

Consumer Acceptance and Purchase Decisions of Butter Cake from Jasmine Rice Flour

Amporn Sae-Eaw¹, Penkwan Chompreeda^{1*}, Thongchai Suwonsichon¹,
Vichai Haruthaithanasan² and Witoon Prinyawiwatkul³

ABSTRACT

The objectives of this study were to evaluate and identify consumer sensory attributes influencing product acceptance and purchase decision, and to predict overall acceptance and purchase decision of butter cake from Jasmine rice flour. Four butter cake formulations were prepared from Jasmine rice flour with varying particle sizes: less than 80, 100, 120 and 150 mesh size. Consumers (n=700) evaluated their acceptability of seven sensory attributes using a 9-point hedonic scale. Overall acceptance and purchase decision were also determined with a binomial (yes/no) scale. Data were analyzed ($\alpha=0.05$) using ANOVA, MANOVA, Descriptive Discriminant Analysis (DDA) and Logistic Regression Analysis (LRA). Result indicated at least 71% of consumers accepted all products and greater than 56 % would purchase the products if commercially available. ANOVA results indicated all products were accepted with overall liking scores greater than 6.0. Results from MANOVA and DDA indicated the Jasmine rice butter cake products were differentiated by appearance acceptability (overall appearance and crumb color) with a canonical correlation of 0.67-0.84. Results from LRA indicated overall liking and flavor were the two most influential attributes determining overall acceptance and purchase decision. Based on the full logit model, overall acceptance and purchase decision could be predicted with 82% and 76% accuracy, respectively.

Key words: consumer acceptance, descriptive discriminant analysis, logistic regression analysis, odd ratio, purchase decision

INTRODUCTION

Thai Jasmine rice varieties, such as Khao Dawk Mali 105 (KDML 105), are very popular and widely gained acceptance in many countries due to their specific characteristics, particularly flavor, soft texture and unique aroma. Currently, consumer demand for Jasmine rice, in both domestic and international markets, is increasing, resulting in a surplus of broken rice from a milling process. Broken

rice is considered a by-product with low economic value.

Rice flour has many unique attributes and non allergenic properties. It is free of sodium, cholesterol, and gluten (Shih and Daigle, 2002). However, converting rice flour into bakery products is difficult due to its lack of gluten, the major contributing structure-forming protein (Moore *et al.*, 2006). Several studies have been attempted to improve quality of baked products, such as breads,

¹ Department of Product Development, Faculty of Agro-Industry, Kasetsart University, Bangkok 10900, Thailand.

² Kasetsart Agricultural and Agro-Industrial Product Improvement Institutes, Kasetsart University, Bangkok 10900, Thailand.

³ Department of Food Science, Louisiana State University Agricultural Center, Baton Rouge, Louisiana 70803-42000, USA.

* Corresponding author, e-mail: fagipkc@ku.ac.th

cakes and cookies, which were formulated with rice flour alone or in combination with other flour substitutes or novel ingredients (Bean *et al.*, 1983; Gallagher *et al.*, 2004; Moore *et al.*, 2006).

Particle size distribution is one of the important physical characteristics that affect quality of bakery products. Several researchers have studied the effects of rice flour particle size on processing conditions and final product quality (Kohlwey *et al.*, 1995; Wang and Yung, 1997). Rice flours with varying particle sizes has different chemical and physical properties, which cause differences in functional properties of the end products. Particle size also affects food sensory attributes which are important for designing food processing, final product quality and consumer's need.

We successfully developed non-wheat butter cake products prepared from broken Jasmine rice flour. However, in order to ensure the product success in the market, a consumer test of the product must be evaluated to understand the critical determinant that contributes and influences sensory quality that drives consumer acceptance and purchase decision. The objectives of this study were to 1) evaluate and

identify consumer sensory attributes influencing overall product acceptance and purchase decision, and 2) to predict overall product acceptance and purchase decision of non wheat butter cake products prepared from Jasmine rice flour with different particle sizes.

METERIAL AND METHODS

Materials

The commercial broken Jasmine rice (Khao Dok Mali 105 variety) was obtained from Chia Meng Rice Mill Co., Ltd. The other cake ingredients were food-grade obtained from local market in Bangkok, Thailand.

