Consumer Survey of Selected Thai Rice for Elderly Using Focus Group and Acceptance Test

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Abstract

This survey aimed to study on the attitude and acceptance of elderly toward 9 varieties of Thai rice. The focus group discussion was conducted by 36 elderlies, separating into 3 groups and quoting by age; 60–69, 70–79 and 80 years old and over. Most of subjects normally consumed polished white rice because of softness and easily chewing. Especially the 80 years group, they often had the trouble of chewing and swallowing, thus they need softy to mushy rice. The subjects normally liked texture of unpolished color rice or brown rice mixed with polished white rice rather than unpolished color rice alone. The subjects were familiar with rice and brown rice because they knew that brown rice and color rice were good for health. However, elderly could not explain how brown rice or color rice was beneficial to their health. The consumer survey of 9 Thai rice varieties were involved by 216 elderlies with different genders, age, educations, vocations, income, living, and attendant. The sensory acceptance test was conducted using 9 point hedonic scale with Balanced Incomplete Block design (n = 216). The results showed that the liking score of Hom Mail brown rice was the highest but not significantly different (p>0.05) from those of Kam LeumPua and Kam Doi Saket in all attributes (appearance, color, aroma, flavor, sweetness, overall taste, hardness, softness, tooth pack and overall liking). In conclusion, the colored rice has high potential to be developed for the elderly consumer product with aroma, soft texture and health benefit.

Keywords: Thai rice, Elderly, Focus group, Hedonic scale, Colored rice

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1. Introduction

Colored rice or pigmented rice is famous which the rice grain is purple or red and brown color in its layer. Colored rice has received much attention due to its beneficial health effect on heart disease (Hou *et al*., 2010). The phenolic compounds have been found as major active compounds for antioxidant capacity (Yawadio *et al*., 2007). For colored rice, the main bioactive compound of phenolic content has been reported as anthocyanins (Zhang *et al*., 2006). The content of antioxidant such as phenolic in colored rice is exaggerated by genotype and environment (Goffman *et al*., 2004). Colored rice is concentrated in rice bran layer, subsequent in colored rice with different color. Elderly are those when their physical, psychological, and social status deteriorates. It is the age to be closely supervised by the family. The basic needs for the elderly are physical, mental, social and economic. The three requirements factor will affect the health and nutrition of the elderly, for example: deterioration of the body can't choose the right quality food properly. The inability to smell or chew food causes over nutrition or lack of nutrition and income problems resulting in cost savings. Dietary intake is therefore inferior in quantity and quality (Suthatam, 2013). The United Nations estimated that by 2050, the proportion of the elderly population in developed countries will increase by more than 35%, while the developing countries will account for 20% of the population in the developing world. The criterion for the elderly in Thailand is a person who is over 60 years old, but Thailand countries is divided into 3 groups: (60–69, 70–79, and 80 year over). Physical activity with metabolic syndrome of the elderly usually decreases by 10% per year, resulting in lower energy requirements (Suthatam, 2013). Therefore, this survey aimed to study on the attitude and acceptance of elderly toward 9 varieties of Thai rice because the elderly consume rice normally but they not consume colored rice. Researchers has recognized the importance of using Thai color to increase value for finding high potential rice to developed with aroma, texture and health benefits for elderly consumer.

2. Materials and Methods

2.1 Rice samples

Samples are 9 varieties of Thai Rice including Hom Mali brown rice 105 (HMBR105), Sticky rice RD6 (SRRD6), Sinlek (SL), Red Hom Mali brown rice (RHMER), SangYod (SY), Hom Nin (HN), Riceberry (RBR), Kam LeumPua (KLP) and Kam Doi Saket (KDSK). The samples were purchased from organic market in Chiang Mai, Thailand except the sticky rice RD6 and Kam Doi Saket which were supported by Lanna Rice Research Center, Chiang Mai University, Thailand.

2.2 Rice preparation

A group of purple rice (HN, RBR, KLP and KDSK) was soaked for at least 2–3 h even though SY, SRRD6 and RHMBR were soaked just for 15–30 min. Then, the soaking water was used for rice cooking. The ratio of rice and water for purple rice, SY, SRRD6, RHMBR, HMBR, SL cooking was 1:1.5 and 1:2 respectively (Phanasomburna, 2009). All rice samples were cooked by electric rice cooker. (KS-ZT18, Sharp, Thailand) and samples were stored in a plastic bag until further experiment.

