers and technicians at the "Station" constantly carried out their fundamental work for introducing, characterizing and selecting new rice strains from exotic germplasm, in order to support and promote rice cultivation in Italy and in the Mediterranean region.

In 1925 Giovanni Sampietro, at that time director of the Experimental Rice Station in Vercelli, realized the first manual cross between two rice varieties (36, 38); the main result of his work was the variety Vialone nano, obtained from the cross Vialone x Nano, released in 1937. This variety is still one of the best quality Italian rice, holding first a PGI label. This label refers to the region and production area of a specific product, whose characteristics are strictly related to a geographic area, the only place where it can be produced with those characteristics.

The period 1025-1950 was characterized by an intense breeding activity with release of several new varieties: in 1933 Agostano was obtained from the cross Nano x Chinese Ostiglia, an early maturing rice well diffused from 1933 in the Fer-

Fig.2 - The first historical site downtown, before 1926, named "Regia Stazione sperimentale di risicoltura e delle colture irrigue"

rara area, well adapted to peaty soils. In 1945 Carnaroli was released, still today one of the excellent most appreciated Italian rice varieties; it has to be mentioned that it comes from the breeding activity of a private rice farmer, Mr. Ettore De Vecchi from Paullo (Milan). Carnaroli top value grain quality can be accounted to the specific amylose/amylopectin ratio and the endosperm proteins, conferring an optimal combination of physical and cooking properties for pleasing textural attributes.

Independent breeding activities of other private farmers were also successful, as in the case of Mr. Domenico Marchetti from Arborio (Vercelli) who realized the variety Arborio – this also a traditional rice variety – from the cross Vialone x Lady Wright. He was the father of other good new varieties of that time: Rosa Marchetti, Pierina Marchetti and Ariete. Both Carnaroli and Arborio today hold the PGI "Rice of the Po river delta". The new breeding activity at that time joined the continuous introduction of rice exotic accessions and varieties, thus contributing to the exploitation of the available genetic resources that allowed Italian rice production to reach very good performance, quite peculiar for our environment.

Even during the war periods, because of restrictions in wheat import, rice was deeply investigated with research for technological innovation, mostly for making bread with rice and wheat flour mixtures (7,8). In the same years, an easier rice classification was issued, based and the grain types and organoleptic characteristics: that is still the basis of the actual rice type classification (36).

Fig.3 - The old rice variety Lencino, one of the two parents of Carnaroli

Varietal classification according to rice grain

Cultivated rice type is classified according to the grain characteristics: grain type, milling yield, presence of pearl in the endosperm, and amylose content. An early classification accounted to the mean milled grain length in three classes: *common*, *semifine* and *fine*, and a top quality *superfine*. This classification, still adopted today in some countries such as India, was later adopted with modifications by the

European legislation in four classes: Round, Medium, Long A and Long B, according to the length/width ratio. Other classes are aromatic rice – or fragrant – and pigmented rice.

The whitening – or milling – process yielding the sole endosperm white rice, determine the "milling yield" that is the final presence of intere grains (10). This parameter varies according to the rice grain type: for the round type it is 63%; for Carnaroli and Vialone nano, it is reduced to 55%, and 56% for Arborio. These latter three high quality rices have therefore a lower milling yield. High milling yield is defined when the rice sample has a value higher than 60%. The endosperm texture is defined by the cellular architecture; when the cells are compact, the endosperm is crystalline and transparent. This is the case for the traditional varieties: Baldo, Ariete, Lido and Rosa Marchetti, and Gladio among the newly bred varieties. These are mainly preferred by industry for the *parboling* process. If the cells are less compact,

the endosperm is partially or completely opaque, with a white nucleus, the *pearl*. Pearled traditional varieties are: Balilla, Padano, Vialone nano, S.Andrea, Roma, Arborio and Carnaroli; recent pearled varieties are Centauro and Karnak.

Harvested rice is called "*paddy rice*", in which the grain is strictly enclosed in the bracts (floral glumes). Paddy rice is then conferred to the rice mill, where it undergoes a series of cleaning steps till the whitening step yielding the final commercial white rice. White rice consists of the starchy endosperm only, while a dehusked (or dehulled) grains yield the *whole rice* (or *brown rice*) in which the pericarp – rich in

nutritional value - and the embryo are still present (for details of the milling process, see "From paddy to white rice" by G.Nocca, this book).

Rice consumption can be as flour – as other cereals – or mainly as whole grain (later as white rice), easy to store. White rice is almost completely formed by the starchy endosperm (80% carbohydrates, in the two forms amylose and amylopectin), storage proteins (6-7%), a small amount of lipids (0.4%) and crude fiber (less than 1%), very low mineral content and group B vitamins (souce: Food composition tables, CREA; www.crea.gov.it). Rice is a high energy food giving 334 kcal/100 gr. Rice is highly digestible, as its proteins are gluten-free. It has a glycemic index higher than other cereals, though the GI is affected by genotypes, type of preparation and other factors. Whole rice has a lower GI, but it has a higher nutritional content, as it contains all the bran nutrients, mainly lipids, vitamins, minerals, proteins and other bioactive molecules such as antioxidants.

A special mention must be given to the *parboiling* (from *partially boiled*) process, an ancient rice processing which is still used by industry and appreciated today by consumers (21). Parboiled rice is the major staple food throughout South Asia, where over 90% of the world's parboiled rice is produced and consumed. Parboiling is a rice processing known in Mesopotamia since at least 4000 years ago. The process consisted in a short water soaking time of paddy rice, a steam precooking, and then dried in the sun. With this treatment, starch is partially gelified, and lipids, hydrosoluble vitamins and minerals migrate from bran to the endosperm, thus enriching its nutritional content. Today, technologies have evolved greatly though conserving the main characteristics of the old process.

Rice varietal evolution in Italy

Actual breeding of new rice varieties is essentially driven by agronomic and industrial needs: high yield, short cycle, blast resistance and grain quality. Specific high amylose, Long A rice grain type for parboiling is requested by industry. Consumers are trained in the present time, to choose quality labelled rice, though more expensive, mostly of the Long A type, good for traditional Italian dishes, such as risotto (15, 35, 36, 43, 3).

At present, about 240 rice varieties are formally inscribed in the national catalogue, though no more than 100 are currently cultivated; out of them just 20 cover 70% of the Italian rice cultivated area, accounting to 220.000 hectars, most of them in

the Po plane. Traditional Long A rice for the national market and traditional use, is satisfied by 6 varieties. The most recent varieties have a short cycle, a trait that makes the cultivation easier namely for the herbicide treatments, targeted to eliminate the *weedy rice*, also called *red rice* because of the generally red pericarp. This "variant" is considered a weedy species, as its presence is constant in rice fields, difficult to eliminate for the ancestral characters of persistence – it stays for years in soil without germination – high tillering with many panicles, scalarity in flowering and self-seed dispersal.

