

Acceptability attributes of crackers made from different types of composite flour

*Noor Aziah, A.A. and Komathi, C.A.

*Food Science and Technology Division, School of Industrial Technology,
Universiti Sains Malaysia, 11800 Penang*

Abstract: There is an increasing demand for fibre rich food and food ingredients. In this study, pumpkin pulp, unripe banana pulp, unripe mango pulp and peel which are high in dietary fibre were processed into flour and substituted at 5% level for wheat flour in a composite flour crackers formulation. The control crackers comprised of 100% wheat flour. Sensory evaluation was conducted using a 9-point hedonic scale with 31 panelists evaluating the crackers based on colour, crispiness, taste and overall acceptance. Different types of composite flour crackers were not significantly different ($p \leq 0.05$) in term of crispiness. For colour, taste and overall acceptance, the pumpkin, banana and control crackers differ significantly ($p \leq 0.05$) with the mango pulp and mango peel crackers.

Keywords : dietary fibre, composite flour, crackers, mango, banana, pumpkin

Introduction

The bakery industry in Malaysia has grown tremendously over the recent years. According to Sudha *et al.* (2007), bakery products are varied by addition of value added ingredients. Among the added ingredients, dietary fibre has gained tremendous attention. Vergara-Valencia *et al.* (2006), reported that there is an increasing demand for high fibre ingredients in food products.

de Escalada Pla *et al.* (2007) reported that, fruits and vegetables are important sources of dietary fibre, although the content is not as high as in cereals. Fruits and vegetables have been shown to have high content of soluble dietary fibre. Soluble dietary fibre plays an important role in lowering serum cholesterol and glucose level, while insoluble dietary fibre is essential in maintaining intestinal health.

Composite flour is a binary or ternary mixture of wheat flour with flour from other crops (Shittu *et al.*, 2007). Composite flour is considered advantageous in developing countries as it reduced the importation of wheat flour and encourage the use of locally grown crops as flour (Hugo *et al.*, 2000). Arogba (1999) reported that composite sorghum (Yellow Kaura variety)-maize (white flint variety)-wheat flour cookies is highly accepted in Nigeria. Local raw materials substitution for wheat flour is increasing due to the growing market for confectioneries.

Banana, pumpkin and mangoes are commonly found in Malaysian markets and continuous supply is available throughout the year to serve the growing demand. These commodities are rich in fibre. Pumpkin, banana and mangoes are not only being consumed raw or cooked as meal, but are also processed into various food products, including chips, flakes jellies, juices, puree, nectar and processed into fruit leather.

Jun *et al.* (2006) reported that pumpkin is a good source of carotene, pectin, mineral salts, vitamins and other substances that are beneficial to health. These facts lead to the processing of pumpkin into various food products. Unripe mango pulp has been reported by Vergara-Valencia *et al.* (2006) to have high starch content and high levels of hemicellulose, lignin, cellulose and carotenoids. Mango peel on the other hand, has high proportion of soluble dietary fibre, which is similar to citrus fruits and also a substantial amount of pectin and polyphenols (Larrauri *et al.*, 1996). Green banana pulp, as reported by Zhang *et al.* (2005) contains 70% to 80% starch on a dry weight basis, which is comparable to starch content of white potato pulp and corn grain endosperm. Due to the high starch content, banana is often processed into flour (Waliszewski *et al.*, 2003).

In this investigation, pumpkin pulp, unripe banana pulp, unripe mango pulp and unripe mango peel were processed into flour, which was then substituted at 5% for wheat flour in crackers formulation. Previous

*Corresponding author.
Email: naziah_usm@yahoo.com
Tel: 604-6533888 ext 2223

works on bakery products utilized composite flour and fibre substitution for wheat flour based on substitution levels ranging from 5% to 40%. Ajila *et al.* (2007) studied the physicochemical and sensory properties of soft dough biscuits with mango peel flour substitution for wheat flour at 5%, 10%, 15% and 20%. They reported that biscuits with 5% substitution with mango peel flour obtained the highest score in sensory evaluation for overall acceptance. Similarly, Basman and Koxsel (1999) studied the properties of Turkish flat bread (bazlama) substituted with wheat bran at 5%, 10%, 15% and 20%. Bazlama substituted with 5% wheat bran was reported to be the most acceptable in all the sensory attributes investigated. Based on the studies conducted by these researchers, it was shown that 5% substitution for wheat flour in bakery products with fibre-rich ingredients obtained the highest acceptance score from the sensory panelists. Therefore, in this work, crackers with 5% substitution level with the respective flour types were used to determine the acceptability attributes of the composite flour crackers in terms of colour, crispiness, taste and overall acceptance

