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### MARKETING OF VALUE-ADDED RICE PRODUCTS IN JAPAN: GERMINATED BROWN RICE AND RICE BREAD

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**Marketing of Value-Added Rice Products in Japan:  
Germinated Brown Rice and Rice Bread**

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## **I. INTRODUCTION**

Rice consumption in Japan has been decreasing since the mid 1960s. During recent years, it has been decreasing by 1% a year. Accordingly, the domestic rice production, which is the heart of agriculture in Japan, has also been decreasing. The same trend is observed in many Asian countries, such as Taiwan, Malaysia, Singapore, and even in China. In China, per capita rice consumption has been steadily decreasing since the early 1990's. To stop declining rice consumption is a critical issue. To develop some value-added rice products is important to encourage rice consumption as a whole. Germinated brown rice (GBR) and rice bread (RB) are two examples that attract consumers.

GBR and RB currently are becoming increasingly popular setting up fair sized industries in Japan during the last several years. Large companies have been producing rice cookers designed for GBR and RB, marketing channels for them are being developed, more products based on GBR and RB are on the road, and more and more retail shops are selling GBR and RB. Even school lunch is involved nationwide. The GBR and RB can grow to be some of the keys for recovering the popularity for rice in Japan and other Asian countries.

## **II. GERMINATED BROWN RICE (GBR)**

### *BACKGROUND OF GBR RICE*

Nutrition of germinated grains has been studied since decades ago. Finney (1978) showed enhancement of wheat and soybean seeds if they were germinated. Tkachuk (1979) also found similar situation in wheat. Saikusa, Horino and Mori (1994) found that  $\gamma$ -aminobutyric acid (GABA) increased dramatically if brown rice is soaked in 40 degrees in Celsius water for 8 hours to 24 hours. Okada et al. (2000) reported that intake of GABA for 8 consecutive weeks suppressed blood pressure and improved sleeplessness, and autonomic disorder observed during the menopausal or presenile period. More recently, Jeon et al. (2003) found that GBR may be effective for suppressing liver damage. In Japan, people in the ancient era may have been eating brown rice soaked (Kayahara, 2003).

GBR was established for marketing in Japan in 1995. GBR products were developed and marketed first by Domer Co. (Ueda City, Nagano Pref.) and the city government, Mino-cho of Kagawa Pref., was one of the earliest organizations engaged in the production of GBR. It is now produced by several private companies including agricultural cooperatives. During the last decade, 49 items related to GBR have been patented. The method to make GBR is quite simple. Soak the brown rice for one night or two depending on temperature and they are germinated. This

process make the internal minerals change, and the brown rice becomes more nutritious, easier to chew and tastier.

### *CONTRIBUTION OF GBR TO HEALTH*

Eating brown rice became popular in Japan back in the 1970's. That was because of rich fiber and other nutrients contained in the brown rice. However, the popularity did not last long due to the fact that brown rice had to be cooked in the pressure cooker and was still hard to chew and less tasty. GBR overcame the problem. It can be cooked in an ordinary rice cooker and is soft enough to chew even for children. Further, an added benefit is the fact that GBR is much more nutritious.

During the process of being germinated, nutrients in the brown rice change drastically. Various types of analyses on germinated brown rice have been conducted in Japan. Those major nutrients that increase in content in the GBR are  $\gamma$ -aminobutyric acid (GABA), dietary fiber, inositols, ferulic acid, phytic acid, tocotrienols, magnesium, potassium, zinc,  $\gamma$ -oryzanol, and prolylendopeptidase inhibitor (Kayahara and Tukahara, 2000). Kayahara and Tsukahara indicate that volume of nutrients contained in GBR relative to milled rice are 10 times for GABA, nearly 4 times for dietary fiber, vitamin E, niacin and lysine, and about 3 times for vitamin B<sub>1</sub> and B<sub>6</sub>, and Magnesium (Fig. 1). Accordingly, they conclude that continuous intake of GBR is good for accelerating metabolism of brain, preventing headache, relieving constipation, preventing cancer of colon, regulating blood sugar level, preventing heart disease, lowering blood pressure as well as preventing Alzheimer's disease (Table 1).

