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Study on physicochemical and anti-oxidant properties of coconut cream extracted from two BARI varieties

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Abstract

Coconut cream is the aqueous extract from matured coconut which improves immune system, gives energy, slows aging and hydrates body. A study was conducted on extracted coconut cream of BARI-1 and BARI-2 coconut varieties to compare their physicochemical (proximate, chemical, mineral and phytochemical) characteristics, antioxidant activity (total phenolic content and DPPH free radical scavenging activity) and sensorial property. The results showed that fat (23.25 ± 0.13%), carbohydrate (7.24 ± 0.06%), phosphorus (85.22 ± 0.95 mg/100 g) and potassium (61.25 ± 0.84 mg/100 g) were significantly higher in BARI-2 cream than that of BARI-1. In contrast, protein (4.01 ± 0.08%), moisture (67.29 ± 0.41%), ash (1.30 ± 0.02%), acid value (2.77 ± 0.05 mg KOH/g) and free fatty acid (1.39 ± 0.03%) were significantly higher in BARI-1 coconut cream as compared to BARI-2. Peroxide value and flavonoids were not detected in both cream samples. Total phenolic content (6.33 ± 0.22 GAE mg/100 g) and DPPH free radical scavenging activity (66.92 ± 0.02%) at 50,000 µg/mL concentration were significantly higher in BARI-2 coconut cream than that of BARI-1. Sensorial property was satisfactory in both biscuits made from the coconut cream. From the above results, it can be concluded that BARI-2 coconut cream was better than that of BARI-1 coconut cream in terms of antioxidant activity and all others physicochemical analyses except protein content.

Introduction

Coconut (*Cocos nucifera*: Arecaceae) is found along sandy shorelines throughout the tropics. It is not only spread by human but also by natural means. In tropical low land, it is cultivated for commercial purposes. It is also found in warmer subtropical areas (Osawa *et al*., 2007). A great number of coconut varieties exist as a result of cross-pollination. These varieties are distinguished on the basis of colour, size and shape (Ochse *et al*., 1961). Bangladesh Agricultural Research Institute (BARI) has released two varieties of coconut, named BARI-1 and BARI-2.

There is an increasing demand for the aqueous extract of solid coconut endosperm for houshold use as well as in the food industry, although oil recovery remains the major concern in the coconut industry (Gwee, 1988). The emulsion which is extracted from matured endosperm (kernel) of coconut with or without any addition of coconut water/water is called coconut cream. Emulsion which is found by the removal of water from coconut cream is called coconut cream concentrate. Concentrated coconut cream can be obtained by further removal of water from the coconut cream concentrate. Coconut milk is defined as the diluted emulsion which is extracted from matured endosperm (kernel) of coconut. Light coconut milk is obtained from either the bottom portion of centrifuged coconut milk or by further dilution of coconut milk (Codex, 2003). Coconut cream has high amount of medium-chain fatty acid (MCFA) which the body processes differently from other saturated fats. By consuming MCFAs in the daily diet to replace long-chain fatty acids (LCFAs) like animal fats, body weight maintenance could be controlled and improved without raising the cholesterol levels (St-Onge and Jones, 2002; Rahman *et al*., 2015). Coconut cream has a high proportion of lauric acid which is a saturated fat. Lauric acid boosts blood cholesterol that is also found in breast milk as well as sebaceous gland secretions (Amarasiri

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and Dissanayake, 2006; Shin *et al*., 2015). Free fatty acids (FFA) are produced by the hydrolysis of oils and fats. The level of FFA depends on time, temperature and moisture content because the oils and fats are exposed to various environments such as storage, processing, heating or frying. Peroxide value is one of the parameters to indicate the stability of coconut oils against oxidation (Marina *et al*., 2009). Acid value is the indicator of the amount of free acid in fats or oils which is responsible for the rancidity due to heat or light (Demian, 1990).

Antioxidants are beneficial for humans. For controlling oxidative stress, dietary antioxidants play an important role in our body (Nikki, 2001). The oxidants and antioxidants are maintained in equilibrium during normal metabolism (Singh and Sharma, 2009; Zzaman *et al*., 2014). The pathogenesis of diseases like atherosclerosis, cataract, diabetes, carcinogenesis and accelerated ageing originate from excess free radical production (Van't Veer *et al*., 2000). Nutritionists, food manufacturers and consumers raise considerable interest on natural antioxidants in recent years because of their presumed safety and potential therapeutic value (Takeoka and Dao, 2003; Abedin *et al*., 2015).