Fig.5 - Operative scheme for rice hybridization (figure from the Institute Annals, 1941)

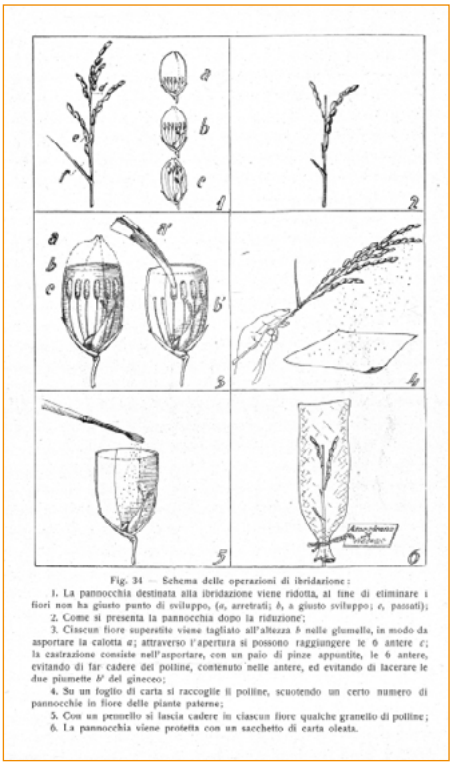

Fig. 34 — Schema delle operazioni di ibridazione:
1. La pannocchia destinata alla ibridazione viene ridotta, al fine di eliminare i fiori non ha giusto punto di sviluppo, (*a*, arretrati; *b*, a giusto sviluppo; *c*, passati);
2. Come si presenta la pannocchia dopo la riduzione;
3. Ciascun fiore superstite viene tagliato all'altezza *b* nelle glumelle, in modo da asportare la calotta *a*; attraverso l'apertura si possono raggiungere le 6 antere *c*; la castrazione consiste nell'asportare, con un paio di pinze appuntite, le 6 antere, evitando di far cadere del polline, contenuto nelle antere, ed evitando di lacerare le due piumette *b'* del gineceo;
4. Su un foglio di carta si raccoglie il polline, scuotendo un certo numero di pannocchie in fiore delle piante paterne;
5. Con un pennello si lascia cadere in ciascun fiore qualche granello di polline;
6. La pannocchia viene protetta con un sacchetto di carta oleata.

In 1963 the official Catalogue of Italian rice varieties was set up: on March 4th, 1980, 54 varieties were registered; in 1998 they were 118, till 143 today, all described in the Quaderni ENSE (11, 31, 40, 41) and by Ente Nazionale Risi (3). Before 1980 the most preferred grain type was Long A but since then new varieties with the thin long grain – the Long B type – spread on the market. They are also known as "*indica rice*" though being a specific selection of the *japonica* ssp. germplasm. From 1990 a new intense pulse in genetic research occurred, strongly supported also by private seed companies, in search of new innovative rice types. The private sector develops research very often in collaboration with the institutional bodies aimed at breeding for new varieties now mostly covered by patent. Growers ask for the development of new varieties responding to agronomical parameters, while consumers' requests are driven by market and actual trends. As an example, fragrant rice had a recent development following Basmati appreciation, originally coming from India and Pakistan. Today the Italian panorama accounts 17 fragrant varieties. The same was for pigmented rice – black and red pericarp varieties – among which Venere was the first to be present on the market, now followed by

others with different grain characteristics (Venere is a medium type while Artemide is a Long B type grain). Fragrant rice varieties are characterized by a specific aroma, as a mixture of more than 100 volatile compounds, where 2-acetyl-l-pirroline seems to be the most prominent (42). With regard to pigmented rice varieties, they contain red to deep purple to black pigments with antioxidant properties in their pericarp. They were well known also in former times, like the so called *Rosso Gorei* (selected in 1922 by a farmer, Mr.Silvio Baldi) (36), although white polished rice was always preferred. Today the various new trends in food preparation make them more attractive; the cultivated pigmented rice varieties present on the market are generally patented.

In summary, Italian rice production is today very well represented and characterized by a wide availability of diversified varieties, much more than in other rice producer countries, like USA and Spain. This is due to an intense breeding activity, mostly from the private sector, reflecting producers and market specific requests. Rice is presently cultivated in various areas of our country, well differentiated in climate, soil and cultural conditions, from the Po plane to some areas in the center of Italy and south, such as in the Sibari plane in Calabria. The relatively wide genetic differences present in the available germplasm resources allow a continuous innovation to meet

Fig.6 - Experimental field trials and Cascina Boraso (CREA at Vercelli)

the very actual goal of a sustainable rice cultivation system, coping with the climate change and the need of an oculate water management.

This tale is dedicated to the memory of Antonio Tinarelli who was a great teacher to me and still could have been longer
With deep gratitude

Elisabetta Lupotto

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The origin of rice in Asia and its spread in the Mediterranean and Italy[1]

Origin and domestication

Asian rice (*Oryza sativa*) is native to a vast region extending from eastern India to southern China in which its wild progenitors grew in the early Holocene. In this territory, which lies within the tropical and sub-tropical monsoon rain belt, rice developed a surprising variability which allowed it to colonize quite different ecosystems. Wild rice is still present in many areas of the Ganges plain in India, in the northern regions of Burma, Thailand and Vietnam and in the continental and insular areas of South-East Asia[1].

The process of domestication took place in the centre of the plant's area of origin in communities of proto-farmers. After a first phase of simply gathering the seeds, they started to cultivate natural fields of wild rice, adopting over time a series of new practices aimed at manipulating the environment: sowing and harvesting certain species or varieties of plants, with clearance and tillage of soils. Wild rice cultivation exploited the ability of young plants to resist transplantation from one field to another. This characteristic may have developed early only in regions where, following heavy flooding, wild rice fields were periodically inundated by fairly rapid masses of water that were capable of uprooting young rice plants from their original locations and depositing them further downstream in muddy fields as they flowed away[2]. Observation of this phenomenon may have stimulated some groups of proto-farmers to exploit it to their own benefit and obtain wild rice fields in more accessible areas or on land closer to villages. This development may have occurred independently and perhaps even simultaneously in multiple locations in the same region to meet the food needs of different human groups. The choices made by the first farmers, who saw in wild rice a possible food source, changed the destiny of many populations, favouring the social and cultural growth of those groups which based their economy on rice[3].

