# Rice quality in the European Union

The European Union
is almost self-sufficient
in terms of rice volumes
produced, but is far from
meeting needs for high
quality varieties.
Round- and medium-grain
rices, which generally
become soft when cooked,
are mainly produced
in the European Union,
while the greatest demand
is for long- and slender-
grain rices that remain
firm when cooked.
Production options should
thus be adjusted, with
in-depth research on
varieties most preferred
by consumers and the
food industry.

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There has been steady European demand for cereals and cereal-based products for human consumption, but rice is an exception. Its share of the market is rising at the same rate as in USA. For 25 years, rice consumption has been expanding beyond the traditional rice-growing areas, especially in Africa and Europe.

## Rice production and trade in Europe

Rice is grown in 10 European countries, along with the Russian Federation and Ukraine. According to FAO statistics (1993), rice production in this whole zone was 3.17 million t/annum in 1992, or
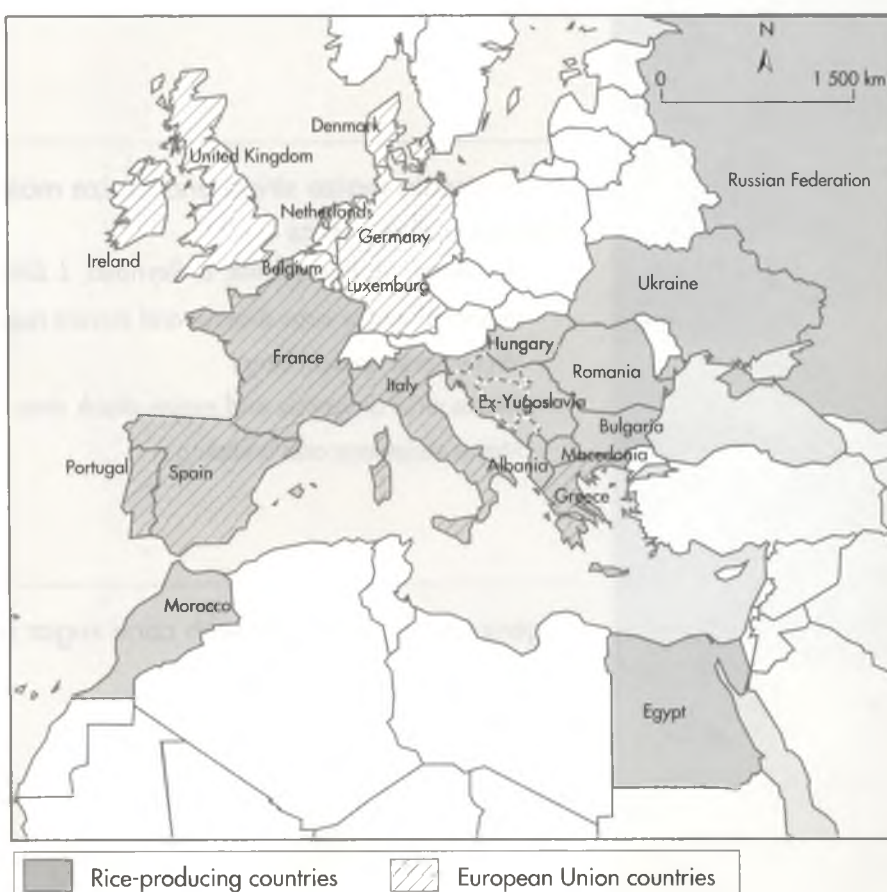


Figure 1. Rice-producing countries in Europe and the Mediterranean region.

0.6% of world production, which was estimated at 528 million t for the same year (Table 1; Figure 1).

There are five rice-producing countries in the European Union (EU): Italy (59% of the EU output), Spain (25%), France (5.5%), Portugal (5%) and Greece (4.5%). In 1992, they produced 2.21 million t of paddy rice, equivalent to about 1.46 million t of white rice, on 361 000 ha of rice cropland.

European Union, where annual consumption is estimated to be 1.5 million t of white rice equivalent, has an apparent mean annual self-sufficiency rate of 85-90% for rice production/consumption. In fact, there is excess production of round- and medium-grain rice, which are traditional crops and represent 83% of the overall European production.

However, there is a marked deficit of slender long-grain indica rice, generally grown in the tropics, due to the high domestic market demand. European Union thus exports about 400 000 t and imports about 600 000 t of white rice equivalent. Half of the imports are husked (i.e. "cargo") indica varieties from USA (53%), Thailand (15%), India/Pakistan (14%) and Surinam. The other half is made up of rice from various origins that is re-exported after milling or whitening. EU imports represent 4% of the 15 million t world rice trade.

Finally, the needs of the three countries — Austria, Finland and Sweden — that are to join the EU in 1997, and of Norway, are estimated at 140 000 t of white rice equivalent (Table 2). The rice production sector in Europe, under present conditions, will only be able to partially meet this increased demand with European japonica varieties. This means that there will be more imports of long-grain indica varieties, thus further increasing the EU deficit.

# European Union consumption patterns

The increase in rice consumption and changing habits are part of a general dietary diversification trend that has been noted in Europe.

