Paper 9

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Quality Assays of Rice Grains during Storage and Processing in Japan

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Abstract

Rice is one of the most important cereals in the world. Japanese people use about 10.2 million tons in 1993. We use about 9.2 million tones for cooked rice as staple foods and 973,000 tones for processing, such as rice wine (sake), rice crackers and miso fermentation, etc.

Processing suitabilities of rice differ depending on the products. Low amylose rice is more suitable for soft rice crackers and high amylose rice is preferred more for rice noodle.

Pre-cooked rice products, such as frozen cooked rice, retort-pouched rice and aseptic rice, are increasing recently in Japan. In our laboratory, relationship between freezing condition and palatability of cooked rice was investigated.

Japanese National Food Agency started the storage of 1.5 million tones of rice in 1996. We carried out the storage test using high quality rices since 1995 until 1996. As indices for the quality deteriorations of rice grains during the storage, germination ratio, enzyme activities, fat acidity, physical properties of cooked rice were clarified to be useful. We applied colorimetric method for the measurements of fat acidities in the place of titration method. In addition to above-mentioned physico-chemical tests, NIR spectroscopy, "Midometer" measurement and sensory test were carried out.

Keywords

- Rice processing, storage, physico-chemical measurements, sensory test
- Japan

Physico-chemical measurements of rice qualities

Chemical components

Moisture contents of rice grains produced in Japan, Korea and China (Northern region) were rather higher (14-15%) and those in USA, Thailand and Australia were lower (12-13%).

Amylose contents of rice grains in Japan, China (Northern), USA and Australia and a part of Thailand were low (15-22%), and many rice grains in Thailand some in USA and Australia showed rather higher values (23-36%) (Figure 1).

Gelatinization properties

Gelatinization properties of milled rice flours were evaluated using a Rapid Visco Analyser. All of samples in Japan, China (Northern) and most of those in USA and some of Australia and Thailand revealed low final viscosities(lower than 300 RVU) and many samples in Thailand and some of Australia and a part of USA. samples showed rather higher final viscosities (higher than 300 RVU) (Figure 2).

Physical properties of cooked rice grains

Japanese breeders try to develop new varieties with diversified properties, such as high-quality rices, big-grains, long-grains, indica-japonica hybrids, aromatic rices, for the enhancement of rice utilizations in Japan. Those rice grains were subjected to the measurements of physical properties with a Tensipresser (Figure 3). Two-dimensional expression of "Max length" (continuous compression test) and Hardness (low-compression test) were found to be useful for the classifications of each group (high-quality rice, medium-quality rice, hard rice, indica-japonica hybrid rice).

Detection of quality deterioration during the storage of rice grains

Low temperature storage of rice grains

Quality of rice grains deteriorates during the storage. It proceeds rapidly under the higher temperature and high humidity. Therefore, rice grains are mainly stored in the air-conditioned wharehouses in Japan. The temperature is maintained under 15 degrees and RH is 70 to 75%.
The capacity of governmental air-conditioned wharehouses is about 4.9 million tones.

Fat acidity

Fat acidity increases during the storage of rice grains (Figure 4). In our laboratory, colorimetric method for the fat acidity measurement was developed (reference 1)

Change in eating quality during the storage of rice grains

Storage test of various rice cultivars were carried out since 1995, and until 1996 in our laboratory. Sensory test of cooked rice showed that the low-temperature storage was effective to maintain the eating quality well. The eating quality of grains stored under the low temperature (l.t.) for one year was about the same level than those stored under natural temperature, until before the summer season.

The degree of deterioration differed depending on the cultivars. The eating quality of Koshihikari was maintained well compared with other cultivars (Figure 5).

Processing of rice grains in Japan

Processed rice products in Japan

Most of rice grains are used as cooked rice as staple food in Japan and only 0.97 million tones of rice are used for processing. Milled rice grains are used for "Sake" wine brewing and "Miso" fermentation. And rice crackers, such as "Senbei", "Arare", are very popular in Japan.

Recently, pre-cooked rice products, such as frozen, chilled, retort-pouched and aseptic, are increasing (Figure 6).

