

PRESENT STATUS OF RICE PRODUCTION AND UTILIZATION IN CHINA

Fan, Zhihong

College of Food Science and Nutritional Engineering, China Agricultural University,
Beijing 100094, China

Abstract: China is the largest rice producer in the world, with about 28 million hectares rice-planting area. Most of the rice is consumed domestically as daily staple food, with a small proportion consumed as feed and deep-processed products. The low elastic elasticity and low profit of rice production, which hampers the development of the industry, is due to the low quality of rice grain, low processing level and undeveloped rice processing technique. Promotion of high-quality species, effective quality control, adoption of modern processing techniques, fully use of low-quality indica rice, and utilization of specialty rice are considered as priorities in rice industry.

Key words: rice, production, utilization, rice foods

1. Brief introduction of rice production situation in China

Rice-planting history can be retrospect to 7,000 year ago in China, proved by the unearthed rice grains in Hemudu, Zhejiang Province. Since 1,000 years ago, Rice has been the most important crop in China. The rice production in China ranks the first in the world, accounting for 23 percent and 37 percent in 2001, in terms of planting area and yield, respectively[1].

Rice is incredibly widely cultivated in China, from the China-Russia border in the northeast, to the Hainan Island in the South China Sea, or the Xinjiang Autonomous Region near the Middle Asia. In recent years, influenced by the reforestation policy and the decrease of comparative benefit of grain production, the rice planting area has been decreasing substantially. However, the rice planting area still reaches to about 28 million hectares, which account for 28 percent of the total grain planting area, and 40 percent of the total grain production in China[2].

Present production

The total production of rice has been slowly decreasing in the past several years, after the highest record in 1997, when the total yield was 6.35 percent higher than the total consumption. In the past 3 years, the planting area early-season rice dropped dramatically, while the high quality rice climbed to about 50 percent

of the rice-growing area.

In 2002, the rice planting area numbers to 27.95 million hectares, 3 percent lower than the previous year, while the yield per unit area increased for 2 percent, reaches 6,285 kilograms per hectare. Among the different species, the first-season rice production planting area is 5.91 million hectares, 19.4 percent decreased, but the percentage of high-quality early rice reached 69%, increased for 6 percent, compare to the previous year. The growing area and yield of late-season rice decreased for 7.0 percent and 6.7 percent, respectively. The mid-season and single-season rice increased 0.3 percent, while the yield increased 3.8 percent[3]. A further drop of 4.2 percent in total rice-planting area is expected, according to the latest analysis figures[4]. That means that the amount of rice stock will decrease substantially.

Table 1. Rice production, consumption and storage in 10 years (million tons)

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Production	186	177	176	185	195	201	199	199	188	178	176
Consumption	183	184	185	187	188	189	190	191	192	194	192
Storage	9	8.6	8.6	8.5	8.9	9.3	9.6	9.9	9.4	8.7	8.5

Aside from the lowland rice, the production of upperland rice is stretching, due to the limitation of water resources. The planting area of upperland rice reaches 1.77 million hectares, account for 1 percent of the total rice growing area[5].

In the year 2002, the total production of rice refining industry is 18.78 million tons, among which about 30 percent is high quality polished rice. The total output value, total sells income and total profit of the industry are 22.1 billion, 19.71 billion and 327 million Chinese Yuan[6].

Import and export

China is one of the traditional rice exporting countries, but the amount of rice export is limited by unsatisfactory quality, poor package and low processing level. In 2002, the export rice grain amount to about 26.7 million tons, including 150 thousand tons to Korea and 885 thousand tons to Japan, only account for 1.6 percent of the total production[2]

China imports small amount of rice from Thailand, about 267 thousand tons in 2002, with no significant increase after China's entry to WTO[3]. It is considered that the surplus domestic market, sufficient stock and low price restricts the rice import demand. According to official figures, the rice grain stock exceeded 25 million tons every year since 1996.

The rice stock in China accounts for 66 percent of the world rice stock[4]. If the rice production drops further in China, the deficit of domestic rice supply would pose great impact on world rice market.

Present consumption

Over 60 percent of Chinese population takes rice as daily staple food, especially in the south and well-developed area. The yearly total rice consumption is about 200 million tons, with 80 percent of which consumed as grain ration[2].

