目錄

第二屆米食加工與營養國際研討會
-由主食到保健-
2nd Symposium on Rice Products and Nutrition
- From Staple Food to Nutraceuticals

壹、主題：

強化國際**米食加工與營養**議題之學術交流，聚焦於「米食加工對**保健營養強化**議題」的討論，並**現場展示**台灣近年米食產品及相關研究成果。以促進臺灣**米食加工**技術與國際的發展同步，及國內產官學界交流。並建立國際合作及參加國際研究團隊的討論平台。

貳、主辦單位：行政院農業委員會農糧署

參、承辦單位：國立宜蘭大學食品創意與教育發展中心、國立宜蘭大學食品科學系

肆、協辦單位：中華穀類食品工業技術研究所、國立臺灣大學食品科技研究所

伍、日期：中華民國101年6月8日(星期五)

陸、地點：國立臺灣大學應用力學所國際會議廳（台北市大安區羅斯福路四段一號）

柒、講者：

1. Dr. NobuyaShirai(白井展也)：全國野菜茶業研究所(NIVTS, NARO)，前日本食品綜合研究所研究員(NFRI, NARO)。
2. Dr. Shin Lu(盧訓)：中華穀類食品工業技術研究所所長(China Grain Products R&D Institute)。
3. Dr. Melissa Fitzgerald：國際稻米品質網(INQR)主席、昆士蘭大學食品科學系系主任(Department of Food Science, University of Queensland)，前國際稻米研究所稻穀品質營養及採後中心主任(GQNPC, IRRI)。
4. Dr. Ken'ichiOhtsubo(大坪研一)：日本新潟大學自然科學系教授(NigataUniversity)，前

日本食品綜合研究所部長(NFRI, NARO)。

捌、主持人：

1. 盧訓所長(Dr. Shin Lu)：中華穀類食品工業技術研究所所長(China Grain Products R&D Institute, Director)。

2.張永和研發長(Dr. Yung-Ho Chang)：靜宜大學研發長(Providence University, Dean of research and development)。

3.葉安義教授(Dr. An-I Yeh)：台灣大學食品科技研究所教授(NTU Institute of Food Science and Technology, Professor)

4.游若筴所長(Dr. Roch-Chui Yu)：國立台灣大學食品科技研究所所長(NTU Institute of Food Science and Technology, Director)。

玖、活動特色：

1.國外講師演講時進行即席翻譯。

2. 研討會手冊內容概要為中英對照。

3. 會場展示近年米食研發計畫成果暨相關產品。

4. 會場邀請業者展示近年開發的米食產品。

《第二屆米食加工與營養國際研討會》日程表

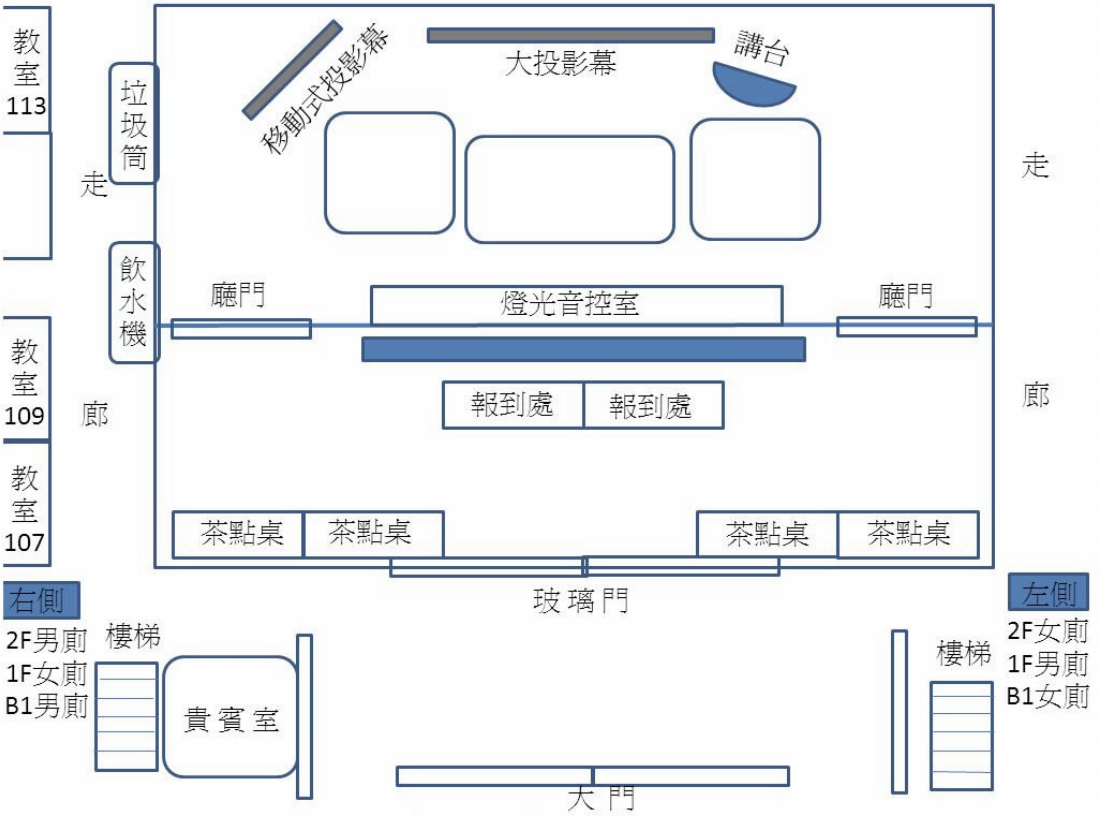
時間：101 年 6 月 8 日(星期五)　09：00 ～17：00

地點：國立臺灣大學應用力學所 1 樓國際會議廳

時間	主題	講者	主持人
8:30～9:00	報到		
9:00～9:05	歡迎及長官致詞		
9:05～9:10	開幕及主辦單位致詞		
9:10～10:30	米的營養特性及保健功效 Nutraceutical Properties and Health Benefits of Rice	白井展也,日本食品綜合研究所 Dr. NobuyaShirai, NFRI, Japan	穀研所盧訓所長 Dr. Shin Lu, Director of CGPRDI, Taiwan
10:30～11:00	中場休息		
11:00～11:30	國內米食加工與保健營養研究發展現況 Rice Processing and Nutrition Research and Development in Taiwan	穀研所盧訓所長 Dr. Shin Lu, Director of CGPRDI, Taiwan	靜宜大學張永和研發長 Dr. Yung-Ho Chang, Dean of R and D Providence University Taichung
11:30～12:10	討論		
12:10～13:10	午餐休息 (近年米食研發成果暨相關產品展示)		
13:10～14:30	加工技術對米食消化性質影響 Effect of Processing on Digestibility of Rice and Rice Products	Fitzgerald 博士，前國際稻米中心營養室主任 Dr. Melissa Fitzgerald, IRRI	國立台灣大學葉安義教授 An-I Yeh, Professor,NTU, Taiwan
14:30～15:00	中場休息		
15:00～16:20	米穀粉添加對烘焙及米食品營養之影響 Effect of rice flour addition on nutritional quality of bread and food products	大坪研一教授,新瀉大學,前日本食品綜合研究所 Dr. Ken'ichiOhtsubo, Professor of Nigata University, Japan	國立台灣大學游若筱所長 Dr. Roch-Chui Yu, Director of NTU, Taiwan
16:20～16:50	討論		
16:50～17:00	總結及閉幕		

《第二屆米食加工與營養國際研討會》會場資訊

一、研討會會場平面圖



二、注意事項

(1)應用力學所全面**禁止吸煙**，如需餐飲請在門廳內飲用。會議廳內**嚴禁攜帶飲料、餐點**進入。

(2)校內停車時於入校時抽取計時票，請於服務台(報到處)核章即有半價優惠。

(3)中午用餐地點為教室 113、教室 109，用餐時間為中午 12:10～13:10，敬請提早進入會場。

(4)本活動不提供免洗杯，請自行攜帶環保杯，會場有熱水桶、溫水桶及飲水機。

講者

Dr. NobuyaShirai

演講題目

米的營養特性及保健功效

Nutraceutical Properties and Health Benefits of Rice

CURRICULUM VITAE

NobuyaShirai, Ph. D.

NobuyaShirai,Ph.D.（白井展也）

National Institute of Vegetable and Tea Science, (National Agriculture and Food Research Organization:NARO)

2769 Kanaya, Shimada, Shizuoka 428-8501,Japan

Phone;+81-547-45-4101　Fax;+81-547-46-2169

EDUCATION

1996- Tokyo University of Fisheries (Doctoral student)

1995- Tokyo University of Fisheries (Research student)

1993- Miyazaki University (Master's student)

1989- Miyazaki University (Baccalaureate)

PROFESSIONAL EXPERIENCE

2000- National Food Research Institute (A part-time researcher)

2003- National Food Research Institute (Research fellowship for young scientists; Japan society for the promotion of science)

2006- National Food Research Institute (Senior Researcher)

2011- National Institute of Vegetable and Tea Science (Senior Researcher)

Nutraceutical Properties and Health Benefits of Rice

NobuyaShirai

National Institute of Vegetable and Tea Science (National Agriculture and Food Research Organization: NARO), Shimada, Japan (nshinya@affrc.go.jp)

INTRODUCTION

Rice is the most popular staple food among Asian populations and is a component of a variety of cuisines. Generally, Rice is polished before consumption to improve its taste.However, unpolished brown rice (BR) and rice bran, a by-product of the rice-milling process, contain large amounts of essential dietary components including, vitamins, oryzanol (a mixture of components including sterols and ferulic acid), fiber, minerals, and gamma-aminobutyric acid (GABA) [1-4]. Therefore, BR consumption is believed to be more beneficial for human health than polished rice (PR) consumption. In particular, there are some reports that GABA has been shown to help prevent hypertension and improve emotional stability and learning ability [5-7]. Suzuki et al. have reported that BR soaked in water to induce slight germination is richer in GABA content than non-germinated brown rice [4]. Despite germinated brown rice (GBR) have these apparent advantages over PR, BR,GBR are not widely used as food stuff, partly due to their less inviting appearance and a perceived poorer taste.

The purpose of this study was to investigate the effect of GR and GBR consumptions on ICR mouse behavior in an open-field test with repeated exposure. The relationship between behavioral changes (adaptation) and the GABA concentration in the rice was also investigated.

MAIN CONTENT

Animal experiment

Extruded polished rice (PR), brown rice (BR), and germinated brown rice (GBR) were prepared as described in Suzuki's study [4]. The compositions of the experimental diets are shown in Table 1. Male mice of Crj:CD-1(ICR) strain (four weeks old) were obtained from Charles River Japan Inc. (Atsugi, Kanagawa, Japan). All animals were switched from a laboratory chow, MF (Oriental Yeast Co., Ltd., Tokyo, Japan) to experimental diets at three months of age. Thirty mice were randomly divided into three groups of ten animals each and fed on each experimental diet (containing PR, BR, or GBR) for three months. These animals were housed in suspended stainless-steel cages with wire mesh bottoms. The animal room was kept at 24±0.5°C at a relative humidity of 65±5%. Room lighting consisted of 12-hour periods of light and dark. The diets and water were given ad libitum. All mice were maintained according to the guidelines for experimental animals of the National Food Research Institute, Japan.

Open field test

The open field test apparatus was constructed of black painted wood and consisted of a simple square arena 50 cm X 50 cm with 40 cm high side walls. The arena was lit up by two fluorescent lights without any shadow. A video-tracking and motion-analysis system (Library Co., Ltd., Tokyo, Japan) was used to assess open field behavior of mice. The analytical system analyzed pictures acquired in real time and the directly recorded X-Y co-ordinates for each mouse movement were stored on the computer (Figure 1). The room temperature was kept at 22~25Cº, but humidity was uncontrolled. The experiment was undertaken between

米的保健性質與健康效益

白井展也(NobuyaShirai)

日本農研機構野菜茶業研究所
National Institute of Vegetable and Tea Science
National Agriculture and Food Research Organization (NARO)
Shimada, Japan (nshinya@affrc.go.jp)

摘　　要國立宜蘭大學馮臨惠翻譯

米是亞洲人最重要的主食，也是許多美食的主要成分。一般而言，為了改善口感，稻米都精白成白米食用。然而，未精白的糙米(BR)及精白副產品的米糠含有大量的必需營養成分；包括維生素、米糠醇(固醇與阿魏酸的混合物)、纖維、礦物質及 4-氨基丁酸(gamma-aminobutyric acid, GABA)。[1-4]. 因此，食用糙米比食用白米較有益於人體的健康。特別是，有些研究報告顯示：4-氨基丁酸(GABA)有助於預防高血壓及改善情緒穩定性及學習能力[5-7]。 Suzuki 等研究報告將糙米浸水誘導發芽，其 GABA 含量較沒有發芽的糙米為高 [4]。雖然，發芽糙米 (GBR) 較白米及糙米，具有明顯的營養優勢，但是 GBR 並未廣泛的應用於食品，主要是因為不討好的外觀及較差的風味。本報告的目的是；在曠場試驗，探討重複食用 GR 及 GBR 對 ICR 小鼠行為的影響。同時也研究小鼠體內 GABA 含量與行為改變 (適應性 adaptation)的關係。

主要內容

動物試驗

依據 Suzuki [4]的研究準備擠壓的精白米(PR)、糙米(BR)及發芽糙米(GBR)。測試飼料的配方成分如表一。公小鼠(Crj:CD-1(ICR) strain, four weeks old)得自 Charles River Japan Inc. (Atsugi, Kanagawa, Japan)。所有的小鼠在三個月齡由實驗室飼料(MF, Oriental Yeast Co., Ltd., Tokyo, Japan)轉換為測試飼料。三十隻小鼠隨機分成三組，每組十隻餵食每種測試飼料(包括 PR, BR, or GBR)三個月。所有小鼠均飼養於懸掛不銹鋼絲網底籠。動物房控制溫度為 24±0.5℃，相對溼度為 65±5%。室內燈光為 12-小時亮與暗的週期。飼料與水採自由採食。所有小鼠的飼養是依據日本綜合食品研究所實驗動物的規定進行。

9:00 and 12:00. The distances traveled in the open field were measured for 3 minutes at 0, 2, 4, 7, and 12 weeks.

Table 1 Components of the diets (g/kg)

	Polished rice	Brown rice	Germinated brown rice
Corn starch	303.8	310.2	312.2
Sucrose	150.0	150.0	150.0
Casein	186.8	184.4	183.6
Cellulose powder	50.0	50.0	50.0
Palm oil	47.4	43.4	42.2
Salt mixture	40.0	40.0	40.0
Vitamin mixture	20.0	20.0	20.0
L-methionine	2.0	2.0	2.0
Sample rice	200.0	200.0	200.0
GABA(mg/kg diet)	8.2	22.4	169.3

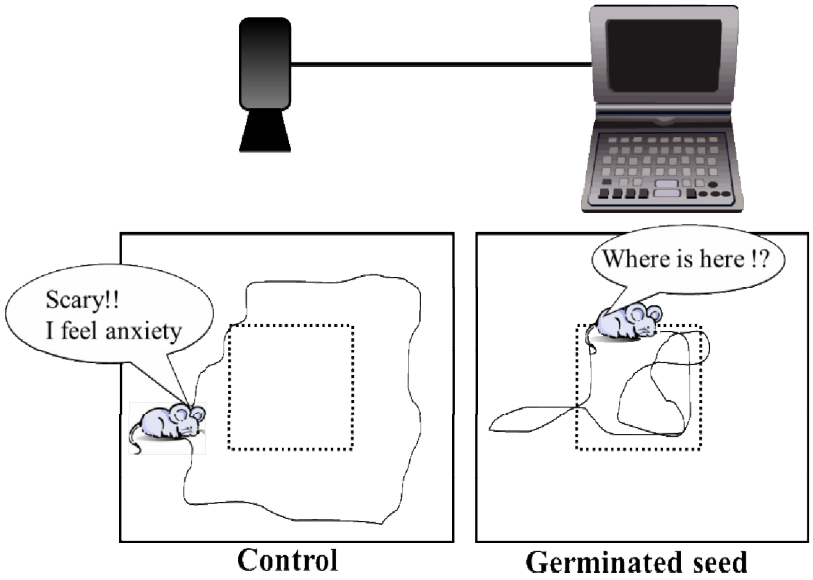


Figure 1 Open field system

The locomotion distances achieved in the open field test by mice at the 1 or 3 minutes during the intake of the three experimental rice diets is depicted in figure2. These distances decreased over the 12 week period for mice in all three groups. The locomotion distance was significantly lower in the BR diet group than in the PR diet group following 1 minute in the open field after 4 weeks. In the GBR diet group significant reductions in locomotion distance compared with the PR group were observed following 1 minute in the field after only 2 weeks. This difference following one minute in the field was maintained at 4 weeks and 7 weeks. Additionally, at 4 weeks there was a statistically significant reduction in the GBR group compared with the PR group after the 3 minutes in the field.

曠場試驗(Open field test)

曠場測試裝置是由漆黑色木材構成的之簡易 50 公分 X 50 公分正方區域(牆高 40 公分)。藉兩隻日光燈照明為無陰影區域。運用一組影像追蹤及動作分析系統 (Library Co., Ltd., Tokyo, Japan)評估小鼠的曠場行為。分析系統分析即時擷取影像並直接記錄每隻小鼠移動的 X-Y 座標，且貯存資料到電腦(Figure 1)。測試室溫維持在 22~25C°，但溼度不控制。試驗均在上午 9:00 及 12:00 實施。在餵食 0、2、4、7 及 12 週測量曠場 3 分鐘移動距離。

Table 1 Components of the diets (g/kg)

	Polished rice	Brown rice	Germinated brown rice
Corn starch	303.8	310.2	312.2
Sucrose	150.0	150.0	150.0
Casein	186.8	184.4	183.6
Cellulose powder	50.0	50.0	50.0
Palm oil	47.4	43.4	42.2
Salt mixture	40.0	40.0	40.0
Vitamin mixture	20.0	20.0	20.0
L-methionine	2.0	2.0	2.0
Sample rice	200.0	200.0	200.0
GABA(mg/kg diet)			
	8.2	22.4	169.3

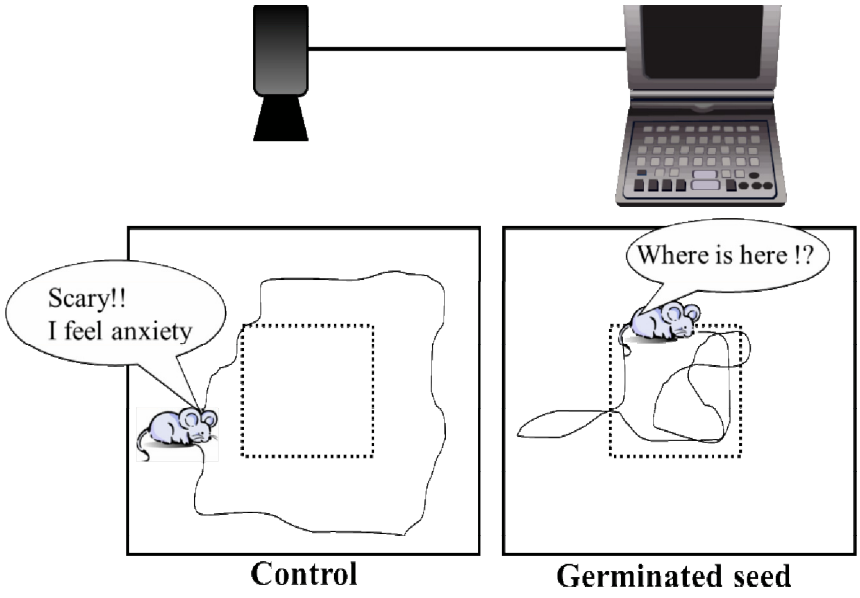


Figure 1 Open field system

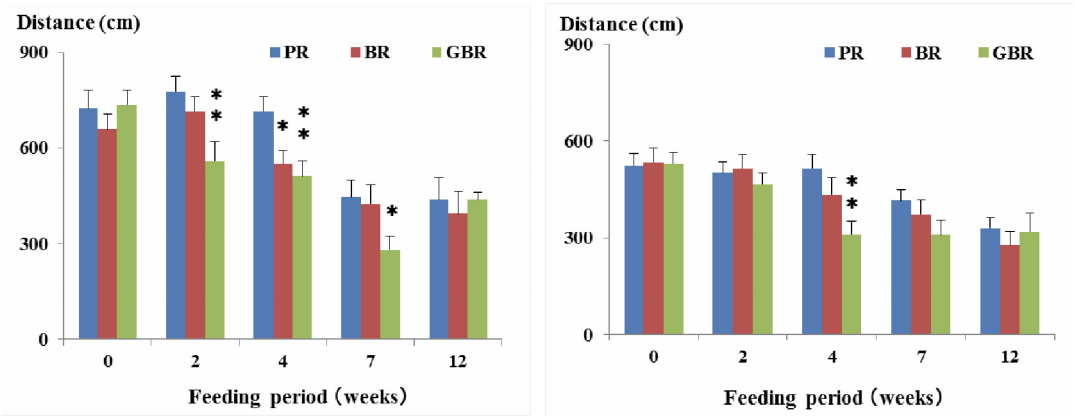


Figure 2 The locomotion distance of mice fed polished rice (PR), brown rice (BR), and germinated brown rice (GBR) diets in 1 or 3 min at 0, 2, 4, 7, and 12 weeks.

CONCLUSION

The significant reduction in locomotion distance exhibited by mice in the GBR diet group compared with PR diet group after 4 weeks suggests that an intake of GBR may enhance this adaptation to the initially novel environment of the open field test with repeated exposure. GBR diet has a positive effect on locomotion distance on an open field test.

REFERENCES

[1] Ardiansyah, Shirakawa, H., Koseki, T., Ohinata, K., Hashizume, K. & Komai, M. (2006). Rice bran fractions improve blood pressure, lipid profile, and glucose metabolism in stroke-prone spontaneously hypertensive rats. Journal of the American Chemical Society, 54, 1914-1920.

[2] Jariwalla, R.J. (2001). Rice-bran products: phytonutrients with potential applications in preventive and clinical medicine. Drugs under experimental and clinical research, 27, 17-26.

[3] Champagne, E.T., Wood, D.F., Juliano, B.O. & Bechtel, D.B. (2004). Rice: chemistry and technology 3rd ed., edited by E.T. Champagne, American Association of Cereal Chemists. pp. 77-107.

[4] Suzuki, K., Okadome, H., Okunishi, T., Nakamura, S. &Ohtsubo, K. (2003). Development of a novel food material using germinated brown rice by twin-screw extrusion. Nippon Shokuhin Kagaku KogakuKaishi, 50, 474-482 (in Japanese).

[5] Aoki, H., Furuya, Y., Endo, Y.& Fujimoto, K. (2003). Effect of gamma-aminobutyric acid-enriched tempeh-like fermented soybean (GABA-Tempeh) on the blood pressure of spontaneously hypertensive rats. Bioscience, Biotechnology, and Biochemistry, 67, 1806-1808.

[6] Mamiya, T., Asanuma, T., Kise, M., Ito, Y., Mizukuchi, A., Aoto, H. &Ukai, M. (2004). Effects of pre-germinated brown rice on beta-amyloid protein-induced learning and memory deficits in mice. Biological and Pharmaceutical Bulletin, 27, 1041-1045.

[7] Ishikawa, K. & Saito, S. (1978). Effect of intraventricular gamma-aminobutyric acid (GABA) on discrimination learning in rats.Psychopharmacology, 56, 127-132.

圖 2 描述三組實驗小鼠接受不同飼料期間在曠場測試一及三分鐘達成的移動距離。對所有三組的小鼠，在 12 週期間，移動距離均呈現減少現象。以糙米飼養四週的小鼠，於一分鐘曠場的移動距離顯著的低於餵食精白米的小鼠。僅餵食兩週，發芽糙米小鼠群比較精白米小鼠群，於一分鐘曠場的移動距離，顯著地減少。這種一分鐘曠場的移動距離的差異在第四及七週繼續維持。此外，在第四週，發芽糙米小鼠群，於三分鐘曠場的移動距離也統計上顯著的較精白米小鼠群減少。

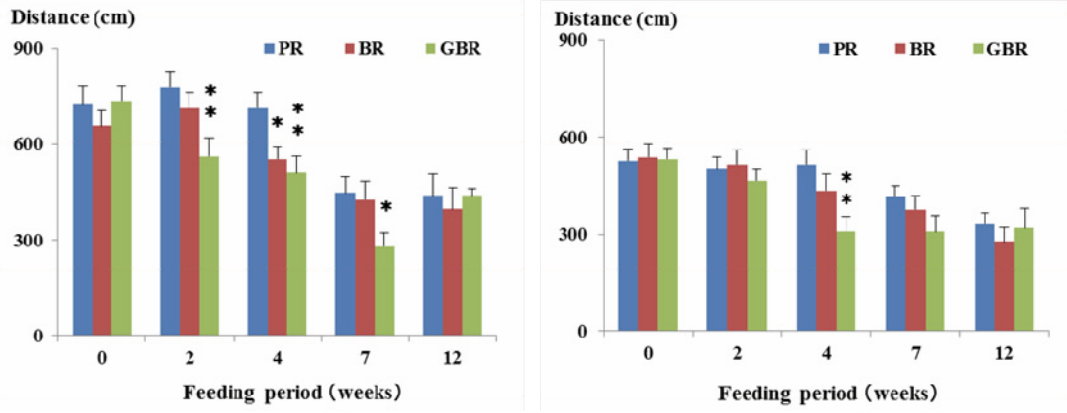


Figure 2　The locomotion distance of mice fed polished rice (PR), brown rice (BR), and germinated brown rice (GBR) diets in 1 or 3 min at 0, 2, 4, 7, and 12 weeks.

結　　論

實驗結果顯示：食用發芽糙米的小鼠群比食用精白米的小鼠群，在四週後，展現顯著地降低移動距離，此結果建議：食用發芽糙米，對參與反覆接觸曠場測試的小鼠可強化對最初新環境的適應性。發芽糙米飼料對小鼠在曠場測試的移動距離具有正面影響。

2nd Symposium on Rice Products and Nutrition

Nutraceutical Properties and Health Benefits of Rice

独立行政法人農業・食品産業技術総合研究機構
野菜茶業研究所
Nobuya Shirai,Ph.D.(白井展也)
Inst. Vegetable and Tea Science,NARO,

National Agriculture and Food Research Organization (NARO)

NARC:National Agricultural Research Center
NICS:National Institute of Crop
NIFTS:National Institute of Fruit Tree Science
NIFS:National Institute of Floricultural Science
NIVTS:National Institute of Vegetable and Tea Science
NILGS:National Institute of Livestock and Grassland Science
NIAH:National Institute of Animal Health
NIRE:National Institute of Rural Engineering
NFRI:National Food Research Institute
NARCH:National Agricultural Research Center for Hokkaido Region
NARCT:National Agricultural Research Center for Tohoku Region
WeNARC:National Agricultural Research Center for Western Region
KONARC:National Agricultural Research Center for Kyushu Okinawa Region
NFA:National Farmers Academy
BRAIN:Bio-oriented Technology Research Advancement Institution

National Food Research Institute

Production quantity Ranking
Rice: 5 Rank

National Food Research Institute was established as the Rice Utilization Laboratory in 1934. It is part of the National Agriculture and Food Research Organization (NARO) through its merger with the National Institute for Rural Engineering on April 1, 2006. NFRI is implementing wide-ranging research on food science and technology based on the mid-term plan for NARO for FY2006 to 2010. NFRI is executing mission-oriented research programs that contribute to a healthier and enriched life, a secure supply of safe food, and technical innovation in agriculture and food industries. The research programs include clarification and utilization of functional properties of foods, development of innovative technologies for food distribution and processing, development of techniques to ensure food safety, and development of technologies for biomass conversion.

National Institute of Vegetable and Tea Science, (NIVTS)
Shimada, Shizuoka, Japan

Production quantity Ranking
Rice: 30 Rank
Tea leaf: 1 Rank

National Institute of Vegetable and Tea Science, (NIVTS) Kanaya branch station

Kanaya branch station (National Institute of Vegetable and Tea Science) was established in 1919. Kanaya branch station is implementing research to produce good quality tea, to achieve high yield and decrease the cost. Additionally, we try to promote the rationalization of tea cultivation and manufacture.

Table Proximate composition of rice, wheat, and corn (%)

	Moisture	Protein	Lipids	Carbohydrate	Ash
Raw					
Brown rice	15.5	6.8	2.7	73.8	1.2
Polished rice	15.5	6.1	0.9	77.1	0.4
Wheat	12.5	10.6	3.1	72.2	1.6
Corn	14.5	8.6	5.0	70.6	1.3
Cooked					
Brown rice	60.0	2.8	1.0	35.6	0.6
Polished rice	60.0	2.5	0.3	37.1	0.1

Estimate essential amount for adult man: 50g/day

(Dietary reference intake for Japanese, 2005)

Cooked brown rice (About 1786g)

Rice bowl (about 12 bowls)

Table Amino acid composition of rice and flour (g/100g edible portion)

	Ile	Leu	Lys	Met	Cys	Phe	Tyr	Thr	Trp	Val
Polished rice	290	570	250	170	160	370	280	240	99	430
Red rice	300	610	290	180	180	380	290	270	100	460
Weak flour	310	600	210	140	220	420	240	220	93	350
Strong flour	450	880	270	210	310	640	330	350	130	510

	His	Arg	Ala	Asp	Glu	Gly	Pro	Ser	Amino acid score (1973)	Amino acid score (1985)
Polished rice	180	550	390	650	1300	320	310	340	65	61
Red rice	210	610	430	720	1400	360	340	360	68	64
Weak flour	200	310	250	360	2800	310	1100	420	44	42
Strong flour	290	430	350	490	4500	430	1900	600	38	36

Standard tables of food composition in Japan (5th revised and enlarged edition)

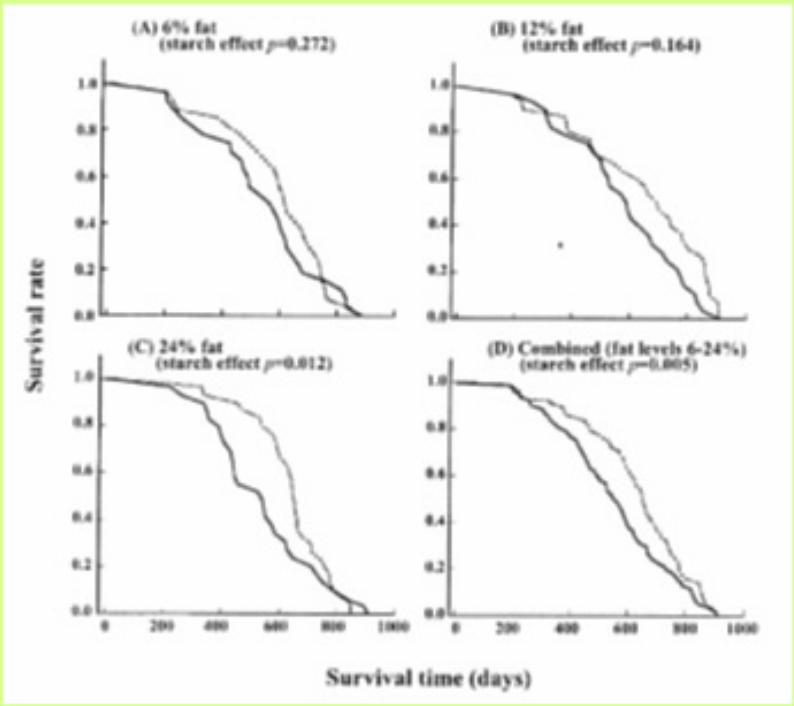


Figure Survival curves for mice fed on diets containing corn or rice starch with different amount of soybean oil. (BBB 2005 69:13-8)

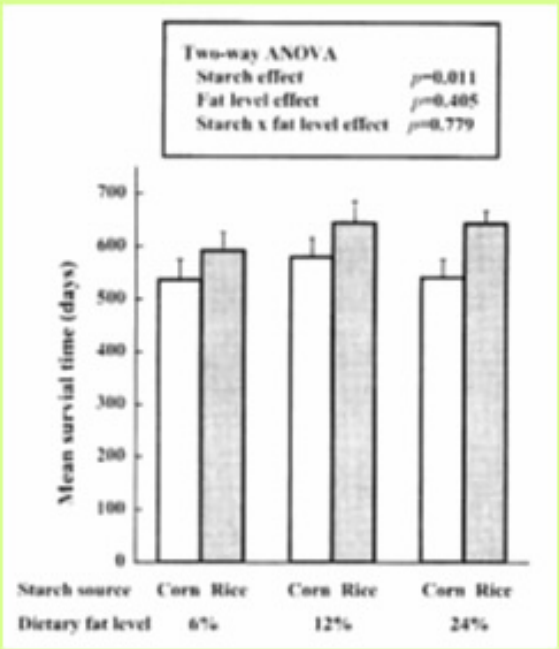


Figure Mean survival time for mice fed on diets containing corn or rice starch with different amount of soybean oil. (BBB 2005 69:13-8)

Lipids

Rice bran oil

Table Fatty acid composition of oil (%)

	Rice bran oil	Soy bean oil	Rape seed oil
16:0	16.9	10.6	4.3
18:0	1.9	4.3	2.0
18:1	42.6	23.5	62.7
18:2	35.0	53.5	19.9
18:3	1.3	6.6	0.8

Standard tables of food composition in Japan
5th revised and enlarged edition

Characteristic

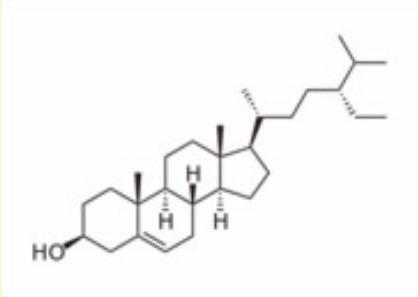
- Tough for oxidation
- Good taste
- Healthy

Effect

Lowering plasma cholesterol concentration

- γ-oryzanol
- Tocotrienols
- Plant sterol

Plant sterol (Phytosterol)



β-sitosterol

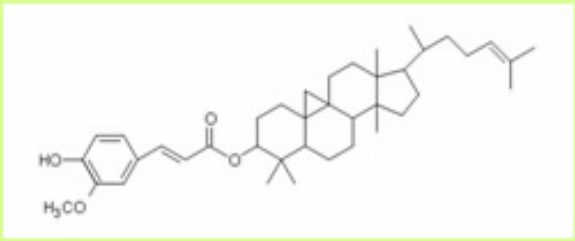
Plant sterol content of each oil (mg/100g)

Rice bran oil	961
Sesame oil	800
Rape seed oil	760
Corn oil	660
Soy bean oil	303
Safflower oil	283

Effect

Inhibition of cholesterol absorption

γ-oryzanol



Ferulic acid — Sterol

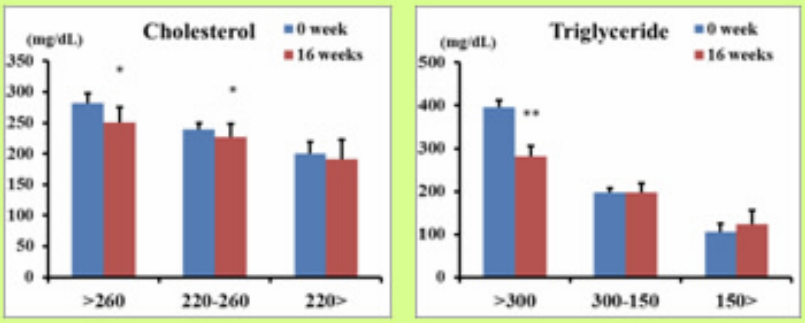
Effects

- Neurofropic action
- Anti-oxidant action
- Lowering action of plasma lipid
- Anti-inflammatory action
- Antiallergy action
- Skin care

Table Effect of oryzanol on menopausal disorder and autonomic dystonia

Application	Dose (mg/day)	Period	Effect	Ref.
Menopausal disorder	5-10	10-38days	Menopausal index 50%down	1
	90	14days	Climacteric symptom 76.6%improve	2
	15-30	7-14days	Autonomic dystonia symptom70-90%improve	3
	300	4-8weeks	Subjective symptoms >80% improve	4
Autonomic dysonia	135	21days	74% Available	5

1) Sanfuzinka no zissai 1963, 12:147-9
2) Sanfuzinka no sekai 1965, 17:179-83.
3) Sanka to fuzinka 1970, 37:1488-94.
4) Nihon Sanka Fujinka Gakkai Zasshi. 1982, 34:243-51.
5) Rinsho to kenkyu 1964, 41:347-51.