To the best of our knowledge at the moment, there is limited study on coconut cream. Therefore, the aim of the present work was to analyse the physicochemical characteristics and antioxidant activity of BARI-1 and BARI-2 coconut cream samples, prepare biscuits with the two coconut cream samples, evaluate the sensorial property of the formulated cookies, and compare between the two coconut cream samples with respect to their nutritional values.

Materials and methods

Raw material collection

BARI-1 and BARI-2 coconuts (Figure 1) were collected from Bangladesh Agricultural Research Institute (BARI), Barishal, Bangladesh. The average weight was 1,250 ± 12 g and 1,600 ± 18g for BARI-1 and BARI-2, respectively.

Sample preparation

The coconuts were first dehusked and the shell was opened. The endosperm was then scrapped, blended and pressed to coconut cream. The coconut cream was then filtered with a muslin cloth. The filtered coconut cream was transferred into several test tubes (≈5 mL/tube) and refrigerated until further use.

Physicochemical characteristics

For proximate analysis, the protein content was determined by Micro-Kjeldahl method according to Magomya *et al*. (2014). The protein factor was 5.30 (Jeffrey *et al*., 2010). The fat content was determined according to Ravichandran and Parthiban (2000) using chloroform: methanol (2:1 v/v) to separate the fat content from the cream sample. Total ash and moisture contents both were determined according to AACC (2004). The carbohydrate content was determined by subtracting method according to Lilla *et al*. (2005).

Chemical analysis was done by the determination of acid value, free fatty acid (FFA) percentage and peroxide value. Acid and peroxide values were determined according to AOAC (2002). The FFA% was also determined according to AOAC (2002) with linoleic acid as the factor.

Qualitative phytochemical tests were done on coconut cream samples by observing the colour changes. Test for flavonoids and alkaloids were conducted according to Trease *et al*. (2002). Steroid and terpenoid tests were conducted according to Mbatchhou *et al*. (2012). Test for glycosides was conducted according to Sofowara (1993).

For mineral analysis, calcium (Ca), iron (Fe) and phosphorus (P) were determined by spectrophotometric method according to AOAC

BARI-1 Coconut BARI-2 Coconut

Figure 1. BARI-1 and BARI-2 coconut samples used in the present work.

(2002). Sodium (Na), potassium (K) and zinc (Zn) were determined by Flame Atomic Absorption method in accordance with Cookbook supplied with software SOLAARM element specific measurement conditions, the lamp current value, slit width and flame conditions were used. Cookbook was also followed to prepare the standard solutions for conducting the calibration curve.

Anti-oxidant activity

Anti-oxidant activity was evaluated by quantifying the total phenolic content (TPC) and DPPH free radical scavenging activity. The TPC was determined using the Folin-Ciocalteu phenol reagent according to Amorim *et al*. (2008), and the DPPH free radical scavenging activity was determined by using DPPH reagent according to Chang *et al*. (2001). Stock solution was made by methanol extraction. For TPC, 0.2 mL methanol extract was taken into a test tube and added with 8.3 mL distilled water. Then, 0.5 mL Folin–Ciocalteu reagent was added to the same tube and kept at room temperature for 5 min. After that, 1 mL 35% saturated aqueous solution of sodium carbonate (Na_2CO_3) was transferred to the tube and shaken vigorously. The solution was incubated at room temperature for 20 min. The absorbance was read at 765 nm using T60 UV-Visible Spectrophotometer against a reagent blank. Gallic acid was used as standard in calibration curve preparation (10 − 60 mg/100 mL). Quantification (mg/g of aril and peel powder) was obtained by reporting the absorbance in the calibration curve. The results of total phenolic were expressed in terms of Gallic acid equivalent in mg/g of dry powder.

For DPPH radical scavenging activity, 1 mL methanol extract was placed into a test tube and mixed with 4 mL DPPH solution (0.1 mM in methanol) and shaken vigorously. The mixture was incubated for 30 min at room temperature in the dark. After incubation, the absorbance was read at 517 nm using T60 UV-Visible Spectrophotometer. Triplicate measurements were carried out for each sample. The percentage of DPPH radical scavenging was measured from the following equation where the absorbance of DPPH solution without extract was used as control:

$$\% \text{ scavenging of DPPH} = (1 - \text{Absorbance of sample} / \text{Absorbance of control}) \times 100$$

Sensorial evaluation

Sensorial evaluation of biscuits, made from the coconut cream samples, was carried out with 7-point hedonic scale (1 = extremely dislike and 7 = extremely like) according to Marina and Nurul (2014). A total of 30 panellists from the Department of Food Engineering and Tea Technology, Shahjalal University of Science and Technology, Bangladesh participated in the sensory evaluation. The attributes were colour, aroma, bitterness, taste and overall acceptance.