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Cultivation and spread

The geography of the origin and spread of rice has received precise chronological confirmation from archaeological excavations conducted in prehistoric and protohistoric sites in many regions of Asia. In recent years, archaeologists have paid particular attention to the recovery of charred seeds and the search for plant impressions in pottery, bricks or the compact layers of clay that formed the floors of dwellings, in an attempt to locate the possible centre of the plant's domestication and the routes by which its cultivation spread[4]. In some cases, in order to identify traces of the presence of rice in archaeological deposits, samples of archaeological soil or fireplace ash have been examined in search of tiny practically indestructible particles of silica called phytoliths, which in the rice plant perform tasks of particular importance[5]. Similarly, genetic research has tried to clarify the complex history of the domestication and spread of this cereal[6]. The analysis and study of plant remains, seeds, impressions and phytoliths have made it possible to ascertain whether the finds were of wild or domesticated rice; in some cases, it has also been possible to establish which subspecies they belonged to[7].

Fig.1 - Aligrama (Pakistan), charred rice grains (*Oryza sativa*).

It has thus been demonstrated that already 10,000 years ago wild rice was a source of food for prehistoric populations in some regions of China, Korea, Thailand and Vietnam and some islands of Southeast Asia. We also know that the oldest remains of cultivated rice have been found in south-eastern China and date back to a period between 10,000 and 8,000 years ago[8]. The earliest evidence of rice cultivation in fields not submerged by water, nor irrigated, but whose humidity depended only on rainfall, has been found in northern China and dated to about 5,000 years ago. From the archaeological documentation we also know that, between the fourth and third millennia BC, the cultivation of rice underwent a rapid expansion towards the

south-eastern regions of continental Asia and towards the west, through India and Pakistan, reaching the upper valleys of the River Indus. Italian research has focused on a better understanding of pre-protohistoric agriculture through the analysis of plant remains and of straw and seeds impressions, including rice, found in the archaeological deposits of Ghalegay, Loebanr III, Barikot, Aligrama and Kalako-dherai in Swat (northern Pakistan) is based in the latter geographical context. The study of this rich archaeobotanical record has made it possible to document different phases of a single process of agricultural development that occurred in the area from the beginning of the third millennium BC[9].

The descent along the River Indus, reaching the present region of Baluchistan, occurred about a thousand years later and was probably the last migration of rice towards the West. Also in Pakistani Baluchistan, the contribution of Italian research has shed light on the cultivation of this cereal by an agricultural community settled in the site of Pirak, in the period between the end of the 2nd millennium and that of the 1st millennium BC[10].

Moving westwards, evidence concerning rice becomes more sporadic. This cereal is mentioned in a Middle-Assyrian tablet, dated to the 11th or 10th century BC, found at Tell Barri in northeastern Syria[11]. Further textual evidence, although in some cases ambiguous, is present in 8th - 7th century BC Neo-Assyrian archives and in 6th century BC biblical sources[12]. Diodorus Siculus (19.13.6), a Greek historian of the first century BC, refers to its cultivation in Susiana in the late fourth century BC. In a precise account of a conflict that took place in 318/317 between Eumenes of Cardia and Seleucus, the historian recounts that Eumenes, due to the absolute lack of grain, supplied his troops with rice, sesame and dates, products that the region provided in abundance[13]. The first ambassador of the Chinese Han dynasty in Central Asia noted in the second century BC, that rice grew in Parthia and Mesopotamia[14].

The earliest archaeobotanical evidence for rice consumption in the Near East comes from first century BC contexts investigated in the Ville Royal II, Susa. Charred rice grains were found on the floor of a Parthian period warehouse in the city[15], while further evidence of this cereal comes from glume imprints on brick fragments found in several sites in the Susa plain south of the River Dez, dating to a period between 25 BC and 250 AD[16].

From the descriptions given in The Periplus of the Erythraean Sea (14, 31, 37, 41), a Roman period guide dating to the first century AD, we know that wheat and rice were products that were traded along the routes of the Persian Gulf and the Red

Sea: they came from the regions of Ariacia (southern Afghanistan) and Barygaza (a harbour on the west coast of India) and were destined for the emporia of the Arabian Peninsula. The archaeobotanical evidence regarding rice in this area includes remains of desiccated grains, spikelets, and desiccated husks found during investigations conducted in Egyptian Red Sea ports, particularly in the 1st – 2nd and 4th – 6th century AD Roman levels of Berenice[17], and the 1st – 3rd century AD Roman levels and 11th – 15th century Islamic levels of Myos Hormos[18]. A single spikelet, however, was found in the Roman fort of Didymoi, in the eastern desert of Egypt[19]. In 2nd – 3rd century AD pre-Islamic layers at the site of Mleiha, in south-eastern Arabia, numerous grain remains were found either scattered in the archaeological deposits or gathered together in thickened masses, probably related to food leftovers[20].

Knowledge and cultivation of rice in the Mediterranean and Italy

The first reference to a bread made from rice appears in Philoctetes by the Greek tragic poet Sophocles in the 5th century BC, although the Classical Mediterranean world became acquainted with oriental rice mostly after the conquest of Asia by Alexander the Great. Theophrastus, a contemporary of Alexander, was the first to describe rice in his treatise on the history of plants (4.4.10). He spoke of it as a cereal that grew in water for a long time and whose grains were particularly suitable for boiling to meet the dietary needs of the peoples of Asia. The Greek geographer Strabo, who lived in the Roman imperial period, gives in his Geography (15.1.18) an even more detailed description credited to Aristobulus, Alexander's companion on his expeditions in Asia, according to whom rice was cultivated in closed and well-watered beds. The plant was four feet high, producing many ears and grains, and was harvested at sunset of the Pleiades, that is at the beginning of autumn, and then subjected to a winnowing similar to that of barley. According to Aristobulus, rice was cultivated in Bactria (in Afghanistan) and in the lands on the

Fig. 2 - Pirak (Pakistan), silicified rice spikelets (*Oryza sativa*).

lower courses of the Tigris and Euphrates where, evidently, it had arrived before the passage of Alexander's army. Although the geographical information relating to the distribution of rice cultivation reported in Strabo is considered by some authors to be unreliable[21], it can be said in any case that before the fourth century BC the cultivation of rice was practised in the Near East, but probably not in other areas of the Mediterranean basin.

In the Roman world rice was not known as a cereal suitable for human consumption, but rather as a medicinal product. In the form of a decoction, it was prescribed to treat stomach diseases as mentioned, as well as in a satire by the first century BC Roman poet Horace (*Sermones* 2.3.155)[22], in the first century medical texts of Dioscorides and by Galen in the second century[23]. A clear indication of the use of this cereal in the Roman world comes from the inscription *orissa* painted on an amphora (CIL IV 10756), found in a house in the Vesuvian city of Herculaneum, which testifies to its presence in southern Italy in 79 AD[24].

Fig. 3 - Pirak (Pakistan), siliceous rice glumes and rice glume impressions (*Oryza sativa*) from the archaeological deposit.