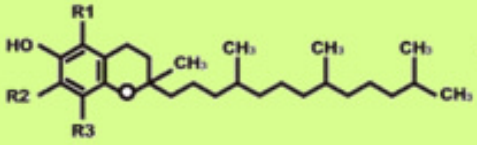


n=7-21 n=4-20

Figure Effect of oryzanol administration on plasma cholesterol and triglyceride concentrations of human. (Fragrance Journal 1982 53:125-6)

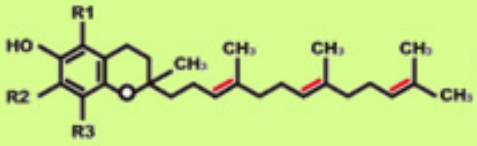
Tocotrienols

▪Tocopherol



- Antioxidative action
- Improvement of immunity
- Reducing risk of prostate cancer

▪Tocotrienol



- Antioxidative action
- Improvement of hypercholesterolemic
- Reducing cancer risk

Vitamins

Table Vitamins concentration of rice, wheat, and corn

	Vitamin B1 mg	Vitamin B2 mg	Niacin mg	Vitamin B6 mg
Brown rice	0.41	0.04	6.3	0.45
Polished rice	0.08	0.02	1.2	0.12
Wheat	0.41	0.09	6.3	0.35
Corn	0.03	0.10	2.0	0.39
Deficiency	beriberi	dermatitis	dermatitis	dermatitis

	Folate μg	Pantothenic acid mg	α-Tocopherol mg
Brown rice	27	1.36	1.2
Polished rice	12	0.66	0.1
Wheat	38	1.03	1.2
Corn	28	0.57	1.0
Deficiency	anemia	dermatitis	underactive neurological function

Standard tables of food composition in Japan 5th revised and enlarged edition

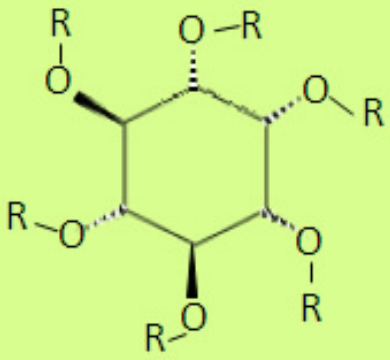
Mineral

Table Minerals concentrations of rice, wheat, and corn

		Brown rice	Polished rice	Wheat	Corn
Calcium	mg	9	5	26	5
Iron	mg	2.1	0.8	3.2	1.9
Magnesium	mg	110	23	80	75
Phosphorus	mg	290	94	350	270
Potassium	mg	230	88	470	290
Zinc	mg	1.8	1.4	2.6	1.7

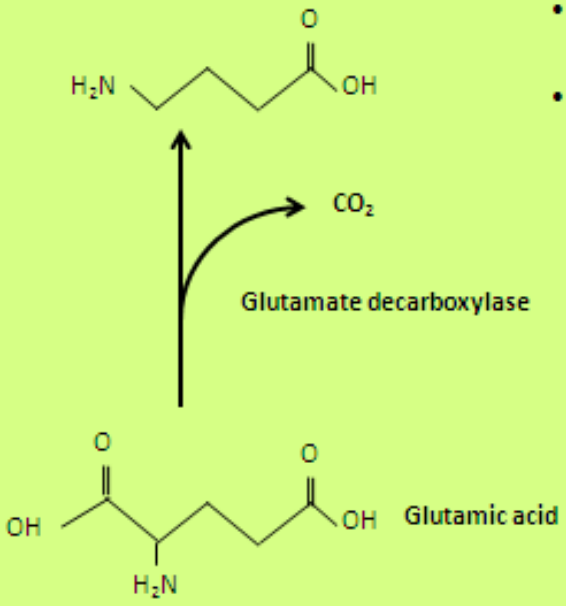
Standard tables of food composition in Japan 5th revised and enlarged edition

Phytic acid



- **Reducing of cancer risk**
  - **Colon**
  - **Breast**
  - **Lung**
  - **Skin**
- **Anioxidative action**
- **Prevention of urinary tract stone and kidney stone**
- **Prevention of Dental plaque**

γ(gamma)-aminobutyric acid: GABA



- **Lowering effect of blood pressure**
- **Relaxation**

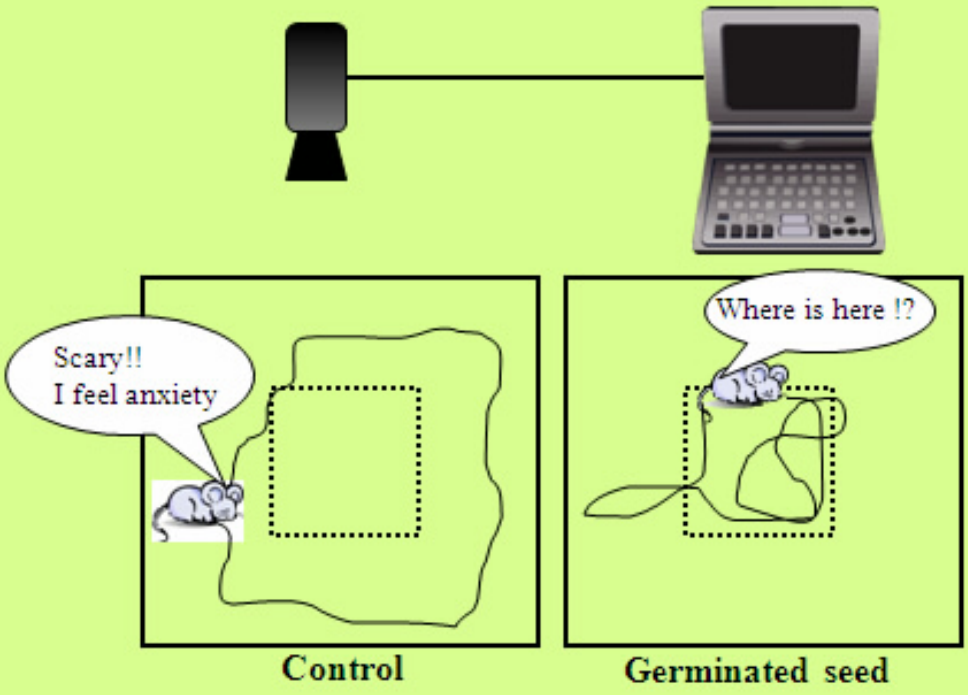


Figure Operation of open field test.

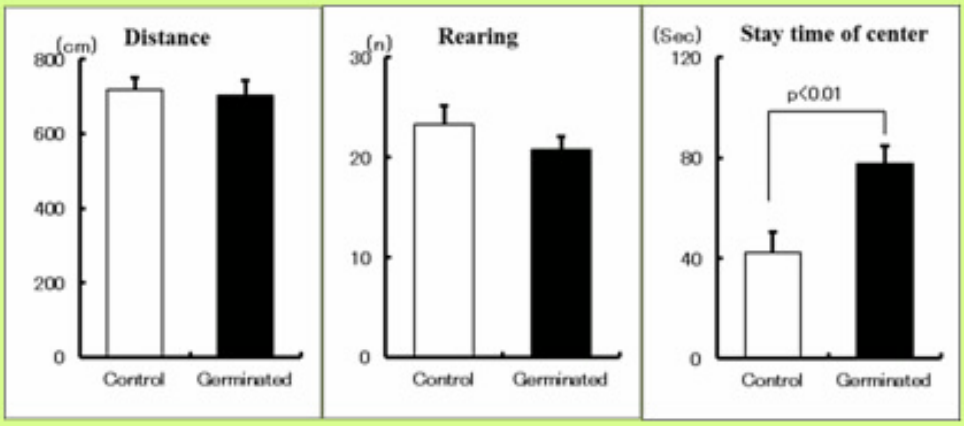
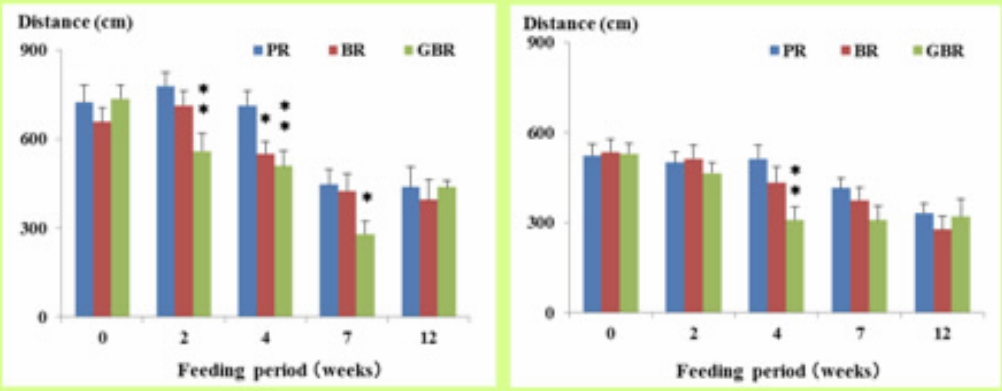


Figure The behaviour of SHR fed control and 10% germinated lotus diets in the open field for 5 min at 10 weeks.

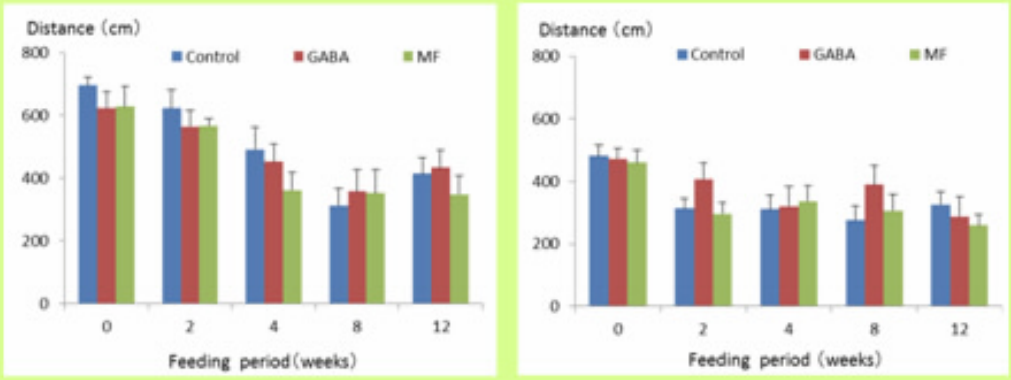
Nippon shokuhin kogaku kaishi 2008; 55, 566-70



1 min 3 min

Figure The locomotion distance of mice (ICR male age:3 month) fed 20% polished rice (PR), brown rice (BR), and germinated brown rice (GBR) diets in 1 or 3 min at 0, 2, 4, 7, and 12 weeks.

(FSTR 2010; 16, 621-6)



1 min 3 min

Figure The locomotion distance of mice (ICR male age:5 months) fed control, GABA (0.02%) and MF diets in 1 or 3 min at 0, 2, 4, 8, and 12 weeks.

(FSTR 2010; 16, 621-6)

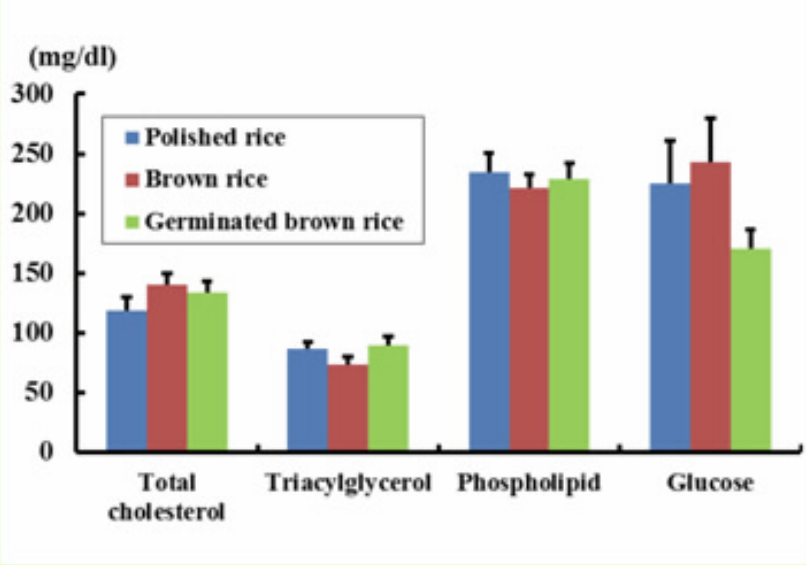


Figure Plasma lipids and glucose concentrations of mice fed 20% polished rice, brown rice, and geminated brown rice diet

(FSTR 2010; 16, 621-6)

Table The plasma Ca, Mg. Fe, and Zn concentrations in mice fed the 20% polished rice, brown rice, and geminated brown rice diet

		Polished rice	Brown rice		Germinated brown rice
Ca	(mg/dl)	6.5 ±0.4	7.5 ±0.4	*	6.8 ±0.1
Mg	(mg/dl)	1.4 ±0.1	1.4 ±0.1		1.4 ±0.1
Fe	(μg/dl)	118 ±9	112 ±9		124 ±7
Zn	(μg/dl)	130 ±13	127 ±23		139 ±11

* $p<0.05$

(FSTR 2010; 16, 621-6)

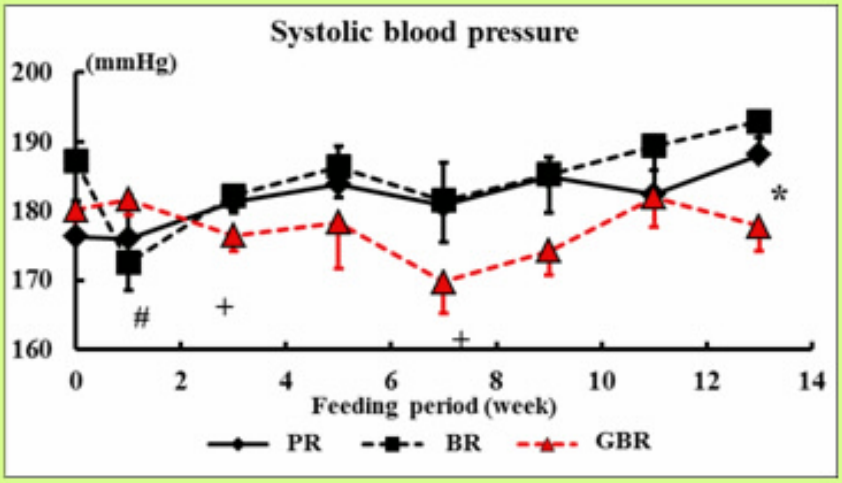


Figure Time course of systolic blood pressure on SHR fed the 25%polished rice, brown rice, and geminated brown rice diet with 0.25% NaCl during the feeding period.
*: compared with the value for the initial polished rice ($p<0.05$)
#: compared with the value for the initial brown rice ($p<0.05$)
+: compared with the value for the initial germinated brown rice ($p<0.05$)
Values for each dietary group with small different letters are significantly different at $p<0.05$ by Bonferroni test.

Nippon shokuhin kogaku kaishi 2011; 58, 324-9

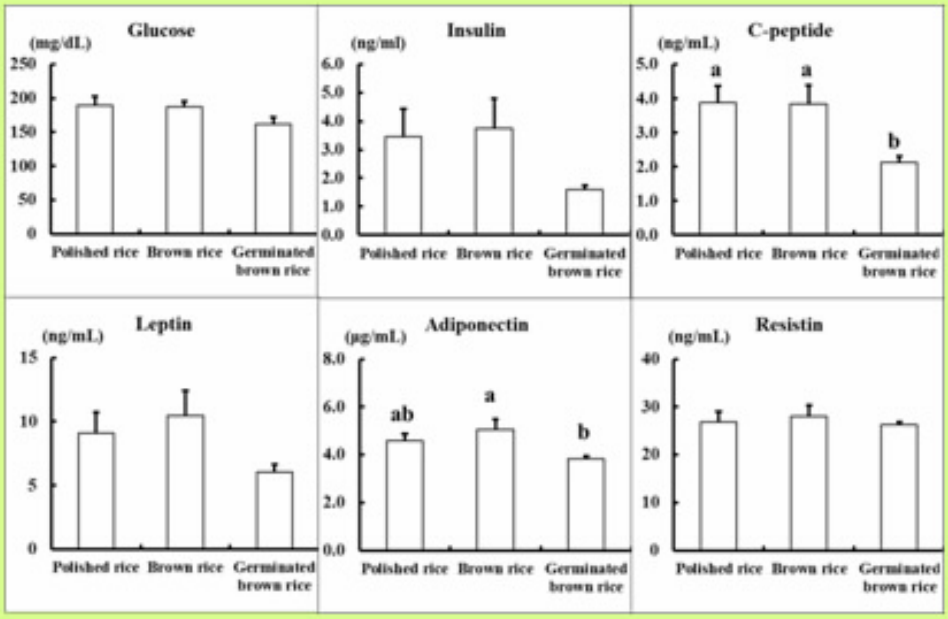


Figure Plasma glucose, insulin, C-peptide, leptin, adiponectin, and resistin concentrations of SHR fed the 25% polished rice, brown rice, and geminated brown rice diet

Nippon shokuhin kogaku kaishi 2011; 58, 324-9

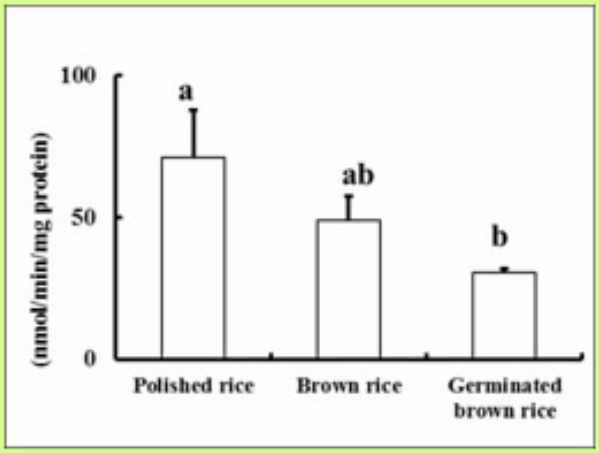


Figure Hepatic glucose-6-phosphate dehydrogenase activity of SHR fed the experimental diets.

Nippon shokuhin kogaku kaishi 2011; 58, 324-9

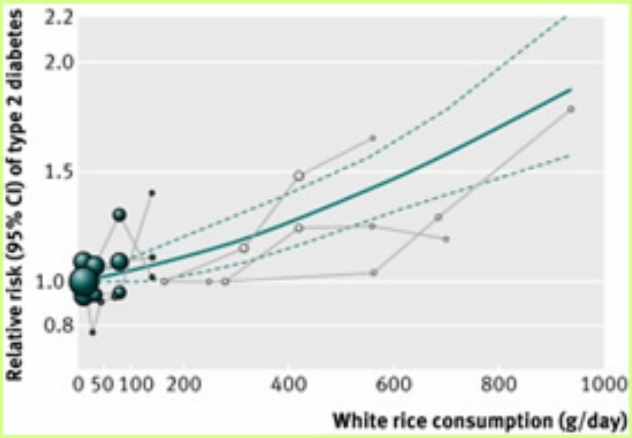


Figure Dose-response relation between white rice intake and risk of type 2 diabetes..

BMJ. 2012 Mar 15;344:e1454. doi: 10.1136/bmj.e1454

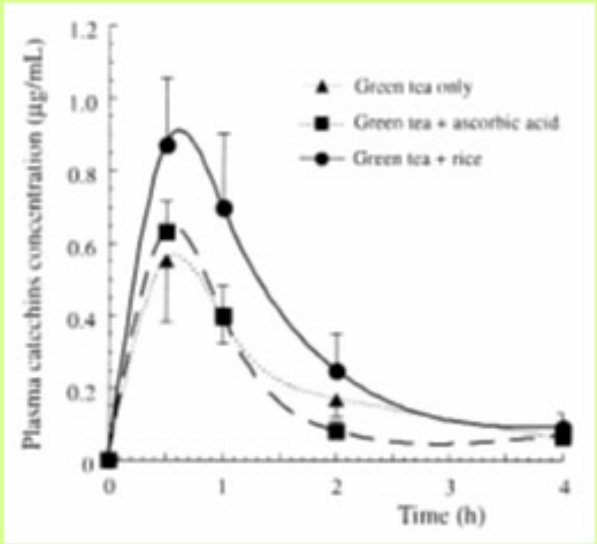


Figure Plasma catechins concentration after administering the green tea extract. (BBB 2011 75:152-4)

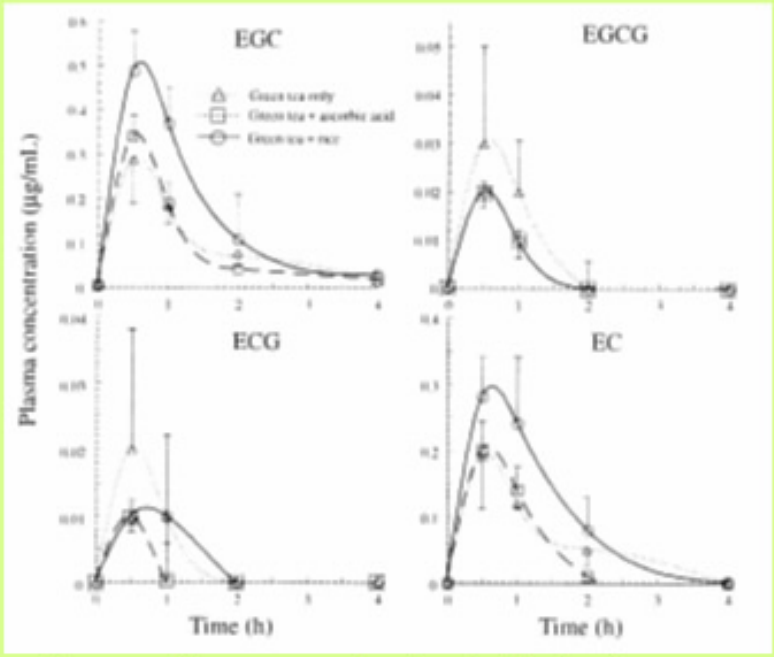


Figure Plasma catechins concentration after administering the green tea extract. (BBB 2011 75:152-4)

CONCLUSION

- Rice has valuable nutritional components.

  γ-oryzanol
  Phytic acid
  Tocotrienol

- Germinated brown rice has positive effect on some human health.

  Reducing anxiety
  Lowering effect of blood pressure

- These findings suggest that rice may be one of valuable staple food for human. However, rice is not perfect source of nutrient.

Hiramitsu Suzuki, Kagawa Nutrition University
Ken'Ichi Ohtsubo, Niigata University
Keitaro Suzuki, National Institute of Crop

Thank you for your attention !!

講者

盧訓 博士

演講題目

國內米食加工與保健營養研究發展現況

Rice Processing and Nutrition Research and Development in Taiwan

現職

中華穀類食品工業技術研究所所長(2005/8~present)

學歷

美國內布拉斯加大學食品科學系博士

美國德州農工大學食品科學系碩士

中興大學農業化學系學士

經歷

萬能科技大學民生學院院長(2003/02~2005/8)

萬能科技大學生物技術系教授(2003/02~2005/8)

國立中興大學食品科學系教授

國立中興大學食品科學系主任暨研究所所長

亞洲蔬菜研究發展中心 AVRDC 農化系 研究助理(1977/02~1978/01)

退輔會欣欣食品工廠Food Manufactury 技師(1975/12~1977/01)

內政部職業訓練局 技術檢定組 技術士檢定命題委員(1988迄今)

經濟部中央標準局 農業暨品組 規範起草委員(1991迄今)

經濟部工業局 民生工業組 計畫評核委員(1997迄今)

農委會中部辦公室 特產科 食品加工諮詢委員(1991迄今)

專長

食品科技 、穀類加工、澱粉化學、食品工廠衛生、藥膳製備

藥用保健植物於食品加工之應用、電腦在食品科技上之應用

Food Science, Cereal Tech.、HACCP

Chinese Medicine Used in Foods Processing

台灣米食文化之發展與創新

盧訓(Shin Lu)

中華穀類食品工業技術研究所

前　　言

稻米，是中國南方及台灣地區人民之主食，在中國之歷史淵遠流長，並與炎黃子孫之生活息息相關。史記上記載:「禹令益予眾庶，稻可種卑溼」，因此稻米在中國已有三千年之栽種歷史。我國以農立國，春耕、夏耘、秋收、冬藏，所謂『誰知盤中飧，粒粒皆辛苦』，中國人對稻米有份難以割捨之感情。

稻米除可當米飯食用外，亦可供釀酒及磨粉製成糕餅點心等，還有糟糠可餵食家畜禽，穀殼可充當燃料使用。從中國一首民謠中，我們可以瞭解中國人在一年四季配合節慶製作出各種形形色色的米食密不可分。就是「正月十五鬧元宵；二月二，撐腰糕；三月三，眼亮糕；四月四，神仙糕；五月五，小腳粽子箬葉包；六月六，大紅西瓜顏色俏；七月七，巧果兩翹；八月八，月餅小紙包；九月九，重陽糕；十月十，新米糰子新米糕；十一月裏雪花飄；十二月裏糖元寶」。

稻米在台灣，不論稻或秈稻，均以碾成白米供人食用為主，釀酒為副。秈米可以製造發粿、碗粿、爆米花（爆米香）等製品，糯米供製造各種點心(年糕、米糕、油飯、粽子等)。每逢節日慶典，家家戶戶傳出搗米、磨米聲，以及撲鼻之糕餅蒸氣香味，使大街小巷顯得喜氣洋洋，人手一口年糕或菜頭粿，確實能抒解一年之辛勞。

主要內容

稻米品種

台灣栽培稻之種類依稻型分類可分秈稻（在來；indica），稻（蓬萊；japonica）；以直鏈澱粉含量又分為非糯性（ ｎｏｎ-ｗａｘｙ ） 及糯性（waxy），而糯性又依形狀細分為圓糯(糯)及長糯（秈糯）。一般而言，秈稻細長， 稻粗短。秈稻通常做為米食加工之原料，像米粉絲、米苔目、碗粿及蘿蔔糕等等。稻為一般煮飯用原料，而糯稻由於具高黏性，適合做為湯圓、麻糬、年糕及肉粽之原料。

磨米的介紹

「鑿引清泉養萬民，撞磨米漿糊千肚」，即點出磨米對於製造美味傳統米食製品之重要性。磨米之目的即是要賦予米食更多之利用性。綜合過去與現代之磨米方法大致可分為傳統磨米法及工業磨米法兩種。不同之磨米方法可產生不同性質之粉狀物質，即米穀粉。不同之米穀粉則各有其特性及其不同之應用，並可由其製出各種不同風味之傳統米食加工製品。

（一）傳統磨米法

石磨是由兩塊軸心貫穿的圓石相疊而成，米由磨孔置入經兩石之間之磨齒轉動碾磨，可用來磨粉與磨漿。通常是在碾磨時勺入一瓢水、一瓢米，米漿由磨嘴流入棉布袋中紮緊，用扁擔或石頭將米漿內水分壓乾，此為濕粿糰，乾燥後磨粉即為濕磨米穀粉。

（二）工業磨米法

1. 乾磨

即使用磨粉機，直接將米磨成細米粉末。由於乾磨可避免濕磨所造成之廢水問題，故仍廣泛使用於製粉工業。如將米粒經焙炒或擠壓加熱後再研磨之粉，則稱熟粉。熟粉之製作與加工在中式傳統糕點中日漸式微，有值得研究並推廣之必要。其產品有鳳片糕、雪片糕、糕仔崙及豬油糕等。

2. 半乾磨

即將米浸泡一段時間後瀝乾，直接加以研磨成潤濕細粉，即潮粉或濕粉。日本米穀粉產業多採用半乾磨方式，利用米粒胚乳內外層之成分差異所造成之吸水速率不同而製成不同等級之穀粉。

3. 濕磨

俗稱水磨，即將米浸泡後，用磨漿機加水一起研磨成米漿；米漿去水乾燥後所得之粉即為水磨粉。濕磨用米漿機。由於多量的水於濕磨過程中有潤溼作用，故水磨粉所含之破損澱粉遠少於乾磨及半乾磨者。水磨粉色澤較白、粉粒之顆粒較細、加工特性良好，為主要之磨粉方法。

台灣傳統米食製品之加工製造

米是最簡樸、最基本的民生必需品；可是，一旦傳統節日來臨，家家戶戶都會興高采烈的舂米、磨米，平凡的稻米頓時改變了模樣，成為各色各樣的節令米食。中國以農立國，百姓終年辛勞，從四季循環變化中演化出一連串各具生活情趣的節慶。由年頭到年尾的歲時節慶中，人們一方面以各式精緻的米食祭拜天地祖先，一方面也藉此放下手中工作，品嚐芬芳的米食，暫時悠遊於歲月之間。台灣之傳統米食製品的產生，就是延續此種精神而留傳下來。

經過不斷研發，分別以糯米、在來米、蓬萊米先加水磨成漿，壓去水分後之粿糰，再做成各種糕點食品稱為” 粿”。

比較常見的「粿」，大概有下面幾種：

麻糬(齊粑)：不論婚、喪、喜、慶，廟會拜拜都會用到。為什麼齊粑會成為客家人在婚、喪、喜、慶時，最重要的食物呢！有種說法是這樣的，因為客家人早期生活較窮困，而齊粑的原料是糯米，糯米吃後很容易就有飽足感，所以在上菜前吃了後，對桌上的菜就不會吃的那麼多了，這對勤儉的客家人來說，是有其意義在的！

紅龜粿:另名稱叫新丁粄,為了要慶賀家中有新添的男丁而做的。新丁粄就是紅粄 ，紅粄要做足足滿一斤，通常在農曆十月十五下元節時「祭天公」，以感謝上天賜男丁之福，這時候的紅粄就叫做新丁粄，在新丁粄祭拜上天后，要分發給鄰舍，是把快樂分享給大家的意思。

發粿：一般遇辦喪事或掃墓時也大都會做發粿。作法是把酵粉放在粿漿裏，使它發酵後在蒸，蒸到粄面隆起而分裂，稱之為「笑」 ，蒸發粄要蒸笑了才好，因為是發財致富的一種徵兆。

菜頭粿：客家人最常吃也最普遍的食物。材料除了在來米及白蘿蔔之外，沒有添加其他的東西。吃的時後多半沾醬油加蔥或桔醬。為過年期間最受歡迎的食物，象徵好彩頭。

豬籠粄（菜包）

千百年前，客家原為華北住民,以麵食餃子為主,南遷後限於環境,逐然改成米食,以米食做成餃子形菜包,藉此追懷祖先,以解相思之情。這是菜包的濫觴。

清明節的時候，要作豬籠粄和打艾粄。豬籠粄因為形狀像裝豬仔的竹籠而得名；又因為包了餡，所以叫它菜包。

配合節慶之米食產品是哪些??

新年：一年之中粿做最多的時候，有『甜粿』、『鹹甜粿粄』、『菜頭粿』。

元宵：『菜包』，因其形狀像豬籠，所以又稱『豬籠粄』。元宵後的掛紙（掃墓）要打發粿，如果是新建的墳，則必須打『紅粿』。

清明節：『發粿』、『艾粿』、『苧葉粿』。

端午節：包粽子，不打粿，但有一種叫『粿粽』。

中元節：包粽子，打齊粑。

中秋節：打芋粄。

冬至：打『粿仔圓』，即湯圓。

結　　語

台灣居民以米食為主，除傳統之米食文化必須發掘繼承並予發揚外，也應配合現代化米食之發展，創新及保健產品之開發也將是米食發展另一課題。本所持續開發出發芽玄米、富含 gaba 米糠及米麵共食之烘焙產品，同時接受農委會補助做米食推廣及研發工作，將“稻米文化”完整傳授給後代子孫，應視為一種責任，勿讓下一代迷失於西方之速食文化－漢堡、薯條。因此，米食製品之多元化開發及推廣，乃是維護及保存台灣飲食文化之研究與主事者所必須關注的事，且為符合時代潮流及國人對米食嗜好之變化，更應將“米食文化”與“食品科技”融合在一起，俾利傳承與創新相結合，這是本所責無旁怠之使命。

參考文獻

[1] 盧訓，1990，米苔目之品質特性研究，中式冷凍調理食品及穀類產品研究成果發表會，10~12。

[2] 盧訓、林明山、林子清、呂政義，1993，添加不同澱粉對米苔目品質及其冷凍安定性之研究，食品科學 20(1)：64~74。

[3] 盧訓，呂政義，陳文志，不同碾磨技術對米粉理化性質之研究，台灣省台中區農業改良場特刊 13，310~326。

[4] 陳美枝，1992，濕熱處理及油炸對膨發米食（鍋粑）之影響，國立中興大學食品科學研究所碩士論文。

[5] 林靜淑，1993，探討不同浸漬條件及脫水方式對年糕品質之影響，國立中興大學食品科學研究所碩士論文。

[6] 黃瑞美，林子清，蔣見美，呂政義，不同品系稻米及製程對發粿品質之影響， 中國農業化學會誌，28(3)267~274。

[7] 黃瑞美，林子清，呂政義，添加物及貯藏對發粿品質之影響，食品科學，19(1)86~93。.

[8] 蘇瑞文，1998 浸漬與碾磨對濕磨米穀粉理化特性及碗粿品質之影響國立中興大學食品科學研究所碩士論文。

[9] 沈瑞昇，1998 磨粉方法對米穀粉理化特性及米食製品質地之影響國立中興大學食品科學研究所碩士論文。

[10] 黃月花，2000 比較不同熱處理後熟粉之理化特性及其產品之試製國立中興大學食品科學研究所碩士論文。

[11] 王文美、盧訓、許煥祺。2006。不同光源照射發芽糙米之理化特性及抗氧化活性之比較。中華農學會報 7:296-310

[12] Phoency Lai , Ken Yuon Li , Shin Lu , Hua Han Chen 2011Physicochemical characteristics of rice starch supplemented with dietary fibre Food Chemistry 127 :153–158 (SCI)

[13] Shin Lu , Jih-Jou Chen , Yu-Kuo Chen, Cheng-yi Lii , Phoency Lai , Hua-Han Chen 2011 Water mobility, rheological and textural properties of rice starch gel Journal of Cereal Science 53: 31~36

[14] S.Lu, Hunhan Chen. 2008 Healthy rice based cereal products-Recent development. 13th ICC Cereal and Bread Congress “Cereals worldwide in the 21th century: present and future”. Madrid, Spain June 15-1 S. Lu and T.C. Lin 2000 Chapter 20 “Rice base snack food” in Snack Food, edited by L. Lusas and L.W. Rooney. Technnmic Publishing Co., PA., U.S.A.

[15] 盧訓 2001 台灣保健植物藥膳食譜 國立中興大學、行政院農委會出版

[16] Shin Lu ， 2004 ，Rice / Chinese Food Uses. MS 146 In “Encyclopedia of Grain Science” Ed. By H. Corke and C.E. Walker. Elsevier Ltd. Barcelona, Spain

[17] Shin Lu and Wai. Kit. Nip, 2006 Manufacture of Asia Oriental Noodles, article 157 In “Handbook of Food Science Technology and Engineering” Ed. Y.H. Hui, Taylor & Francis Group Boca Raton, London, New York

臺灣米食加工與保健營養研究發展現況

中華穀類食品工業技術研究所
盧訓 所長

101.06.08

綱要

1.全球稻米產量與消費量分析

2.台灣傳統米食

3.米食科技化發展

4.健康導向米食多元化應用

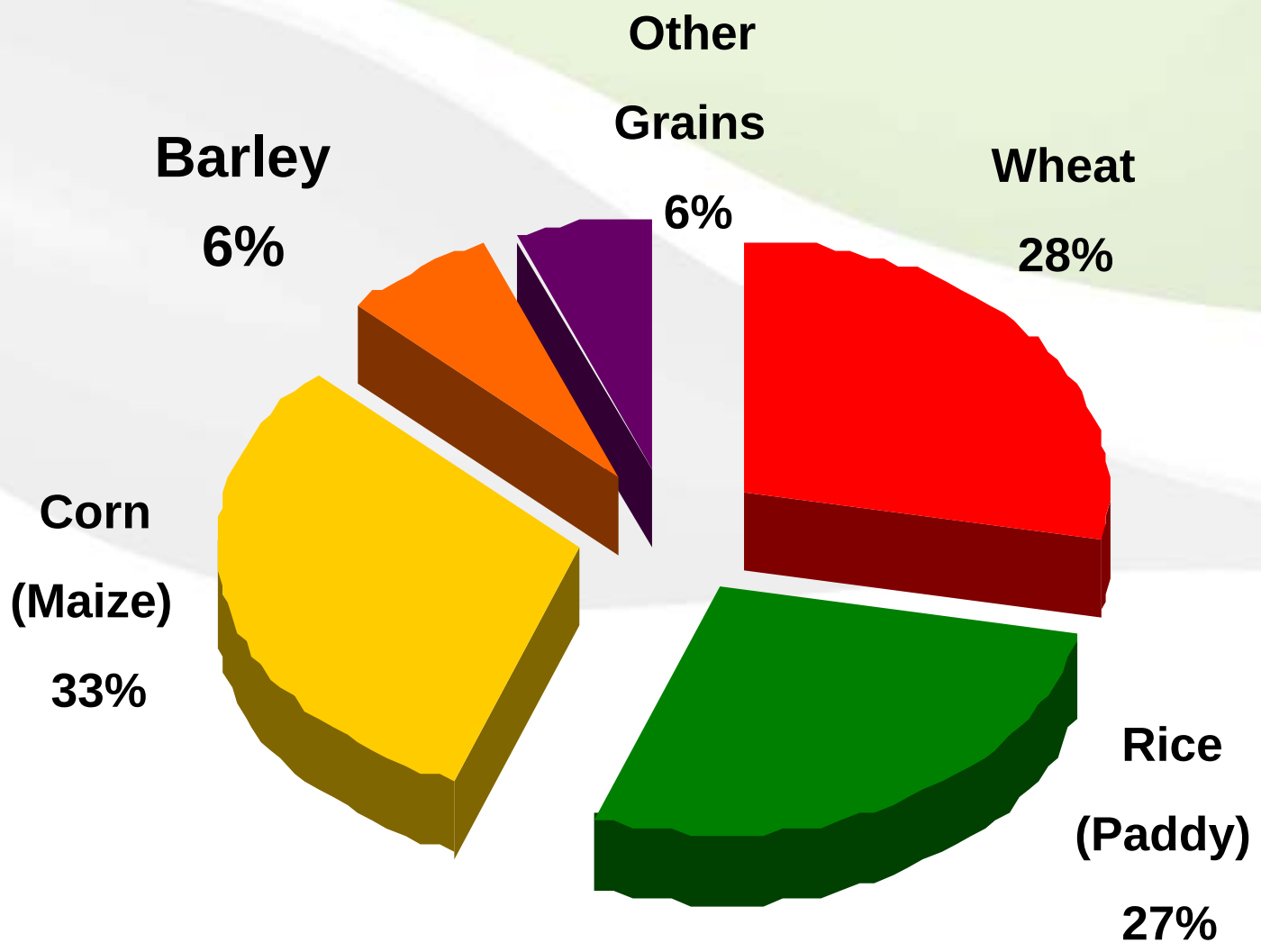
5.米麵共食產品之應用

全球稻米產量與消費量概況

- 自由貿易
- VS
- 糧食安全 + 食品品質安全

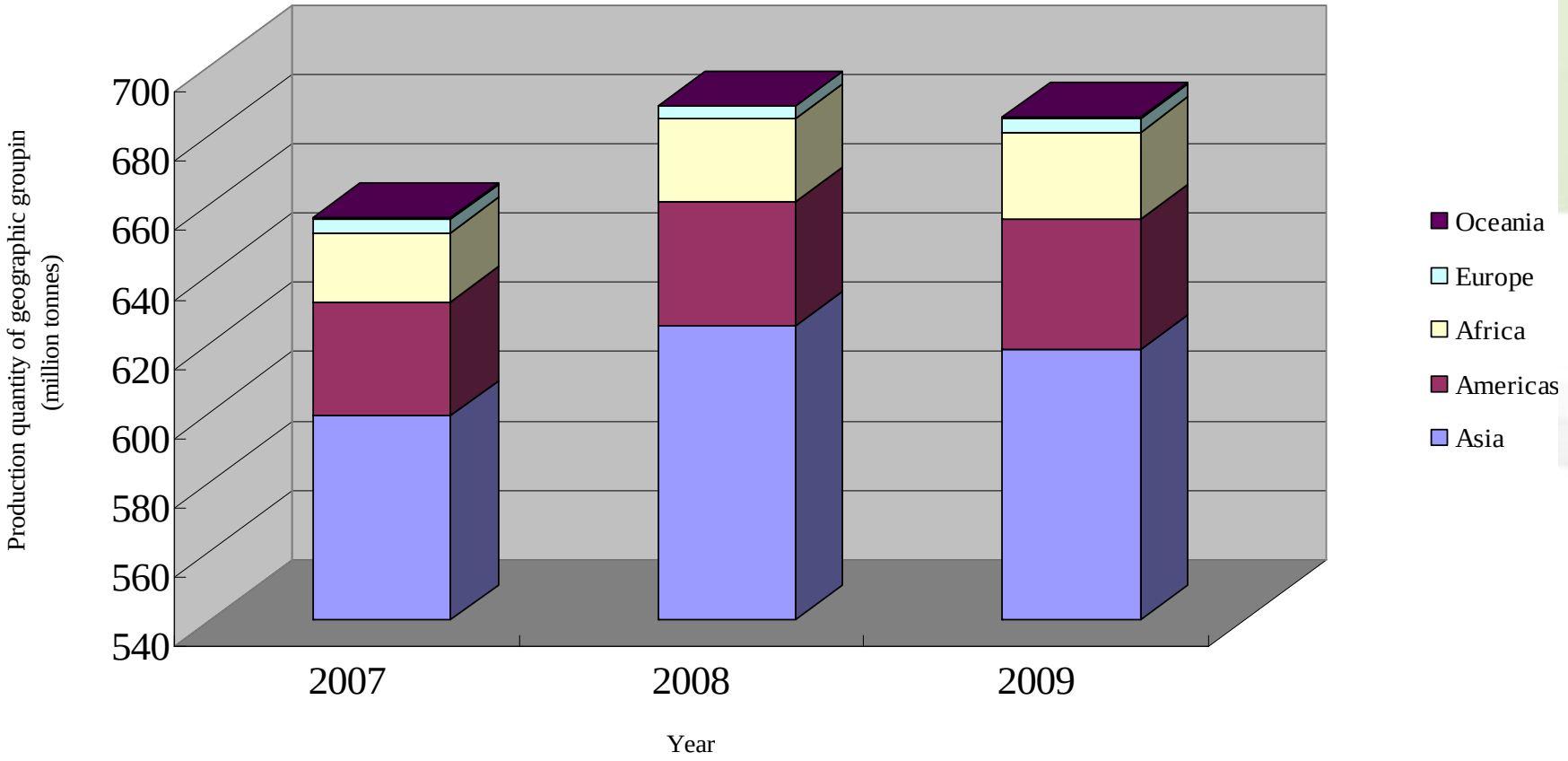
World Cereal Grain Production

Annual (2008), 2 525 Million Metric Tons



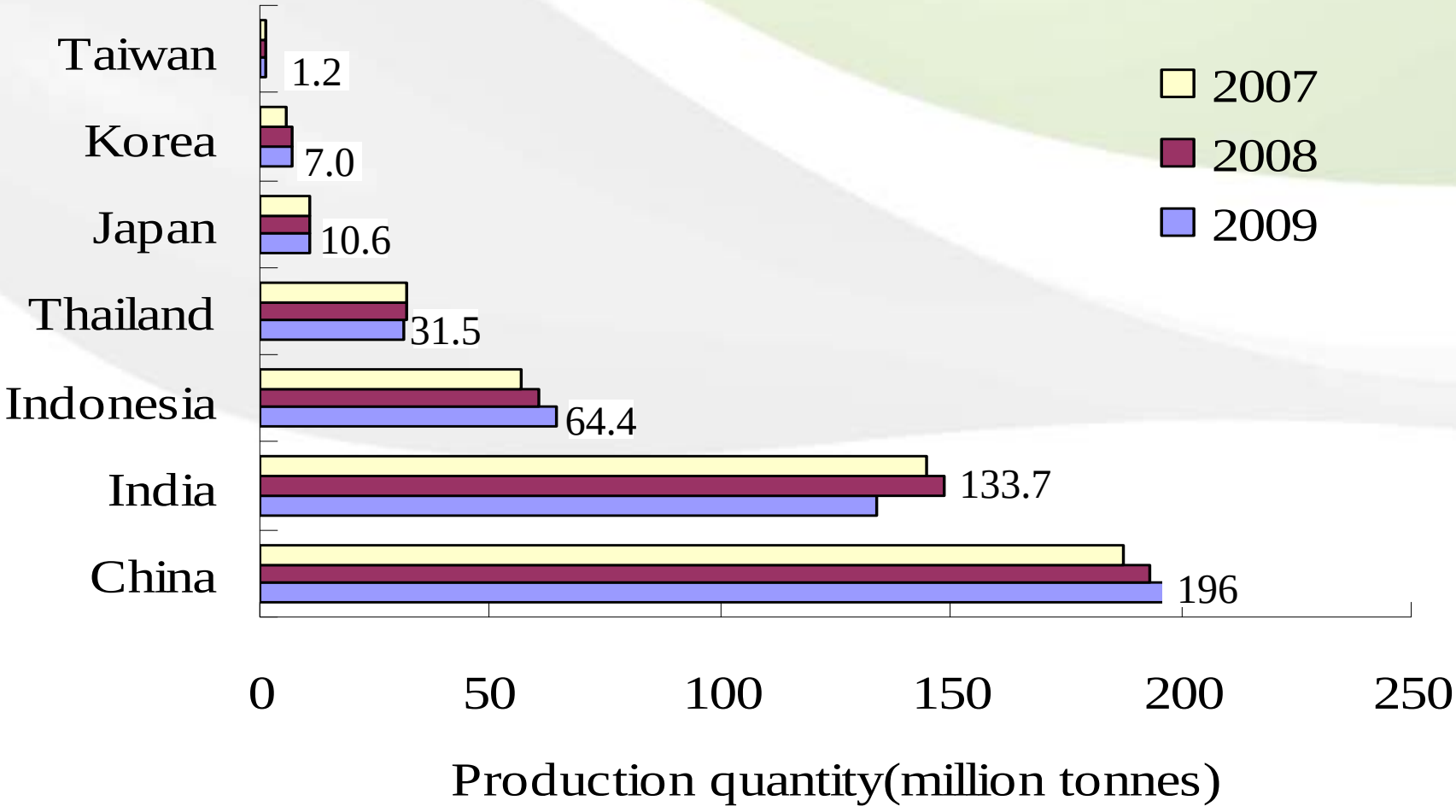
Source: http://faostat.fao.org/. Access July 2010