Statistical analysis

The experiments were carried out in triplicates and data obtained from experiments were analysed using the Statistical Package for the Social Sciences (Version 21; IBM corporation, 1989). Analysis of Variance was used to obtain the significant difference between BARI-1 and BARI-2 coconut cream. Significant difference was determined at $p < 0.05$.

Results and discussion

Physicochemical characteristics

Table 1. Proximate analysis, chemical analysis and TPC of BARI-1 and BARI-2 coconut creams

Composition	BARI-1 (%)	BARI-2 (%)
Protein	4.01 ± 0.08^b	3.35 ± 0.02^a
Fat	20.97 ± 0.36^a	23.25 ± 0.13^b
Ash	1.30 ± 0.02^a	1.10 ± 0.01^a
Moisture	67.29 ± 0.41^b	64.95 ± 0.07^a
Carbohydrate	5.69 ± 0.17^a	7.24 ± 0.06^b
Chemical Analysis	BARI-1	BARI-2
Acid value (mg KOH/g)	2.77 ± 0.05^b	1.64 ± 0.05^a
Percent FFA (oleic acid)	1.39 ± 0.03^b	0.83 ± 0.02^a
Peroxide value (milliequivalent peroxide/ kg oil)	ND	ND
TPC Gallic acid (mg/100g)	4.01 ± 0.08^a	6.33 ± 0.22^b

*Values are means ± standard deviations. Values in column with different letter superscripts are significantly different at $p \leq 0.05$.

The results for proximate and chemical analysis are shown in Table 1. The protein contents obtained from BARI-1 and BARI-2 coconut cream samples were 4.01 ± 0.08% and 3.35 ± 0.02%, respectively. There was significant difference between BARI-1 and BARI-2 coconut cream samples in protein contents. The protein content in coconut cream should be 3.63% (USDA, 2015) which is almost similar to that obtained in the present work.

The fat contents were 20.97 ± 0.36% and 23.25 ± 0.13% for BARI-1 and BARI-2 coconut cream samples, respectively. There was a significant difference between BARI-1 and BARI-2 coconut cream samples in fat contents. According to Codex (2003), the minimum fat content in coconut milk should be 20% which is almost similar to that obtained in the present work.

The ash contents were 1.30 ± 0.02% and 1.10

± 0.01% for BARI-1 and BARI-2 coconut cream samples, respectively. There was a significant difference between BARI-1 and BARI-2 coconut cream samples in ash contents. According to USDA (2015), coconut cream should contain 1.15% ash which is almost similar to that obtained in the present work.

The moisture contents obtained from BARI-1 and BARI-2 coconut cream samples were 67.29 ± 0.41% and 64.95 ± 0.07%, respectively. There was a significant difference between BARI-1 and BARI-2 coconut cream samples in moisture contents. According to Codex (2003), the maximum moisture for coconut cream should be 74.6% which is almost similar to that obtained in the present work.

The amount of carbohydrate was 5.69 ± 0.17% and 7.24 ± 0.06% respectively for BARI-1 and BARI-2 coconut cream samples. There was a significant difference between BARI-1 and BARI-2 coconut cream samples in carbohydrate contents. According to USDA (2015), coconut cream should contain 6.65% carbohydrate which is almost similar to that obtained in the present work

The acid values were 2.77 ± 0.05 mg KOH/g and 1.64 ± 0.05 mg KOH/g in BARI-1 and BARI-2 coconut cream samples, respectively. A significant difference existed between BARI-1 and BARI-2 coconut cream samples in acid value. The edibility of oil depends on its acid value. It is the parameter to measure the extent at which glycerides in oil are decomposed by lipases as well as the actions of light and heat. The low content of acid value indicates that the oil is better for consumption (Demian, 1990). In this regard, BARI-2 coconut cream was comparatively better than that of BARI-1. A study by Sani *et al*. (2014) found that the acid value of coconut oil to be 0.79 ± 0.21 mg KOH/g, which is also in agreement with the Codex standard. In the present work, it was expected that the acid value should be higher in the coconut cream since coconut oil is extracted from coconut cream.

