

RESEARCH REPORT 2022-2023
ON
POSTHARVEST TECHNOLOGY OF CROPS

Program Leader
Md. Hafizul Haque Khan



Postharvest Technology Division
Bangladesh Agricultural Research Institute
Gazipur-1701
October 2023

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PHYSICOCHEMICAL PROPERTIES AND BIOACTIVE COMPOUNDS OF SOME SELECTED COFFEE LINES AND CASHEW NUT IN HILLY AREAS OF BANGLADESH

M.G.F.CHOWDHURY, M.A. HOSSAIN, M.H.H. KHAN, M.R. AHMAD, M.T. ISLAM, M.M. MOLLA

Abstract

This study was conducted to generate information on physicochemical and bioactive compounds of selected coffee and cashew nut line in hilly areas of Bangladesh. Six coffee lines and 3 coffee samples were collected from Khagrachari and two cashew nut samples were from local cashew nut processors. Six coffee lines and 3 coffee samples exhibited the range of percent moisture, dry matter, ascorbic acid content, fat, starch, beta-carotene, phenolic compounds, and antioxidant capacity were from 2.22 to 12.24%, 82.20 to 98.31%, 5.80 to 123.48 mg/100g, 12.54 to 18.35%, 28.84 to 36.80%, 6.25 to 76.23 mg/100g, 88.23 to 163.13 GAE/100g, 60.57 to 77.29 % inhibition, respectively where as non-roasted and roasted cashew nut samples showed the percent moisture, ash, ascorbic acid, titratable acid and antioxidant were 0.77 & 1.41%, 1.67 & 1.53%, 3.27 & 4.47 mg/100g, 0.38 & 0.55%, 53.47 & 47.99 % inhibition, respectively.

Introduction

Coffee and cashew nuts are high value crops are grown in Bangladesh. It is popular all over the world because of its nutritional composition. Coffee is one of the important diets and holds 2nd position in consumption after water. Caffeine is the major composition of coffee and it is found in over 63 plants species (Smith, 2005). Moreover, information on the chemical composition of coffee, habitual coffee consumption and the potential impact of specific components on our health and well-being affect consumer choices. Cashew nut is one of the most important edible nuts in international trade, is the fruit of cashew trees (*Anacardium occidentale* L.), and its kernel is the most widely industrialized cashew product. Keeping this view, the nutritional and bioactive compounds of coffee and cashew nut were determined.

Materials and Methods

Six coffee lines such as CCKHA-001, CCKHA-002, CCKHA-003, CCKHA-004, CCKHA-005 and CCKHA-013 and non-roasted, semi-roasted and roasted coffee were collected from Hill Agriculture Research Station, BARI of Khagrachari. Non-roasted and roasted cashew nut were also collected from locally processed one cashew nut processors “Kishanghor Agro” at Balaghat in Bandarban. Spectrophotometric and HPLC will be used for evaluating physicochemical properties and bioactive compounds of coffee and cashew nut lines. The required weight of sample was randomly selected for nutritional and bioactive compounds analysis and evaluation were conducted in PHTD Lab, BARI and free fatty acid was determined using BCSIR Lab, Dhaka. Moisture, dry matter, ash and starch content were determined based on the AOAC official methods (AOAC, 2005). The titratable acidity and ascorbic acid content were determined following the methods of Ranganna (2007). The fat content was determined by the soxhlet extraction device, and the method was followed as described by Ranganna (2007). Total carotenoid was done according to Lee and Castle (2001). The total antioxidant activity was examined based on the DPPH free radical scavenging activity and the method adopted by Kamal *et al.* (2019). Total phenolic content was determined by the Folin-Ciocalteu method following the procedure of Kamal *et al.* (2019) with slight modification. Beta-carotene was determined by the methods of Igbokwe *et al.* (2013) with some modifications. Caffeine was evaluated according the method described by Smith (2005).

Results and Discussion

In the case of selected coffee lines and collected coffee samples, the percent moisture was observed with a range from 2.22 to 12.24% among the treatments. Similarly, the percent dry matter, ascorbic acid content, fat, starch, beta-carotene, phenolic compounds, and antioxidant capacity were found with a range from 82.20 to 98.31%, 5.80 to 123.48 mg/100g, 12.54 to 18.35%, 28.84 to 36.80%, 6.25 to 76.23 mg/100g, 88.23 to 163.13 GAE/100g, 60.57 to 77.29 % inhibition, respectively (Table 1).

In the case of non-roasted and roasted cashew nut samples, the observed percent moisture, ash, ascorbic acid, titratable acid and antioxidant were 0.77 & 1.41%, 1.67 & 1.53%, 3.27 & 4.47 mg/100g, 0.38 & 0.55%, 53.47 & 47.99 % inhibition, respectively (Table 2). The percent free fatty acid as oleic oil in roasted cashew nut sample was found 24.39% (Table 2).

In case of caffeine properties, semi-roasted coffee exhibited 6.07 g/100g and the observed caffeine in two roasted coffee samples were found 6.17 & 6.07 g/100g (Table 3) which are closed to reported information (6.80 g/100g).

Table 1. Mean value of physiochemical properties and bioactive compounds (% moisture, % DM, (mg/100g) ASC, % fat, % starch, (mg/100g) BTC, (GAE/100g) phenol, (% inhibition) ANT of selected coffee grown in Khagrachari.

Coffee lines	Moisture (%)	DM (%)	ASC (mg/100g)	Fat (%)	Starch (%)	BTC (mg/100g)	Phenol (GAE/100g)	ANT (% inhibition)
CCKHA-001	2.67	98.31	70.56	18.20	34.28	13.47	88.43	60.57
CCKHA-002	4.46	97.86	99.96	17.37	36.21	26.80	104.67	66.24
CCKHA-003	2.22	98.30	105.84	18.11	35.40	76.23	120.66	68.11
CCKHA-004	2.58	97.74	88.20	17.15	32.21	25.27	108.86	69.04
CCKHA-005	2.37	97.81	123.48	16.21	36.80	29.47	163.13	76.51
CCKHA-013	2.84	98.10	111.72	18.35	34.36	65.33	162.53	69.63
Non-roasted	10.49	89.06	5.80	14.54	31.20	6.25	111.67	77.29
Semi-roasted	9.04	82.20	8.14	16.25	32.60	8.36	123.67	71.85
Roasted	12.24	87.48	12.43	12.54	28.84	9.29	116.64	67.74

Note: DM= Dry matter; ASC=Ascorbic acid; BTC=Beta-carotene; ANT=Antioxidant capacity

Table 2. Mean value of physiochemical properties and bioactive compounds (% moisture, % ash, (mg/100g) ASC, % titratable acid, (% inhibition) ANT, (%) FFA of cashew nut grown in Bandarban hill tracts.

Cashew nut	Moisture (%)	Ash (%)	ASC (mg/100g)	Titratable acid (%)	ANT (% inhibition)	FFA as oleic oil (%)
Non-roasted	0.77	1.67	3.27	0.38	53.47	-
Roasted	1.41	1.53	4.47	0.55	47.99	24.39

Note: ASC=Ascorbic acid; ANT=Antioxidant capacity; FFA=Free Fatty Acid

Table 3. Mean value of (g/100g) caffeine properties of coffee samples collected from Khagrachari.

Type of coffee	Amount of caffeine (g/100g)
Semi-roasted	6.07
Roasted-1	6.17
Roasted-2	6.07

Conclusion

Coffee and cashew nut are rich in physiochemical and phytochemical constituents which have potential application in the nutraceutical, pharmaceutical and cosmetic industries. Nutritional information will add value in agro industry.

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EFFECT OF HEAT STRESS AND EDIBLE COATING ON IMPROVING QUALITY RETENTION AND SHELF LIFE OF MANGO FRUIT DURING AMBIENT STORAGE

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Abstract

This experiment was conducted to study the effect of hot water treatments and fruit coatings that stimulate the fruit antioxidant system and will maintain postharvest quality of mango at ambient storage condition. BARI Aam-3 dipped into hot water at 55°C for 5 mins and wax coating was applied as a surface coating. Postharvest treatment was applied to control disease for the study. Fruit immediately after HWT using hand applicator on a washing & waxing line or left uncoated. Among the treatments, hot water treatment with Endura Fresh TM370 coated fruit performed best in terms of overall quality, and it significantly reduced weight loss (~9%) after 18 days fruit harvested. Wax coated fruit significantly increases fruit peel appearance and coated fruit also showed more firmer than non-coated fruit after 3 weeks.

Introduction

Mango is a climacteric, with persistently high respiration and ethylene production rates during ripening and softening or compositional changes happen after harvest. It is king and popular fruit in Bangladesh. In 2020-2021 the total production of mango was 12.1 million tons from 1.13 thousand hectares (BBS, 2022). Postharvest loss occurs after harvesting due to inappropriate postharvest management. Heat stress treatment has a significant role in controlling the quality of the produce. Slow down respiration and delay senescence are indispensable to maintain quality and shelf life (Escrinbano and Mitcham, 2014). Edible coating has the potential benefit of fruits to maintain properly internal atmosphere which stabilizes the produce and thereby promote shelf life. Coatings forms barrier against O₂ and CO₂ diffusion to reduce respiration rate.

Materials and Methods

BARI Aam-3 was collected from farmers' orchard of Chapainawabganj and then washed with 1000 ppm thiabendazole and 0.1% calcinated calcium and then treated with hot water at 55°C for 5 mins. After that, food grade wax coating (endura fresh TM370 & endura fresh TM9000) and another commercial postharvest treatment were applied. Physicochemical parameters and shelf life were studied during 3 weeks storage. Treated mango were washed appropriately by required amount of detergent conc. in the BARI fabricated brush pad @8-10 rpm for few seconds and then washed again with ambient water. For uniform surface coating a hand sprayer was used to apply wax @500 fruit/L on the fruit peel. The fruit surface was dried with hot air for 1-2 mins. Fruits were stored separately at ambient temperature. Weight loss (%PWL) was determined for 24-fruit per treatment compared to the initial weight just after treatment. The fruits were weighed every week for 3 weeks. Fruit firmness was determined by using a Digital Firmness Tester. Total Soluble solids (TSS) content was measured by using a temperature-compensated automatic refractometer. Ascorbic acid content was determined according to Ranganna (2007). Total carotenoid extraction was done according Lee and Castle (2001) using Spectrophotometer. The total antioxidant activity was determined based on the DPPH free radical scavenging activity and the method adopted by Kamal et al. (2019). Statistical analysis and data processing were performed using SPSS 17.0.

Results and Discussion

In Table 1, it was observed that the maximum weight loss was found in endura fresh TM370 coated with commercial treated fruit (12.97%) which was followed by endura fresh TM370 coated fruit (10.24%) and endura fresh TM9000 coated with commercial treated fruit (10.33%) (Table 1) after 3 weeks. The fruit weight loss significantly increased during storage and the highest weight loss exhibited in non-coated fruit. Coating increased peel appearance of fruit turned from greenish to yellowish during storage. In case of fruit firmness, treatments were significant difference during 3 weeks of storage. Initially treated fruit were found higher firmness and then reduced with storage period. Coated fruit decreased slower firmness than non-coated fruit (Table 1). In Table 2, TSS were significant difference among the treatments. TSS increased (13.86-25.32%) with the storage period because of the climacteric nature. After 3 weeks, the highest TSS was observed in endura fresh TM370 coated fruit (25.32%) (Table 2). In case of ascorbic acid content there were no significantly difference among the treatments except endura fresh TM370 coated fruit after 2 weeks. The highest ascorbic acid was observed in endura fresh TM370 coated fruit (15.56 mg/100g) which was followed by non-coated fruit (14.56 mg/100g) after 2 weeks (Table 2). As shown in Table 3, significant effect on total

carotenoids content ($p < 0.001$) were observed during storage. Similarly, antioxidant capacity were significant differences among the treatments.

Conclusions

To summarize, hot water with wax coated fruit (endura fresh TM370) significantly reduced weight loss (~9%) after 18 days. Coated fruit significantly increases peel appearance and firmness during storage. This study will perform as a commercial purpose of mango growing area where cold storage facility is not available.

Table 1. Changes of physiological weight loss (%PWL) and fruit firmness (N) on treated mango during 3 weeks of storage

Treat ment	Weight loss (% PWL)				Fruit firmness (N)			
	Initial	Week 1	Week 2	Week 3	Initial	Week 1	Week 2	Week 3
T ₁	-	6.72±0.53a	9.18±0.78b	-	1.97±8.63a	1.01±4.61b	0.49±9.63b	-
T ₂	-	4.63±0.20b	8.95±0.06c	10.24±1.19b	1.98±7.28a	1.01±7.68b	0.77±8.52a	0.39±11.63a
T ₃	-	4.42±0.58b	7.27±1.09d	-	2.14±18.61a	1.10±6.74b	0.63±13.18ab	-
T ₄	-	6.17±0.53a	10.58±0.08a	12.97±3.13a	2.02±8.85a	1.07±4.12ab	0.58±6.24b	0.31±3.54a
T ₅	-	4.32±0.06b	7.93±2.07d	10.33±0.37b	1.94±5.88a	1.13±6.09a	0.51±1.87b	0.39±2.03a

Values are mean ± standard deviation of 3 replicates; Different lowercase letters in each column are differed significantly among the samples. Note: T₁=Control; T₂=Endura Fresh TM370; T₃= Endura Fresh TM9000; T₄= Endura Fresh TM370+CT; and T₅= Endura Fresh TM9000+CT. CT=Commercial treatment.

Table 2. Changes of total soluble solids (%) and ascorbic acid (mg/100g) on treated mango during 3 weeks of storage

Treat ment	Total soluble solids (%)				Ascorbic acid (mg/100g)			
	Initial	Week 1	Week 2	Week 3	Initial	Week 1	Week 2	Week 3
T ₁	15.11±0.23a	21.46±0.26a	23.41±0.74bc	-	31.22±0.69a	13.06±0.53a	14.56±0.39ab	-
T ₂	15.13±0.08a	21.91±1.03a	25.34±0.20a	25.32±0.42a	31.44±1.07a	12.56±1.07a	15.56±0.50a	14.11±0.84a
T ₃	15.01±0.12a	21.27±0.85a	22.78±0.27c	-	31.44±1.83a	12.78±0.84a	13.89±0.19b	-
T ₄	13.86±2.24a	20.21±2.29a	23.62±0.08b	24.00±0.51b	29.98±2.34a	13.67±0.87a	13.89±1.16b	14.00±0.88a
T ₅	15.17±0.09a	21.56±0.46a	22.86±0.22c	23.43±0.33b	32.00±1.00a	13.98±1.05a	13.44±0.69b	13.22±1.17a

Values are mean ± standard deviation of 3 replicates; Different lowercase letters in each column are differed significantly among the samples. Note: T₁=Control; T₂=Endura Fresh TM370; T₃= Endura Fresh TM9000; T₄= Endura Fresh TM370+CT; and T₅= Endura Fresh TM9000+CT. CT=Commercial treatment.

Table 3. Changes of total carotenoids (mg/100g) and antioxidant (% inhibition) on treated mango during 3 weeks of storage

Treat ment	Total carotenoids (mg/100g)				Antioxidant (% inhibition)			
	Initial	Week 1	Week 2	Week 3	Initial	Week 1	Week 2	Week 3
T ₁	31.39±1.23a	67.16±2.28b	69.02±2.93c	-	72.29±0.58b	65.35±3.15a	67.07±0.99a	-
T ₂	30.33±1.57a	90.99±1.04a	93.45±2.68ab	73.10±7.27b	74.08±1.48b	54.07±3.35b	61.85±0.79bc	37.31±1.94b
T ₃	28.76±1.05a	71.05±6.51b	70.34±3.22c	-	74.53±2.24b	54.43±6.33b	63.08±3.55b	-
T ₄	30.97±1.88a	93.02±3.09a	95.46±0.80a	94.74±0.75a	79.03±1.30a	56.53±2.33b	58.92±1.03c	30.28±1.73c
T ₅	30.41±1.90a	90.67±1.13a	84.09±10.8ab	89.84±2.79a	72.54±0.48b	57.48±2.07b	59.39±1.49c	43.45±2.92a

Values are mean ± standard deviation of 3 replicates; Different lowercase letters in each column are differed significantly among the samples. Note: T₁=Control; T₂=Endura Fresh TM370; T₃= Endura Fresh TM9000; T₄= Endura Fresh TM370+CT; and T₅= Endura Fresh TM9000+CT. CT=Commercial treatment.