全球稻米(Paddy)產量



Source: http://faostat.fao.org, Sep.,2011

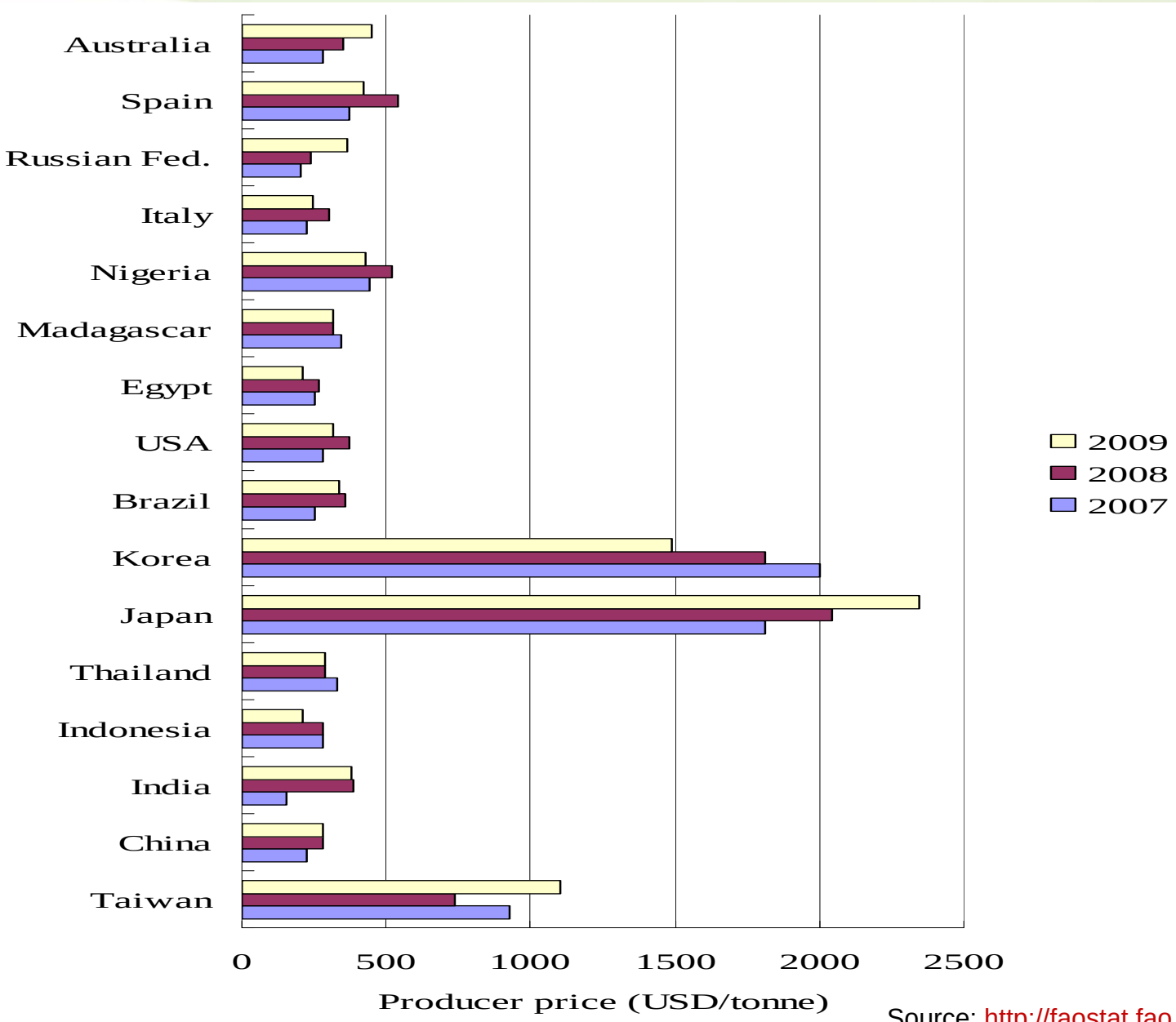
亞洲主要國家稻米(Paddy)產量



備註：2009年產量標註於圖中

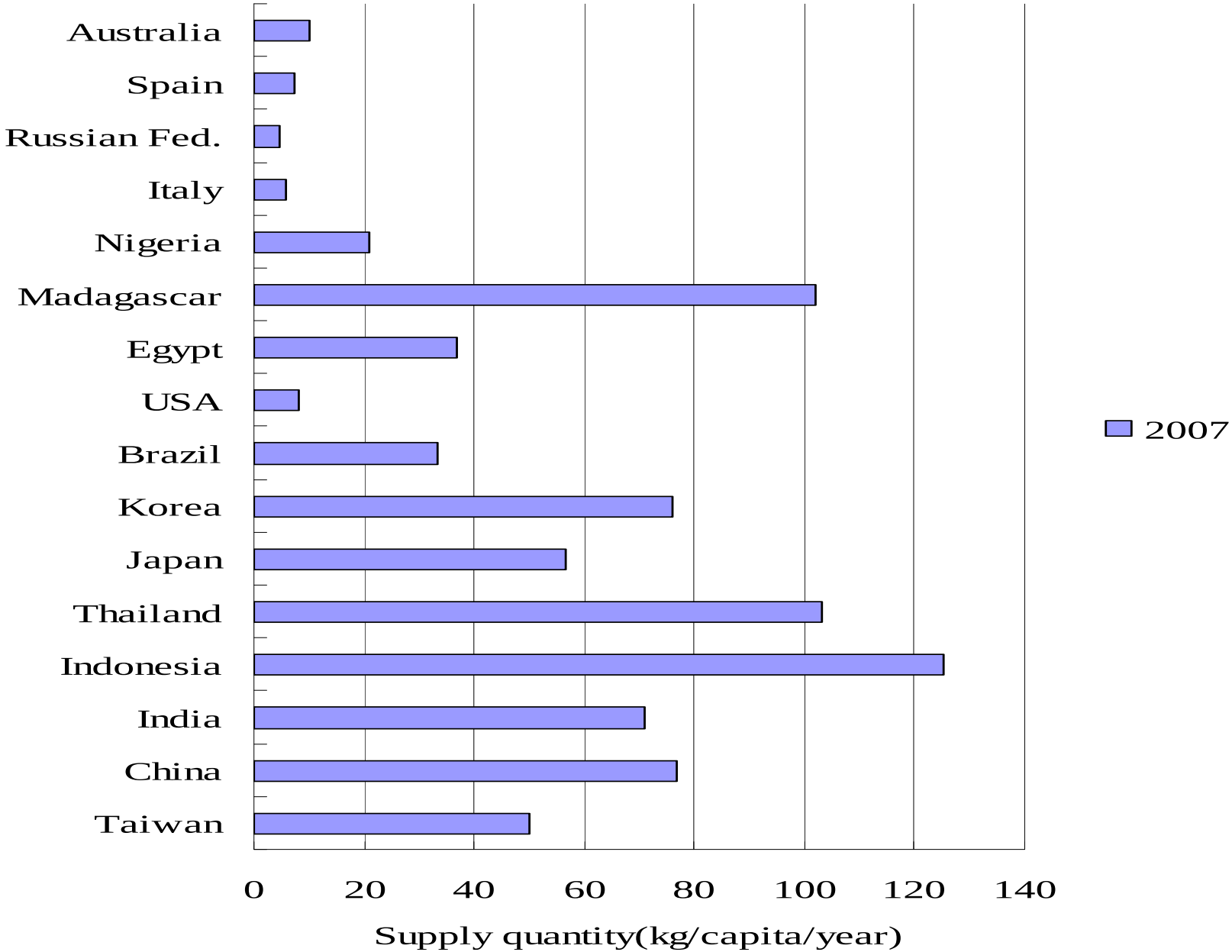
Source: http://faostat.fao.org, Sep.,2011

稻米生產主要國家之稻米(Paddy)價格



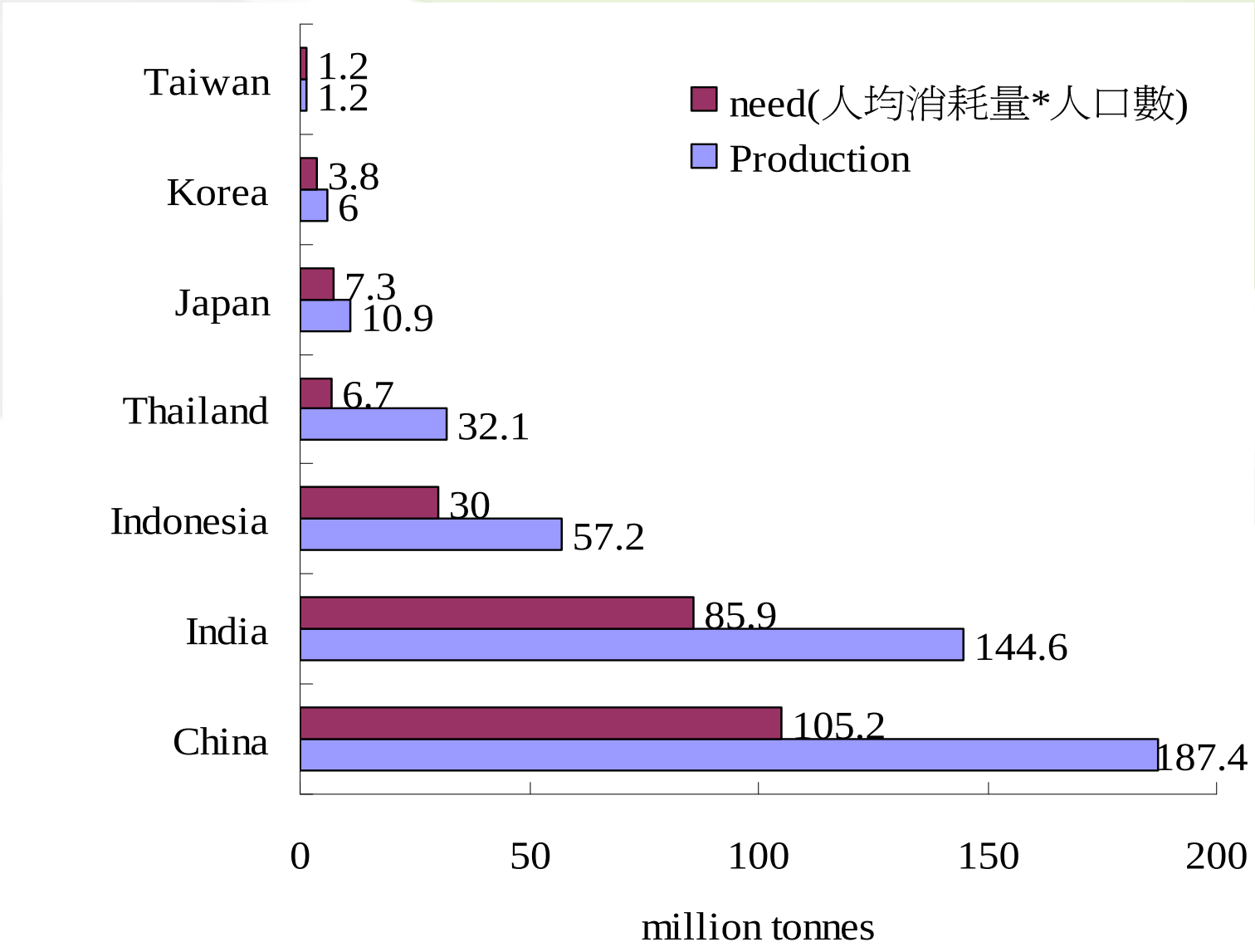
Source: http://faostat.fao.org, Sep.,2011

稻米生產主要國家之米(milled)消耗量



Source: http://faostat.fao.org, Sep.,2011

2007年亞洲主要國家稻米(Paddy)供需情況



Source: http://faostat.fao.org, Sep.,2011

- 理想與現實
- ????????

- 吳明敏：加強米食研發和推廣

- 美國農業部公佈世界17個國家最新的每人每年稻米(白米)消費，消費量最多的前12國都是亞洲國家，平均126公斤。台灣的消費量最少，僅50公斤，居亞洲12國最後一名(農委會資料，2009年48.09公斤)，日本68公斤、南韓108公斤。

- 2010年，我國的稻米收穫面積24.4萬公頃，目前休耕面積20.9萬公頃。如果多投入稻米品種改良和米食製品的研發、推廣，依照每公頃收穫量6,000公斤和2,300萬人口推估，全年全國將需增加6億9千萬公斤稻穀的供應，假設全由國內稻農生產，預估可減少11.5萬公頃休耕面積。稻米保價收購和休耕補貼是我國目前的主要稻米產業政策，每年約花費公帑100億元。

台灣的環境適合稻米生產，大肆投入研發和推廣生產效率相對不利的產品如麵粉、麵食和烘培等小麥製品，不符合國家資源的有效配置，更悖離農民權益的確保。我國的食品加工研究，對米食製品的開發及推廣著力較少。農政單位除應寬列預算支持稻米更爲優質品種的研發之外，也應積極鼓勵現有法人、大學相關系所等投入米食製品研發及推廣，或可評估新成立專責的「米食研究及推廣中心」的必要性。

- 提高米食消費量，除了品質提升和多樣化之外，確保產品安全、明確標示產地、鼓吹「地產地銷」，減少食物里程等都是重要配套。多消費米食，是讓稻業保價收購與休耕補貼制度改弦易轍、提高糧食自給率的良方。

台灣傳統米食介紹

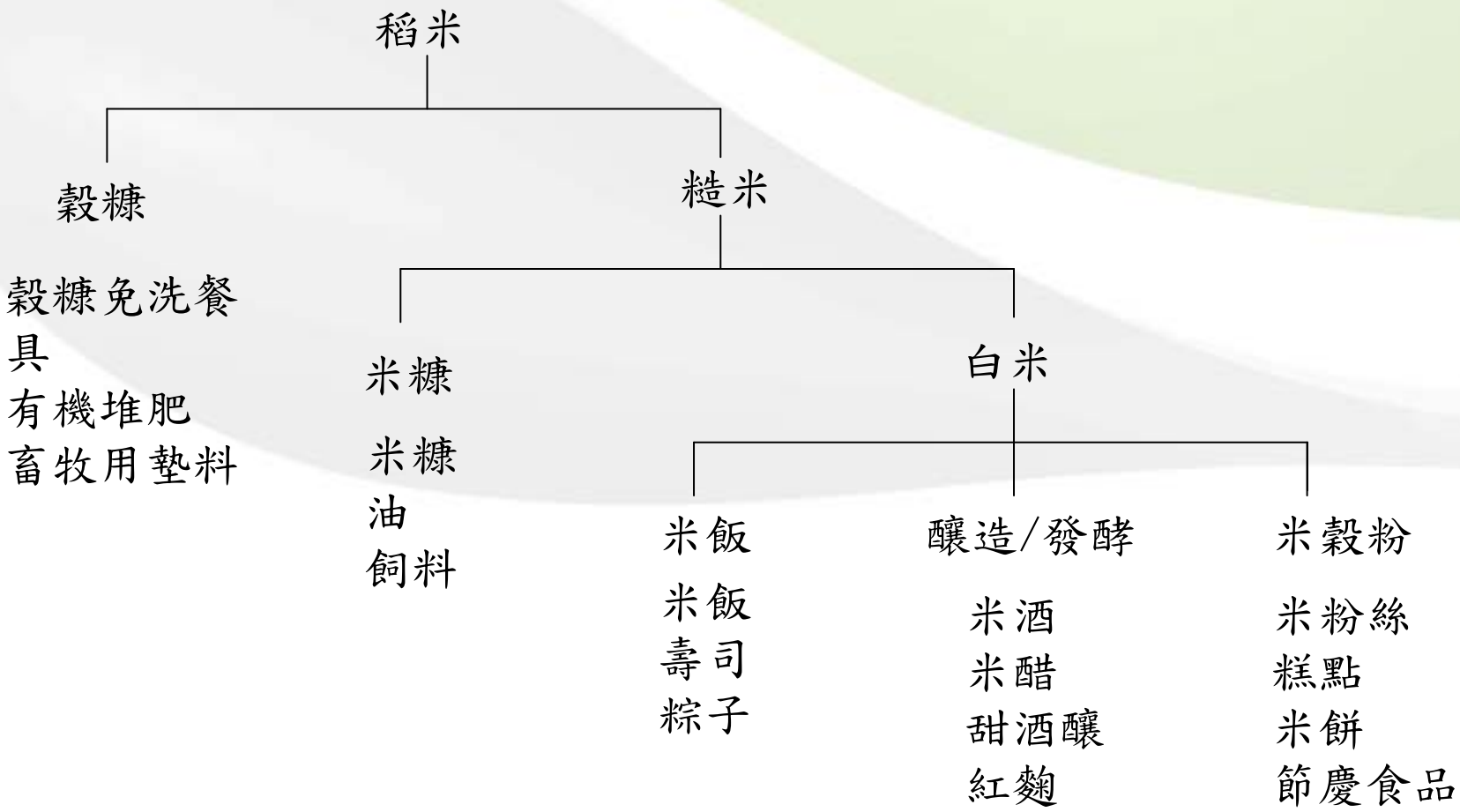
稻米之分類

- 依米粒外型：超長型（extra long），長型（long），中型（medium）及短型(short）。
- 以直鍊澱粉含量區分：糯性，低直鍊澱粉含量，中直鍊澱粉含量與高直鍊澱粉含量四種。
- 台灣一般分類：籼稻（indica rice）粳稻（japonica rice）及糯稻（waxy rice）。糯稻又分為籼糯與粳糯兩種。

表: 稻米米質特性上的分類

類型		米粒外觀特性	米飯特性	一般用途
粳米		短圓、透明（部分品種米粒有局部白粉質）	介於、糯之間	一般食米
秈米		細長、透明度高	煮熟後米飯較乾、鬆	蘿蔔糕、米粉、炒飯
糯米	粳糯	圓短、白色不透明	煮熟後米飯較軟、黏	釀酒、米糕
	秈糯	細長、白色不透明		八寶粥、粽子

傳統稻米用途


稻米
穀糠
糙米
穀糠免洗餐具
有機堆肥
畜牧用墊料
米糠
白米
米糠油
飼料
米飯
釀造/發酵
米粉粉
米飯
壽司
粽子
米酒
米醋
甜酒釀
紅麴
米粉絲
糕點
米餅
節慶食品

米麵食
與中國文化息息相關

過新年
吃年糕

十二月裹
糖元寶

十一月裹
雪花飄

十月十
新米糰子新米糕

九月九
重陽糕

八月八
月餅小紙包

七月七
巧果兩翹

六月六
大紅西瓜顏色俏

五月五
小腳粽子箬葉包

四月四
神仙糕

三月三
眼亮糕

二月二
撐腰糕

正月十五
鬧元宵

（二）工業磨米法

- 1. 乾磨
- 即使用磨粉機，直接將米磨成細米粉末，又稱「鬆糕粉」。 由於乾磨可避免濕磨所造成之廢水問題，故仍廣泛使用於製粉工業。如將米粒經焙炒或擠壓加熱後再研磨之粉，則稱熟粉或「糕仔粉」 。熟粉之製作與加工在中式傳統糕點中日漸式微，有值得研究並推廣之必要。其產品有鳳片糕、雪片糕、糕仔崙及豬油糕等。
- 沒有水磨粉的粘韌感，但也缺了潮粉的勻潤。

- 2. 半乾磨
- 即將米浸泡一段時間後瀝乾，直接加以研磨成潤濕細粉，即潮粉或濕粉。日本米穀粉產業多採用半乾磨方式，利用米粒胚乳內外層之成分差異所造成之吸水速率不同而製成不同等級之穀粉。**如江南一帶的鬆糕。**

- 3. 濕磨
- 俗稱水磨，即將米浸泡後，用磨漿機加水一起研磨成米漿；米漿去水乾燥後所得之粉即為水磨粉。濕磨用米漿機。由於多量的水於濕磨過程中有潤溼作用，故水磨粉所含之破損澱粉遠少於乾磨及半乾磨者。水磨粉色澤較白、粉粒之顆粒較細、加工特性良好，為主要之磨粉方法。

鑿引清泉養萬民，撞磨米漿糊千肚

傳統石磨

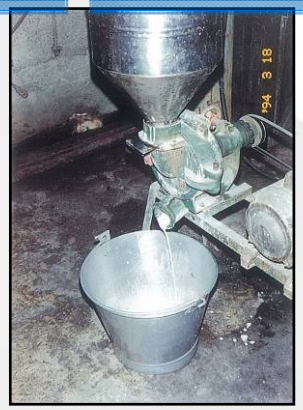
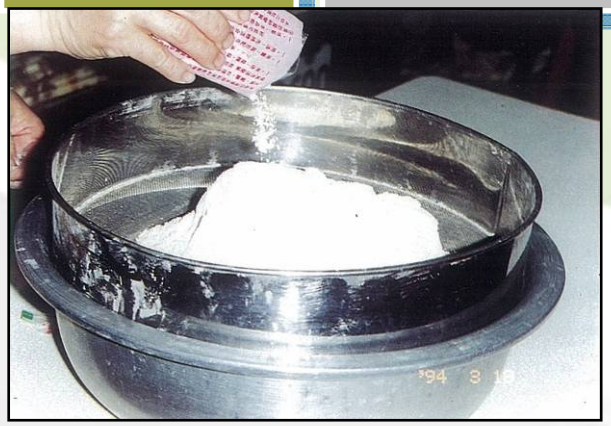
工業磨米

- 乾磨
  - 鳳片糕
  - 雪片糕
  - 豬油糕
- 半乾磨
  - 鬆糕
- 濕磨
  - 年糕
  - 蘿蔔糕

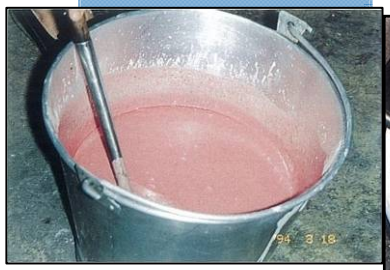
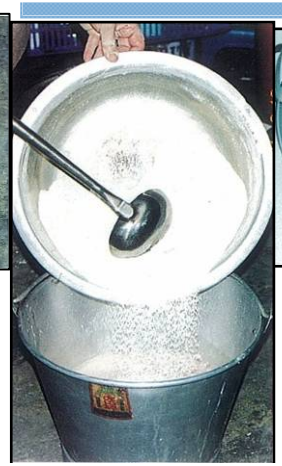
台灣傳統米食

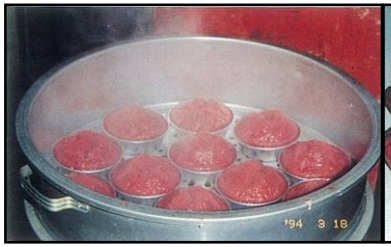
發糕

蓬來米 → 洗米、浸米 → 加紅麴磨漿 → 麵粉過篩 → 加發粉

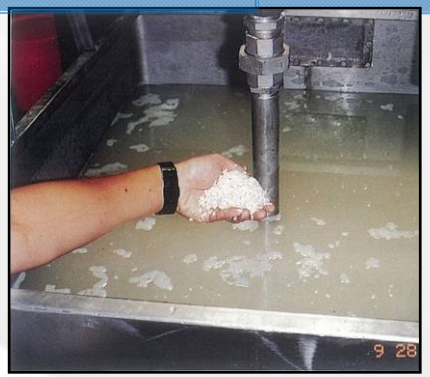
加糖攪拌 → 加麵粉 → 裝紙倒入米糊 → 蒸煮 → 發糕

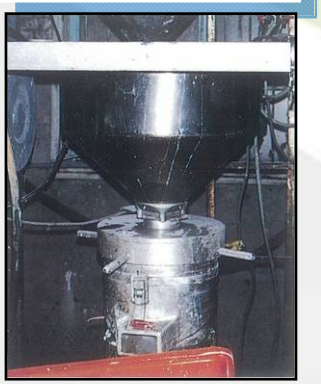





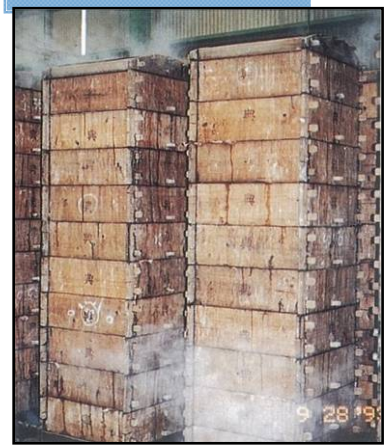

年糕製作

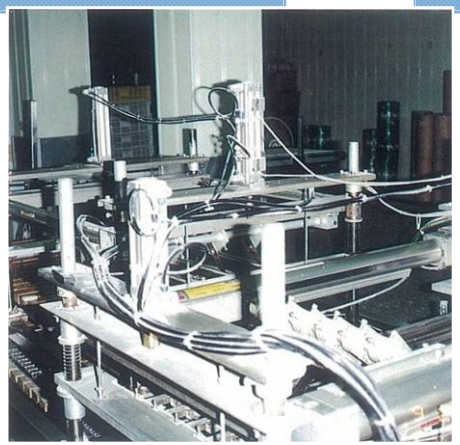
圓糯米 → 洗米、浸米 → 磨漿 → 乾燥 → 攪拌

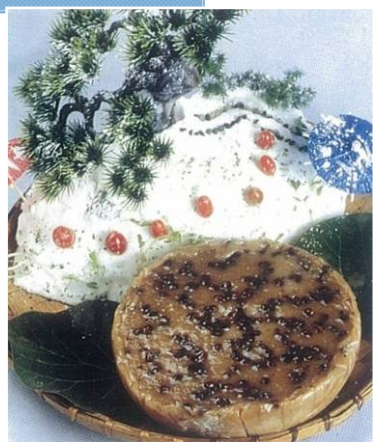




充填 → 蒸煮 → 輸送、包裝 → 成品

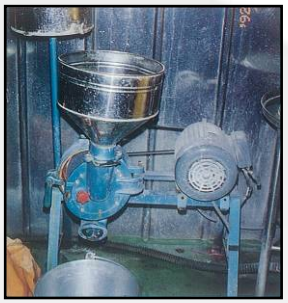




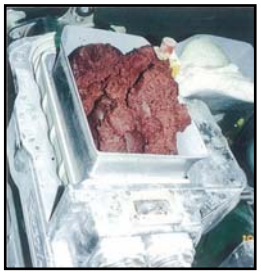


麻糬

糯米 → 磨漿 → 糯米粉 → 加料、蒸煮、攪拌

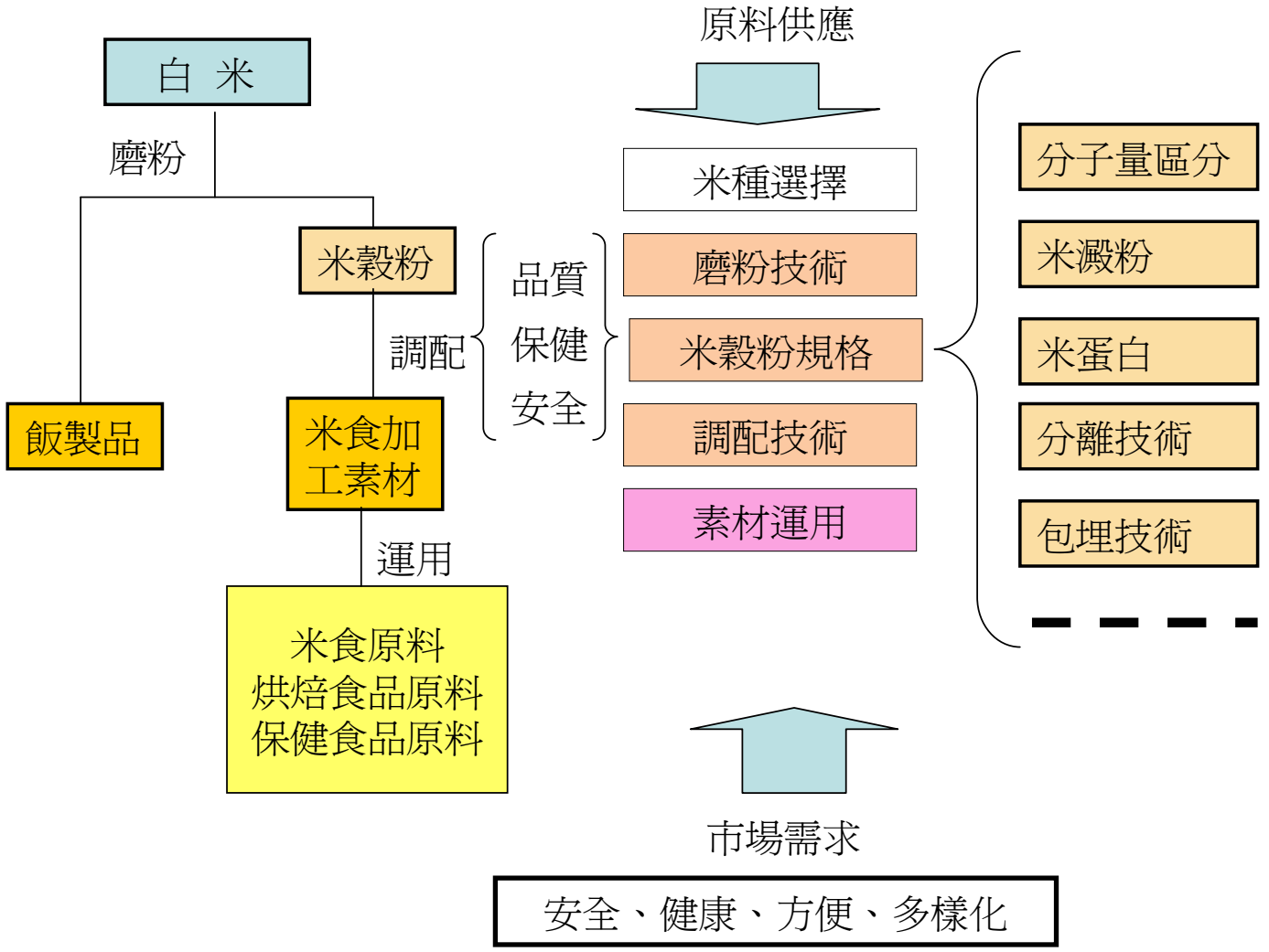


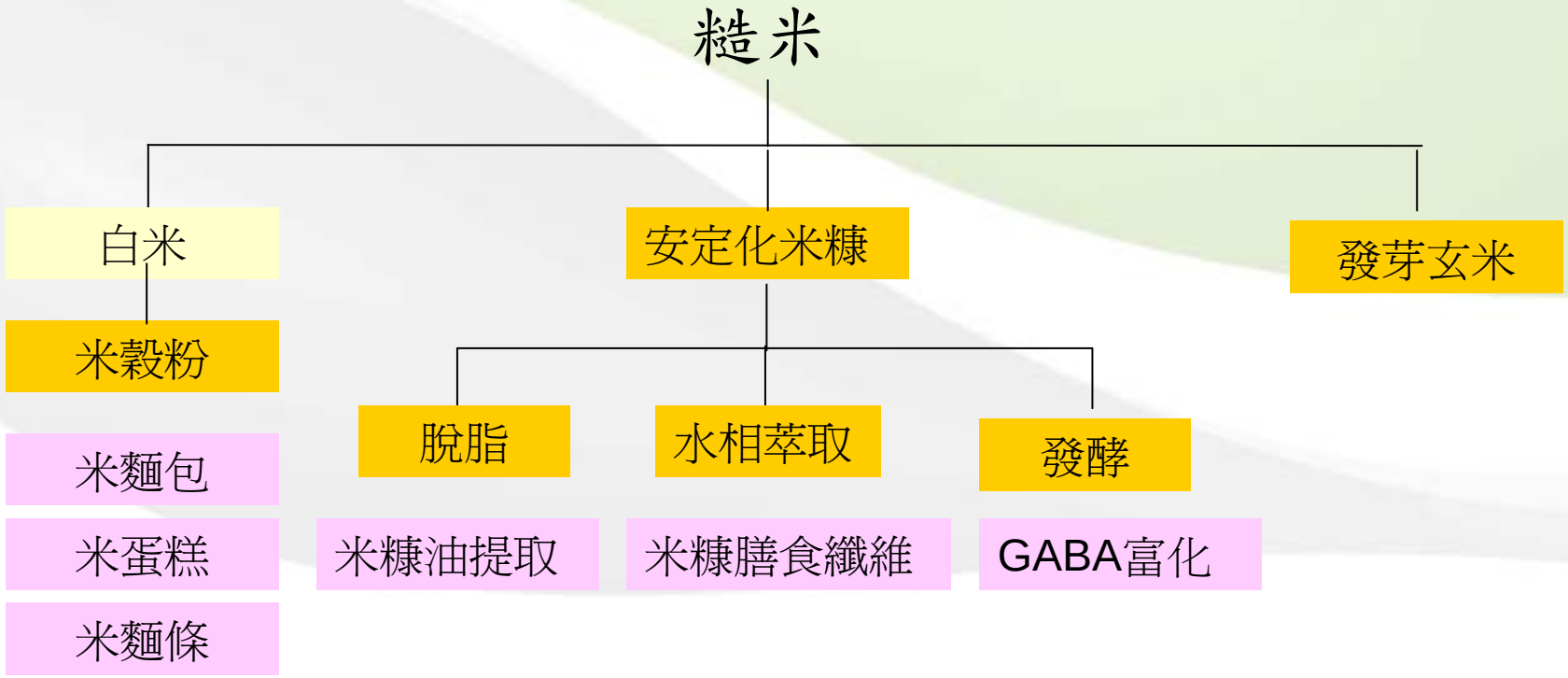
冷卻 → 混餡 → 包外皮 → 成品



米食產品科技化研究

米穀粉研究範圍與相關技術應用





提高稻米消費量

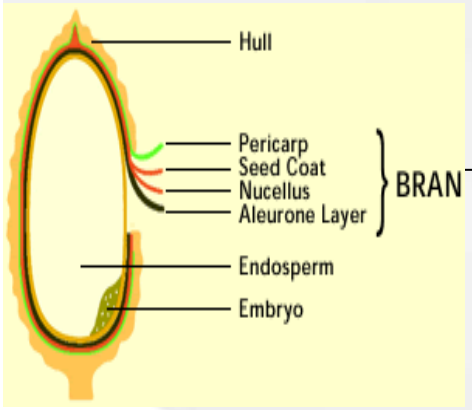
提高稻米健康與機能性，作爲保健食品素材

舉實例

- 糙米
- 米糠所含膳食纖維約佔30％，經人體及動物試驗已證實膳食纖維具有：
- 降低膽固醇、降低血糖濃度及胰島素分泌量、促進腸胃蠕動、防止便秘、預防結腸癌及預防肥胖等功能。米糠油中，約含有1.5％以上的米糠醇，是由三萜烯醇（Triterpene alcohols）與植物固醇（Phytosterols）所形成的阿魏酸酯（Ferulate esters）。