"New characteristic rice" research project

Since 1990, Japanese Ministry of Agriculture, Forestry and Fisheries, supported the research project named : "New characteristic rice" until 1995. For the purpose of enhancement of rice consumption, Japanese breeders tried to develop various kinds of new rice varieties, such as big-grains, long-grains, aromatic, pigmented, low-amylose, etc.
In addition to the national institutes, many universities, prefectural research institute and private companies took part in the project for the basic and practical research program.

Physical properties of frozen cooked rice

The frozen cooked rice is one of the main products among the pre-cooked rice products and its production is about 110,000 tones, and market is about 40 billion yens (400 million dollars) per year in Japan.
In our laboratory, the relationship between the physical properties of frozen cooked rice grains after thawing and the freezing conditions were investigated. As shown in figure 7 and figure 8, medium-speed freezing is the best condition for the eating quality and physical property of the frozen cooked rice.

"Quick-cooking rice"

House wives in Japan soak milled rice grains from 30 minutes to 2 hours before cooking and keep warm without the removal of rid of rice cooker after cooking for 15 to 20 minutes in order to prepare the good quality cooked rice.
Recently, several private companies developed "Quick-cooking rice" which contains more than 40% of moisture and can be cooked without soaking and warm-keeping (Figure 9).
By the collaborative work with the company, we revealed that the processing conditions, such as washing, pasteurising and gelatinising, affect the quality of the product markedly (Figure 10).

Conclusions

- 1)Rice is one of the most important food materials in Japan.
- 2)There are various kinds of characteristic rice cultivars in Japan.
- 3)Rice quality deteriorates during the storage.
- 4)Processing technology promotes the consumption of rice grains.