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EFFECT OF VACUUM FRYING ON THE NUTRITIONAL AND KEEPING QUALITY OF PINEAPPLE CHIPS

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Abstract

The aim of the study was to evaluate the effect of vacuum fried pineapple chips processing using BARI developed vacuum fryer at suitable frying temperature and time. Uniform size of pineapple were collected and peeled and then thinly sliced. Corn flour (16% & 18%) were added with raw chips and stored in the refrigerator (-14°C) for 12-24 hrs. Pineapple chips were vacuum fried at 100, 105 and 110°C for 60 mins and then were de-oiled at 1400 rpm for 2 mins and packed in metalex foil packet (3 layer, ~60 micron) for 3 month quality evaluation. Pineapple chips mixed with 16% corn flour and then fried at 105°C for 60 mins performed better among the treatments in terms of quality attributes and shelf life during 3 months of storage.

Introduction

Pineapple is one of the major and popular fruit in Bangladesh and widely cultivated in the districts of Tangail, Mymensingh, Sylhet, Bandarban etc. The annual production is about 218 thousand MT covering an area of 14.64 thousand hectares during 2019-2020 (BBS, 2020). It is mainly eaten as fresh with ripe form and a little percent is used as processed products. About 1/3rd of total production of pineapple are lost lack of appropriate handling and processing technology. Vacuum frying is an emerging and novel technology for preparing chips. Due to lower frying temperature vacuum fryer makes the products healthier as they taste better and crispier and contain minimum residual oil and retain more nutrients (Garayo and Moreira, 2002). Keeping this in view, the study was undertaken to prepare quality chips.

Materials and Methods

Uniform size and matured Jaldugi pineapple variety was collected from the farmers' field of Madhupur, Tangail and then transported to PHTD of BARI, Gazipur. Pineapple were peeled with thinly sliced and then added 16% and 18% corn flour. Raw chips were packed in a HDPE packet (~60 micron) and stored in a refrigerator (-14°C) for 12-24 hrs. After that stored chips were fried at three different temperature viz. 100, 105 and 110°C for 60 mins using BARI vacuum frying and do-oiling machine. After de-oiled of pineapple chips, metalex foil packet were used for evaluating quality during 3 months of storage at one month interval. Moisture content was determined according to the method described by AOAC Official method (AOAC, 2005). Textural properties of fried pineapple chips were determined to estimate resistance by a texture analyzer (Stable Micro System, Godalming, UK). The analyzer probe (p-5) was directly inserted in the middle of the chips by the back extrusion method. The titratable acidity was determined following the methods of Ranganna (2007). Ascorbic acid content was determined according to Ranganna (2007). The total antioxidant activity of vacuum fried pineapple chips was determined based on the DPPH free radical scavenging activity and expressed as the percentage inhibition. For this analysis, the method adopted by Kamal et al. (2019) was used. Statistical analysis and data processing were performed using software SPSS 17.0 (IBM INC., New York).

Results and Discussion

Initially, the moisture content of fresh pineapple was observed 86.80%. It was observed in Table 1 & Table 2 that an increase in the oil temperature resultant in a significant reduction ($p < 0.05$) of moisture retention of the vacuum fried (VF) pineapple chips with the same pressure. During storage, as the VF pineapple chips were packaged in metalex foil packet there was the absorption of moisture by penetration where the moisture content attained prominently from 4.21% to 8.78% (Table 1) and (2% to 7.39%) (Table 2) among the treatments. In case of titratable acidity, there were significant difference among the treatments throughout the storage period. Titratable acidity increased upto 2nd months and a bit decreased in all treatments (Table 1 & Table 2). In case of texture for 16% corn flour added chips, the maximum (2.34 N) was observed in treatment T₂ (105°C) and the minimum (1.80 N) was in treatment T₃ (110°C) (Table 1) after 3 months. Thermal degradation of ascorbic acid increased with increasing frying temperature-time of VF chips. The antioxidant properties ranged from 5.25 to 10.30 % on the day of processing which was found to accelerate from 34.80 to 75.91% after 3 months (Table 1). It can be seen that the antioxidant properties were found to increase in all treatments irrespective of the storage period. Almost similar results were exhibited for 18% corn flour added chips (Table 2).

Conclusion

Without proper processing, pineapple slices turns into grayish black rapidly due to catalase enzymatic action that hampered chips appearance. Corn flour is added to maintain its textural properties. According to the appearance and quality attributes, 16% corn flour added VF chips (105°C for 60 mins) performed better among the treatments.

Table 1. Physicochemical properties of VF pineapple chips in corporation with 16% corn flour during 3 months of storage

Treatment	Storage period	Moisture (%)	Titrateable acid (%)	Ascorbic acid (mg/100g)	Antioxidant (% inhibition)	Texture (N)
T ₁	Initial	8.78±0.58a	3.50±0.60a	10.34±1.38c	6.57±0.10b	2.01±56.15ab
	Month 1	6.91±0.23a	4.86±0.41a	10.31±0.52c	20.17±0.53b	2.18±44.19a
	Month 2	5.52±0.73b	4.86±0.17a	11.17±0.76b	28.41±0.37b	2.60±65.02ab
	Month 3	4.80±1.17ab	2.89±0.45a	11.43±0.51b	34.80±0.17c	1.99±17.09ab
T ₂	Initial	6.45±1.17b	3.46±0.71a	13.35±0.53b	10.30±0.11a	2.39±48.21a
	Month 1	4.66±0.93b	4.58±0.58a	14.22±0.32a	15.68±0.11c	2.17±34.70a
	Month 2	7.18±0.13a	4.69±0.25a	13.07±0.90ab	29.25±0.09a	2.68±14.73a
	Month 3	5.77±0.24a	2.53±0.16a	11.00±2.0b	75.91±0.16a	2.34±20.65a
T ₃	Initial	4.34±0.73c	2.05±0.13b	16.99±1.39a	5.27±0.11c	1.16±41.52b
	Month 1	4.21±0.57b	2.94±0.16b	15.11±1.04a	60.89±0.25a	2.06±15.52a
	Month 2	4.27±0.34c	3.11±0.17b	14.40±1.15a	26.82±0.54c	1.83±14.57b
	Month 3	3.36±0.27b	1.94±0.14b	14.67±1.52a	60.53±0.75b	1.80±22.51b

Values are mean ± standard deviation of 3 replicates; Different lowercase letters in each column are differed significantly among the samples. Note: VF=Vacuum fried chip; T₁=VF at 100°C; T₂=VF at 105°C; and T₃=VF at 110°C.

Table 2. Physicochemical properties of VF pineapple chips in corporation with 18% corn flour during 3 months of storage

Treatment	Storage period	Moisture (%)	Titrateable acid (%)	Ascorbic acid (mg/100g)	Antioxidant (% inhibition)	Texture (N)
T ₁	Initial	5.16±0.66a	2.77±0.26a	16.38±2.73a	8.54±0.09a	2.02±77.94a
	Month 1	4.40±0.36b	3.60±0.01a	16.47±0.59a	38.51±0.41a	1.69±23.50ab
	Month 2	6.82±0.17a	3.76±0.33a	14.20±0.69a	20.99±0.72b	1.80±16.50a
	Month 3	7.29±0.97a	2.25±0.16a	15.00±1.01a	62.53±0.49c	2.19±11.06a
T ₂	Initial	5.72±0.43a	1.85±0.08b	13.04±1.39a	5.59±0.08b	2.40±14.57a
	Month 1	6.01±0.16a	2.48±0.12b	13.83±0.68c	37.54±0.68a	1.98±34.07a
	Month 2	6.89±0.69a	2.62±0.16b	13.33±0.76a	23.57±0.42b	1.24±37.82a
	Month 3	5.70±0.69b	2.53±0.11a	15.03±1.07a	64.01±0.24b	2.11±26.72a
T ₃	Initial	4.18±0.69a	1.72±0.10b	14.56±1.57a	4.41±0.14c	1.65±14.17a
	Month 1	2.00±0.32c	2.47±0.19b	14.13±1.25b	16.18±0.11b	1.36±31.76b
	Month 2	7.35±0.60a	2.73±0.24b	14.60±0.36a	46.60±0.67a	1.91±60.62a
	Month 3	7.39±0.59a	1.57±0.13a	14.13±1.20a	67.48±0.67a	1.63±15.95b

Values are mean ± standard deviation of 3 replicates; Different lowercase letters in each column are differed significantly among the samples. Note: VF=Vacuum fried chip; T₁=VF at 100°C; T₂=VF at 105°C; and T₃=VF at 110°C.

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A COMPARATIVE STUDY ON THE USE OF COOKING OILS, FOOD HABITS, DIETARY HABITS, LIFESTYLE HABITS AND HEALTH ATTITUDES WITH THE FOCUS TO RURAL, PERI-URBAN AND URBAN PEOPLE IN BANGLADESH

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Abstract

The purpose of the study was to find out the different cooking oils and mostly used cooking oils and explore the health attitudes regarding food and lifestyle habits of the respondents. Results reveal that 80-82 % people consume soybean oil, 10-12 % people mustard oil, 3-4 % people extra virgin olive oil and 1-2 % extra virgin coconut oil. Approximately 76.90 % respondent goes to late sleeping from 11:00-12:00 am, arise in the morning (5:00-6:00 am) 46.20 % and 84.60 % respondents do not walk and exercise regularly. During the study, the heart attack, stroke, high blood pressure and diabetes were recorded as 25 %, 37.50 %, 25 % and 12.50 % respectively. The highest consumption oil was recorded as 10 L per family consisted 3-6 members.

Introduction

Edible oil is an important source of essential fatty acids and vitamin E, but excessive oil intake greatly increases the risk developing obesity, coronary heart disease, and diabetes. All the oils content 99% of fat. High fat content, together with the type of fat in the diet, has been blamed for causing conditions such as obesity, insulin resistance and metabolic syndrome etc. Therefore, life threatening conditions such as stroke and acute myocardial infarction can be directly related to either the fat content or fat type in the diet. Current guidelines recommend that adults limit their oil intake to 25–30 g per day (Rong et al., 2017). Recently different types of oil are being introducing in the country dishes from abroad. As a result, a large increase in the consumption of edible oil in the food dishes. Food & dietary habits and life style is a key tool to keep the health in good but their modification may threaten the health as well as their effects on cardiovascular health. Hence, the present study has under taken to collect reliable data by FGD and individual survey on the use of different oils in food dishes and their impact on food and dietary habits, health conditions and lifestyle changes of the rural, peri-urban and urban communities in Bangladesh.

Materials and Methods

The survey was conducted by online focusing researchers, University teachers, doctors, government and non-government employees, peri-urban, urban and rural communities of the country. Sometimes rural communities' data was taken by direct conversation to the respondents. The pre-designed questionnaire was prepared and pre-tested to the respondents.

Results and discussion

Experimental edible oils and their consumption in Bangladesh

Table 1 represents the experimental common edible oils (soybean oil, mustard oil, extra virgin olive oil and extra virgin coconut oil). In this study, the four edible oil was selected due to their availability in Bangladesh. The oil cost is shown here during the conducting of the study. Out of 4 edible oils, soybean oil is mostly used (80-82 %) by the Bangladeshi people. The rural people are mostly consumed soybean oil rather than other edible oils. In some cases, mustard oil is also used by the rural people. Now a days, people's awareness is gradually increasing for the consumption of mustard oil. Extra virgin olive and coconut oil are called elite oil due to their high price. But for diet purpose, their consumption demand is increasing in the country. It is noteworthy that all the edible oil contained crude fat (Table 3) especially saturated fat. Consuming too much saturated fat increases cholesterol levels in blood leading to a greater risk of cardiovascular diseases.^[1]

Table 1. Baseline information on experimental edible oil and their consumption by Bangladeshi

Common edible oil	Source of experimental oil	Oil cost/liter (BDT)	Consumption rate (%)
Soybean oil	Teer brand, BD	140-160	80-82
Mustard oil	Resco brand, BD	200-220	10-12
Extra virgin olive oil	Italiano, Itali	1400-1450	3-4
Extra virgin coconut oil	Ceylon Naturals, Sri Lanka	1250-1300	1-2

Table 2: Life style and food habits of the respondent people

Particulars	Times	% respondents
Meal in a day	2	23.10
	3	76.90
Regular exercise	Yes	15.40
	No	84.60
Morning walk	Yes	15.40
	No	84.60
Sleeping at night	9.00-10.00	7.70
	10.00-11.00	15.40
	11.00-12.00	76.90
	12.00-1.00	7.70
Arising at morning	4.00-4.30	7.70
	4.30-5.00	15.40
	5.00-6.00	46.20
	6.00-7.00	23.10
	7.00-8.00	7.70
Smoking	Yes	23.60
	No	76.40

Table 3: Oil consumption and health attitudes of the respondents

Particulars	Size	% respondents
Oil consumption	1-2 L	7.70
	3-4 L	46.20
	5 L	30.80
	10 L	15.40
Health attitudes	Heart attack	25.0
	Stroke	37.50
	High blood pressure	25.0
	Diabetes	12.50
	Acidity (Gastroenterology)	55.50
	Non-acidity	33.30

Conclusion

Dietary habits of Bangladeshi population are changing with decreasing rice dependency and increasing tendency to intake junk foods those are responsible for changing their health attitudes. These studies confirm that heart attack, stroke, high blood pressure and diabetes are increasing tremendously due to their uncontrolled life style and food habits.

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SHELF LIFE EXTENSION OF PINEAPPLE POMACE BALL (LADDU) THROUGH POSTHARVEST TREATMENTS

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Abstract

The purpose of the study was to develop pineapple by-product (small ball-laddu) using pineapple pomace. There were four treatments with 3 replications and the experiment was laid out in complete randomized design (CRD). Then developed laddus were stored in polyethylene Terephthalate (PET) boxes at ambient temperature for storage studies. The studies confirmed that all treated potassium metabisulphite (KMS), potassium sorbet (KS) and KMS+KS treated laddus could be extended more than 60 days, whereas the control sample could be stored up to 30 days only.

Introduction

Pineapple (*Ananas comosus*) is one of the most important fruits in the world. This fruit juice is the 3rd most preferred worldwide after orange and apple juices (Cabrera et al., 2000). After processing into pineapple juices, the rest of the pulp results in massive waste generations called pineapple pomace. It (pomace) is a rich source of dietary fiber where it can contribute to reduce the body weight and different cardiovascular diseases. On the hand, the drying, storage and shipment of this wastage is cost effective and hence efficient, inexpensive and eco-friendly utilization is becoming more and more necessary. Hence the present study was undertaken to develop and increasing the shelf life of pomace laddu.

Materials and Methods

The pomace was collected from the preparation of jelly and it was incorporated for the preparation of laddu (Fig.1) according to the following treatments.

T₁= Pineapple pomace 250 g (24.90 %) + coconut meat 250 g (24.90 %)+ jaggery 500 g (49.80%) + cardamom seed 2 g (0.20 %) + Ghee 2 g (0.20 %) (control)

T₂= Pineapple pomace 250g (24.83 %) + coconut meat 250g (24.83 %) + jaggery 500g (49.65 %) +cardamom seed 2g (0.20 %) + Ghee 2g (0.20 %) + potassium metabisulphite (E-224) 3g (0.3 %)

T₃= Pineapple pomace 250 g (24.83 %) + coconut meat 250 g (24.83 %) + jaggery 500 g (49.65 %) + cardamom seed 2 g (0.20 %) + Ghee 2 g (0.20 %) + potassium sorbet (E-202) 3 g (0.3%)

T₄= Pineapple pomace 250 g (24.75 %) + coconut meat 250 g (24.75 %) + jaggery 500 g (49.50 %) + cardamom seed 2 g (0.20 %) + Ghee 2 g (0.20 %) + potassium metabisulphite (E-224) 3 g (0.3%) + potassium sorbet (E-202) 3 g (0.3 %)



Fig.1: Pineapple pomace and laddu

Results and discussion

Nutritional composition: After 60 days of storage highest TSS, pH, Acidity, Vitamin-C, β -carotene, total sugar, reducing sugar and energy value was recorded by the T₄ treated laddus than others. A fair amount of β -carotene, TSS, vitamin-C, total and reducing sugars might be contributed to covert highest energy value in the T₄ treated laddus than others. The lowest water activity (a_w ; Table 1) present in T₄ could be contributed to increase the maximum shelf life than others, indicates that highest a_w enhanced the faster growth of microorganisms to get the lower shelf life of other treated laddus (Fig.2).