Table 2 shows the results of analyses on nutrients contained in GBR relative to the situation of brown rice before germination. In these analyses, we selected not only Japanese rice but also California medium grains (Calrose and M401 varieties) and Vietnamese long grains (ordinary grains and jasmine rice). Through many chemical analyses, it was indicated that level of moisture and length of period after harvest influence whether the brown rice can be germinated or not. These two factors appear to influence the magnitude of change in nutrients. Therefore, those two items are shown in the table as well. The results of the analyses indicate that there is a significant change in profiles of free amino acids for all brown rice as they get germinated. GABA increased from 3.6 to 6.1 for the Vietnamese ordinary long grain despite the extremely low germination rate. GABA in Calrose increased more than two times from 4.9 to 10.9 and for M401 more than three times from 2.7 to 9.8 with germination rates of 90% and 56%, respectively. For the Japanese Koshihikari and Hitomebore varieties, GABA increased from 7.6 to 16.6 and from 10.5 to 13.6, respectively, with high germination rates.

### *PREPARATION AND MARKETING OF GBR*

The basic procedure to prepare GBR is; first select good brown rice to germinate; second, soak it for some 20 hours in warm water at around 30 to 40 degrees in Celsius or longer with cooler temperature; changing water a few times depending on smell being developed during the soaking; wash it lightly before cooking. GBR producing companies pack it into two types; dry and wet. Moisture level of dry and wet GBR are generally at 15% and 30%, respectively. The marketing procedures are conducted mainly through three routes: Catalogue, internet and retail shopping.

Market prices of the GBR is at the range of 1,000 yen (appr. US\$9.00) to 800 yen (US\$7.00) per 1kg comparing the prices for the ordinary milled rice ranging from about 300 yen to 600 yen depending upon quality. Although GBR can be easily prepared at home, they are priced extraordinarily high for sale. The GBR was originally started in 1995. Nowadays, GBR products are being sold as much as 15,000 MT in Japan, and the marketed value as much as approximately 15 billion yen. Total rice consumption in Japan is currently about 9 million MT in brown rice basis. The industry has targeted total sales of GBR in Japan at 90,000 MT, a 1% of the total rice consumption, in the near future.

GBR is also served at restaurants. An oriental atmosphere restaurant in Kyoto has served home-made GBR rice since 5 years ago. The owner insists that GBR attracts young women.

GBR is often quoted in periodicals featuring health and fashion. Both the aged for mainly health and young mainly for fashion and health appear to appreciate the GBR.

GBR is already applied to many products such as GBR rice-balls, GBR soup, GBR bread, GBR doughnuts, GBR cookies, GBR rice burger, etc. GBR is mixed with other materials in those products. GBR can be applied to many dishes in the world. Italian risotto, Spanish paella, Brazilian fejoada, and Indian curry & rice, etc may be suitable for using GBR. It can be used even for sushi. Among all those possibilities, making GBR at home is the best, cheapest and most nutritious. Because GBR is eaten as brown rice, there is no 10% loss which usually occurs during the milling process from brown rice. GBR's high nutrition content is quite critical when food supply is short.

GBR can be applied to indica rice. Indica rice often contains some bitter tasting material on the outer layer of the grains. Accordingly, it is suggested to soak it in the refrigerator for an extra day or two before cooking (Horino, 2004). Horino hints that the parboiled rice process may be applied for GBR rather easily for the indica rice. Before steaming the rough rice, the rice can be germinated first.

