

## **Consumer purchasing intent of brown rice cookies developed by MARDI**

(Kecenderungan pengguna membeli biskut beras perang yang dibangunkan oleh MARDI)

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### **Abstract**

Consumer acceptance for two types of brown rice cookies developed by MARDI was evaluated. The major objective was to identify the sensory attributes influencing purchasing intent. Attributes considered were taste, aroma, colour, shape, texture and overall acceptability. A total of 410 consumers evaluated the products using 5-point Likert scale. Purchase intent was accessed using binomial (yes/no) scale. Data were analysed using ANOVA, MANOVA, DDA and LRA. ANOVA results showed that both products were well accepted with overall liking score of slightly greater than 4. All attributes except shape of product 1 (high fibre chocolate almond brown rice cookies) was preferred over product 2 (puff brown rice cookies) indicating that there was a significant difference in terms of consumer preference between both products. MANOVA analysis supported the ANOVA results which showed that there was a significant difference for both products when all attributes were simultaneously considered. DDA results showed that products were differentiated mainly by taste and overall acceptability. In assessing whether consumers would buy the products, the LRA on purchase intent with full logit model indicated that purchase intent could be predicted with 84.5% accuracy.

### **Introduction**

Brown rice is rice with the hulls or husk removed. It consists of pericarp, seed coat, testa, aleurone layer, germ or embryo and endosperm. From a nutraceutical perspective, a high level of inositol, largely as gamma oryzanol, tocotrienols, phytosterols and choline, is present in the bran; all of which have been identified as possessing positive health characteristics. Bran also contains a significant level of vitamins including B and E. Also present

are a number of minerals such as iron, potassium, magnesium and phosphorus.

MARDI has developed brown rice cookies with high nutritional value which warrant the product as functional food suitable for people who need to increase dietary fibre intake or people with spruce celiac disease. *Table 1* shows the comparison of nutrient composition of brown rice cookies developed by MARDI with that of wheat-based cookies (Rosniyana and Hashifah 2008).

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Table 1. Nutrient composition of MARDI brown rice cookies compared with that of wheat-based cookies

Nutrients content per 100 g	Brown rice cookies	Wheat-based cookies
Protein (g)	12.80	8.8
Fat (g)	35.49	25.0
Crude fibre (g)	1.8	0.1
Carbohydrate (g)	45.5	60.3
Ash (g)	1.5	2.3
Calcium (mg)	25	10
Iron (mg)	10	2.4
Magnesium (mg)	336	50
Sodium (mg)	12	438
Potassium (mg)	511	116
Phosphorus (mg)		
Thiamine (mg)	0.64	0.47
Riboflavin (mg)	0.70	0.35
Pyridoxine (mg)	1.7	–
Niacin (mg)	7.6	0.6
Tochoperol (mg)	074	Not stated
Dietary fibre	11.2	Not stated
Soluble fibre	1.0	Not stated
Starch	27.4	Not stated

Source: Rosniyana and Hashifah (2008)

Individuals with Celiac Spruce Disease have a lifelong intolerance to wheat. It is a problem of malabsorption of certain proteins in the diet, mainly gluten, which will impair intestinal absorption that can lead to severe malnutrition. People with this disease have to strictly adhere to a gluten-free diet. Brown rice flour is an ingredient which is gluten-free, contains complex carbohydrate, high in fibre, minerals and vitamins, free from fat and cholesterol and non-allergenic, which is good for people with Celiac Spruce Disease (Bond 2002).

It is a challenging task to develop gluten-free food products because of the undesirable off-taste or texture imparted by brown rice flour, regardless of its high nutritional benefits. It has been shown that health improving benefits are often capable of motivating consumers to increase the overall liking of a product, which ultimately increases the purchasing intent of consumers

for a particular product (Kahkonen et al. 1996). The two types of brown rice cookies developed by MARDI have been accepted by taste panellists. However, consumer acceptance of these products has yet to be determined to ensure success in the market. Therefore, a consumer study was carried out with the objective of identifying the sensory attributes that influence acceptance and purchasing intent of brown rice cookies developed by MARDI.

### Preparation of brown rice cookies

Product development involves design and optimization on the process parameters to achieve the most acceptable and nutritious product. Brown rice was prepared from parboiled rice, whereby the paddy was soaked and steamed at a particular time and temperature. The paddy was then dried and dehusked to produce brown rice. The parboiled brown rice was dried at 60 °C to bring down the moisture content between 5 – 6%, ground into flour and sieved through a 50-mesh sieve.

Popped brown rice, which was also used as an ingredient, it was made by heating the whole grain rice (with a typical moisture content of 13 – 15% w/w) in a confined mould at a temperature of 150 – 180 °C. During heating, steam pressure builds within the mould. Upon opening the mould, pressure is released rapidly, causing flash vaporization of superheated water and steam. This process causes the grain to melt and fuse during their expansion into popped rice.