Table 1: Nutritional composition of pineapple pomace Laddus after 60 days of storage

	T ₁	T ₂	T ₃	T ₄
TSS (°B)	69.80±0.02b	71.87±0.02a	71.89±0.01a	71.90±0.01a
pH	4.52±0.02	4.53±0.03	4.55±0.05	4.59±0.02
Acidity (%)	0.29±0.02	0.31±0.02	0.33±0.03	0.34±0.04
Vitamin-C (mg/100g)	5.89±0.02	5.90±0.03	5.93±0.02	5.95±0.02
β-carotene (mg/100g)	14.03±0.03	14.13±0.13	14.15±0.15	14.17±0.17
Total sugar (g/100g)	32.21±0.21	32.37±0.37	32.38±0.38	32.39±0.40
Reducing sugar (g/100g)	6.11±0.11	6.51±0.40	6.53±0.40	6.55±0.40
Energy (Kcal)	437.11±1.11b	441.03±1.03a	441.10±1.10a	441.17±1.17a
Water activity (a _w)	0.73±0.02	0.63±0.01	0.65±0.02	0.68±0.03

All values are means of triplicate determinations ± SD. Means within columns with different letters a, b indicates significant result (p<0.05). No letter means non-significant difference.

Residual analysis of KMS and KS on the storage of pomace ball

Here, Table 2 represents the residual effects of KMS and KS on the developed and stored laddus after 30 and 60 days of storage periods. The control sample (T₁) was not considered for residual analysis due to its terminating shelf life after 30 days of storage. Results show that after 30 and 60 days of storage, the KMS (T₂) and KS (T₃) treated laddus were gained lower amount of residue than the sample treated communally by the KMS and KS treated laddus (T₄). The study indicates that the residue level of both KMS and KS treated laddus were decreased gradually with the advancement of storage periods. The results are an fully agreement with the findings of Khan et al. (2021), those reported that ready to cook (RTC) jackfruit treated with KMS by several processing and stored up to 6 months could be contributed to lower the residue level of KMS within the acceptable range of limit.

Table 2: Residual effect of KMS and PS after storage of pineapple pomace ball

Treatment	Applied doses (0.30 %) (3.00 g/kg)	Residue (ppm)	
		30 days of storage	60 days of storage
T ₂	3.00±0.00	76.28±5.43b	71.28±3.11b
T ₃	3.00±0.00	83.83±5.53b	78.01±4.413b
T ₄	3.00±0.00	130.20±10.10a	110.31±5.01a

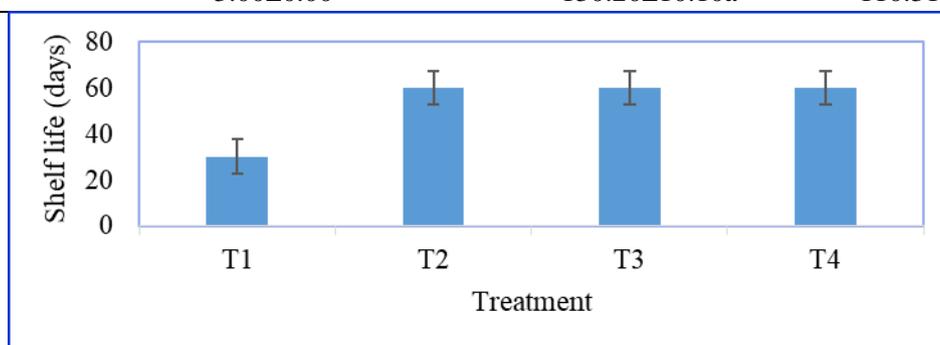


Fig.2: Shelf life of pineapple pomace laddu

Conclusion

Findings suggest that 'Laddus' prepared from pineapple pomace is a rich source of crude fiber and energy which could be preserved 60 days more without any quality deterioration.

Acknowledgement

The research was conducted by the financial assistance of the Ministry of Science and Technology, Bangladesh secretariat, Dhaka under the project ID: SRG 221022.

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THE NUTRITIONAL, PHYSICOCHEMICAL, MINERALS AND BIOACTIVE COMPOUNDS ANALYSIS OF COOKED LENTIL

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Abstract

An attempt has been taken to cook lentil with edible portion and peel to determine their nutrition and antioxidant status as a part of reducing milling cost. All the analysis was performed by internationally recognized method using HPLC and Double Beam Spectrophotometer. Then the obtained data has been verified with reputed national and international journals and books. Results revealed that lentil cooked with peel is the rich source of physicochemical nutritional and antioxidant activities. Highest crude protein (28 %) and lower fat (5.73 %) was recorded in lentil cooked with peel. Sensory data also confirmed that all the evaluator was highly satisfied to the cooked lentil with peels although non-significant differences were found between peel and without peel.

Introduction

Conventionally, plants and fruits have been used for obtaining compounds with biological activity (Márquez et al., 2003). Specifically, fruit peels have been recorded as potential sources of bioactive compounds with antioxidant and antimicrobial properties. Peel is considered as non-consumable item and it is discarded as waste material. Literature suggest that peel is promising sources of valuable components, such as phenolic compounds (polyphenols, flavonoids and tannins), and other bioactive components (Gyawali et al., 2014). The peel of some fruits like apple, hawthorn, and pomegranate present a significantly greater amount of phenolic compounds in comparison with the pulp. In Bangladesh all kinds of lentils are milling by commercial miller. The milling of lentils results in massive waste generations called peel and is considered as waste material although sometimes this waste materials are using as feed of the animal. These waste materials are dumping here and there. The shipment of this wastage is cost effective and hence efficient, inexpensive and eco-friendly utilization is becoming more and more necessary. Hence, the present study was undertaken to utilize the lentil peel into processing of human food with minimizing the milling cost of lentil.

Materials and methods

Physicochemical properties of lentil:

Fresh selected BARIMosur-8 was collected from the Regional Agricultural Research Station and Pulses Research Center, Ishordi, Pabna. Moisture, protein, ash, vitamin-C, total, and reducing sugar content were determined according to the procedure described by Ranganna (1995). pH was recorded by a digital pH meter (Delta 320, Mettler, Shanghai). Total acidity (%) was measured using Auto Titrator (Metrohm 814, USB Sample Processor, Switzerland). Total soluble solid (TSS; °Brix) was recorded using a digital hand refractometer (Model NR151). Antioxidant activities were determined by HPLC and Double Beam Spectrophotometric method.

Results and discussion

Physicochemical characteristics of the cooked lentil: Moisture determination is one of the most important and most widely used measurements in the processing and testing of foods. The highest amount of moisture content was recorded in lentil cooked with edible portion and peel, indicates that peel is the also source of moisture more or less. The highest ash content was found in lentil cooked with edible portion (5.84±0.04%). The pH value of the cooked edible portion and edible portion with peel were calculated as 0.50±0.00 % and 1.28±0.02 % respectively, indicates that lentil cooked with peel is the rich source of acidity. The pH values of the cooked edible portion and edible portion with peel were recorded as 6.47±0.03 and 5.74± 0.50 indicates that lower pH level is present in peel than edible portion of lentil. Total sugar content of edible portion and edible portion+peel calculated as 1.58±0.02 % and 1.67±0.03 % respectively (Table1), indicates that peel is also source of sugar that jointly (with edible portion) increased the total sugar of the sample. Lentil cooked with peel is the lower source of carbohydrate content than edible portion seed of lentil. Lentil cooked with peel is the lower source of crude fat than cooked edible portion (Table 1). Thus, it can strongly be said that intake of low carbohydrate content may decrease the fat content in the human body. Protein content of cooked edible portion and edible portion+peel found 27.56±0.10 and 28.0±0.15 % indicates that lentil cooked with peel is the rich source of protein which are capable to meet the daily protein requirement of all age's people.

Antioxidant activities of cooked lentil: Antioxidant activities e.g. ascorbic acid, β-carotene, total carotenoid, anthocyanin, total phenol and lycopene are detected in cooked edible portion (seed) and

cooked with peel of BARI Mosur-8 (Table 2). Ascorbic acid of the edible portion and peel ranged from 5.76 ± 0.04 and 5.88 ± 0.2 mg/100g. Lentil cooked with edible portion and peel is the rich source of total β -carotene content TC of the lentil cooked with edible portion and peel were calculated as 10.64 ± 0.04 g and 7.46 ± 0.04 mg/100 g respectively. The highest anthocyanin was recorded in lentil cooked with edible portion than peel as 0.51 ± 0.01 g and 0.11 ± 0.01 mg/100g respectively. Lentil cooked with peel retained highest TPH than edible portion. Lycopene found rich in lentil cooked with edible portion (1.07 ± 0.01).

Table 1: Physicochemical and nutritional properties of cooked lentil-8

Parameters	Cooking with edible part	Cooking with edible part + peel	LSD
Moisture (%)	9.31 ± 0.02	9.41 ± 0.09	NS
Ash (%)	$5.84\pm 0.04a$	$5.03\pm 0.03b$	**
Total acidity (%)	$0.50\pm 0.00b$	$1.28\pm 0.02a$	*
pH	$6.47\pm 0.03a$	$5.74\pm 0.5b$	*
Total sugar (%)	$1.58\pm 0.02b$	$1.67\pm 0.03a$	*
Carbohydrate (%)	$18.99\pm 0.04a$	$18.49\pm 0.03b$	*
Crude fat (%)	$6.06\pm 0.06a$	$5.73\pm 0.03b$	**
Crude protein (%)	$27.56\pm 0.10b$	$28.0\pm 0.15a$	*

All values are means of triplicate determinations \pm SD. * & ** indicate significant result at $p < 0.05$ & $p < 0.01$

Table 2: Antioxidant activities of cooked lentil

Parameters	Cooking with edible part	Cooking with edible part + peel	LSD
Vitamin-C (mg/100 g)	$5.76\pm 0.04b$	$5.88\pm 0.02a$	*
β -carotene (mg/100 g)	$16.03\pm 0.03b$	$19.97\pm 0.03a$	**
Total carotenoid (mg/100 g)	$10.64\pm 0.04a$	$7.46\pm 0.04b$	*
Anthocyanin (mg/100 g)	$0.51\pm 0.01a$	$0.11\pm 0.01b$	*
Total phenol (mg GAE/100g)	$5.52\pm 0.03b$	$5.98\pm 0.02a$	*
Lycopene (mg/100 g)	1.07 ± 0.03	1.01 ± 0.01	NS

All values are means of triplicate determinations \pm SD.

Sensory evaluation of lentil both fresh and cooking condition: Most of the expert panelists suggest that lentil cooked with peel no bitterness was found during sensory evaluation (Table 3). It was more acceptable by the panelist even nutritionally.

Table 3: Sensory evaluation of cooked lentil

	Cooking with edible part	Cooking with edible part + peel	LSD
Color	7.60 ± 1.17	6.80 ± 1.54	NS
Flavor	7.60 ± 0.84	7.40 ± 1.42	NS
Taste	7.80 ± 0.63	7.00 ± 1.33	NS
Bitterness	7.40 ± 1.17	7.30 ± 1.63	NS
Overall acceptability	7.62 ± 0.69	7.27 ± 1.14	NS

All values are means of triplicate determinations \pm SD. NS indicate non-significant result at $p < 0.05$

Conclusion

Lentil cooked with peel is the source of antioxidant and it is also acceptable by the sensory evaluator even children.

Acknowledgement

The research was conducted by the financial assistance of GIFS-KGF, BARC project.

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EFFECT OF MOISTURE CONTENT ON RECOVERY PERCENTAGE OF LENTIL DURING DEHULLING PROCESS

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Abstract

An investigation was carried out to determine the effect of moisture content on recovery percentage of lentil during dehulling. It was bothering to maintain desired moisture level. There was five moisture level viz. 6 %, 8%, 10%, 12% and 14 %. The desired moisture levels were maintained by adding calculated amount of distilled water, thoroughly mixing and then sealed in separate polythene bags. The sealed lentil was kept at 5 °C in a refrigerator for 7 days to allow a uniform distribution of moisture throughout the lentil. Before conducting the test, the required quantity of lentil was allowed to warm up to room temperature for 12 h for conditioning. Results revealed that 8% moisture contributed to get maximum recovery percentage of lentil during dehulling.

Introduction

Bangladesh, each year about 190.74 thousand MT of lentil are produced from 144.51 thousand ha of land (Anon, 2023). Among the major food crops in the Asia-Pacific region, particularly South, East and Southeast Asia, pulses as nutritionally rich food, play an important role in improving the diet of the people. The countries in the region grow a dozen of summer and winter pulses to meet the dietary requirements, particularly for the poorer section of the society, to whom animal protein is less accessible. Therefore, it is called poormen protein in Bangladesh. Based on requirement the present lentil production cannot meet the national demand of the country. As a result the gap is not only widening in quantity but its major porting is going to postharvest loss especially percent broken and powder form loss due to its proper moisture level maintaining during dehulling. Moisture level of lentil during dehulling significantly affects broken and powder formation. Hence, the present study was undertaken to find out the proper moisture content on recovery percentage of lentil.

Materials and Methods

Collection of lentil: Fresh selected BARI Mosur-8 was collected from the Regional Agricultural Research Station and Pulses Research Center, Ishordi, Pabna.

Moisture level maintain of the experimental lentil: After cleaning and grading the lentil, moisture content of the collected field lentil was 13.10 %, which were adjusted to a desired level of 6 %, 8 %, 10 %, 12 % and 14 % by the addition of water or drying. The reduction of moisture content to desire level was achieved by drying the lentil using standard hot air oven dryer according to the method described by Ranganna (1995). The lentil of the desired moisture levels were prepared by adding calculated amount of distilled water, thoroughly mixing and then sealing in separate polythene bags (Baryeh and Mangope 2002). Then the lentil was kept at 5 °C in a refrigerator for 7 days to allow a uniform distribution of moisture throughout the lentil. Before conducting the test, the required quantity of lentil was allowed to warm up to room temperature for 12 h for conditioning (Carman 1996). Then the lentil was dehulled according to the following treatments by the commercial pulse dehuller.

Treatments

T₁= 6 % moisture

T₂= 8 % moisture

T₃= 10 % moisture

T₄= 12 % moisture

T₅= 14 % moisture

Results and Discussions

Recovery percentage of lentil: Recovery percentage of dehulled lentil is shown in Table 1. Results revealed that moisture content affects the percent recovery of lentil. Percent lentil during dehulling recorded as 59.81 %, 75.19 %, 66.10 %, 56.01 % and 49.03 % at 6%, 8 %, 10 %, 12 % and 14 % moisture content. The decreased recovery percentage 66.10 %, 56.01 % and 49.03 % was recorded by the moisture level 10 %, 12 % and 14 % respectively. Lower recovery percentage (59.81 %) was observed at 6 % moisture level but at 8 % moisture level the recovery percentage was increased (75.19 %) and then decreased, indicates that the recovery percentage was gradually decreased with the advancement of moisture level (Fig.1). In Bangladesh context, fresh lentil collected from the field possessed 12 % above moisture content. Hence, it is desired to sorting, grading and drying the field lentil before dehulling to minimize the broken percentage of lentil. The decrease in percent lentil from

10% to 14 % moisture content could be attributed to less friction between hull and carborundum at higher moisture content. Lower percent below 10% moisture content might be due to tight adherence of hull with cotyledon (Goyal et al., 2010). It indicates that moisture content of lentil affects the development of cracks in hull during fighting process.