In 2002, the total rice consumption amounts to 138.6 million tons (as polished rice), 0.84 percent more than that of the previous year. The domestic consumption accounts for 98.4 percent of the total production.

Table 2. Rice consumption in China in the year 2002-2003(million tons, as polished rice)

Total domestic consumption	grain rations	seed	Feed	Industrial use	export	Other uses
136.37	117.44	1.58	8.81	1.90	2.20	4.40

Along with the improvement of people's living standard, the direct consumption of rice grain continues to decrease in the 10 years. The direct rice consumption as staple food is 96 kilogram per capita in 2000[1]. It is expected that this figure will further decrease in developed areas. The feed consumption is increasing, and the rice for industrial use remains stable.

2. Utilization of Rice as foods in China

Traditionally, rice is used in daily cooking, in making festival foods and snack foods in China. The utilization of rice in producing healthy foods, functional factors, rice starch, high-protein rice powder and fat substitutes has just started.

2.1 Rice cooking

Rice is regard as the best staple food, for its light taste match best with any kind of delicious Chinese dishes, and is served in almost every restaurant and dining place. It can also be cooked with meat, eggs, vegetables, mushrooms; or with preserved fruit, nuts and raisins, to make special tasty variations[7]. Among them some are made of glutinous rice and black rice. The convenient packaged rice, frozen rice is also produced in small scale.

2.2 Rice porridge, gruels and congee

Rice used to be cooked into gruel or porridge with other cereals and legumes. Sometimes it is cooked with meat, vegetable, nuts, and traditional tonics. Canned mixed rice porridge, also called eight-precious congee, has become daily food in urban areas, which contains kidney bean, red bean, Chinese jujube, lotus seed, dried longan, and other crude cereals. In some products, chestnut, seaweeds, pumpkins or ribes oil[8] are added to porridges. Quick-edible gruel products using puffing and extrusion techniques save consumers from the time-consuming gruel cooking[9].

2.3 Rice noodles and rice vermicelli

The rice noodle production consumes about 1 million tons of rice each year, accounting for about one third of the rice used in food processing purpose. Instant rice vermicelli[10], fermented rice noodles[11], soy-rice noodles[12] and fish meat rice noodles[13] have been developed. After fermentation, the rice noodle

acquired a pleasant sour flavor and rich B vitamins, especially riboflavin.

2.4 Rice cakes

Traditionally, in the New Year's day, the people in the north eat jiaozi, while the people in the south eat rice cake foods. The rice cake can also be made into many delicious dishes, deep fried or stir-fried. Various rice cake products has been developed and processed with modern techniques[14,15].

2.5 Rice crackers

Rice crackers are well accepted by children and young people after introduced from Japan recent years. Some researchers tried to add nutrients and healthy factors such as oligosaccharides and calcium into rice crackers[16].

2.6 Rice glue ball or dumpling

Rice glue ball used to be eat only in Jan 15 on the lunar calendar, but now frozen rice glue is supplied all year round as snack food in China. The most popular fillings include nuts, preserved fruits, jams, red bean paste, sweet-scented osmanthus and taro, as well as meat and other animal constituents[17].

2.7 Glutinous rice dumpling(wrapped in bamboo or reed leaves)

This ancient rice food is made to commemorate a great poet over 2,000 years ago, who threw himself to river on May 5 in lunar calendar when his country is broken by foreign army. However, it can be found in supermarket almost all year round, with various fillings such as red bean paste, Chinese jujube, lotus seed paste, and meat.

2.8 Alcohol fermented rice products

Rice is commonly produced into yellow wine and sake in the south, but it is also made into sweet rice wine. The sweet rice wine, made of glutinous rice, is widely produced at household scale in southern China. It is believed that it has a skin-improving and cold-resistant function[18]. In recent years, it has been developed into canned and bottled sweet rice wine products, with pure starter culture of *Rhizopus* and yeasts[19].

2.9 Puffed rice and baked rice foods

This category of rice food includes puffed rice tea, baked rice tea, puffed rice snack, and puffed rice powders. Puffed rice snack is made of puffed rice and maltose syrup. Baked rice and backed rice tea is a special custom in some south regions, often used in food therapy of gastro-intestinal infection[20]. It is believed by the local people that this kind of tea has a function of reducing body fat accumulation. The mechanism of this function is till to be studied, but it is assumed that the key points may be the formation of resistant starch and the fat-absorptive effect of backed starch.

