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Processing and Quality Evaluation of Crackers from Cassava Flour

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Abstract

Cassava flour and cassava starch were processed from fresh cassava root to prepare cassava crackers. Five different types of cassava crackers were prepared with different ratio of cassava flour and cassava starch as main ingredients. Each type of fried cassava crackers was analyzed for moisture, ash, protein, fat, sugar and total carbohydrate. Based on visual color of fried cassava crackers, 130°C and minimum frying time 15 second were selected as suitable frying conditions. A range of moisture content (2.67 to 3.01%), ash content (1.68 to 2.05%), protein (9.58 to 11.13%), fat (19.73 to 21.95%), sugar (3.87 to 4.41%) and carbohydrate (89.41 to 89.57%) were found in fried cassava crackers. Significant ($p<0.05$) difference in sensory attributes was observed and S_5 sample (cassava flour: wheat flour: baking powder= 67:30:3) was most accepted cassava crackers to panelists. Results of this study shows that cassava root has good potential in the production of various snacks especially crackers.

Keywords: Cassava flour, Cassava crackers, Cassava starch, Quality, Sensory evaluation.

Introduction

Cassava (*Manihot esculenta*) belongs to the family of Euphorbiaceae and is used as a staple food in many tropical countries of Asia, America and Africa. Not only cassava root is playing an important role to minimize food crisis in African countries but also it is being used as a valuable and cheap calorie source for millions of people living in developing countries[1-3].

But major limitations of cassava root as a food crop include the presence of toxic cyanoglucosides and rapid perishability as a consequence of heat generation from respiration[4]. High physiological activities and viability to micro-organisms cause post-harvest losses during storage of fresh cassava. Therefore, processing of this root is only one way to prolong the shelf-life and reduce toxic cyanoglucoside to safe level for human consumption. Dehydrated cassava, cassava flour, cassava gari, chips and crackers are processed form of fresh cassava[5]. The demand of cassava flour is increasing day by day in bakery industry as substitute of flour, binding and filling agent. This root can be dried naturally by sun drying or artificially in cabinet or oven dryer[6,7].

In Bangladesh, cassava is grown and consumed by the tribal people lived in Madhupur, Garo hill and Chittangong hill tracks where annual production of cassava is about 30,000 tons. Usually, tribal people consume cassava after boiling in water and sometimes cassava is being used in the preparation of rooti by mixing boiled cassava with rice or wheat flour[8]. As potato cracker is popular food item in Bangladesh, so cassava cracker may be processed and introduced in market of Bangladesh.

In manufacturing of cassava crackers, cassava flour is mixed with hot water for partial gelatinization to form dough, which is then steamed or boiled for complete gelatinization. Then fully gelatinized dough is sliced and dried mechanically to lower the moisture content. The half finish product is finally fried in hot soybean oil whereby it expands to porous, crispy and low density crackers. It has been reported that frying is most important step in making crackers because color, flavor and taste greatly depend on the frying process[9]. This indicates that quality of cassava cracker needs to be developed and perfected. Therefore, this study was aimed to develop the processing method of cassava crackers with optimal sensory attributes.

Materials and Methods

Preparation of cassava flour: The fresh and tender cassava roots were collected from local market of Modhupur. The fresh cassava was then washed manually to remove adhered dirt and other field damaged portion. The clean cassava was peeled and sliced circumferentially as well as thinly with a sharp knife. The cassava slices were treated in 0.4% KMS solution for 10 minutes. Treated cassava slices were sun dried at 30±1°C for two days to lower the moisture content up to 8-10%. The dried cassava slices were ground into flour using a lab grinder. Then flour was sieved and stored in high density polyethylene bags

for further use.

Preparation of cassava starch: Washed and peeled cassava (1kg) was chopped and blended with water (1.2L) for 10min and sieved through a mesh (MIC 200). The residue was then rinsed with tap water to remove additional remnants of starch. The resulted slurry was allowed to settle for 1hr. After that, the starch was carefully suspended in distilled water and the supernatant was decanted to remove non-starch materials. Following the method of Abera and Rakshit[10], the cassava starch was dried in a cabinet dryer at 45°C for 18h to lower the moisture content (11–12%). Dried starch was blended and sieved to get fine cassava starch. Finally, cassava starch was packed in high-density polyethylene and stored at ambient condition until required.

Processing of cassava crackers: Formulation of cassava crackers: Basic formulation of cassava crackers used in this research is presented in Table-1.

Preparation of cassava crackers: Five types of cassava crackers were prepared using cassava flour, wheat flour, cassava starch and baking powder as given in the basic formulation (Table-1). The ingredients were weighed accurately and mixed well with the addition of water. Mixture was needed for 20 min for the preparation of dough. The dough was then rolled to thin shit about 1-2mm. The rolled dough was cut into small pieces about $23\times23\times1mm^3$. The pieces were then subjected to direct steam for 20-30 minutes. After cooling steamed pieces were dried in an oven at 45^oC for 14hr. All the dried samples were then fried in soybean oil at 130^oC, 140^oC and 150^oC for 15 seconds, 13 seconds and 10 seconds respectively. After frying, the crackers were allowed to drain out excess oil. Then testing salt was applied when the crackers were free from excess fat. The amount of salt could be added depending upon the individual taste. After salting, the crackers were packed in high density polyethylene bags and stored at ambient condition.

