

CHINESE-AMERICAN

JOINT COMMISSION ON RURAL RECONSTRUCTION

Food & Fertilizer Series: No. 3

# GERM RICE

by

Ralph N. Gleason & Yang Yuch-heng



TAIPEI, TAIWAN, CHINA

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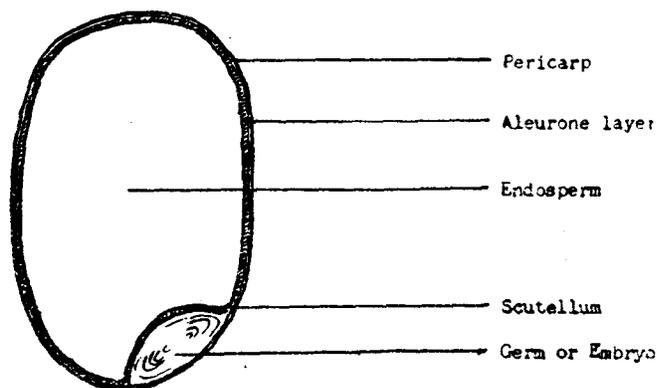
# GERM RICE

By

Ralph N. Gleason (葛理生) & Y. H. Yang (楊月恆)

## A. Germ rice—what is it?

To understand what “germ rice” is, it is necessary to study first the structure of a rice grain. The paddy rice as harvested from the field is covered with a yellowish brown “husk”. After the husk or hull is removed in a process called “husking”, “brown rice” is produced. Brown rice is the grain in its natural state. The structure is shown below.



A milling process called “polishing” changes the brown rice into “polished rice” or “white rice”. By this process, the pericarp, the aleurone layer, and almost all of the germ of the seed are polished off and become “rice bran”. The remaining white rice, which is the type normally eaten, consists only of the “endosperm” and very small remnants of the aleurone layer and the germ. The germ retained in ordinary white rice is only about 5 per cent, but if a specially designed polishing machine is used, as much as 80 per cent of the germ can be retained. Such rice is called “germ white rice” or “germ rice”.

The machine used for milling germ rice is different from the ordinary screw-type of rice polishing machine now used on Taiwan. The screw-type machine removes the bran and polishes by constant friction and relatively high pressure among the rice grains themselves while being driven forward by the screw. As the germ of the rice grain cannot withstand such treatment and remain intact, this most nutritious part of the rice is removed and goes into the rice bran.

In germ rice milling, the bran is removed and the rice polished by bringing the rice grains in contact with the rough surface of an abrasive roller (emery stone disc) which revolves at high speed. The grains are subjected to very little pressure and most of the germ is retained.

## B. Why eat germ rice?

### 1. Germ rice is more nutritious than ordinary white rice:

The purpose of promoting germ rice is to improve the nutrition and the health of rice-eating people. The outer layer of brown rice (including the pericarp, the aleurone layer and the germ) contains most of the protein, fats, vitamins, and minerals. The ordinary method of polishing leaves all these nutrients in the rice bran which is usually fed to domestic animals. The ordinary white rice, used for human consumption, consists chiefly of the endosperm which has very little nutrient content other than carbohydrate. If only the germ of rice, which has a high concentration of the essential nutrients, could be saved and eaten, the people's nutrition and health could be improved.

The Nutrition Chemistry Research Laboratory, Agriculture College, National Taiwan University, provided the following data on the composition of rice and on the comparative digestibility of several kinds of cooked rice:

#### (a) General composition:

Item analyzed	Moisture (%)	Crude protein (%)	Fat (%)	N-free extract (%)	Crude fiber (%)	Ash (%)
Brown rice	13.30	8.80	2.20	73.40	1.00	1.30
Polished rice	13.91	7.72	0.77	76.79	0.25	0.57
Rice bran	11.46	15.08	20.07	37.64	7.32	8.43
Rice germ	5.73	24.30	21.05	25.68	9.77	13.47

#### (b) Digestibility:

Type of rice	Protein (%)	Fat (%)	N-free extract (%)
Cooked polished rice	83.7	85.6	99.8
Cooked brown rice	70.8	34.7	97.3
Cooked germ rice	84.2	82.2	99.7