The archaeobotanical evidence of rice in the central-western Mediterranean basin is quite scarce. The earliest discovery comes from twelfth century BC levels at the Mycenaean centre of Tiryns, where a single non-charred grain of rice was found. It was interpretable as an importation, if not an intrusion[25]. For the Roman period it is so far absent in Italian territory, but is documented in the Roman colony of *Mursa*, in Lower Pannonia, now in Croatia. Here, in an early 2nd century archaeological context interpreted as a commercial installation located in the immediate vicinity of the colony, fragments of rice grains were found, as well as black pepper[26].

Rice has also been found in Central Europe in deposits of the same age, or in

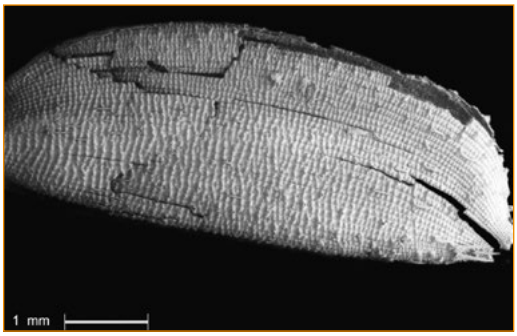
some cases slightly earlier; these are always imports found in Roman ritual or military contexts. Charred rice grains, probably used for medicinal purposes, were found in the area of a military hospital dating to the early 1st century located in the Roman legionary camp of *Novaesium* (Neuss am Rhein), on the bank of the Rhine in Germany[27]. From a *favissa*, a votive deposit dating from the second half of the 1st to the 2nd century, located within the sanctuary dedicated to Isis and the Magna Mater in *Mogontiacum*, the capital of the Roman province of Upper Germany, a single grain preliminarily identified as *Oryza sativa* was recovered[28]. Further evidence of the presence of this cereal comes from the Swiss site of Zurzach[29].

The oldest archaeobotanical evidence for rice during the 1st millennium also comes from various Central Asian contexts located along the so-called Silk Road, a set of trade routes linking East Asia with the Mediterranean. The oldest evidence of rice in this area comes from the Uzbek site of Khalchayan, where two charred grains of this cereal were found. Radiocarbon dating of these remains (1714-1756 cal yr BP) has allowed them to be dated to the Kushan period[30]. Archaeobotanical investigations carried out during excavations in three mainly medieval fortified settlements in southern Kazakhstan have documented the presence of rice, particularly in the 4th-5th century levels of Karaspan-tobe and the 7th century levels of Djuvan-tobe[31] and Konyr-tobe[32]. At the Tuzusai site in south-east Kazakhstan, numerous phytoliths from contexts dated to between the end of the 1st millennium BC and the 1st millennium AD have also been reported to include those from rice[33]. Charred remains of this cereal also come from the 5th-7th century levels of the Uzbek site of Munchak Tepe[34], as well as from the high-altitude mining settlement of Bazar-Dara (10th-11th century), in the Tajik Pamir[35]. Charred remains of rice are also attested in the Tibetan sites of Kaerdong (5th-7th century) and in the roughly contemporary site of Zebang[36], and also as funerary offerings in some burials in the Astana necropolis in Xinjiang, dating to the Tang dynasty (618-907)[37]. Some rice glumes were identified in the levels of the ancient city of Karakorum (12th-15th century), capital of the Mongol empire. They were also linked to importation[38].

Egypt was the first step on the route by which rice cultivation spread in the Mediterranean. It was Arab colonisation that brought the crop from Egypt to Spain, probably shortly after 1000 AD. The Arab conquest of the western Mediterranean favoured the spread of rice cultivation, both to meet the needs of the Arabs themselves and because rice was beginning to become part of the eating habits of the conquered peoples.

Numerous sources from the early Islamic period attest to the widespread cultivation of this cereal in the wetlands or areas with a certain availability of water in the Middle East, at the end of the first and beginning of the second millennium[39]. Archaeobotanical finds in the Islamic levels of various rural sites along the River Euphrates in Turkey[40] and Syria date to the same period[41].

Fig. 4 - Pirak (Pakistan), rice glume (*Oryza sativa*). SEM LEO 435 VP.



Rice was known in Italy long before its cultivation began; it was considered a spice and was sold for medicinal purposes. Some traces of the presence of rice in Italy can be found in 13th century documents, but it is not clear to whom the introduction of this cereal into the peninsula was due. To date, the earliest archaeobotanical evidence of rice consists of chaff remains found during investigations carried out in the 12th century Civic Tower of Pavia. These remains have been interpreted as the residue of husking imported unbleached rice, which is more resistant to pest attacks[42]. Further indications of the presence of this cereal come, lastly, from investigations conducted in the archaeological area of Classe, the harbour of the Late Antique city of Ravenna. Analysis of the fills of a pit (15th-17th century), probably due to agricultural activity, allowed the identification of charred rice remains – also found in a nearby 8th century food storage context, which were however considered to be an infiltration[43].

The earliest document demonstrating rice cultivation in Italy dates to 1468 when, during the Medici period, landowner Leonardo Colto dei Colti asked the "Signori Priori della libertà e Gonfalonieri della giustizia del popolo fiorentino" to guarantee the availability of water for rice cultivation in the Serchio plain near Pisa. A letter from Galeazzo Maria Sforza, promising to send twelve sacks of rice to the Duke of Ferrara, dates back to 1475. With the beginning of cultivation in Lombardy, rice went from being used exclusively by apothecaries to becoming part of the Lombard diet[44].

From Lombardy rice quickly spread to all the marshy areas of the Po Valley. However, this spread was followed by an increase in the number of cases of malaria, and many measures were taken to limit its cultivation near towns. Despite the bans, rice cultivation continued to expand because its yield and hence its profitability com-

pared to traditional cereals was so high that the economic factor prevailed over the risk of disease. Rice was therefore immediately popular, despite the risks involved in growing it, the duties and the bans, and its success was probably also due to the food crisis that occurred throughout the western Mediterranean in the 16th century. Famines alternated with plagues, harvests were scarce and it was not easy to get supplies abroad. Under these conditions, rice was seen as the cereal that could somehow meet the demands of a population on the brink of starvation.

From the Po Valley, rice cultivation spread to Emilia and Tuscany, where however penetration was slower due to the reduced availability of water for its cultivation. By the end of the 17th century, rice was widely cultivated in the Po Valley, Tuscany and some areas of Calabria and Sicily. In 1700, rice paddies in the Milan area covered an area of more than 20,000 hectares, while a century and a half later, rice paddies in the Vercelli area alone reached 30,000 hectares.