2.10 Crispy rice

The crispy rice is a specialty in Chinese food. It is used in making dishes as well as snacks, usually deep fried and flavored with spices. The sound of pouring hot soup over just deep fried crispy rice delights everybody and adds joyful atmosphere in banquets.

2.11 Rice thick soups and weaning food

Thick soup made of rice, legumes and some tonic materials are traditional healthy food for the weak, the elderly and children. The most welcomed instant-type thick soups are made of black rice, black soy bean and black sesame[22]. Weaning food based on rice is still used in rural areas, made of high-protein starch powder.

2.12 Ciba

The ciba , which is made by pestling cooked glutinous rice, is a famous food in southwest China. It is usually topped with a mixture of powdered sesame, peanut, bake rice and yellow sugar, shapes like egg and tastes sweet and soft. In Yunnan province, the ciba is often filled with various sauces and baked. If shredded and steamed, topped with minced meat and sauce.

2.13 Rice in Chinese dishes

Crispy rice, glutinous rice and rice powder are often used in cooking dishes. Steaming with glutinous rice powder with is a unique style of cooking. Wrapping meat or chick in glutinous rice and steaming is also a common practice in Southern China.

2.14 Rice in other foods

Rice can be made into steaming buns, bread and biscuits, usually mixed with wheat flour or glens. The steaming buns made of purple rice and wheat has becoming popular in north part of the country.

3. Challenges in rice industry

3.1 Resource constraints and population pressure

Along with the economic development and improving living standard, a slight decrease of direct rice consumption can be predicted. However, the population will increase to 1.6 billion in the mid-21 century, while the rice-planting area will continue to shrink, because of the limitation of water resources and urbanization in developed areas. This means that the yield per unit area has to be further improved to meet the future demand[23].

3.2 Relatively poor edible quality

The consumers pay more attention to the edible quality of rice and rice products. Clean rice and polished rice gradually occupied the urban market. Most urban dwellers prefer the japonica type[24], and it is discovered that the higher the income is, the more japonica rice is consumed in most rural areas[25]. The low-quality early indica rice keeps long in stock for years. The utilization of poor acceptable rice is still a great task for food researcher[26].

3.3 Incomplete quality-insurance system in rice production

Separate quality standards for rice used in feed, in rice wine brewing, in extracting starch, and in various rice food producing are yet to be set up in China. Because of the lack of quality testing device, the existing quality standard often can not be fully carried out. Well organized field management, proper post-harvest handling and better rice grain processing equipment are also urgent problems in upgrading rice quality in China[27].

3.4 Need for rice from better environment and ecological agricultural practice

According to the report of Rice and Rice Product Quality Supervision and Test Center, which is subordinated to the Ministry of Agriculture, most products are within the safe range in terms of chemical and heavy metal pollution. Only 5.2 percent of the products did not meet the standard on chemical residues[4]. However, the consumers are expecting rice and rice products with guaranteed safe quality. Up to 2002, the Production of Green Food rice and organic rice only account for 1.42 percent of the total yield of rice unable to meet the market criterion[4].

3.5 Low processing capacity of rice products

The low profit of rice production seriously curbs the development of rice industry and result in an unstable rice market. Up to 2002, only less than 2 percent of rice grain is used in industrial processing. Most of the rice processing is carried out in household level or in very small-scale factories. Rice products of high additional value and of healthy image are expected in future years[28].

4. Trends of rice industry in China

4.1 Developing of high acceptable rice products made of early-season indica rice

These low-value rice has been used in production of rice noodles, yellow wines, sake, rice-milk beverages, instant rice soups, rice crackers, rice biscuits, instant rice gruels, rice flakes, rice beer, crispy rice, and rice bread[1,29]. Blending rice technique and fermentation technique are also used in improving the quality of early-season indica rice. Blending with japonica rice and glutinous rice can remarkably upgrade the cooking quality of a mixture with more than 50 percent early-season rice[30]. The application of natural flavor agent can further improve the acceptability of the blended rice[31]. Rhizopus and alcohol yeast fermentation can

change the mouthfeel and gel property of early-season indica rice into that of japonica rice produced in the northeast region, with a pleasant odor like the flavor of steamed spongy cake and bread[32].