## Changing food habits

Rice formerly had a staple food status, but only within producing regions, and was considered as a luxury dessert product elsewhere. It is now of interest for diversifying conventional diets. Consumption patterns have changed; there is increasing consumer demand for high quality varieties and rice dishes, with a willingness to pay more for these products. Traders once classified rice as a product with no market potential, whereas it is now considered as a dynamic

Table 1. Paddy rice production in Europe and the Mediterranean countries in 1992 (FAO, 1993).

| Country | Area (1 000 ha) | Yield (t/ha) | Production (1 000 t) |
|---|---|---|---|
| France | 24 | 5.3 | 125 |
| Greece | 14 | 7.0 | 101 |
| Italy | 216 | 6.0 | 1 314 |
| Portugal | 21 | 5.2 | 110 |
| Spain | 86 | 6.5 | 554 |
| TOTAL European Union | 361 | 6.1 | 2 214 |
| Albania | 1 | 0.5 | 1 |
| Bulgaria | 5 | 2.5 | 11 |
| Hungary | 5 | 3.11 | 15 |
| Romania | 16 | 2.4 | 39 |
| Yugoslavia, SFR | - | - | - |
| Macedonia, FR | 8 | 5.0 | 43 |
| **TOTAL Europe** | **397** | **5.6** | **2 323** |
| Russian Federation | 265 | 2.8 | 754 |
| Ukraine | 24 | 3.8 | 92 |
| Egypt | 511 | 7.6 | 3 910 |
| Morocco | 7 | 3.0 | 22 |

Table 2. Estimate of 1993-1994 imports of white rice equivalent by future European Union members and Norway (source: *Marchés rizicoles Hebdo* n° 412).

| Country | Population (1 000 inhabitants) | Imports (1 000 t) | Consumption per capita (kg/year) |
|---|---|---|---|
| Austria | 7.7 | 66.7 | 8.7 |
| Finland | 5.0 | 20.9 | 4.2 |
| Sweden | 8.5 | 39.6 | 4.7 |
| Norway | 4.2 | 12.0 | 2.8 |
| **TOTAL** | **25.4** | **139.2** | **5.5** |

Table 3. Mean per capita consumption of white rice equivalent in European Union from 1970 to 1990 (kg/person/year).
(Source: OECD, CEC, Eurostat, from CHATAIGNIER, 1991).

| Country | 1970 | 1980 | 1990 | Annual increase (%) relative to 1970 |
|---|---|---|---|---|
| United Kingdom | 1.4 | 3.3 | 3.7 | 8.2 |
| Germany | 1.6 | 2.0 | 3.4 | 5.6 |
| Ireland | 1.0 | 2.1 | 1.8 | 4.0 |
| Belgium + Luxemburg | 1.6 | 4.2 | 3.5 | 5.9 |
| Netherlands | 3.0 | 3.5 | 5.1 | 3.5 |
| Denmark | 1.6 | 2.1 | 2.7 | 3.4 |
| France | 2.5 | 3.7 | 4.1 | 3.2 |
| Italy | 3.9 | 4.6 | 5.7 | 2.4 |
| Spain | - | 6.3 | 6.3 | - |
| Portugal | - | 15.7 | 15.1 | - |
| Greece | - | 5.2 | 5.1 | - |

# Indica or japonica?

Six groups of Asian cultivated rice *(Oryza sativa)* have been characterized using molecular markers (GLASZMANN *et al.,* 1984). *Japonica* and *indica* are the most important of these groups. The four other groups are not as well known but scientists and agriculture and food industries are now taking an interest in them for their special qualities (wild and aromatic rices), i.e. aus, sadri, basmati and two groups of floating rices from India and Bangladesh.

### *Indica* group

The *indica* group includes tropical rices that are generally grown under aquatic conditions in Asia. They have often been considered as unsuitable for modern agriculture because of their poor response to high fertilizer input. Nevertheless, the International Rice Research Institute (IRRI) has extended some high-performance varieties to intensive cropping systems: IR refers to *indica* varieties.

The poor adaptability of these rices to some harsh soil conditions and their susceptibility to low temperatures has hindered their extension.

*Indica* rice varieties tend to have longer and more slender grains than those of the other groups, but this is not always the case.

### *Japonica* group

The *japonica* group is grown in mountainous regions of Asia, temperate parts of northern China, Korea, Japan and the Mediterranean region. Rainfed varieties are dominant in Latin America and western Africa.

*Japonica* rices are of considerable interest for certain qualities such as cold and drought resistance, and their adaptability to poor soils.

There is marked morphological variability between *japonica* varieties, e.g. the group includes temperate short-stemmed, round-grain varieties of Korea and Japan that grow well under intensive irrigated cropping conditions, as well as long-stemmed, large-grain varieties grown in the tropics.

Grain-shapes in this group also vary, despite general opinion, they are not always round or large, e.g. *japonica* rice grown in southern USA, under irrigated subtropical conditions, has a long and slender grain. However, rice varieties in this group generally have round, short or medium grains.

### What is indica-type rice?

European Union has decided to classify all slender long-grain rices within the indica type category, i.e. white rice with grains longer than 6 mm and a length/width ratio of more than 3 mm. This encompasses most varieties in the *indica* group and some in the *japonica* group, recently selected varieties in particular.

easy-to-cook product. Rice is a food in itself, of considerable interest for manufacturers seeking new food products.

There are no longer clearcut differences in consumption patterns between southern Europe (rice producers) and northern Europe (rice importers). The increased rice consumption in the North corresponds to lower potato and cooked vegetable consumption. Rice, as pasta, is thus a supplementary source of carbohydrates and a high energy food.

Rice cooking methods can differ between regions and depend on the rice dish prepared. They are also currently changing with the increasing consumption of long-grain indica rices. Round- and medium-grain japonica rices are generally used in the preparation of various meals and soups in southern European rice-producing regions where these varieties grow well. For instance, bulky long-grain *japonica* varieties produced in Italy are used for preparing risotto.