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From paddy...to white rice[1]

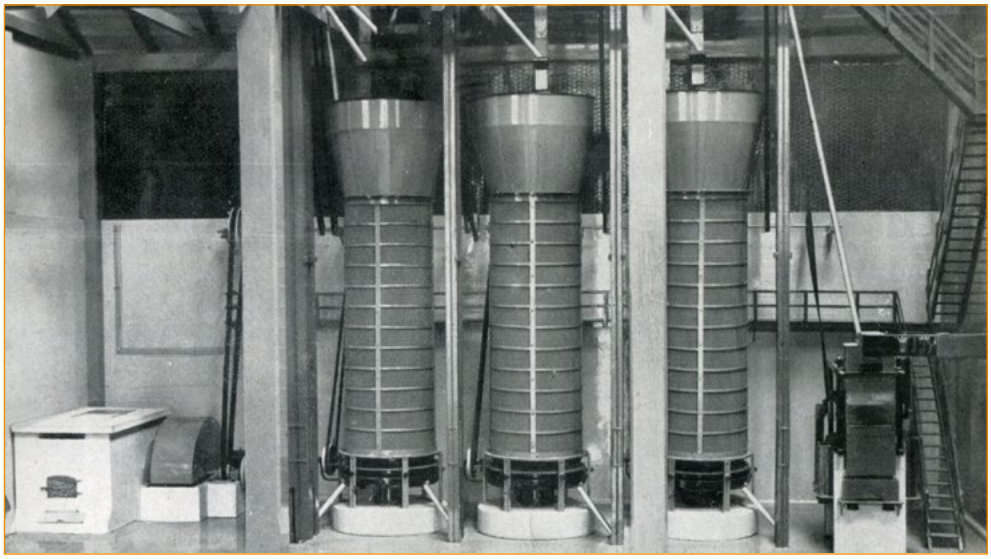
The introduction of rice cultivation in Italy was very advantageous since the beginning: this was because of the high availability of water in the Po valley, and the favourable ground conformation where the water delivery in some areas followed the natural slope and the free water flow favoured inexpensive and productive harvest. However, the effective use of the rice grain nutrients was not easy for many reasons. The grain water content after rice harvesting, prevents a long and healthy preservation of the paddy rice: in order to favour drying, rice farmers were forced to set up wide farmyards close to the fields. Just after harvesting, huge paddy rice amounts were spread on the pavement, in layers not too thick, exposed to sun in the open air, continuously moved upside down to decrease the water content (Fig.1). The early autumn rains were harmful to a perfect upshot of the drying process, as the method itself had critical weaknesses. Only with the development of the drying units in the late XIX century, the paddy yield loss notably decreased in rainy autumn seasons (Fig.2). Unlike all other cereals, rice is consumed not as flour after milling, but as entire grain, and this use was not easy to obtain, because of the specific rice grain structure, compared to wheat. Each spikelet – the paddy rice – consists of a kernel enclosed in bracts (the glumes): the glumes close the grain throughout the grain ripening time, resulting in a tight and permanent closure at complete maturation, as a tough cellulosic layer.

Fig. 1 - Paddy rice drying on the farmyard.

Source: R. Piacco, Il riso, Ramo editoriale degli Agricoltori, Rome 1958.

1 Giuseppe Nocca - agronomo e storico dell'alimentazione

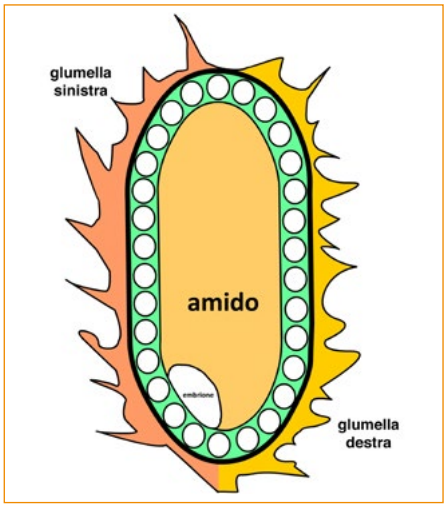
Fig. 2 – Guidetti Drying Unit



Source: R. Piacco, Il riso, Ramo editoriale degli Agricoltori, Rome 1958.

Figure 3 shows a schematic drawing of a rice spikelet anatomy: the side glumes (hull) were outlined unevenly and coloured in two different shades. They enclose the kernel, consisting of a surface thick bran layer, containing the aleurone layer, a starchy nucleus, and the embryo. The starchy endosperm, and its nutritional content, can be available only after removal of the glumes and the outer layers (hull and aleurone layer), immediately after harvest. It is indeed impossible, for the human digestive mechanism, to absorb the kernel complex carbohydrates if enclosed in the tough hull layer, made of cellulose resistant to stomach acids.

Fig. 3 - Schematic drawing of a rice husked kernel



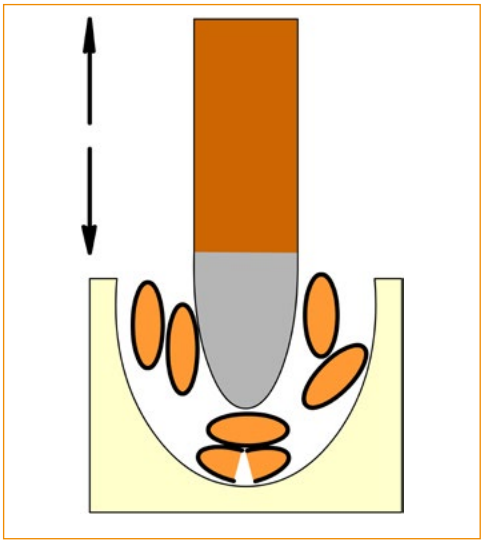
Source: author

It was not easy, in the XVI century, to carry out the de-husking process to whole grain rice without damaging the

original paddy, and a subsequent further removal of the aleurone layer till white rice, as a suitable and reliable technology able to work small grains like rice was not yet available. The husk removing was undoubtedly the easiest work to do. What are called the "*pile*", a sort of workshop in the rice farm, in which the kernels were peeled, were realized at first. The rice outer hulls are easily removed with simple rubbing, even by hand pressure only. But it was necessary to build a kind of pestle to obtain suitable and increased grain yield; this was achieved by a rice pestle, alternatively moved up and down, powered by a water wheel set in a river. During the Renaissance period, many "*pile*" were built, mainly in the Po valley, where even a small difference in height between the level of water channels available, could be used to set the water wheel.