Free fatty acid value stands for the undesirable aroma and flavour in fats. Hydrolytic rancidity is responsible for the formation of FFA which is the hydrolysis of an ester by lipase or moisture (Osawa *et al*., 2007). In the present work, the FFA values were 1.39 ± 0.03% and 0.83 ± 0.02% in BARI-1 and BARI-2 coconut cream samples, respectively. As BARI-2 coconut cream contained significantly lower FFA value than that of BARI-1, it could be said that BARI-2 coconut cream was comparatively better. High temperature and excessive amounts of water is responsible for the accelerated hydrolysis (Lawson, 1985). Since, BARI-1 coconut cream contained higher moisture content than that of BARI-2, BARI-1 probably had higher FFA value. Another study conducted on Malaysian and Indonesian virgin coconut oil (VCO) by Marina *et al*. (2009) gave FFA range of 0.15-0.25% which is also in agreement with the Codex standard. It was expected that FFA% should be higher in coconut cream (as observed in the present work) than that of VCO since VCO is extracted from coconut cream.

Peroxide value was absent in both samples of the coconut cream after 48 h extraction. The formation of peroxides and hydro-peroxides in the initial stage of lipid oxidation is determined by the peroxide value. The peroxide value reflects the oxidative level and the tendency of vegetable oils to become rancid. Unsaturated fatty acids have the ability to react with oxygen easily to form peroxides. The oil which contains high peroxide values are unstable and easily become rancid (Ojeh, 1981). The present work showed zero value of peroxide in coconut cream samples which might indicate that the BARI-1 and BARI-2 coconut cream were stable against initial oxidation and rancidation.

The qualitative phytochemical analysis is given in Table 2. Alkaloids are the bioactive constituent of plants responsible for its medicinal values (Edeoga *et al*., 2005). Alkaloids were in moderate concentration in BARI-1 and high in BARI-2 coconut cream samples assessed in the present work. The result is in agreement with Odenigbo and Otisi (2011).

Table 2. Qualitative phytochemical test of BARI-1 and BARI-2 coconut creams

Test	Observation	Inference	BARI-1	BARI-2
Alkaloids (picric acid test)	Yellow precipitate	Alkaloids present	++	+++
Steroids (conc. H_2SO_4 test)	A reddish and brown interface was observed	Steroids present	n.d.	+++
Glycosides (conc. H_2SO_4 test)	Colour development from blue to bluish green	Glycosides present	++	++
Terpenoids (conc. H_2SO_4 test)	Clear upper and lower layers with a reddish brown interphase	Terpenoids present	++	+++
Flavonoids (diluted HCl test)	yellow colour didn't turn colourless	Flavonoids absent	n.d.	n.d.

* n.d. (not detected); + present in low concentration; ++ present in moderate concentration; +++ present in high concentration.

Due to the relationship with sex hormones, the steroidal compounds are of importance and interest in pharmacology. Steroids are given to mothers or feeding mothers to ensure their hormonal balance (Okwu, 2001). In the present work, steroids were absent in BARI-1coconut cream which is supported by a study of Edeoga *et al*. (2005). However, steroids were present in high concentration in BARI-2 coconut cream sample. This might be due to the difference in seed variety and the propagation system of BARI-1 coconut as compared to its BARI-2 counterpart.

In living organisms, glycosides play a vital role. Many plants store chemicals in the form of inactive glycoside. Enzymatic hydrolysis is responsible for its activation which causes the sugar to be broken down thus rendering the chemical available for use. Poisons are often attached to sugar molecules as part of their expulsion from the body of animals including humans (Brito-Anas, 2007). Glycosides were present in moderate concentration in both BARI-1 and BARI-2 coconut cream samples which is supported by a study of Obidoa *et al*. (2010).

The antioxidant properties in coconut cream samples were confirmed by the presence of terpenoids. Antioxidants reduce the formation of free radicals. They react with and neutralise the free radicals by which they protect the cell from oxidative damage (Dichter and Delanty, 2000). Coconut is used to defend against arterosclerosis and to obstruct the growth of cancer cell which is affirmed by the presence of phenolic compounds (Sabir *et al*., 2003). Terpenoids were present in moderate concentration in BARI-1 coconut cream in the present work and in high concentration in that of BARI-2. This is supported by a study of Odenigbo and Otisi (2011) for Nigerian coconut seed flesh.

Flavonoids were absent in both BARI-1 and BARI-2 coconut cream samples in the present work. This is also supported by Odenigbo and Otisi, (2011) for Nigerian coconut seed flesh.