Fig 1 : Amylose contents of Rice grains

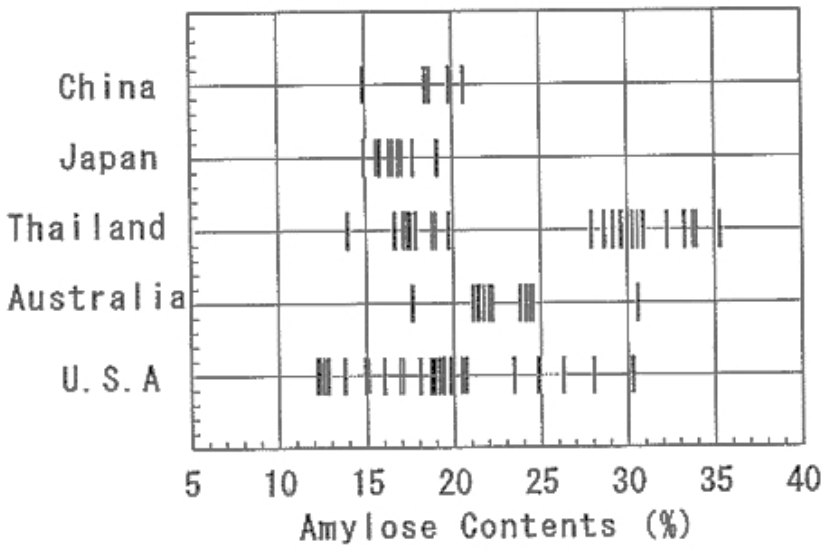


Fig. 2 : Final viscosities of Rice flours

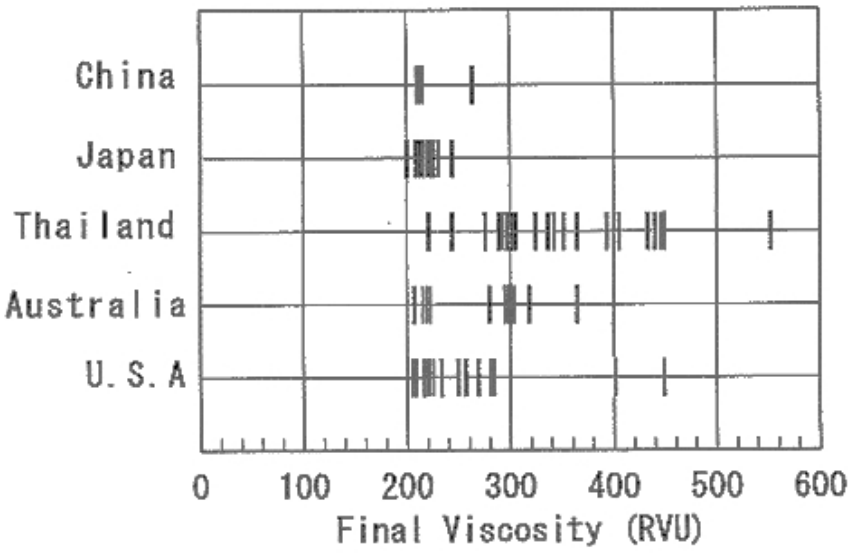


Fig.3 : Physical properties of Japanese rices measured with a Tensipresser