Table 1. Effect of moisture content on recovery percentage of lentil

Treatment	Recovery percentage
T ₁	59.81
T ₂	75.19
T ₃	66.10
T ₄	56.01
T ₅	49.03

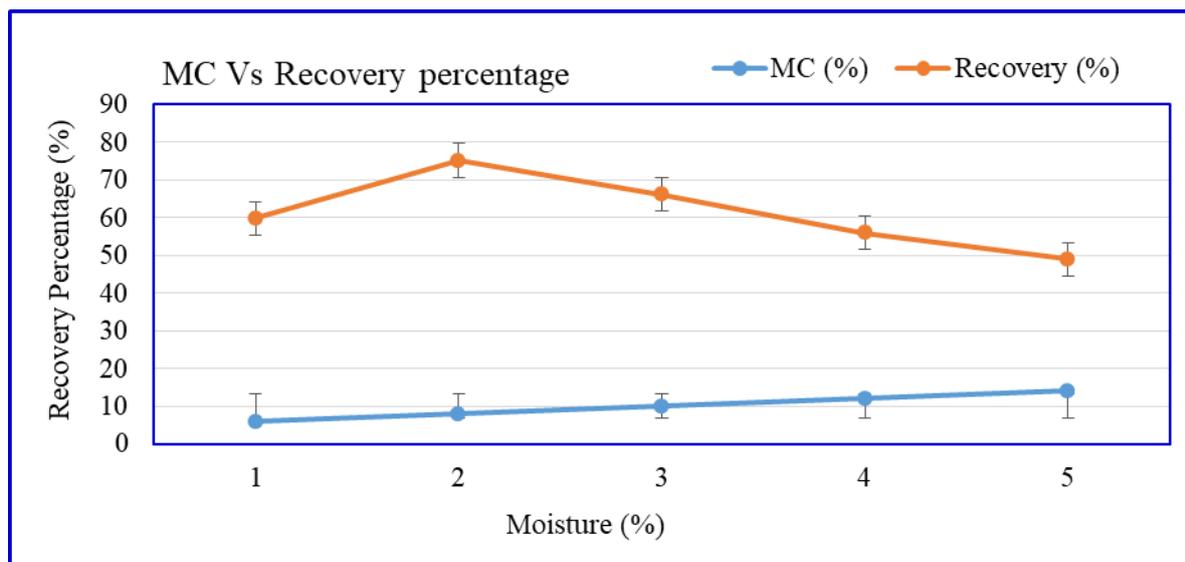


Fig.1: Moisture content effect on recovery percentage

Conclusion

Lentil subjected to recovery percentage by maintaining different moisture levels, 8 % moisture gave the maximum recovery percentage (75.19 %). Lower recovery percentage (66.10-49.03 %) was recorded with increasing moisture level (10-14 %).

Acknowledgement

The research was conducted by the financial assistance of GIFS, Canada-KGF, BARC project.

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EFFECT OF DIFFERENT MILLING METHODS ON RECOVERY PERCENTAGE OF LENTIL

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Abstract

A study was conducted to investigate the effect of different milling on recovery percentage of lentil. It was difficult to prepare uniform seeds during milling as it is pre-requisite to get highest recovery yield. Maximum dehulling efficiency (DE) (87.03 %), milling recovery (MR) (75.19 %) percentage and football recovery (FR) (8.11 %) was obtained by the commercial dehuller than others. Lowest broken (14.2 %) and powdery percentage (1.78 %) was also observed by the commercial dehuller. Local pulse dehuller operated manually caused significant losses in yield by enhancing higher broken percentage (36.04 %) and powder form (10.31 %). The study recommends using clean and uniform seeds for maximizing the good milling recovery yield with football recovery percentage.

Introduction

BARI Mosur-8 is a good source of protein, vitamins, minerals (Fe, Zn, P & S), dietary fiber and essential amino acids threonine, lysine, valine, isoleucine, leucine, phenylalanine and also good source of non-essential amino acids histidine, serine, arginine, glycine, aspergine, glutamine, asparagine, tyrosine and trypsin. All these benefits increase the importance of lentil in our diet to combat human micronutrient malnutrition globally. During dehulling, noticeable amounts of cotyledon material and germ are removed resulting into considerable loss of lentil. In home and large-scale processing, the loss of cotyledon in terms of powder and broken is observed due to technological intervention (Singh, 1995). Method of dehulling significantly affects broken and powder formation. Hence, the present study was undertaken to find out the proper milling method on recovery percentage of lentil.

Materials and Methods

Collection and dehulling of Mosur (lentil): Fresh selected BARI Mosur-8 was collected from the Regional Agricultural Research Station and Pulses Research Center, Ishordi, Pabna. After cleaning and grading the grains, moisture content of the grain was maintained 8 %, 10 %, 12 % and 14 % by adjusting to a desired level by the addition of water or drying. The reduction of moisture content to desire level was achieved by drying the grain using standard hot air oven dryer according to the method described by Ranganna (1995). The grain samples of the desired moisture levels were prepared by adding calculated amount of distilled water, thoroughly mixing and then sealing in separate polythene bags (Baryeh and Mangope 2002). The samples were kept at 5 °C in a refrigerator for 7 days to allow a uniform distribution of moisture throughout the sample. Before conducting the test, the required quantity of grain was allowed to warm up to room temperature for 12 h for conditioning (Carman 1996). Then the grain was dehulled according to the following treatments.

Treatments

T₁=Local pulse (dhal) dehuller (hand operated stone grinder)

T₂= Laboratory grade mini dhal dehuller

T₃= TM05 (Satake Engineering Co., Hiroshima, Japan) grain testing mill and

T₄= Commercial pulse dehuller

Results and Discussions

Milling of lentil: Milling characteristics viz. ME, MR, FR , broken percentage and powder form was affected by the different millers. The highest ME (87.03%), MR (75.19%), FR (8.11%), lowest broken percentage (14.92 %) and powder form (1.78 %) were found in treatment T₄ by commercial pulse dehuller (miller) (Table 1; Fig.1).

Table 1. Dehulling efficiency of lentil using different dehullers/mills

Treatment	Dehulling efficiency (DE)	Milling recovery (MR)	Football Recovery (FR)	Broken percentage	Powder form
T ₁	51.31±1.00d	49.20±1.00d	4.45±0.5d	36.04±1.00a	10.31±.31a
T ₂	78.03±0.98b	71.10±1.00b	7.78±0.02b	19.10±1.00c	2.02±0.02c
T ₃	69.31±0.92c	63.01±1.00c	6.01±0.01c	25.10±1.00b	5.88±0.12b
T ₄	87.03±1.00a	75.19±1.04a	8.11±0.11a	14.92±0.08d	1.78±0.02d



Fig.1: Dehulling of lentil using different dehullers

Moisture and milling efficiency: Moisture is the main effect to maintain the milling characteristics of lentil. Moisture involves several milling process like removal of seed coat, recovery percentage of broken, football recovery percentage, milling recover etc. Results indicate that higher the moisture content lower the milling efficiency (ME) (Fig.2). Higher moisture content resulted split to produce two separated cotyledons (split). Moisture content of seeds prior to dehulling is crucial for maximizing the DE, MR, FR and minimizing the broken and powdery percentage during milling.

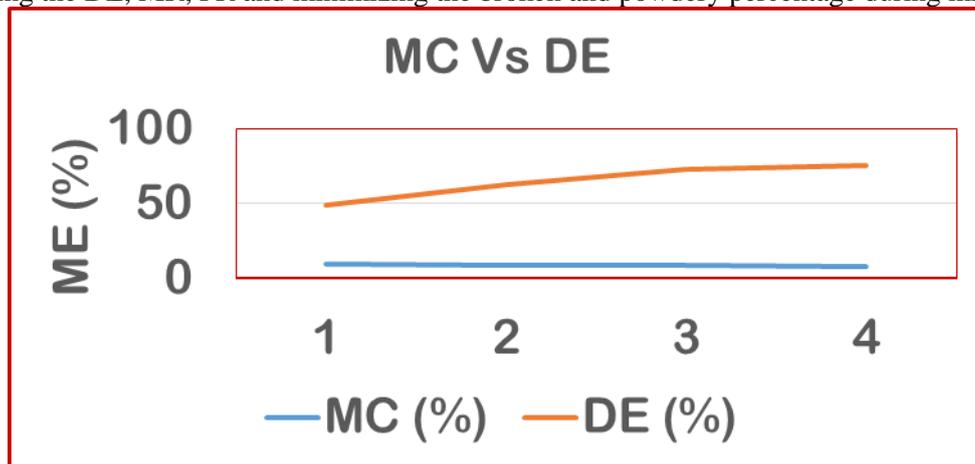


Fig.2: Effect of moisture content on dehulling efficiency of lentil

Conclusion

The obtained results are a crucial step in better understanding of the different mills and their effect on recovery percentage of lentil. Lentil milled using commercial pulse dehuller (T₄) with moisture content 8.14 % was maximized the DE (87.03 %), MR (75.19 %), FR (8.11 %), reduced the broken (14.92 %) and powdery percentage (1.78 %) of lentil.

Acknowledgement

The research was conducted by the financial assistance of GIFS-KGF, BARC project.

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OPTIMIZATION OF PROCESSING METHOD FOR PLUM JAM AND ANALYSIS OF THE CHANGES IN QUALITY CHARACTERISTICS DURING STORAGE

S. PERVIN, M.H.H KHAN, M.G.F. CHOWDHURY, M.M. MOLLA AND A.A. SABUZ

Abstract

Plum is a versatile fruit with limited availability during a specific season. To promote year-round consumption, plum can be processed into value-added products like jam. This study aimed to optimize the processing method for plum jam using the BARI Alu bukhara-1 variety and investigate the changes in quality characteristics during 12 months of storage. Five treatments with varying sucrose percentages were analyzed. The pH decreased during storage, while acidity decreased significantly. The color intensity gradually shifted from light-yellow to light red. Microbial growth was not observed for up to nine months, and panelists favored jam made with 100% sucrose for its balanced sweetness and appealing flavor. The findings contribute to enhancing plum utilization and providing a nutritious and convenient food option through plum jam consumption.

Introduction

Plum (*Prunus domestica*) is a versatile fruit with various culinary applications, but its availability is limited to a specific season. To address this constraint and promote its year-round consumption, plum can be processed into value-added products like jam. BARI Alu bukhara-1, a new plum variety developed by the Bangladesh Agricultural Research Institute (BARI), offers increased yield and benefits for farmers (Anonymous, 2014). Functional foods, including fruit-based products, are gaining popularity for their preventive health benefits. Plum jam, rich in nutrients and functional properties, can serve as a convenient and nutritious food option. This research aims to optimize the processing method for plum jam using the BARI Alu bukhara-1 variety and investigate the changes in quality characteristics during storage. Jam production can extend the shelf life of plums, ensuring availability beyond the harvest season. The study intends to explore the right proportions of fruit, acid, pectin, and sugar to achieve the desired jam texture and taste. The results will contribute to enhancing plum utilization, offering a value-added product, and promoting preventive health care through functional food consumption. Therefore, the present study was carried out to achieve the following objectives: (i) to optimize the processing method for plum jam at various concentrations of sugar and plum pulp percentage; and (ii) to analyze the quality characteristics of plum jam during storage.

Materials and Methods

Plum (*Prunus domestica*) with optimal ripeness was collected from local farmer. After sorting, the plum was washed and dried under a ceiling fan. Fully matured plum was washed with water thoroughly then heating and pulping were done to remove seed. At first sugar was added to the measured pulp and boiled with continuous stirring. Finally, citric acid and pectin, potassium meta-bisulphite were added and TSS was observed about 62%. Remove the pan from the burner and transfer the prepared jam to a sterile glass bottle. Cooling, waxing and capping were also done sequentially. All packaged products were properly labeled and stored at ambient temperature (25-35°C). The physicochemical and sensory properties of all products were analyzed at intervals of three months after storage for 12 months. There were five treatments for making jam, as T₁ = Using 0% sucrose in plum pulp; T₂ = Using 25% sucrose in plum pulp; T₃ = Using 50% sucrose in plum pulp; T₄ = Using 75% sucrose in plum pulp; and T₅ = Using 100% sucrose in plum pulp. The pH, acidity (%), color, microbial count and overall acceptability of stored plum jam were analyzed by standard methods. The study was conducted using CRD with each treatment replicated three times, and data analysis was performed using statistical software from R.

Results and Discussion

Initially, the maximum pH of 2.79 was observed with treatment T₅ and the pH of 2.53 was lowest with treatment T₁. The initial pH of the plum jam was lower than that of the final product and analogous outcomes were stated by Bhuiyan *et al.* (2012) in hog plum. During preparation, the initial acidity measurement was higher for treatment T₁ and lower for treatment T₅. However, the acidity decreased significantly month by month during storage. Similar results was found by Chaudhary and Verma (2012) in the aonla jam. During 12-month storage, the jam's light-yellow color shifted to a

light red. Treatment T₁ showed high brightness and low lightness, while decreased lightness was noted over time; higher sucrose content led to red color. Sahni (1997) findings on amla chutney, indicating consistent color intensity decline during prolonged storage (Figure 1). No microbial growth was observed in the plum jam for up to nine months of storage. However, after 12 months, small numbers of non-pathogenic bacteria were found in various treatments, which were within the acceptable limit for human consumption. In Table 1, the panelists rated the jam made with 100% sucrose (treatment T₅) with the highest overall score of 8.0 (i.e., like very much), followed by treatment T₄ with 75% sucrose, which received an overall score of 7.0 (i.e., like moderately). The plum jam with 100% sucrose was particularly favored by the panelists for its well-balanced sweetness, minimal bitterness, appealing color, and overall flavor, as documented in the recorded datasheet. These results align with Ullah *et al.* (2018) on jam made from carrots and apples.

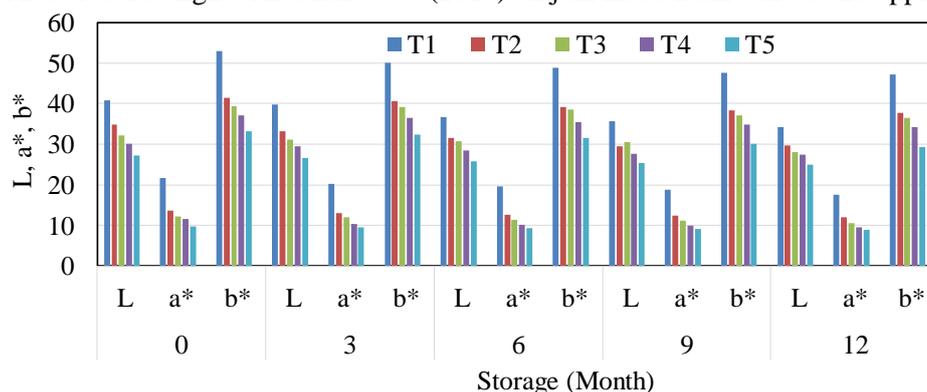


Figure 1. Effect of sucrose on color parameters of plum jam in storage

Table 1. Effect of sucrose on overall acceptance of plum jam in storage

Treatments	Overall acceptance of plum jam with different storage times (months)				
	0	3	6	9	12
T ₁ =0% sucrose in plum pulp	4.0e	3.5e	3.5e	3.5e	3.5e
T ₂ =25% sucrose in plum pulp	6.5d	6.0d	6.0d	6.0d	5.5d
T ₃ =50% sucrose in plum pulp	7.0c	6.5c	6.5c	6.0c	6.0c
T ₄ =75% sucrose in plum pulp	7.5b	7.0b	7.0b	7.0b	7.0b
T ₅ =100% sucrose in plum pulp	8.5a	8.0a	8.0a	8.0a	8.0a
CV (%)	3.421	3.264	3.264	3.864	5.833
LSD _{1.0%}	0.431	0.431	0.431	0.527	0.814

The mean values in the columns are displayed in significant result ($p < 0.01$) with various letters a, b, c, d and e.