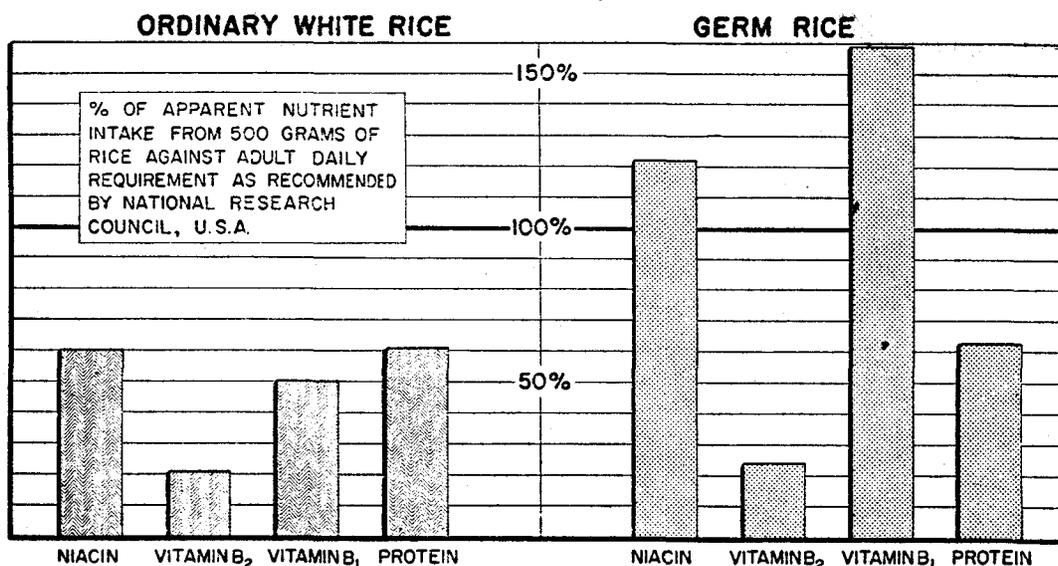
The Food Research Laboratory, Medical College of National Taiwan University, has provided the following preliminary data showing comparative vitamin contents: (unit: mg/100 gm)

Vitamin	Germ rice (5 samples)		Ordinary white rice	Brown rice (2 samples)
	Germ only	Whole grain		
Thiamine (B <sub>1</sub> )	11.0	0.34	0.11	0.38
Riboflavin (B <sub>2</sub> )	1.9	0.06	0.03	0.07
Niacin	12.8	3.00	1.50	No data available

The above data show that germ rice contains about 3 times as much vitamin B<sub>1</sub> as ordinary white rice and twice as much vitamin B<sub>2</sub> and niacin. Tests of urine specimens from consumers of germ rice show a high rate of absorption of the vitamins B<sub>1</sub> and B<sub>2</sub> in germ rice.

It is estimated that average rice-eating adults consume about 500 grams of rice daily. If in the form of germ rice, 1.7 mg of vitamin B<sub>1</sub>, 0.32 mg of vitamin B<sub>2</sub> and 15.0 mg of niacin could be provided which corresponds to 140 per cent, 20 per cent, and 125 per cent, respectively, of the National Research Council's (USA) recommended dietary allowance of these nutrients. Therefore, the consumption of germ rice could apparently solve any vitamin B<sub>1</sub> or niacin deficiencies of rice consumers.

### COMPARISON ON NUTRITION VALUE BETWEEN ORDINARY WHITE RICE AND GERM RICE



## 2. Germ rice milling gives additional yield of polished rice:

To produce and consume germ rice will not only improve health but also increase the food supply. The weight of the germ represents 2.5-3.0 per cent of the total weight of brown rice. If 80 per cent of the germ is retained a net gain of 2 per cent will be added to the amount of edible rice ( $2.5\% \times 80\% = 2\%$ ). Actual polishing tests on Taiwan have shown that the whiteness of 94 per cent germ rice is about the same as that of 92 per cent ordinary polished rice.