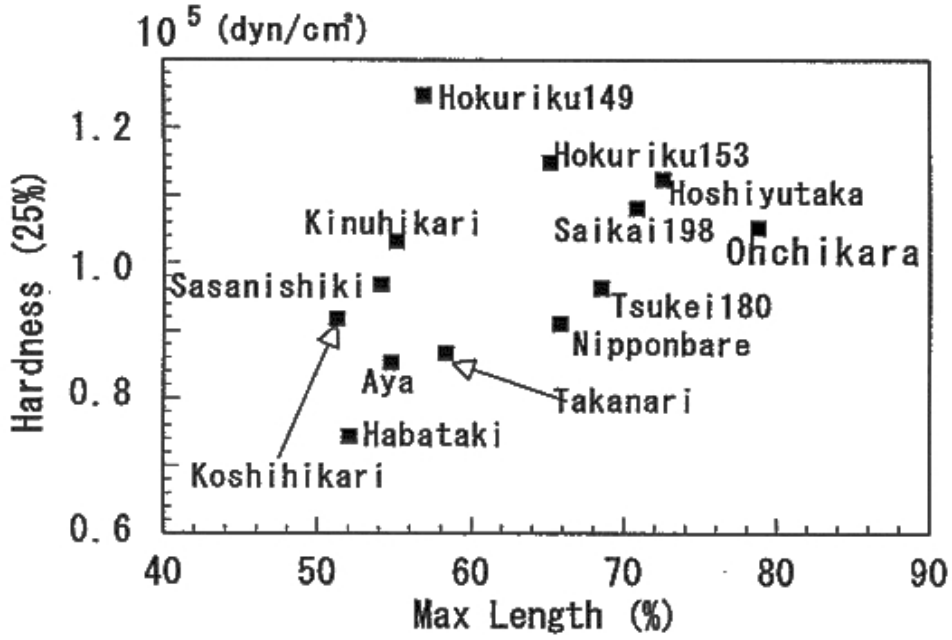
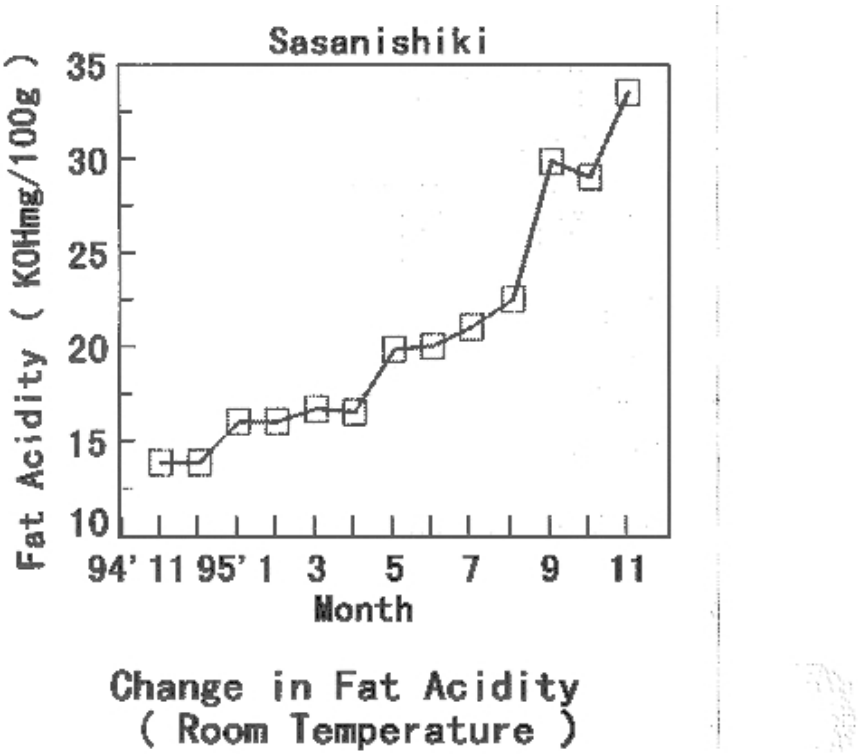
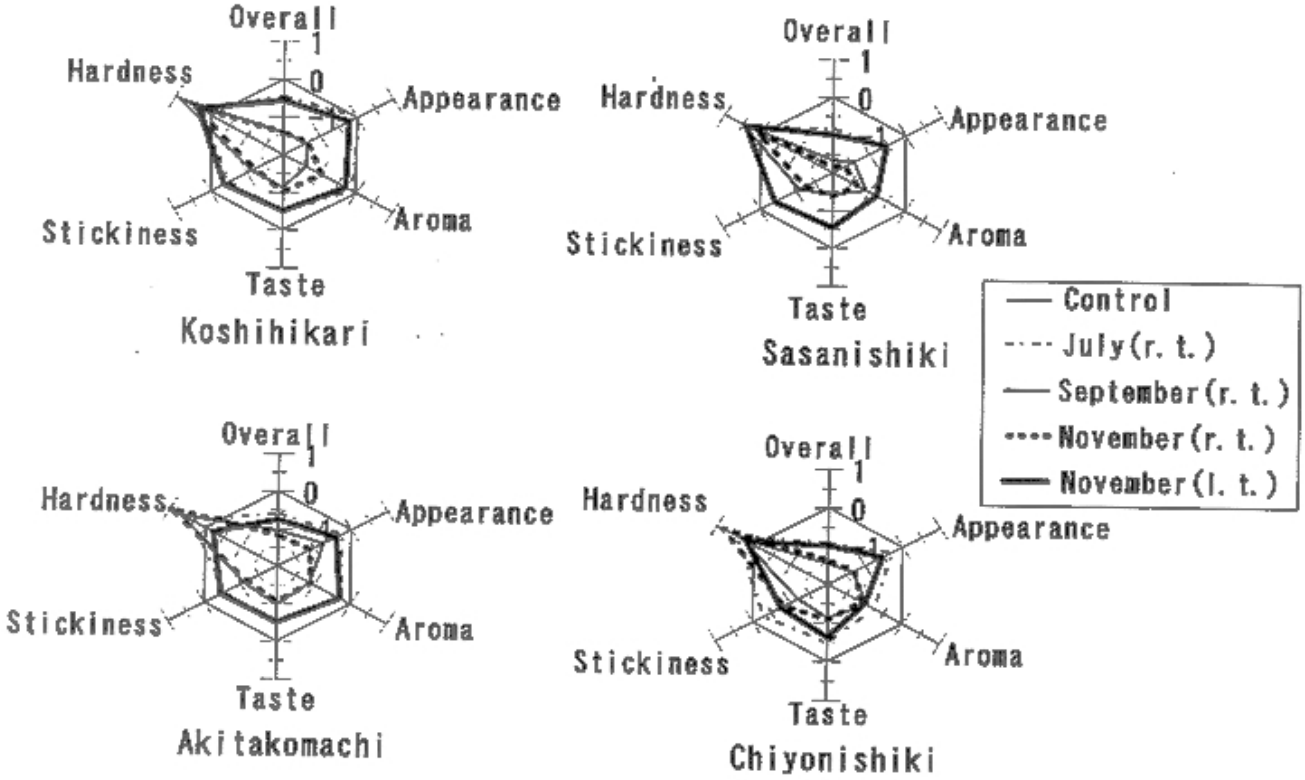


Fig 4 : Fat acidities during Rice storage



Change in Fat Acidity
(Room Temperature)