2.3 Physiochemical measurement of rice

2.3.1 Color

Color of rice samples was determined by Hunter-Lab (Mini-scan EZ, Virginia, USA). Prior to color measurement, the instrument was calibrated with white calibration tile. The color parameter (L*, a* and b*) were analyzed with 3 replicates for all samples.

2.3.2 Total phenolic content

Rice samples (10g) of each accession were extracted with 100 mL of 40% acetone for 24 h at room temperature (30±2°C). The mixture was filtered through filter paper (Whatman No.4) and supernatant was collected and stored at 4°C (Hyun-Il *et al*., 2012). Total phenolic content were assayed using the Folin-Ciocalteau method (Aguilar-Garcia et al., 2007). Briefly, Folin-Ciocalteau reagent was diluted with water 1:9 (v/v). To 2.5 mL of this reagent, 60 µL of the sample extract was added and incubation at room temperature (30±2°C) for 2 min, 2 mL sodium carbonate solution (7.5%) was added. The mixture was incubated for 15 min and the absorbance was measured at 760 nm.

2.3.3 Scavenging ability by the DPPH radical assay

DPPH radical scavenging ability of rice samples was measured according to the methodized by (Williams *et al*., (1995). An extracted rice sample (0.2 mL) was mixed with 2.8 mL 60 µM DPPH, and left to stand in dark place for 30 min at room temperature (30±2°C) and the absorbance was measured at 515 nm.

2.3.4 Proximate analysis

Moisture content, protein, lipid, fiber, ash and carbohydrate were determined with standard procedures (AOAC, 2000). Protein was estimated from total nitrogen using a conversion factor of 5.95 (FAO, 2003)

2.4 Focus group discussions

A focus group discussion was conducted by 36 elderlies. The groups were separated into 3 groups quoting by age; 60–69 year, 70–79 year and 80 years old. The trained moderator began each group session by clarifying the objective of the study and informing the elderlies about how they might respond to questions. Frist, the focus group discussions with

engagement questions involved discussion about familiarity of brown rice and colored rice including consumption habits of the elderly. Then, engagement questions involved discussion about consumption and benefit of brown and color rice. Finally, exploration question led to discussion about rice cooking and rice texture requirements of the elderly. The translation process was conducted independently by researchers to check the reliability of the process.

2.5 Consumer acceptance test

A consumer survey for selected Thai Rice was involved by 216 elderlies with different gender, age, education, vocation, income and living behavior and attendant. Sensory acceptance test was conducted using 9 point hedonic scale with Balanced Incomplete Block design (BIB), consisted of 12 blocks, when t=9, k=3, r=4 and λ=1. Sensory attributes evaluated include, appearance, color, aroma, flavor, sweet, overall taste, hardness, softness, tooth pack and overall liking. Rice sample were packed in plastic cup with cover.

2.6 Experimental design and data analysis

Sensory data were analyzed by multivariate analysis of variance and the data means were compared by Duncan's new multiple range test (DMRT) at 95% confidence level.

3. Results and Discussion

3.1 Physiochemical properties of rice samples.

3.1.1 Antioxidant properties and color

The total phenolic contents of rice samples were in the range of 21.94–635.01 mg Gallic/100 mL samples of which KLP (635.01 mg Gallic/100g samples) was the highest, but not significantly different (p>0.05) from KDSK (628.26 mg Gallic/100g samples) and RBR (630.52mg Gallic/100g samples). However, it was significantly different ($p\leq$0.05) from HMBR105, SL, SRRD6, RHMBR, SY and HN. The DPPH assay values were in the range of 4.34–90.82 (% scavenging ability). There were significant differences ($p\leq$0.05) among KDSK (90.82%), KLP (90.34%) and RBR (90.66%) from another rice samples (Table1).

The color parameters (L*, a* and b*) of the 9 varieties of Thai Rice exhibited the brightness denoted by L* which were in the range of 12.79–62.41. The values of a* and b* were in the range of -0.08–12.02 and 1.97–19.92 respectively. The L* values of SRRD6 was the highest one (62.41) and L* are shown not significantly difference (p>0.05) on RBR (12.84) from KLP (12.79). A* values of RHMBR was the highest (12.02) and b* values of SL was the highest (19.92) are shown significantly difference ($p\leq$0.05) from all another rice.