Conclusion

The optimization of plum jam processing using the BARI Alu bukhara-1 variety demonstrated favorable changes in quality characteristics during storage. Plum jam can be a valuable value-added product to promote year-round plum consumption and support preventive health care through functional food consumption.

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STANDARDIZATION OF PROCESSING METHOD FOR OSMO DEHYDRATED SUGAR COATED PLUM

S. PERVIN, M.H.H. KHAN, M. M. MOLLA, M.G.F. CHOWDHURY AND A. A. SABUZ

Abstract

The study aimed to standardize the processing method for osmo-dehydrated sugar-coated plum to enhance its shelf life, overall quality and minimize postharvest losses. Plum fruits were treated with 40, 50, and 60 °Brix sugar syrup and sugar coating. Texture analysis revealed a decrease in firmness during storage due to cell structure breakdown and enzymatic activity. Color intensity decreased significantly over 12 months of storage, while total phenolic content declined with increasing brix and prolonged storage. Osmo-dehydrated plum exhibited excellent energy content. The highest overall rating was given to plum treated with 50 °Brix sugar syrup and sugar coating. In conclusion, osmotic dehydration with sugar coating is a viable method to enhance plum preservation and create a value-added product.

Introduction

Plum (*Prunus domestica*) is a valuable spice crop known for its antioxidant properties and mild laxatives (Miletic *et al.*, 2012). However, postharvest losses due to perishability are significant in Bangladesh. The release of the high-yielding variety "BARI Alu bukhara-1" offers potential to enhance plum production. Osmotic dehydration, a promising preservation method, improves quality and reduces drying time (Birwal *et al.*, 2016). This research aims to optimize dehydration conditions using locally available machinery and low-level technology for cost-effective processing and long-term preservation. Osmotic dehydration allows diversification of plum products, meeting the demand for dried prunes domestically and internationally. The study aims to enhance plum utilization, minimize losses, and extend shelf life through value-added product development. The present study standardizes and produces high-quality osmo-dehydrated plum products.

Materials and Methods

Plum (*Prunus domestica*) with optimal ripeness was collected from local farmer. Fruits were sorted, washed and cleaned. Then, the fruits were dipped in 40, 50 and 60 °Brix sugar syrup for 24 h and then it boils for 15 min. The drying temperature was maintained at 60 °C. After drying, the plum was preserved in a glass container. Finally, the treated plums were analyzed after 3 months' interval up to 1 year in an ambient condition. There were six treatments to prepare sugar coated osmo-dehydrated plum. These were: T₁= 40 °B in plum; T₂= 40 °B in plum with sugar coating; T₃= 50 °B in plum; T₄= 50 °B in plum with sugar coating; T₅= 60 °B in plum; and T₆= 60 °B in plum with sugar coating. The texture, color, total phenolic content, energy and overall acceptability of osmo-dehydrated stored plum were analyzed by standard methods. The study was conducted using CRD with each treatment replicated three times, and data analysis was performed using statistical software from R.

Results and Discussion

The texture of osmo-dehydrated plum decreased from an initial maximum of 166.47 N to 110.27 N in T₁ but it was 147.27 N to 89.74 N as lowest in T₅ at the end of storage, likely due to cell structure breakdown and enzymatic activity during storage, resulting in softer fruit texture. Similar findings were reported for osmo-dehydrated apricot by Sharma *et al.*, 2006. The color intensity of osmo-dehydrated plum, initially light yellow color significantly decreased to light dark after 12 months of storage. Treatments T₄ had the highest brightness, while T₁ had the lowest. The color of osmo-dehydrated plum decreased significantly during prolonged storage, as described by Goncalves *et al.* (2007). In osmo-dehydrated aonla, total phenolic content ranged from 145.0 to 134.0 mg GAE/100 g at the beginning of storage, and after 180 days, it varied between 95.4 to 78.5 mg GAE/100 g from treatment T₁ to T₆, respectively (Table 1). Total phenolic content significantly decreased with increasing brix used as the osmotic agent and further decreased with the increase in storage period, consistent with findings by Kamal *et al.*, 2020. The calorific value (energy content) of the osmo-dehydrated plum was presented in Table 2. It is seen that all sample showed an excellent source of energy, which ranged from 99.68 to 70.13 KCal/100 g at the beginning and 75.07 to 61.87 KCal/100 g at the end of storage period. These values were found to differ significantly among the dehydrated plum prepared using different brix as well as extension of storage period. The highest overall rating (7.5) was given by panelists to osmo-dehydrated plum from treatments T₄ (50°B in plum with sugar coating), indicating like moderate to like very much but lowest rating (5.0) was in treatment T₁ after

12 months of storage. However, sensory values of osmo-dried plum showed a decrease rate during storage.

Table 1. Effect of brix and sugar coating on total phenol (mg GAE/100 g) of osmo-dehydrated plum during storage

Treatments	Total phenol (mg GAE/100 g) of osmo-dehydrated plum with different storage (Month)				
	0	3	6	9	12
T ₁ = 40 ⁰ B in plum	145.0a	119.2a	113.8a	104.0a	95.4a
T ₂ = 40 ⁰ B in plum with sugar coating	143.5b	113.5b	101.7b	98.7b	94.2b
T ₃ = 50 ⁰ B in plum	140.0c	110.3c	102.5c	93.2c	87.5c
T ₄ = 50 ⁰ B in plum with sugar coating	138.5d	102.1d	99.7d	91.5d	85.0d
T ₅ = 60 ⁰ B in plum	135.0e	93.5e	88.6e	83.2e	80.6e
T ₆ = 60 ⁰ B in plum with sugar coating	134.0f	92.3f	87.1f	82.4f	78.5f
CV (%)	0.162	0.138	0.124	0.110	0.096
LSD _{1.0%}	0.391	0.251	0.213	0.176	0.144

Table 2. Effect of brix and sugar coating on energy (Kcal/100 g) of osmo-dehydrated plum during storage

Treatments	Energy (Kcal/100 g) of osmo-dehydrated plum with different storage (Month)				
	0	3	6	9	12
T ₁ = 40 ⁰ B in plum	70.13f	64.93e	63.12e	62.93e	61.87f
T ₂ = 40 ⁰ B in plum with sugar coating	70.65e	65.12e	64.56d	63.94d	62.75e
T ₃ = 50 ⁰ B in plum	86.64d	76.95d	75.48c	74.34c	72.87d
T ₄ = 50 ⁰ B in plum with sugar coating	88.45c	77.81c	75.94b	74.58c	73.94c
T ₅ = 60 ⁰ B in plum	95.47b	78.92b	77.84a	76.97b	74.49b
T ₆ = 60 ⁰ B in plum with sugar coating	99.68a	79.54a	78.08a	77.79a	75.07a
CV (%)	0.255	0.259	0.231	0.202	0.175
LSD _{1.0%}	0.377	0.332	0.289	0.251	0.213

Conclusion

Osmotic dehydration with sugar coating at 50⁰Brix showed the most promising results for preserving plum, enhancing overall quality and energy content. This technique presents an effective method for extending plum shelf life and creating value-added products for commercial use.

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OPTIMIZATION OF PROCESSING METHOD FOR DRAGON FRUIT JAM

S. PERVIN, M.H.H KHAN, M.G.F. CHOWDHURY, M.M. MOLLA, A.A. SABUZ AND A.S.M.H. RASHID

Abstract

This research aimed to optimize the processing method for dragon fruit jam and assess its quality parameters during long-term storage at ambient temperature in Bangladesh. Five treatments were employed, varying the sugar content in the dragon fruit pulp. The pH, acidity, TSS (%), color, microbial growth, and sensory evaluation were conducted over a storage period of six months. The results revealed that higher sugar content led to lower initial pH and higher acidity in the jam. TSS values were highest in treatment T₅ (100% sugar in pulp). Color intensity decreased during storage, and microbial growth remained within acceptable limits. Sensory evaluation indicated that jam with 80% sugar in pulp (T₄) received the highest overall rating. These findings offer valuable insights for optimizing dragon fruit jam processing for extended shelf life and consumer acceptance.

Introduction

Dragon fruit (*Hylocereus undatus*) is a tropical fruit that has become increasingly popular in recent years. Processed dragon fruit products are rarely available in our markets and very little work has been done on processing of dragon fruit in our country. A number of locally processed fruit products are now available in the market. If quality products from dragon fruit are developed, it might be welcomed by the consumers who have affinity for dragon fruit round the year. So the scope of utilizing dragon fruit remains bright in Bangladesh. Development of varieties of products like jam utilizing local produces is critically important for expanding the country's developing food industries. Jam is a homogeneous and molded product which is obtained by boiling fresh, frozen or semi-processed chemically canned fruits with added sugar, pectin and acid (Sandulachi, 2011). Therefore, the present study was carried out to achieve the following objectives: (i) to optimize the processing method for dragon fruit jam and (ii) to evaluate the quality parameters of the prepared jam for long time storage at ambient temperature of Bangladesh.

Materials and Methods

Dragon fruits were collected from the Regional Agricultural Research Center, Chittagong. Fruits were sorted, washed and cleaned. The major ingredients for the preparation of jam were sugar, citric acid, pectin and other chemicals were used from the laboratory store. The fully ripe healthy and fresh dragon fruit was washed thoroughly with potable water and the skin was removed by a knife. The seeds were removed and then dragon fruit was blended by a blending machine. The jam formulations were prepared by following the composition stated by Touati *et al.* (2014), which contains fruit pulp, sugar, pectin and citric acid. Pectin and citric acid were added as much as needed, following the rules by RDC (Technical Regulation of Good Practices for Food Services). There were five treatments for making jam, as T₁=Using 20% sugar in dragon pulp; T₂=Using 40% sugar in dragon pulp; T₃=Using 60% sugar in dragon pulp; T₄=Using 80% sugar in dragon pulp; and T₅=Using 100% sugar in dragon pulp. In preparation, pectin was mixed with equal amount sugar in a stainless steel pot. The remaining sugar was mixed with dragon fruit pulp and heated; then, sugar mixed pectin was added and continued the heating; citric acid was added and continued the heating. When TSS of the jam becomes 65° brix, then the KMS was added and prepared dragon fruit jam kept into glass jar and required data were collected with two month interval for a period of 6 months. The pH, acidity (%), TSS (%), color, microbial growth and overall acceptability of stored dragon fruit jam were analyzed by standard methods. The study was conducted using CRD with each treatment replicated three times, and data analysis was performed using statistical software from R.

Results and Discussion

Initially the maximum pH of 3.92 was observed with treatment T₅ and at the end of six months it was 3.64 but the pH of 3.52 was lowest with treatment T₁ and finally it was 3.12. On the other hand, initially the maximum acidity of 0.91% was observed with treatment T₁ after six months it was 1.07% but the acidity of 0.71% was lowest with treatment T₅ and finally it was 0.92%. The pH of stored dragon fruit jam likely decreased and acidity increased due to natural fermentation processes, and these findings similar with that of Stella *et al.* (2011) in orange nectars. In Table 1, initially the maximum TSS of 61.42 was observed with treatment T₅ and at the end it was 64.90 but the TSS of 34.30 was lowest with treatment T₁ and finally it was 38.90. A similar study was carried out by Hai *et al.*, 2014 for longan fruits. Initially, the jam color intensity was light red to red for the treatments of T₁

to T₅, respectively but finally it has gradually decreased and changes to dark color after six months of storage. The highest brightness was observed with treatment T₁ and the lowest with treatment T₅, but the lightness values were decreased up to 6 months of storage. The microbial growth of the dragon fruit jam from various treatments was not observed for up to four months of storage. However, the microbial growth of the dragon fruit jam was observed in small numbers (13 to 21×10⁻¹); these were non-pathogenic bacteria and an acceptable limit for human consumption for various treatments (T₁ and T₂) after six months of storage at ambient condition. In Table 2, among the treatments, the panelists gave the highest overall rating 7 (i.e., like moderately) of jam made with 80% sugar in pulp with treatment T₄ followed by 100% sugar in pulp and rating 6 (i.e., like slightly) with treatment T₅. The decrease in sensory values during storage was also shown for ready-to-eat peanut chutney by Veerapandian *et al.* (2014).

Table 1. Effect of percent sugar on the TSS (%) of dragon fruit jam in storage

Treatments	TSS (%) of dragon fruit jam with different storage (Month)			
	0	2	4	6
T ₁ =Using 20% sugar in dragon pulp	34.30e	37.80a	38.60e	38.90e
T ₂ =Using 40% sugar in dragon pulp	42.10d	44.40b	45.60d	45.80d
T ₃ =Using 60% sugar in dragon pulp	52.30c	54.40c	55.20c	55.70c
T ₄ =Using 80% sugar in dragon pulp	56.10b	59.20d	60.30b	60.80b
T ₅ =Using 100% sugar in dragon pulp	61.42a	63.42e	64.30a	64.90a
CV (%)	0.626	0.595	0.584	0.579
LSD _{1.0%}	0.561			

Table 2. Effect of percent sugar on overall acceptability of dragon fruit jam in storage

Treatments	Overall acceptability of dragon fruit jam with different storage (Month)			
	0	2	4	6
T ₁ =Using 20% sugar in dragon pulp	5.00c	4.50c	4.50d	4.50c
T ₂ =Using 40% sugar in dragon pulp	6.00b	5.50b	5.50bc	5.00c
T ₃ =Using 60% sugar in dragon pulp	6.00b	5.50b	5.00cd	5.00c
T ₄ =Using 80% sugar in dragon pulp	8.00a	7.00a	7.00a	7.00a
T ₅ =Using 100% sugar in dragon pulp	8.00a	6.00b	6.00b	6.00b
CV (%)	5.618	6.505	6.622	6.742
LSD _{1.0%}	0.675			

The mean values in the columns are displayed in significant result ($p < 0.01$) with various letters a, b, c and d.

Conclusion

This study successfully optimized the processing method for dragon fruit jam and examined its quality parameters during long-term storage. The research outcomes contribute to enhancing the production of high-quality dragon fruit jam with improved shelf life and consumer acceptance.

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STANDARDIZATION OF PROCESSING METHOD FOR DRAGON FRUIT JELLY

S. PERVIN, M.H.H KHAN, M.M. MOLLA, M.G.F. CHOWDHURY, M.M. RAHMAN AND A. A. SABUZ

Abstract

Dragon fruit jelly is a popular fruit-based product, and this study aimed to standardize its processing method and assess the changes in quality characteristics during storage at ambient temperature in Bangladesh. Six treatments were employed, varying the juice and sugar proportions in the jelly. The pH, acidity, TSS (%), color, and microbial growth were analyzed during a storage period of one year. The results indicated that the pH decreased and acidity increased over time. TSS increased during storage with 33% juice+70% sugar in jelly exhibiting the highest level. Color intensity decreased and lightness values reduced during prolonged storage. Microbial growth was minimal and within acceptable limits for human consumption. Sensory evaluation revealed 33% juice+50% sugar in jelly was the highest overall acceptance.

Introduction

Dragon fruit (*Hylocereus undatus*) is a tropical fruit that has become increasingly popular in recent years. Processed dragon fruit products are rarely available in our markets and very little work has been done on processing of dragon fruit in our country. If quality products from dragon fruit are developed, it might be welcomed by the consumers who have affinity for dragon fruit round the year. Dragon fruit contains 0.20- 1.04 % (Kanjana *et al.*, 2006) pectin, so its jelly usually call for added pectin. Development of varieties of products like jelly utilizing local produces is critically important for expanding the country's developing food industries. Therefore, the present study was carried out to achieve the following objectives: (i) to standardize the processing method for dragon fruit jelly and (ii) to analyze the quality characteristics of dragon fruit jelly during storage at ambient temperature of Bangladesh.