### III. RICE BREAD (RB)

#### a) *Growing business*

RB became possible to make by the creation of fine rice flour developed by the Niigata Food Products Research Institute (Niigata-ken Shokuhin Bunseki Senta). Rice bread is getting more popular in Japan. In Tottori City, some 15,000 kids have been enjoying rice bread twice a month. According to the questionnaire the City office surveyed as of 2002, 50% of the kids feel that rice bread is enjoyable, 23% neutral, and 27% moderately dislike it. After a year of eating rice bread regularly, about 80% of the kids show their fondness toward rice bread.

RB is generally made with 80% rice flour and 20% gluten. In Japan, rice is relatively much more expensive than wheat. For rice bread, therefore, low quality rice or old rice, which is substantially cheaper than ordinary new rice, is being used. Rice that is 5 to six years old can be used for rice bread and the quality of the bread is not necessarily impaired much, according to the bakeries..

More varieties of rice bread are being developed; plain rice bread, raisin rice bread, nut rice bread, rice bread rolls, croissant rice bread, and many other kinds. They have established gluten-free rice bread using only rice flour mainly. This type of rice bread is suitable for those who are allergic to gluten.

Rice bread is being sold commercially, and the number of bakeries selling rice bread is increasing nowadays. Prices of RB at bakeries are quite expensive relative to wheat rice. In a Tottori bakery shop, one loaf of rice bread is sold for 450 yen (about US\$4.00) and wheat bread for 150 yen (about US\$1.40). Rice bread is about 3 times as expensive as wheat rice. In this bakery, which started selling rice bread in November 2002, rice bread has now grown to account for 20% of its total sale value.

There are no official statistics to show how much of rice bread is being consumed in Japan. In 2001, one milling company used as much as 1,100 MT of rice for bread flour.

#### b) *Costs of Rice Bread*

Costs of rice bread in Japan is relatively much more expensive than wheat. Tables 3 and 4 show cost items to produce rice bread flour in Japanese yen and the U.S. dollars, respectively, converting yen into dollar using exchange rate of 105 yen a dollar. One kilogram of brown rice costs 120 yen or US\$1.14, which is the price for low quality rice and substantially cheaper than the costs for table rice at around \$4.00/kg. Charge for milling for milled rice is \$0.1/kg. A loss of 15% occurs when low quality rice is milled with a milling rate at 85%. Therefore, accumulated price for 1kg of milled rice turns out to be \$1.46. Then, a charge for flouring is \$0.86/kg with milling rate at 80%. Thus, accumulated costs so far is \$2.89/kg. Finally, rice flour must be added

with wheat gluten to become sticky. This is \$3.81/kg in Japan. If rice flour 80% and gluten 20% are mixed, the cost for the mix becomes \$3.08. This compares with wheat flour at \$0.8 in Japan. Rice bread flour is nearly 4 times more expensive over wheat flour. Rice bread at the school lunch in Tottori is being subsidized by the city government just for the additional portion of the cost over wheat bread. The national Japanese government provides subsidies to schools if they use old rice for bread. Rice bread is provided at schools in 11 prefectures out of 47 in Japan as of 2003 replacing wheat bread. The number may be increasing in 2004.

What would be the cost different between rice bread flour and wheat flour in the world market? Table 5 indicates an estimate based on world prices. Price of milled rice is from Thai 100%B market price. Adding charge for flouring at \$0.1/kg and gluten at \$2.7/kg, costs of rice bread flour become \$0.84, which compares with \$0.25/kg at the wholesale market (Wheat Outlook Yearbook, 2003). Rice bread flour still appears to be almost 3 times more expensive than its counterpart of wheat.

#### IV. CONCLUSIONS

Germinated brown rice (GBR) and rice bread (RB) are two examples of recent rice products that have been becoming quite popular in Japan. GBR holds much more nutrition over milled rice or ordinary brown rice. Because it can be prepared at home without much effort, GBR could be well used as a tool to improve food security in food shortage regions. For developed countries, GBR can be a dietary food for improvement of health. Despite of the high prices of GBR marketed in Japan, increase in consumption appears to be prominent. Currently, GBR is being produced using japonica rice. However, indica rice may be well suited as well. Because GBR is easily made at home once good brown rice is obtained, it's popularity should spread throughout the world.