Swelling of rice after cooking is considered very important and the latter varieties are usually cooked in small quantities of water to avoid loss of solids through drainage. In contrast, parboiled and indica-type rices do not show marked loss of solids after cooking and are thus often cooked in excessive quantities of water in most parts of Europe.

Consumers generally prefer firm cooked rice. Hence, rice cookers developed in Japan and USA have recently become very popular for home cooking. The water quantity and cooking time are controlled automatically according to the quantity of rice to cook. Rice cooked by this technique is firmer.

Traders currently consider that, unless there is substantial investment in research for alternative uses and in marketing, the only future for round-grain rice will be for making cakes and flour. Medium-grain rices seem to be limited to traditional preparations such as paella in Spain and risotto in Italy.

# Research on aromatic rice

In France, the Laboratoire des Substances Naturelles, ENSIA (Ecole nationale supérieure des industries alimentaires, Massy, France), in collaboration with the Centre de coopération internationale en recherche agronomique pour le développement (CIRAD, France), are developing an improved technique to extract and identify all aromatic compounds from several varieties of rice marketed in Europe. Genetic analyses to characterize aromatic rices are currently under way, as part of a thesis study, at the Laboratoire de technologie des céréales (CIRAD), with the support of ENSIA.

The Flour and Milling and Baking Research Association (FMBRA, United Kingdom) has used an image analysis technique to assess, in variety blends, alteration of aromatic rices by non-aromatic varieties (WHITWORTH, 1993). They have also used the Rapid Visco Analyzer to measure viscosity of rice slurries. The results indicated that there is some relationship between this viscosity and the presence of aromatic compounds.

Other studies were carried out some 10 years ago in USA to extract aromas, identify the components and even synthesize acetyl-2-pyrroline1, the main compound of this aroma.

## Consumption rates

Rice consumption has increased at a faster rate in northern European countries where people are not traditional rice consumers, as compared to southern Europe. Consumption reached 3.5 kg/person in northern Europe in 1990. However, rates are still below 5.7 kg in Italy, 6.3 kg in Spain and 7 kg in USA (Table 3). It is predicted that rice consumption will continue to rise in northern Europe and gradually level off in southern Europe.

In Italy, annual rice consumption per inhabitant includes about 5 kg of *japonica* rice (round- and medium-grain varieties) and 300 g of indica rice (slender long-grain varieties). Imported long-grain rice is generally preferred in northern Europe. In United Kingdom, the mean annual rice consumption per person includes 700 g of European *japonica* rice and 3.7 kg of indica rice (1993-1994 data; Table 4).

## How can production be adjusted?

Over the last 20 years, producers have made efforts to adjust their production to meet domestic market demand for long-grain rice, especially in Italy, Spain and France.

In Italy, cropping of round-grain (i.e. short-grain) rice dropped from 70%

of the overall cultivation zone in the 1940s to 12% in 1989. Over the same period, long-grain rice cropping in Italy increased to 60% in 1989. In France, 65% of the area was cropped with round-grain varieties in 1980, and only 15% in 1993. Long-grain varieties (long A and long B) now account for 79% of the rice cropping area: 25% Thaïbonnet (long B, indica), 37% Ariete (long A) and 17% Koral (long A).

Since 1988, the Commission of the European Communities (CEC) has had an active role in these developments by allocating subsidies to rice growers. These grants increased from 100 ECU/ha ($35 000 US) in 1988 to 330 in 1993 to farmers who planted indica type long-grain rice. Until 1993, it provided farmers with an incentive to plant rice that was most in demand in EU. Initially, the subsidy was calculated to compensate for the reduction in their revenues due to the lower yields of *indica* rices as compared to *japonica* varieties (i.e. field production 0.5-1 t/ha lower in temperate climates, with only 58% milling yield, as compared to 61-62% for japonica).
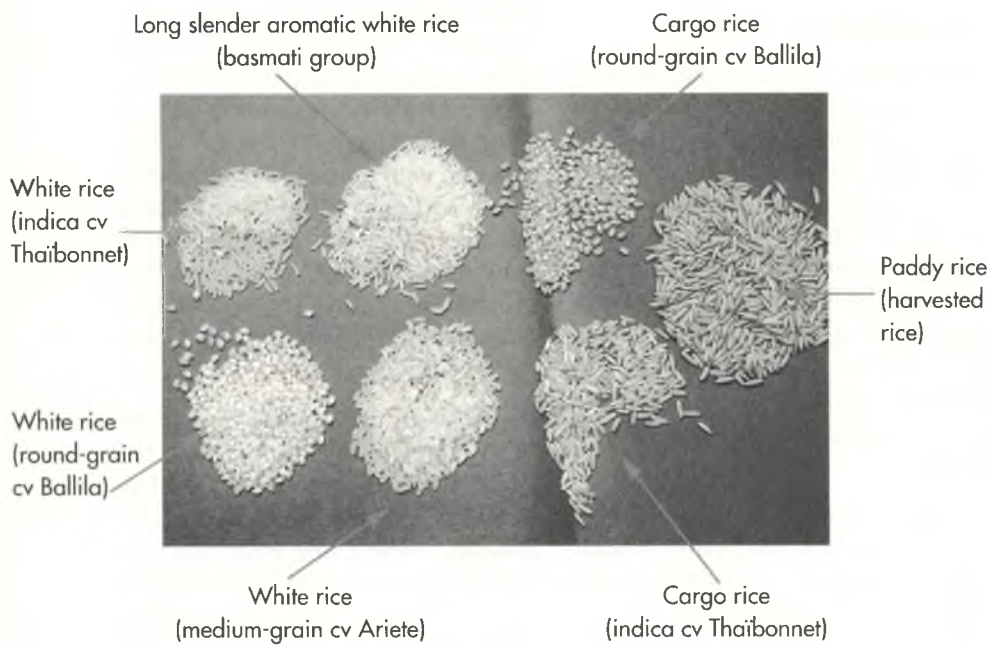
Since 1993, after the last GATT agreement, no direct subsidies are allowed for areas planted with indica rice. CEC has set up another procedure whereby no subsidies are provided for land cropped with indica rice, but the producer's purchase price is fixed at 94% the CEC intervention price, as compared to 90% for other rices. Moreover, rice research institutes are to introduce and acclimatize new early varieties from other temperate regions in the world, such as Chili and USA.