Preparation of Jasmine rice butter cakes

Cakes were prepared from Jasmine rice flour with four different particle sizes (less than 80, 100, 120 and 150 mesh size) using the creaming method (Figure 1) which adapted from Haruthaithanasan *et al.* (2002) and Petchmak *et al.* (2004).

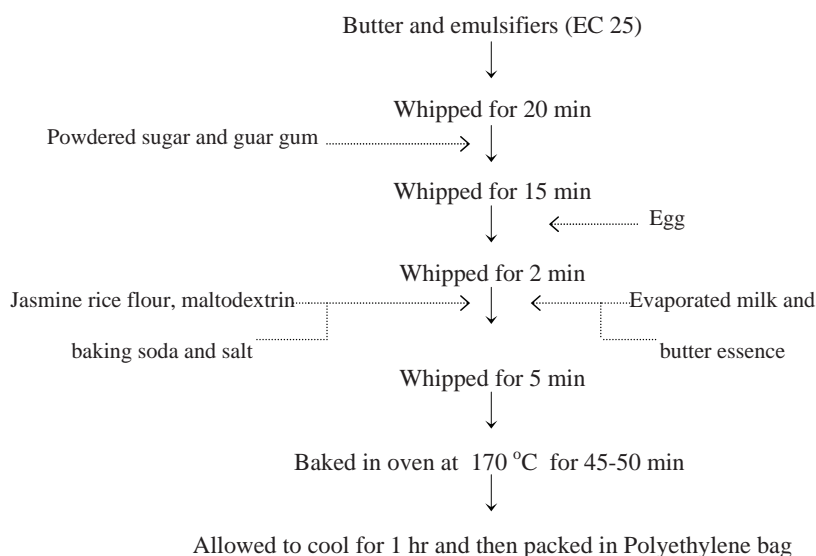


Figure 1 Flow chart depicting the process used to prepare Jasmine rice butter cake

Source: Adapted from Haruthaithanasan *et al.* (2002) and Petchmak *et al.* (2004)

Consumer acceptance test

Seven hundred (n=700) Thai consumers, who were older than 17 years, were recruited from Bangkok area, Thailand. They were prescreened for potential food allergies to rice flour and all other ingredients used in Jasmine rice butter cake formulations. The central location test for consumer acceptance was conducted from three locations; Kasetsart University, King Mongkut's Institutes of Technology Ladkrabang and Muang Thong Thane. Consumers were asked to provide their demographic information. Following the randomized completed block design (Cochran and Cox, 1957), each consumer was presented with four coded Jasmine rice butter cake products (each slice with 1.5×3.0×5.0 cm. dimension). Consumers were instructed to visually evaluate each sample, then take at least three-fourths of the butter cake slice, and slowly masticate the product before providing acceptability ratings for seven sensory attributes, including overall appearance, crumb color, odor, butter odor, softness, flavor and overall liking using a 9-point hedonic scale (1 = dislike extremely, 5 = neither like nor dislike, and 9 = like extremely; Peryam and Pilgrim, 1957). Consumers rated overall acceptance and purchase decision using the binomial (yes/no) scale.

Statistical data analysis

All data were analyzed at $\alpha = 0.05$ using the SAS software version 9.1.3 (SAS Inst. 2003). The Chi-square test was performed to identify the relationship between two categorical variable. Analysis of variance (ANOVA) was performed to determine if overall difference existed among the four Jasmine rice butter cake products in terms of acceptability of each sensory attribute and overall liking. The Tukey's studentized range test was performed to locate the differences among the four Jasmine rice butter cake products. The Multivariate Analysis of Variance (MANOVA) was performed to determine if the four Jasmine rice butter cake products were different when all sensory attributes were

simultaneously considered. The Descriptive Discriminant Analysis (DDA) (Huberty, 1994) was performed to identify sensory attributes underlying the differences among four Jasmine rice butter cake products. The Logistic Regression Analysis (LRA) (Allison, 1999) was performed to identify sensory attributes influencing overall acceptance and purchase decision.

RESULTS AND DISCUSSION

Consumer demographic information

Of 700 consumers who participated in this study, 44.4% were male and 55.6% were female. The majority of the participating consumers (60.5%) were of 17-21 years of age. About 16.6, 7.9 and 15.1% of participating consumers were 22-26, 27-31 and over 31 years of age, respectively.