Rice bread came out just a few years ago. It is now developed into several type of bread and they are quite attractive to the consumers in Japan despite the fact that they are much more expensive than wheat bread. In the world market, the costs of rice bread is still much greater than wheat; however, it has the potential to grow in many countries in the future. Nowadays, gluten-free rice bread (100% rice) has been developed. This type of bread is good for those who are allergic to gluten. Rice bread is now used for school lunch in many areas in Japan. This way, kids can develop taste for rice bread and this may lead them to appreciate rice for life.

GBR and RB may hold great potential in many ways. First, the very Asian peoples may re-recognize the significance of rice as a healthy food. Second, eating as GBR instead of milled rice, it is possible to save 10% in volume. Third, people can enjoy new types of rice products such as RB. Finally, those new ways of consuming rice may attract those people who are traditionally non-rice eaters.

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## V. References

- Bahadur, Hari KC: "Useful Germinated Brown Rice," The Rising Nepal, April 9, 2003  
<http://www.nepalnews.com.np/>
- California Rice Research Board: "Rice Utilization and Product Utilization – 02," visited in January 2004.  
<http://www.syix.com/rrb/02rpt/prodlevel.htm>
- Domer Corporation: official homepage for germinated brown rice, in Japanese  
<http://www.hatsuga.com/>
- FANCL: official home page for germinated brown rice in Japanese (English in part)  
<http://www.fancl.co.jp/genmai/top.html>
- Finney, P. L.: "Potential for the Use of Germinated Wheat and Soybeans to Enhance Human Nutrition," Advances in Experimental Medicine and Biology, 105 Nutr. Improv. Food Feed Proteins, 681-701, CODEN: AEMBAP ISSN: 0065-2598, 1978
- Horino, Toshiroh: telephone conversation with the authors, National Agricultural Research Center for Western Region (WeNARC), Fukuyama, Hiroshima, Japan, February 2004.
- Jeon Tae Il, Hwang Seong-Gu, Lim B. O, and Park D. K.: "Extracts of *Phellinus Linteus* Grown on Germinated Brown Rice Suppress Liver Damage Induced by Carbon Tetrachloride in Rats," Biotechnology Letters, 25(24) pp.2093-6, December 2003.
- Kayahara, Hiroshi and Kikuichi Tsukahara: "Flavor, Health and Nutritional Quality of Pre-germinated Brown Rice," presented at 2000 International Chemical Congress of Pacific Basin Societies in Hawaii, December 2000.
- Kayahara, Hiroshi and Takamura Miyake: Surprising Live Germinated Brown Rice, (in Japanese), Shougakukan-Square Co. Tokyo, 2003.
- News in Science: "Soaked brown rice is better for you," December 19, 2000  
<http://www.abc.net.au/science/news/stories/s225249.htm>
- Okada, Tadashi, Tomoko Sugishita, Taro Murakami, Hiromichi Murai, Takayo Saikusa, Toshiroh Horino, Akihiko Onoda, Osami Kajimoto, Rei Takahashi, and Takeo Takahashi: "Effect of the Defatted Rice Germ Enriched with GABA for Sleeplessness, Depression, Autonomic Disorder by Oral Administration," Nippon Shokuhin Kagaku Kaishi, Vol. 47, No. 8, 596-603, 2000.

Saikusa, Takayo, Toshiroh Horino and Yutaka Mori: "Distribution of Free Amino Acids in the Rice Kernel and Kernel Fractions and the Effect of Water Soaking on the Distribution," J. Agric. Food Chem., Vol. 42, 1122-1126, 1994.

ShopNatural, Tucson Cooperative Warehouse: website visited in February 2004.

