EFFECT OF PAPAYA AND STORAGE TIME ON THE QUALITY OF THE NEWLY DEVELOPED PAPAYA CRACKERS

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ABSTRACT

Crispy nutritious papaya crackers were developed from locally available papaya and whole wheat flour by baking in oven at 130°C for 35 min. Crackers were packed in high density polyethylene pouches and stored under ambient condition for 90 days. The influence of papaya and storage condition on physicochemical compositions was evaluated in present study. Physicochemical analyses of fresh crackers revealed the presence of moisture (3.3-3.6%), ash (4.07-4.12%), protein (6.35-8.13%), fat (1.75-1.94%), fibers (11.50-13.75%), minerals like sodium (6.1-6.61 mg/100g), magnesium (122.44-115.28 mg/100g), potassium (469.62-443.34 mg/100g), calcium (24.99-21.97 mg/100g) and phosphorus (307.66-229.13 mg/100g). Among various studied physicochemical parameters only slight increases was reported in the moisture content while in case of other parameters like fat, ash, fiber, protein and mineral content some reduction was reported at the 90 days of storage. This study introduced the formulation of crackers by using whole wheat flour and papaya which can be a good source of fiber and minerals.

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1 Introduction

Papaya (*Carica papaya* L.) is one of the important and versatile fruits of the family Caricaceae and grown worldwide in the tropics and subtropics including India, Bangladesh, Malaysia, Australia, Hawaii, Philippines, Sri Lanka, South Africa and other countries in tropical America (Anuara, 2008). In Bangladesh, papaya is available all around the year, therefore ripe papaya is consumed as fruit and green papaya as vegetable. According to BBS (2011), papaya production in Bangladesh was 1.25 lac metric tons from 1.24 thousand hectares of land with an average yield of 7 ton/ha. However, it was also reported that papaya production in Bangladesh is far below compared to other neighboring countries (Chowdhury, 2008). Furthermore, post-harvest losses of papaya is recorded almost 39.9% in Bangladesh (Hasan, 2010) and it is a major cause of unavailability of papaya (Mondal et al., 1995). Unavailability of effective preservation and processing techniques are major reasons of post-harvest losses of papaya.

Nowadays, fast food snacks especially crackers have emerged as popular items because of unique flavor and texture to the modern consumers of all age groups. Excess use of these fast foods can be harmful for human beings and according to Thunstrom (2011), higher consumption of these fast food items can cause several diseases like diabetes, cardiovascular disease, cancer, dental caries and osteoporosis, overweight as well as obesity because of less fiber and excess fat content.

On the other hand, dietary fiber is tremendous attention in food processing where bakery products could be modified by addition of value added ingredients (Vergara-Valencia et al., 2006; Sudha et al., 2007). Consumption of food made of whole grain is associated with the lowering of glucose level in blood, cardiovascular disease, cancers and other diseases because of its dietary fiber and micronutrients (McKeown et al., 2002). High amount of dietary fiber, vitamin E, vitamin B complex, minerals, antioxidants and phytoestrogens are found in the bran and germ of whole grains (Jacobs et al., 1998). In Bangladesh, there are less whole wheat products whereas in developed countries, whole wheat products have been gained much popularity.

Fresh papaya could be explored for the production of papaya crackers. It can be used incorporation with wheat flour for better quality crackers. According to Tietze (2002), mature papaya is a rich source of vitamin A, E, B complex, ascorbic acid compared to carrots and oranges. Furthermore, a recent study also shows that papaya contains arginine amino acid, which is essential for male fertility (Rovira, 2009).

Therefore, papaya crackers with whole grain flour may be one of potential processed products in Bangladesh. In some areas of Bangladesh, papaya is very cheap due to lack of storage, transportation and processing facility. Moreover, substantial amount of foreign exchange could be earned by processing and

exporting papaya crackers. Based on the above discussion, the present work was aimed to formulate and analyze the nutritional composition of papaya crackers and also, to assess the storage stability of prepared papaya crackers.

2 Materials and methods

2.1 Sample collection

Fresh, fully mature and sound papaya and whole wheat flour were purchased from local market at Basherhat for preparation of crackers.

2.2 Formulation of papaya crackers

Three formulations of papaya crackers viz F1, F2 and F3 were developed using papaya and whole grain wheat flour with the addition of seasoning (baking powder, corn flour, sugar, garlic, ginger and salt) as given in Table 1.