## Diversity of rice products

European Union rice consumption can be divided into three main sectors: home consumption (79% of the market), catering and collectivities (18%) and industry (3%) (CHATAIGNIER, 1991). The latter two groups are expected to increase their percentage of sales within the next 10 years.

Table 4. Estimate of 1993-1994 indica/japonica consumption, in white rice equivalent, in European Union (source: *Marchés rizicoles hebdo* n° 412).

| Country | Population (1 000 inhabitants) | Indica (1 000 t) | (kg/capita) | Japonica (1 000 t) | (kg/capita) |
|---|---|---|---|---|---|
| Italy | 56 | 20 | 0.3 | 300 | 5.0 |
| Spain | 35 | 10 | 0.3 | 215 | 6.1 |
| Ireland | 3 | 4 | 1.1 | 1 | 0.3 |
| Greece | 10 | 11 | 1.1 | 41 | 4.1 |
| Denmark | 5 | 7 | 1.2 | 11 | 1.9 |
| Belgium + Luxemburg | 10 | 15 | 1.4 | 3 | 0.3 |
| Germany | 78 | 118 | 1.5 | 62 | 0.8 |
| Netherlands | 14 | 29 | 2.0 | 6 | 0.4 |
| France | 56 | 144 | 2.4 | 124 | 2.0 |
| Portugal | 10 | 29 | 2.9 | 116 | 11.6 |
| United Kingdom | 57 | 207 | 3.7 | 40 | 2.7 |
| **TOTAL** | **334** | **594** | **1.7** | **919** | **0.7** |

Long slender aromatic white rice
(basmati group)

Cargo rice
(round-grain cv Ballila)

White rice
(indica cv
Thaïbonnet)

Paddy rice
(harvested
rice)

White rice
(round-grain
cv Ballila)

White rice
(medium-grain cv Ariete)

Cargo rice
(indica cv Thaïbonnet)

Differents forms of rice.
Photo T. Erwin

## Rice processing

Paddy rice is the rough harvested form, with the grains still enclosed in protective glumes and glemma, called husks. After the husks are removed (the operation is known as dehulling), it becomes husked or cargo rice. Whole (or brown) rice is unprocessed (or only slightly processed) cargo rice: the outer layer can undergo some chafing. White rice is obtained by removing the germ and all the caryopsis layer (the operation is known as whitening).

Parboiled rice is obtained by soaking paddy rice in hot water, followed by cooking and drying. This rice can then be milled to obtain whole or white parboiled rice.

With respect to white rice (as opposed to whole and brown rice and blends, etc.), precooked parboiled rice, quick-cooking rice, cooked rice packed in plastic pouches and frozen have had considerable success. The latter type can be used for collective catering purposes after reheating in microwave ovens. Precooked rices account for 6-8% of the French market, probably more than in the other European Union countries where they were only recently introduced. Although white rice dominates the market, parboiled rice has increased its share of the market since the 1970s. It now represents 45-50% of French market sales, 23% in United Kingdom, 17% in Italy, compared to only 10% in USA (HOGG, 1991; LECHEVALLIER, 1990; MAZZINI, 1992).

There has been an increase in the variety of table rice consumed in the last 10 years, although still only accounting for a small share of the market: brown or half-milled rice, rice blends, wild rice and organic rice (cultivated without chemicals). This consumption was almost nonexistent at the outset of the 1980s. In 1992, aromatic rice consumption, in United Kingdom, reached about 40 000 t of basmati rice from India and Pakistan.

France was the second largest market (8 000 t) and Germany was third (3 000-4 000 t). It would be reasonable to expect further increases in European Union imports of this type of rice — to 70 000-80 000 t in 1995-1996 and 100 000 t by the year 2000.

Sales of processed rice products such as snack and breakfast foods have markedly increased, especially to a young urban clientele. However, these products still only account for a small share of the market.

In addition to these trends, the processed rice industry is moving away from canned seasoned cooked rice to focus on rice-based convenience foods and ready-made dishes. Several frozen or pasteurized cooked rice dishes have been launched by manufacturers and large-scale grocery stores. The quality of such dishes is steadily improving, with sales increasing substantially in urban areas.

The development of rice specialities and new higher added value products is related to the higher average income in some countries. This has segmented the rice market, diversified prices and provided better margins for manufacturers. For instance, prices for aromatic rice are 3-fold higher, and dried precooked rices in pouches are 2- to 3-fold higher than for standard long-grain white rice.