<http://www.shopnatural.com/Merchant2/merchant.mvc?>

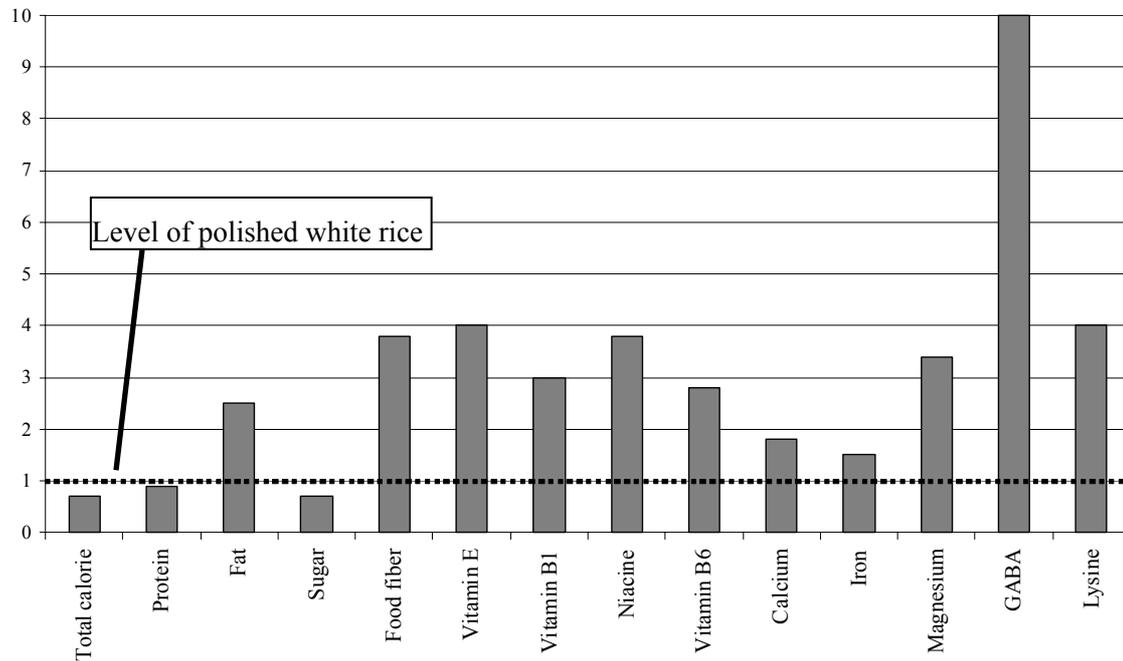
Tkachuk, Russell: "Free Amino Acids in Germinated Wheat," J. Sci. Food Agric., 30, pp.53-8, 1979

U.S. Department of Agriculture: Wheat Situation and Outlook Yearbook, Market and Trade Economic Division, Economic Research Service, WHS-2003, March 2003.

U.S. Department of Agriculture: Rice Outlook, RCS-04a, January 2004.

Yang, F., T. K. Basu, and B. Oraikul: "Studies on Germination Conditions and Antioxidant Contents of Wheat Grain," International Journal of Food Sciences and Nutrition, 52, 319-330, 2001.

**Figure 1. Ratios of nutritional volumes of pre-germinated brown rice compared with those of polished rice level indicated on the dotted line**



Source: Kayahara and Tsukahara (2000)

**Table 1. Selected examples of biological activities in Pre-germinated brown rice**

$\gamma$ -Amino butyric acid (GABA)	Hypotensive effect, Accelerating metabolism in brain, preventing headaches or depressions aftereffects of cerebral arteriosclerosis and cerebral apoplexy, Preventing climacteric disorder, Preventing presenile derangement such as insomnia and mental irritation, Activating renal function
Food fiber	Relieving constipation, Preventing cancer of colon, Regulating blood sugar levels
Inositols	Accerelating fat metabolism, Preventing fatty liver, Preventing arteriosclerosis
Ferulic acid	Scavenging superoxides, Suppressing melanogenesis
Phytic acid	Antioxidative effect, Protecting cardiovascular disease, Preventing platelet aggregation
Tocotorienols	Scavenging superoxides, Protecting skin from ultraviolet rays
Magnesium	Preventing heart diseases
Potassium	Lowering blood pressure
Zinc	Activating reproductive function, Preventing arterio Sclerosis
$\gamma$ -Oryzanol	Antioxidative effects, Preventing skin aging, Modulating cholesterol values
Prolylendopeptidase inhibitor	Possible preventing Alzheimer's disease