Inside the workshops, stone bowl-shaped mortars were set, able to contain small amounts of paddy rice to be dehusked. A wooden pointed pole, covered with metal (the pestle), could keep on moving up and down into the mortar, without touching the bottom, stopping exactly at 26 mm. Figure 4 schematically represents the process called "*sbramatura*" (dehusking). The pressure of up-and-down movement of the pestle makes a friction between the pestle and the paddy grains, among the paddy grains mixture, and between the paddy grains and the side mortar. The outcome is a mix of grains and hulls, that is called "*lolla*". Figure 4 also shows the eventual broken grains (brokens) caused by pestle's pressure. A double following step includes first a separation of the hull from the whole rice (*or brown rice*), obtained with sieves of different gauges, and the separation of the whole rice from the broken rice. Broken rice is a consequent outcome of the process and the brokens were utilized to feed livestock. The hull was a perfect fuel because of its cellulose content (45,58% of cellulose),

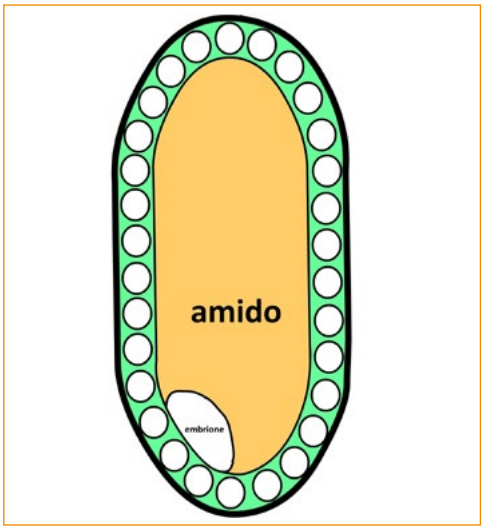
Fig. 4 - Pattern of punch-pole in a pestle



Source: author

suitable for combustion. The whole rice produced according to the described process likely fed the local populations for many centuries, including, besides the starchy endosperm and the storage proteins, its germ with bioactive molecules, minerals and lipids and the dietary fibers of the outer layers (pericarp) (Fig.5).

Fig. 5 - Schematic drawing of a whole rice kernel (brown rice)



Source: author

It is still impossible to date the beginning of true rice milling process, with removal of pericarp and embryo from the whole rice ending to white rice (milled rice) in order to select the starchy endosperm for culinary purposes. The process is obtained through an abrasive bran removal machine, indicated as "*abrasive whitener*". There are no examples left of ancient whiteners with abrasive helix screw, adopted to polish the rice grains by means of friction between the grain surfaces. Figure 6 shows the working method of the ancient whiteners with screw. Inside a hopper a worm screw pushes down the rice grains bulk already dehulled. The screw keeps on moving down the kernels, until the bottom, when they slowly go up and alongside, according to the centrifugal driving force, following a return to the screw central axis with a circular movement. The final result is the white rice, in which the polished grain is cleaned of the outer layers (pericarp and aleurone layer) - the so called "pula", the bran - until the appearance of the white shade of the inner starchy endosperm (Fig. 7). This polishing method was not always efficient, and it was necessary to wait the early XIX century when a new type of whiteners, the so called Amburgo Minghetti, were realized.

The new working method was based on a lapped truncated cone-shaped stone, known as magnesian concrete. Figure 8 schematically shows the patented working method at that time. Inside a closed cylindrical metal box is set the mentioned lapped truncated cone-shaped stone; the stone is enclosed in a

Fig. 6 - Pattern of action of a helix whitener

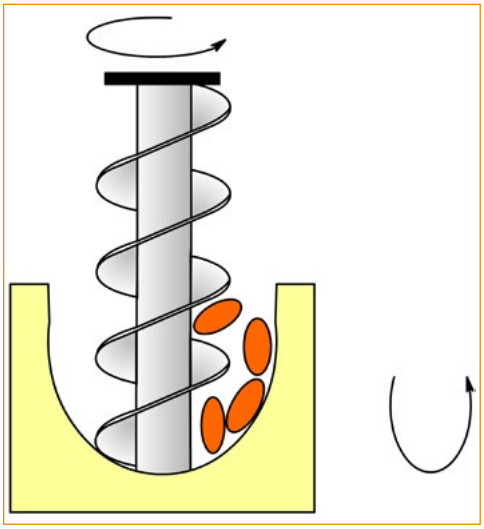
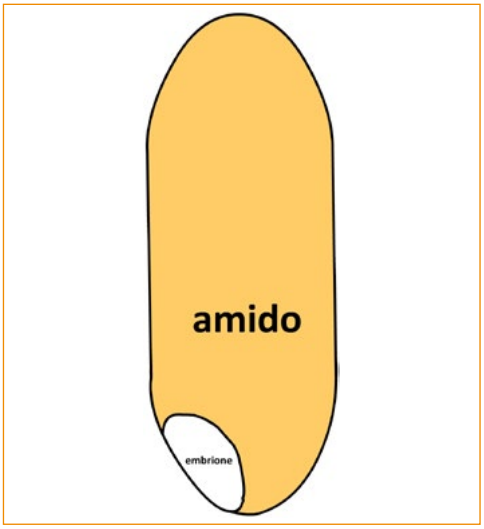


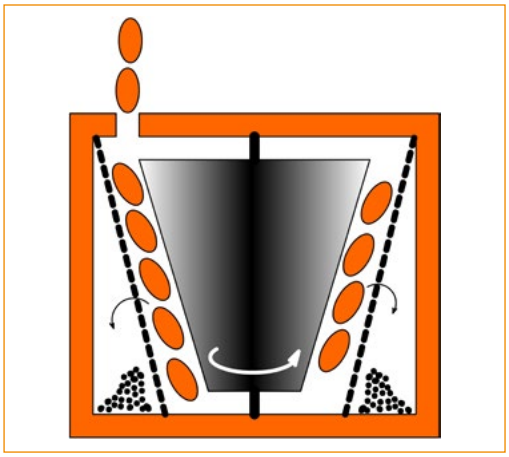
Fig. 7 - Schematic drawing of a white rice kernel (polished rice) .



Source: author

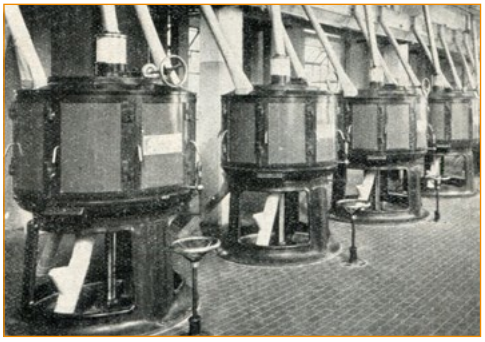
perforated metal basket and it turns. The whole rice grains come into the basket from above and the stone gives them a rapid circular movement: the grains clash each other, crashing the side metal basket. The lapped stone surface steady rubs the grains, they crash each other and rub on the metal basket. The circular motion makes a centrifugal force that prevents the falling of the grains and it allows the removal of the outer layers (the pericarp). Through the metal net the dusty wastes of "*pula*" separate and settle at the bottom of the cylindrical box. The working time of turning stone is settled by the skilled workers, depending on the degree of polishing desired. The Amburgo

Fig. 8 - Pattern of action of the Amburgo Minghetti whiteners



Source: author

Fig. 9 - Amburgo Minghetti whiteners in series



Fonte: R. Piacco, Il riso, Ramo editoriale degli Agricoltori Roma 1958.