- *米糠醇經實驗證實具有高度的抗氧化活性，其抑制油脂氧化的作用比**Vit E**高出六倍。*
- *在研究顯示，其主要抗氧化機制，爲具有清除**DPPH**自由基及部分還原的能力，且隨濃度的增加，其抗氧化能力也增加。*

糙米(Brown Rice)之營養價值



碾米

→ 白米

→ 米糠

安定化

加工
調配

安定化米糠

應用

營養成分:
碳水化合物
蛋白質
脂肪
微量元素

保健功效成分:
膳食纖維
米糠醇
植物固醇

保健功效：
抗氧化
降膽固醇
調節血糖
抑制癌症(乳癌、結腸癌)

添加安定化米糠之市售產品

水萃取米糠纖維在食品中的應用

米糠纖維粉末

淺黃褐色，流動性佳

奶油蛋糕

蘇打餅乾

饅頭

安定化米糠

由於米糠並不耐貯存，所以米糠前處理的過程相當重要，需先進行米糠的安定化處理，可使米糠在室溫下保存三個月。

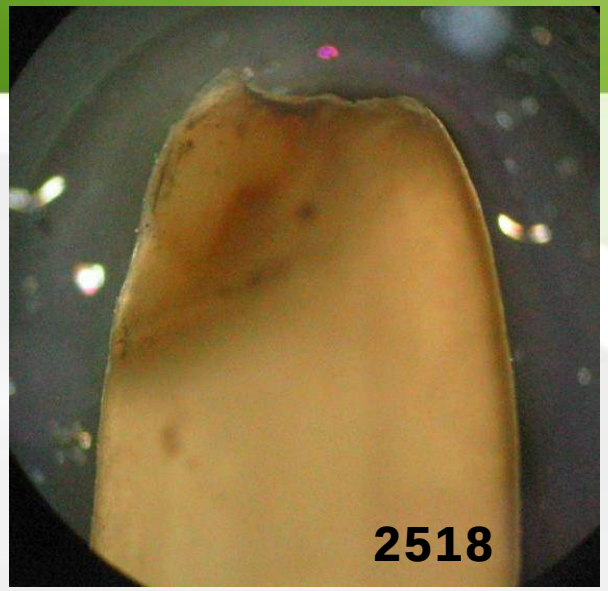
米糠GABA、糙米GABA

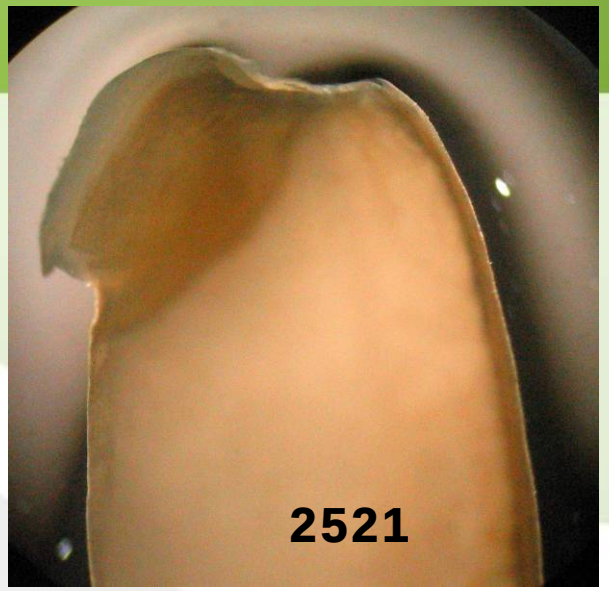
應用米糠、糙米等作為培養基進行乳酸菌發酵後，可明顯有效提升米糠發酵物中GABA之含量至50倍（每克乾重含15[illegible]），耐熱性佳，可[illegible]應用於加工食品、[illegible]、飲料等食品中。

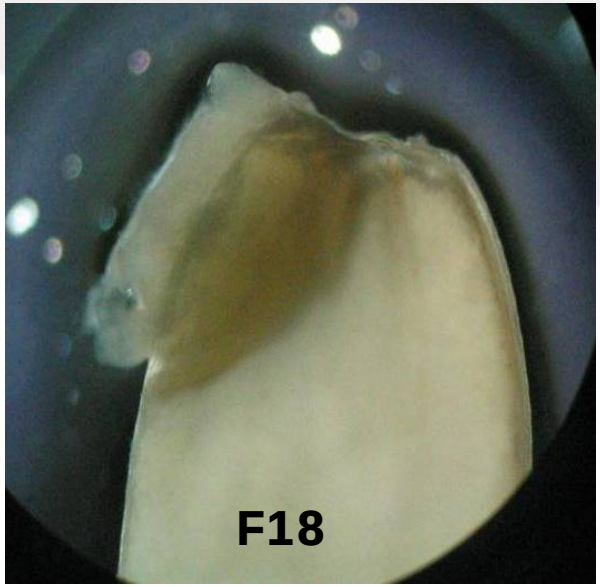
米糠纖維

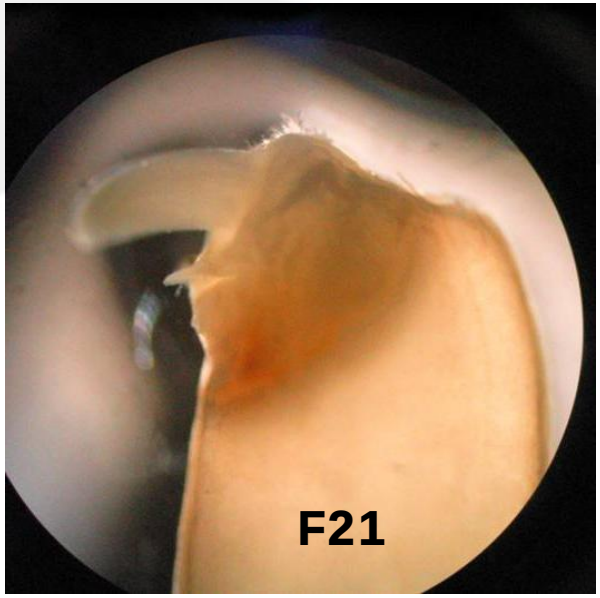
本所分離得到之米糠纖維含量已在40%以上，與美國之米糠膳食纖維商品(NutraCea Rice Bran Fibet)所含之纖維量相當，符合商品化之價值。

■健康導向米食多元化應用





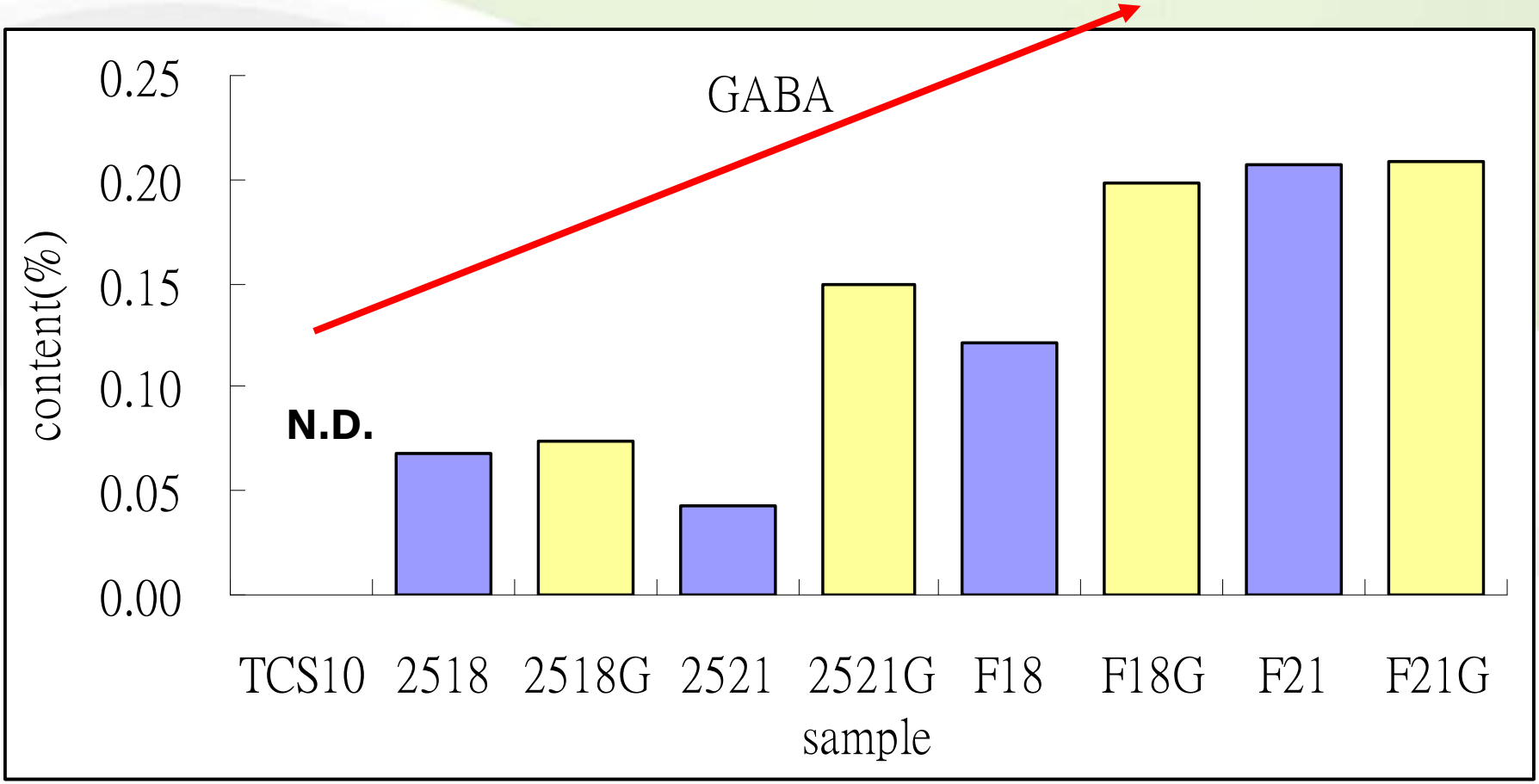




圖三 發芽糙米之外觀照相圖

表　　性米發芽18及21小時之胚芽長度

sample	胚長 (mm)		
	A	B	C
TCS10	1.61±0.09 d	1.02±0.07 b	-
2518	1.89±0.03 c	1.02±0.02 b	-
2521	1.89±0.07 c	1.05±0.09 b	-
F18	2.03±0.02 b	1.53±0.22 a	-
F21	2.10±0.08 a	1.57±0.24 a	1.80±0.09



圖九、發芽糙米及胚芽中GABA含量

營養成分分析(每一100克之含量)

米的種類	白米飯	發芽糙米飯
熱量	144 Kcal	129 Kcal
蛋白質	2.1 g	2.5 g
脂質	0.5 g	0.9 g
碳水化合物	31.3 g	27.4 g
鈉	2.1 mg	0.6 mg
水分	66.1 g	68.8 g
灰分	< 0.1	0.4
總食物纖維	0.6 g	1.4 g
水溶性食物纖維	< 0.5 g	< 0.5 g
不溶性食物纖維	0.6 g	1.4 g

GABA米糠富化流程

pH 調整

高壓滅菌
121℃、
15分鐘

冷卻

乳酸菌接種
進行培養

0.4 L

2.5 L

14 L

冷凍乾燥

milling

富含GABA素材

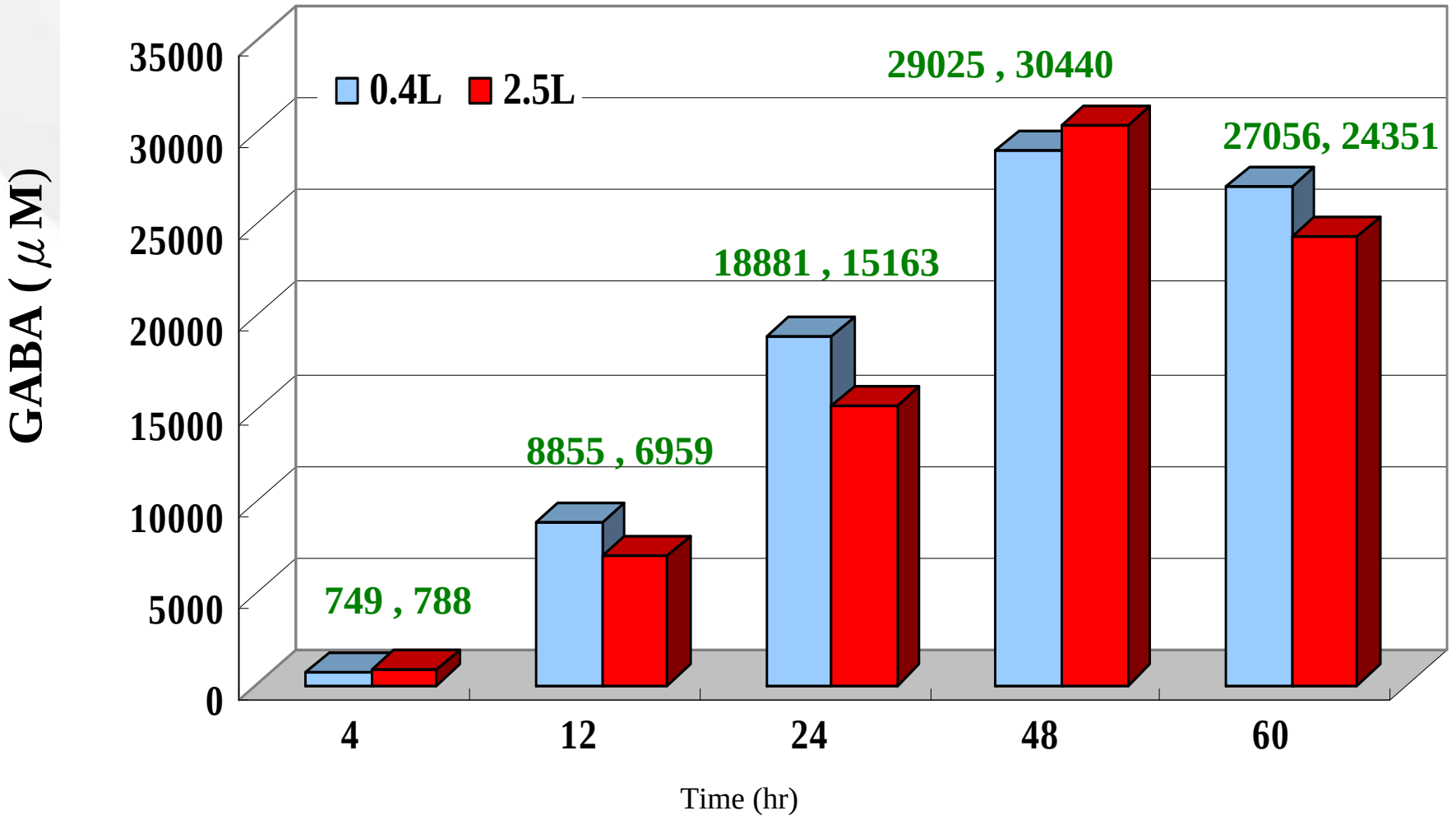
Recommended Dietary Intake of GABA

1. Intaking 18mg daily could reduce the blood pressure.
2. Intaking 26.4mg daily could improve the sleeplessness, somnipathy and depression.

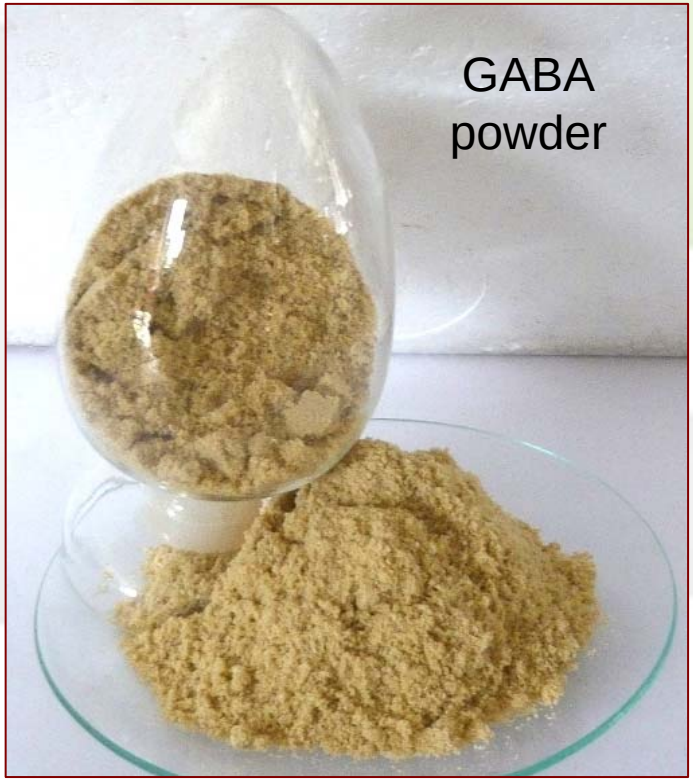
(大森正司等,1987;Tadashi *et al*.,2000)

研究成果

米糠經乳酸發酵60h後GABA含量變化情形(0.4及2.5L)

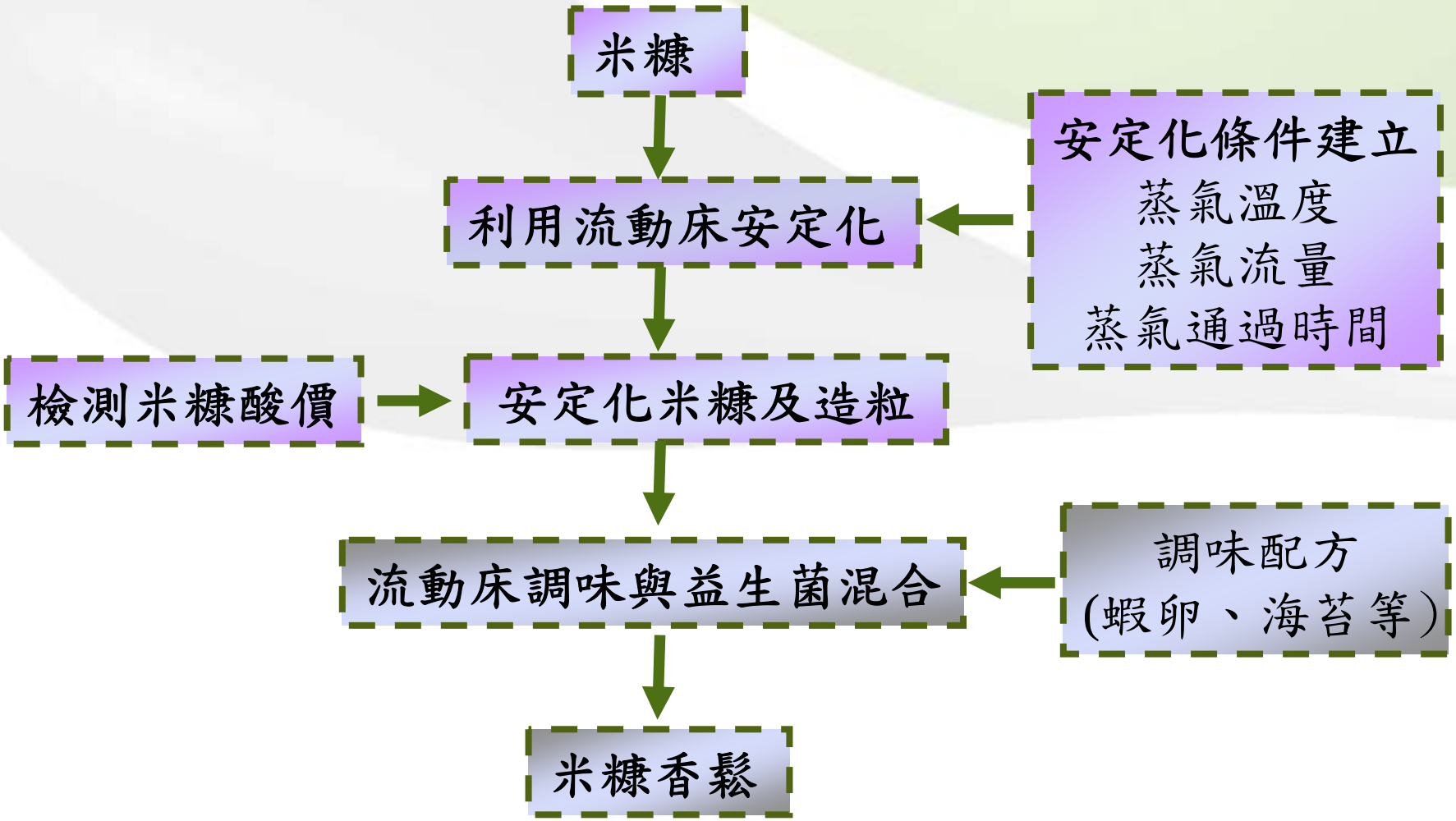


含GABA之產品



米糠香鬆

米糠香鬆開發方法


米糠
利用流動床安定化
安定化條件建立
蒸氣溫度
蒸氣流量
蒸氣通過時間
檢測米糠酸價
安定化米糠及造粒
流動床調味與益生菌混合
調味配方
(蝦卵、海苔等)
米糠香鬆

結　　論

1.應用流動床進行米糠安定化試驗，安定化條件以高溫、短時間為佳。

2.益生菌於米糠香鬆調味時添加，避免安定化製程及造粒烘乾製程中高溫處理降低益生菌的菌數。

3.米糠安定化後亦可應用於烘焙產品與即食沖泡飲品之中。

成　果

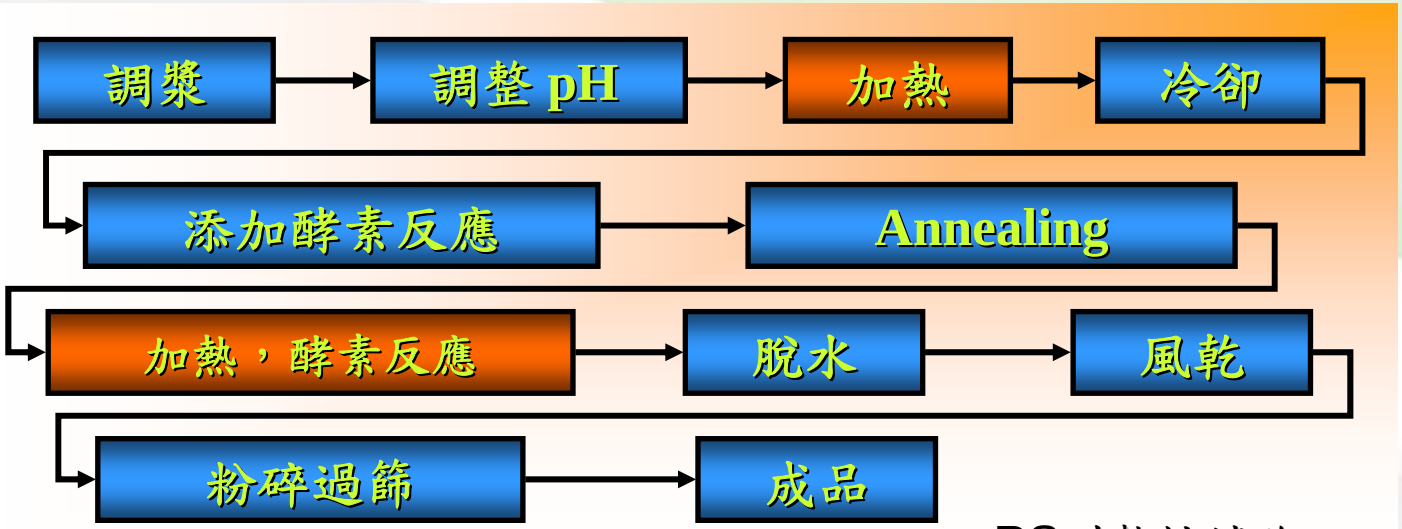
- 應用流動床設備完成米糠安定化製程。
- 應用擠粒機完成安定化米糠造粒、調味。
- 建立米糠香鬆配方。

具 體 效 益

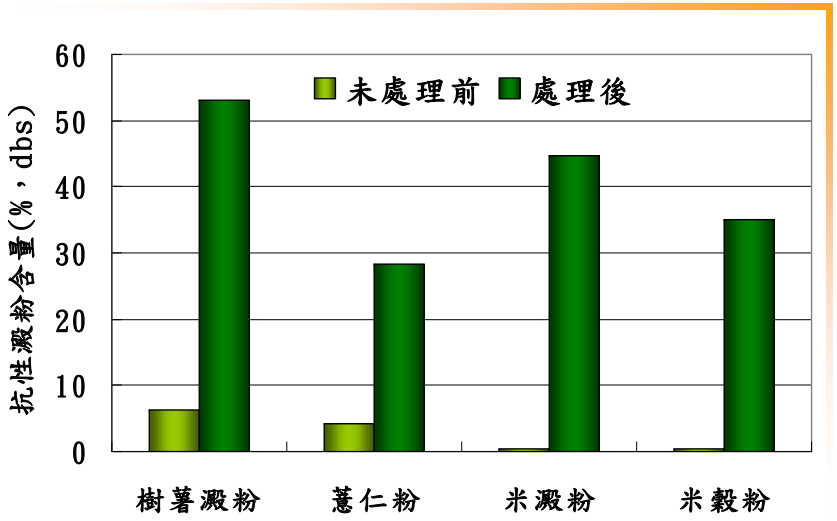
1. 提高米糠之附加價值，市售香鬆售價約每公斤約750元，米糠香鬆成本每公斤約 70元，機能性米糠香鬆成本每公斤約 120元。

2. 具備健康訴求，機能性米糠香鬆每10公克約含6公克米糠及益生菌 3×10^{10} cfu 。

米穀粉抗性澱粉最適製程設計

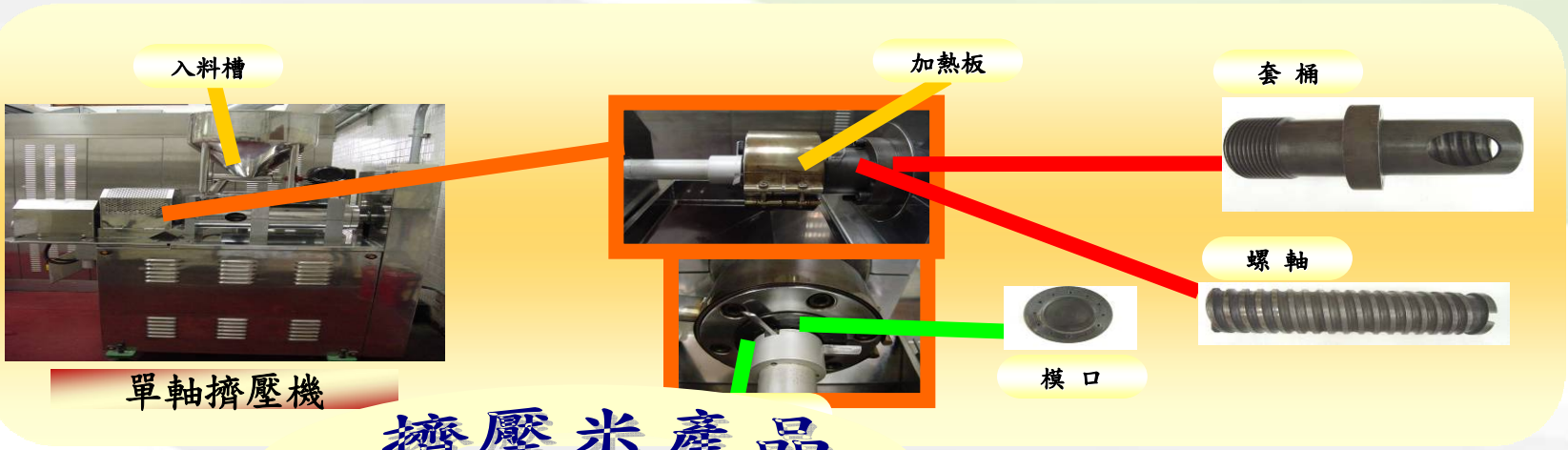


RS耐熱性試驗



	樣品	RS含量 (%,dbs)
米飯	處理後	21.75
	微波加熱	21.26
米穀粉	處理後	34.60
	濕熱處理 90℃，1小時	35.64
	濕熱處理 90℃，2小時	34.33
	殺菌釜 121℃，15分鐘	31.42

擠壓加工技術



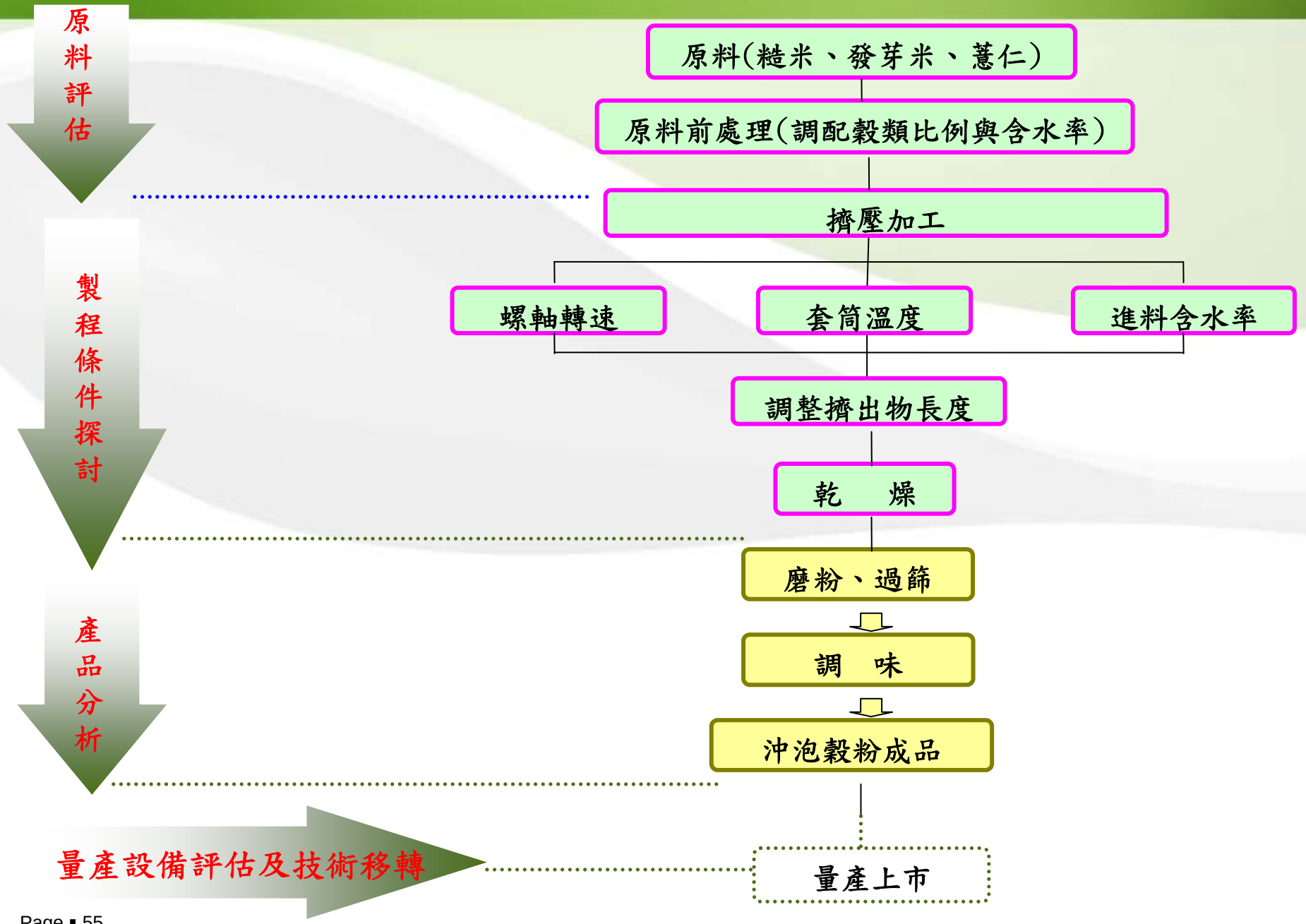
擠壓米產品

沖泡即溶穀粉


飽足順暢
品名:飽足順暢多穀粉
原料:糙米、黃豆、牛奶粉、芝麻、燕麥、杏仁、杏仁、山藥、發芽米、柑橘纖維、關華豆膠
重量:250公克
食用方法:取20公克粉末倒入杯中，加入150-200 c.c 熱水，充分攪拌均勻，溫涼後飲用，避免燙口，沖泡水量可依個人喜好調整。(素食可食)
保存期限:三個月
有效日期:2012/04/05
注意事項:儲避免日光直射及高溫、潮濕處，開封後請冷藏。
添加柑橘纖維、糙米、黃豆以及燕麥。以複方概念，為您調配出飽足順暢配方。
營養成分
每一份量21公克，本包裝含12.5份
每份
熱量 75大卡
蛋白質 2.5公克
脂肪 2.1公克
飽和脂肪 1.3公克
反式脂肪 1.1公克
碳水化合物 11.5公克
鈉 13毫克


銀髮樂活
品名:銀髮樂活多穀粉
原料:糙米、杏仁、牛奶粉、紫米、燕麥、芝麻、豆漿粉、芝麻、山藥、黃豆、發芽米、關華豆膠、鈣
重量:250公克
食用方法:取20公克粉末倒入杯中，加入150-200 c.c 熱水，充分攪拌均勻，溫涼後飲用，避免燙口，沖泡水量可依個人喜好調整。(素食可食)
保存期限:三個月
有效日期:2012/04/05
注意事項:儲避免日光直射及高溫、潮濕處，開封後請冷藏。
添加鈣，維持骨骼及牙齒的健康，以及添加對銀髮族有益之成分(芝麻、山藥、黃豆、薏仁)，以複方概念，為您調配出銀髮樂活配方。
營養成分
每一份量21公克，本包裝含12.5份
每份
熱量 75大卡
蛋白質 2.5公克
脂肪 2.1公克
飽和脂肪 1.3公克
反式脂肪 1.1公克
碳水化合物 11.5公克
鈉 41毫克

沖泡穀粉製作流程圖


原料評估
製程條件探討
產品分析
原料(糙米、發芽米、薏仁)
原料前處理(調配穀類比例與含水率)
擠壓加工
螺軸轉速
套筒溫度
進料含水率
調整擠出物長度
乾　燥
磨粉、過篩
調　味
沖泡穀粉成品
量產設備評估及技術移轉
量產上市

穀粉配方之功效

原料名稱	功能/指標功能
糙米	1.膳食纖維 2.維生素B群。
黑糯米	1.抗氧化 2.抗炎性 3.提升HDL膽固醇 4.抗動脈粥狀硬化。
發芽糙米	1.可改善便秘 2.異位性皮膚炎 3.失眠 4.更年期 5.可排毒 6.降血壓 7.降血脂 8.具有GABA（452 mg/100 g）

市場潛力

- 全米加工應用，增加產品利用性
- 具機能性之一般食品型態穀粉，可滿足營養及機能雙重需求
- 高貯存性，提升產品貨價壽命，增加產值

關鍵技術 --- 擠壓加工

操作特性

1. 高溫短時操作
2. 調整操作及元件組合參數可生產多元性質之素材與成品
3. 簡化食品加工製程
4. 不產生廢棄物

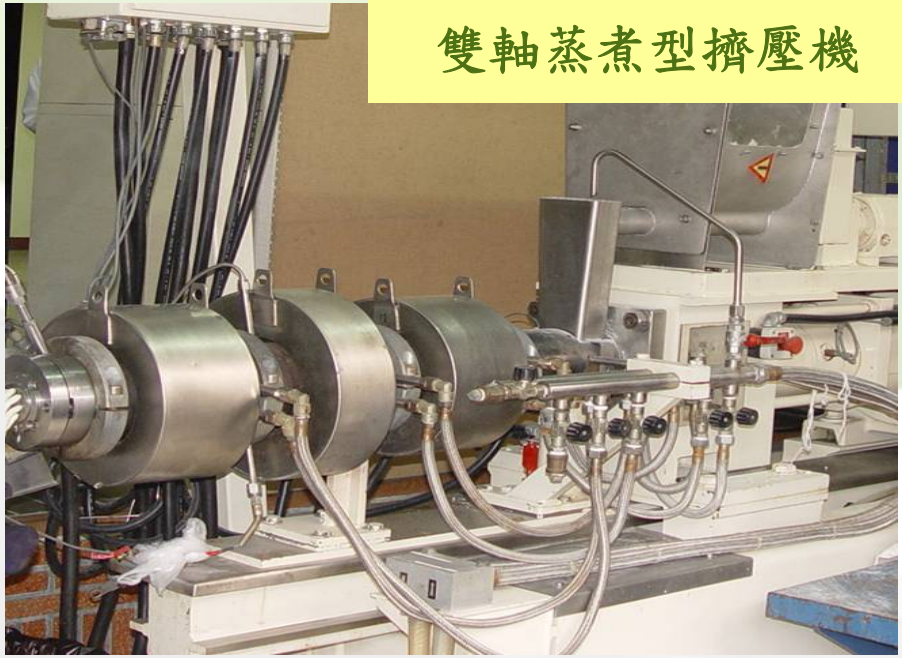
優 點

1. 有效率之穀類油脂安定化之技術及應用方法，可延長產品保存期限
2. 且為連續式生產，成本較為經濟
3. 生產具機能性附加價值之食品或素材

穀研所現有之擠壓設備

單軸膨發型擠壓機

雙軸蒸煮型擠壓機



本所已開發之擠壓穀物產品與技術

穀粉素材

熟粉糕點

米烘焙品

沖泡穀粉包

膨發點心

穀物棒

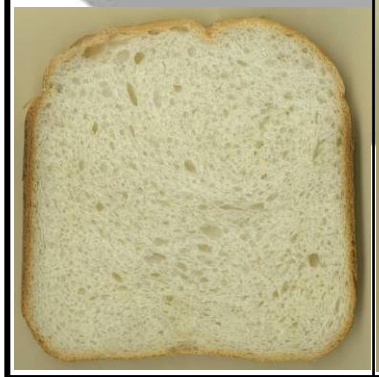
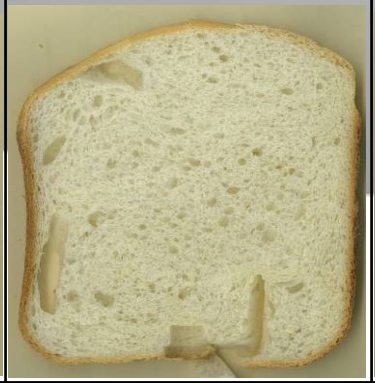
米麵共食產品之應用

米麵條

米穀粉應用於烘焙產品

類別	產品名稱	組合	米穀粉	比例(%)
麵包類	乳酪米麵包	組合麵粉	蓬萊米粉	30
	御飯養生麵包	組合麵粉	蓬萊米粉	30
	米湯種花卷	米湯種(組合麵粉)	蓬萊米粉	30
	米湯種紅豆烤餅	米湯種(組合麵粉)	蓬萊米粉	30
蛋糕類	米戚風巧克力卷	米粉糊	蓬萊米粉	100
	米抹茶紅豆茶會蛋糕	米粉糊	蓬萊米粉	100
	米戚風香草布丁卷	米粉糊	蓬萊米粉	100
酥糕類 (伴手禮)	芋泥麻糬月餅	餡料	糯 米 粉	50
	棗泥麻糬月餅	糕皮(組合麵粉)	蓬萊米粉	30
	酥皮山藥月餅	油皮(組合麵粉)	蓬萊米粉	30
	酥皮桂圓月餅	油酥(組合麵粉)	蓬萊米粉	30
	米鳳梨酥	餡料	蓬萊米粉	50
點心類 (伴手禮)	米桂圓發糕	米粉糊	蓬萊米粉	80
	紫米麻糬	熟粉皮	蓬萊米粉	100
	養生米香	米花糖	蓬萊米粉	-
	米蔬果軟糖	軟糖	蓬萊米粉	10

不同比例高筋麵粉與蓬萊米粉（麵筋含量13%）對麵包的影響

				
				
3.6ml/g	4.17ml/g	3.69ml/g	3.10ml/g	2.86ml/g
100% 高筋麵粉	75%高筋麵粉25%蓬萊米粉	50%高筋麵粉50%蓬萊米粉	25%高筋麵粉75%蓬萊米粉	100% 蓬萊米粉

米月餅

米鳳梨酥

米湯種麵包

米戚風蛋糕


米月餅


紫米蔴薯


養生米香

- 提供對麵粉麩質過敏者更多樣的選擇

- 改善中式糕點產品的酥硬性及產品
- 回軟性

- 減少麵粉使用量及增加食品口感，
- 增加國產稻米的利用範圍。

米食文化與藝術的結合

結合文化與藝術

有機稻場兼具教育研究文化休憩多重功能

稻草人
招牌模樣可愛

中興穀堡稻米博物館

池上秋收「稻穗音樂節」

Thank You !

