



Characteristics of Hang Rice and its Cooking

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Abstract

This paper explained characteristics of Hang rice or “Horm Thong” rice, which is famous in the northeastern region of Thailand. Hang rice is high nutritious rice. It riches in vitamin E, folic acid, pantothenic acid, vitamin B and niacin. Moreover, it consists a lot of minerals such as magnesium, selenium and calcium, for example. In addition, Hang rice has gamma-aminobutyric acid (GABA) as same as brown rice. Because of Hang rice harvesting, characteristics of Hang rice are differing from brown rice and other high nutritious rice. Contents in this paper described some characteristics of Hang rice, Hang rice processing, morphology, nutritional value, selected physical properties of Hang rice and Hang rice cooking in recently. General data could be used to further product development of Hang rice.

Keywords : *cooking, Hang rice, high nutritious rice, physical property*

1. Introduction

High nutritious food and healthy food have been promoted to many people. Brown rice is one of raw materials produced in Thailand, promoted as high nutritional material to produce many food products. Brown rice is one of high nutritious rice that is partially polished and maintains thiamine that used in the biosynthesis of neurotransmitter acetylcholine and gamma-aminobutyric acid (GABA) caused by decomposition of glutamic acid that is beneficial to health. GABA was applied as a neurotransmitter inhibitor of disease which was related to the nervous system and controlling of blood pressure. Brown rice contains phosphorus that helps to prevent

strengthen of teeth and bones, for example. Brown rice could be produced from many varieties of rice such as jasmine rice and sticky rice (1,2). In addition, Hang rice (parboiled rice), one type of brown rice produced from many kinds of rice cultivars, is an interesting alternative to healthy food production.

Hang rice or “Khao Horm Thong” in Thai was early produced in Na Bor village, Varichaphum, Sakhon Nakhon province, Thailand. Since farmers did not have enough rice to consume, they harvested grains with immature stage but fully form dough stage about 85% of grain's maturity. These materials would be cracked and fractured in polishing step. This rice could not be husked. Then farmers streamed the

rice and dried before partially polishing. The rice's color is yellow-gold and its smell is good. Farmers call it "Hang rice" or "Horm-Thong Rice" ("Horm" means smell good and "Thong" means gold or gold-like-color in Thai). It is famous in Sakon Nakhon and relate province in the northeastern region of Thailand such as Khon Kaen, Maha Sarakham and Kalasin. Cooked Hang rice has soft and good flavor. Nowadays, Hang rice has been used as main food by cooking Hang rice or mixed with white rice before cooking.

2. Hang rice processing

Hang rice could be produced from many varieties of rice. Normally, jasmine

rice (*Oryza sativa* L. cv. Khao Dowk Mali 105 or *Oryza sativa* cv. KDML 105) and sticky rice (*Oryza sativa* var. glutinosa) were used to produce Hang rice. Hang rice production starting from harvesting grain with 80-85% mature stage. Then grain was kept at room temperature for 2 nights and steamed at 100°C (Figure 1.1a). After that, rice grain was cooled using conventional air before dried using air drying (Figure 1.1b), sun drying or hot air tray dryer depending on places where Hang rice was produced. Rice was partially polished before packing. To produce germinated Hang rice, grain was soaked for 12 hr before steaming. Hang rice was shown in Figure 1.1c.

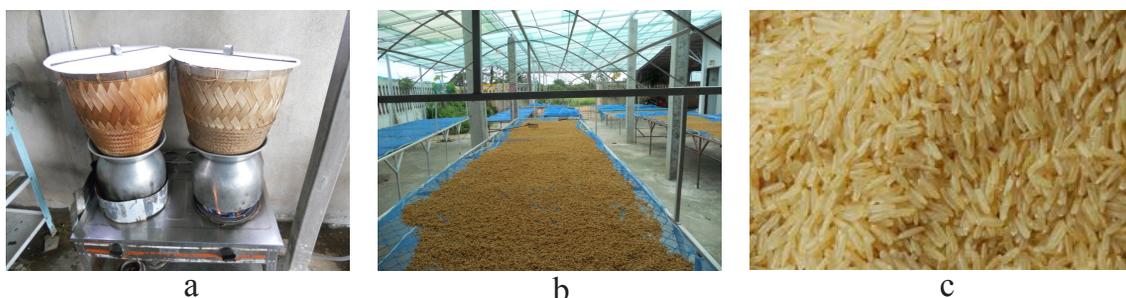


Figure 1. Hang rice processing, a: steaming; b: conventional air drying; c: Hang rice.

In Hang rice process, Hang rice was steamed, dried and polished as mentioned. Starch molecules in rice were heated during steaming and these affected hydrogen bond unfolded, absorbed more water and swollen. Starch had more viscous and less turbidity. Finally, rice was gelatinized. After that, gelatinized rice was dried using hot air dryer and hence induced pre-gelatinization to the starch molecules. Moreover, drying at high temperature affected stress inside starch molecules and induced breakage, hardness and shape to the rice after cooking (3). Morphology, physical and chemical properties of Hang rice were therefore different from those of other rice.