## Technological and cooking characteristics of rice

Rice quality is evaluated in various ways by consumers in different regions. For instance, a soft texture is preferred in some southern Asian markets, as in southern Europe, while firmer cooked rice is more successful elsewhere in Europe. Parboiled rice has a slight typical aroma in India, but none in Europe.

Table 5. CEC Regulation n° 1423/76 sets a reference standard for rice quality. It provides a basis for calculating the intervention price of paddy rice.

Healthy, true-to-type marketable rice, without any objectionable odour, meeting average round rice standards, harvested under normal conditions in European Union, of a type corresponding to cv Ballila.
Moisture content: 14.50%.
Milling yield in head rice from paddy of 63%, of which the proportion of defective grains should not exceed (by weight):
– chalky grain, 3%;
– red streaked grain, 3%;
– spotted grain, 0.50%;
– yellow grain, 0.05%;
– amber grain, 0.125%.

Quality assessment is also dependent on the ultimate use of the rice, since technological and cooking performances can vary for different rice varieties. They are related to the morphological and chemical characteristics of the grain which, in turn, are related to genetic aspects and cropping conditions.

# Grain quality criteria and measurements

There are three main rice quality criteria: milling quality, appearance and cooking quality. Appearance and cooking quality are essential parameters for rice growers, traders, manufacturers and consumers. Milling quality is important for rice growers and millers.

European Union has defined a standard market quality for rice. It includes milling yield, moisture content, and percentage of broken, immature, chalky and coloured grains (Table 5). This classification, which aims at defining CEC market intervention conditions, is insufficient for manufacturers and distributers.

## Milling quality

Milling quality is measured by the white-grain milling yield as a percentage of paddy rice.

The price paid to the farmer and the miller's margin are calculated according to a standard milling yield set by EU regulation. It varies from 68 to 71 kg of white rice, including 56 to 64 kg of head rice and the rest

brokens, mainly used for animal feed. However, milling yields actually obtained by millers fluctuate from year to year according to varietal susceptibility and agroclimatic conditions (CLEMENT & SEGUY, 1994). Yields are also higher when milling is carried out at 14-16% grain moisture content. Moreover, parboiling reduces the percentage of brokens obtained in rice mills (MESTRES et al., 1993).

## Appearance

The appearance of white and parboiled rices is evaluated by grain size, shape, colour, gloss, translucency and uniformity. A classification was officially established by EU in 1988 according to morphological criteria based on length/width ratios for white grains (Table 6). Consumers currently prefer A and B long-grain rices. Traders' customary references are a "US" rice (North American standards) with a white rice grain length of more than 7 mm and a "Surinam" rice with a grain length of more than 8 mm.

A chalky core (white, non-translucent) on white rice, which is a varietal and agronomic feature, and a yellow rather than amber parboiled rice colour, are considered as defects by many consumers. Indeed, white core, the floury part of rice endosperm, is eliminated by parboiling or cooking, i.e. starch is gelatinized thus making the grain translucid.

## Physicochemical characteristics

The physicochemical characteristics are useful cooking quality indicators. They are all related to certain properties of starch, the main component of milled rice. The amylose content (a starch component, along with amylopectin) is the best indicator (PONS et al., 1992). It is positively correlated with the moisture absorption capacity during cooking and with firmness (pressure resistance) of cooked rice, i.e. as the amylose content increases, the cooked rice is firmer when eaten. Conversely, it is negatively correlated

Table 6. Length/width grain ratio classification for white rice (European Union standard, 1988).

| Grain type | Length (mm) | Length/width |
|---|---|---|
| Short grain | < 5.2 | < 2 |
| Medium grain | < 6.0 | < 3 |
| Long A | > 6.0 | < 3 |
| Long B | > 6.0 | > 3 |
| Indica | | |

## White rice grade standards

The percentages of brokens, damaged grains and chalky grains are used in European Union, regardless of the length/width ratios, to classify rice into the following four quality grades:
– superior quality rice, with not more than 5% brokens (15% for precooked rice);
– rice with up to 10% brokens (25% for precooked rice);
– second choice rice, with up to 50% brokens. For this grade the percentage of brokens must be indicated on the bag;
– rice brokens, with more than 50% brokens.

Superior quality cannot have more than 1% of damaged and chalky grains, and not more than 6% for other rices.

The maximum moisture content is set at 15% for white rice and 13% for precooked rice.



Measuring firmness in cooked rice with an Instron texturometer.
Photo T. Erwin

with stickiness (JULIANO, 1985). Grain elasticity (i.e. capacity to recover its original shape after the first chew) and the gelatinization temperature of rice flour dissolved in water are also analysed. The latter parameter is a good indicator of rice cooking performance.

## Relationships between instrumental measurements and sensory analyses

Information on consumers' sensorial evaluations of rice texture is limited or hedonic, i.e. consumers express their preference on the organoleptic qualities of cooked rice, which is by definition not objective (DALLAR & PONS, 1994; JULIANO, 1985; OKABE, 1979). There are no published sensory evaluations of rice in Europe.

A texture profile was recently developed in France based on a sensory analysis of different cooked rice textures by a trained panel (ROUSSET et al., 1994). The results were compared with rice textures measured with instruments. The trained panel was able to describe rice texture by not less than 19 sensory attributes, and six of them were the best descriptors for differentiating samples. Elasticity of cooked grain showed the most marked differences, followed by juiciness, firmness, granular texture, stickiness and grain length. Finally, the texture classifications for the samples according to these sensory attributes were not far from those determined instrumentally.