講者

Dr. Melissa Fitzgerald

演講題目

加工技術對米食消化性質影響

Effect of Processing on Digestibility of Rice and Rice Products

Personal Details

Name	Melissa Anne FITZGERALD
Place of Birth	Sydney, Australia
Nationality	Australian
Current Address	Grain Quality, Nutrition and Postharvest Centre International Rice Research Institute (IRRI) DAPO 7777 Metro Manila Philippines Ph: 632 580 5600 extn 2755 Mob: +63 917 545 3035 Email: m.fitzgerald@irri.org

Academic Achievements

Qualifications	PhD June 1997, La Trobe University, Victoria Australia B.Sc. Hons 1990, University of Sydney, Australia
Awards and Distinctions	NSWDPI Staff Award 2001 Excellence in Agriculture Nancy Millis Award 1993 Excellence in Agriculture Eva Saunders Memorial Award 1989 Excellence in Plant Physiology

From January 16 2011

Australian Food and Grocery Council Chair, School of Agriculture and Food Sciences, University of Queensland.

Research: I will be establishing a metabolomic profiling platform for volatile compounds and primary and secondary polar and non-polar metabolites for food flavour, fragrance, nutritional value, and medical impact, and searching for candidate genes for these compounds. Researhc products will be delivered to breeding programs and food manufacturers.

Teaching: Improving the quality of food science graduates in Australia through new undergraduate and postgraduate strategies.

Employment History

April 2007 – December 31 2010

Head, Grain Quality, Nutrition and Postharvest Centre (GQNPC), International Rice Research Institute (IRRI), Philippines. Global Leader Theme 4 Global Rice Science Partnership (GRiSP).

April 2004 – March 2007

Principal Research Scientist, Rice Improvement Program, NSW Department of Primary Industries, Australia, but seconded from NSWDPI to IRRI as Head of the Grain Quality and Nutrition Research Centre.

April 1997 – March 2004

Head of chemistry and quality in the Rice Improvement Program, NSW Department of Primary Industries, Australia.
Research Scientist (1998 – 1999)
Senior Research Scientist (2000 – 2004)

January 1994 – March 1997:

PhD student, School of Botany, La Trobe University with Dr John Anderson and at Tatura Agricultural Institute, Agriculture Victoria with Dr David Ugalde.

January 1991 – December 1993:

Research Assistant, School of Botany, University of Melbourne with Dr Malcolm Calder and Prof. Bruce Knox.

Current Interests

My current research interests lie with understanding the basis of flavour, taste, sensory and nutritional value of foods from genetic, structural, rheological, functional and medical perspectives. My interest in metabolites, how these affect taste and flavour, and the potential nutritional/medical value of different metabolites in food has been growing over the past few years. The discipline has now reached the stage where metabolite data can be developed into phenotyping tools for associating with genotype maps of segregating populations. As genotying technology improves, it is becoming increasingly possible to find candidate genes for the chemistry of food flavour, fragrance and nutrition.

I am interested in developing an exciting research program that attracts good quality food geneticists, chemists, engineers and biochemists, and provides collaborative opportunities with social scientists, medical professionals, nutritionists and molecular biologists, and further down the application pathway, with different members along value chains for cereals, fruit and vegetables, and their products.

Professional Memberships and Affiliations

Chair, International Network for Quality Rice inqr.irri.org
Member, AACC International and Chair of Rice Methods Committee.
Liaison Member ISO TC34/SC4
Adjuct Professor: Departments of Human Ecology, Molecular Biology and Biochemistry, and Chemistry at the University of the Philippines, Los Baños, and on the Graduate Committee.
Member RACI Chemistry Division

PUBLICATIONS 2009 - CURRENT

1. Boualaphanh, C.; Calingacion, M.; Daygon, D.; Moing, A.; Mumm, R.; Hesselhof Hansen, T.; Erban, A.; Allwood, W.; Ward, J.; Kofod Schoerring, J.; Hall, R.; Fitzgerald, M., A metabolomics approach to identify new traits of rice quality in traditional and improved varieties of Laos. Metabolomics **submitted**.

2.Butardo, V., Fitzgerald, M., Bird, A., Gidley, M., Flanagan, B., Larroque, O., et al. **2011**. Impact of Down-regulation of Starch Branching Enzyme IIb in Rice by Artificial microRNA and Hairpin-RNA-Mediated RNA Silencing. *Journal of Experimental Botany*, doi:doi: 10.1093/jxb/err188.

3.Tran, N., A; Daygon, V., D; Resurreccion, A.; Cuevas, R., P,; Corpuz, H.; Fitzgerald, M. A. **2011**. A single nucleotide polymorphism on the Waxy gene explains gel consistency.. *Theoretical & Applied Genetics 123: 519-25*. DOI: 10.1007/s00122-011-1604-x

4. Boualaphanh, C., Daygon, V., Calingacion, M., Sanitchon, J., Jothityangkoon, D., Mumm, R., Hall, R., Fitzgerald, M. **2011**. Use of new generation SNP genotyping for rapid development of near-isogenic lines in rice. *Crop Science* **51**.

5. Boualaphanh, C.; Calingacion, M.; Jothityangkoon, D.; Sanitchon, J.; Cuevas, R.; Fitzgerald, M. **2011**. Yield and quality of non-aromatic and aromatic Lao rice in response to nitrogen fertilizer *Science Asia* **37:** 89-97

6. Champagne, E. T.; Bett-Garber, K. L.; Fitzgerald, M. A.; Grimm, C.; Lea, J.; Ohtsubo, K.; Jongdee, S.; Xie, L.; Bassinello, P.; Resurreccion, A. P.; Ahmad, R.; Habibi, F.; Reinke, R. **2010,** Important Sensory Properties Differentiating Premium Rice Varieties. *Rice*, 270-281.

7. Cuevas, R. P.; Daygon, V. D.; Morell, M. K.; Gilbert, R. G.; Fitzgerald, M. A. **2010** Using chain-length distributions to diagnose genetic diversity in starch biosynthesis. *Carbohydrate Polymers*, 81, 120 - 127.

8. Cuevas, R.; Fitzgerald, M. A.; Gilbert, R. G., Structural differences between hot-water-soluble and hot-water insoluble fractions of starch in waxy rice (Oryza sativa L.). *Carbohydrate Polymers* **2010,** 81, 524 - 532.

9. Cuevas, R.; Daygon, V.; Corpuz, H.; Waters, D. L. E.; Reinke, R. F.; Fitzgerald, M. A. **2010.** Melting the Secrets of Gelatinisation Temperature. *Functional Plant Biology*, 37, 439 - 447.

10. Kovach, M. J.; Calingacion, M.; Fitzgerald, M. A.; McCouch, S. R. **2009.** The origin and evolution of fragrance in rice (*Oryza sativa* L.). *Proceedings of the National Academy of Science*, 106, (34), 14444-14449.

11. Fitzgerald, M. A.; Resurreccion, A. P. **2009** Maintaining the yield of edible rice in a warming world. *Functional Plant Biology*, 36, (12), 1037 - 1045.

12. Fitzgerald, M. A.; McCouch, S. R.; Hall, R. D. **2009.** More than just a grain of rice, the global quest for quality. *Trends in Plant Science*, 14, (3), 133-139.

13. Fitzgerald, M. A.; Bergman, C. J.; Resurreccion, A. P.; Möller, J.; Jimenez, R.; Reinke, R. F.; Martin, M.; Blanco, P.; Molina, F.; Chen, M. H.; Kuri, V.; Romero, M. V.; Habibi, F.; Umemoto, T.; Jongdee, S.; Graterol, E.; Reddy, R.; Zaczuk Bassinello, P.; Sivakami, R.; Shoba Rani, N.; Das, S.; Wang, Y. J.; Indrasari, S. D.; Ramli, A.; Rauf, A.; Dipti, S. S.; Xie, L. H.; Thi Lang, N.; Singh, P.; Castillo Toro, D.; Tavasoli, F.; Mestres, C. **2009.** Addressing the dilemmas of measuring amylose in rice. *Cereal Chemistry*, 86, (5), 492-498.

14. Champagne, E. T.; Bett-Garber, K. L.; Thomson, J. L. **2009.** Fitzgerald, M. A., Unraveling the Impact of Nitrogen Nutrition on Cooked Rice Flavor and Texture. *Cereal Chemistry*, 86, (3), 274-280.

Exploring the nutritional value of rice

Melissa Fitzgerald

AFGC Chair in Food Science and Technology,
School of Agriculture and Food Sciences,
University of Queensland, Brisbane St Lucia, QLD 4072
Australia

The world is undergoing an unprecedented increase in diseases such as diabetes, cardiovascular disease and some cancers. This is occurring in most countries of the world. These are going to have an enormous impact in each country, particularly on the economy. The cost of managing, treating and caring for the sufferers of these two diseases is having a large impact on many economies, and will severely affect the progress made by countries in economic transition. Rice feeds a huge proportion of the global population, especially those in developing countries. This has led researchers to take steps towards understanding the nutritional potential of rice, and its ability to mitigate some of these diseases. For example, rice varieties differ in glycaemic index, which offers consumers the ability to choose a particular variety based on nutrition. Rice also contains a wealth of compounds in the grain that are involved in human physiology. This review will focus on the research around the world that explores the nutritional potential of rice, and then suggest ways that rice can be used as a vehicle to deliver greater nutrition.

探索稻米的營養價值

前國際稻米研究中心營養室主任
澳洲昆士蘭大學食品科技主任
Melissa Fitzgerald 博士

世界各國均面對有關糖尿病、心血管及癌症等疾病正快速增長的問題。這個問題對每個國家都造成重大的影響，尤其是在經濟方面。用於治療、照護與管理這類疾病患者的費用對許多經濟體造成巨大的衝擊，也嚴重地影響這些經濟轉型國家的進步。稻米餵養世界，特別是開發中的國家，主要的人口。因此，許多的研究人員致力於瞭解稻米的營養潛力，以及減輕這些疾病的能力。例如，不同昇糖指數的稻米品種，可使消費者基於營養需求有選擇特定品種的能力。稻米也含有豐富的利於人體生理的成分。本演講聚焦於回顧全世界有關探索稻米的營養價值之研究發展，也提出使用稻米成為輸送更多營養載具的建議方法。

講者

Dr. Ken'ichi Ohtsubo

演講題目

米穀粉添加對烘焙及米食品營養之影響

Effect of rice flour addition on nutritional quality of bread and food products

大坪　研一（オオツボ　ケンイチ） OHTSUBO Ken'ichi

自然科学系 生命・食料科学系列
農学部 応用生物化学科 応用生物化学
教授

生年月日

1951/01

電話番号

025-262-6360

FAX 番号

025-262-6360

電子メールアドレス

ohtsubok@agr.niigata-u.ac.jp
【特定電子メール法に基づく表示】広告メール、迷惑メールの送信はお断りします

出身大学

1. 東京大学 理学部 生物化学科 (1974/03)

取得学位

1. 農学博士, 東北大学 (1989/03)

学内職務経歴

1. 農学部 応用生物化学科 応用生物化学 教授 (2008/04 -)

学外略歴

1. 食品総合研究所, 研究員 (1981/04 - 1990/03)
2. 北陸農業試験場, 室長 (1990/04 - 1993/03)
3. 食品総合研究所, 部長（学部長含む） (2005/06 - 2008/03)

研究分野（科研分類）

1. 食品科学

研究分野（ReaD 分類）

1. 穀類とその製品

研究関連受賞

1. "日本醸造協会技術賞", 「大坪研一」「中村澄子」「原口和朋」, 日本醸造協会(2008)
2. "飯島記念技術賞", 大坪研一, 飯島記念食品科学振興財団(2008)

論文

1. "Characteristics of pregelatinized ae mutant rice flours prepared by boiling after preroasting", 「Sumiko Nakamura」「Hikaru Satoh」「Ken'ichi Ohtsubo」, Journal of Agricultural and Food Chemistry, Vol.59, pp.10665 - 10676(2011)
2. "Acceleration of germination of super-hard rice cultivar EM10 by soaking with red onion", S. Nakamura and K.Ohtsubo, Bioscience, Biotechnology and Biochemistry, Vol.75, No.3, pp.572 - 574(2011)
3. "Influence of physicochemical properties of rice flour on oil uptake of tempura frying batter", S. Nakamura and K. Ohtsubo, Bioscience, Biotechnology and Biochemistry, Vol.2010, No.12, pp.2484 - 2489(2010)
4. "Palatable and bio-functional wheat/rice products developed from pre-germinated brown rice of super hard cultivar EM10", 「S. Nakamura」「H. Satoh」「K. Ohtsubo」, Bioscience, Biotechnology, and Biochemistry, Vol.74, No.6, pp.1164 - 1172(2010)
5. "PCR method for the detection and identification of cultivars of rice flours used in yeast leavened breads containing both wheat and rice flours", 「S. Nakamura」「K. Ohtsubo」, Journal of Cereal Science, Vol.52, No.1, pp.16 - 21(2010)
6. "Characteristics of bread prepared from wheat flours blended with various kinds of newly developed rice flours「（共著）」", 「S. Nakamura」「K. Suzuki」「K. Ohtsubo」, Journal of Food Science, Vol.74, No.3, pp.E121 - E130(2009)
7. "Cultivar identification of Korean rice based on DNA markers for blast resistance", 「Masahiro Kishine」「Sumiko Nakamura」「Ushio Matsukura」「Ken'ichi Ohtsubo」, Bioscience, Biotechnology and Biochemistry, Vol.72, No.10, pp.2767 - 2769(2008)
8. "Novel method for preparation of the template DNA and selection of primers to differentiate the material rice cultivars of rice wine by PCR", 「Ken'ichi Ohtsubo」「Keitaro Suzuki」「Kazutomo Haraguchi」「Sumiko Nakamura」, Journal of Biochemical and Biophysical Methods(2008)
9. "Grain qualities and their genetic derivation of 7 new rice for Africa (NERICA) varieties", 「Masahiro Kishine」「Keitaro Suzuki」「Sumiko Nakamura」「Ken'ichi Ohtsubo」, Journal of Agricultural and Food Chemistry, Vol.56, No.12, pp.4605 - 4610(2008)
10. "Novel preparation method of template DNAs from wine for PCR to differentiate grape (Vitis vinifera) cultivar", 「Sumiko Nakamura」「Kazutomo Haraguchi」「Nobuhito Mitani」「Ken'ichi Ohtsubo」, Journal of Agricultural and Food Chemistry, Vol.55, pp.10388 - 10395(2007)

工業所有権

1. (特許) "穀粒中の混合品種の有無および混合された品種の判別方法", 「大坪研一」「中村澄子」「宮村　毅」「雲　聡」「加藤郁之進」
2. (特許) "発芽玄米膨化物及びその製造方法", 「大坪研一」「岡留博司」「奥西智哉」
3. (特許) "膨化玄米", 「大坪研一」「岡留博司」「井邊時雄」「佐藤宏之」「久能昌朗」
4. (特許) "稲の同質遺伝子系統識別方法及び当該識別技術を利用した米の産地識別方法", 「大坪研一」「中村澄子」「星　豊一」「松井崇晃」「石崎和彦」
5. (特許) "餅試料の原料米の品種判別方法", 「大坪研一」「中村澄子」「與座宏一」「今村太郎」「宍戸功一」
6. (特許) "小麦含有米菓およびその製造方法", 「大坪研一」「関口恭史」「中川力夫」「金子成延」「鈴木啓太郎」「中村澄子」「長谷川裕正」

担当授業科目

1. 食品安全学(2010 年度 第２学期)
2. 実地見学(2010 年度 第２学期)
3. 食品・栄養科学実験(2010 年度 第２学期)
4. 米利用科学論(2010 年度 第２学期)
5. 米科学論(2010 年度 第２学期)
6. 生物化学実験(2010 年度 第１学期)
7. 食品製造学(2010 年度 第１学期)
8. 実践型食づくりプロジェクト(2010 年度 第１学期)
9. 生命と環境の化学 I(2010 年度 第１学期)
10. 生物化学実験(2010 年度 第１学期)

全 12 件 [全件表示]

科研費（文科省・学振）獲得実績

1. 基盤研究(C) 大麦の細胞壁関連酵素と麦飯物性との関係解明に関する研究 (2010/04～2013/03)

Quality assay and utilization of rice in Japan

Ken'ichi Ohtsubo and Sumiko Nakamura

Graduate School of Science and Technology, Niigata University
8050 Ikarashi 2-no-cho, Nishi-ku, Niigata, 950-2181 Japan

INTRODUCTION

As the bread is very important food all over the world, wheat/rice blended bread is a promising food. For the people living in the tropical or the semi-tropical regions, high-yielding and low-cost rice is promising crop to prepare their bread.

Rice bread has been investigated since 5 decades ago. Since then, rice bread was investigated by many researchers. As the protein composition and its properties of rice are different from wheat, gluten is not formed during the dough preparation. Therefore, it was reported that the qualities of the bread made from 20% rice and 80% wheat flours are acceptable, but those of the bread from 30% rice and 70% wheat are not acceptable. In north-eastern Asia, steamed bread is popular in the place of leavened hearth bread in USA and Europe. Rice-pulse combination or the extrusion process was used to compensate the lack of gluten in case of rice bread. Various gums, surfactant, or the hydro-philic polymers has been reported to be effective to improve the dough property of the flours less or without the wheat gluten.

The novel sophisticated methods for the preparation of fine granule rice powders were developed in Niigata Prefectural Food Research Institute of Japan, which markedly contributed to the rice bread industry. But, they need enzyme treatment or the double pulverizing process to prepare the fine flours from rice. Other researchers developed the alternative method by the kneading in the hot water for dough preparation, addition of very hard-gluten wheat flour, application of foam-molding method in processing of plastic chemical industry to compensate the lack of gluten.

In the present paper, we searched for new-characteristic rice cultivars suitable for making it possible to prepare the rice/wheat blended bread without the use of above-mentioned sophisticated or the high-cost technology. In the decade, Japanese rice breeders have developed various new rice cultivars of different starch properties, such as

稻米品質認證與應用

大坪研一(Ken'ichi Ohtsubo) 中村純子(Sumiko Nakamura)

日本 新潟大學科技學院
8050 Ikarashi 2-no-cho, Nishi-ku, Niigata, 950-2181 Japan

前　　言　　國立宜蘭大學　須文宏翻譯

由於麵包是全世界的重要主食選項，以小麥混合稻米製作麵包便成為一種很有前景的食品。特別是生活在熱帶或亞熱帶的人們，更是期待運用當地高產量低價格的稻米來製作麵包。

以白米製作麵包的研究大約在五十年前便已展開，有許多人進行米麵包製程的研究。相關報告指出，白米的蛋白質組成及屬性與小麥不同，米麵糰中無法形成麵筋。因此，20%白米和 80%的小麥麵粉製成的麵包品質可以接受，但 30%白米和 70%小麥麵粉製成的麵包品質則無法被接受。相對於歐美普遍的烘焙麵包，東北亞則是流行蒸的麵包「饅頭」。以稻米混合其他穀物 (Rice-pulse combination)或運用擠壓加工程序 (extrusion process)，都可在缺乏麵筋的狀況下生產麵包，此外，運用各式膠體、乳化劑、親水性聚合物都能在低或無小麥麵筋的狀況下，有效地改善麵糰特性。

日本新潟食品研究所所發展的微細化稻米穀粉製備新方法，對米麵包產業的發展頗有貢獻。但是，他們的產程非常複雜，需要經過酵素處理或雙製粉程序，才能製作出微細化稻米穀粉。其他的研究，則是運用在熱水中揉麵糰，或添加超高筋小麥麵粉，或運用高分子化工業中應用的發泡成型法 (foam-molding method)，作為彌補缺乏麵筋狀態下的替代方法。

本研究嘗試尋找新的水稻品種，不需要經由上述複雜或成本高的製粉技術，便能製備出具有適合製作水稻/小麥混合麵包的特性。近十年，日本的水稻育種已經開發出各種不同澱粉性質的水稻新品種，如紫糯米、高直鏈澱粉或含糖水稻 (sugary rice)。因此，藉由幾個不同澱粉特性的水稻品種組合，似乎可以不需複雜的製粉過程，就可得到價格低廉的稻米穀粉，也使得製作米麵包變得可行。

purple waxy rice, high-amylose rice or the sugary rice. Therefore, in bread making, it seemed to be possible to compensate the problem of rice by the combination of several rice cultivars of different starch properties without the sophisticated process if the price of the new rice flours will become lower.

For the evaluation of final qualities of the bread products, sensory test and physical measurements have been reported. It has been reported that the physical properties of the dough is very important to prepare the high-quality bread. For the rice/wheat blended dough, novel method to evaluate its physical properties was searched for.

Not only the properties just after the bread preparation, but also the resistance against the firming or the hardening of the bread after making, is very important, too. Compared with ordinary wheat bread, wheat-rice blended bread or rice bread was reported to be inferior to in terms of staling. Therefore, it was necessary to investigate about the staling quality for our bread prepared from wheat-flours blended with the various kinds of new-characteristic rices.

The present authors have reported about the sensory test and physical measurements for rice qualities. We tried to introduce the continuous progressive compression test (CPC test) to the evaluation of the physical properties of the dough and crumb. The aim of the present study is to improve the qualities of the bread made from rice and wheat flours by selecting the suitable characteristic rice cultivars of the different starch properties. And another objective is to propose the novel quality assay method for the evaluation of the physical properties of the dough and bread products by the introduction of CPC test.

Pre-germinated brown rice (PGR) is prepared by soaking the brown rice in the water, which activates the glutamate decarboxylase, and gamma amino butyric acid (GABA) content in pre-germinated brown rice increases to twice that of ordinary brown rice and ten times that of white rice. In the case of PGR, palatability is improved compared with ordinary brown rice due to the activated enzymes, which cause partial decomposition of starch. Decomposition of starch leads not only to generation of much amount of glucose and other oligosaccharides but also to softening of the texture of the cooked rice. As GI of PGR is about 60% of the ordinary white rice, it is expected to retard the increase of blood sugar after meal. The development of low GI wheat/rice bread by the use of super hard rice is promising to prevent people from diabetes. As the palatability and bio-functionality is improved by the germination of brown rice, super hard rice, EM10, was added to the wheat flours as PGR.

對於麵包產品的品質鑑定，主要為感官品評和物性測定。根據相關研究顯示，麵糰的物性是製備高品質麵包的主要監測項目。因此，對於水稻/小麥混合麵糰的物性評估，是本研究的重點。

對於麵包質地的鑑定，不僅只關注麵包剛做好時的性能，對於麵包製成後之抗硬化或抗老化現象發生的評估也是非常重要的。小麥與稻米混合製成的麵包或純粹米麵包的保鮮特性都明顯地較普通的小麥麵包為差。因此，本研究針對小麥麵粉混合各種新特性水稻製成麵包的老化特性評估實有必要。

本文作者已針對稻米品質的感官品評和物性測量發表報告，我們試圖引入連續漸進壓縮試驗（CPC test）去分析麵糰和米穀粉的物理性質。從已經選擇具有不同澱粉特性的合適水稻品種中，本研究期望能改善從稻米和小麥麵粉製成的麵包品質。此外，本研究也期望通過引進 CPC test，提出一種針對麵糰和麵包產品的新式物性品質檢測方法。

預發芽糙米（PGR）是將糙米浸泡水中製成，其中會增加谷氨酸脫羧酶活性，使得γ-氨基丁酸（GABA）含量增加為普通糙米的兩倍，和白米的十倍。同時由於酵素活性增加導致澱粉部分分解，也改善了適口性。澱粉分解，不僅產生較多葡萄糖和其它寡醣，也使得米飯質地變軟。預發芽糙米的 GI 值是約為普通白米的 60%，可以延緩飯後血糖上升，因此，發展使用超硬水稻的米麥混合麵包，即可適用於糖尿病人食用。使用超硬稻米 EM10 的預發芽糙米添加到小麥麵粉，確實有改善適口性和生物功能性的效果。

過長時間在溫水中發芽，微生物迅速增加，有時會導致衛生方面的問題。此外，長時間浸泡的預發芽糙米煮熟後的味道會變得不好。在本研究中，試著尋找新方法製備預發芽糙米，以避免長時間浸泡，為了防止長時間溫水浸泡下的異味和微生物侵擾問題，發展出逐步加熱、短時間浸泡的發芽方法。

目前已經有許多針對小麥的聚合酶鏈鎖反應 (PCR) 分析研究，但由於本研究主角為小麥/稻米混合麵包，至少由兩個或兩個以上不同的穀粉，加上酵母組成，因此必須制定專門的聚合酶鏈鎖反應引子 (PCR primers) 從水稻的 DNA 來區分出水稻品種。此外，我們需要建立正對照組，以確認 PCR 反應正常進行。兩種陽性對照的聚合酶鏈鎖反應引子是必要的。第一種引子只針對小麥，不包含從稻米和酵母的 DNA 擴散影響，另一種引子則是針對水稻 DNA，而不包含小麥和酵母的 DNA 擴散影響。

During germination in the warm water for long time, microorganisms increase rapidly, which causes, sometimes, the problems in terms of hygiene. Moreover, flavor of the cooked PGR is deteriorated after soaking for long time. In the present paper, we searched for the novel method to prepare PGR without soaking for long time. In order to prevent the problems of off-flavor and microorganism infestation during the germination for long time in the warm water, novel germination method to soak SHR for short time followed by gradual heating was investigated.

There are already many meaningful reports on PCR analyses of wheat. As our wheat/rice blended bread consists of two or more different grain flours, wheat and rice, and yeast, it is necessary to develop the suitable PCR primers which specifically amplifies only the DNAs from rice and are also able to differentiate the rice cultivars. Furthermore, we need positive controls that confirm that the PCR reaction has proceeded properly. Two kinds of PCR primers for positive control are needed. The first primer is one that amplifies all the wheat cultivars without proliferation of DNAs from rice and yeast (positive control for wheat). The other primer is one that amplifies all the rice DNAs without proliferation of the DNAs from wheat and yeast (positive control for rice).

We had previously reported on the PCR method to detect waxy corn blended with waxy rice products, and we used similar methods to search for suitable primers that amplify the specific DNAs that exist universally in the target plant species. As consumer interest increases in the specific premium rice cultivars or other cereal grains that they prefer in their foodstuffs, the development of technology to identify the rice cultivars in yeast leavened wheat/rice blended bread is a demonstration that the technology exists and can be meaningfully applied to a product subjected to a process that complicates cereal ingredient identification.

MAIN CONTENT

1. Characteristics of bread prepared from wheat flours blended with various kinds of newly developed rice flours

Characteristics of the bread prepared from wheat flour blended with the flour of various kinds of newly developed rice cultivars were investigated.

Qualities of the bread made from wheat flour blended with rice flour have been reported to be inferior to those from 100% wheat flour bread. To improve its qualities, we searched for the new-characteristic rice flours among the various kinds of newly-developed rice cultivars

我們曾運用 PCR 方法檢測糯玉米與糯米混合產品，本研究則採用類似的方法來尋找合適的引子，擴增目標植物物種的特定 DNA 片段。當消費者越來越喜歡特定品種穀類製品時，發展適當的分析技術以酵母發酵後小麥/稻米混合麵包中穀類品種，是非常有意義的工作。

主要內容

1. 運用各種新品種稻米製作小麥/稻米混合麵包的特性分析

本研究針對小麥麵粉，混合數種新品種稻米製作的麵包，進行產品特性分析。.

一般以米粉混合麵粉製成的麵包品質比不上 100%的小麥麵粉麵包。為了提高品質，本研究搜尋各種新特點的新開發水稻品種，將其穀粉與小麥麵粉混合製作麵包。結果顯示，最適合的新稻米品種為紫糯、高直鏈澱粉稻米和含糖稻米。小麥和這三種稻米混合生產的麵包與傳統的麵包小麥/米（3.58）相比，表現出較高的比容值（3.93）。

我們採用新方法，連續漸進壓縮試驗（CPC test）測量麵糰和麵包的物理性質，並加上感官品評。為了決定最合適的水稻品種和混合麵粉的比例，我們針對水稻/小麥混合麵包開發一系列的鑑定方法，包含麵包體積、物理性質及口感的可接受度，甚至包含儲存 4 天後的抗老化現象。

我們試著增加稻米與小麥的比例，也試著添加一部份煮熟的米飯，並以連續漸進壓縮試驗測試麵糰與麵包品質。結果顯示麵包的比容值與品質均保持良好，即便稻米含量已從 30%提高到 40%。

2. 以超硬品種 EM10 的預發芽糙米製作小麥/稻米混合麵包的適口性和生物功能性探討

以預發芽的超硬品種稻米米飯混合小麥麵粉，可以生產高品質與具生物功能性的麵包。

超硬稻米（SHR）不適合作為米飯食用，因為它的適口性低。然而由於其質地堅硬，同時具高抗性澱粉含量，被認為是適合作為製作麵包或麵條的混合材料。

to blend with the wheat flour for the bread preparation. The most suitable new characteristic rices are combination of purple waxy rice, high-amylose rice and sugary rice. Specific volume of the bread from the combination of wheat and these three kinds of rice flours showed higher specific volume (3.93) compared with the traditional wheat/rice bread (3.58).

We adopted the novel method, continuous progressive compression test, to measure the physical properties of the dough and the bread in addition to the sensory evaluation. As a result of the selection of the most suitable rice cultivars and blending ratio with the wheat flour, we could develop the novel wheat/rice bread, of which loaf volume, physical properties and tastes are acceptable and resistant to firming on even 4 days after the bread preparation.

To increase the ratio of rice to wheat, we tried to add a part of rice as cooked rice grains. The specific volume and qualities of the bread were maintained well although the rice content of total flour increased from 30% to 40%.

2. Development of palatable and bio-functional wheat/rice products from pre-germinated brown rice of super hard cultivar, EM10

It became possible to produce high-quality and bio-functional wheat/rice bread and wheat/rice noodle by blending, with wheat flour, pre-germinated brown rice of super hard cultivar as the cooked rice.

Super hard rice (SHR) is not suitable for table rice because of its low palatability. Nevertheless, it was found to be suitable as a blending material for bread-making or noodle-making due to its hard texture and high resistant starch content.

We developed a novel rapid germination method to improve the quality and to save time for germination. By blending the pre-germinated SHR (30% w/w dry base) as cooked rice gel with wheat flour (70% w/w dry base), the bread became very soft and hardening after bread-making was retarded markedly. Similarly, blending pre-germinated SHR as cooked rice gel with wheat flour gave the high-quality noodle of similar texture with durum semolina noodle. Furthermore, resistant starch of the SHR blended bread and noodle increased markedly.

When white waxy rice (9%) was soaked and cooked with the pre-germinated brown rice of SHR (21%), the rice gel is very useful as a material for bread-making and noodle-making

我們開發了一種新型快速發芽方法，可以提高品質並縮短發芽時間。以預發芽超硬稻米米飯（30%w / w 乾基）混合小麥麵粉（70% w/w 乾基），所生產的麵包變得非常柔軟，同時麵包老化速度明顯變緩。同樣的，以預發芽超硬稻米米飯混合麵粉製作麵條，同樣可獲得質地類似於以杜蘭硬粒小麥製成義大利麵相同的高品質麵條。此外，不論是麵包或麵條，產品的抗性澱粉含量均顯著增加。

3. 超硬品種 EM10 與紅洋蔥同時浸泡可加速發芽

紅洋蔥有加快水稻種子萌發和抑制發芽過程中微生物侵擾的作用。在 35°C 下與紅洋蔥一起浸泡 16 小時後，超硬水稻 EM10 有較高的發芽率（2.3 倍），同時比沒有紅洋蔥存在的狀況，含有更多的 GABA（2.3 倍）和葡萄糖（2.9 倍）。由於紅洋蔥的存在，也使得發芽的 EM10 糙米同時強化了槲皮素（18 mg/100 g）含量。

4. 米穀粉理化性質對於天婦羅油炸麵糊吸油表現的影響

米穀粉和麵粉的理化性質會影響天婦羅油炸麵糊的吸油表現。米穀粉對於天婦羅炸麵糊的品質與脆度提升，均較小麥麵粉為佳，而且油炸後的吸油量較少。而直鏈澱粉含量的增加，以及粉漿特性中較高的一致性/破裂性黏度比值(consistency/ breakdown ratio)，都是導致油炸麵糊吸油減少的原因。特別是超硬大米 EM10，其相對直鏈澱粉含量與一致性/破裂性黏度比值均高，它的天婦羅油炸麵糊油炸後油含量是所有試驗麵糊中最低的。

有關影響油炸麵糊中的油含量的理化性質指標，主要為直鏈澱粉含量、一致性/破裂性黏度比值及吸油指數。本研究提出的“吸油指數”雖不完美，但卻不失為一個簡單估計麵糊吸油含量的方法。

by blending with wheat flour (70%) to prepare the soft, tasty and bio-functional wheat/rice bread and wheat/rice noodle.

3. Acceleration of germination of super-hard rice cultivar EM10 by soaking with red onion

Red onion accelerated the germination of rice seeds and inhibited microbial infestation during germination. After germination with red onion for 16 h at 35℃, super-hard rice EM10 showed a higher germination ratio (2.3 times), and it contained more GABA (2.3 times) and glucose (2.9 times) than that soaked without onion. Due to soaking with red onion, germinated EM10 was fortified with quercetin (18 mg/100 g).

4. Influence of physicochemical properties of rice flour on oil uptake of tempura frying batter

Physicochemical properties of rice flour and wheat flour influenced oil uptake properties of tempura fried batter. Rice flours gave a better quality than wheat flours in overall qualities and crispness of tempura fried batter. Rice flour resisted oil absorption more than wheat flour. Increase of starch apparent amylose and increase of consistency/ breakdown ratio of pasting properties led to the decrease of oil uptake of the batter. Particularly, super hard rice, EM10, showed higher apparent amylose content and higher consistency/ breakdown ratio than the others and batter from EM10 revealed lowest oil content after frying among all the batters examined.

Among the physicochemical properties which influence the oil content of fried batter, apparent amylose content, consistency/ breakdown ratio and oil absorption index were proposed as useful indexes for oil absorption on frying.

Our method of “oil absorption index” could be a simple method to estimate the oil content of batter flours although it is not perfect.

5. PCR method for the detection and identification of cultivars of rice flours used in yeast leavened breads containing both wheat and rice flours

The identification of cereal grain sources in yeast leavened breads is challenging because of the mixtures of DNA from yeast and mixtures of related grains. DNA is decomposed during the fermentation and bread consists of not only rice but also wheat, yeast, sugar, butter, shortening etc.

Wheat-specific and rice-specific PCR primers were developed to amplify the wheat DNA or rice DNA to detect the contamination of rice in wheat bread and to detect wheat

5. 運用聚合酶鏈鎖反應(PCR)鑒別小麥/稻米混合的酵母發酵麵包中的稻米品種

要在酵母發酵麵包中鑒別穀物來源是具有挑戰性的，因為包含酵母和相關穀物的 DNA 均混合在一起。 DNA 麵包發酵過程中會分解，而且麵包中除了稻米之外，還包含有小麥、酵母、糖、奶油、起酥油等成分。

有關特定小麥和水稻的 PCR 引子早已發展到可以複製小麥或水稻的 DNA，以作為檢測小麥麵包摻雜的水稻品種，或稻米麵包中摻雜的小麥品種。聚合酶鏈鎖反應中的引子技術，可以防止過敏患者在不知不覺中吃進麵包裡污染的含過敏原穀物。

我們開發了一種新的方法來識別或區分小麥/水稻混合麵包中的水稻品種。 PCR 實驗中的 DNA 模板，採用 70％乙醇提取的 DNA 溶液以 CTAB 法進行。其中，4 種合適的 PCR 引子被發展或選擇作為複製樣品水稻的 DNA 材料，而不會受到小麥或酵母衍生的 DNA 增殖干擾。這項實驗，使得小麥/水稻混合麵包中的 4 種水稻品種得以被區分鑒定。

contamination in rice bread. These primers are useful for PCR to prevent allergic patients from eating, unconsciously, bread contaminated with allergen cereals.

A novel method was developed to identify or differentiate the cultivar of rice using a wheat/rice blended bread as a sample. The template DNA for PCR was prepared by the CTAB method followed by the extraction of DNA with 70% ethyl alcohol.

Four kinds of suitable PCR primers were developed or selected to amplify only the DNAs of material rice without the proliferation of DNAs derived of wheat or yeast. It became possible to identify or differentiate these 4 kinds of characteristic rice cultivars from each other by PCR using the wheat/rice blended bread as a sample.