Figure 1 9 Thai rice varieties; A= HMBR105, B= SRRD6, C= SL, D= RHMBR, E= SY, F= HN, G= RBY, H= KLP and I= KDSK

Table 1 Scavenging ability (%) (DPPH assay), total phenolic content and color measurement of 9 Thai rice

Samples	Color			TPC (mg Gallic/ 100 g samples)	Scavenging ability (%) (DPPH assay)
	L*	a*	b*		
HMBR105	42.91±0.24^{c}	3.44±0.02^{g}	18.44±0.05^{b}	49.83±1.22^{d}	26..37±0.39^{e}
SL	46.58±0.22^{b}	3.71±0.07^{f}	19.92±0.18^{a}	36.55±1.69^{e}	16.19±0.19^{f}
SRRD6	62.41±0.88^{a}	-0.08±0.02^{i}	11.75±0.24^{e}	21.94±2.19^{f}	4.34±0.91^{g}
RHMBR	25.40±0.49^{d}	12.02±0.07^{a}	13.72±0.14^{d}	428.25±2.36^{b}	88.43±0.31^{c}
SY	24.54±0.22^{e}	11.35±0.01^{b}	17.62±0.05^{c}	426.70±2.30^{b}	89.69±0.18^{b}
HN	14.29±0.67^{f}	5.11±0.12^{c}	6.09±0.31^{f}	410.43±2.17^{c}	80.31±0.19^{d}
RBR	12.84±0.30^{g}	2.49±0.07^{h}	1.97±0.36^{i}	630.52±7.81^{a}	90.66±0.19^{a}
KLP	12.79±0.34^{g}	4.07±0.04^{d}	3.87±0.21^{g}	635.01±5.18^{a}	90.34±0.18^{a}
KDSK	14.50±0.96^{f}	3.86±0.07^{e}	3.29±0.02^{h}	628.26±5.08^{a}	90.82±0.70^{a}

Note: Values are mean±SD (n=3). Values followed by different letters in the same column are significantly different by Duncan's multiple tests (p≤0.05). TPC= Total phenolic content

3.1.2 Proximate composition

The moisture content, protein, ash, crude fiber, fat and carbohydrate content of 9 varieties of rice are shown in Table 2. The moisture content of rice samples were in range of 11.97–13.93% by weight and protein contents were in the range of 7.24–9.097%. The highest protein rice was KDSK, HN, KLP and RBY which consisted more than 8% of protein. The Fat contents were in the range of 0.45–3.18% weight samples. Rice variety with the highest fat

content rice was HMBR (3.18% weight samples) which was not significantly different (P>0.05) from other rice samples except SL and SRRD6. The crude fibers were in the range of 0.42–1.33% weight samples and KLP was the highest (1.33% weight samples) but not significantly different (P>0.05) from those of other rice samples except SRRD6 (0.42% weight). Ash contents of rice were in the range of 0.45–1.66% weight and the highest ash content rice was found in KDSK but not significantly different (P>0.05) from that of KLP (1.65% weight samples), SRRD6 which consisted less than 1% of ash content. The carbohydrate contents of rice were in the range of 71.49–77.31% weight samples. The highest carbohydrate content was found in SRRD6.

Table 2 Proximate composition; moisture content, protein, fat, crude fiber, ash and carbohydrate content of 9 varieties Thai rice

Rice samples	Moisture content	Protein content (dry basis)	Fat content (dry basis)	Crude fiber (dry basis)	Ash content (dry basis)	Carbohydrate (dry basis)
HMBR105	13.17±0.14^{c}	7.39±0.02^{e}	3.18±0.71^{a}	1.09±0.25^{ab}	1.59±0.01^{b}	73.57±0.87^{cd}
SL	12.56±0.04^{e}	7.71±0.04^{d}	2.09±0.05^{b}	1.43±0.41^{a}	1.48±0.01^{c}	74.72±0.48^{b}
SRRD6	13.93±0.49^{a}	7.42±0.01^{e}	0.45±0.04^{c}	0.42±0.01^{c}	0.45±0.02^{g}	77.31±0.09^{a}
RHMBR	13.70±0.12^{b}	7.24±0.07^{f}	2.69±0.16^{a}	1.08±0.32^{b}	1.43±0.02^{d}	73.83±0.18^{c}
SY	12.85±0.03^{d}	7.43±0.03^{e}	2.61±0.12^{ab}	1.18±0.01^{ab}	1.27±0.01^{f}	74.63±0.13^{b}
HN	11.97±0.02^{f}	8.88±0.02^{b}	3.14±0.12^{a}	1.19±0.61^{ab}	1.32±0.03^{e}	73.48±0.16^{cd}
RBR	12.48±0.02^{e}	9.06±0.05^{a}	3.03±0.03^{a}	1.10±0.25^{ab}	1.43±0.01^{d}	72.81±0.12^{d}
KLP	12.61±0.01^{e}	8.05±0.01^{c}	2.91±0.13^{a}	1.33±0.26^{ab}	1.65±0.03^{a}	73.42±0.09^{cd}
KDSK	13.88±0.03^{a}	9.09±0.01^{a}	2.83±0.05^{a}	1.04±0.20^{b}	1.66±0.01^{a}	71.49±0.04^{e}

Note: Values are mean±SD (n=3). Values followed by different letters in the same column are significantly different by Duncan's multiple tests ($p \leq 0.05$).