Materials and Methods

Dragon fruits was collected from the Regional Agricultural Research Center, Chittagong. Fruits were sort, wash and clean. The major ingredients for the preparation of jelly were sugar, citric acid, pectin and other chemicals were used from the laboratory store. The fully ripe healthy and fresh dragon fruit was washed thoroughly with potable water and the skin was removed by a knife. The seeds were removed and then dragon fruit was blended by a blending machine. Jelly prepared from dragon fruit with different formulations and there were six treatments T₁= (one third juice and two third water) for 1litre +50% sugar in jelly, T₂= (one third juice and two third water) for 1litre +60% sugar in jelly, T₃=(one third juice and two third water) for 1litre +70% sugar in jelly, T₄= (Half juice and half water for 1litre) +50% sugar in jelly, T₅= (Half juice and half water for 1litre) +60% sugar in jelly, T₆= (Half juice and half water for 1litre) +70% sugar in jelly. In preparation, pectin was mixed with equal amount sugar in a stainless steel pot. The remaining sugar was mixed with dragon fruit juice and heated; then, sugar mixed pectin was added and continued the heating; citric acid was added and continued the heating. When TSS of the jelly becomes 67⁰ brix, then the KMS was added and prepared dragon fruit jelly kept into glass jar and required data were collected after three month interval for a period of 1 year. The pH, acidity (%), TSS (%), color, microbial growth and overall acceptability of stored dragon fruit jelly were analyzed by standard methods. The study was conducted using CRD with each treatment replicated three times, and data analysis was performed using statistical software from R.

Results and Discussion

The pH of dragon fruit jelly increased from an initial maximum of 4.19 to 3.21 in T₄ after 1 year, but the lowest pH of 3.97 reached 3.17 in T₃. In contrast, the highest initial acidity of 0.82% (T₁) decreased to 1.21% after 1 year, while the lowest acidity of 0.51% (T₆) increased to 0.94%. The observed changes in pH and acidity during storage likely resulted from the natural degradation of acids over time. The results agreed with Touati *et al.* (2016) in fruit nectars. In Table 1, treatment T₅ exhibited the highest initial total phenolic content of 2.34 mg GAE/100 g, which decreased to 2.17 mg GAE/100 g after 1 year, while treatment T₅ had the lowest initial total phenolic content of 2.31 mg GAE/100 g, which eventually reached 2.14 mg GAE/100 g. This study was consistent with findings by Kamal *et al.*, 2020. In Figure 1; the jelly color intensity initially showed red for treatments T₁ to T₃ and yellow for treatments T₄ to T₆, but it gradually decreased to light red and light yellow, respectively, after 1 year of storage. Treatment T₆ had the highest brightness but treatment T₁ had the lowest, while lightness values decreased over time during storage. Microbial growth in the dragon fruit

jelly was minimal and non-pathogenic, remains within acceptable limits for human consumption in treatments T₅ (12 to 18×10⁻¹) and T₆ (8 to 16×10⁻²) after twelve months of ambient storage. However, the jelly exhibited a shorter shelf life compared to pickle, as reported by Bhuyan *et al.* (2012). Among the treatments, the panelists rated jelly made with 33% juice+50% sugar (T₁) the highest at 7.5 (i.e., like moderately to like very much), followed by 33% juice+60% sugar (T₂) with a rating of 7 (i.e., like moderately). Similar to Veerapandian *et al.* (2014) with peanut chutney, a decline in sensory values was observed during storage.

Table 1. Effect of percent juice and sugar on total phenol (mg GAE/100 g) of dragon fruit jelly in storage

Treatments	Total phenol (mg GAE/100 g) of dragon fruit jelly with different storage (Month)				
	0	3	6	9	12
T ₁ = (one third juice and two third water) for 1litre +50% sugar in jelly	2.31b	2.26b	2.16bc	2.06c	1.98b
T ₂ = (one third juice and two third water) for 1litre +60% sugar in jelly	2.32ab	2.28ab	2.31a	2.23ab	2.14a
T ₃ =(one third juice and two third water) for 1litre +70% sugar in jelly	2.41a	2.37a	2.29a	2.27a	2.19a
T ₄ = (Half juice and half water for 1litre) +50% sugar in jelly	2.28c	2.22b	2.14c	2.02c	1.97b
T ₅ = (Half juice and half water for 1litre) +60% sugar in jelly	2.31b	2.28ab	2.23ab	2.17b	2.14a
T ₆ = (Half juice and half water for 1litre) +70% sugar in jelly	2.34ab	2.30ab	2.25a	2.21ab	2.17a
CV (%)	3.546	2.520	2.158	1.832	2.003
LSD _{5,0%}	0.147	0.102	0.086	0.070	0.075

The mean values in the columns are displayed in significant result ($p < 0.05$) with various letters a, b and c.

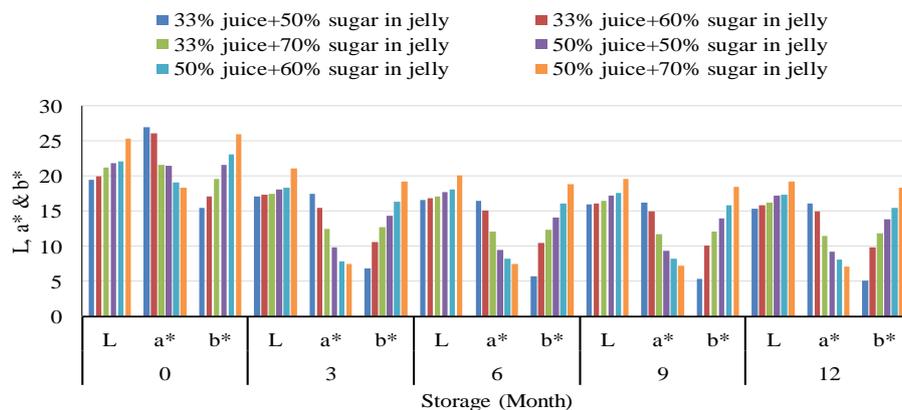


Figure 1. Effect of percent juice and sugar on color parameters of dragon fruit jelly in storage

Conclusion

This study successfully standardized the processing method for dragon fruit jelly and investigated its quality changes during storage. The findings provide valuable insights for producers to enhance the shelf life and sensory appeal of dragon fruit jelly for commercial purposes.

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BLANCHING EFFECT ON THE QUALITY AND SHELF LIFE OF TARO ROOT

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Abstract

Taro is a valuable tropical root crop in Bangladesh, but its perishable nature presents storage challenges. Blanching is commonly used to enhance product stability during freezing. This study investigates the effect of blanching on frozen taro roots to optimize storage and product quality. Seven blanching treatments were evaluated for physicochemical quality parameters over six months. Blanching significantly affected texture, color, and antioxidant property. Blanching at $80\pm 1^\circ\text{C}$ for 6 minutes demonstrated the most suitable attributes. Overall, blanching improved the shelf life and quality of frozen taro roots.

Introduction

Taro (*Colocasia esculenta*) is a significant tropical root crop widely cultivated and consumed in Bangladesh due to its nutritional value and culinary versatility. However, the perishable nature of fresh taro roots poses challenges for its storage and distribution. Blanching, a pre-freezing treatment, is commonly employed to inactivate enzymes and improve product stability during freezing. Understanding the effect of blanching on frozen taro roots is crucial for optimizing storage and enhancing product quality. The study will investigate various blanching durations and temperatures to determine the most suitable treatment for maintaining desirable product attributes during long-term storage. Therefore, the present study was carried out to achieve the following objectives: (i) to evaluate the physicochemical quality parameters of the frozen taro roots; and (ii) to investigate the shelf life of the product for long time storage.

Materials and Methods

Fresh taro roots were obtained from the local market and subjected to sorting, grading, washing, and cutting. The cut taro roots were immersed in water with 1g/L potassium metabisulfite (KMS) for 10 minutes. Subsequently, blanching was performed using water and steam for 3, 6, and 9 minutes, followed by cooling in water. Processed taro roots were then packed in high-density polyethylene bags and stored in a deep freeze. There were seven treatments to prepare processed taro roots. These were: T₁=Control; T₂=Water blanching for 3 min; T₃=Stream blanching for 3 min; T₄=Water blanching for 6 min; T₅=Stream blanching for 6 min; T₆=Water blanching for 9 min; T₇=Stream blanching for 9 min. Data on texture (N), color, antioxidant property (%), enzyme inactivation time, and overall acceptability were collected periodically over 6 months. The study was conducted using CRD with each treatment replicated three times, and data analysis was performed using statistical software from R.

Results and Discussion

During storage, the texture of taro roots decreased significantly. T₁ (control) exhibited the highest initial texture of 57.47 N to 41.56 N, followed by T₃ (stream blanching) with a decrease from 43.45 N to 30.34 N. The lowest texture was observed in T₆ (water blanching) with a decline from 22.33 N to 17.46 N. This decrease in texture is attributed due to cell structure breakdown and enzymatic activity (Sharma *et al.*, 2006). In Figure 1, the color intensity of stored taro roots exhibited an initial very light yellow color, which gradually decreased to light yellow over 6 months of storage. Treatment T₅ showed the highest brightness, while T₁ displayed the lowest. As storage continued, the color of the taro roots slowly decreased, aligning with the findings of Singh *et al.* (2015).

The initial DPPH values (antioxidant property) of taro roots ranged from 13.54% to 18.27%, which decreased 10.32% to 15.08% after 6 months of storage. The reduction in antioxidant activity may be attributed to enzyme reactions and degradation of bioactive compounds (Kulkarni & Aradhya, 2005; Kamal *et al.*, 2019). In Table 2, the blanching effect and quality parameters were tested, it would be concluded that the treatment T₅ (blanching at $80\pm 1^\circ\text{C}$ for 6 minutes) with six months storage was found suitable. Therefore, taro root can be stored at deep freeze using the above blanching condition for the six months. The panelists gave the highest overall rating (8.0) of taro roots from treatments T₅ (stream blanching for 6 min) and T₆ (water blanching for 9 min), indicating "like very much," followed by treatment T₇ (stream blanching for 9 min), indicating "like moderate." However, sensory attributes slightly decreased from the initial to final storage period, consistent with findings by Chowdhury *et al.* (2022).

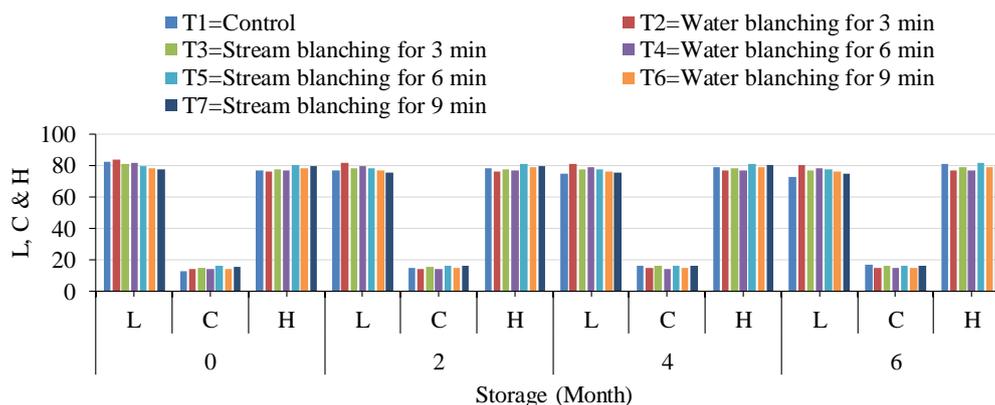


Figure 1. Effect of blanching on color parameters of taro root during storage

Table 1. Effect of blanching on % DPPH values (antioxidant property) of stored taro root

Treatments	% DPPH (Antioxidant property) of taro root with different storage (Month)			
	0	2	4	6
T ₁ =Control	18.27a	15.32b	15.04a	14.87b
T ₂ =Water blanching for 3 min	15.14d	12.65d	12.34c	12.18d
T ₃ =Stream blanching for 3 min	16.87c	14.32c	14.13b	14.08c
T ₄ =Water blanching for 6 min	14.61e	11.58f	11.34e	11.14f
T ₅ =Stream blanching for 6 min	17.87b	15.64a	15.23a	15.08a
T ₆ =Water blanching for 9 min	13.54f	10.78g	10.56f	10.32g
T ₇ =Stream blanching for 9 min	15.03d	12.08e	11.79d	11.67e
CV (%)	1.140	1.195	1.057	0.908
LSD _{1.0%}	0.317	0.276	0.239	0.203

The mean values in the columns are displayed in significant result ($p < 0.01$) with various letters a, b, c, d, e, f and g.

Table 2. Inactivation time of enzyme for water and steam blanching of taro root

Treatments	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇
Peroxidase	+	+	+	+	-	-	-
Catalase	+	+	+	-	-	-	-

Conclusion

The findings of this research can contribute to the development of efficient processing techniques for taro root preservation, addressing post-harvest losses, and promoting its year-round availability in Bangladesh.

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PRESERVATION OF AONLA BY OSMOTIC DEHYDRATION METHOD

S. PERVIN, M.H.H KHAN, M.M. MOLLA, M.G.F. CHOWDHURY, M.M. RAHMAN AND A. A. SABUZ

Abstract

The study aims to optimize dehydration conditions for producing high-quality value-added products with extended shelf life. Eight treatments were used to osmo-dehydrate aonla, and the physicochemical properties were analyzed during a 6-month storage period. The results revealed that the texture, vitamin C, and total phenolic content of osmo-dehydrated aonla decreased with increasing storage period and osmotic solution concentration. The color intensity also decreased significantly during prolonged storage. Sensory evaluation indicated that osmo-dehydrated aonla maintained overall acceptability throughout the storage period. Overall, the research demonstrates the potential of osmotic dehydration as an effective preservation method for aonla, yielding value-added products with enhanced quality and shelf life.

Introduction

Aonla (*Emblica officinalis*), commonly known as Indian gooseberry or "amla" in Bangladesh, is a nutritionally rich fruit with health benefits, but its seasonal availability poses challenges. Osmotic dehydration offers a promising preservation method by removing moisture from fruits using hypertonic solutions, extending shelf life and retaining nutrients. This research aims to preserve aonla using osmotic dehydration and optimize conditions for high-quality value-added products. The study investigates the effects of osmotic solution concentrations on physicochemical quality parameters. Therefore, the present study was carried out to achieve the following objectives: (i) to optimize the dehydration condition for aonla; and (ii) to produce value-added products.

Materials and Methods

Aonla was collected from the local market. Fruits were sorted, washed and cleaned. Then, the balancing was done with 2% salt solution with 70°C temperature for 10 minutes and wash with cool water. As per treatment, the fruits were dipped in 50 and 60 °Brix sugar syrup for 24 h and boiled it for 15 min. Then, the treated samples were placed into cabinet dryer with drying temperature was maintained at 60 °C. After drying, the osmo-dehydrated aonla was preserved in a glass container. Finally, the treated aonla were analyzed after 2 months' interval up to 6 months in an ambient condition. There were eight treatments to prepared osmo-dehydrated aonla and these were T₁= (50°B+sucrose powder) in aonla; T₂= (50°B+glucose powder) in aonla; T₃= (50°B+2% salt+sucrose powder) in aonla; T₄= (50°B+2% salt+glucose powder) in aonla; T₅= (60°B+sucrose powder) in aonla; T₆= (60°B+glucose powder) in aonla; T₇= (60°B+2% salt+sucrose powder) in aonla; and T₈= (60°B+2% salt+glucose powder) in aonla. The texture, vitamin C, total phenolic content, color and overall acceptability of osmo-dehydrated stored aonla were analyzed by standard methods. The study was conducted using CRD with each treatment replicated three times, and data analysis was performed using statistical software from R.