Consumer acceptability, overall product acceptance and purchase decision

ANOVA indicates that overall appearance and crumb color were significantly different among four Jasmine rice butter cake products (Table 1). The mean score of overall appearance for the R100 product was lower than that of R120 and R150 products. The mean acceptability score of crumb color for the R100 product was lower than the R80 product. No significant differences were observed for the acceptability scores for odor, butter odor, softness, Flavor and overall liking among the four Jasmine rice butter cake products. All four products had an overall liking score of greater than 6.0 (Table 1).

At least 71% of consumers indicated their positive overall acceptance for all products. Jasmine rice butter cakes made from coarse flour (R80 and R100 products) had lower positive overall acceptance and purchase decision than those made from finer flour (R120 and R150 products).

As the results of consumer acceptability, product acceptance and purchase decisions of Jasmine rice butter cake, this results agree with

Table 1 Mean consumer scores for sensory acceptability and positive product acceptance and purchase decision (%) of four Jasmine rice butter cake products.^{1/}

Attribute	Product ^{2/}			
	R80	R100	R120	R150
Acceptability ^{1/}				
Overall appearance	6.26 ± 1.62 ab	6.06 ± 1.61 b	6.37 ± 1.52 a	6.28 ± 1.56 a
Crumb color	6.56 ± 1.46 a	6.31 ± 1.57 b	6.48 ± 1.43 ab	6.49 ± 1.45 ab
Odor	6.57 ± 1.65 a	6.51 ± 1.53 a	6.50 ± 1.54 a	6.51 ± 1.53 a
Butter odor	6.38 ± 1.67 a	6.34 ± 1.66 a	6.37 ± 1.58 a	6.41 ± 1.64 a
Softness	6.27 ± 1.80 a	6.32 ± 1.71 a	6.42 ± 1.66 a	6.50 ± 1.65 a
Flavor	6.15 ± 1.84 a	6.13 ± 1.76 a	6.21 ± 1.68 a	6.29 ± 1.69 a
Overall liking	6.31 ± 1.70 a	6.32 ± 1.71 a	6.36 ± 1.64 a	6.47 ± 1.59 a
Positive (yes) overall acceptance (%) ^{3/}	75.29	71.14	76.86	78.71
Positive (yes) purchase decision (%) ^{3/}	59.57	56.29	60.86	64.71

^{1/} Mean ± standard deviation from 700 responses and based on a 9-point hedonic. Mean values in the same row not followed by the same letter are significantly different ($p < 0.05$).

^{2/} Product R80, R100, R120 and R150, respectively, contained difference flour particle size (less than 80, 100, 120 and 150 mesh size).

^{3/} Based on the binomial (yes/no) scale from 700 responses.

Haruthaithanasan *et al.* (2002) and Nukit *et al.* (2006) who studied Thai consumer acceptance on butter cake from Jasmine rice flour, point out that consumer accepted cake products with the range of slightly like to moderately like (6.0 to 7.9 from 9 scores). More than 70% of consumer accepted product and would purchase. Thus, this study confirmed feasibility of substituting 100% Jasmine rice flour for production of butter cake products that was guarantee product success, consumer acceptance and purchase decisions of rice bakery product on Thai consumer.

Results (Table 2) from acceptance indicated that approximately 34.6% of accepted consumer were male and 40.9% female. For age group, 44.1% of accepted consumer were categorized in the 17-21 years of age group. The second age group (22-26 years old) including 12.2% of accepted consumer and 6.3% of accepted consumer were in the 27-31 years of age. The last, 12.9% of accepted consumer were at least 31 years old. Next, purchase decision results indicated that 25.7% and 34.7% of

purchased consumer were male and female, respectively. For consumer age, 32.8% of purchased consumer were categorized in the 17-21 year of age group. Only 5.4% of purchased consumer were categorized in the 27-31 year of age group.

Based on Chi-Square results of acceptance on gender (the Pearson χ^2 statistic with $p = .007$) and age ($p = .000$), it could be concluded that there were a significant correlation between acceptance and consumer demographic (Table 2). The similar results could be explained as in the Pearson χ^2 results of purchase decision on gender ($P = 0.014$) and age ($p = .000$). Therefore consumer acceptance and purchase decision correlated with consumer demographic (gender and age).