4.2 Promoting specialty rice and black rice products

The most important specialty rice in China are rice with dark epidermis color, such as red, green, brown, purple and black rice. The dark-colored rice is proved to have physiological functions of anti-oxidation, preventing iron-deficiency anemia, anti-stress, and immuno-modulating, due to the rich contents of bioflavonoids[33]. The anti-oxidant properties is positively correlated to the pigment content of colored rice[34]. The mineral contents of the colored rice are much higher than white rice, indicating the justice of traditional use of them as tonic ingredients in food therapies[35]. Among them, the black rice has the most powerful healthy effect, and the green glutinous rice is the most delicious type, with higher content of vitamin K and lipid, and a faint fragrance after cooking. These precious specialty rice have been developed into black rice wine, black rice paste, black rice fermented beverage, black rice oral liquid, black rice dumplings, black rice ice creams[33], black rice and rainbow mixed rice, and black rice instant gruels[36].

4.4 Promoting production of green rice and organic rice

The Green Food certificate is a registered quality mark in China, which requires good agricultural environment and strictly controlled cultivation and processing practice. There have been more than 200 rice products won the Green Food certificate in China. Organic rice planting area covers only about 2,000 hectares, but the area of certified organic farm in turning period reached 15-20 thousand hectares in 2003[37]. Realizing the importance of safety quality on rice trade in international and domestic market, in many regions, the local government is setting up plans to accelerate the production of Green Food rice and organic rice.

4.4 Developing of rice food of high nutritional value and healthy functions

The idea of using rice as healthy food can be dated to a thousand years ago in China. With the rich source of genetically diversified rice, China has developed some functional rice, such as rice for anemia patients, rice for high blood pressure patient, and high mineral rice[38]. The techniques of nutritional fortification of rice has been developed, by which lysine, vitamin B1, B2, iron and calcium can be successfully and simply fortified into clean rice. A great number of nutrified rice foods have found their place in market and accepted by the consumers[39]. The regulations on nitrification of staple food will be established in near future.

4.5 Combination and cooperation of the rice research, producing and processing bodies

Most of the rice producers are separated farmers, and most of the 8971 rice processing enterprises are small-scale factories. The government is encouraging the combination of rice producing and processing enterprises, and is about to give more favorable policies to stimulate the development of large-scale rice

enterprises[4]. The rice industry association, organized by authorities in rice relevant research and representatives from rice industry, is just set up in Sept 28, 2003, with the task of vitalize the rice production and utilization in China.

References(all in Chinese)

1. XIE Jian, XIE Kesheng, Technology progress and developing trend in rice processing industry in China, *Grain and Feed Industry*, 2002(8)
2. LIU Guicai, Rice market analysis in 2002 and a prospect to 2003, *China Food and Nutrition*, 2003(3) : 20-22
3. Zhengzhou Grain Market, Domestic rice market analysis in 2002, *China Rice*, 2003(2) : 30-33
4. ZHAI Huqu, CHENG Shihua, Benefiting Chinese people by developing rice industry, in the Inaugural Conference of China Rice Industry Association, Sept. 28, 2003
5. CAO Quizhang, BAI Shizhi, Developing upland rice production and promoting the water-saving cultivation, *Crop Magazine*, 2002(6), 40-41
6. China Association of Grains, Statistical data in 2002, *Grain and Oil Processing and Food Mechine*, 2003(8)
7. ZHENG Youchuan, Features of Chinese rice diet, *Agricultural Archaeology*, 2002(1) : 272-273
8. KONG Linghui and YUAN Lin, Developing of nutritious instant gruel, *Food Science and Technology*, 2003(6) : 14,19
9. HONG Bokeng, SUN Guoyong et al, Study on polyunsaturated acid containing healthy eight-treasure congee, *Journal of Harbin Univeristy of Commerce Natural Science Edition*. 18(5) : 556-558(2002)
10. ZHOU Guoyao, YAO Huiyuan, Guo Guanxin, Research of Instant Rice Vermicelli, *Grain and Feed Industry*, 1999(9) : 45-46
11. LU Jiali, Development of fermented nutritious rice noodle, *Western Grain and Oil Technology*, 25(1) : 37-39(2000)
12. LI Lite and CHENG Minghua, Current status of production and research of rice noodle, *Food and Mechine*, 2000(3) : 10-12
13. TAO Xuehong and RUI Hanming, Rice vermicelli containing fish meat, *Grain and Oil Food Science and Technology*, 2001, 9(4) : 25-26
14. SHEN Jianfu, ZHANG Yin and WU Xiaoqin, Feasibility study of industrial production of Chinese rice cake, *China Grain and Oil Food Science and Technology*, 1999(1) : 27-29
15. LI Gongguo and SUN Jian, Rice cake crackers made by microwave puffing, *Grain and Oil Food Science and Technology*, 2002, 10(2) : 19-20
16. ZHAO Xiangzhong, LU Xiaobin and YAN Bin, Rice cracker fortified with calcium and oligosaccharides, *Grain and Oil Processing and Food Mechine*, 2003(6) : 60-61
17. WANG Shuzhen, Dumpling with Bone mash fillings and its nutrients analysis, *Food Industry*, 2000(5) : 12-13