Assuming the annual consumption of rice on Taiwan is only 1,000,000 tons, then an actual saving (or increase in availability) of 20,000 tons could be realized if germ rice were consumed by all. Moreover, these 20,000 tons of germ rice so saved is a foodstuff of high nutritional value. To obtain an increase of 20,000 tons in rice production in normal ways would require much effort on the part of the various agricultural specialists and the farmers.

## 3. Germ rice milling reduces substantially the percentage of broken kernels in polished rice:

The percentage of "brokens" (i.e. broken kernels) in the polished rice is an important factor determining its market value. Numerous milling tests have shown that only 0.3-5.0 per cent of broken kernels are found in germ rice milling compared to 10-20 per cent in the ordinary screw-type of milling. Moreover, the loss of nutrients during the washing of whole grains of rice in preparation for cooking is much lower than in the case of broken kernels.

### C. Is the milling of germ rice more difficult? Does it cost more?

The milling of germ rice is just as simple as that of ordinary rice. The same rice polishing system (conveyors, separator, motor, etc.) can be employed, except that the polishing machine (screw-type) in the ordinary mill must be replaced with a germ rice machine which has an emery stone disc. The cost of polishing is practically the same, except that the process for germ rice is a little slower and requires a longer time to obtain the same degree of whiteness. Owing to the higher milling yield, however, the polishing of germ rice is more profitable than the ordinary rice, as can be readily seen from the following calculations:

Item	Ordinary white rice	Germ rice
Polishing cost per 100 kilograms	NT\$2.00	NT\$2.50
Amount of polished rice obtained	92 kgs	94 kgs
Amount of rice bran obtained	8 kgs	6 kgs

The gain of 2 kilograms yield of germ rice is now worth about NT\$7.00. The loss of 2 kilograms of bran is valued at about NT\$3.00. The difference between the two amounting to NT\$4.00, will not only meet the extra polishing expenses (NT\$0.50) but net the processor an extra profit of NT\$3.50.

The cost of converting an established mill to germ rice milling (assuming existing screw-type unit has no salvage value) is estimated below.

1. From an old mill of 1,000 kg/hour polished rice capacity to a germ rice mill of equal capacity:

Item	Available from old mill	To be added	Unit cost	Total cost
Milling machine, 13" stone	—	3	NT\$7,000	NT\$21,000
Conveyor system	2	1	3,000	3,000
Sieves	2	1	200	200
Motor, 5 H.P.	2	1	6,000	6,000
Labor and other expenses	—			600
Total				NT\$30,800

2. From an old mill of 1,000 kg/hour polished rice capacity to a germ rice mill of 600 kg/hour capacity:

Item	Available from old mill	To be added	Unit cost	Total cost
Milling machine, 13" stone	—	2	NT\$7,000	NT\$14,000
Conveyor system	2	—	—	—
Sieves	2	—	—	—
Motor, 5 H.P.	2	—	—	—
Labor and other expenses	—	—	400	400
Total				NT\$14,400

3. From an old mill of 500 kg/hour polished rice capacity to a germ rice mill of 300 kg/hour capacity:

Item	Available from old mill	To be added	Unit cost	Total cost
Milling machine	—	1	NT\$7,000	NT\$7,000
Conveyor system	1	—	—	—
Sieves	1	—	—	—
Motor, 5 H.P.	1	—	—	—
Labor and other expenses	—	—	—	300
Total				NT\$7,300

The rice milling industry in Taiwan is very much over-expanded. It is estimated that not more than one-third of the total rated capacity (10 hour/day basis; 25 days/month) is being utilized. Therefore, the conversion of existing units to germ rice milling resulting in some decrease of rated capacity will not affect materially the actual business of the individual mills or the operations of the industry as a whole.

#### **D. But does not germ rice have some disadvantages?**

Germ rice might have two disadvantages:

1. Cooked germ rice is a little yellowish in color, and a slight difference in taste may be detected since the germ rice is not as bland as ordinary white rice. Protein, fat, vitamins and minerals are concentrated in the germ; therefore, its color, composition and taste are naturally different from those of the endosperm which is chiefly made up of carbohydrate.