Table 3. Mineral analysis of BARI-1 and BARI-2 coconut creams

Mineral	BARI-1 (mg/100 g)	BARI-2 (mg/100 g)
Ca	16.23 ± 1.40^{a}	23.50 ± 1.34^{b}
Fe	0.28 ± 0.02^{b}	0.22 ± 0.01^{a}
P	59.02 ± 0.97^{a}	85.22 ± 0.95^{b}
Na	7.99 ± 0.09^{a}	10.79 ± 0.27^{b}
K	38.11 ± 0.79^{a}	61.25 ± 0.84^{b}
Zn	0.10 ± 0.02^{a}	0.10 ± 0.01^{a}

*Values are means ± standard deviations. Values in column with different letter superscripts are significantly different at $p \leq 0.05$.

Mineral analysis is given in Table 3. Calcium (Ca) is important for blood clotting, functioning of certain enzymes and controling fluids through cell membranes. Bone and teeth diseases occur due to its deficiency (Potter and Hotchkiss, 2006). According to USDA (2015), raw coconut cream should contain 11 mg/100 g Ca. The result in the present work showed that BARI-1 and BARI-2 coconut cream samples were both rich in Ca at 16.23 ± 1.40 mg/100 g and 23.50 ± 1.34 mg/100 g, respectively. The significant difference in Ca content between BARI-1 and BARI-2 coconut cream samples might probably be due to the different variety.

Iron (Fe) is a component of blood haemoglobin that carries oxygen and muscle myoglobin which stores oxygen (Potter and Hotchkiss, 2006). Raw coconut cream should contain 2.28 mg/100 g Fe (USDA, 2015). The present work showed that BARI-1 and BARI-2 coconut cream samples were not rich in Fe. This might probably be due to the environment and soil condition on which the coconut varieties were grown. There was a significant difference between BARI-1 (0.28 ± 0.02 mg/100 g) and BARI-2 (0.22 ± 0.01 mg/100 g) Fe content which might be due to their variety difference.

Phosphorus (P) is an essential part of every living cell and involved in the enzyme-dominated energy-producing reactions of the metabolism. Furthermore, P is also responsible to control the acid-alkaline reaction of the blood (Potter and Hotchkiss, 2006). Raw coconut cream should contain 122 mg/100 g P (USDA, 2015). The present work showed that BARI-2 coconut cream contained significant amount of P (85.22 ± 0.95 mg/100 g) while BARI-1 only contained 59.02 ± 0.97 mg/100 g. Both varieties did not achieve the reference value. This might also be due to the environment and soil condition on which the varieties were grown. The significant difference between BARI-1 and BARI-2 coconut cream samples in P contents might be due to the variety difference and propagation system.

Sodium (Na) is the major extracellular ion of the body. Essentially, Na and Cl are involved with maintaining the osmotic equilibrium and body fluid volume. Due to the loss of these ions, weakness, nausea, and muscle cramps would take place (Potter and Hotchkiss, 2006). Raw coconut milk should contain 4 mg/100 g Na (USDA, 2015). The present work showed that both coconut cream samples were rich in Na. BARI-2 coconut cream contained significantly higher amount (10.79 ± 0.27 mg/100 g) of Na than BARI-1 (7.99 ± 0.09 mg/100gm). Variety difference might be the probable cause behind this.

Potassium (K) is the principal intracellular cation which helps to regulate the osmotic pressure and pH equilibrium with Na. It is also responsible in cellular

enzyme function (Potter and Hotchkiss, 2006). Raw coconut cream should have 325 mg/100 g K (USDA, 2015). However, the present work showed that both BARI-1 and BARI-2 coconut cream samples were not rich in K. Environment as well as soil condition might probably be responsible for this. BARI-2 coconut cream contained significantly higher amount of K (61.25 ± 0.84 mg/100 g) than BARI-1 (38.11 ± 0.79 mg/100 g). This might be attributed to the variety difference.

Zinc (Zn) is an absolutely necessary constituent of enzymes responsible for protein and carbohydrate metabolism and nucleic-acid synthesis. Impaired growth and development, skin lesions, and loss of appetite are due to Zn deficiency (Potter and Hotchkiss, 2006). Raw coconut cream should contain 0.96 mg/100 g Zn (USDA, 2015). In the present work, both BARI-1 and BARI-2 coconut cream samples were not rich in Zn. There was no significant difference between BARI-1 and BARI-2 Zn contents.