18. DU Shiliang, Ideas on novel sweet rice wine product series, *Brewery Science and Technology*, 1998(4) : 52-53
19. HUANG Peizhong, Study on bottling procedure of sweet rice wine, *China Brewery*, 1998(1) : 23-24
20. 林祥熙, 炒米鹽茶治療急性胃腸炎333例, *Chinese Folk Therapy*, 1999(9) : 41
21. 陳曉平, 馬鐵俊, 吉林黑香米糊的研制, *Food Science*, 1996(10) : 68-69
22. YAO Huiyuan, Trends in world rice industry and developing strategy in the future decade, in the Inaugural Conference of China Rice Industry Association, Sept. 28, 2003
23. SUN Yajun and ZHANG Zhigang, A brief talk on prospect and strategy of rice industry in China, in the Inaugural Conference of China Rice Industry Association, Sept. 28, 2003
24. HUANG Ji, Correlation between income increase and rural rice consumption, *Agricultural Economics Problems*, 1994(8) : 49-52
25. WU Ming, Trends in rice refining processing and rice products, *Jiangxi Food Industry*, 2002(4) : 50
26. YA Zhou, Difficulties and countermeasures in upgrading rice quality in China, *Reclamation and Rice Cropping*, 2003(2) : 46-47
27. ZHANG Hui and YAO Huiyuan, Latest advancement of comprehensive utilization and processing of rice. *China Rice*, 2003(1) : 11-13
28. WANG Yalin and JIANG Xianjun, Study on technique of producing fermented carbonated milk-rice wine, *China Brewery*, 2001(3)
29. ZHOU Qingming, ZHONG Bin and SUN Huanliang, Study on Recipe and Quality of Blending rice mainly by low quality early indica rice. *Journal of Hunan Agricultural University (Natural Sciences)*, 27(5) : 327-329(2001)
30. YAO Huiyuan, Research and industrialize of rice flavor agents, *Grain and Oil Processing and Food Mechine*, 2003(2) : 14-15
31. CHEN Weiping and DONG Kaifa, Studies on improvement of edibility characteristics of early indica rice by fermentation, *Journal of Jiangxi Agricultural University*, 23(4) : 498-502 (2001)
32. ZHOU Yun and ZHANG Shouwen, Functional features and exploision of specialty rices, *Grain and Oil*, 2002(7) : 36-38
33. SUN Ling, CHEN Junqiu et al, Relation between epidemis colour of rice and its antioxidation properties, *Acta of China Grain and Oil*, 17(4) : 25-28(2002)
34. WU Shizhao, YANG Jun et al, Amino acid and mineral content of some high-quality and specialty rice in southern China, *Journal of Huanan Agricultural University*, 17(3) : 19-24(1996)
35. WU Huixun, LIANG Langdu, and LI Xixian, Study on the technique of black rice quick-edible gruel. Glutinous black rice, red bean, mungbean, *Guangzhou Food Industry Science and Technology*, 19(2) : 38-39(2003)
36. JIN Liandeng and ZHU Zhiwei, Basic technique and marketing prospect of organic rice production, *China rice*, 2003(5) : 39-40
37. HU Peisong, Research and developing of functional rice, *China Rice*, 2003(5) : 3-5
38. LU Bushi and ZENG Meixia, Study on nutrients fortified rice production. *Natural Science Journal of Xiangtan University*, 1999(2) : 64-67