Overall product differences and discriminating sensory attributes

Based on MANOVA results (the approximate F value of 1.77 and the Wilks' Lambda statistic with $p = 0.0163$), it can be concluded that the four Jasmine

rice butter cake products were significantly different when all seven sensory attributes were compared simultaneously. Since there were some differences among the four treatments of Jasmine rice butter cake products, DDA was performed to determine which attributes were underlying the group differences (Sae-Eaw *et al.*, 2007).

Results from DDA report the canonical structure r^2 's (Huberty, 1994), which identifies constructs that largely accounted for the group difference. From the first dimension (Can 1) of the pooled within group variances with 49.34% explained variance, overall appearance (with a canonical correlation = 0.8378) and crumb color (0.6659) are the two attributes that significantly contributed to the

underlying differences among all four samples (Table 3). DDA results supports the ANOVA results from Table 1, and therefore, it can be concluded that the main construct that accounted for the group differences was the appearance attribute, a composite of overall appearance and crumb color.

According to ANOVA and DDA results, the appearance attribute was the sensory attributes that differences among the four Jasmine rice butter cake. This was due to cake from varying flour particle sizes, which affected the appearance product. Several researchers point out that rice flour with varietals differences in the particles size greatly affected the physicochemical properties such as pasting properties and gel consistency, which cause differences in the

Table 2 The correlation between consumer demographic and acceptance and purchase decision of Jasmine rice butter cake.

Variables		Acceptance (%)		Purchase decision (%)	
		Yes	No	Yes	No
Gender	Male	34.6	9.8	25.7	18.7
	Female	40.9	14.7	34.7	20.9
	Pearson χ^2	7.35 ($p=.007$)		6.01 ($p=.014$)	
Age group	17-21 yr	44.1	16.4	32.8	27.7
	22-26 yr	12.2	4.3	10.0	6.5
	27-31 yr	6.3	1.6	5.4	2.4
	Over 31 yr	12.	2.3	12.2	3.0
	Pearson χ^2	30.41 ($p=.000$)		105.24 ($p=.000$)	

Table 3 Canonical Structure r^2 's describing differences among Jasmine rice butter cakes.^{1/}

Attribute	Can 1	Can 2	Can 3
Overall appearance	0.8378 ^{2/}	0.2532	-0.0152
Crumb color	0.6659 ^{2/}	-0.2422	0.6243
Odor	0.0594	-0.2102	0.1678
Butter odor	0.1118	0.0723	0.2929
Softness	0.1621	0.6472	0.4089
Flavor	0.1841	0.3391	0.4884
Overall liking	0.1101	0.3869	0.6171
Cumulative Variance Explained	49.34%	89.45%	100.00%

^{1/} Based on the pooled within group variances. Can 1, 2, and 3 refer to the first, second, and third canonical discriminant functions, respectively.

^{2/} Indicates attributes which accounted for the group differences in the first dimension.

functional properties and hence, resulting in sensory properties and the end product quality (Halick and Kelly, 1959; Yamazaki *et al.*, 1971; Cagampang *et al.*, 1973).

Predicting overall acceptance and purchase decision using logistic regression analysis

Results from LRA reported the Wald χ^2 value at $p < .05$, which identifies consumer sensory attributes influencing overall acceptance and purchase decision. Results (Table 4) indicated that overall liking was the most critical attribute influencing overall acceptance, followed by flavor, overall appearance and crumb color. The odds ratio estimate of overall liking was 1.797 for overall acceptance, indicating the probability of the product being accepted is 1.797 times higher (than not being accepted, $p < .0001$) with every 1-unit increase of the overall liking score (based on a nine-point hedonic scale).

For purchase decision, all sensory attributes except butter odor were influential (Table 4). The odds ratio estimate of overall liking for purchase decision (1.613) was lower than that for overall acceptance (1.797), indicating that consumers perceived overall liking as more critical to overall

acceptance than to purchase decision. However, odor and softness influenced purchase decision but not overall acceptance. Butter odor influenced neither overall acceptance nor purchase decision.