Materials and Methods

Pumpkin (*Cucurbita moschata*), unripe banana (*Musa paradisiaca* L. cv Awak) and unripe mangoes (*Mangifera indica* L. cv Chokanan) were obtained from a local farm, while wheat flour, salt, bicarbonate soda, yeast and shortening were purchased from Sim Company, Penang.

Preparation of banana pulp, pumpkin pulp, mango pulp and mango peel flour

Pumpkin pulp, unripe banana pulp, unripe mango pulp and unripe mango peel were soaked in 0.1% sodium metabisulphite solution for 30 min, washed, sliced and dried at 60°C for 24 hours in hot air oven (AFOS Mini Smoker, England). This is followed by milling with grinder (Retsch Micro Universal Bench Top Grinder, Germany) to produce the respective flour types.

Preparation of crackers

The crackers were prepared according to the modified method of Manley (2001). Formulation of the crackers is stated on Table 1. Yeast was mixed with water (25°C) to form a suspension, to which the other ingredients were then added and kneaded to form smooth dough. Substitution of wheat flour with banana, pumpkin, mango pulp and mango peel flour was conducted based on 5% of the weight of the wheat flour. The dough was later proofed for 2 hours in a proofer (Bakbar E81, New Zealand), followed by sheeting to 1.0mm thickness using a dough sheeter (Esmach, Italy). The dough was then cut into squares measuring 3cm x 3cm and 'docked' prior to baking at 170°C for 15 min.

Sensory evaluation

Sensory evaluation was carried out with 31 panelists comprising of postgraduate students from Universiti Sains Malaysia, Penang. Testing was done in the sensory laboratory. Each panelist was served with 5 randomly arranged cracker samples on a rectangular plastic tray. The crackers were individually sealed in a pouch and coded with a three-digit number prior to testing. The 5 samples consisted of 4 types of composite flour crackers and a control (100% wheat flour). Water was provided for rinsing between the samples. Panelists were required to evaluate the colour, crispiness, taste and overall acceptance of the crackers using the 9-point hedonic scale with 1=dislike extremely, 2=dislike very much, 3=dislike moderately, 4=dislike slightly, 5=neither like nor dislike, 6=like slightly, 7=like moderately, 8=like very much, and 9=like extremely.

Statistical analysis

All results were analyzed statistically at 5% significance level. Mean score values of the crackers' acceptability attributes were subjected to Dunnett test (SPSS for Windows software version 11.5, USA) to compare the acceptability attributes of the composite flour cracker types against the control and Duncan Multiple Range test (SPSS for Windows software version 11.5, USA) to compare the sensory attributes between the composite flour cracker types.

Table 1. Formulation of the crackers

Ingredients	Amount (g)
Wheat flour	100.00
Shortening	9.64
Salt	2.02
Sodium bicarbonate	0.16
Yeast	3.48
Water	50.00

Results and Discussions

Results of sensory evaluation in terms of colour, crispiness, taste and overall acceptance are presented in Table 2. The mango pulp and mango peel crackers were significantly different ($p \leq 0.05$) in colour. The mango peel crackers was shown to be the least liked by the panelists. Broyart *et al.* (1998) reported that the initial acceptance of baked products is much influenced by colour, which can also be an indicator of baking completion. As mango peel flour imparts a dark brown colour to the crackers, this might have given the panelists an impression of 'over-baked' product, thus affecting their likings. For colour, among the control, pumpkin and banana crackers, the colour of pumpkin crackers was rated the highest (7.52) by the panelists. The desirable colour of crackers is mainly due to the Maillard browning during baking. However, in pumpkin crackers, the colour could be partially contributed by the carotenoid in pumpkin flour which imparts a yellowish colour to the crackers. Similar findings were reported in a study by Brannan *et al.* (2001) who observed that an increased flour and thus muffin visual lightness (with more yellowness and brownness rather than dark and yellow green) yield a higher aroma, texture and colour acceptability scores. However, colour was not significantly different ($p \leq 0.05$) among the control, banana and pumpkin crackers.