Source : Kayahara and Tsukahara (2000)

**Table 2. Main free amino acids profiles and properties of brown rice (BR) and germinated brown rices (GBR)**

Harvested year	2003				2002				2002			
Analyzed date	January 2004				October 2003				October 2002			
Moisture(%)	14.8		13.5		12.3		12.7		14.2		14.7	
Germination rate(%)	10		36		90		56		93		82	
Amino acids	BR	GBR	BR	GBR	BR	GBR	BR	GBR	BR	GBR	BR	GBR
Aspartic acid	5.9	0.6	7.9	0.9	8.0	2.7	26.2	4.0	23.5	3.9	14.2	2.6
Glutamic acid	10.8	2.6	9.8	3.7	18.2	8.5	25.0	7.5	32.2	9.5	17.1	5.5
Alanine	5.8	8.8	3.6	11.1	10.2	18.9	8.9	15.8	4.2	27.9	5.4	32.3
GABA	3.6	6.1	4.1	6.4	4.9	10.9	2.7	9.8	7.6	16.6	10.5	13.6
Total*	57.9	34.1	46.0	46.8	68.0	78.1	103.0	77.5	93.3	79.3	71.6	76.5

Experimental procedure: Three grams of brown rice was scaled in a 50ml centrifuging tube (Corning) and added with 20 ml of distilled water. After germination at 30°C for 20 hours, water was discarded and 6 ml of 5% TCA (trichloroacetic acid : containing ornithine ( 5µmol/ml ) as a standard substance ) was added to germinated rice, which was then homogenized and centrifuged. The resulting supernatant was poured into a test tube, and its pH was adjusted to 2.2 with sodium hydroxide. A mixture of 400µl of the pH adjusted supernatant and 1.2 ml of citrate buffer solution ( pH 2.2 ) was passed through a filter ( 4.5 µm ) and 40 µl of the filtrate was analyzed on an amino acid analyzer.

\* This includes other types of free amino acids.

**Table 3. Costs of producing rice bread flour in Japan, yen/kg**

	<i>Original costs</i>	<i>Milling rate</i>	(1kg basis) <i>Accml. costs</i>
	<i>per 1kg</i>	<i>%</i>	<i>1kg equiv.</i>
Raw brown rice (low quality)	120	100	120
Charge for milling	10	85	153
Charge for flouring	90	80	304
Gluten	400		323
<b><i>Total for rice bread flour mix</i></b>			<b>323</b>

**Table 4. Costs of rice bread flour in Japan, US\$/kg**

	<i>Original costs</i>	<i>Milling rate</i>	(1kg basis) <i>Accml. costs</i>
	<i>per 1kg</i>	<i>%</i>	<i>1kg equiv.</i>
Raw brown rice (low quality)	1.14	100	1.14
Charge for milling	0.10	85	1.46
Charge for flouring	0.86	80	2.89
Gluten	3.81		3.08
<b><i>Total for rice bread flour mix</i></b>			<b>3.08</b>

**Table 5. Costs of rice bread flour in the world market, US\$/kg**

	<i>Original costs</i>	<i>Milling rate</i>	(1kg basis) <i>Accml. costs</i>
	<i>per 1kg</i>	<i>%</i>	<i>1kg equiv.</i>
Milled rice	0.2	100	0.20
Charge for flouring	0.1	80	0.38
Gluten	2.7		0.84
<b><i>Total for rice bread flour mix</i></b>			<b>0.84</b>

Sources: USDA (2004 and 2003); ShopNatural.