Minghetti whiteners were lined up, so that the rubbing work, till the final degree, was carried out through several steps. The first pericarp abrasion step yields the "*pula*", a following step gives the "*farinacci*", formed of the smaller particles and rich in protein and mineral salts. Table 1 reports the analytic data at that time, with the proximate composition of the husk left over particles.

Tab. 1 – Proximate composition of some outer particles left over the "sbramatura" and the "sbiancatura"

Left over fractions	Ashes	Proteins	Insoluble fiber	Lipids
Hull	17.06	3.28	45.58	1.13
Chaff 1°	11.09	11.94	10.67	15.80
Chaff 2°	14.15	12.62	8.8	14.86
Pericarp powder	9.65	12.81	6.15	18.88
Pericarp powder 4°	6.15	12.31	2.30	10.38

Source: R. Piacco, Il riso, Ramo editoriale degli Agricoltori, Roma 1958.

From the data reported in table 1, it is easy to understand how the polishing time determines the changes in composition of the various fractions. Longer times of polishing yield a "*pula*" richer in fats and proteins, whilst longer abrasion times yield fractions poorer in fats , fiber and ashes, though still rich in proteins. If the whitening process were too long, the rice grains would lose the pericarp and also a higher amount of starch, in the form of rice flour. Otherwise, with a shorter inappropriate polishing, whole grains with different colours, depending on the residual presence of pericarp layers, would be obtained. During the whitening process, the embryo loss occurs; the embryo is rich in polyunsaturated lipids that make the rice not preservable.

This short report allows us to realize that the desirable white cereal grain was obtained not before the mid XIX century, because the technology needed a powerful energy to move the screw or the lapped stone. Moreover, to our knowledge, there

are no studies showing the stone overheating and the residual effects on the nutritional and organoleptic properties of the white rice obtained. On the other hand, the dehusking technology adopted, the so called "*sbramatura*", developed in the late Renaissance, allowed the populations to eat an excellent whole rice, obtained without frictions and kernel tissues overheating. The later technology evolution calls for reflection on the true nutritional benefits derived from the different industry and consumer choice for the cereal quality we eat today.

Rice, a faithful ally in the kitchen[1]

Rice has the virtue of being a faithful ally in the kitchen, because it always allows me to enhance many flavors and as many emotions within a dish, since it is a cozy ingredient with any food you want to prepare it. For this reason, rice rebels by untying itself from all the other ingredients if you do not respect it in an authentic way.

I learned as a young man to have respect for this element, and today it has become my workhorse in the activities that see me engaged above all at the Italian Embassies abroad.

The recipe that I present to you, "Brown rice sauteed with cooked sole and eggplant pulp with mint and leafy vegetable extract", represents a current food model che utilizza il riso integrale in sostituzione del pane; it is served, in fact, with a fillet of sole, aubergines and a vegetable extract.

This is a model of healthy cuisine that does not give up on taste and which tells about the Genomic kitchen, a fundamental tool of Nutriscience.

1 Renato Bernardi (chef) - www.chefberardi.it

Ingredients for 4 people
Brown rice 250g
Sole 400g
Chicory mix beets spinach 300g
Eggplants 200g
Leek 50g
Fresh mint 30g
Extra virgin olive oil and salt to taste

Method

Lightly boil the leafy vegetables, extract the juice with kitchen extractor and place it in a pan with extra virgin olive oil. Cook the sole fillets in it. Boil the rice in lightly salted water, place it in a glass bowl, and season it with mint. Cook the leek in a non-stick pann, add the diced eggplants, add the brown rice and sauté quickly. Serve the seasoned brown rice, side by side with the fish. Bring to the table and serve.

Brown rice sauteed with cooked sole and eggplant pulp with mint and leafy vegetable extract

Ingredients for 4 people
Vialone nano rice 250g
Crabmeat 200g
Saffron pistils 3g
Prosecco 50ml
Vegetable margarine 20g
Carrot, celery and onion to taste
Extra virgin olive oil to tast
Salt to taste
Peppercorns to taste

Method

Wash the crabs and strip them. Make a broth by putting inside carapace, herbs, peppercorns in cold water, bring to a boil over low heat.

Brown the chopped onion and squeezed onion in a pan with a drizzle of extra virgin olive oil; toast the rice inside, sprinkle with the prosecco and add the saffron.

When cooked, stir in the vegetable margarine and add more saffron where needed. Serve.

Vialone nano rice with saffron with prosecco and crabmeat

Ingredients for 4 people
Black rice 200g
Red lentils 80g
Celeriac 150g
Red tomato 100g
Basil 30g
Aromatic herbs to taste
Salt to taste
Pepper to taste
Extra virgin olive oil to taste

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Method

Leave the lentils to soak for at least 4 hours. Then put them in a pot for cooking, add water and herbs (except carrots), bring to a boil, then reduce the heat and simmer. stir frequently to prevent the lentils from sticking to the bottom of the pot. Once ready, drain and let them cool.

In the meantime, wash, peel and cut the celeriac into strips, cut the tomato into cubes and put them both in a glass bowl. Add the drained lentils, salt and pepper. Arrange the rice on a plate, place the lentils next to it, decorate to taste and serve.

Black rice with basil red lentils salad celeriac and tomato

APPENDIX

The many non-food uses of rice[1]

Rice, as we have seen, is one of the most widespread and versatile cereals, rich in various nutraceutical properties. Its uses are numerous also in fields other than human and animal nutrition, different are also the products realized from this cereal: rice oil, rice starch, rice flour, rice milk, rice paste, rice vinegar, rice «beer» (for ex. *sake*, the Japanese drink made from the fermentation of rice, water and koji spores), rice powder, rice straw, rice paper, etc. …. In short, nothing is thrown away from rice, but almost everything is used and / or everything is transformed.

In personal care rice water is considered, for example, an exceptional product for women's beauty and skin and hair care; this is a natural remedy already known in ancient civilizations, especially in Asia. It is an effective and inexpensive treatment that can also be prepared at home, ensuring a good supply of antioxidants, vitamins (especially E) and minerals (calcium, phosphorus, iron, potassium and zinc). Also in the cosmetic field, rice oil is used (as a make-up remover or as a treatment against stretch marks) and rice starch powder (it closes the pores and makes the finish more opaque, thanks to its absorbent properties of water and sebum).