Two types of brown rice cookies i.e. high fibre chocolate almond brown rice cookies (product 1) and puff brown rice cookies (product 2) were developed from the local MR 220 variety, using only selected ingredients according to the MARDI proprietary formulation.

### Consumer acceptance test

A total of 410 untrained consumers participated in this study. Respondents were randomly selected and volunteered

to participate in the survey which involved sensory evaluation and answering survey questions in a structured questionnaire. Respondents were presented with coded samples of two types of brown rice cookies i.e. product 1 (high fibre chocolate almond brown rice cookies) and product 2 (puff brown rice cookies) following the Randomized Block Design (RBD). Respondents were instructed to evaluate each sample for shape, colour, taste, aroma, texture and overall acceptability. Score for attributes was based on the 5-point Likert scale (1 = Dislike extremely, 3 = Neither like nor dislike, 5 = Like extremely). This scale is useful in consumer testing because it defines psychological states of 'like' and 'dislike' on a linear scale.

In determining whether respondents would purchase the products tested, respondents had to answer a question on whether they would purchase the products if found in the market. This question was rated using the bi-polar scale of yes and no, and Logistic Regression Analysis (LRA) was applied to determine odd ratio estimate and correct prediction rate for purchasing intent of brown rice cookies developed by MARDI.

### Statistical analysis

Survey data was analysed using SAS software version 9.1, by SAS Institute, Cary, N.C., USA. Types of analysis performed were Analysis Of Variance (ANOVA), Multiple Analysis Of Variance (MANOVA), Descriptive Discriminate Analysis (DDA) and LRA. ANOVA was performed to determine consumer perceptions and acceptability of each sensory attribute while MANOVA was performed to determine if the two products were different when all the sensory attributes were simultaneously considered.

In its simplest form, ANOVA provides a statistical test of whether or not the means of several attributes of the products being compared are all equal. If the means are equal, the products in question are not

significantly different, which also indicates that the attributes of the products being compared are also not significantly different from each other in terms of consumer preference towards those product attributes. In MANOVA, all attributes of each product being compared are statistically considered simultaneously. DDA was performed in order to identify sensory attributes underlying the differences in the two types of brown cookies tested (Huberty 1994). The LRA was performed to identify sensory attributes influencing purchasing decision (Allison 1999).

### Results and discussion

ANOVA results showed that product 1 was significantly different ( $p < 0.05$ ) from product 2 considering each attribute separately. Respondents perceived product 1 to be better than product 2 in each attribute except for shape whereby product 2 was preferred to product 1 (*Table 2*).

MANOVA analysis was performed to determine whether there were any differences between the two types of brown rice cookies when all of the sensory attributes were considered simultaneously. MANOVA technique produced a F value of 13.12 for 'Wilk's Lambda statisticS' ( $p < 0.0001$ ) which indicated that the two products were significantly different considering all attributes simultaneously. As for the other statistics (Pillai's Trace, Hotelling Lawley Trace and Roy's Greatest

Table 2. Mean score for consumer acceptability for brown rice cookies

Attribute	Product 1	Product 2
Taste	4.38 ± 0.71a	4.09 ± 0.88b
Aroma	4.03 ± 0.85a	3.99 ± 0.91b
Shape	3.84 ± 0.96b	3.99 ± 0.92a
Colour	4.20 ± 0.80a	4.03 ± 0.89b
Texture	4.10 ± 0.85a	3.92 ± 0.93b
Overall acceptability	4.37 ± 0.69a	4.16 ± 0.83b

Mean values in the same row not designated by the same letter were significantly different ( $p < 0.05$ )

Table 3. Multivariate statistics and F approximations

MANOVA	Test criteria and F approximation for the hypothesis of no overall form effect				
Statistics	Value	F value	Numerator DF	Denominator DF	Pr >F
Wilks' Lambda	0.837	13.12	6	404	<0.0001
Pillai's Trace	0.163	13.12	6	404	<0.0001
Hotelling Lawley Trace	0.194	13.12	6	404	<0.0001
Roy's Greatest Root	0.194	13.12	6	404	<0.0001

Table 4. Canonical structure describing differences among brown rice cookies

Attribute	Canonical structure
Taste	0.6201*
Aroma	0.0801
Shape	-0.2874
Colour	0.3549
Texture	0.3461
Overall acceptability	0.4574*

\*Indicates sensory attributes which largely account for group differences

Table 5. Logistic regression analysis on purchase intent

Attributes	Coefficient	Pr >X2	Odd ratio
Taste	0.8394	0.0020*	2.315
Aroma	-0.0310	0.9014	0.970
Shape	0.3995	0.0510*	1.491
Colour	-0.0839	0.7224	0.920
Texture	0.1202	0.6337	1.128
Overall acceptance	0.7996	0.0209*	2.225

\*Significance at  $p < 0.05\%$

Root), they were also significant at  $p < 0.0001$ , (Table 3).

