Environmental responsibility of rice var. Kum Bangpra and Riceberry in lowland and upland conditions

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Abstract Rice (*Oryza sativa* L.) var. Kum Bangpra is improved purple pericarp variety from pure line selection for five years during in-season and off-season to yield the desirable phenotypic characters. The chemical and physical properties were compared with Riceberry in lowland and upland conditions. Result revealed that the two rice varieties under lowland conditions was significantly differed in plant growth paramet ers eg. plant height, tillers , harvesting time, panicle's number per hill, and yield. Kum Bangpra variety gave the highest yield of 705.80 kg. per Rai. Riceberry resulted to yield 462.20 kg per Rai, which the growth parameters and yields were similar resulted in upland and lowland conditions. Kum Bangpra variety and Riceberry yielded 654.80 and 412.60 kg. per Rai, respectively. It is noticed that Kum Bangpra variety gave greater yield than Riceberry in both conditions. In lowland condition found that Kum Bangpra variety expressed straw-colored husk, round grain shape, dark purple husked grain, gelatinization temperature at 67 ℃, soft and sticky cooked rice. Whereas Riceberry revealed dark purple husk, long and slender grain, dark purple husked grain, gelatinization temperature at 70 ℃, and incoherent soft cooked rice. Kum Bangpra variety contained greater amount of GABA, protein, fiber, omega 3, gamma oryzanol, and antioxidants than Riceberry. It is suggested that Kum Bangpra variety found low starch and amylose content of 7.15 % which is considered to appropriate the dietary and sugar intake.

Keywords: environment, responsibility, rice, lowland, upland

Introduction

The two lines of wild rice or barnyard millet or chicken panic grass (*Oryza rufipogon* and *Oryza officinali*) is known as thai rice that expressed pericarp in red, purple, and black colors. The red rice line is grown in combination with white rice in paddy field. The red rice is smaller grains than other rice. It can grow well in the field but the seeds is easily falled and survive overseason. It is also shown that wild rice (*Oryza rufipogon*) contains only 26 % amylose content in rice starch, requires high cooking

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temperature to achieve gelatinization, produces low gel consistency (hardness) and no aroma. The second rice line is dark purple to black color seed, high protein and minerals eg. Iron, Zinc, Copper, Calcium, Potassium, and vitamin B. The black purple color grains showed anthocyanin which it is an antioxidant. Anthocyanin in black rice promotes black and soft hairs, prevent split-end hairs, blood circulation, prevent hairs fall (Wanchai, 1988). Champagne *et al*. (2004) reported that brown rice is the layer containing the bran, rich nutrition eg.dietary fiber, phytic acid, vitamin B, gamma oryzanol and gamma amino butyric acid (GABA) which is non protein-based amino acid and play an important role of inhibitory neurotransmitters in sympathetic nervous system (Bao *et al*., 1995). GABA can be utilized as a nutritional influenced the blood pressure (Nakagawa and Onota, 1996; Diana *et al*., 2014). The objective was to aimed to evaluate the agronomic characters, chemical and physical properties of rice var. Kum Bangpra and compared with Riceberry in lowland and upland conditions.

Materials and Methods

The experiment was performed in Randomized Complete Block Design (RCBD) in five replications. Treatments were designed for planting Kum Bangpra and Riceberry in 10 plots of 10 m ^{2} by transplanting 30-days of rice seedlings with 30 x 30 cm. The same spacing was designed in the plots both in lowland upland conditions. The experiment was conducted in August to December 2017 at the paddy fields, Plant Science Research Field, Department of Plant Production Technology, Faculty of Agriculture and Natural Resources, Rajamangala University of Technology Tawan-Ok at Bangpra Campus, Thailand. Rice var. Kum Bangpra was gathered from previous research findings from pureline selection method. Riceberry was used to compare. The experiment was repeated two times. Data were recorded according to the method of Yoshida (1981). Plant growth parameters were collected as plant height, number of plants per hill, harvest age, number of panicles per hill and yield per Rai. Data were subjected to analysis of variance. Treatment means were compared using Duncan" s Multiple Rang Test (DMRT) at 95 %.