## Industrial and consumer requirements

In 1970, the qualities preferred by household consumers were taste (flavour) in Italy, appearance in France, quickness of cooking in Germany and the Netherlands and the rice brand in Belgium. Generally, the rice-producing country (country of origin) was the least important

factor, while the major criterion was that the rice should not be sticky.

In 1994, EU household consumer rice quality preferences seemed to be more homogeneous. Non-stickiness is still the most important criterion, followed by long slender grain and then quickness of cooking, except for traditional cuisine in rice-growing regions and for dessert recipes (cakes and puddings). Parboiled rice is only of interest because the grains are firm and unsticky after cooking and these qualities are not lost with overcooking.

Consumers are relatively unaware of innovations concerning rice that is available on the market. The industry should inform and "educate" consumers to guarantee successful development of their activities. With the introduction of new varieties of rice (wild and aromatic), ready prepared meals, individual portions of boil-in-the-bag rice, wet-pack canned rices and instant rice (i.e. cooked in 3-5 min), manufacturers are seeking types of rice that will stand up well to specific treatments or that will be better suited for specific preparations.

The industrial requirements can be expressed by the following questions: are amylose content and gelatinization temperature the only two factors to consider for long-grain rice? Is it possible to find a rice variety with a very low starch hardening rate after cooking and cooling (termed "retrogradation" by specialists)? Is there any rice that does not require parboiling but yet has the same texture as parboiled rice after cooking and canning, or cooking and freezing? What are the critical parameters to obtain instant rice? Is there a reliable method to assess the authenticity and purity of a shipment of aromatic rice?

## European research on rice quality

Various research programmes have been set up, some with CEC backing,

## Measuring cooking quality

Cooking quality cannot be described and evaluated according to only one or two criteria. Several methods have been developed to assess the cooking properties and texture of cooked rice. Texture, a major factor determining cooking quality, has always been difficult to measure (JULIANO et al., 1984). The criteria most commonly used to define texture are as follows:
– the firmness and stickiness of cooked grain, measured with a universal texturometer (Instron);
– the thickness, firmness and elasticity of cooked grain, measured with a viscoelastograph (Chopin);
– the moisture absorption capacity or extent of swelling of cooked grain, determined by the cooked grain weight over the uncooked weight.

at national levels in several countries. They aim at adjusting the quality of EU rice to meet domestic market requirements. They cover the whole rice sector, from cultivation techniques to quality analysis techniques, while specifically focusing on aromatic rice. These programmes are being implemented by national research organizations, with input from other organizations within the EU research network.

## Standardizing analytical methods

At the EU level, the programme to promote indica type rice highlighted an urgent need to standardize analytical methods in the involved research laboratories.

Measurements of amylose content, firmness and stickiness were harmonized from 1988 to 1990 through comparisons of techniques used in six European laboratories (France, Italy, Netherlands, Portugal, Spain and United Kingdom). It was found that the same procedure was used in all laboratories, but the precision of the results varied, thus hindering experimental reproducibility. For instance, the precision of amylose determinations is highly dependent on the purity of amylose and amylopectin standards supplied by manufacturers, which were found to vary between shipments.

In 1991, a ring test was set up, coordinated by the Flour and Milling and Baking Research Association (FMBRA, United Kingdom) under the auspices of the Community Bureau of Reference (Brussels), between five laboratories (France, Italy, Netherlands, Portugal and United Kingdom) to analyse samples produced by one of the laboratories. The results were fully satisfactory. These samples will now be used as standards until year 2000. This coordinated approach facilitates interlaboratory interpretations and greatly improves the reliability of amylose content measurements.

## International research cooperation

The Mediterranean Region Cooperative Research Network on Rice was established after an FAO consultation meeting in France in 1990. The members are Bulgaria, Egypt, France, Greece, Hungary, Italy, Morocco, Portugal, Romania, Russia, Spain and Turkey; it is also open to other Mediterranean countries. The Network aims at promoting rice research cooperation between all countries that produce this cereal under the Mediterranean climate. Five working groups were set up, to cover: biotechnology, breeding, agronomy, processing, economics/marketing. Each group has got together at least once since 1990 to prepare their work programme.

The rice processing group, for instance, met in Egypt in 1992 and recommended three main focuses for work: utilization of by-products, extension of rice milling technology to villages (of particular interest for Egypt), and rice quality. The group should meet again in 1995 to further discuss these three topics. The rice quality group will concentrate on interlaboratory comparisons of analytical techniques to assess the quality of rice varieties grown in the region.

The scientific aspects of the Network's activities are as follows:

– improving water use efficiency in rice cultivation through high technology irrigation;

– increasing yields through wideranging hybridization or the use of new biotechnology tools;

– using molecular biology techniques to overcome constraints concerning water stress, salinity and high aluminium levels, to enable successful cropping of high quality rice (indica) in the Mediterranean climate;

– improving drying, storage and handling equipment and techniques to reduce percentages of broken grains and energy consumption;

A mini-rice mill is used in the laboratory to mill small quantities of rice.
It can also be used in industrial plants to test the technical quality of a batch
before processing.