Crispiness is perceived when food is chewed between molars, and is usually expressed in terms of hardness and fracturability. In this study, there was no significant difference ($p \leq 0.05$) in crispiness between the different samples with different composite flour cracker types. This observation could be due to the small percentage of wheat flour substitution in

the crackers formulation, which did not affect the gluten network in the dough nor the development of an open internal structure upon baking. This is similar to the report by Fan *et al.* (2007), in which *Auricularia auricula* (black woody ear mushroom) polysaccharide flour was used to substitute wheat flour in bread formulation. They found that the acceptability of texture, taste, and colour of the bread was not affected by up to 12% substitution. Sudha *et al.* (2007) also reported similar findings in biscuits prepared from different cereal fibre. The biscuits were found to be crispy at incorporation level of 40% oat bran, with a very small increase in hardness.

No significant difference ($p \leq 0.05$) was observed in terms of taste between the control, pumpkin and banana crackers. This could probably be due to the nature of banana and pumpkin flour which did not impart any additional flavour to the crackers. However, mango pulp and mango peel crackers were significantly different ($p \leq 0.05$) in taste as compared to the control, pumpkin and banana crackers. This might be due to the sourness in mangoes utilized as flour. The lowest score for the mango peel crackers could be attributed to the 'leafy' after-taste, as commented by some of the panelists.

There was no significant difference ($p \leq 0.05$) in term of overall acceptability among the control, pumpkin and banana crackers. This could be attributed to the close resemblance of the cracker types in terms of the colour, crispiness and taste of the commercial crackers in the market. However, the mango pulp and mango peel crackers were significantly different ($p \leq 0.05$) in overall acceptance. The lower ratings for the mango pulp and mango peel crackers could be due to the unattractive colour and the unpleasant taste of the crackers.

Table 2. Mean scores for colour, crunchiness, taste and overall acceptance of the control and composite flour crackers

	Sensory attributes			
	Colour	Crunchiness	Taste	Overall acceptance
Control crackers	7.32 ± 1.33 ^{ab}	7.13 ± 1.46 ^a	7.03 ± 1.30 ^a	7.13 ± 1.34 ^a
Banana crackers	6.65 ± 1.36 ^b	6.87 ± 1.34 ^a	6.71 ± 1.58 ^a	6.87 ± 1.36 ^a
Mango pulp crackers	5.26 ± 1.69 ^c	6.77 ± 1.23 ^a	5.90 ± 1.72 ^b	6.13 ± 1.23 ^b
Mango peel crackers	4.23 ± 1.52 ^d	6.35 ± 1.80 ^a	5.29 ± 1.66 ^b	5.39 ± 1.76 ^c
Pumpkin crackers	7.52 ± 1.21 ^a	7.06 ± 1.48 ^a	7.06 ± 1.50 ^a	7.03 ± 1.43 ^a

* Data is expressed as mean ± standard deviation, with different superscripts in the column indicating statistically significant difference at $p \leq 0.05$, (n=31)

Conclusion

Substituting 5% of wheat flour in the crackers formulation with pumpkin pulp, unripe banana pulp, unripe mango pulp and peel flour did not affect the crispiness of the composite flour crackers. This suggests that substituting 5% of wheat flour with different fibre rich composite flour in crackers formulation did not affect crispiness, which is an important textural characteristic of crackers. This would definitely encourage the utilization of fibre rich flour to be incorporated in bakery products, particularly crackers. However, the colour and taste of composite flour crackers would be dependent on the type of flour used for substitution. In conclusion, pumpkin pulp flour and unripe banana pulp flour were found to be the most suitable composite flour to be incorporated in crackers. In this study, there was no significant difference ($p \leq 0.05$) observed in colour, crispiness, taste and overall acceptance of pumpkin pulp and banana pulp crackers as compared to the control.

Acknowledgement

The authors would like to acknowledge the financial assistance provided by Universiti Sains Malaysia under the Short Term Research Grant.

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