3. Nutritional values of Hang rice

Hang rice was one type of brown rice since Hang rice was partially polished to eliminate the husk. Nutritional values of Hang rice consisted mainly of carbohydrate, protein, lipid, vitamin B, vitamin E and some minerals, which were found in rice germ and rice bran as same as in the case of brown rice. Besides, Hang rice was composed of GABA (gamma-aminobutyric acid) caused by decomposition of glutamic acid that is beneficial to health. GABA was applied as a neurotransmitter inhibitor of disease which was related to the nervous system and controlling of blood pressure, for example (1,2).

Hang rice is rich not just carbohydrate but also vitamins, minerals other nutrients such as GABA. Hang rice consisted of carbohydrate, protein and lipid of 74.97%, 5.60% and 2.86% by weight, respectively (Table 1). Besides, Hang rice was found to have GABA content, varying depending on sources of rice growing. From Tables 1 and

2, it was found that GABA content of Hang rice achieved from Nabor Village, Sakon Nakhon Province, Thailand had GABA content of 2.77 ± 0.21 mg/100 g sample, which was higher than those of others. It should be noted that, germination process could increase GABA content of Hang rice and other brown rice.

Table 1. Nutrition values of Hang rice (% wet basis)

Nutrition values	Hang rice
Carbohydrate (%)	74.97±0.46
Moisture (%)	12.62±0.18
Protein (%)	5.60±0.64
Lipid (%)	2.86±0.60
Carbohydrate (%)	74.97±0.46
GABA (mg/100g sample)	2.77±0.21
Vitamin B1 (mg/100g sample)	0.39±0.00

Note: Hang rice achieved from Nabor Village, Sakon Nakhon Province, Thailand

Source: Srijesdaruk (5) (in Thai); Kerdpi boon et al. (4)

It was found from data in Table 2 that Hang rice had vitamin B1, B2 and niacin higher than that of brown rice. Besides, Hang rice had a lot of minerals and vitamins, especially for vitamin E. Comparison

of nutritional value between Hang rice and white rice was shown in Table 3. It was found that Hang rice was composed of important nutritional values such as vitamin B1, vitamin B2 and niacin.

Table 2. GABA content (mg/100g sample) of brown rice, germinated brown rice, Hang rice and germinated Hang rice from different places

Nutrition values	Brown rice	Hang rice	Germinated Hang rice
Amphoe Varichaphoom, Sakon Nakhon Province		2.77±0.21	
-T. Nonglad,	0.53±0.02		1.55±0.16
-T. Jampa,	0.29±0.50	1.06±0.35	1.33±0.09
-T. Plahlo			
Khonkaen Province			
-Amphoe Waeng Yai	0.20±0.10	0.62±0.02	2.16±0.05
-Amphoe Ubolratana	0.13±0.00	0.66±0.11	1.14±0.08

Applied from Srijesdaruk (5) (in Thai); Kerdpi boon et al. (4)

Hang rice also had vitamins and minerals such as vitamin B1, vitamin B2, vitamin B5, vitamin E, folic acid, magnesium and so on (Table 3). Recently,

Hang rice has been promoted as nutritious rice and sold as a special food product in the northeastern region of Thailand, especially for Sakon Nakhon province.

Table 3. Nutritional value comparison between white rice and Hang rice in 100 g sample

Nutrients	White rice	Hang rice
protein (g)	6.4	7.6
vitamin B1 (mg)	0.07	0.34
vitamin B2 (mg)	0.03	0.05
niacin (mg)	0.11	0.62
pantothenic acid (mg)	0.225	1.50
folic acid (mg)	3.00	20.00
vitamin E (g)	1.00	159.48
calcium (mg)	24.00	32.00
magnesium (mg)	14.00	52.00
manganese (mg)	0.90	1.50
cobalt (g)	0.90	4.20
selenium (g)	31.80	38.30

Sources: Applied from Chuvitkul (6) and Panyangnoi (7)

4. Physical properties of Hang rice

Morphology is a branch of bioscience dealing with the study of the form and structure of organisms and their specific structural features. This includes aspects of the outward appearance (shape, structure, color and pattern) as well as the form and structure of the internal parts like bones and organs. Many researchers have been studied on the morphology of rice and its cooking (8,9). For example, Leelayuthsoontorn and Thipayarat (8) determined textural and morphological changes of Jasmine rice under various elevated cooking conditions. Jasmine white rice was cooked under controlled pressure at temperatures of 80 100 120 and 140°C and pressure of 0 0.1 0.3

and 0.5 MPa. Results were found that using of higher cooking temperature induced softness and stickiness to cooked rice. Moreover, morphology of cooked rice from higher temperature displayed more porous structure to rice image captured from scanning electron microscope. However, pressure range in this experiment did not much affect morphological property of rice structure. Ong and Blan (9) studied the effect of amylopectin structure on textural property of rice harvested from different 11 rice cultivars grown in Nigeria. Each variety of rice had different amylose to amylopectin ratio. It was found that rice, consisted of long chain of amylopectin had more soft and sticky after cooking. Besides, they

described that rice, consisting of long chain of amylopectin, had more compact structure. Morphology of Hang rice was shown in Figure 2. Hang rice's color is yellow. Hang rice had an average width of 2.25 ± 0.13 mm, average length of 8.78 ± 0.53 mm, perimeter of 17.32 ± 0.92 mm and surface area of 15.56 ± 1.50 mm² (Table 4). Hang rice was in the range size between white rice and brown rice by the regulation on the basis of the size and shape in USDA (10). The average width of Hang rice of 2.12 to 2.38 mm that was grouped as the "very length" of rice group as white rice (average

width of 2.3-2.7 mm) and brown rice (average width of 2.4-2.8 mm).