Results

The research finding showed that in lowland the plant height (143.08 cm) in Kum Bangpra variety is significantly higher than riceberry (137.00). The number of plant per hill in Kum Bangpra (14.00) was higher than rice berry (13.08). The harvesting day of Kum Bangpre was 110.60 days which faster than rice berry 120.60 days). The number of panicles per hill in kum bangpra was 13.50 which higher than rice berry (12.80). It inerestedec that

yield perv rai in kum bangpra was 705.80 kg/rai which higher than rice berry (462.20 kg.rai) as seen in Table 1. Result in upland showed plant height, number of plant per hill, number of panicle per hill in kum bangpra variety higher than rice berry as seen in Table 2. The harvesting days in kun bangpra (110.60 days) was faster than riceberry variety (130.40 days). It was noticed that yield of kum banfpra variety was 705.80 kg/rai which higher than riceberry variety(462.20 kg/rai). The physical traits of Kum Bangpra and Riceberry rice varieties was compared husk color, grain shape, husked grain color, gel temperature and cooked rice texture and cooked rice texture as seen in Table 3.

Table 1. Plant height, number of plants per hill, harvest age, number of panicles per hill and yield per Rai of 2 rice varieties in lowland condition

Rice variety	Agronomic Traits				
	Plant Height (cm.)	Number of Plants per Hill (Plants/Hill)	Harvest Age (Days)	Number of Panicles per Hill (Panicles/Hill	Yield (kg/Rai)
Kum Bangpra	143.08[a]	14.00[a]	110.60[b]	13.50[a]	705.80[a]
					462.20[c]
Riceberry	137.00[b]	13.08[b]	130.60[a]	12.80[b]	
Mean	140.04	13.54	120.60	13.15	584.00
F-test	**	**	**	**	**
C.V. (%)	0.67	1.33	0.88	2.10	3.70

** Highly statistically significant difference at 99% confidence level. In the same column, different letters signify statistical difference when comparisons were made with DMRT. Note:- 1 rai is 1,600 m^2.

Table 2. Plant height, number of plants per hill, harvest age, number of panicles per hill and yield per rai of 2 rice varieties in upland condition

Rice variety	Agronomic Traits				
	Plant Height (cm.)	Number of Plants per Hill (Plants/Hill)	Harvest Age (Days)	Number of Panicles per Hill (Panicles/Hill	Yield (kg/rai)
Kum Bangpra	124.60[a]	14.60[a]	110.60[b]	14.00[a]	654.80[a]
					412.60[c]
Riceberry	102.20[b]	13.60[b]	130.40[a]	13.20[a]	
F-test	**	**	**	ns	**
C.V. (%)	1.60	4.05	0.95	4.10	3.78

ns = Not significant difference, ** = Highly significant difference at 99% confidence level. In the same column, different letters signify statistical difference when comparisons were made with DMRT method. Note:- 1 rai is 1,600 m^2.

The chemical component was analyzed both in Kum Bangpra and Riceberry varieties. It found that Kum Bangpra variety contained higher amount of GABA (20.54 mg/kg), protein (9.17g/100g), fiber (8.02g/100g),

omega 3 (30.62mg/100g), gamma oryzanol (241.23mg/kg.)and antioxidant (106.23mg.Ascorbic acid/100g) than Riceberry variety. But in Riceberry variety contained more Vitamin B2 (0.042 mg/100g.), Vitamin E (0.55 mg/100g.), Iron (13.80 mg /kg.), Zinc (31.90 mg/kg) and anthocyanin (21.50 mg/100 mg) than Kum Bangpra variety as seen in Table 4.