Blancher →
Husker →
Mill cone for whitening
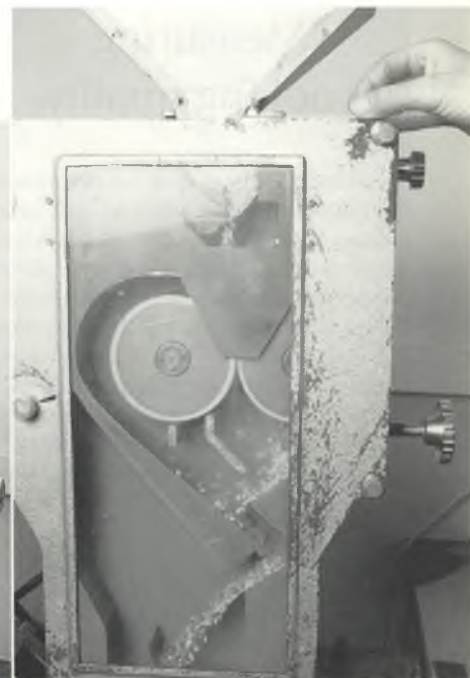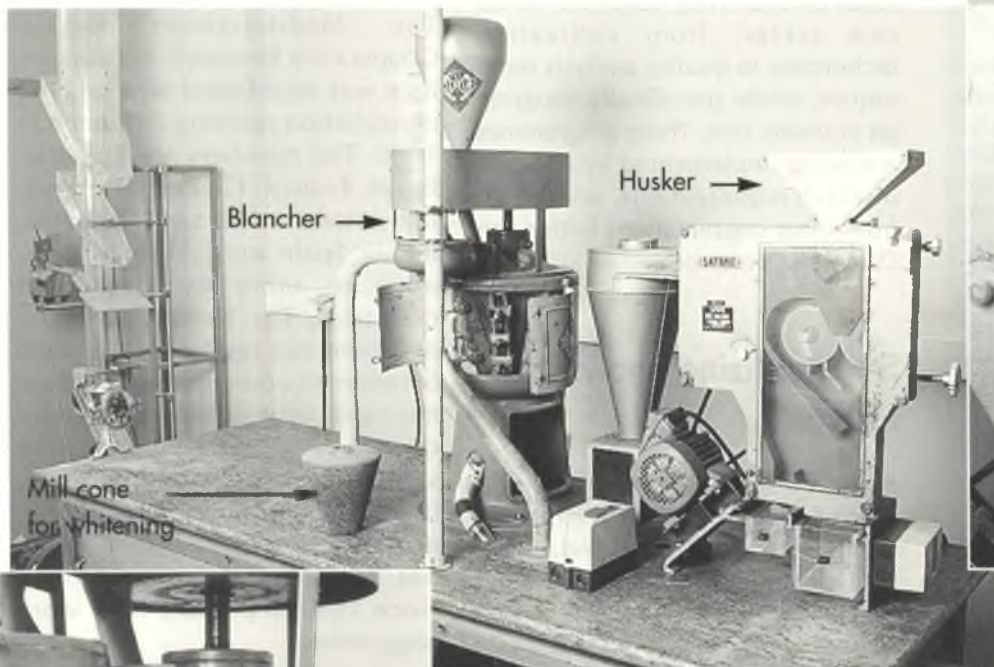
The husker removes the external
layers (husk) of paddy rice grain
to obtain cargo rice.
Photo T. Erwin

General layout.
Photo T. Erwin



The blancher. After several runs,
the mill cone gradually wears down
the outer caryopsis layer of the cargo
rice grain to obtain white rice.
Photo T. Erwin

– improving objective methods for measuring rice quality, flavour compounds and the effects of storage on rice quality;

– investigating rice grain protein/starch interactions during processing; new processing techniques; nutritional quality of rice enriched or not with vitamins or amino acids; finding uses for low gelatinization temperature rice varieties;

– developing expert systems to aid rice producers in decision making, evaluating the cost-effectiveness of input applications in flood irrigation systems and the impact on rice yield and quality.

## Institutional research

Institutional research has mainly been strenghtened in France with the founding of the Centre français du riz (CFR) in 1988 by a joint decision of the French Ministry of Agriculture, the Association des producteurs de riz and the Office national interprofessionnel des céréales (ONIC). Prior to this, Italy was the only country with specialized rice institutions, such as the Ente Risi and the Centro di Ricerche sul Riso. The latter institution carried out a comprehensive study on the cooking qualities of 90 *japonica* rice varieties cultivated in the country, while taking the cooking criteria of the EU indica rice programme into account (MAZZINI *et al.*, 1990). Most of the varieties had high stickiness and low hardness results in the cooked rice texture analyses. This indicates that they would not qualify for the European indica rice programme.

# European prospects

The European Union, with 350 000 to 370 000 ha cropped with rice, is not yet self-sufficient, but it could become so if the crop zone were to

expand beyond 400 000 ha. Nevertheless, the main objective for the coming years should be to meet EU market demand for long-grain indica rice.

Rice breeders are working in all EU rice-growing countries to improve milling yields with long — and slender — grain varieties and enhance their agronomic traits (i.e. earliness, productivity, and resistance to cold, blast and shattering). Selection programmes are based on varietal introductions, haploid methods, hybridization, mass selection and mutagenesis. Many genetically
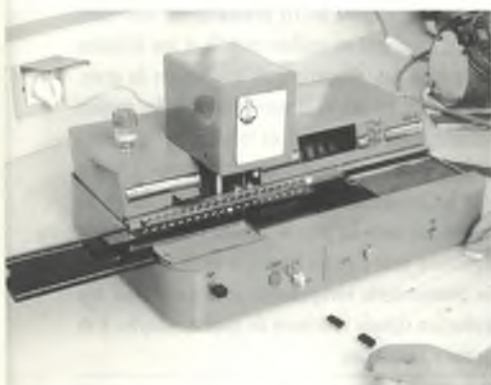


Semiautomatic measurements of rice grain lengths/widths using a Russian HP3-8 apparatus.
Photo T. Erwin



improved varieties should be obtained within the next 2-4 years.