REFERENCES

[1] Atwell, W.A. 2001. Products from Hard wheat flour. In: Atwell WA, (Ed.), Wheat flour products. The American Association of Cereal Chemists Inc., St Paul, USA, pp. 79-95.

[2] Egawa, K., 1993. Preparation of rice flour for bread and method for bread bakery. Hokurikunogyo no shingizyutsu 5, 95-101 (In Japanese).

[3] Huang, S., Preston, K. R., Breads of the Pacific region. In: Blakeney AB, O'Brien L, editors. Pacific people and their food. St Paul, Minn.: The American Assn of Cereal Chemists Inc. p 143-70 (1998).

[4] Kang, H. J., Hwang, I. K., Kim K. S., Choi, H. C., 2003 Comparative structure and physicochemical properties of Ilpumbyeo, a high-quality japonica rice, and its mutant, Suweon 464, J. Agric. Food Chem., **51**, 6598-6603.

[5] Nakamura, S., Suzuki, K., Haraguchi, K., Yoza, K., Okunishi, T., Matsui, T., Ishizaki, K., Yoshii, Y., Ohtsubo, K., 2004a. Cultivar identification of waxy rice and detection method to detect the foreign cereals in the processed rice products. Nippon Nogei Kagaku Kaishi 78, 984-993 (in Japanese).

[6] Nakamura, S., Okadome, H., Yoza, K., Haraguchi, K., Okunishi, T., Suzuki, K., Satoh, H., Ohtsubo, K., 2004b. Cultivar identification of wide range rice in the world by PCR and its application to palatability estimation. Nippon Nogei Kagaku Kaishi 78, 764-779. (in Japanese).

[7] Nakamura, S., Suzuki, K., Ohtsubo, K., 2009 Characteristics of bread prepared from wheat flours blended with various kinds of newly developed rice flours. Journal of Food Science 73, E121-130.

[8] Nakamura, S. and Ohtsubo, K. 2010 PCR method for the detection and identification of cultivars of rice flours used in yeast leavened breads containing both wheat and rice flours. Journal of Cereal Science, **52**, 16-21.

[9] Nakamura, S., Satoh, H., Ohtsubo, K., 2010 Palatable and Bio-Functional Wheat/Rice Products Developed from Pre-Germinated Brown Rice of Super-Hard Cultivar EM10. Biosci.Biotechnol. Biochem. 74, 1164-1172.

[10] Nakamura, S. and Ohtsubo, K. Influence of physicochemical properties of rice flour on oil uptake of tempura frying batter. Biosci. Biotechnol. Biochem. 74, 2484-2489.

[11] Nakamura, S. and Ohtsubo, K. 2011 Acceleration of germination of super-hard rice cultivar EM10 by soaking with red onion. Biosci. Biotechnol. Biochem. 75, 572-574.

[12] Nishi, A., Nakamura, Y., Tanaka, N., Satoh H., 2001 Biochemical and genetic analysis of the effects of amylose-extender mutation in rice endosperm. Plant Physiol. 127, 459-472.

[13] Ohtsubo, K., Suzuki, K., Yasui, Y., Kasumi, T., 2005 Bio-functional components in the processed pre-germinated brown rice by a twin-screw extruder. J. Food Composition Analysis 18, 303-316.

[14] Ohtsubo, K., Nakamura, S., 2007. Cultivar Identification of Rice (Oryza sativa L.) by Polymerase Chain Reaction Method and Its Application to Processed Rice Products. Journal of Agricultural and Food Chemistry 55, 1501-1509.

[15] Ohtsubo, K., Nakamura, S., Tsuji K., Utsunomiya, K., Masuda, Y., Hasegawa, M., 2012 Possibility of diabetes preservation by high-amylose rice. In: Ogawa S, editor. Rice studies, present and future. Wakayama: Sankyo Publishing, Co. Ltd. Tokyo, pp.109-115.

[16] Okadome, H., Toyoshima, H., Ohtsubo, K., 1999 Multiple measurements of physical properties of individual cooked rice grains with a single apparatus. Cereal Chem. 76, 855-860 .

[17] Pasqualone, A., Montemurro, C., Grinn-Gfron, A., Sonnante, G., Blanco, A., 2007. Detection of soft wheat in semolina and durum wheat bread by analysis of DNA microsatellite. Journal of Agricultural and Food Chemistry 55, 3312-3318.

[18] Shewry, P.R., 2009. Wheat. Journal of Experimental Botany 60, 1537-1553.

[19] Yeh, A-I., Preparation and applications of rice flour. In: Champagne ET, editor. Rice, 3rd ed. St Paul, Minn.: The American Association of Cereal Chemists Inc. p 495-539 (2004).

[20] Zhao, H., Wang, R., Guo, A., Hu, S., Sun, G., 2004. Development of primers specific for LMW-GS genes located on chromosome 1D and molecular characterization of a gene from Glu-D3 complex locus in bread wheat. Hereditas 141, 193-198.

Figure 1. Novel rice bread by purple rice

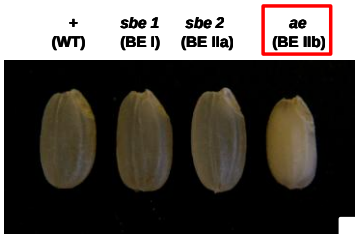
Niigata University and Bon-Ohhashi Inc. developed novel rice bread using pre-germinated purple rice. This purple rice cultivar was developed by Niigata Prefectural Research Institute. This bread is made by the use of patented method of Niigata University. This bread is tasty and its crumb is very soft, and it contains much GABA. Purple rice is promising to have the Bio-functionality to remove the active oxygen.

A

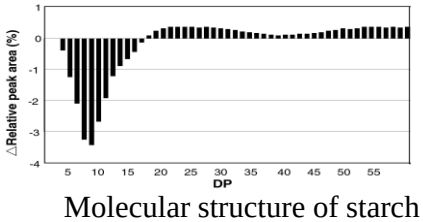
a b c d e

B

Figure 2. Wheat/rice Bread and Wheat/rice Noodle from EM10



Various mutant rice



Molecular structure of starch
(Less short chains in amylopectine)

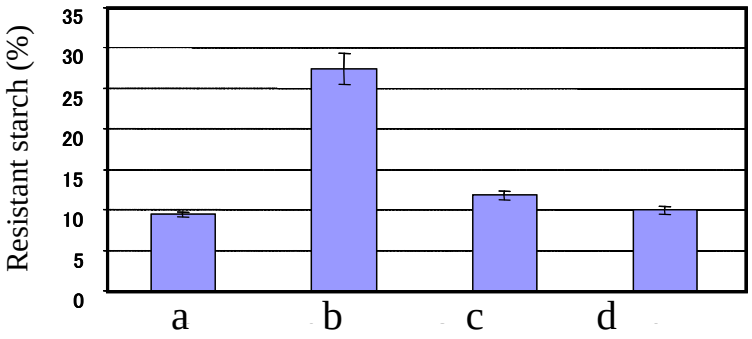


Figure 3. Resistant starch of the various rice

a: wheat, b: EM10, c: high-amylose rice, d: low-amylose rice

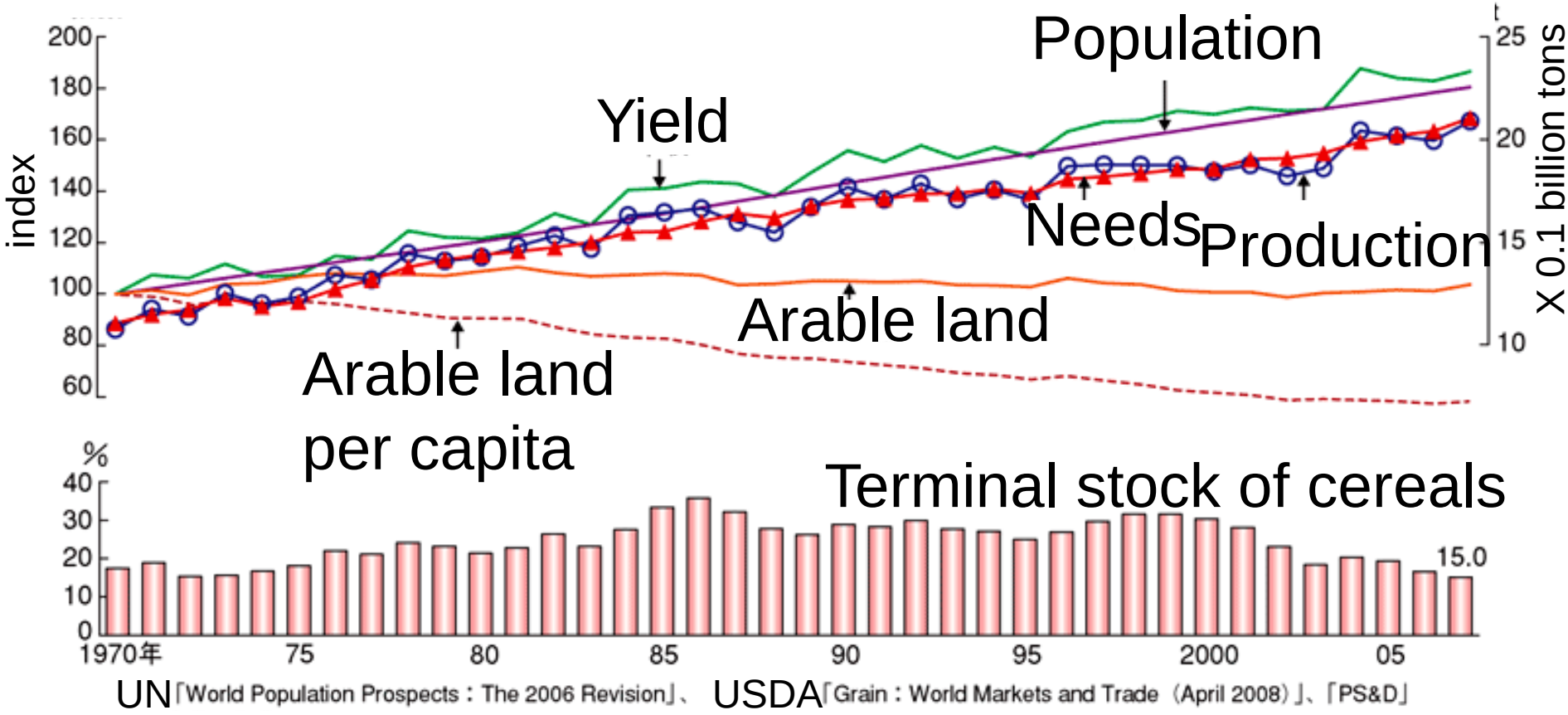
Figure 4. Development of “Tomato Bread”

1. Super-hard rice --- Resistant starch
2. Pre-germinated brown rice --- GABA
3. Tomato --- Lycopene
4. Bread making method --- Durable palatability

2nd Symposium on Rice Products and Nutrition
June 8, 2012, National Taiwan University, Taipei, Taiwan

Effect of rice flour addition on nutritional quality of bread and food products

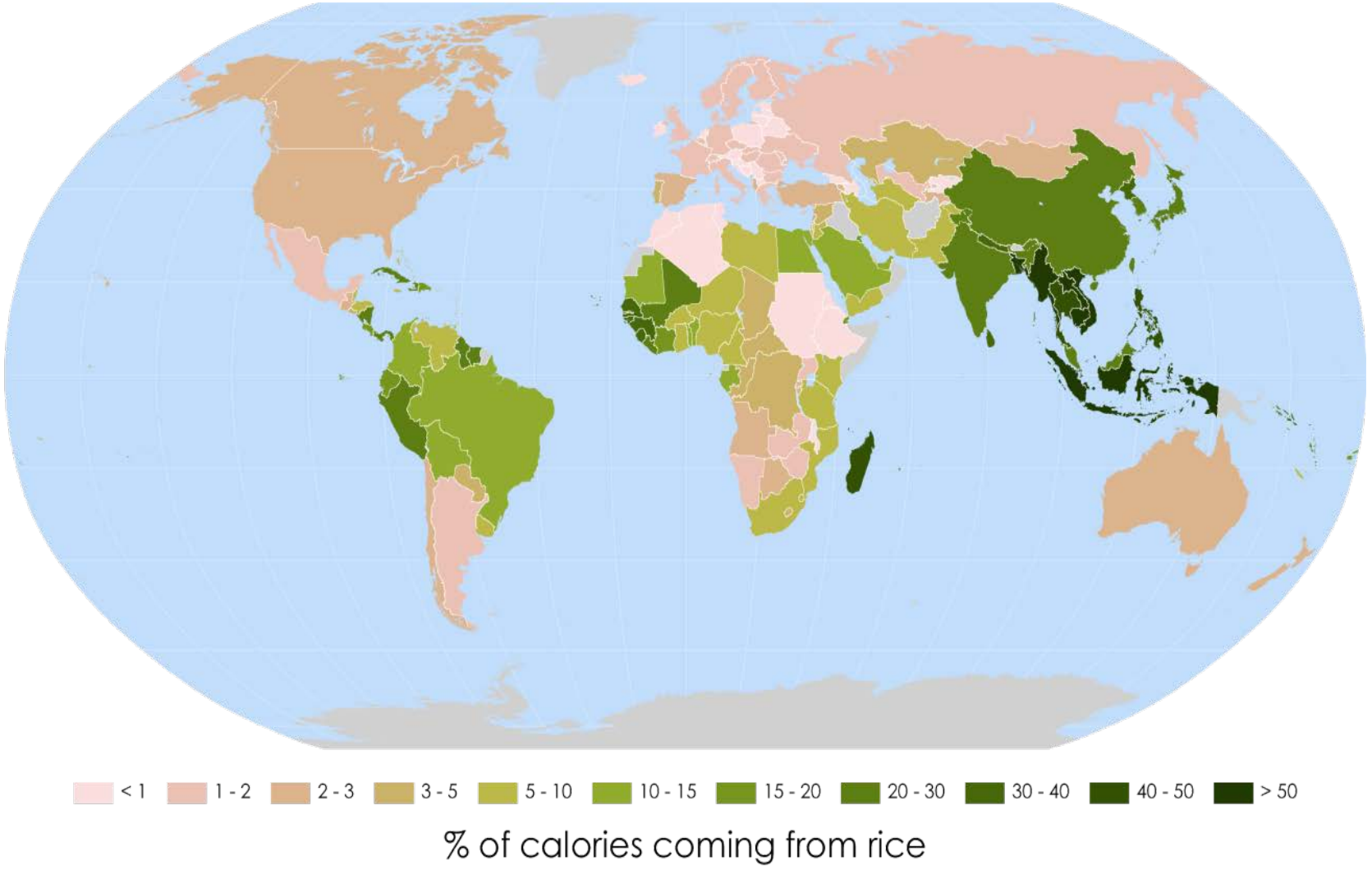
Ken'ichi Ohtsubo
Professor, Ph.D.
Niigata University
Niigata City, Japan

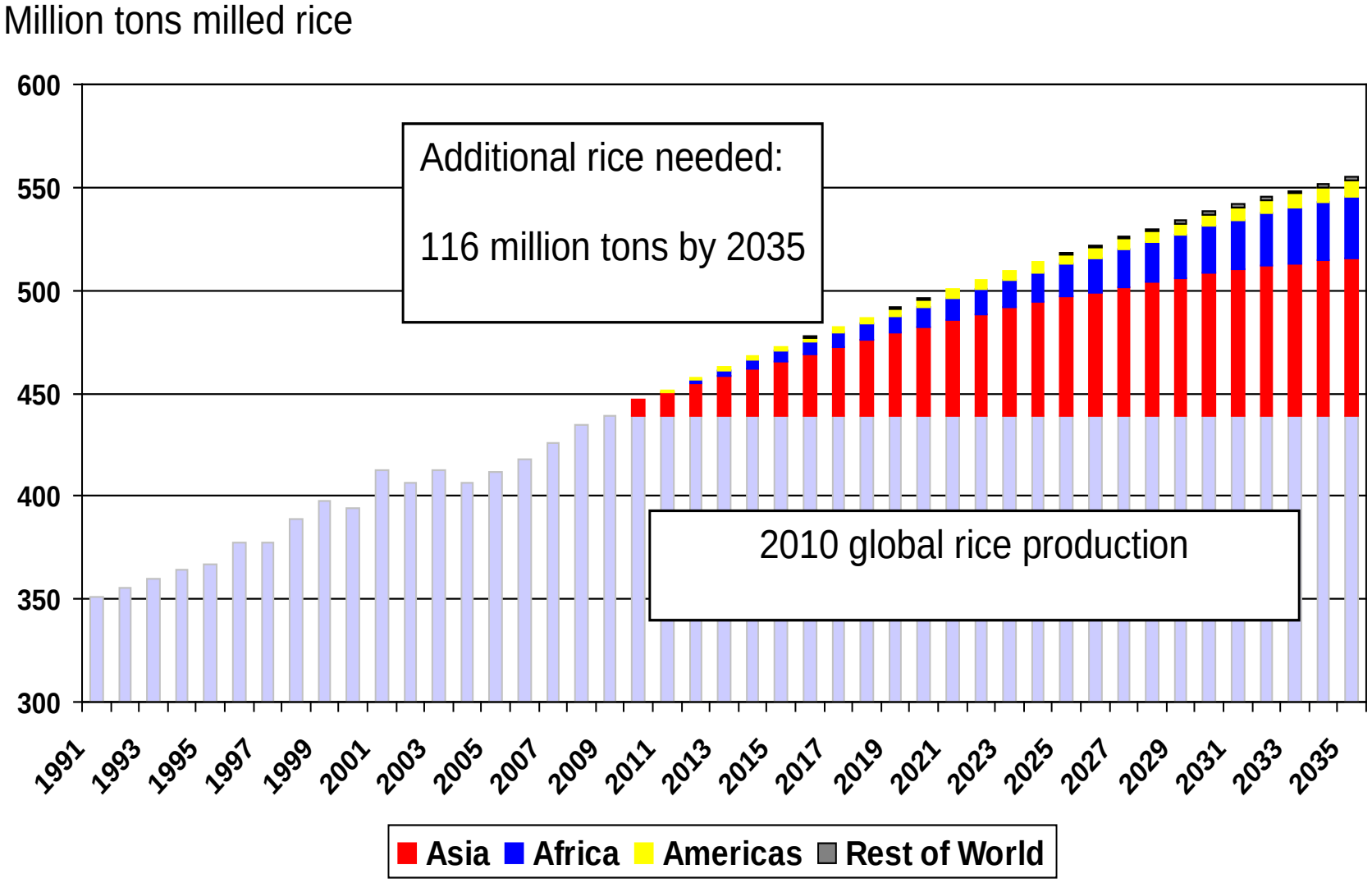


UN「World Population Prospects：The 2006 Revision」、 USDA「Grain：World Markets and Trade（April 2008）」、「PS&D」

1. World population is increasing steadily.
2. Arable land is not increasing and arable land per capita is decreasing.
3. Recently, world cereal consumption is more than production, and terminal stock of cereals is decreasing year by year.

Share of rice of total caloriesconsumed（Sources: FAO and World Bank, 2010）

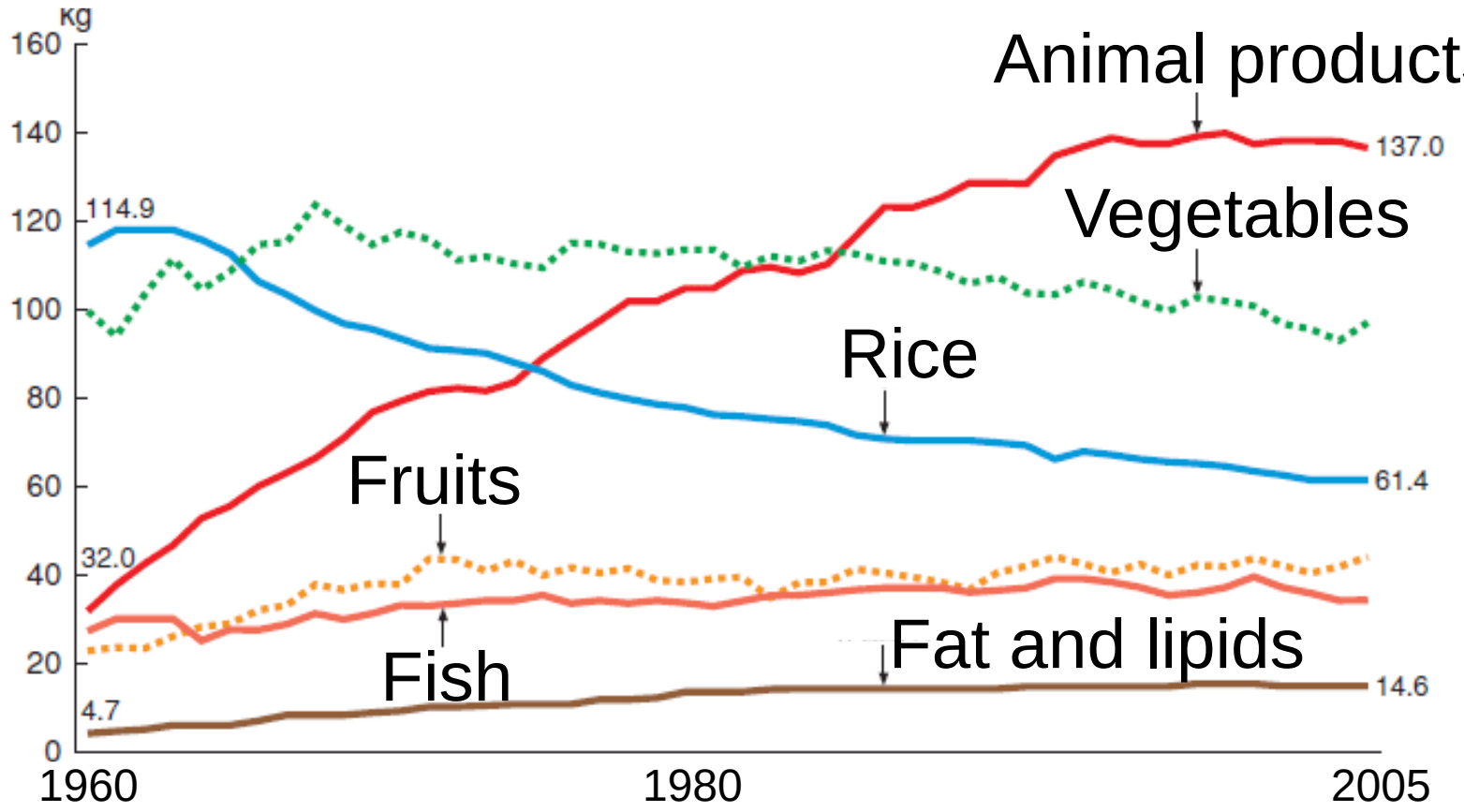




Global rice production increases needed to meet demand by 2035. (Dr. Mutsuo Iwamoto)

IRRI
INTERNATIONAL RICE RESEARCH INSTITUTE

Consumption per capita for each item



Although the consumption of animal products increased 4.8 times, rice consumption decreased to the half compared with 48 years ago.

(Ministry of Agriculture, Forestry and Fisheries, Japan)

Rice milling system (Satake Inc.,Japan)

De-stoner

Milling machine

Color sorter

Prewashed rice machine

Weighing packer

Rice inspection system (Satake Inc.)

Grain tester

NIR system

Taste analyser

Taste analyser for cooked rice

Aging tester

Japanese processed rice products

Frozen cooked rice

Retort pouched rice gruel

Dried cooked rice

Cooked rice ball

Pregerminated Brown rice

Aseptic cooked rice

Possibility of Diabetes Prevention by High-amylose rice

Ken'ichi Ohtsubo1), Keisuke Tsuji2), Kazunori Utsunomiya3),
Yasunobu Masuda4) Mineo Hasegawa4) and Keitaro Suzuki5)

1) Niigata University, 2) Kio University, 3) Jikei Medical University
4) QP Corporation 5) National Food Research Institute

Background

Diabetes patients are more than 8.2 million and 18.7 million including those to be diabetes in the near future in Japan. It is indispensable to prevent diabetes for the reduction of the increase of the medical costs. It has been reported by the large-scale medical tests that the inhibition of drastic increase of the blood glucose after meals reduced the rate of diabetes initiation.

Objective

We aim to evaluate the palatability of the high-amylose rice of which eating qualities are inferior to ordinary Japonica rice. The another objective of this research is to clarify the mechanism to prevent diabetes initiation by the high-amylose rice by the feeding test of rats and diet test by the human beings.

Texture and palatability of cooked rice grains

Texture of cooked rice by Tensipresser

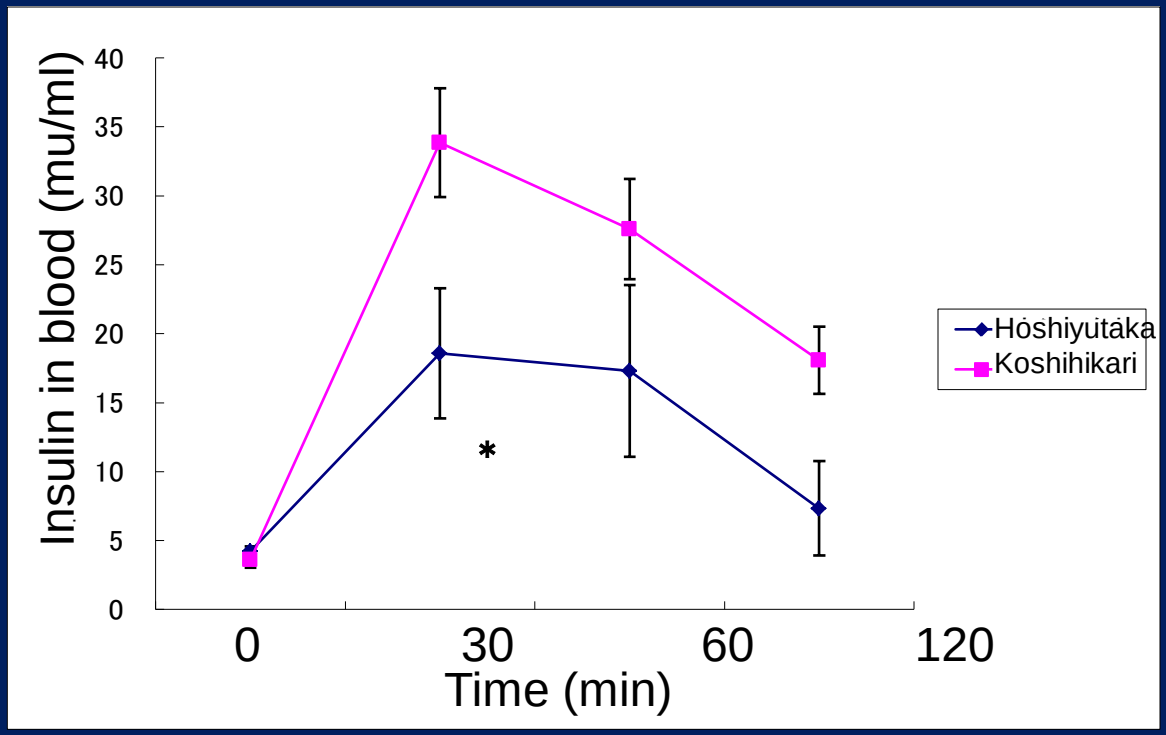
Parameters/rice samples	Koshihikari (AC=17.8%)	Yumetoiro (AC=31.2%)	Hoshiyutaka (AC= 29.7%)	Chugoku 134 (AC=28.7%)
Surface hardness	81.5	93.4	93.4	85.0
stickiness	19.6	2.69	2.50	3.46
adhesion	1.24	0.27	0.17	0.25
Overall hardness	2140	3120	2760	2750
stickiness	500	180	240	250
adhesion	1.90	1.03	0.43	0.42

Palatability of rice samples

Parameters/rice samples	Koshihikari (Low-amylose)	Yumetoiro (High-amylose)	Hoshiyutaka (High-amylose)	Chugoku 134 (High-amylose)
Palatability	82.0	30.0	32.0	33.7
Whiteness	42.0	40.6	35.7	32.0
Appearance	8.5	0.2	0.8	1.2

Cooked rice from high-amylose rice is hard and non-sticky.
Palatability of cooked rice from high-amylose rice is inferior to that from low-amylose one

Change in blood insulin after meal



By serving the retrograded rice samples (2hrs after cooking), increase of blood insulin was more inhibited for high-amylose rice than for low-amylose one.

Conclusions for "Diabetes-prevention rice"

- Proximate components and gelatinization properties of the high-amylose rice were clarified
- Texture and eating qualities of the cooked rice from high-amylose rice were reported
- In the case of high-amylose rice, drastic increase of blood glucose and insulin after meals were inhibited.
- The inhibition was accelerated by the retrogradation of the gelatinized starch

Significance of rice flour utilization

1. promotion of rice consumption by the use of rice flours
   Novel market: Big market of bread, noodle and cake
   (more than 6 million dollars)

2. Enhancement of bio-functionality
   Blending with other functional foods

3. Maintenance of paddy field & Improvement of food supply
   Utilization of efficient production of rice in Japan

↓

Rice is not suitable for bread, noodle and cake because it is harder than wheat and does not generate gluten.
It is necessary to utilize the newly-developed characteristic rice cultivars with rice flouring technology and development of novel market for rice flours..
Replacement of imported wheat (5000000t) with domestic rice flour！（R10 Project in Niigata）

Various types of rice milling machine

Hammer mill (Satake)

Milling machines for home use

Roller mill (Satake)

Jet mill (Nishimura Inc.)

Various rice products in Asia

Various processed rice products in Japan

Fortified Rice

Rice cake

Miso

Rice flours

Rice noodles

Rice cracker

Rice wine & vinegar

Development of New Characteristic Rice Varieties

1. Research Project started in 1989
2. Supported by Ministry of Agriculture, Forestry and Fisheries to enhance rice consumption
3. Low-amylose, high-amylose, giant embryo, aromatic, pigmented and high-prolamin rices were bred and utilized
4. Support by each prefecture and food industry are necessary to increase their production

Niigata Prefectural Agricultural Research Institute
Crop Research center
Nagaoka City, Niigata, Japan

A:hard rice, B:soft rice, C:very soft rice, D:aromatic waxy rice, E:aromatic rice, F: aromatic hard rice, G:red rice, H:red waxy rice, I:purple waxy rice, J:giant embryo rice

Novel rice bread by purple rice

Niigata University and Bon-Ohhashi Inc. developed novel rice bread using pre-germinated purple rice. This purple rice cultivar was developed by Niigata Prefectural Research Institute. This bread is made by the use of patented method of Niigata University. This bread is tasty and its crumb is very soft, and it contains much GABA. Purple rice is promising to have the Bio-functionality to remove the active oxygen.

Development of new rice noodle

(Niigata Pref. Res. Ins. Agric. and Matsuya Inc.)

Development of high amylose rice cultivar, “Koshinomenziman”
Preparation of rice flour
Noodle making method(extrusion)
Addition of pigmented rice

Rice noodle（left：Koshihikari, right：high amylose rice）

Koshinomenziman showed suitability for noodle

Noodle making by extrusion method

Pigmented rice（color & functionality）

Pre-germinated brown rice（taste & functionality）

(K.Nakamura et al: Appl for Japan patent 2007-152578, Rice noodle& preparation method)

Main Chemical Components

	Moisture content (%)	SD	**Amylose content (%)**	SD	Moisture absorption index	SD	Starch damage (%)	SD	**Oil absorption index (%)**	SD
Koshinomenjiman-a	12.8	0.0	**26.3**	0.5	2.05	0.1	13.88	0.4	**36.7**	0.2
Hoshiyutaka	11.2	0.1	**26.3**	0.5	1.95	0.1	12.90	0.1	**36.7**	0.3
Koshihikari-a	12.5	0.2	**13.7**	0.0	2.08	0.3	11.29	0.2	**45.3**	0.1
EM10	12.3	0.1	**36.4**	0.5	2.01	0.1	12.29	0.2	**29.4**	0.4
Koganemochi	13.5	0.3	**0.0**	0.1	1.83	0.1	11.04	0.3	**66.2**	0.4
Koshihikari-b	10.1	0.1	**13.7**	0.0	2.02	0.0	14.32	0.2	**33.5**	0.3
Koshinomenjiman-b	11.5	0.3	**26.3**	0.5	1.59	0.1	7.99	0.1	**35.1**	0.1
Commercial Rice Flour-a	12.3	0.1	**22.8**	0.3	1.09	0.0	2.56	0.1	**54.9**	0.4
Wheat Flour	13.6	0.2	**30.1**	0.5	0.81	0.0	4.14	0.0	**61.1**	0.8
Commercial Rice Flour-b	12.1	0.2	**22.9**	0.3	1.10	0.0	2.12	0.1	**36.3**	0.4
Commercial Rice Flour-c	11.0	0.2	**14.9**	0.1	2.01	0.0	10.78	0.1	**39.9**	0.2

SD; Standard deviation of estimated value

Kochinomenjiman-a and Koshihikari-a were milled by a cyclone sample mill (UDY Corporation, Fort Collins, USA)

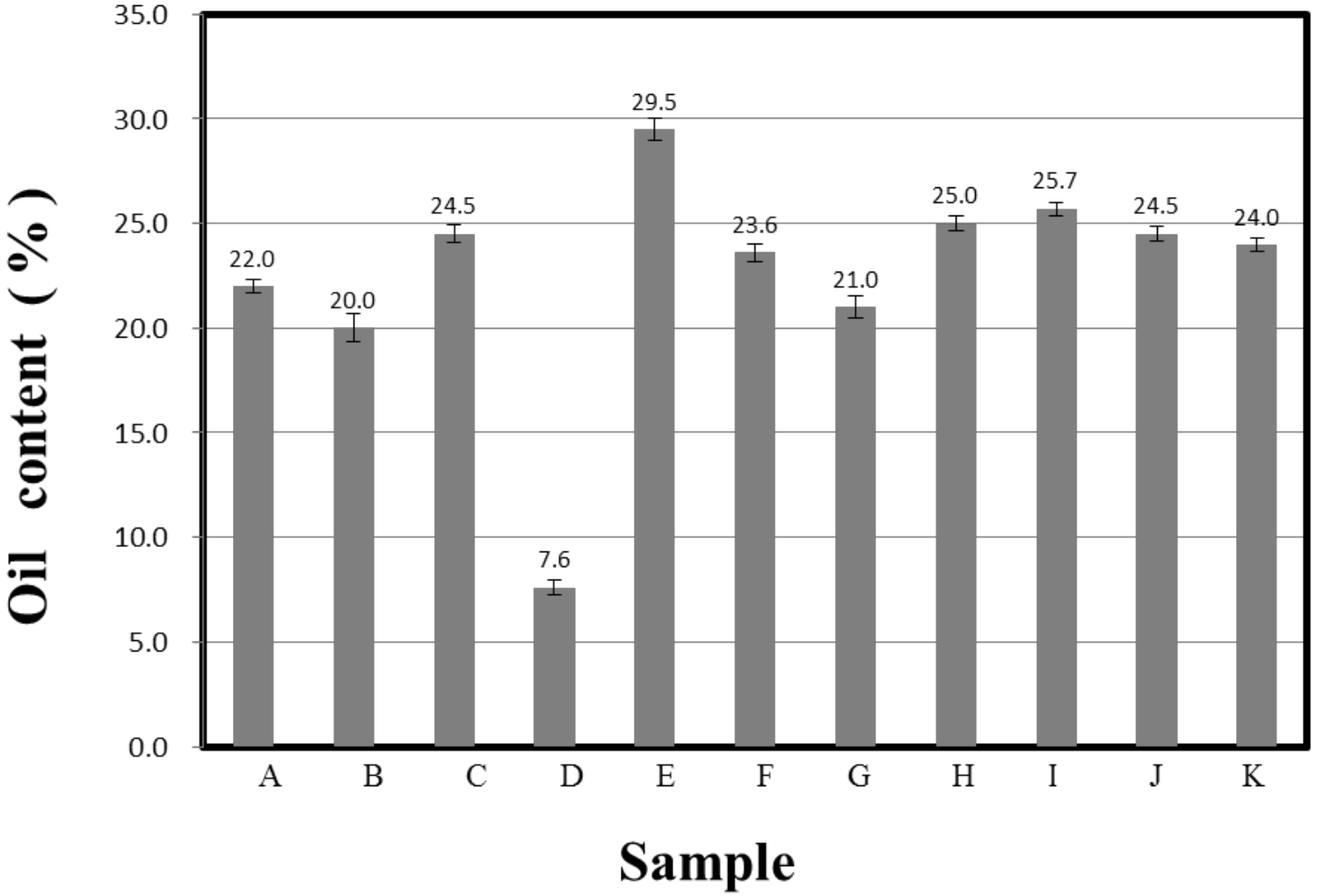
Koshinomenjiman-b and Koshihikari-b were milled by a cyclone sample mill (Shizuoka Seiki Co.)