Table 3. Physical traits of Kum Bangpra and Riceberry rice varieties

Physical Trait	Varieties	
	Kum Bangpra	**Riceberry**
Husk Color	Straw Color	Dark Purple
Grain Shape	Relatively Round	Long and Slender
Husked grain Color	Dark Purple	Dark Purple
Gel Temperature (℃)	67	70
Cooked Rice Texture	Sticky and Soft	Incoherent and Soft

Table 4. Chemical components of Kum Bangpra and Riceberry rice varieties

Chemical components	Variety		Reference Test
	Kum Bangpra	**Riceberry**	
GABA (mg./kg.)	20.54	18.95	TAS 4003-1012
Protein (g./100 g.)	9.17	8.30	AOAC 2012
Starch (%)	67.87	79.20	EC-Method 1999/79
Fiber (g./100 g.)	8.02	4.95	AOAC 2012
Vitamin B	0.029	0.042	Food Chemistry (1984)
Vitamin E (mg./100 g.)	0.20	0.55	LC Analysis of Food(1979)
Iron (mg./kg.)	11.43	13.80	AOAC 2012
Zinc (mg./kg.)	21.28	31.90	AOAC 2012
Amylose (%)	7.15	15.6	AOAC 2012
Omega3 (mg./100 g.)	30.62	25.51	AOAC 2012
Anthocyanin (mg./100 g.)	17.42	21.50	AOAC 2012
Gamma Oryzanol (mg./kg.)	241.22	46.20	AOAC 1995
Antioxidant (mg. Ascorbic acid/100 g.)	106.23	47.50	DPPH-Method

Discussion

The research findings found the lowland cultivation gave better agronomic traits than upland cultivation. Both tested varieties of Kum Bangpra and Riceberry gave higher yields in lowland than upland cultivation. De Datta and Zarate (1970) explained that in lowland commonly longer internode than upland cultivation. Lowland plantation is common for rice growing system which give better culm growth, yields, number of plants per hill, and number of panicles per hills (De Datta and Zarate, 1970).

The physical traits of rice varieties is controlled by genotype characters. Kum Bangpra variety is purple color that seem to be an

antioxidant which also encountered in Riceberry variety. Withthis, Tester and Morrison (1990) stated that rice gelatinization is affected by temperature for cooked rice. The gelling property of rice starch depended on rice varieties. amylopectin and amylose are affected to chemical properties and physical trait factors and the processing method (Ahmed *et al*., 2016). Ngamchuen (2003) started that low amylose in rice is often used as raw material for fermented Japan's sake, rice vinegar or Shoyu. It provides high viscosity and long time for gelatinization which related to low gel temperature.

The research finding found chemical properties of Kum Bangpra variety encountered GABA, protein, fiber, omega 3, gamma oryzanol and antioxidants including Vitamin B, Vitamin E, Iron, Zinc, and anthocyanin. Dyall and Michael-Titus (2008) reported that essential fatty acids are important for structural and functional brain and nervous systems. Shahida and Ahmad (2017) said it helps to reduce cholesterol. Zinc aids co-operated to protein synthesis (Christos *et al*., 2012), healing acne, preventing hair loss and stimulating hair roots (Rushton, 2002). As results, both varieties found iron in appropriate levels. Abbaspour *et al*. (2014) reported that iron helps in energy production and transportation of hemoglobin in red blood cells. Vitamin E was found in both rice varieties in this study. It helps anti-aging and prevents oxidative stress (Leslie and James, 1999; Rizvi *et al*., 2014).

Vitamin B1found in kum bangpra and riceberry varieties. It is suggested that these rice varieties would help the rice consumers to maintain the functions of brain, nervous system, and digestive system (Abdoulaye, 2008; Makarchikov, 2009). The research finding found gamma oryzanol in kum bangpra variety much higher than rice berry variety. It is possible that the consumers of kum bangpra rice variety would get benefit to reduce cholesterol and triglyceride in blood vessels, promotes normal circulation of blood, reduce risk of heart disease, diabetes, hypertension, and dementia (Diana *et al*., 2014).

Moreover, the result on chemical traits of Kum Bangpra rice variety contained low starch and low amylose content of 7.15 %. Frei (2003) stated that amylose content of 2-12 % in rice grains is grouped as very low amylose content (2-12%), and is considered to suitable for diabetes patients.

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