There are also several and various practical advice, easily available on the web, concerning further uses of rice at home, always for non-food purposes, such as for example: to massage sore muscles or to relax; to warm hands and feet with hot compresses; to build games for children (for ex. nice maracas) or for cats. Rice is also used to protect household tools from rust; to reactivate wet appliances (mobile phone); to clean bottles and jars; to check that the frying oil is hot enough; to anticipate the ripening of unripe fruit; to remove moisture from the salt; to clean the coffee grinder or silverware; to make a natural glue (basmati rice is especially recommended); to eliminate the classic incrustations in the kitchen using rice as an abrasive sponge or to eliminate bad smells from plastic or glass food containers.

In the energy sector some rice by-products (such as straw, husk and chaff) are

1 By Paola Sarcina (creator and director of the Cerealia festival)

used as fuel and for district heating networks. In recent years a famous car manufacturer has started experimenting with alternative and more sustainable materials: building automotive elements starting from the rice husk, which constitutes 20% of the total rice harvest and is usually disposed of. Through this experimentation the husk is transformed into Oryzite, obtaining a material that, combined with other thermoplastic compounds can be modeled to create some car interior coatings which, in addition to being more ecological, are lighter and more performing than traditional synthetic plastics.

Rice straw is a raw material widespread all over the world that finds different uses, some come to us from traditional cultures, others are more recent thanks to the growing sensitivity for the recovery and reuse of materials and for sustainability and the circular economy. In fact, in the last ten years a process of development of efficient and sustainable systems in the rice production chain has started, so that the life cycle of the cereal does not close only with the part destined for production for food consumption, but it is possible to give new life to everything that remains in the field after the harvest, respecting sustainable, environmental and socio-economic development. Hence also the use of rice straw in bio-architecture (eco-bricks, panels, etc.): the low thermal transmittance value of the rice straw bale, the strong insulating capacity of prefabricated frames in rice straw and wood, the capacity to carry loads and the perfect breathability of the wooden and straw walls of this cereal. Furthermore, the chemical composition of the rice straw has a high concentration in silica which makes it durable and non-rotting. Rice straw is a material with a high thermal insulation and sound absorbing power and can be used in anti-seismic structures. Then by combining the rice straw with the wool panels for green building are created through a bio-composite in which the wool acts as a protein matrix responsible for the cohesion between the fibers, while the rice straw constitutes the reinforcing fiber. The described technique is the result of a research project carried out by the CNR (*RiceRes*) which also concerns the experimentation of the use of husk for tires and other applications. The *RiceRes* research project, in particular on rice husks, also provides for further applications in the fields of nutraceuticals, cosmetics and pharmacology.

Finally, from rice straw, objects for the home and furnishings are produced such as brooms, tatamis, chair covers, shoe soles, baskets, padding for pillows and mattresses, booths. In Thailand rice straw is now at the center of the eco-sustainable business project of Jaruwan Khammuang, founder of Fang Thai, whose technology makes it

possible to produce paper from rice paddies, recycling up to 300 tons of agricultural waste per year. The straw fibers are used and transformed into packaging, notebooks and paper tableware (biodegradable disposable plates and cups).

To conclude, here an artistic curiosity: in Japan, in the Niigata prefecture, famous for its rice fields, the Wara Art Festival has been held every year since 2008, featuring the rice straw left in the field after harvest (*wara*). Straw is woven with great skill to create giant sculptures made by the students of Musashino Art University (MAU). I would like to suggest an idea, hoping that someone will grasp it: why not think of a twinning between the provinces of Pavia and that of Niigata, to start a similar festival in Italy too, involving young Italian students in an artistic project with the MAU students. If someone should take this suggestion, Cerealia festival will be happy to join the project!

A bridge to the East: PROMOItalia Partner of the Cerealia festival in China[1]

For the official presentation of 2018 Year of Italian Food in the World (MIPAF / MIBACT, Rome 20.02.2018) and also based on the indications emerged during talks with the Institutions there, the idea of setting up a Focus Group was born. In a foreign territory such as China, very far not only geographically, it could be interested to collect the experiences of those who deal with and are interested in Italian food in various ways, in all possible facets and meanings: nutrition, emotion, knowledge, sharing, territory and environment.

The associative tool seemed the most natural and the most tested to gather all the voices of those involved in Italian food in China - producers, distributors, journalists, bloggers, restaurateurs, chefs, pizza chefs, pastry chefs, bakers, sommeliers, agronomists, food technicians, nutritionists. In Shanghai in November 2018, based on the initiative of Cristina Corsini and Giovanna Sangiuolo, founders and respectively President and Vice President / representative in Italy, the Association for the Promotion of the Enogastronomic Culture and the Enhancement of the Italian Catering Technique was born in the territory of the People's Republic of China, Hong Kong and Macao. In the initials, PROMOItalia was presented by the Director of the Italian Cultural Institute in Shanghai Alberto Manai to a parterre of companies and exponents of the Italian Chamber of Commerce in China, with the hope that the newborn Association could contribute to establishing stable relationships between all Italian food operators in China, overcoming the boundaries of the different product sectors, adopting common institutional / business / consumer targets, in a network logic where analysis, study, research, training, business and markets converge.

That dream became real in less than three years. We can say to be happily fulfilled. Today PROMOItalia, which has added the word food to the institutional logo, is the only non-profit actor in China that has proven capable of continuously carrying out annual programs of activities in the country, in addition to the annual periodic events provided by the MAECI or the MISE calendar (*Week of Italian Cuisine in the World / Authentic Italian Table*), bypassing the logic of mere conviviality that often limits the elitist factions of the promotion of F&B or the sparse nature of presences not locally rooted.

1 Cristina Corsini and Giovanna Sangiuolo (President and vice President of Italy PROMOItalia) - www.promoitaliafood.org

PROMOItalia promotes Italian food in China as a valorization of the cultural, economic, social and anthropological heritage that is expressed in Italian food, even before the focus on individual products and/or producers. Its strategy in the country is based on continuous and constant cultural activities shared between Italian and Chinese restaurateurs offering Italian cuisine, with the organization of events, educational programs, making public engagement. PROMOItalia also identified new communication formats in China to promote Italian food, such as the *Italy/China Forum on Italian Cuisine and the Mediterranean Diet* (III edition in 2022) and presented in China the *Vegetable Festoons of the Loggia of Cupid and Psyche of Villa Farnesina* representing the first botanical atlas in the world, created by Raffaello Sanzio and Giovanni da Udine.

PROMOItalia today collaborates with primary institutions (among the most recent, the Accademia Nazionale dei Lincei, the CNR Istitute of Pisa, the ASACERT, the Confederation of Italians in the World) and joining the Cerealia Festival Network, as a Partner for China, on the assumption of awareness of the validity of the participatory economy model. It strengthened the Association's commitment to the involvement of different actors, public and private, according to methods of interaction that are always different and adhering to the contexts and subjects involved from time to time, allowing the realization of large-scale events, projects and initiatives with great recognition in Middle-earth.

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