EU rice industries are focusing on diversification of rice blends and ready-made rice dishes. There will be further research on rices with traits that could upgrade the quality of final processed products.

The industry should provide consumers with more comprehensive information. Rice is considered as an easy to prepare garnish to accompany fish or meat dishes and, in contrast, as a speciality to be cooked with care. In the first case, the ideal would be a slender, unsticky and translucent white rice or parboiled rice, or

precooked rice, which have a relatively neutral taste. In the second case, tasty rice (possibly aromatic) should be carefully prepared (controlled water quantities and cooking times) for festive occasions and gourmet meals.

# How can the South benefit?

All of the research and analysis techniques discussed here are quite sophisticated. They might be difficult to apply in developing tropical and subtropical countries because of the long-term costs or, more subjectively, due to differences in standard rice quality criteria. However, simple routine methods could be implemented to assess cooking characteristics of local rice varieties in Africa, e.g. extent of grain swelling after cooking, firmness measurements with a penetrometer (rather than a more expensive Instron texturometer), and stickiness evaluated by hand testing.

Experience in Asia and Africa has shown that local rices are preferred over imports. For instance, in China, Côte d'Ivoire and Vietnam, consumers have a low opinion of imported rices, which never taste or cook as well as local varieties. In Africa, rice imported from Asia is only eaten because it is sold cheaper than the local types. Local rices are always used for festive occasions. In Côte d'Ivoire, the local variety IRAT 216 is highly esteemed by consumers, despite the fact that instrumental analyses indicate that it is a very average quality rice by European standards.

Countries that intend to improve their rice production should thus take both the objective analytical results and consumer preferences into consideration when developing their policies. Finally, in the longer term, it would be interesting to set up a breeding programme for African aromatic rices, with the aim of competing with Asian aromatic rices that now dominate world markets.

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## Abstract... Resumen... Résumé

**J. FAURE, F. MAZAUD — Rice quality in the European Union.**

Five European Union countries produce rice, supplying approximately 2.1 million tonnes of paddy rice (i.e. 1.4 million tonnes of white rice). Total consumption is 3.1 million tonnes in the whole of Europe. Consumption increases each year and imports are required to make up for insufficient production and to meet consumer preference for long grain rice of the indica type. The variety of rice-based foods resulting from industry efforts in diversification and the now broader range of special types of rice available today, such as aromatic, wild and pre-cooked rice requires better control and more accurate definition of grain quality features. It is increasingly important to measure the technological and culinary qualities according to the end-use criteria that are equally important for industrialists and breeders. Cooperation between European Union countries has received financial backing from the Commission of the European Communities to promote high-quality European Union rice production suited to this growing market.

Keywords: rice, grain, *indica*, *japonica*, agrofood technology, quality, research, consumption, market, European Union.

**J. FAURE, F. MAZAUD — La calidad del arroz en la Unión Europea.**

Cinco paises de la Unión Europea son productores de arroz y suministran aproximadamente 2,1 millones de toneladas de arroz paddy (es decir 1,4 millón de toneladas de arroz blanco), sobre un total de 3,1 millones para toda Europa. El consumo aumenta cada año y, para completar la producción insuficiente y responder a la preferencia de los consumidores por el arroz largo y fino del tipo indica, es necesario importar. La diversificación de las preparaciones alimentarias a base de arroz, debido a los esfuerzos de innovación de los industriales y la gama más amplia de arroces especiales disponibles actualmente, como los arroces aromáticos, silvestres o precocidos, requieren un mejor control y una definición más precisa de las características cualitativas del grano. Resulta cada vez más importante medir las cualidades tecnológicas y culinarias en función de la utilización final, según criterios que presenten tanto interés para los industriales como para los seleccionadores. Se ha organizado la cooperación entre los paises de la Unión Europea, con el apoyo financiero de la Comisión de las Comunidades europeas, para promover una producción interior de arroz de calidad, adecuada para este mercado en expansión.

Palabras clave: arroz, grano, *indica*, *japonica*, tecnología agroalimentaria, calidad, investigación, consumo, mercado, Unión Europea.

**J. FAURE, F. MAZAUD — La qualité du riz dans l'Union européenne.**

Cinq pays de l'Union européenne sont producteurs de riz et fournissent environ 2,1 millions de tonnes de riz paddy (soit 1,4 million de tonnes de riz blanc), sur un total de 3,1 millions pour l'ensemble de l'Europe. La consommation augmente chaque année et il faut importer pour compléter la production insuffisante et répondre à la préférence des consommateurs pour le riz à grain long et fin de type indica. La diversification des préparations alimentaires à base de riz, due aux efforts d'innovation des industriels et la gamme plus large de riz spéciaux disponibles aujourd'hui, comme les riz aromatiques, sauvages, précuits, requièrent un meilleur contrôle et une définition plus précise des caractéristiques qualitatives du grain. Il est de plus en plus important de mesurer les qualités technologiques et culinaires en fonction de l'utilisation finale, selon des critères qui présentent autant d'intérêt pour les industriels que pour les sélectionneurs. La coopération entre les pays de l'Union européenne s'est organisée avec l'appui financier de la Commission des communautés européennes, pour promouvoir une production rizicole intérieure de qualité, adaptée à ce marché en expansion.

Mots-clés : riz, grain, *indica*, *japonica*, technologie agroalimentaire, qualité, recherche, consommation, marché, Union européenne.