Chemical analysis: Proximate compositions of cassava cracker including moisture, ash, protein and fat content were determined by following standard methods of AOAC[11]. Cassava cracker was analyzed for total sugar by using Fehling's solution according to Lane and Eyanon[12]. Total carbohydrate content of cassava crackers was analyzed according to Pearson[13].

Sensory evaluation: The hedonic rating test was used to evaluate sensory attributes namely color, flavor, texture, taste, crispiness and overall acceptability of fried cassava crackers. A number of 15 panelists were selected for the sensory evaluation who gave scores based on 9 point hedonic scale where 9 for like extremely and 1 for dislike extremely in accordance with the method of Snedecor and Cochran[14].

Statistical analysis: Obtained data from chemical and sensory evaluation were statistically analyzed by analysis of variance (ANOVA) using statistical program 'SPSS-version 20'. Mean differences were evaluated by DMRT test at 5% significance level.

Results and Discussion

Chemical compositions of fresh cassava root are presented in Table-2. Data reveals that cassava root contained high moisture (67.33%) among chemical compositions. Very low amount fat (0.50%) was observed in cassava root. From Table-2, total carbohydrate (25%) was resulted in cassava root where total sugar was reported 5.5% in this study. However, high moisture content indicates that fresh cassava root is susceptible to decomposition and requires lowering the moisture content for storage. These results were more or less similar to the results reported by Karim *et al*.[15].

Effect of frying temperature on the color of cassava cracker: Cassava crackers were fired at three different temperatures of 130^oC, 140^oC, 150^oC to obtain low moisture content in fried crackers. The development of color at the end of minimal frying time was evaluated visually and is shown in Table-3. Data shows that frying temperature of 150^oC required less frying time (10 second) with resulting dark cassava cracker. On the other hand, frying temperature 130^oC required maximum frying time (15 second) with resulting light yellow color of crackers.

Table-1
Basic formulation of cassava crackers

Sample	Cassava flour (g)	Cassava starch (g)	Wheat flour (g)	Baking powder (g)
Sample 1 (S_1)	75	25	Nil	Nil
Sample 2 (S_2)	28	30	42	Nil
Sample 3 (S_3)	30	50	20	Nil
Sample 4 (S_4)	60	40	Nil	Nil
Sample 5 (S_5)	67	Nil	30	3

Table-2
Chemical composition of fresh cassava root (*)

Components	Quantity (%)
Moisture	67.33±0.12
Ash	0.71±0.15
Sugar	5.5±0.22
Protein	0.96±0.10
Fat	0.50±0.18
Total carbohydrate	25±0.12

*Mean values with standard deviation

Table-3
Effect of frying temperature on the color of fried crackers

Oil Temperature (^oC)	Time Required (second)	Color
130	15	Light yellow
140	13	Yellowish
150	10	Dark and spot present

Chemical compositions of fried cassava crackers: Chemical compositions of fried cassava crackers are given in Table-4. Variation in moisture content of the fried crackers was observed with a range from 2.67 to 3.01% with S_1 sample having lowest and S_2 sample having highest moisture. This range was noticeably lower than the range reported in previous study[16]. A significant ($p<0.05$) difference in ash content of fried crackers was observed in this study. Highest ash content (2.05%) was found in S_3 sample, whereas S_5 sample contained lowest ash (1.68%). Protein content in fried cassava differed significantly ($p<0.05$) in this study. Highest (11.13%) and lowest (9.58%) protein were resulted in S_4 and S_2 samples respectively. Significant ($p<0.05$) difference in fat content of fried cassava samples were also observed in this study. Fat content ranged from 19.73 to 21.95% being highest for S_3 sample and lowest for S_4 sample. Ash, protein and fat content in this study was significantly higher than the previous report[16]. These variation may be due to frying technique, and varietal change of cassava root. From Table-4, sugar content of fried cassava chips differed from 3.87 to 4.41%. It is interesting that no scientific report is available regarding sugar content of fried cassava cracker. Data shows that a range of carbohydrate (59.23-60.98%) was resulted in fried cassava crackers. In contrast, higher range of carbohydrate (89.41-89.57%) was reported by Obasi and Chukwuma[16]. This may be due to difference in frying technique and use of frying oil in this research work.