In cooked germ rice, the careful observer will note a small yellowish spot on the tip of each grain. However, the past year's experience revealed that the germ rice consumer, instead of considering the small yellowish spot objectionable, regards it as a symbol of protection to his health.

2. Germ rice has a poorer storage quality than the ordinary white rice. The germ contains more nutrients, which furnishes a better medium for the growth of molds, bacteria, etc., and its higher fat content would cause the rice to become rancid sooner. Therefore, germ rice cannot be stored for as long a period as the ordinary white rice. However, this constitutes no major problem on Taiwan where the paddy is not milled until the time for consumption and white rice is seldom stored over one month.

Tests on Taiwan have shown that germ rice can be stored about one month

in wet seasons and 2 to 3 months in dry seasons without any material change in quality. Therefore, the storage of germ rice will present no problem if the supply and distribution of rice are regular.

#### **E. How to promote the eating of germ rice?**

The following are among the steps being taken to promote germ rice:

1. Strengthening of educational work to teach the public the advantages of germ rice to human health.

2. Helping the local Farmers Associations and private rice millers to modify their milling equipment to produce germ rice. A demonstration center has been established in Taipei. Others are planned for other areas of Taiwan. However, it is not intended to increase the total milling capacity on Taiwan.

3. Helping the consumers to obtain high quality germ rice at reasonable prices.

4. Encouraging local machine makers and others concerned with industrial development to produce germ-rice milling equipment and emery stone discs so as to remove the need for foreign exchange for importing them.

5. Enlisting the cooperation of all concerned organizations, specialists, and the newspapers, to accelerate the promotion of germ rice.

#### **F. Where to obtain germ rice?**

With the support of the Industrial Development Commission, Provincial Food Bureau, and JCRR, the first germ rice milling demonstration center has been in operation since late 1954 under the sponsorship of Provincial Farmers Association and Taipei Hsien Farmers Association. The germ rice center, in addition to serving as a demonstration center, also does custom processing work for military units and public functionaries. It also handles retail sales at the center and a home delivery service through subscriptions or telephone calls. Families enlisted as regular germ rice subscribers are about 300 in number, and the number is increasing day by day. The name and address of the center follow:

Name: Germ Rice Demonstration Center, Taipei City (臺北市胚芽米示範中心)

Address: No. 1, Shao-hsing North Street, Taipei (臺北市紹興北街一號)

Telephone: 25571 (電話：二五五七一)

#### **G. Where to procure germ rice milling equipment?**

Germ rice machines, except the abrasive rollers which presently must be imported, are already produced locally. In the Germ Rice Milling Demonstration Center of Taipei Hsien Farmers Association, there are four sets of machines. Two

were supplied by Japanese concerns, namely, one from the Satake Engineering Company Ltd. (佐竹), and one from the Nakuno Engineering Corporation (中野). The other two were supplied by local manufacturers, namely, one from the Tatung Engineering Corporation (大東) of Keelung and one from the San Fong Machine Works (三豐) of Fengyuan.

In addition, the Taiwan Machine Manufacturing Corporation, at Kaohsiung, with the support of the Industrial Development Commission, is now producing germ rice machines in large quantity. The efficiency of the locally made machines is reported to be comparable to those imported.

Research is being made to produce locally the abrasive rollers (emery stone discs) of the germ rice machine. The outlook is promising. However, for the time being the rollers must be imported. The cost of a roller of 300 kilograms capacity of polished product per hour costs US\$20-30 CIF each. JCRR has arranged for the importation of 137 pieces for free distribution to those interested in establishing germ rice milling facilities and promoting the consumption of germ rice. These rollers should be available before the end of 1956.