Results and Discussion

The texture of osmo-dehydrated aonla decreased from an initial maximum of 102.97 N to 65.54 N in T₁ but it was 62.54 N to 53.12 N as lowest in T₈ at the end of storage, likely due to cell structure breakdown and enzymatic activity during storage, resulting in softer fruit texture. Similar findings were reported for osmo-dehydrated apricot by Sharma *et al.*, 2006. In Table 1, showed that the fresh aonla vitamin C content was 580 mg/100 g. During the 6-month storage period, osmo-dehydrated aonla showed a declining trend in vitamin C content, with treatment T₁ having the highest initial value of 247.05 mg/100 g and finally it was 214.78 mg/100 g, whereas, treatment T₈ exhibiting the lowest initial value of 216.64 mg/100 g and final value of 184.76 mg/100 g. Vitamin C content in osmo-dehydrated aonla decreased due to its high susceptibility to heat, light, and air during processing, which similar to previous studies by Kamal *et al.* (2019) and Chowdhury *et al.* (2022). In osmo-dehydrated aonla, total phenolic content ranged from 189.92 to 143.18 mg GAE/100 g at the beginning of storage, and after 180 days, it varied between 132.98 to 86.16 mg GAE/100 g from treatment T₈ to T₁, respectively. Total phenolic content significantly decreased with increasing brix used as the osmotic agent and further decreased with the increase in storage period, consistent with findings by Kamal *et al.*, 2020. Figure 1 shows the color intensity of osmo-dehydrated aonla, initially light red color significantly decreased to dark red during 6 months of storage. Treatments T₄ and T₈ had the highest brightness, while T₁ and T₅ had the lowest. The color of aonla decreased significantly during prolonged storage, which consistent with findings by Singh *et al.* (2015). The highest overall

rating (8.0) was given by panelists to osmo-dehydrated aonla from treatments T₄ (50⁰B+2% salt+glucose powder) and T₈ (60⁰B+2% salt+glucose powder), indicating like very much. However, sensory values of osmo-dried aonla showed a decrease rate during storage.

Table 1. Effect of brix and various solute concentrations on vitamin C of osmo-dehydrated aonla during storage

Treatments	Vitamin C (mg/100 g) of osmo-dehydrated aonla with different storage (Month)			
	0	2	4	6
T ₁ =(50 ⁰ B+sucrose powder) in aonla	247.05a	219.56a	217.45a	214.78a
T ₂ =(50 ⁰ B+glucose powder) in aonla	246.85a	219.17b	217.05b	213.65b
T ₃ =(50 ⁰ B+2% salt+sucrose powder) in aonla	217.52d	197.05e	194.15e	193.74d
T ₄ =(50 ⁰ B+2% salt+glucose powder) in aonla	216.82ef	196.12f	194.07e	193.47e
T ₅ =(60 ⁰ B+sucrose powder) in aonla	239.23b	207.13c	205.07c	203.93c
T ₆ =(60 ⁰ B+glucose powder) in aonla	238.72c	206.79d	204.78d	203.87c
T ₇ =(60 ⁰ B+2% salt+sucrose powder) in aonla	217.14e	189.13g	187.64f	185.12f
T ₈ =(60 ⁰ B+2% salt+glucose powder) in aonla	216.64f	189.08g	187.47f	184.76g
CV (%)	0.085			
LSD _{1,0%}	0.340	0.298	0.259	0.224

The mean values in the columns are displayed in significant result ($p < 0.01$) with various letters a, b, c, d, e, f and g.

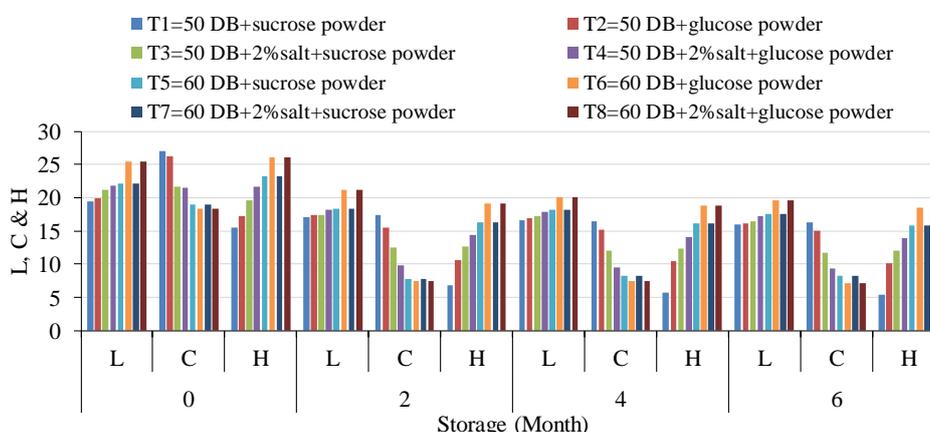


Figure 1. Effect of brix and various solute concentrations on color parameters of osmo-dehydrated aonla during storage

Conclusion

The findings of this study are expected to provide valuable insights into the efficient preservation of aonla, offering opportunities to develop value-added products and enhance its availability throughout the year in Bangladesh. This research can contribute to the promotion of sustainable fruit processing techniques, reduction of food waste, and support the local fruit processing industry in the country.

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EFFECT OF MOISTURE LEVEL ON PROCESSING AND QUALITY OF LENTILCHIPS

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Abstract

The study was conducted to develop lentil chips through find out the proper moisture level and barrel temperature of the single screw extruder. The single screw extruder was installed successfully in the postharvest Technology Division of BARI. Several trial based on moisture level has been done and outlet dice of the single screw extruder has been modified to develop quality chips. Then the product has been incorporated to evaluate by forming of judgments panel groups consist of interdisciplinary trained scientists, staffs and child (6-10 years). Then the quality product has been packed into metalex and polypropylene pouches for storage studies at ambient condition. Results show that moisture at 20% conditioning 2-3 h produced high quality chips that has been acceptable by the consumers.

Introduction

Extrusion is a thermal processing that involves the application of high heat, high pressure, and shear forces to an uncooked mass, such as cereal foods (Kim et al., 2006). It is an emerging technology for the food industries to process and market a large number of products of varying size, shape, texture, and taste. It is becoming popular over other common processing methods due to its low capital cost, feasible process to produce non-fried products, high capacity and high productivity. During extrusion, proper ratio, mixing ingredients, conditioning, high temperature and large shearing forces cause disintegration of the product. As proper mixing ratio, proper moisture level and conditioning time related information is meager for producing the quality products, hence the present study has undertaken to fulfill the above objectives.

Materials and Methods

T₁= 2 % moisture content

T₂= 4 % moisture content

T₃= 6 % moisture content

T₄= 8 % moisture content

T₅= 10 % moisture content

Results and discussion

Ingredients ratio, moisture content and barrel temperature influence the quality of lentil chips. Hence, it was subjected to determine the proper mixing ratio of ingredients, moisture level, barrel temperature and modification of outlet dice of the extruder.



Fig.1. Modification of dice and produced high quality chips (Last one)

Modification of the outlet dice: The screw and sheft was modified to get maximum yield and quality of chips (Fig.2 and Fig.3).

Sensory evaluation

The developed chips were subjected to evaluate the sensory evaluation by forming judgment panel consisting 90 members. All the members were requested to evaluate the color, flavor, crispiness, texture, bitterness, pungency, swelling and overall acceptability (Fig.2). The score obtained for T₁ and T₂ by the expert judgment was higher than others (Table 1). The highest crispiness (7.80) score was found in T₂ although statistically no significant differences were found between T₁ and T₂. The lowest

(5.90) score was recorded in T₅. Most of the expert panelists concluded that treatment T₂ was better considering their color, flavor, crispiness, swelling capacity and overall acceptability. Hence, 2-4% moisture level (T₂ and T₄) was selected for further preparation of chips.

Table 1. Sensory evaluation of the developed lentil chips

Treatment	Sensory attributes							
	Color	Flavor	Crispiness	Texture	Bitterness	Pungency	Swelling	Overall acceptability
T ₁	7.53± 0.82a	7.56± 1.16a	7.73± 0.91a	7.63± 0.88a	7.63± 0.96a	7.26± 1.63	7.90± 1.02a	7.80±0.84a
T ₂	7.80± 0.81a	7.80± 0.88a	7.80± 0.81a	7.20± 1.06a	7.06± 1.59a	6.53± 1.85	8.03± 0.81a	8.00±0.83a
T ₃	6.43± 0.77b	6.46± 0.86b	6.33± 1.06b	6.06± 0.82b	6.16± 1.55b	6.43± 1.19	6.06± 1.28b	6.80±0.71b
T ₄	6.43± 0.77b	6.46± 0.86b	6.33± 1.06b	6.06± 0.83b	6.16± 1.55b	6.43± 1.19	6.06± 1.28b	6.80±0.71b
T ₅	5.93± 1.36b	6.00± 1.46b	5.90± 1.24b	5.86± 1.00b	6.23± 1.67b	6.40± 1.24	6.43± 1.47b	6.23±0.97b

All values are means of triplicate determinations ± SD. Means within columns with different letters a, b, c indicate significant result (p<0.05), no letter means non-significant results.



Fig.2: Sensory evaluation of chips

Conclusion

Chips prepared with 2-4% moisture level and conditioning 2-3 h produced high quality chips that was acceptable by the consumers. The product was very amazing due to oil and sugar free. Further study should be continued to develop smart packages (3D printing package) for better storage and marketing.

Acknowledgement

The research was conducted by the financial assistance of GIFS, Canada-KGF, BARC project.

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THE PHYSICOCHEMICAL, NUTRITIONAL, MINERALS AND BIOACTIVE COMPOUND ANALYSIS OF DIFFERENT EDIBLE PARTS OF SELECTED BARI KACHU VARIETIES

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Abstract

The purpose of the study was to analyze the physicochemical, nutritional, bioactive compounds and minerals of different edible portions of the BARI Pani Kachu varieties. The seven BARI Pani Kachu varieties were selected for the study. Results reveal that vitamin-C content found higher at rhizome (8.23 ± 0.03 mg/100 g), stolon (18.10 ± 0.10 mg/100 g) and leafblade (47.06 ± 0.06 mg/100 g) of the BARI Pani Kachu-3. Petiole of BARI Pani Kachu-1 contained higher amount of vitamin-C (7.24 ± 0.04 mg/100 g). Fe and Zn were highly present at rhizome and stolon portion of BARI Pani Kachu-3 and BARI Pani Kachu-6. Leafblade of BARI Pani Kachu-6 was rich source of Fe (337.00 ± 3.00 ppm) and Zn (56.86 ± 0.04). Petiole of BARI Pani Kachu-5 and BARI Pani Kachu-6 was superior for Fe and Zn.

Introduction

The food habit of South Asian people is predominantly cereal-based. The major portion of diet comes from rice, wheat, and maize, which provide a large share of energy. The daily energy intake in low- and middle-income countries comes from cereals. Staple cereals provide a relatively low number of micronutrients such as essential vitamins and minerals. Minerals play important metabolic roles in human body functioning (Reilly, 2002) and contribute to our daily diet. The potential of aroid to contribute towards food and nutrition security has not been fully exploited in the past mainly because aroid has been regarded as an underutilized and minor crop. Still now BARI has released 7 Pani Kachu varieties that can be cultivated in low, medium low and high land also. Farmers would like to cultivate BARI Pani Kachu varieties but their requirement to high yielding and nutritious variety. BARI released the varieties with little nutritional information due to lack of laboratory and analytical facilities in the past. As the smart farmers and consumers' interest is increasing towards the nutrition facts and security, hence, the present study was undertaken to details analysis the physicochemical, nutritional, bioactive compounds and minerals of different edible portion of the BARI Pani Kachu varieties.

Materials and Methods

Collection and preparation of sample: Fresh selected seven BARI Pani kachu varieties were collected from the research field of Tuber Crop Research Center (TCRC), BARI, Gazipur. The collected samples were dried and grinded for powder. The dried powder was passed through 80 mesh sieve. Then the samples were extracted according to the nature of analysis.

Physicochemical, nutritional, bioactive compound and minerals analysis: Moisture, dry matter, ash, vitamin-C, and β -carotene content were determined according to the procedure described by Ranganna (1995). pH was recorded by a digital pH meter (Delta 320, Mettler, Shanghai). Total acidity (%) was measured using Auto Titrator (Metrohm 814, USB Sample Processor, Switzerland). Total soluble solid (TSS; °Brix) was recorded using a digital hand refractometer (Model NR151). Ca and Mg were determined by KCl extractable method. K, Fe, Mn and Zn were determined by NaHCO_3 extraction followed by Atomic absorption spectrophotometry (Model-AA-7000S, Shimadzu, Tokyo, Japan). P was determined by Bray and Kurtz method while S by turbidimetric method with BaCl_2 . Individual minerals were quantified by comparing the corresponding standard mineral procured from the Sigma Aldrich Chemical Co., USA.

Results and discussion

Experimental edible oils and their consumption in Bangladesh

Table 1 and Table 2 represent the vitamin-C, Fe and Zn content of seven BARI Pani Kachu varieties. In this study, the four edible portions of the Kachu were selected. Vitamin-C was highly present at rhizome, stolon, leafblade and petiole in BAFI Kachu-3. Petiole was rich in BARI Pani Kachu-1. Zn was higher at rhizome, stolon, leafblade and petiole in BARI pani Kachu-6 than other varieties. The highest Fe was found at rhizome of BARI Pani Kachu-1, stolon of BARI pani Kachu-3, Leafblade of BARI pani Kachu-6 and petiole of BARI Pani Kachu-5 as 195.00 ± 2.00 ppm, 547.00 ± 3.00 ppm, 337.00 ± 3.00 ppm and 143.00 ± 3.00 ppm respectively (Table 2). Results revealed that rhizome, stolon and leafblade is the rich source of BARI Pani Kachu-3 than other varieties. Fe and Zn was present at rhizome, stolon, leafblade and petiole in all the selected varieties more or less

Table 1: Vitamin-C (mg/100 g) of different edible portion of BARI Pani Kachu varieties

BARI Pani Kachu variety	Different edible portion of Pani Kachu			
	Rhizome	Stolon	Leafblade	Petiole
BARI Pani Kachu-1	2.73 ± 0.02d	16.29 ± 0.03c	18.10 ± 0.10e	7.24 ± 0.04a
BARI Pani Kachu-2	1.81 ± 0.02e	6.33 ± 0.03g	17.20 ± 0.20f	4.53 ± 0.03c
BARI Pani Kachu-3	8.23 ± 0.03a	18.10 ± 0.10a	47.06 ± 0.06a	3.53 ± 0.03d
BARI Pani Kachu-4	1.81 ± 0.02e	10.10 ± 0.10f	19.91 ± 0.03d	1.81 ± 0.04f
BARI Pani Kachu-5	5.88 ± 0.02b	13.71 ± 0.04d	36.45 ± 0.05c	5.88 ± 0.02b
BARI Pani Kachu-6	3.62 ± 0.06c	10.88 ± 0.08e	16.33 ± 0.03g	2.71 ± 0.01e
BARI Pani Kachu-7	5.88 ± 0.02b	17.06 ± 0.06b	43.51 ± 0.04b	4.28 ± 0.36c

All values are means of triplicate determinations ± SD. Means within columns with different letters a, b, c, d, e, f, g indicates significant result (p<0.05).

Table 3: Fe and Zn of different edible portion of BARI Pani Kachu varieties

BARI Pani Kachu variety	Different edible portion of BARI Pani Kachu			
	Rhizome	Stolon	Leaf blade	Petiole
Fe (ppm)				
BARI Pani Kachu-1	195.00 ± 2.00a	453.00 ± 3.00c	220.00 ± 5.00b	143.00 ± 3.00a
BARI Pani Kachu-2	98.10 ± 0.10b	323.00 ± 3.00e	131.00 ± 2.00d	100.33 ± 1.53d
BARI Pani Kachu-3	71.50 ± 0.50d	547.00 ± 3.00a	193.00 ± 3.00c	114.00 ± 4.00c
BARI Pani Kachu-4	71.30 ± 0.30d	414.00 ± 14.00d	210.00 ± 10.00b	107.00 ± 3.00cd
BARI Pani Kachu-5	91.90 ± 0.90c	462.00 ± 6.00c	217.00 ± 3.00b	143.00 ± 3.00a
BARI Pani Kachu-6	89.90 ± 0.10c	510.00 ± 10.00b	337.00 ± 3.00a	124.00 ± 4.00b
BARI Pani Kachu-7	69.50 ± 0.50d	27.69 ± 0.01f	32.62 ± 0.02e	30.49 ± 0.09e
Zn (ppm)				
BARI Pani Kachu-1	86.32 ± 0.03d	37.29 ± 0.09c	29.71 ± 0.04e	36.45 ± 0.45c
BARI Pani Kachu-2	85.29 ± 0.09d	41.99 ± 0.01b	32.14 ± 0.14d	22.84 ± 0.06e
BARI Pani Kachu-3	91.22 ± 0.03c	29.04 ± 0.04f	21.91 ± 0.04f	36.99 ± 0.01b
BARI Pani Kachu-4	72.86 ± 0.04e	36.45 ± 0.05d	42.37 ± 0.03b	36.12 ± 0.03c
BARI Pani Kachu-5	60.50 ± 0.50f	32.07 ± 0.07e	21.31 ± 0.34g	30.86 ± 0.04d
BARI Pani Kachu-6	102.00 ± 2.00a	51.12 ± 0.03a	56.86 ± 0.04a	42.37 ± 0.03a
BARI Pani Kachu-7	94.09 ± 0.09b	27.69 ± 0.03g	32.62 ± 0.06c	30.49 ± 0.09d

Conclusion

The edible portion of rhizome, stolon, leafblade and petiole of BARI Pani Kachu-6 is the rich source of Zn. Fe is highly found at rhizome and stolon of BARI Pani Kachu-3. Leafblade and petiole of BARI Pani Kachu-6 and BARI Pani Kachu-5 is the rich source of Fe. Vitamin-C is highly present at rhizome, stolon and leafblade of BARI Pani Kachu-3. All the selected edible portion of the BARI Pani Kachu varieties contains vitamin-C, Fe and Zn more or less.