3.2 Focus group discussion

Focus group discussions are showed in Table 3. The engagement questions were talked about the benefits of brown rice or colored rice. All group of 60–69 year old and 70–79 year old had the same of attitude and understanding about brown rice and colored rice. However, elderly could not explain benefit of brown rice and colored rice. The Exploration questions were talked about The texture of the brown rice and / or rice products was the color the elderly needed, 60–69 year old mostly likes rice that is soft and over 80 year old like to eat soft rice because they often had the trouble of chewing and swallowing.

Table 3 The results of focus group discussion from 36 elderlies in 3 ages groups

Question/Age	60–69 year	70–79 year	over 80 year
1. Engagement questions			
1.1 Consumer's familiarity with brown rice and colored rice / Do you know the benefits of brown rice or color rice?	All group of elderlies had the same of attitude and suggestion, they were familiar with color rice and brown rice, for example; rice berry, Sang Yod, Hom nin and other. The elderly know that brown rice or color rice is good for health. However, elderly could not explain how brown rice or color rice was benefit. Most of subjects normally consume the polished white rice because of its softness and easily chewing.		They often had the trouble of chewing and swallowing
1.2 Consumption of brown rice and / or colored rice	The 60-69 years old group had enough budgets for supporting their demand to buy rice. Some elderlies cooke rice by themselves, and they normally cook soft rice with too much water. Elderlies who were 60-69 years old indicated that they like to eat soft cooked rice and normally to cook color rice mixed with polished rice because color rice is expensive.		They like to eat porridge rice.
2. Exploration questions			
2.1 The texture of the brown rice and / or rice products was the color the elderly needed.	The group mostly likes rice that is soft, not too frosty.	The group like to consumed soft cooked rice but not mushy rice	They like to eat soft rice because they often had the trouble of chewing and swallowing.
2.2 What is your desire for brown rice / colored rice	For the opinion of participants on rice product development, all groups of elderly need small soft to medium hard texture product and the appearance of the product like a porridge rice but remained a piece of grain.		

3.3 Consumer acceptance test

Sensory acceptance test were conducted in elderly group using BIB design. Nine point hedonic scales were used to evaluate the acceptance of participant on 9 Thai rice varieties (Table4). Two hundred and sixteen elderly with different gender, age, education, gender, age, education, vacation, income, and attendant were recruited with 20.6% of male and 79.3% of female. Sensory test was conducted to evaluate of appearance, color, aroma, flavor, sweet, overall taste, hardness, softness, tooth pack and overall liking of rice sample (Table 4).

The sensory score were conducted using 9 point hedonic scale. The result was found that the panelists found not significantly difference ($p>0.05$) of tooth pack attribute. The liking scores were between 6.61±1.36–7.03±1.26 (like slightly to like moderately). The result showed significantly difference ($p\leq0.05$) in appearance, color, aroma, flavor, sweet, overall taste, hardness, softness and overall liking of 9 Thai Rice varieties. The appearance attribute was between 5.93±1.88 to 7.43±1.63. There was significantly differences of appearance ($p\leq0.05$) among HMBR105 (6.92±1.77) form SL (6.04±1.75) and RHMBR (5.93±1.88). The color attribute was showed significantly difference ($p\leq0.05$) of HN, RBR, KLP, KDSK form HMBR105. The aroma attribute was showed not-significantly difference ($p>0.05$) on SY and RHMBR form SRRD6. Kam Doi Saket had the highest score in appearance (7.43±1.62), color (7.39±1.00), aroma (7.25±0.96), flavor (7.61±1.00), softness (7.08±1.05), and overall liking (7.33±1.41), but not significantly difference ($p>0.05$) to HMBR105 (7.06±0.87) and KLP (6.99±1.49).