Figure 2. Hang rice

Table 4. Morphology of Hang rice

Characteristics	Hang rice
Width (mm)	2.25 ± 0.13
Length (mm)	8.78 ± 0.53
Surface area (mm ²)	15.56 ± 1.50
Perimeter (mm)	17.32 ± 0.92

Source: Kerdpiboon et al. (4)

In Hang rice process, grains were then steamed and dried using sun drying before polishing. By these steps, protein, lipid, vitamin and minerals in rice germ and husk were absorbed to the surface of rice endosperm. Color of Hang rice was yellow- gold. In addition, starch of Hang rice was found to be pre-gelatinized starch since starch was steamed and induced gelatinization. Then starch was dried and induced pre-gelatinized starch. Gelatinization temperature of Hang rice was 81.73°C (Table 5). Starch gelatinized after achieving water and heating. As shown in Table 5, Hang rice and cooked Hang rice had solubility of $5.53 \pm 0.39\%$ and swelling

power of 8.61 ± 0.18 g/g starch, respectively.

Gelatinization and retrogradation of Hang rice determined using brabender viscoamylograph was found to have gelatinization temperature of $81.73 \pm 0.05^\circ\text{C}$, peak viscosity of 177.25 ± 4.86 BU consistency of 328.50 ± 8.70 BU and setback of 155.50 ± 3.42 BU, respectively. Hang rice had gelatinization temperature higher than that of parboiled rice (gelatinization temperature of parboiled rice was $78 \pm 0.05^\circ\text{C}$). This induced Hang rice had more swelling resistance and breakage of starch granules than that of parboiled rice.

Table 5. Physical properties of Hang rice

Physical properties	Hang rice
Solubility (%)	5.53±0.39
Swelling power (g/g starch)	8.61±0.18
Gelatinization temperature (°C)	81.73±0.05
Peak viscosity (BU)	177.25±4.86
Consistency (BU)	328.50±8.70
Setback (BU)	155.50±3.42

Source: Kerdpiboon et al. (4)

5. Hang rice cooking

Juliano (11) explained that texture of cooked rice depended on the degree of cooking. Rice could be cooked using many techniques depending on amount of water and cooking techniques such as boiling (12,13), soaking before cooking (14), streaming using high temperature and controlled pressure (8,15). Hang rice had morphology and physical properties different from those of other rice. Cooking of Hang rice using the same cooking conditions as other white rice and brown rice was found to be fracture and breakage to the rice (16). Kerdpiboon et al. (16) studied the effects of cooking methods viz. streaming and cooking using Hang rice to water ratios of 2:1, 1:1, 1:2 and 1:3 (w/w), respectively on physical and morphology of the cooked rice. It was found that cooking methods and cooking times had interaction to morphological and physical properties of cooked Hang rice. Hang rice cooked by streaming had less morphological change and elongation ratio than those of cooking by boiling, while hardness was higher than those of cooking by boiling at any rice to water ratios. Using of long cooking time resulted morphological changes of cooked Hang rice. Moreover, increased water

content resulted in increase of color changes and elongation, while hardness significantly decreased ($P \leq 0.05$). In addition, optimized conditions for cooking Hang rice in terms of morphology and physical properties of Hang rice were found to be using rice to water ratios of 1:1 and 1:2 at cooking times of 20 and 15 min, respectively. Recently, Hang rice has been used as main food by cooking Hang rice or mixing with white rice before cooking. Cooked Hang rice is soft and has good flavor. Hang rice could be used to make soup, gruel rice, fried rice or even dessert from Hang rice flour. These products help consumers to have more nutritious foods. Processing of products from Hang rice such as making Hang rice flour to be raw materials for snacks, making of roasted Hang rice to produce roasted Hang rice tea and mixing Hang rice flour with wheat flour to bake bakery product are also interested.

6. Conclusion

Hang rice could be promoted as high nutritious food and healthy since it consisted not only carbohydrate but also protein, vitamins and minerals. Moreover, it had GABA content with was higher than that of brown rice. Hang rice was in the range size

between white rice and brown rice. It is yellow- gold color. Techniques and conditions to produce many products from Hang rice are in further research. The optimized cooking condition to achieve good flavor and texture was different from cooking conditions for other white rice and brown rice. Moreover, starch in Hang rice was pre-gelatinized starch. Using of Hang rice to produce starch based products such as bakery and soup may achieved different texture compared with other rice.

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