Sensory evaluation: For all the fried samples, the color of S_2 and S_4 samples were liked most with a value of 7.50 and 7.38 respectively, whereas S_3 sample was scored with lowest value 6.50 (Figure-1). Based on flavor, both of S_4 and S_5 were preferred most, whereas S_2 sample was found worst. There was significant ($p<0.05$) difference in texture of fried cassava crackers. Panelists preferred the texture of S_5 sample most but S_1, S_2 and S_3 sample were found significantly same. The taste of S_5 sample was most preferred and differed significantly ($p<0.05$) from other fried crackers samples. Data shows that cracker samples were significantly ($p<0.05$) differed in crispiness. Crispiness of S_5 sample was scored with highest value 7.75 and S_2 sample was found having lowest score 6.38. On the basis of overall acceptability, all crackers samples were not preferred by panelists. S_5 sample was liked most, whereas S_1, S_3 and S_4 samples were second choice to panelists. On the other hand, S_2 sample was marked worst in overall acceptability.

Table-4
Chemical compositions of fried cassava crackers (*)

Sample	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Sugar (%)	Total carbohydrate (%)
S_1	2.67 ± 0.18^{b}	1.73 ± 0.09^{ab}	10.09 ± 0.11^{b}	21.06 ± 0.11^{b}	3.93 ± 0.12^{b}	60.52 ± 0.10^{a}
S_2	3.01 ± 0.20^{a}	1.69 ± 0.12^{ab}	9.58 ± 0.18^{bc}	20.33 ± 0.10^{ab}	4.41 ± 0.16^{a}	60.98 ± 0.13^{a}
S_3	2.78 ± 0.23^{ab}	2.05 ± 0.15^{a}	9.94 ± 0.22^{b}	21.95 ± 0.13^{a}	4.05 ± 0.12^{ab}	59.23 ± 0.12^{c}
S_4	2.93 ± 0.14^{a}	1.97 ± 0.11^{a}	11.13 ± 0.13^{a}	19.73 ± 0.16^{c}	3.87 ± 0.15^{b}	60.37 ± 0.18^{ab}
S_5	2.81 ± 0.11^{ab}	1.68 ± 0.10^{ab}	10.77 ± 0.15^{ab}	20.59 ± 0.17^{ab}	4.13 ± 0.19^{ab}	60.02 ± 0.09^{b}

*Mean values with standard deviation; values with different superscript letters within a column are significantly different ($p<0.05$)

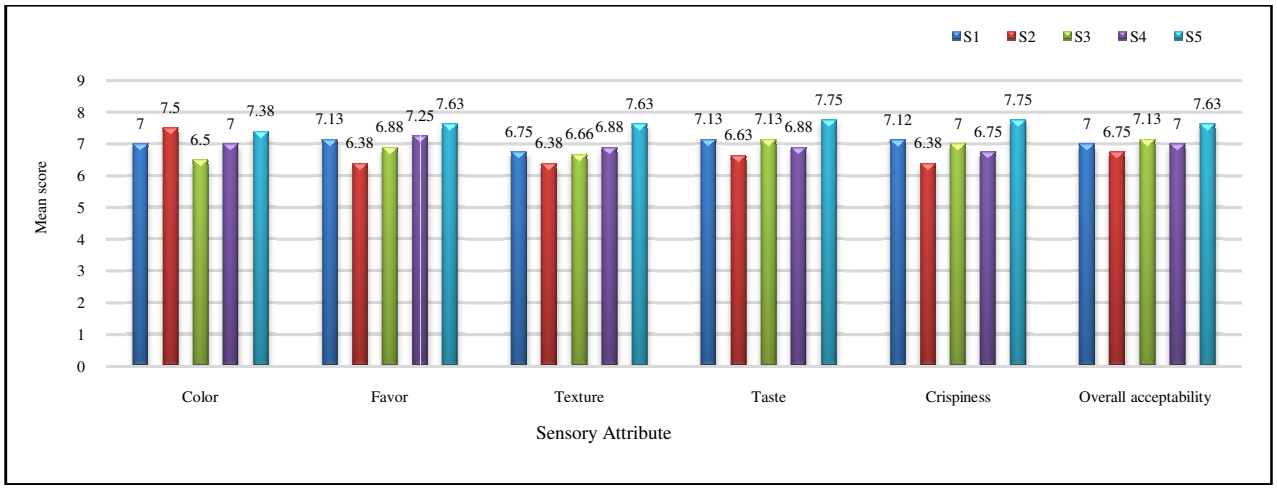

Figure-1
Sensory evaluation of fried cassava crackers

Conclusion

Consumer's interest in crackers has motivated researchers to develop cassava crackers using cassava flour and cassava starch. However, cassava crackers were found to be good source of energy. Sensory evaluation of fried crackers showed that all samples were more or less accepted to the panelists where sample S_5 (cassava flour: wheat flour: baking powder= 67:30:3) was most preferred cassava crackers. Cassava flour or starch could be used as a substitute of wheat flour in bakery industries and products made of cassava flour could be recommended to gluten intolerants. Therefore, cassava crackers could be consumed as a good source of nutrients by snacks favored people of any age.

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