Table 4 Acceptance score of 9 Thai rice using 9- point Hedonic scale

Samples/ Attribute	appearance	color	aroma	flavor	sweet	overall taste
HMBR105	6.92±1.77^{ab}	7.22±1.04^{ab}	7.00±0.75^{ab}	7.47±0.84^{ab}	7.17±0.84^{abc}	7.08±0.78^{ab}
SL	5.97±1.95^{c}	6.89±1.55^{bc}	7.26±0.95^{a}	6.96±1.71^{c}	6.85±1.32^{cd}	6.89±1.42^{b}
SRRD6	6.29±1.68^{bc}	6.79±1.25^{bc}	6.94±0.89^{abc}	7.25±0.92^{abc}	7.39±0.88^{a}	7.37±0.88^{a}
SY	6.04±1.75^{c}	6.69±1.64^{c}	6.61±1.52^{c}	7.08±1.46^{bc}	6.75±1.26^{d}	6.94±1.16^{b}
RHMBR	5.93±1.88^{c}	6.99±1.27^{abc}	6.79±1.09^{bc}	7.25±1.24^{abc}	7.47±0.92^{a}	7.13±1.17^{ab}
HN	6.31±1.80^{bc}	7.00±1.21^{abc}	6.97±1.26^{abc}	7.08±1.67^{bc}	6.94±1.06^{bcd}	6.76±0.99^{b}
RBR	6.37±2.14^{bc}	7.00±1.17^{abc}	7.18±0.91^{a}	7.47±0.99^{ab}	7.22±0.83^{ab}	6.97±0.95^{b}
KLP	6.72±2.18^{ab}	7.24±1.16^{ab}	7.25±1.05^{a}	7.39±1.14^{abc}	7.35±1.02^{a}	7.00±1.27^{ab}
KDSK	7.43±1.63^{a}	7.39±1.00^{a}	7.25±0.96^{a}	7.61±1.00^{a}	7.18±1.05^{abc}	7.12±1.15^{ab}

Note: Values are mean±SD (n=3). Values followed by different letters in the same column are significantly different by Duncan's multiple tests ($p\leq0.05$).

Table 4 Acceptance score of 9 Thai rice using 9-point Hedonic scale (Continue)

Samples/ Attribute	hardness	softness	tooth pack (Ns)	overall liking
HMBR105	6.89±0.78^{ab}	6.85±0.82^{ab}	6.89±0.81	7.06±0.87^{ab}
SL	6.89±1.10^{ab}	6.71±0.97^{abc}	6.83±1.13	6.36±1.18^{d}
SRRD6	6.99±0.91^{ab}	7.11±0.85^{a}	6.97±0.89	6.75±0.73^{bcd}
SY	6.44±1.44^{c}	6.44±1.43^{c}	6.71±1.12	6.43±1.55^{d}
RHMBR	7.14±1.04^{a}	6.93±1.23^{ab}	6.61±1.36	6.60±1.12^{cd}
HN	6.68±0.99^{bc}	6.68±0.99^{bc}	6.81±0.99	6.64±1.13^{bcd}
RBR	7.11±0.88^{a}	6.90±1.13^{ab}	6.85±1.12	6.86±1.09^{bc}
KLP	6.92±1.22^{ab}	6.93±1.15^{ab}	6.67±1.31	6.99±1.49^{abc}
KDSK	7.06±1.20^{ab}	7.08±1.06^{ab}	7.03±1.26	7.33±1.41^{a}

4. Conclusion

The 9 Thai rice varieties were determined proximate analysis and antioxidant properties. The highest protein rice was SL, KDSK and RBR which consisted more than 9% of protein. All rice samples consisted of carbohydrate more than 70% weight samples. The L* values in SRRD6 was the highest, the highest values of a* was RHMBR and the highest values of b* was SL. The result of focus group discussion showed that elderly was familiar with brown rice and colored rice. Soft texture was the rice attribute that they need. Especially, over 80 year old group wanted soft rice because it was easy to chew and digest. For the opinion of participants on rice product development, all groups of elderly need soft to medium hard texture product and the appearance of the product look like a porridge rice but remained a piece of grain. In addition, the sensory acceptance test showed that the liking score of HMBR105 were not significantly different from KLP and KDSK in all attributes (appearance, color, aroma, flavor, sweetness, overall taste, hardness, softness, tooth pack and overall liking). Therefore, the colored rice has high potential to be developed as new rice products for the elderly consumers.

Acknowledgements

We would like to thank the Lanna Rice Research Center, Chiang Mai University, Thailand for supporting the equipment and raw materials for this research.

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