All queries, suggestions, recommendations, or criticisms concerning this program will be received with hearty appreciation. Please write to:

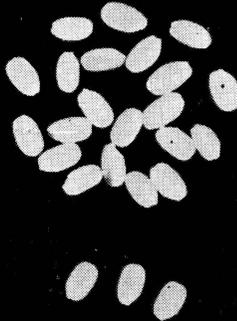
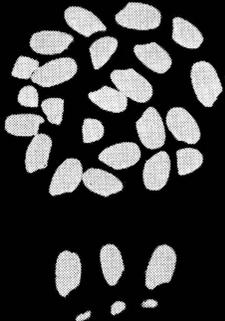
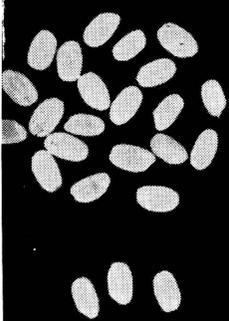
Food & Fertilizer Division  
Joint Commission on Rural Reconstruction  
JCRR Building, 25 Nanhai Road, Taipei  
Tel. 28711-16 and 29380

# 胚芽米 Germ Rice

胚芽米  
Germ Rice  
92% recovery

普通白米  
Ordinary White Rice  
90% recovery

糙米  
Brown Rice

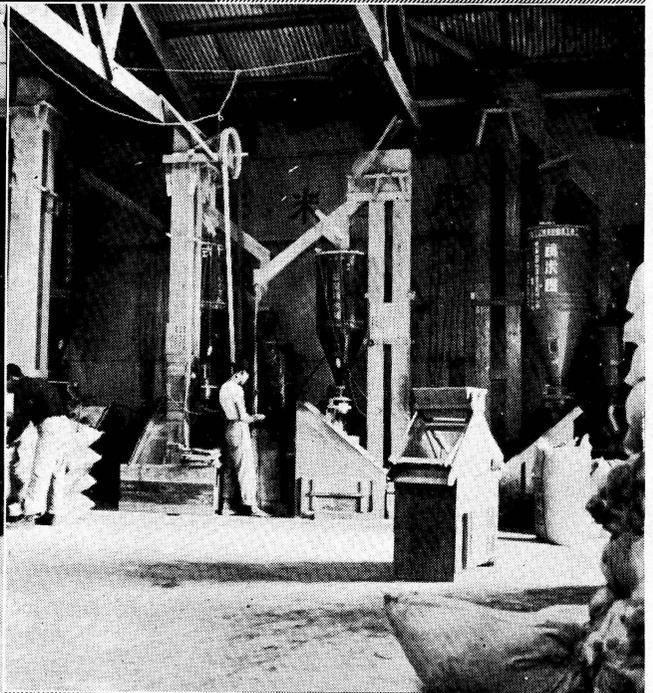


←胚芽米、普通白米與糙米

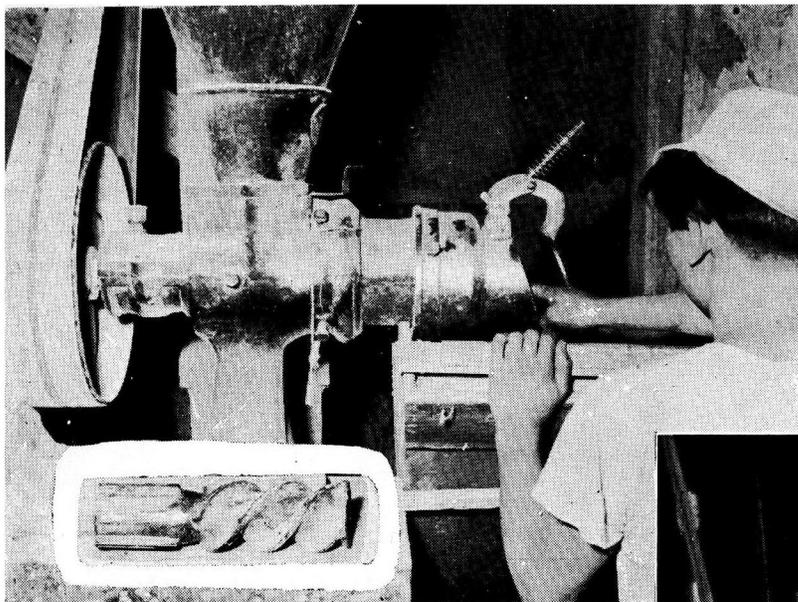
Germ Rice, Ordinary White Rice and Brown Rice