A B C

Fried asparagus using wheat or rice batter

A: wheat, B: high-amylose rice, C: soft rice

（Sensory score: B＞C＞A）



Amount of oil absorbed by the batter measured by extracting with ether in a Soxlhet extractor

A, Koshinomenjiman-a; B, Hoshiyutaka; C, Koshihikari-a; D, EM10; E, Koganemochi ; F, Koshihikari-b; G, Koshinomenjiman-b; H, commercial rice flour-a; I, wheat flour; J, commercial rice flour-b; K, commercial rice flour-c

Pre-germinated brown rice

1. Pre-germinated brown rice was developed in ancient era in Japan, Korea and China

2. Easy to cook by blending with white rice grains

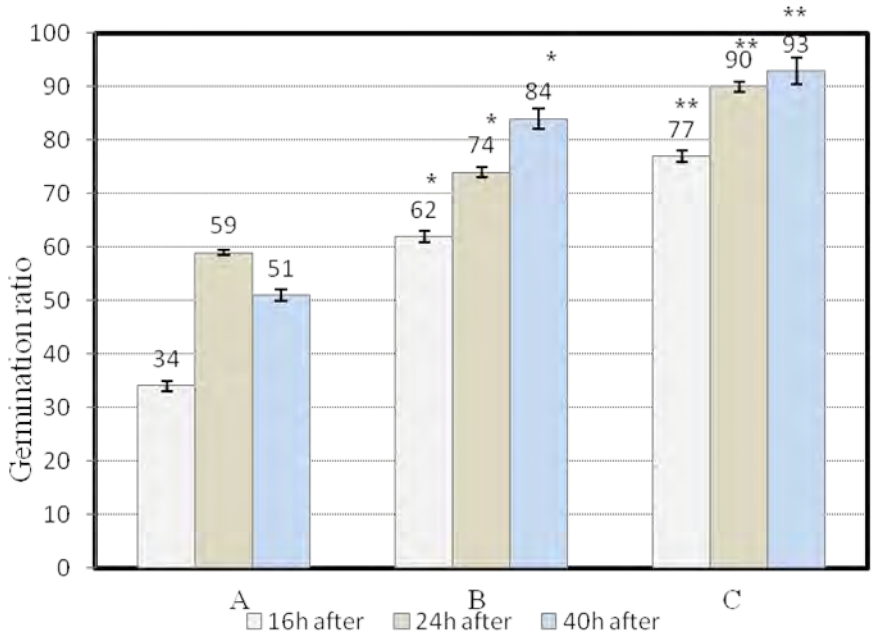
3. Rich In dietary fiber, GABA and phytic acid

4. Shelf-life is about half a year without refrigeration and price is very high

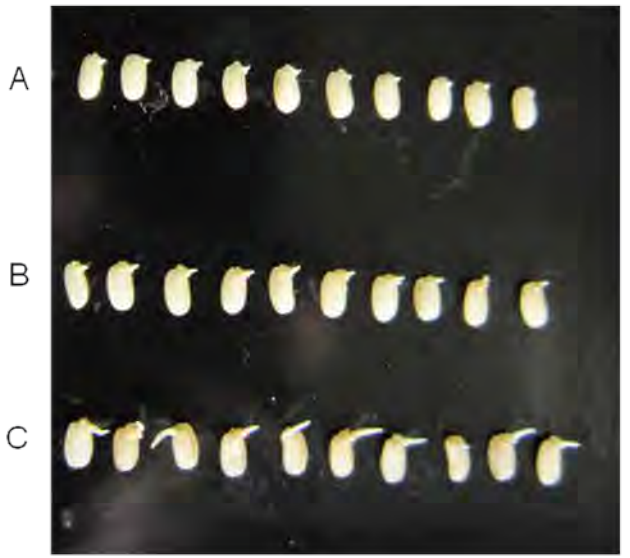
5. Becoming popular year by year because consumers demand bio-functional foods even for rice

Pre-sprouted brown rice

(A)



(B)



16h after

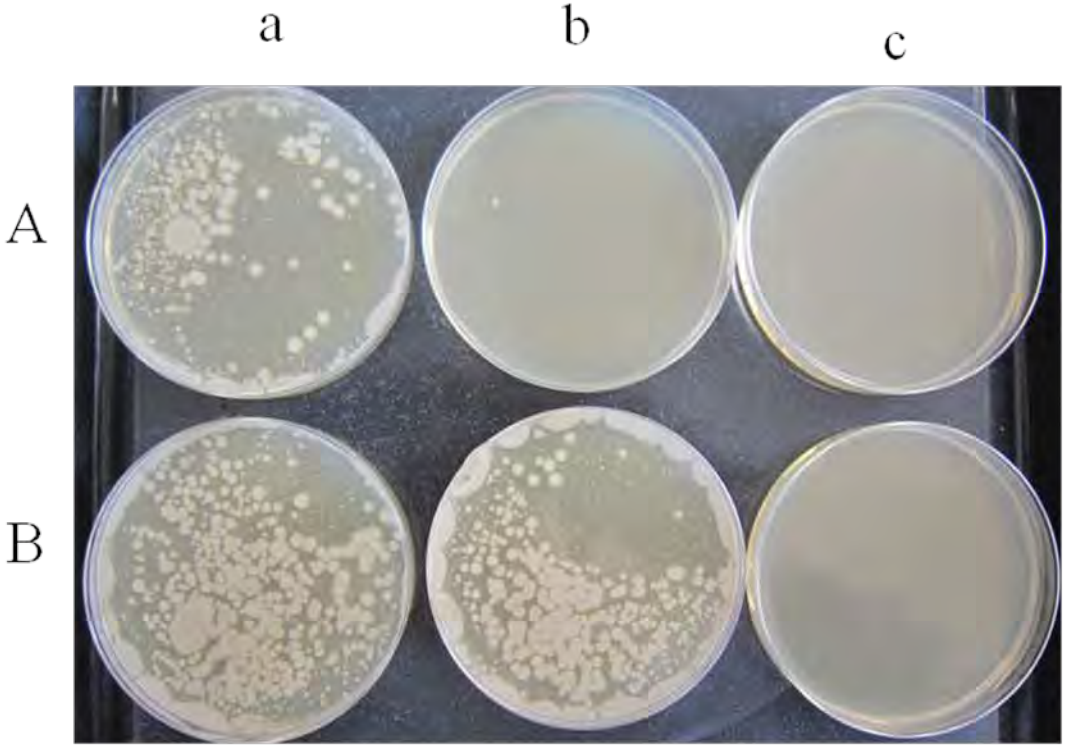
$*p < 0.05$ $**P < 0.01$ By Dunnett

Pre-germinated by soaking in 2% red onion solution with pre-germinated by soaking in deionized water was significantly at the level of 1%

Pre-germinated by soaking in 2% onion solution with pre-germinated by soaking in deionized water was significantly at the level of 5%

A: Soaked in deionized water (pH5.8) B: Soaked in 2% onion solution (pH5.8) C: Soaked in 2% red onion solution (pH5.8)

Germination ratio of EM10 by soaking with/without onion



a: Germinating solution of EM10 (deionized water)(pH5.8)

b:Germinating solution of EM10 (2% onion solution) (pH5.8)

c:Germinating solution of EM10 (2% red onion solution)(pH5.8)

A:after 16h (× 1000, dilution)

B:after 24h (× 1000, dilution)

Inhibition of microbial infestation by the addition of red onion

Characteristics of Bread Prepared from Wheat Flours Blended with Various Kinds of Newly Developed Rice Flours

S.Nakamura, K. Suzuki and K. Ohtsubo

J. Food Sci., 74(3), E121-130, 2009

Wheat/rice blended bread prepared from newly bred rice cultivars

Blend of 3 new rice

Mochiminori

Milkyqueen

Yumetorio

Shun-yo

Hoshinishiki

Koshihikari

Wheat 100%

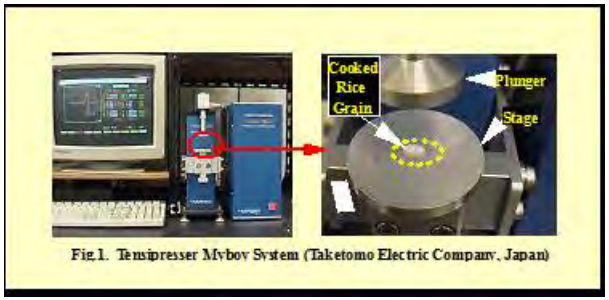
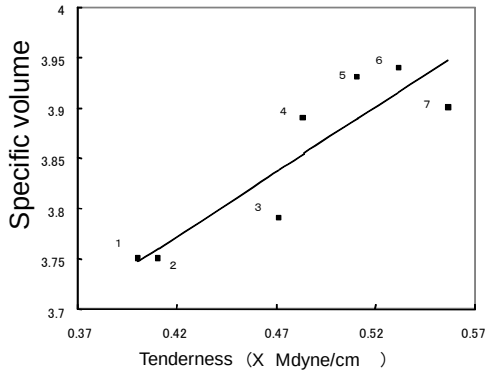


Fig.1. Tensipresser Mvbov System (Taketomo Electric Company, Japan)

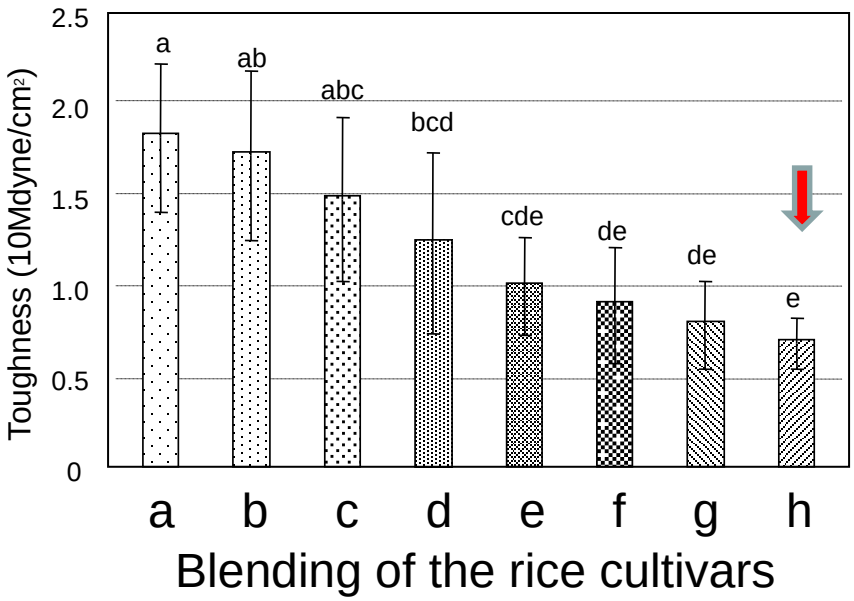


Y=1.28E-06+3.233232 R: 0.90

1:Mochiminori, 2 : Milkyqueen, 3 : Asamurasaki, 4 : Ayunohikari
5 : Yumetoiro, Asamurasaki, Ayunohikari (12%, 12%, 6%mix)
6 : Syun-yo, 7 : Yumetoiro

(1) High quality wheat/rice bread, with high-expansion and low-retrogradation, was prepared by the use of high-amylose, purple-waxy an sugary-mutant rice

(2) CPC-test by a Tensipresser was shown to be useful to evaluate the dough quality

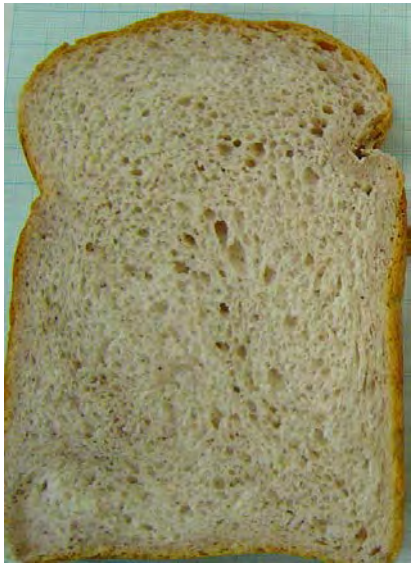


a: Yumetoiro 15%, Ayunohikari 15%
b: Yumetoiro 30%
c: Yumetoiro 12%, Mochiminori 12%, Ayunohikari 6%
d: Ayunohikari 30%
e: Yumetoiro 15%, Asamurasaki 15%
f: Asamurasaki 15%, Ayunohikari 15%
g: Asamurasaki 30%
h: Yumetoiro 12%, Asamurasaki 12%, Ayunohikari 6%

Toughness of the various kinds of wheat/rice breads

a-f: different letter means different significantly (5%)

Best bread



（A） （B） （C）

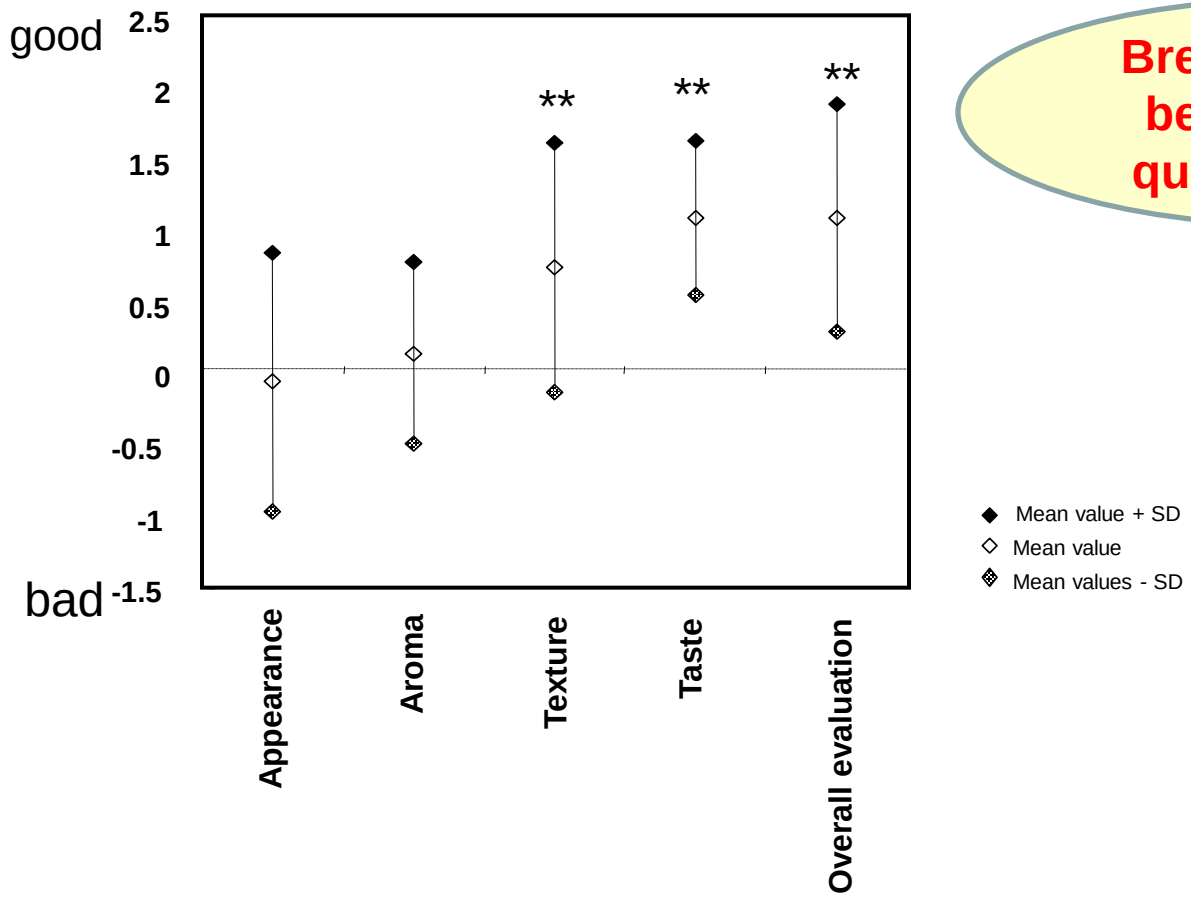
Cross section of the wheat/rice breads

(A)Control (wheat 100%)

(B) Asamurasaki 12%, Yumetoiro 12%, Ayunohikari 6%, wheat 70%

(C) Asamurasaki 16%, Yumetoiro 16%, Ayunohikari 8%, wheat 61%

Ratio of cooked rice is 15.8%. Rice was cooked in the 10% yoghurt solution

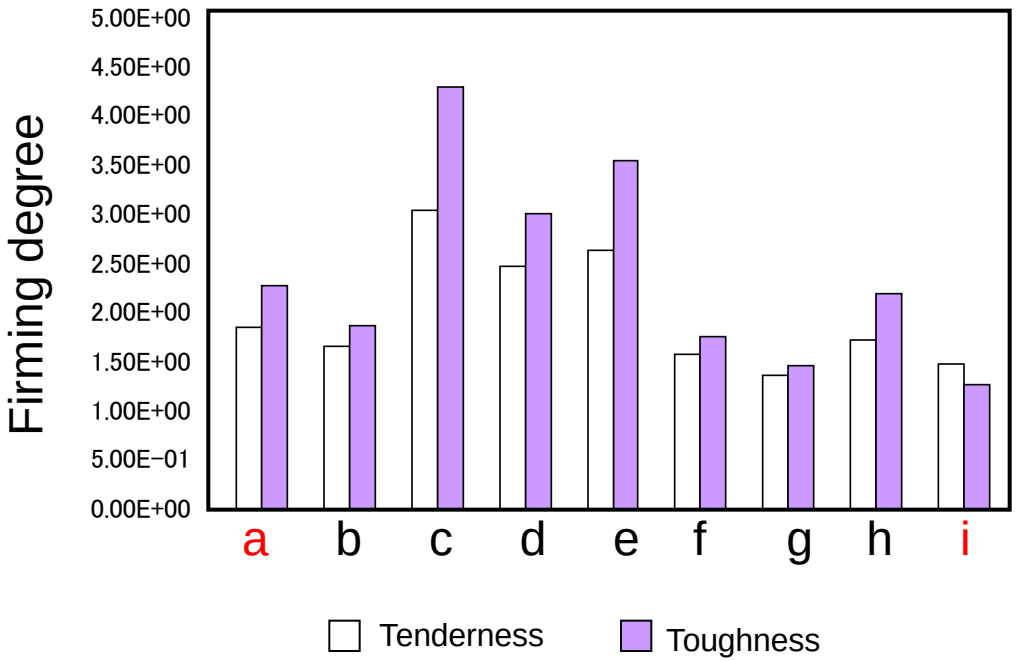


Bread B showed better sensory qualities than A

Sensory qualities of wheat/rice bread

Control: 100% wheat bread (scored as 0)

Texture, Taste and Overall evaluation were significant at the level of 1% (**)



Firming degree of various kinds of wheat/rice blended bread

a：Wheat 100%　b：Yumetoiro 30%　c：Shun-yo 30%　d：Mochiminori 30%
E：Milkyqueen 30%　f：Koshihikari 30%　g：Asamurasaki 30%　h：Ayunohikari 30%
i：Asamurasaki 12%＋Ayunohikari 6%＋Yumetoiro 12%

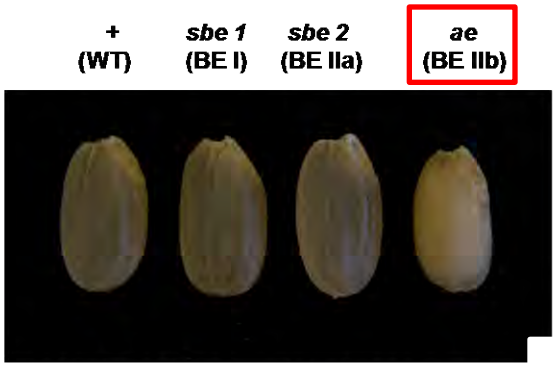
Firming degree: ratio of bread texture after 4 days to that of just after preparation

Firming degree of bread (i) was shown to be lower than that of (a)

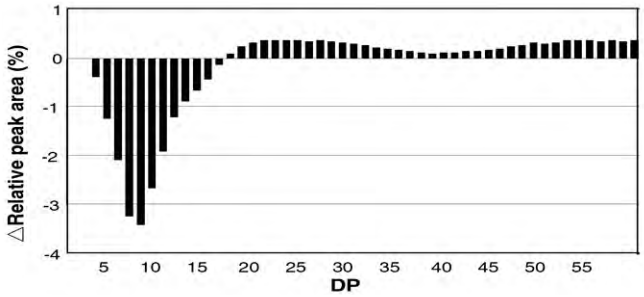
Palatable and Bio-functional Wheat/Rice Products Developed from Pre-Germinated Brown Rice of Super-Hard Rice, EM10

S.Nakamura, H. Satoh and K. Ohtsubo

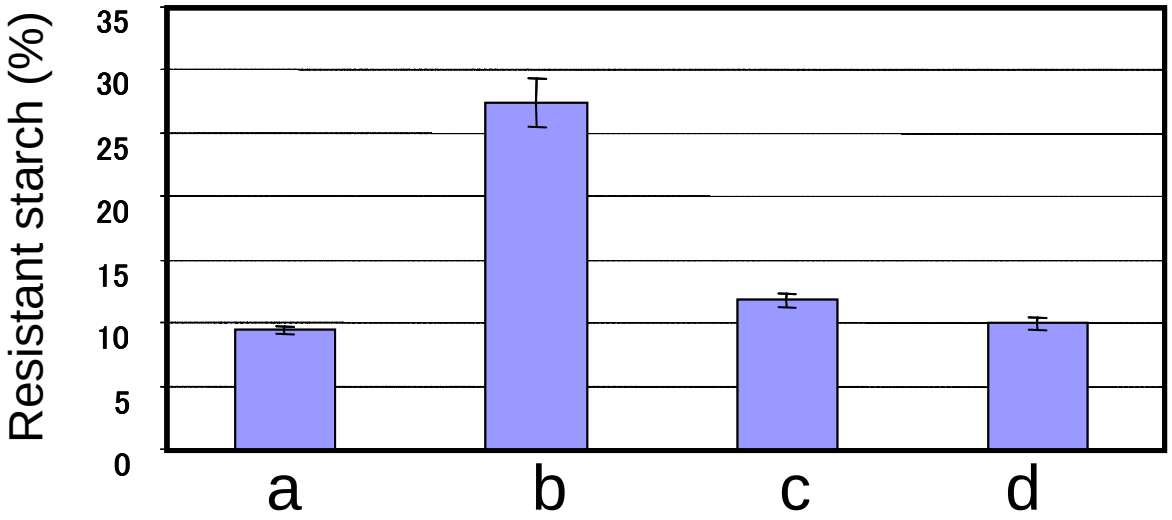
Biosci. Biotechnol. Biochem., 74(6), 1164-1172, 2010



Various mutant rice

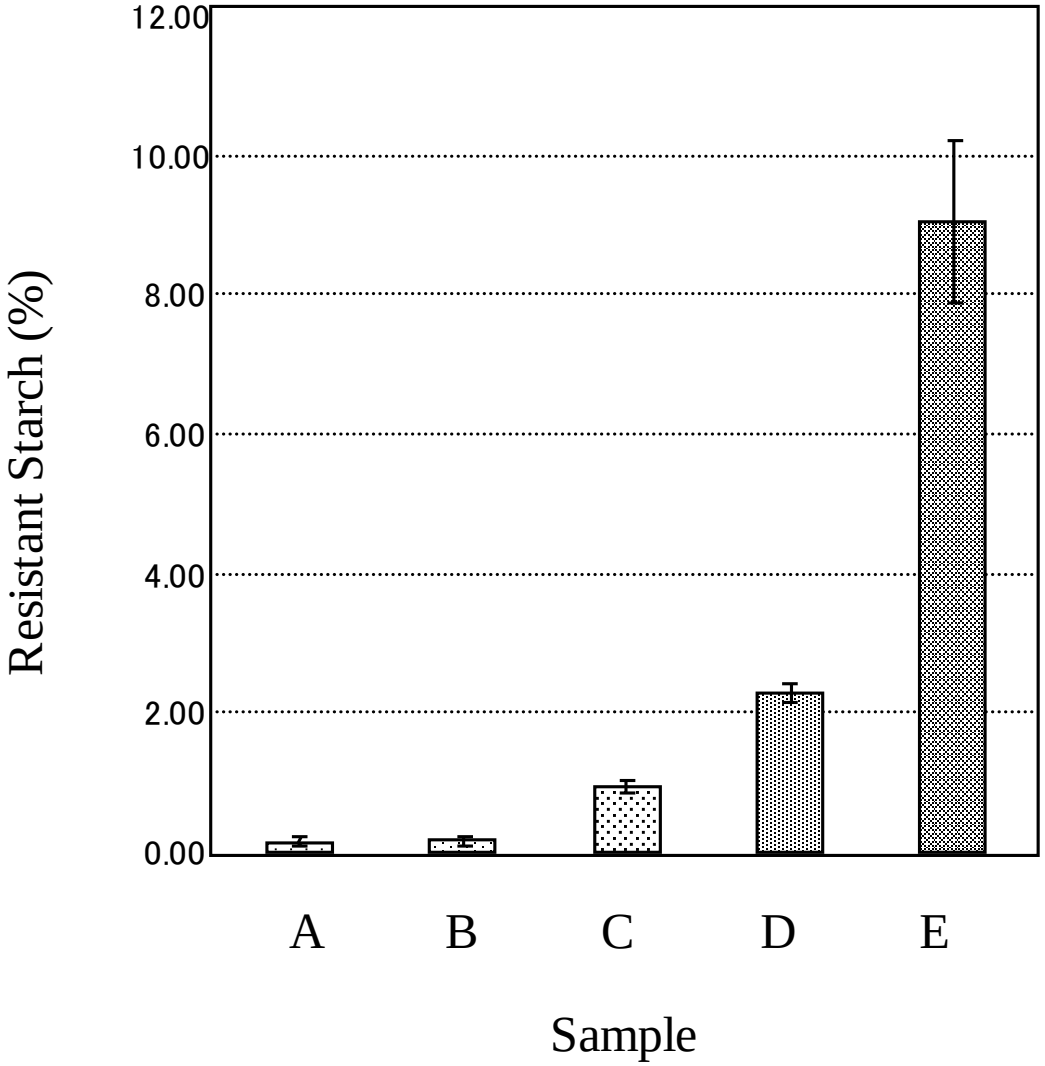


Molecular structure of starch
(Less short chains in amylopectine)



Resistant starch of the various rice

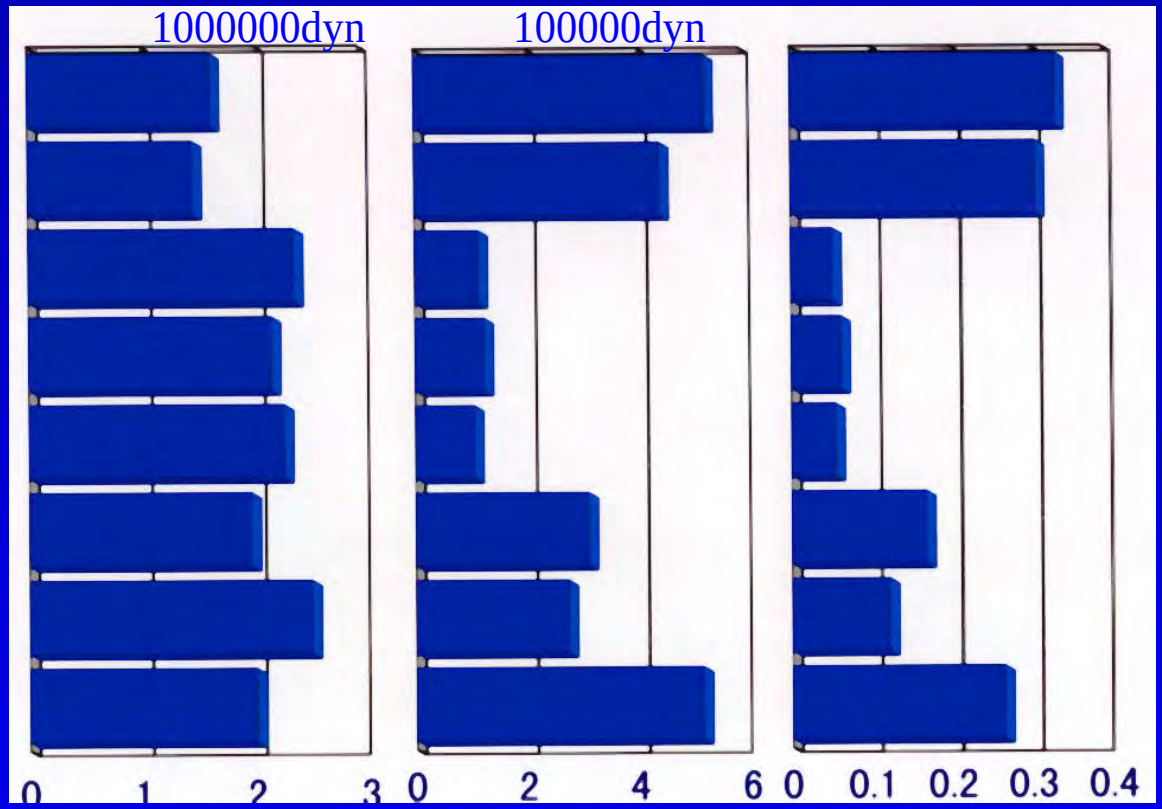
a: wheat, b: EM10, c: high-amylose rice, d: low-amylose rice



Resistant Starch of the Cooked Pre-germinated Brown Rice

A: Low-amylose rice, B: Waxy rice, C: Ordinary rice, Koshihikai
D: High-amylose rice, E: Super hard rice, EM10

Koshihikari
EM5
EM10
EM16
EM72
EM129
EM189
Kinmaze

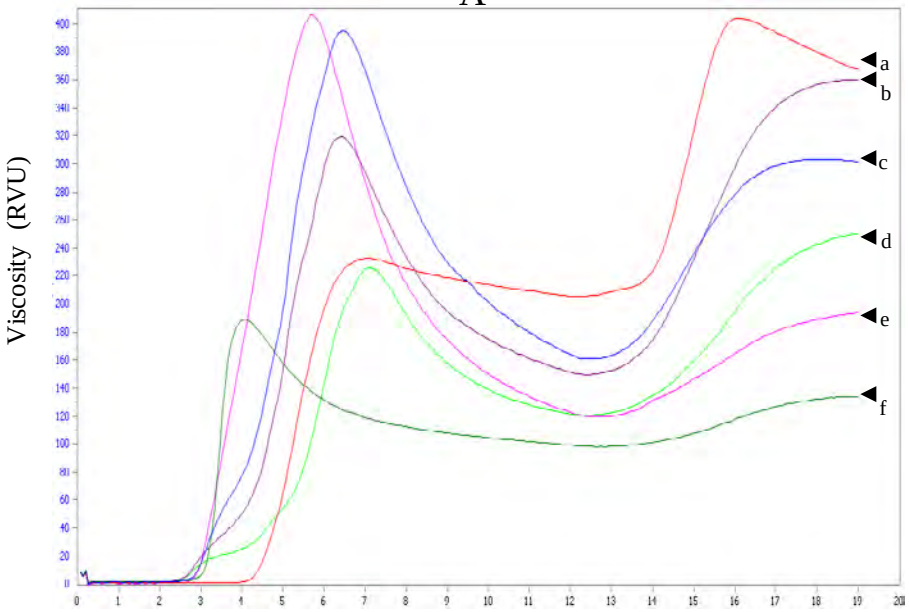


Physical properties of cooked whole grains

Cooked rice grains of SHR are not accepted as table rice because It is too hard and non-sticky

Rapid Visco Analyser

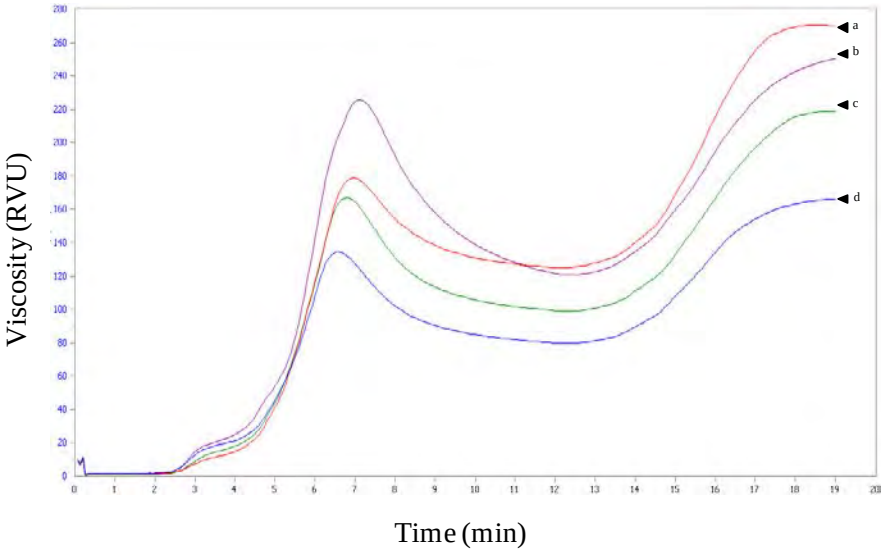
A



Super hard rice
High-amylose rice
Koshihikari
Wheat

Low-amylose rice
Waxy rice

B



Wheat 100%

Wheat/Cooked SHR

Low-retrogradation bread by blending

Fig. 1. Pasting Properties of the Various Types of Rice Flour

A

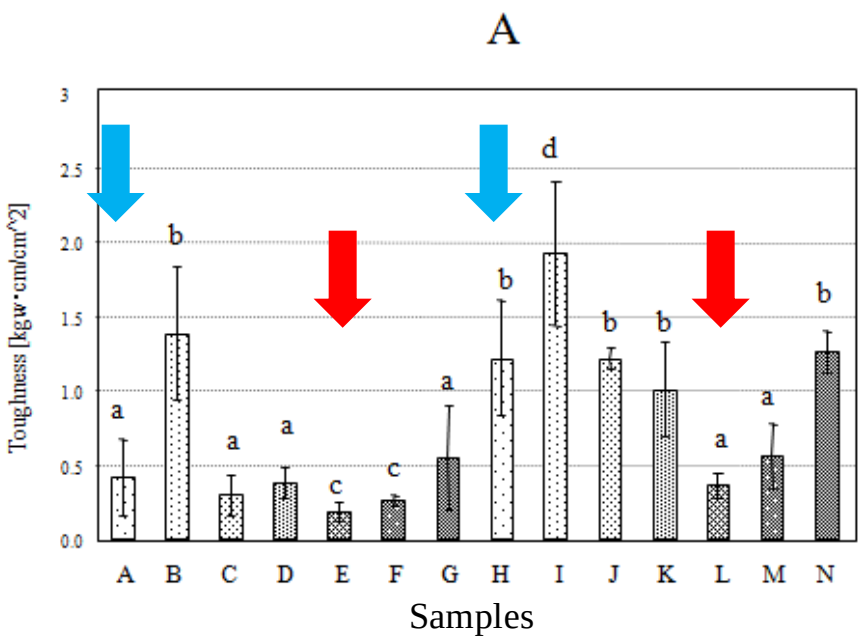
a b c d e

a: wheat, b: pre-germinated brown rice, c: brown rice,
d: white rice, e: cooked pre-germinated brown rice

B

Wheat/rice Bread and Wheat/rice Noodle from Super-hard Rice, EM10

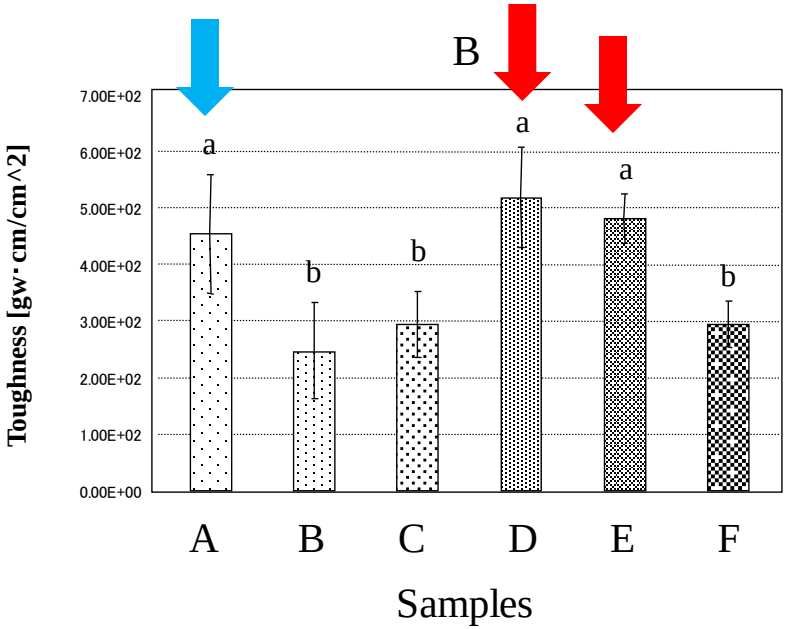
A: wheat 100%
B: 30% EM10
C: 30% Koshihikari
D: EM10/Milkyqueen
E: EM10/Waxy rice
F: EM10/Koshihikari
G: EM10/Hoshiyutaka



A～G：1 day
H～N：4 days
after bread-making

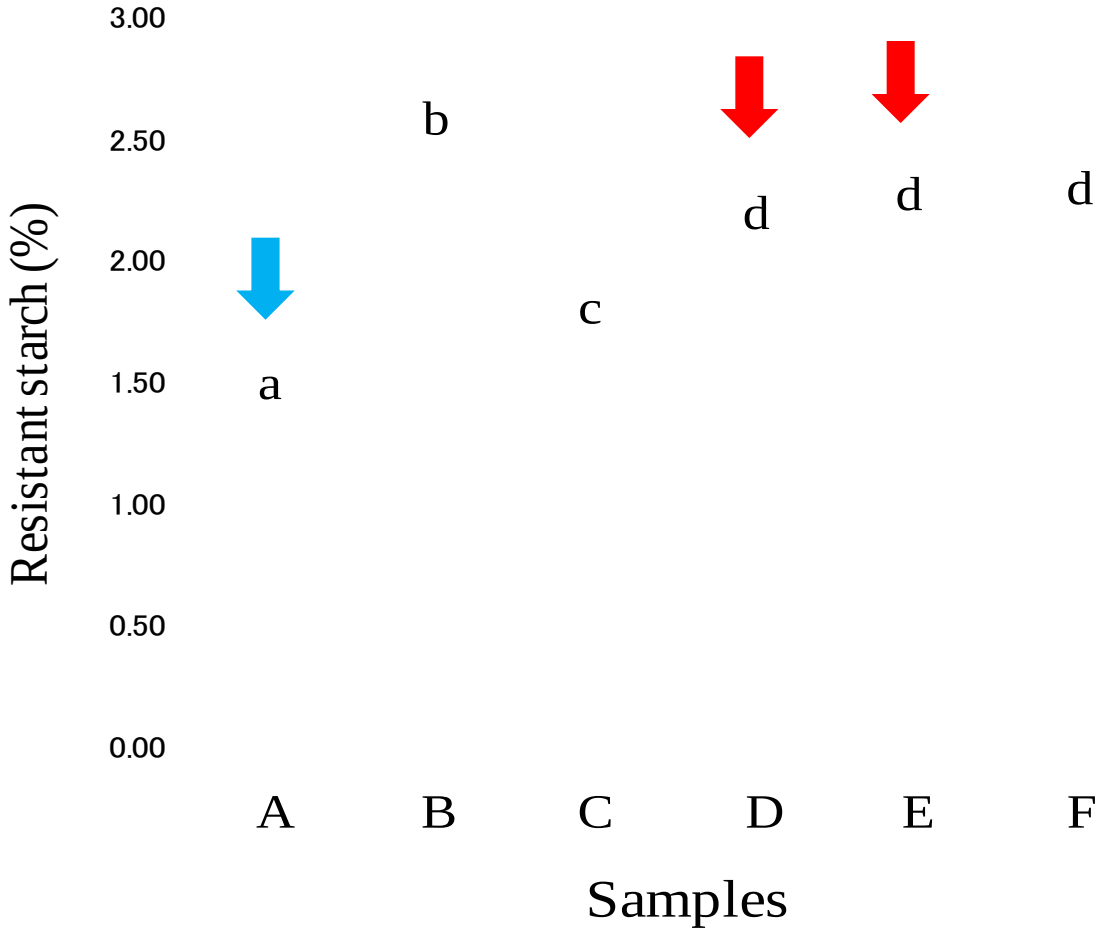
E and L are soft and low-retrograde bread

A: wheat 100%
B: 30% EM10
C: 30% Koshihikari
D: EM10/Milkyqueen
E: EM10/Waxy rice
F: EM10/Hoshiyutaka