Anti-oxidant activity

The results of total phenol content (TPC) are given in Table 1. There was a significant difference between BARI-1 and BARI-2 coconut cream samples in TPC. BARI-2 contained more TPC (6.33 ± 0.22 mg GAE/100 g) than in BARI-1 (4.01 ± 0.08 mg GAE/100 g). The difference in TPC between the coconut cream samples might probably arise due to the different propagation system. In previous study (Sreeramulu and Raghunath, 2011), the TPC in coconut milk was found to be 31 ± 4.9 mg GAE/100 g coconut milk. It was expected that the coconut cream should contain higher TPC value than coconut milk as the coconut milk is a dilution of the coconut cream. However, the present work contradicts this. According to the Folin-Ciocalteu method, flavonoids, anthocyanins and non-flavonoid phenolic compounds can all be estimated (Benvenuti *et al*., 2004). In phytochemical analysis (Table 3), flavonoids were not detected in both of the cream samples. This could be the reason behind the low amount of TPC in both cream samples.

The results of DPPH free radical scavenging activity is given in Table 4. Free radical scavenging activity in all concentrations was significantly higher in BARI-2 coconut cream than in that of BARI-1. BARI-2 had 66.92 ± 0.02% DPPH free radical activity in 50,000 µg /mL whereas BARI-1 had 63.48 ± 0.03%. The difference between the two coconut cream samples might arise due to the lower TPC in BARI-1 than BARI-2 coconut cream. In previous study (Alyaqoubi *et al*., 2015), Malaysian coconut milk yielded 68.39 ± 1.30% of DPPH free radical scavenging activity. It was expected that the coconut cream should contain higher DPPH free radical scavenging activity than coconut milk since coconut milk is the dilution of coconut cream. Although contradictory, the different result between the present and previous studies was slight, which might be due to the variation of the land and environment of these two different countries.

Table 4. DPPH free radical scavenging activity and sensorial evaluation of BARI-1 and BARI-2 coconut creams

Concentration	BARI-1	BARI-2
50 µg/ml	59.46 ± 0.03[a]	61.57 ± 0.02[b]
500 µg/ml	61.28 ± 0.02[a]	63.89 ± 0.02[b]
5000 µg/ml	62.36 ± 0.03[a]	65.02 ± 0.02[b]
50000 µg/ml	63.48 ± 0.03[a]	66.92 ± 0.02[b]
Attributes of Sensory	BARI-1	BARI-2
Colour	6.27 ± 0.45[a]	6.09 ± 0.68[a]
Aroma	6.45 ± 0.51[a]	6.18 ± 0.59[a]
Bitterness	4.00 ± 0.01[a]	4.00 ± 0.01[a]
Taste	6.27 ± 0.63[a]	6.36 ± 0.49[a]
Overall Acceptance	6.18 ± 1.14[a]	6.09 ± 1.11[a]

*Values are means ± standard deviations. Values in column with different letter superscripts are significantly different at $p \leq 0.05$.

Sensorial evaluation

The sensorial property for BARI-1 and BARI-2 coconut cream biscuits is given in Table 4. It is apparent that there was no significant difference between BARI-1 and BARI-2 coconut cream biscuits in terms of sensorial property. The result also showed that the sensorial property was satisfactory for both samples for all the attributes tested. Colour and aroma depend on reducing sugar and amino acids (protein content). Reducing sugar and amino acids are responsible for the Maillard reaction which provides flavour and desirable brown colour of foods (Maillard, 1912). Taste is influenced by the fat content (Bus and Worsely, 2003). In the present work, rich protein and fat contents (Table 1) in both BARI-1 and BARI-2 coconut cream samples were noted which might be the reason behind the obtained good sensorial property. In previous study (Marina and Nurulazizah, 2014), it was also found that the coconut milk based dishes especially those prepared using fresh coconut milk scored higher acceptability than dairy milk dishes.

Conclusion

The present work demonstrated that BARI-2 coconut cream was better than that of BARI-1 coconut cream as BARI-2 coconut cream had significantly higher antioxidant activity and all other physicochemical characetristics except for protein

content. The sensorial property was satisfactory in both coconut cream biscuits with no significant difference between them. So, BARI-1 and BARI-2 coconut cream can be used in bakery products like biscuits, cakes and others based on their good sensorial property demonstrated in the present work. Since fats and oils are the most common ingredients in bakery and food industries, BARI-1 and BARI-2 coconut cream can be used as a source of natural fat and oil. BARI-2 coconut cream can also be a good source of phosphorus and potassium as compared to BARI-1. Further studies can be carried out to analyse the chromatographic profiling and stability of developed coconut cream biscuits to observe the shelf life during storage period to fulfil the requirement of the standard of the developed product.

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