Table 1 Different formulations of papaya crackers.

Formulation	Ingredient		
	Papaya (%)	Whole wheat (%)	Seasoning (%)
F1	40	50	10
F2	30	60	10
F3	20	70	10

2.3 Preparation of papaya crackers

Clean and disease free whole wheat was turned into flour by hammer mill. Simultaneously, papaya was washed with clean water and peeled and sliced longitudinally and boiled for 5 min at 180°C. After boiling, papaya and whole wheat flour were taken in different combination in a bowl as described in Table 1. Boiled papaya was mashed and all seasoning ingredients (garlic, ginger) were added properly for making dough. Dough was transformed into sheet of 2mm thick and cut into desirable shapes. After that, the cut pieces were baked at 130°C for 35min in oven. After baking, crackers were cooled and packaged (50g) in high density polyethylene pouches.

Fresh crackers were subjected to initial physicochemical analysis before packaging. The sealed packages were stored at ambient condition (temperature 25±2°C and relative humidity 68±3%) for storage studies at 30 days intervals for 90 days.

2.4 Physico-chemical analysis

Physico-chemical analyses namely, moisture, ash, protein and fat content were carried out according to standard methods of AOAC (1997). The crude fiber was determined by the method of Ayesha et al. (2002) with slight modification.

The available minerals (calcium, magnesium, potassium, phosphorous and sodium) were determined by atomic absorption methods described by Wahab et al. (2010) with some modifications. For this, one gram of the crackers sample was taken in 50 ml flask. Then, 10 ml of concentrated nitric acid and 5 ml of concentrate edperchloric acid were added to the flask and digested using a hot plate until complete removal of white smoke and solution become clear. 20-30ml of distilled water was then added and filtered, and final volume was made up to 100 ml with distilled water. Absorbance was measured by using atomic absorption spectrophotometer.

2.5 Statistical Analysis

All measurements were carried out in triplicate. The data were analyzed using statistical program SPSS (version 20.0) and significant differences were compared by analysis of variance test (ANOVA) following Duncan's Multiple Range Tests at the significance level of 5%.

3 Results and Discussion

3.1 Physico-chemical characteristics of papaya and whole wheat flour

Data regarding physico-chemical characteristics of green papaya and whole wheat flour have been presented in Table 2. It was observed that green papaya showed high moisture (88.2%), ash (0.63%), very low protein (0.57%), fat (0.63%) and crude fiber content (0.75%). The results of present study are in agreement with the findings of Krishna et al. (2008). On the other hand, wheat flour showed moisture (12.5%), ash (1.7%), high protein (12.3%), fat content (1.8%) and fiber content (1.9%). The results are comparable with the findings of Belderok et al. (2000) who observed slight higher protein and less fiber content (13% and 1.5% respectively) in whole wheat endosperm.

Table 2 Physico-chemical characteristics of green papaya and whole wheat flour.

Composition	Green papaya	Whole wheat flour
Moisture (%)	88.2±0.23	12.5±0.19
Ash (%)	0.63±0.08	1.7±0.10
Protein (%)	0.57±0.11	12.3±0.34
Fat (%)	0.63±0.14	1.8±0.19
Crude fiber (%)	0.75±0.12	1.9±0.23

All values are means ±SD

3.2 Storage studies of papaya crackers

3.2.1 Moisture content

The moisture content of freshly prepared cracker samples F1, F2 and F3 was 3.3, 3.55 and 3.6% respectively (Figure 1A).

It was observed that different ratio of papaya and whole grain flour significantly affected the moisture content of crackers. Figure 1A shows that moisture content of papaya crackers increased throughout the storage period. Change in moisture content was comparatively less for first 30 days of storage but later on the level of moisture content increased with the increasing duration of storage. Maximum increase (101.52%) was reported in F1 sample, whereas minimum increase (72.22%) was observed in F3 sample at the end of storage duration. The increase in moisture of crackers may be due to high water vapor transmission rate through packaging material. Finding of present study are in agreement with the findings of Jagdeesh et al. (2007) and Purohit & Rajyalakshmi (2011). Furthermore, Manikantan et al. (2014) also observed an increase in moisture of banana chips stored in polypropylene based nanocomposite packaging films.