The subsequent step was to determine which attributes were responsible for the underlying differences among the two products using DDA. According to the pooled within canonical structure, attributes taste (0.6201) and overall acceptability (0.4574) contributed significantly to overall differences among the two products resulting in 100 % cumulative variance as shown in Table 4.

Table 6. Correct prediction of purchase intent

Attributes	Purchase intent (%)
Full Model (six attributes)	84.5
A single variable model	
Taste	70.0
Aroma	64.9
Shape	62.1
Colour	57.5
Texture	63.9
Overall acceptance	71.6

The result of LRA reported the Wald  $X^2$  value at  $p < 0.05$  as tabulated in Table 5. Results showed that overall acceptability, taste and shape were the most critical attributes influencing purchasing decision.

The odd ratio estimate of taste was 2.315 indicating the probability of the product being purchased will be 2.3 times higher than not being purchased ( $p < 0.05$ ) with every one unit increase of taste score based on the 5-point Likert scale. The same goes to overall acceptance, the probability of the product being purchased would be 2.2 times higher than not being purchased ( $p < 0.05$ ) with every unit increase of overall acceptability based on 5-point Likert scale (Table 5).

Apart from producing odd ratio estimate of purchasing intent, the LRA also produced the correct prediction rate which is the correct classification of a product either being purchased or not being purchased (Amporn et al. 2007). In this study, all attributes i.e. taste, aroma, shape, colour, texture and overall acceptability were significant ( $p < 0.0001$ ) in determining

purchasing intent but differ in their influencing degree (*Table 6*).

Based on the full logit model with six attributes, purchase intent of the brown rice cookies could be predicted with 84.5% accuracy. Taking attribute overall acceptability alone in a single model could predict purchasing intent with 72% accuracy and taste alone would predict purchasing intent with 70% accuracy. These two attributes were the most important attributes to be considered in product development and marketing the product.

### Conclusion

Findings of the study indicated that both products were favourably acceptable by the consumers with product 1 being more preferred than product 2. The attribute preference of product 1 were significantly different from attributes of product 2, when each attribute was individually considered. The results also indicated that attributes taste and overall acceptability were responsible for the significant differences of consumer preference for the two products reviewed. The attribute taste yielded the most weight in influencing consumer preference as compared to overall acceptability. All the statistical analysis employed indicated that the most important attributes considered by the consumers were taste and overall acceptability and these attributes significantly contributed to the significant differences in preference. These attributes should be considered the most in product development and/or improvement by the researchers and entrepreneurs in order to ensure success in the market.

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## **Abstrak**

Penerimaan pengguna terhadap dua jenis biskut beras perang tempatan yang dibangunkan oleh MARDI telah dikaji. Objektif utama kajian adalah untuk menentukan atribut produk yang mempengaruhi kecenderungan untuk membeli. Atribut yang dinilai ialah rasa, aroma, warna, bentuk, tekstur dan penerimaan keseluruhan produk. Seramai 410 responden telah menilai produk ini berdasarkan skala Likert 5-mata. Tujuan pembelian telah dinilai menggunakan analisis regresi logistik berasaskan skala binomial (ya/tidak). Data telah dianalisis dengan kaedah statistik ANOVA, MANOVA, DDA dan LRA. Hasil ANOVA menunjukkan kedua-dua produk telah diterima baik oleh pengguna dengan memberikan penerimaan keseluruhan pada skor lebih sedikit daripada 4. Kesemua atribut produk 1 (biskut beras perang berserat tinggi coklat badam) kecuali bentuk lebih digemari berbanding dengan produk 2 (biskut bertih beras perang). Analisis MANOVA menyokong hasil analisis ANOVA iaitu terdapat perbezaan ketara penerimaan pengguna terhadap kedua-dua produk apabila kesemua atribut dianalisis bersama. Analisis DDA menunjukkan bahawa atribut utama yang memberikan perbezaan ketara antara dua produk tersebut ialah atribut rasa dan penerimaan keseluruhan. Kedua-dua atribut juga telah membezakan produk dari segi penerimaan keseluruhan dan keinginan untuk membeli. Untuk menganggarkan ketepatan keinginan membeli di kalangan pengguna, regresi logistik telah dijalankan dan didapati bahawa berdasarkan model penuh logit, keinginan untuk membeli dapat diramalkan dengan 84.5% ketepatan.