Fig 5 : Sensory test of stored Rices



Results of Sensory Tests of Various Rice Cultivars

Fig 6 : Processed rice products in Japan

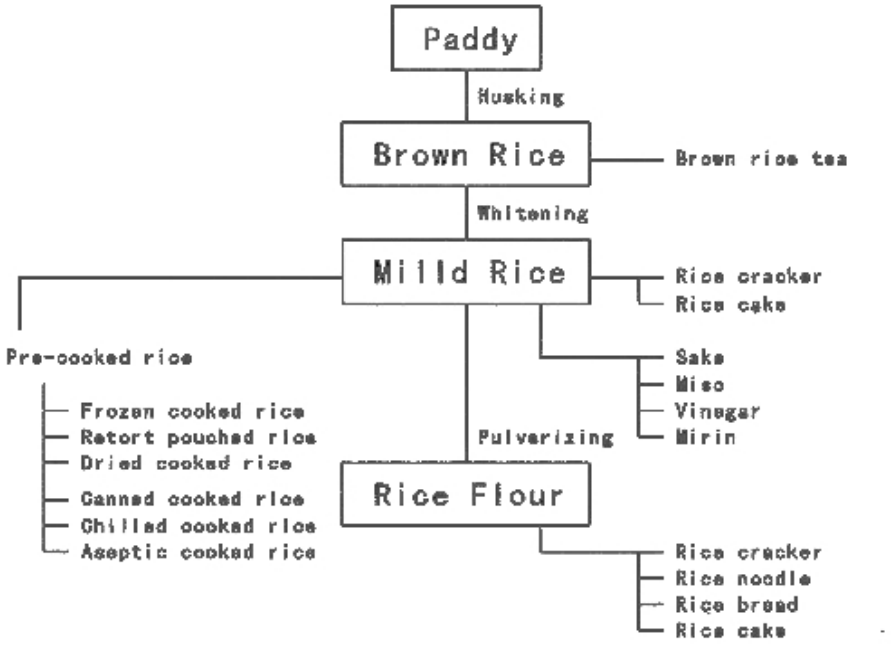


Fig 7 : Change in texture of cooked rice grains by freezing condition

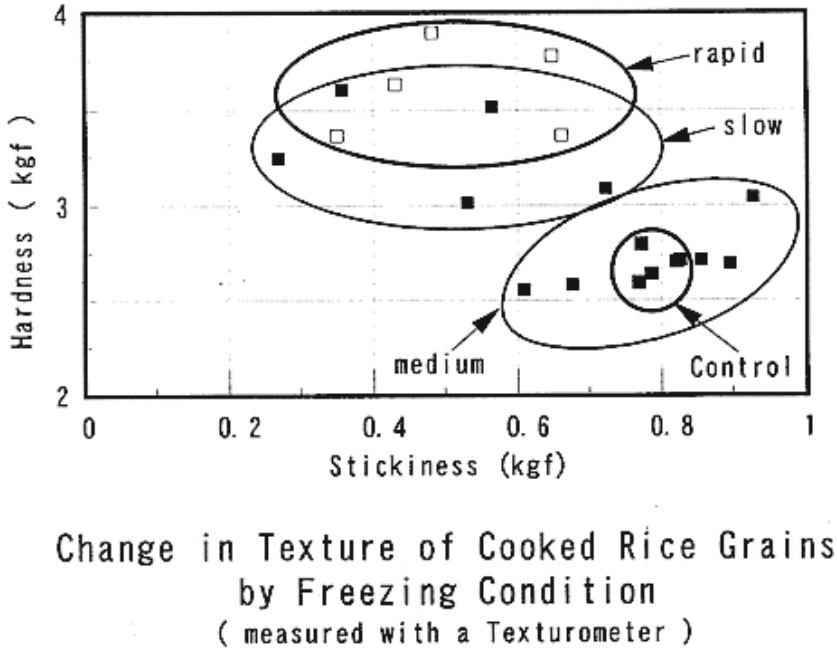


Fig 8 : Sensory test of cooked rice of different freezing conditions

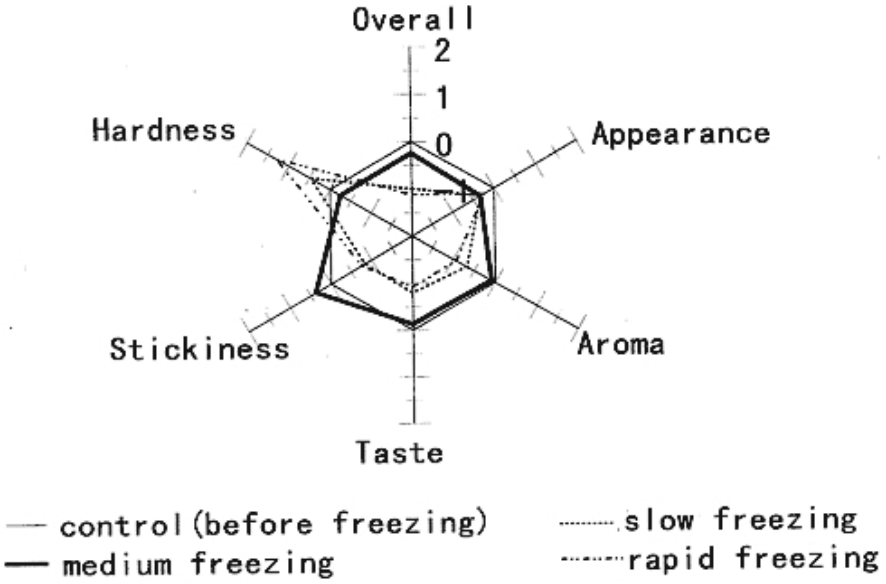
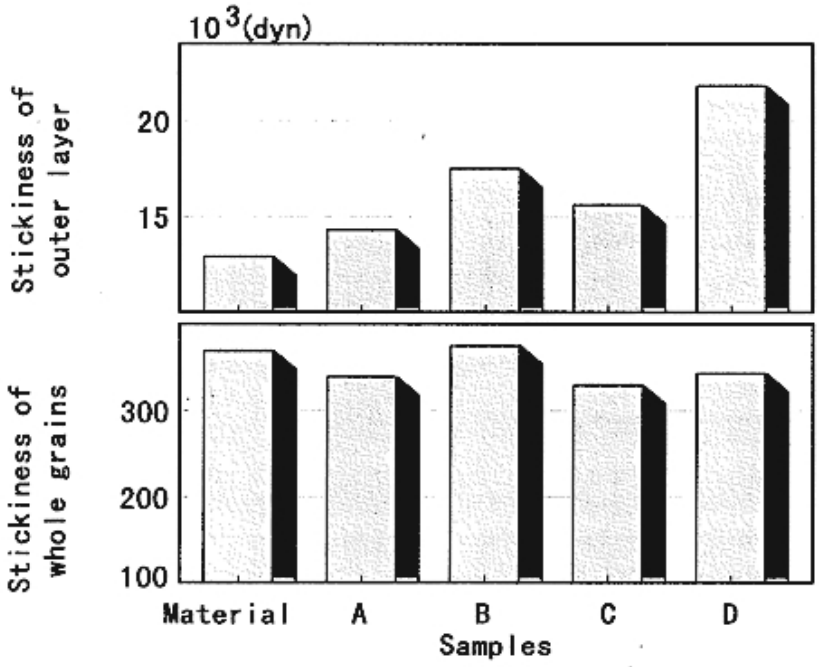


Fig 9 : Characteristics of 'quick-cooking rice'

Characteristics of "Quick-cooking Rice"

Cooking Procedure	Ordinary Rice	Quick-cooking Rice
washing	5 min	—
soaking	30 ~ 60 min	—
cooking	20 ~ 30 min	12 ~ 20 min
warm keeping	10 ~ 20 min	—

Fig 10 : Stickiness of quick-cooking rice grains



Stickiness of Quick-cooking Rice grains
(measured with a Tensipresser)
A : Washed B : Strongly washed
C : Pasteurized D : Best Product
outer layer : 25% of compression ratio
whole grain : 90% of compression ratio
(10 grains were subjected to measurements)

References

1)Ken'ichi Ohtsubo et al .: Report of National Food Research Institute, No.51, p.59-65, 1987.

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