↓臺北市胚芽米中心碾米工場

Rice milling works of Germ Rice Demonstration Center, Taipei

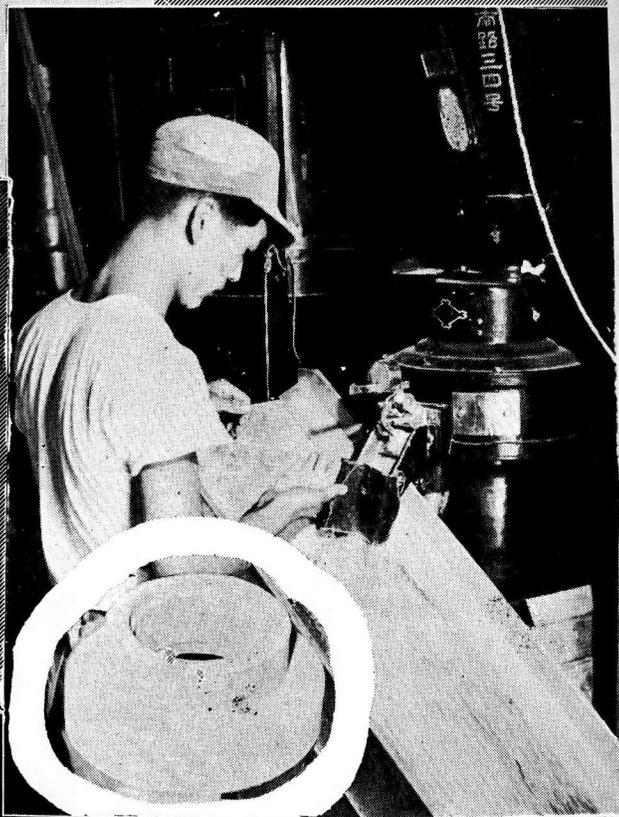


←臺北市胚芽米示範中心門市部  
Retail shop of Germ Rice Demonstration Center, Taipei



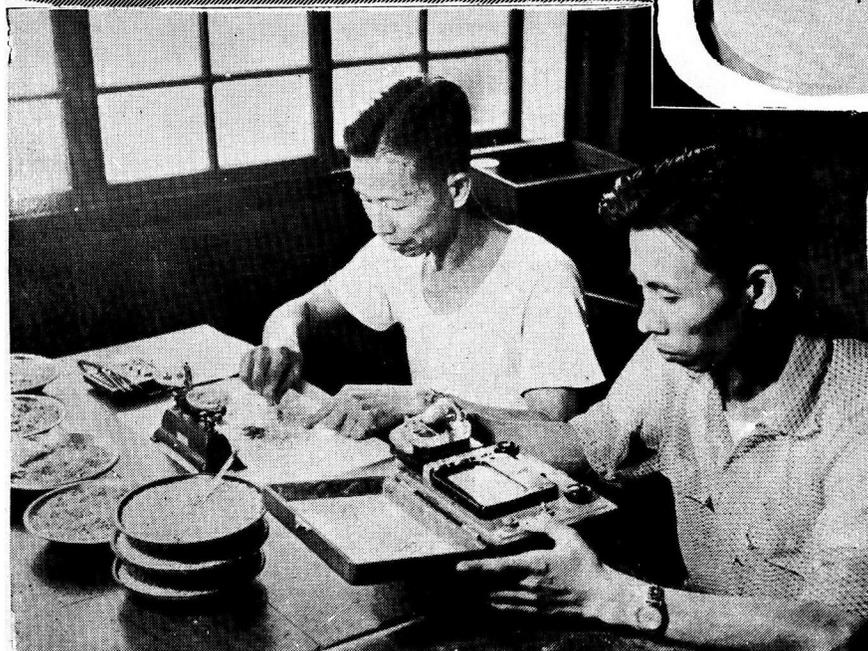
↓ 胚芽米碾米機 (左下角為碾米之砥石盤)

Germ rice milling machine  
Inset: Abrasive roller  
(emery stone disc)



↑ 普通用之螺旋式碾米機 (左下角為機內之螺旋式轉軸)

Ordinary screw-type rice milling machine  
Inset: Screw roller



← 專家檢定胚芽米品質

Inspection of germ rice by  
specialists

行政院農委會圖書室



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