3.2.2 Ash content

Results of ash analysis were presented in Figure 1B. Ash content of fresh crackers of F1, F2 and F3 were reported 4.12, 4.09 and 4.07% respectively (Figure 1B). Significant difference in ash content of fresh crackers was not observed due to variation in papaya and whole wheat grain flour ratio. Ash content of crackers gradually decreased with the increasing of storage time (Figure 1B). Highest ash content (3.63%) was observed in F2 sample, whereas F1 and F3 showed same ash content (3.55%) at the end of storage period. Moisture absorption may be possible reason behind the decrease in ash content of crackers. However, no significant effect of storage time was reported on the ash content of crackers. This result was in line with the finding of Akubor & Adejo (2000) who observed similar trend in decreasing of ash content in stored plantain chips.

3.2.3 Protein content

Figure 1C showed ratio of papaya and whole wheat flour and it was reported that this combination significantly affected the protein content of fresh crackers. Protein content in crackers increased with the increase of whole wheat flour content. However, maximum protein (8.14%) was observed in fresh F3 sample and followed by F2 (7.48%) and F1 (6.36%) sample. Data regarding change in protein content of crackers revealed that there was a gradual decrease in protein content throughout the storage period (Figure 1C).

Maximum decrease (28.75%) was found in F3 sample while F2 sample had minimum decrease (16.04%). One of possible reason of decreasing in protein content of crackers during storage is moisture absorption from the atmosphere. Similarly, Akubor & Adejo (2000) reported a gradual but insignificant decrease in protein content in plantain chips stored in 0.7 mm thick polyethylene bags (26.6 × 18.8 cm).

Figure 1 Change in physico-chemical compositions (A-Moisture, B-Ash, C-Protein, D-Fat and E-Fiber content) of crackers during storage period

3.2.4 Fat content

Fat content of fresh crackers was significantly affected by ratio of papaya and whole grain flour. Fat content of fresh cracker increased with the decreasing of papaya paste (Figure 1D). Moreover, Figure 1D clearly indicates that fat content decreased with the storage period. During storage period, F3

showed maximum decreasing trend from 1.94% to 0.98% and minimum trend 1.84% to 1.22% was observed in F2 sample. Decreasing trend in fat content of stored crackers may be resulted due to hydrolysis and oxidation of oil component. These results are in good agreement with Manikantan et al. (2014) who noted increased free fatty acid in stored banana chips.

3.2.5 Fiber content

Fiber content in F1, F2 and F3 combinations of freshly prepared papaya crackers were 11.5, 12.14 and 13.75% respectively (Figure 1E). The storage period showed significant effect on fiber content of crackers and a reduction

in the fiber content was reported with the passage of storage time, whereas maximum decrease (39.54%) was resulted in F2 sample and minimum (24.17%) in F1 sample. Moisture absorption during storage time may be possible reason of decreasing the amount of fiber content in different combinations of papaya crackers.

Figure 2 Change in mineral contents (A-Calcium, B-Magnesium, C-Sodium, D-Potassium and E-Phosphorous) of crackers during storage period

3.2.6 Mineral content

Results of study revealed that incorporation of whole wheat flour had significant effect on mineral contents of papaya crackers (Figure 2). Maximum calcium, magnesium, sodium, potassium and phosphorous value were found in F3 sample and it was 27.24%, 123.85%, 6.78%, 503.72% and 327.02% respectively. On the other hand, value of mineral contents decreased in all cracker samples with longer storage period. However, maximum mineral contents were found in F3 sample at 90 days of storage period, whereas minimum minerals in F1 sample (Figure 2). Increasing of moisture might have influenced the mineral contents of crackers during storage period. It is interesting to note that there was no published paper regarding change in mineral content of crackers during storage.

Conclusion

This study revealed that the ratio of wheat flour and papaya significantly affected the nutrient compositions of crackers. Additionally fiber content was increased and baking process instead of frying resulted in less fat content of the crackers. Storage study also revealed that storage time significantly affected the quality of crackers. Furthermore, it was also reported that high density polyethylene was not sufficient enough to keep the quality of crackers during storage. We also propose to pack crackers in laminated films containing nitrogen flush for long term storage stability. In addition, the effect of storage conditions on oxidative stability of newly formulated crackers could be assessed before the production at industrial scale.

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Conflict of interest

Authors would hereby like to declare that there is no conflict of interests that could possibly arise.

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