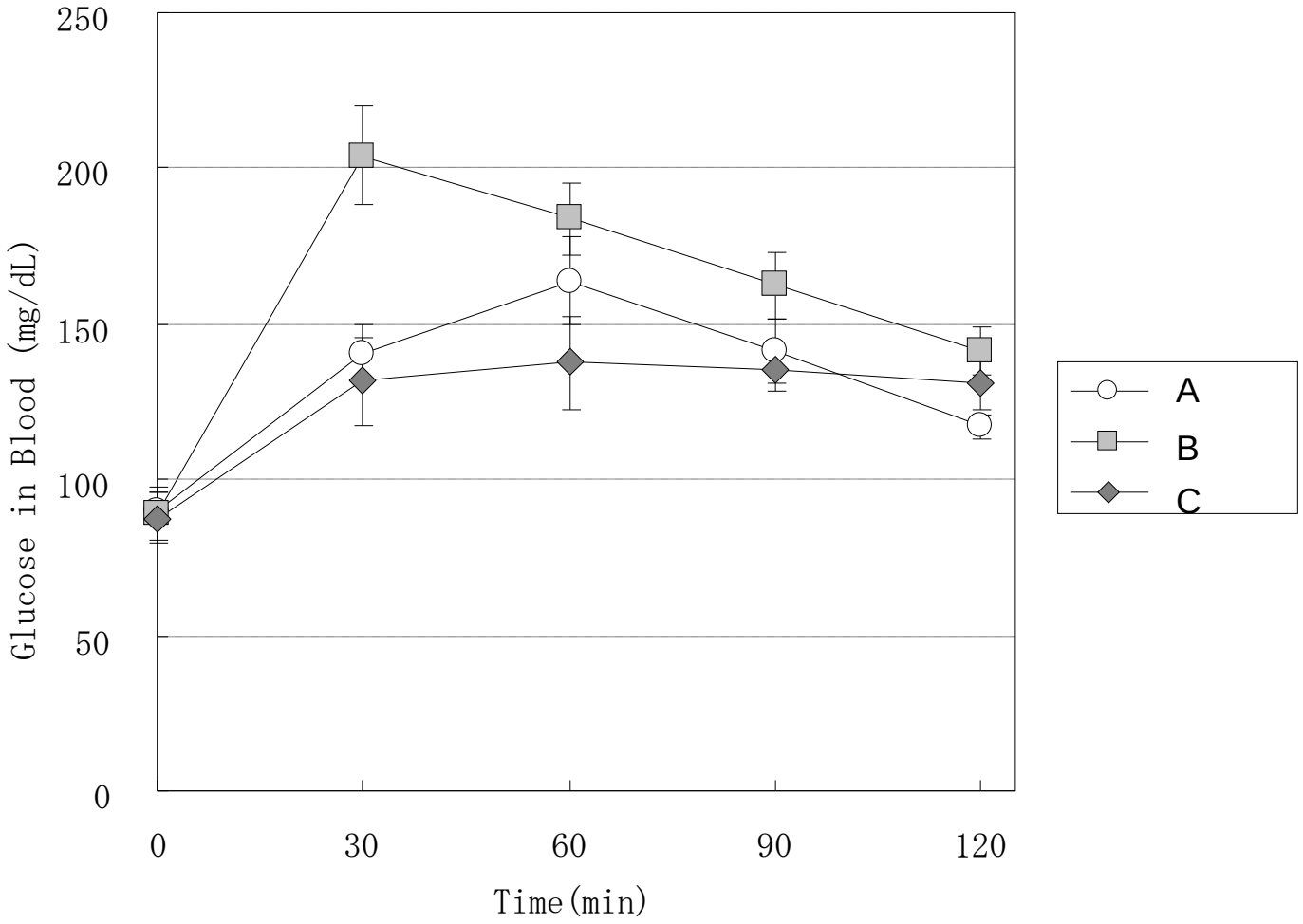
Noodle D and E are similar with noodle A

Physical Properties of Wheat/rice Bread and Noodles



Resistant Starch in Various Noodles from Wheat, Gelatinized Pre-germinated Brown Rice and Gelatinized White Rice

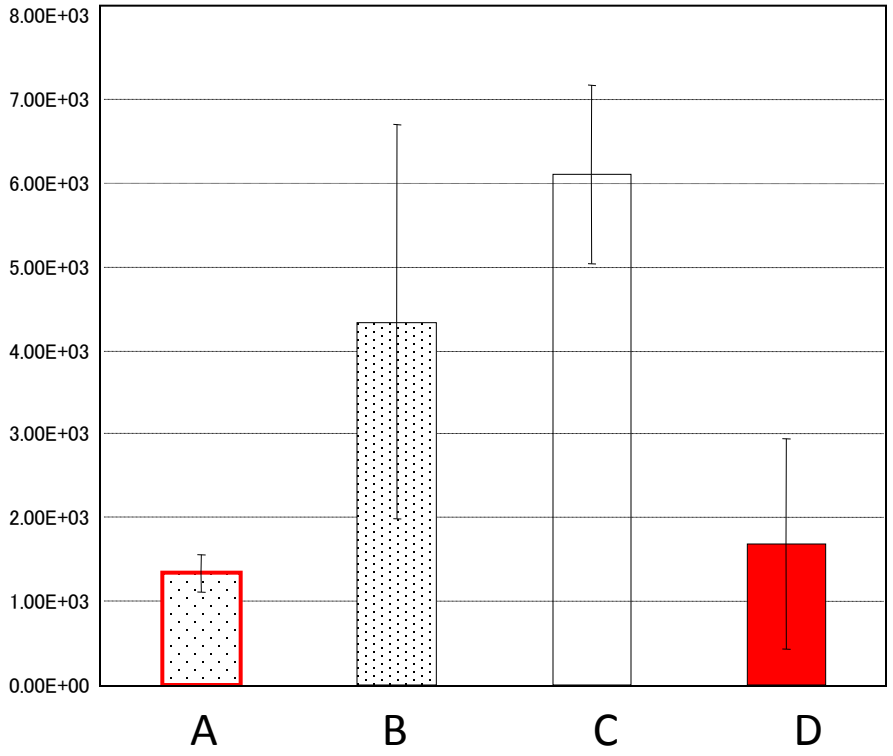
a: wheat noodle (Camellia 100%)
b: 70% of wheat and 30% of EM10 gelatinized pre-germinated brown rice
c: 70% of wheat and 30% of Koshihikari gelatinized pre-germinated brown rice
d: 70% of wheat and 21% of EM10 gelatinized pre-germinated brown rice and 9% of Milky-queen gelatinized white rice
e: 70% of wheat and 21% of EM10 gelatinized pre-germinated brown rice and 9% of Koganemochi gelatinized white rice
f: 70% of wheat and 21% of EM10 gelatinized pre-germinated brown rice and 9% of Hoshiyutaka gelatinized white rice



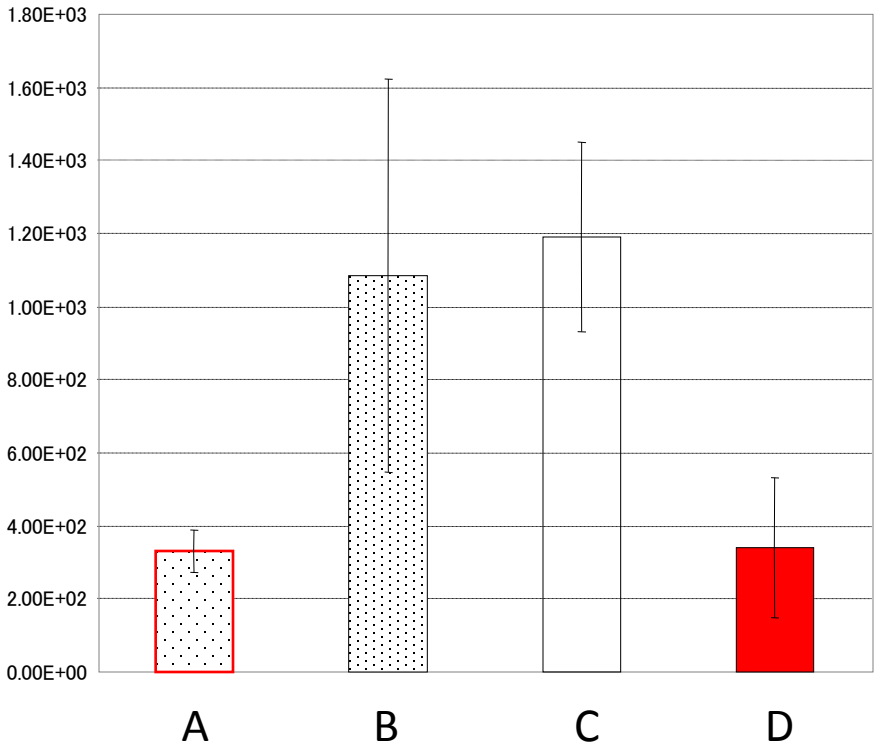
A: wheat flour B: Koshihikari flour C: super-hard rice flour

Inhibition of increase of post-prandial glucose by super hard rice

hardness



max stress



A : Camellia 100% (hard wheat flour)

B : EM10 (super-hard rice 30%)

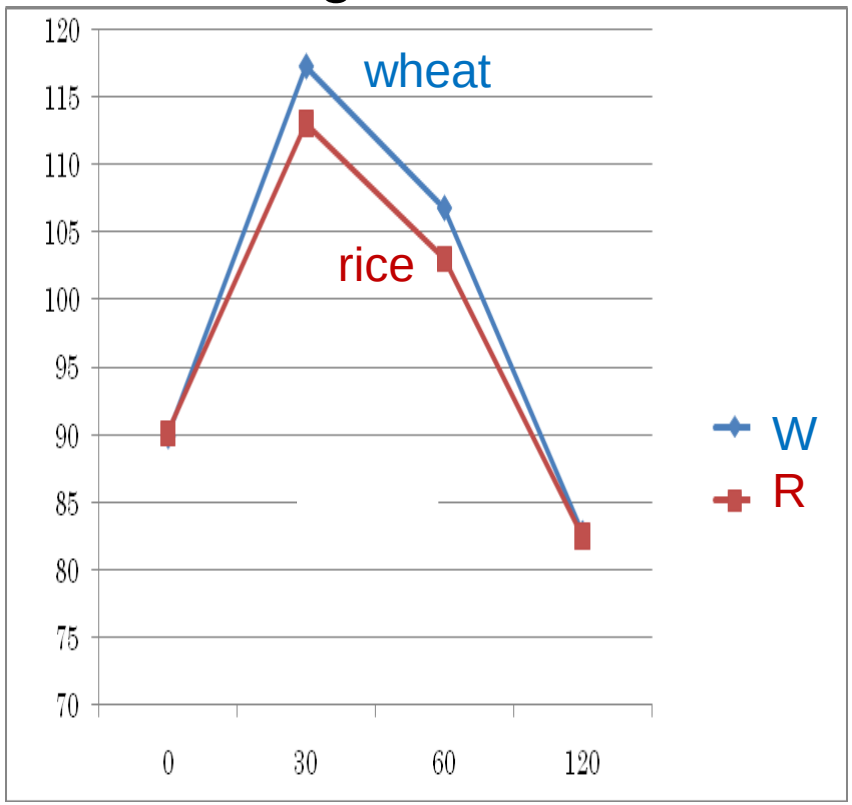
C : EM10 (pre-germinated brown rice 30%)

D : EM10 (cooked pre-germinated super-hard rice 30%)

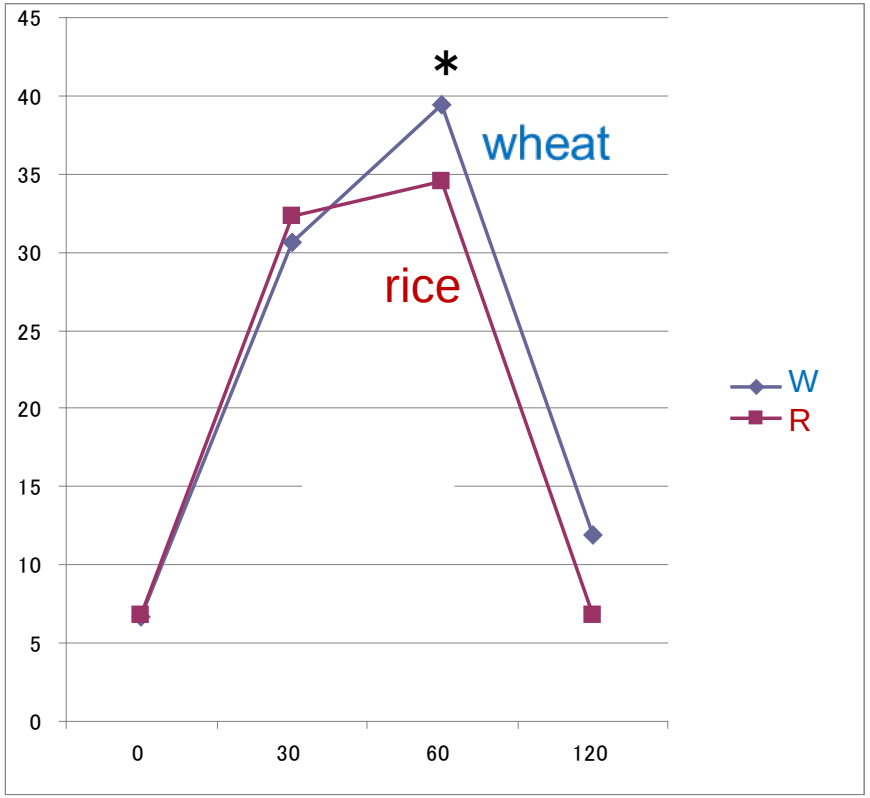
Physical properties of various bread

Post prandial blood glucose and insulin

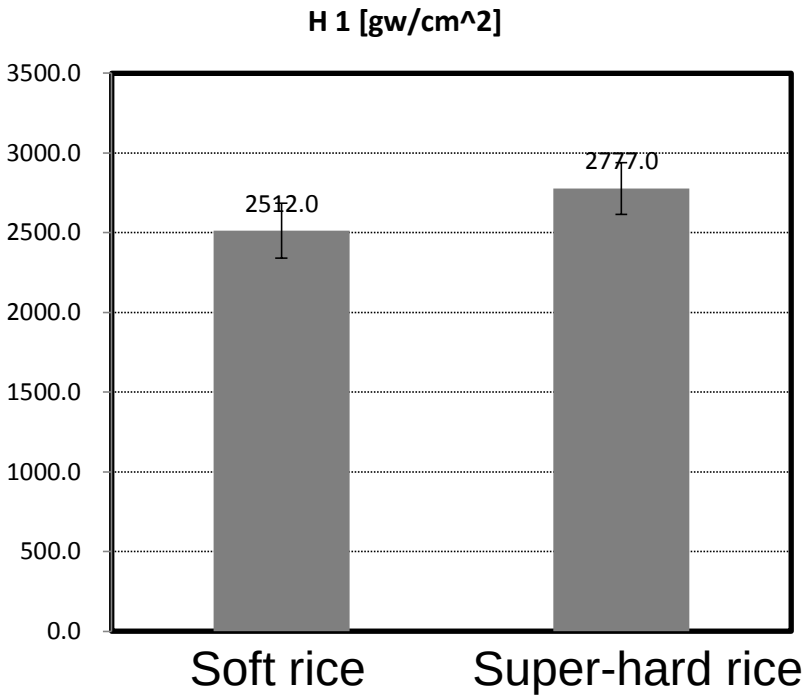
glucose

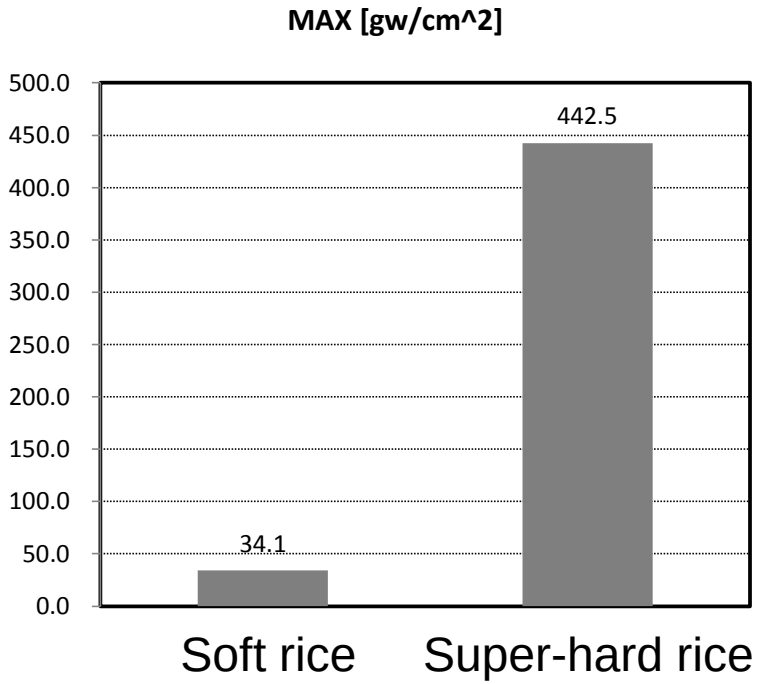


insulin



Bread blended with 40% of super-hard rice showed significant inhibitory effect



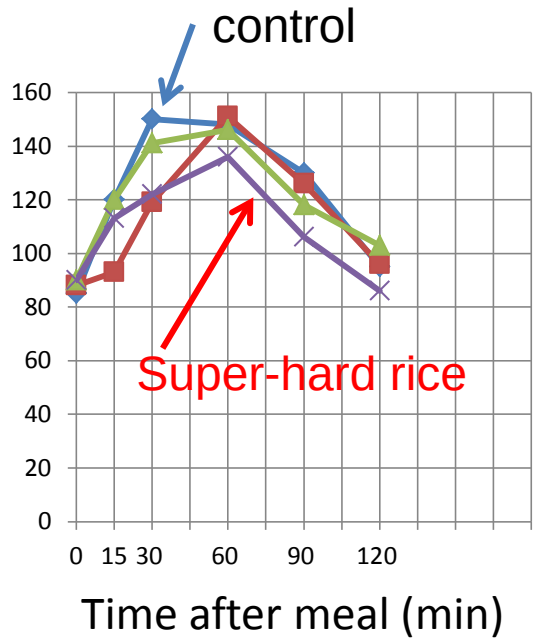


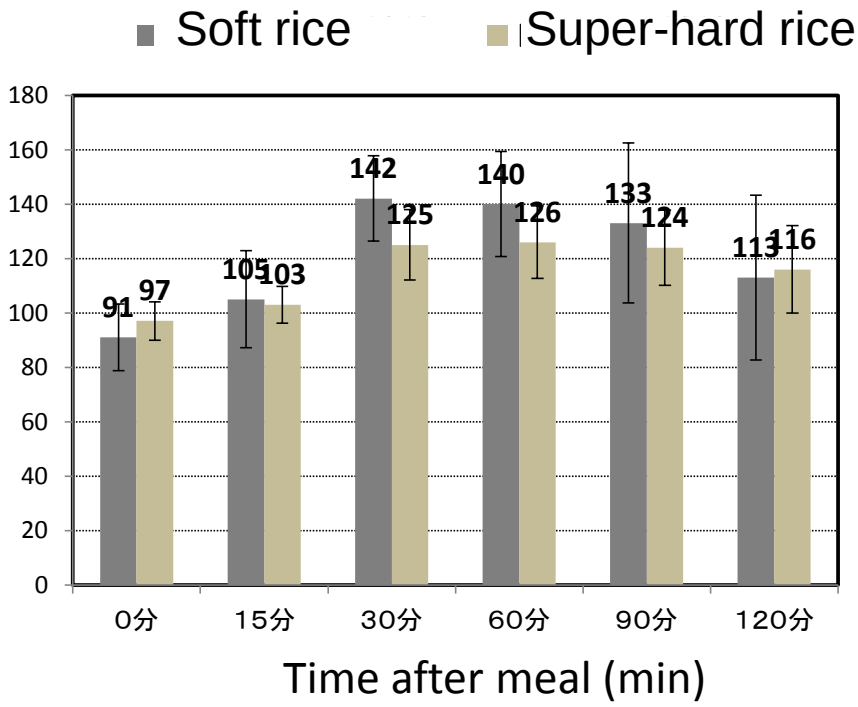
Soft rice 50% Super-hard rice 50%

Physical properties of rice noodle

Human test of rice noodles

(Niigata university & Ibaraki Christianity University)





（Post prandial increase of blood glucose）

Blending of 50% super-hard rice caused inhibition of post prandial increase of blood pressure

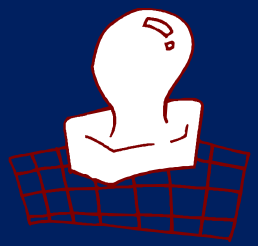
Development of “Tomato Bread”

1.Super-hard rice --- Resistant starch
2.pre-germinated brown rice --- GABA
3.Tomato --- Lycopene
4.Bread making method --- Durable palatability

Procedure of cultivar identification of rice

Materials

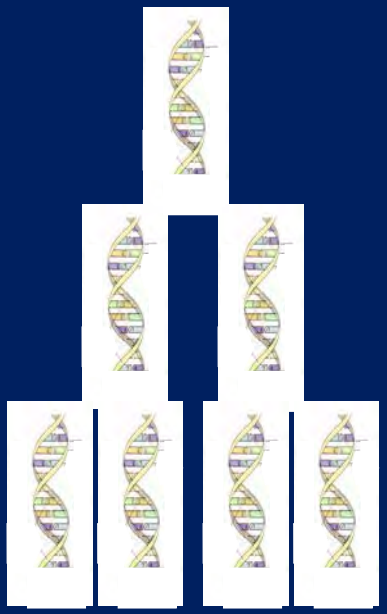
Boiled rice



Rice cake

Extraction of DNA

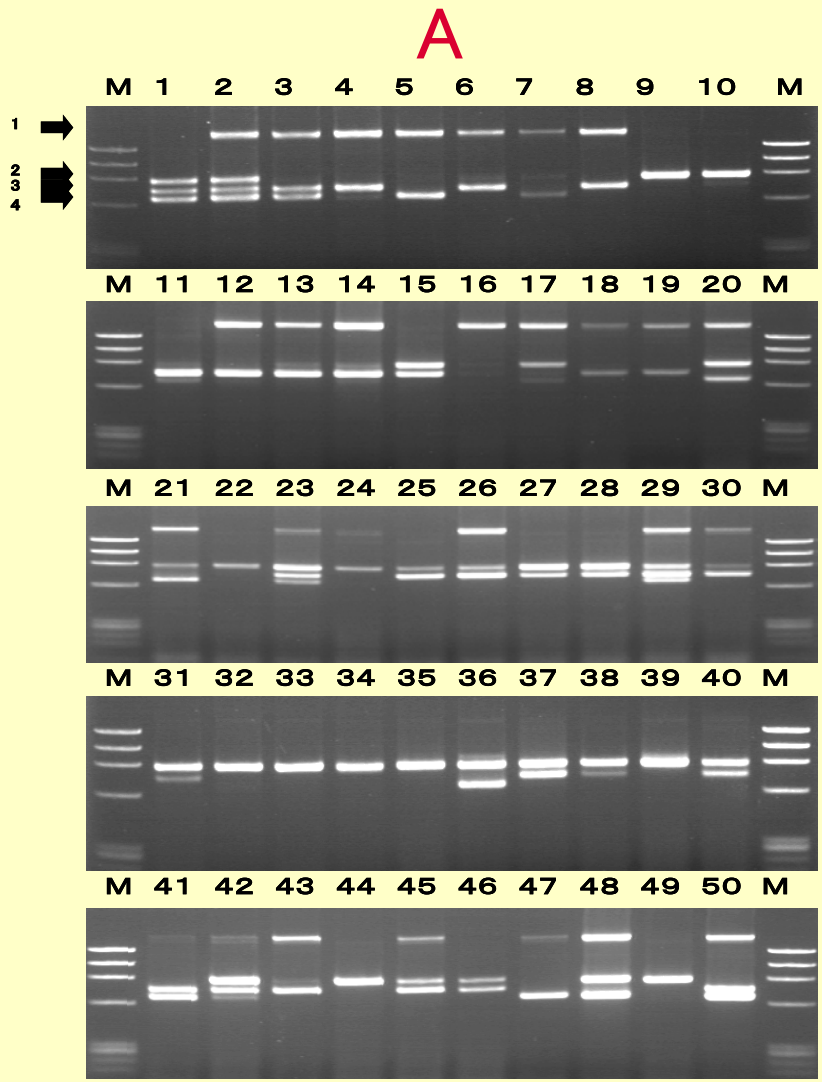
Proliferation of DNA

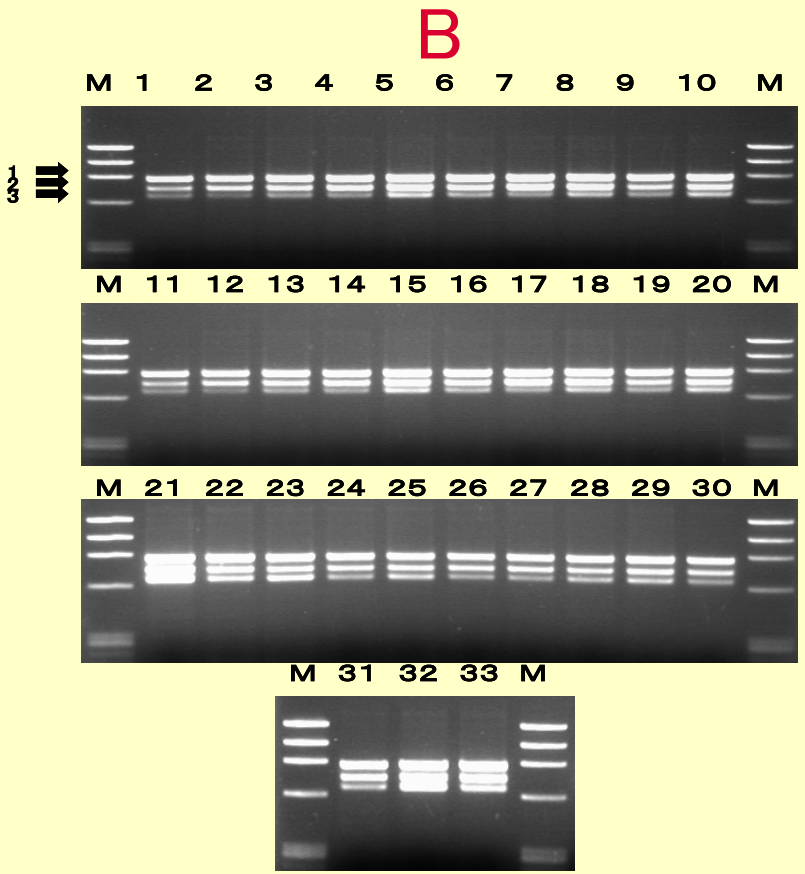


Comparison by Electro -phoresis

Dominant 50 cultivars

"Koshihikari" Identification Kit



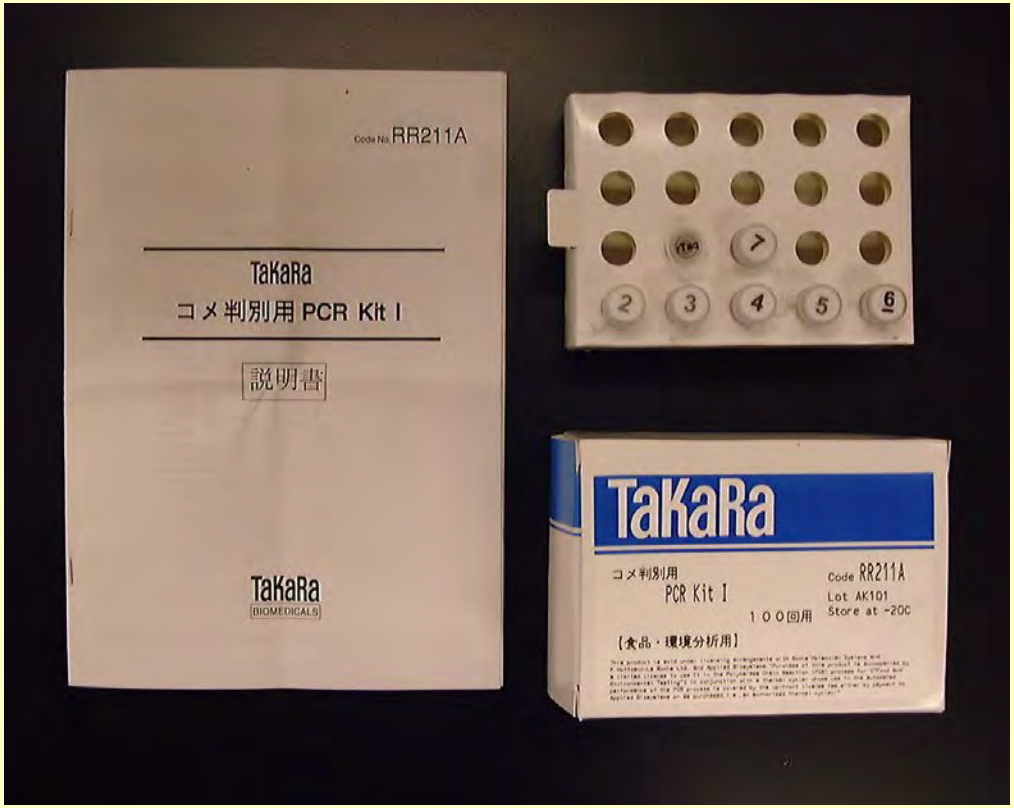


"Koshihikari" can be differentiated by PCR from other 49 cultivars (A), and (B) shows that same patterns for all Koshihikaris from 33 different prefectures appear after PCR.

Commercialized primer set for “Koshihikari”

Contents

1. DNA Polymerase
2. 10×PCR Buffer
3. 25mM $MgCl_2$
4. 2.5mM dNTPs
5. Primer Mixture
6. Control template
7. Loading Buffer
8. DNA Marker

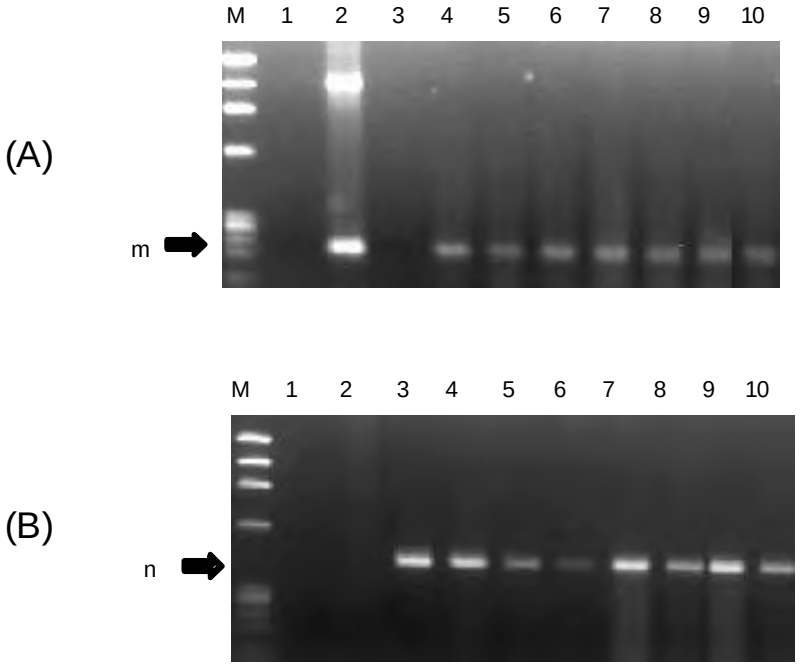


National Food Agency, J. Grain Inspection Association and other institutes are using this primer set for cultivar identification of rice

PCR method for the detection and Identification of cultivars of rice flours used in yeast leavened breads containing both wheat and rice flours

S.Nakamura and K. Ohtsubo

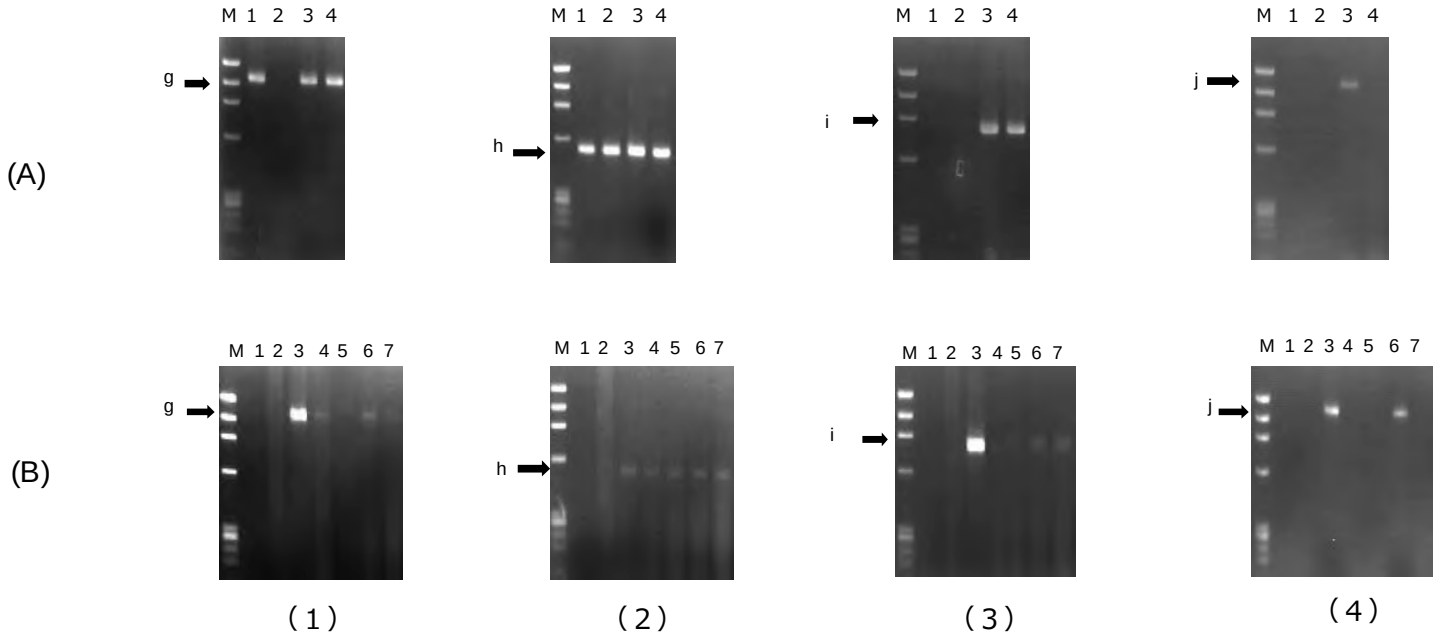
J. Cereal Sci., 52, 16-21, 2010



Results of PCR using a wheat-specific primer and a rice-specific primer

(A) wheat-specific primer (B) rice-specific primer

M: DNA molecular weight marker
1: Yeast (*Saccharomyce cerevisiae*)
2: Wheat flour (Camellia)
3: Rice grain (Koshihikari)
4: Wheat/rice bread (30% Koshihikari)
5: Wheat/rice bread (30% Kirara397)
6: Wheat/rice bread (30% Shun-yo)
7: Wheat/rice bread (30% Yumetoiro)
8: Wheat/rice bread (30% Ayunohikari)
9: Wheat/rice bread (30% Milkyqueen)



(A) Results of PCR using template DNAs from rice grain

M: DNA molecular weight marker. 1:Rice (Koshihikari) 2: Rice (Kirara 397) 3: Rice (Shun -yo) 4: Rice (Yumetoiro)

(B)Results of PCR using template DNAs from rice grain, wheat flour and wheat / rice bread

M: DNA molecular weigh marker
1: Yeast (*Saccharomyces cerevisiae*)
2: Wheat flour (Camellia)
3: Rice grain (Shun-yo)
4: Wheat/rice bread (70% wheat flours and 30% Koshihikari)
5: Wheat/rice bread (70% wheat flours and 30% Kirara 397)
6: Wheat/rice bread (70% wheat flours and 30% Shun-yo)
7: Wheat/rice bread (70% wheat flours and 30% Yumetoiro)

Significance of rice production & utilization

Rice is a treasure of Japan

Food production	Climate condition, soil and water ! Land preservation, roles of lowland field
Eating quality	Harmonize well with various dishes Plain but tasty, eatable every day
Health support	Diabetes prevention (low GI) Reduction of obesity (low fat foods)
Cooking & processing	“Slow food” by an earthen pot “Fast food” as aseptic rice, rice bread

Beautiful scenery of paddy fields in Japan

Conclusions

1. Rice is very important crop as a staple food in Japan and all over the world
2. Rice consumption has been decreased and food self-sufficiency rate of Japan is as low as only 40%
3. Cultivars of material rice can be identified by the PCR method based on DNA polymorphism
4. Bio-functionality of rice is investigated eagerly
5. Various kinds of processed rice products have been developed in Japan and other countries
6. Exchange of information and cooperative research on rice are very important

Acknowledgement

I would like to express our gratitude to the organizing committee of 2nd Symposium on Rice Products and Nutrition.

I would like to express my thanks to Dr. S. Nakamura And other colleagues for their efforts.

Thank you very much for
your kind attention !

第二屆米食營養與加工國際研討會農糧署米食研究成果展示列表

編號	展示研究成果主題	學校/科系	主持人
1	添加物與製粉程序對秈米製品升糖指數的影響 (台灣)	宜蘭大學食品科學系	陳時欣
2	米穀粉於專用麵粉及其相關產品之應用	中華穀類食品工業技術研究所	陳明芬
3	超微細化研磨全穀物產品之開發	臺灣大學農業化學系	賴喜美
4	具益菌生效果米點心食品之開發	屏東科技大學食科系	林貞信
5	標準化糙米機能性食品之生產	臺灣大學農業化學系	黃良得
6	高機能無麵筋糙米麵包之開發	嘉義大學食品科學系	李益榮
7	國產紫米機能飲品研發及品質安定性研究	中興大學食品暨應用生物科技學系	江伯源
8	米製乳酸發酵飲品之製造	中興大學食品暨應用生物科技學系	陳錦樹
9	擠壓蒸煮加工方式生產糕仔粉之研究	屏東科技大學食科系	林貞信
10	一種快速鑑定國內外水稻品種之技術	臺灣大學農藝學系	張孟基
11	射頻加熱殺米蟲之研究	宜蘭大學食品科學系	陳淑德
12	高機能易吞嚥麻糬之開發	嘉義大學食品科學系	李益榮
13	米穀粉應用於中西式米製產品之開發	中華穀類食品工業技術研究所	蔡明原

2012 米食國際研討會產品展示		
序號	展示商品	展示廠商
1	手工養生米菓(大片心型)、手工養生米菓(小片圓型)、米麵包	阿蘭城新風貌促進會
2	米麵條、米麵包、烘焙產品等	臺灣米師博
3	先進包裝米食加工產品包裝材料(常溫流通)	聯盟包裝企業股份有限公司
4	米吐司、米鳳梨酥、一口酥等產品	樂米工坊
5	米香	基隆泉利米香
6	膳鮮熟飯等鮮食產品	南僑化學工業股份有限公司
7	醋、米霖、味噌、調理包等產品	穀盛股份有限公司
8	發芽玄米、日式發芽玄米、發芽玄米牛軋糖、發芽玄米沖調粉、發芽益生菌發酵等產品	亞洲瑞思生物科技股份有限公司
9	各式米粉、米加工品等產品	谷統食品工業股份有限公司
10	穀粉產品等產品	馬玉山食品工業有限公司

11	米香、輕食糙米餐等產品	薿園生技
12	糯米麻糬等產品	曾記麻糬