Results (Table 5) from the correct classification table indicated that of 71.25% accepted consumer and 11.36% non-accepted consumer were observed and predicted as correct classification into a group. On the other hand, 13.14% of non-accepted consumer and 4.25% of accepted consumer were observed and predicted as incorrect classification. Therefore, the overall acceptance of Jasmine rice butter cake products could be predicted with 82.61% accuracy and 17.39% inaccuracy, respectively. The similar results could be explained when predicted the purchase decision as 76.30% prediction accuracy and 23.70% prediction inaccuracy, respectively.

Based on the full logit model with seven sensory attributes, Hit rate of overall acceptance and purchase decision were 82.61% and 76.30% respectively (Table 6). Flavor or overall liking alone could be used to predict overall acceptance with 81.46% and 81.39% accuracy, respectively. Only overall liking, when served as a single predictor, could yield up to 74.86% prediction accuracy when predicted purchase decision.

Table 4 Parameter estimates, probability, and odds ratio estimates for predicting overall acceptance and purchase decision of Jasmine rice butter cake products.^{1/}

Variables	Overall acceptance			Purchase decision		
	Estimate	Pr > χ^2	Odds ratio	Estimate	Pr > χ^2	Odds ratio
Intercept	-5.1160	<0.0001	N/A	-5.7870	<0.0001	N/A
Overall appearance	0.1027	0.0255	1.108	0.0941	0.0201	1.099
Crumb color	-0.1076	0.0284	0.898	-0.1190	0.0063	0.888
Odor	-0.0048	0.9256	0.995	0.0974	0.0343	1.102
Butter odor	0.0607	0.2063	1.063	-0.0597	0.1667	0.942
Softness	0.0576	0.1605	1.059	0.1265	0.0008	1.135
Flavor	0.3736	<0.0001	1.453	0.3846	<0.0001	1.469
Overall liking	0.5862	<0.0001	1.797	0.4783	<0.0001	1.613

^{1/} Based on the logistic regression analysis, using a full model with seven sensory attributes. The analysis of maximum likelihood estimates was used to obtain parameter estimates. Significance of parameter estimates was based on the Wald χ^2 value at $p < .05$. N/A refers to "not applicable."

Table 5 The correct classification of an unknown unit into group of overall acceptance and purchase decision of Jasmine rice butter cake products ^{1/}

Observed(%)	Predicted (%)					
	Overall acceptance			Purchase decision		
	Yes	No	Total	Yes	No	Total
Yes	71.25	4.25	75.50	51.93	8.43	60.36
No	13.14	11.36	24.50	15.25	24.39	39.64
Total	84.39	15.61	100.00	67.18	32.82	100.00
Correct prediction (%)		82.61			76.30	
Incorrect prediction (%)		17.39			23.70	

^{1/} Based on the logistic regression analysis using a full model with seven sensory attributes (*p*-event of 0.05). Yes and/or No means either accepted vs. not-accepted and/or purchased vs. not-purchased.

Table 6 Correct prediction (% Hit Rate) of overall acceptance and purchase decision of Jasmine rice butter cake products. ^{1/}

Attributes	% Hit rate	
	Overall acceptance	Purchase decision
Full Model (7 variables)	82.61	76.30
A Single-Variable Model		
Overall appearance	75.82	65.32
Crumb color	75.79	63.36
Overall cake aroma	76.25	66.50
Butter aroma	76.93	65.32
Softness	78.21	70.10
Flavor	81.46	74.18
Overall liking	81.39	74.86

^{1/} Based on the logistic regression analysis at *p*-event of 0.05. Hit rate (%) is the correct classification of an unknown unit (product) into a group (either accepted vs. not-accepted and/or purchased vs. not-purchased).

CONCLUSIONS

The Jasmine rice butter cake products were differentiated by appearance acceptability (overall appearance and crumb color) as identified by Descriptive Discriminant Analysis. The logistic regression analysis identified overall liking and flavor, as the two most critical attributes influencing overall acceptance and purchase decision of the Jasmine rice butter cake products. These two attributes should be focused on for further product refinement and commercialization. This study demonstrated (1) feasibility of completely substituting

wheat flour with jasmine rice flour for preparation of butter cake products that are acceptable to the Thai consumers, and (2) an alternative way for utilization of broken Jasmine rice.

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