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PHYSICOCHEMICAL AND QUALITY EVALUATION OF DRIED TOMATO SLICES

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Abstract

The main purpose of this study was to investigate the physicochemical and quality evaluation of dried tomato slices. Tomatoes were dried by two different methods viz. cabinet and freeze-drying and changes in nutrient content of tomato slices were examined. As a result of drying applications, the initial moisture content of fresh tomato samples was determined to be 95.43%, whereas dried samples ranged from 11.80% to 15.85%. Losses of nutritional contents of cabinet-dried samples were high compared to others. Between the methods used, it was observed that freeze-dried tomato slices scored highest for color and all other nutritional qualities. Thus, it could be concluded that the freeze-drying method resulted in better end products retaining natural color and nutrients, also employing a simple technique and minimal energy.

Introduction

Tomato is the most important vegetable in Bangladesh. In glut season, its production is very high and most of them goes to the postharvest loss where it is estimated as 32.90% (Hasan *et al.*, 2010). Nutritionally, tomatoes provide beta carotene, vitamins A and C, and lycopene to consumers (Eze, 2012), and are believed to have numerous other health benefits. Of the dehydration options available, drying remains the cheapest and most popular method. Drying achieves moisture removal by the application of heat, the amount of water removed being dependent on the temperature and drying methods and time (Idah, Musa & Olaleye 2010), and will extend the self-life of most fruits and vegetables if carried out properly. The major challenge with the drying of tomato is that many of the tomato contain heat-sensitive nutrients, particularly vitamins which may be lost at excessive temperatures. A number of researchers have been investigated the effects of various drying methods on color parameters of tomato. But there was a lack of information which methods and rehydration time retain more nutrient with extending the better shelf life without any quality deterioration. Hence the present research has carried out to meet the above objectives.

Materials and Methods

Fresh tomatoes (variety: BARI tomato-14) were collected from the farmer's field of Gazipur. Then tomatoes were sorted and graded. After that samples were washed with 0.1% calcium calcinate for 5 min and sliced. The sliced tomatoes were pretreated with 0.1% KMS for 3 min. Finally, samples were dried at $60\pm 1^{\circ}\text{C}$ temperature using cabinet and freeze dryer and solar dryer. The dried tomatoes were packed into high-density polyethylene (HDPE) bags and then analyzed for different quality parameters.

Moisture content, total soluble solids (TSS), ash, pH were determined according to the method described by AOAC (2005). Lycopene and β -carotene content was determined by Nagata and Yamashita (1992). The color parameters were assessed according to Dervisi *et al* (2001).

Results and Discussion

The moisture content of fresh tomatoes is the main barrier for its processing. The data regarding the physicochemical analysis of fresh and dried tomato slices are presented in Table 1, and Table 2 respectively. In this experiment, the initial moisture content of fresh tomato was found 95.43% and the values changed from 11.80% to 15.85% for dried tomatoes. These results also support the observation of Sahin *et al.*, (2010).

TSS and ascorbic acid content of tomatoes were increased compared to the fresh tomatoes for both drying methods. These parameters may be increased with the decreased percentage of moisture content. The average pH value of fresh tomatoes was 4.11 whereas 4.43 and 3.96 were observed for cabinet and freeze-dried tomatoes, respectively. These values are lower than 4.5 as beneficial for the microorganism growth limitations. (Tigist *et al.*, 2013). According to Farooq *et al.*, (2020), the lycopene content of cabinet and freeze-dried tomatoes was 19.19 mg/100g and 36.41 mg/100g

respectively which were close to the present study. The lycopene and β -carotene content of fresh tomatoes showed an increasing trend regarding different drying methods due to release of free lycopene and the concentration effects on β -carotene content of dried tomatoes (Hussein *et al.* 2016). β -carotene content may be increased because of pretreatments in reducing the thermal degradation of carotenoids. The ash content in fresh tomato was 5.73% that was increased for both drying methods and the values varied from 6.55% to 6.89% for cabinet and freeze-dried tomatoes, respectively. These experimental observations for ash content were close to the values reported by Surendar *et al.*, (2018). The color values (L^* , a^* , b^*) were increased for freeze-dried tomatoes than cabinet-dried samples. The a^*/b^* ratio for cabinet-dried tomatoes was higher than freeze-dried tomatoes that explained the big shrinkage in cabinet-dried tomatoes. These observations were in covenant with a former study by Farooq *et al.*, (2020).

Conclusion

The nutritional content of fresh and dried tomatoes varied considerably. Compared to cabinet drying, the loss of nutritional quality was minimal in freeze-drying techniques. Freeze-dried tomato slices were found to be desirable in color retention and other quality. Finally, it can be suggested that dried tomato slices may be utilized as a raw material for further commercial uses in food processing.

Table 1. Physicochemical properties of fresh tomatoes

Parameters	Fresh Tomato	Parameters	Fresh Tomato
Moisture Content (%)	95.43 \pm 0.08	Ash (%)	5.73 \pm 0.36
TSS ($^{\circ}$ B)	4.8 \pm 0.10	Color	
p ^H	4.11 \pm 0.01	L*	34.22 \pm 0.69
Lycopene (mg/100g)	4.76 \pm 0.62	a*	17.76 \pm 1.26
β -carotene (mg/100g)	0.32 \pm 0.05	b*	23.12 \pm 1.93
Ascorbic acid (mg/100g)	11.67 \pm 0.58		

All values are mean \pm S.D. of triplicate determinations.

Table 2. Physicochemical properties of dried tomatoes

Parameters	Cabinet Dried Tomato	Freeze Dried Tomato	Parameters	Cabinet Dried Tomato	Freeze Dried Tomato
Moisture Content (%)	15.84 \pm 1.59	11.80 \pm 0.28	Ash (%)	6.55 \pm 0.42	6.89 \pm 0.28
TSS ($^{\circ}$ B)	8.83 \pm 0.21	9.13 \pm 0.06	Color		
p ^H	4.43 \pm 0.01	3.96 \pm 0.01	L*	27.76 \pm 0.03	47.45 \pm 0.17
Lycopene (mg/100g)	16.13 \pm 0.45	27.06 \pm 0.17	a*	11.73 \pm 0.06	12.78 \pm 0.08
β -carotene (mg/100g)	1.03 \pm 0.34	1.96 \pm 0.51	b*	18.54 \pm 0.18	22.31 \pm 0.25
Ascorbic acid (mg/100g)	17.92 \pm 0.72	38.13 \pm 0.45			

All values are mean \pm S.D. of triplicate determinations.

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EFFECT OF MALTODEXTRIN AND SUGAR COATING ON NUTRITIONAL AND BIOACTIVE COMPOUNDS OF FREEZE-DRIED JACKFRUIT CHIPS

M.G.F. CHOWDHURY, M.H.H. KHAN, M.M. MOLLA, S. PERVIN, A.SABUZ

Abstract

The aim of the study was to standardize the freeze-dried jackfruit chips processing protocol by application of maltodextrin and sugar coating. Jackfruit chips were prepared from matured khaja type jackfruit. The harvested jackfruit was cut into halves and separated into the bulbs. The seed was removed, and bulb was sliced into about 5 mm thickness and treated with 5, 10, 15% maltodextrin and 40% sugar solution then packaged in high density polyethylene packet (~60 micron) and frozen at -18°C for 24-36 hrs. Then the frozen slices were dried in freeze dryer at -53°C for 72 hrs. The dried chips were packaged in foil (~50 micron) packet without nitrogen. According to the quality attributes, 10% maltodextrin coated slices exhibited better quality during 6 months of storage at ambient condition.

Introduction

Jackfruit belongs to the family *Moraceae* and grows commonly in the tropical countries of Southeast Asia. India, Bangladesh, Thailand, Indonesia and Malaysia are five top jackfruit producers in the world with a total production of about 3.11 million tons per year (Saxena *et al.*, 2013). A large quantity of jackfruits still gets spoiled due to lack of proper preservation/processing technology, an integrated supply chain, and/or storage facilities during the peak season. Value addition is an important alternative for reducing the postharvest losses of this nutritive fruit. Freeze drying is applicable to preparing biological products that are unstable in aqueous solutions for prolonged storage periods, but that are stable in the dry form. Keeping this in view, the program was conducted to develop the freeze-dried jackfruit chips and evaluate their quality.

Materials and Methods

Fresh and mature ripe jackfruits (not juicy) of BARI Khatal-2 were collected from HRC of BARI for conducting the study. Several trial experiments were conducted using different pretreatments and freeze-drying time where drying temperature was fixed (-55°C). The jackfruits were washed, peeled, removed from the seed from bulb and sliced lengthwise. Then jackfruit slices were pretreated with different maltodextrin conc. on (5%, 10% & 15%) and 40% sugar solution. Another was without any pretreated sample considered as control treatment. After pretreatments, the slices were packed in HDPE packet and stored in at -18°C till frozen (~24-36 hrs.). The slices were dried in laboratory scale freeze dryer at -53°C for 60-72 hrs. maintaining the vacuum pressure at 0.001 mBar. After drying, the chips were packed in laminated aluminum foil packet and stored at room temperature (26±2°C & 75±5% RH) in a dry and cool place. Jackfruit slices were soaked in maltodextrin solution for 10-15 mins and at least 1 hr. in other solutions. The moisture, ash and starch content were determined based on the AOAC official methods (AOAC, 2005). The titratable acidity and ascorbic acid content were determined following the methods of Ranganna (2007). The fat content was determined by the soxhlet extraction device, and the method was followed as described by Ranganna (2007). All the obtained data were analyzed using IBM SPSS (Version 22.0, SPSS Inc., Chicago, IL) statistical software.

Results and Discussion

Moisture content was presented in Table 1 that all treatments were significant differences during 6 months of storage. The highest moisture content was observed in 10% maltodextrin coated sample (11.37%) followed by 15% maltodextrin coated sample (10.55%). The percentage titratable acid varied from 0.18-2.11%. The titratable acid was highly significantly difference among the treatments. The maximum titratable acid was found in 5% maltodextrin coated sample (1.19%) followed by control sample (0.93%) (Table 1) after 6 months. Similarly, ascorbic acid value was significantly different among the treatments. It was observed that an increase in the freezing time resultant in a significant reduction ($p < 0.05$) of ascorbic acid retention in freeze dried jackfruit chips with the same pressure. The decrease in ascorbic acid in frozen jackfruit slices might be the influence of heat during the blanching step as well as the reaction of metallic constituents (Kamal *et al.*, 2019). The highest ash was observed in control treatment (1.96%) followed by all 3 samples of maltodextrin coated sample (0.98%), (1.08%), (0.98%) (Table 2), respectively. In case of percentage fat, there were highly significant differences among the treatments. Initially, the range of fat content was (0.32 - 7.09%) where the maximum was observed in control treatment (7.09%) followed by 15% maltodextrin coated

sample (3.50%) (Table 3). In case of starch content, all treatments were highly significant differences during 6 months of storage (Table 3).

Conclusion

It can be concluded that 10% maltodextrin coated sample exhibited better quality in terms of physical appearance and nutritional quality during 6 months of storage in metalex foil packet. Improper freeze-drying of jackfruit chips the product may lose its crispiness or may hard where sweetness increases in the product.

Table 1. Effect of freeze-dried jackfruit chips on (%) moisture and (%) titratable acidity during 6 months of storage

Treatment	Moisture (%)				Titratable acidity (%)			
	Initial	Month 2	Month 4	Month 6	Initial	Month 2	Month 4	Month 6
T ₁	6.52±0.01 a	14.39±0.24a	9.85±0.58b	8.94±0.11c	1.02±0.01 a	2.11±0.03a	1.42±0.52a	0.93±0.11b
T ₂	6.61±0.15 a	12.27±0.47b	13.58±0.80a	7.59±0.16d	0.64±0.02 c	0.31±0.01c	0.31±0.02b	1.19±0.08a
T ₃	5.37±0.12 b	11.21±0.19c	9.51±0.62b	11.37±0.80a	0.89±0.01 b	0.29±0.02c	0.30±0.02b	0.61±0.06c
T ₄	5.45±0.05 b	10.64±0.07c	6.78±0.67c	10.55±0.30b	1.02±0.03 a	0.36±0.01b	0.41±0.03b	0.57±0.01c
T ₅	5.14±0.06 b	13.74±0.97a	7.06±0.70c	7.37±0.33d	0.49±0.02 d	0.18±0.01d	0.45±0.05b	0.31±0.02d

Values are Mean ± SD (n=3); Means followed by different lowercase letters in each differed significantly (P<0.05) among the treatments. Note: T₁=Control; T₂=5% maltodextrin; T₃= 10% maltodextrin; T₄= 15% maltodextrin; and T₅= 40% sugar.

Table 2. Effect of freeze-dried jackfruit chips on (mg/100g) ascorbic acid and (%) ash during 6 months of storage

Treatment	Ascorbic acid (mg/100g)				Ash (%)			
	Initial	Month 2	Month 4	Month 6	Initial	Month 2	Month 4	Month 6
T ₁	8.06±0.01a	6.01±0.11b	5.39±0.33b	5.76±0.51a	2.63±0.02 a	1.46±0.12a	2.10±0.041a	1.96±0.07a
T ₂	6.95±0.02b	5.81±0.16b	5.68±0.14b	5.70±0.09a	1.22±0.07 c	1.35±0.05ab	2.57±0.10a	0.98±0.02b
T ₃	6.15±0.02b	5.23±0.29c	5.58±0.18b	5.69±0.31a	1.43±0.03 b	1.62±0.26a	1.79±0.09b	1.08±0.11b
T ₄	8.95±0.08a	6.65±0.10a	6.61±0.16a	5.92±0.11a	0.86±0.04 d	1.14±0.15bc	1.21±0.15c	0.98±0.05b
T ₅	5.51±0.03c	5.02±0.17c	4.57±0.06c	5.06±0.16b	0.80±0.01 d	0.91±0.02c	0.88±0.04d	0.67±0.04c

Values are Mean ± SD (n=3); Means followed by different lowercase letters in each differed significantly (P<0.05) among the treatments. Note: T₁=Control; T₂=5% maltodextrin; T₃= 10% maltodextrin; T₄= 15% maltodextrin; and T₅= 40% sugar.

Table 3. Effect of freeze-dried jackfruit chips on (%) fat and (%) starch during 6 months of storage

Treatment	Fat (%)				Starch (%)			
	Initial	Month 2	Month 4	Month 6	Initial	Month 2	Month 4	Month 6
T ₁	7.09±0.01 a	2.12±0.11a	1.78±0.12b	2.37±0.32a	12.25±0.11a	11.80±0.07a	10.97±0.28a	10.49±0.38a
T ₂	0.60±0.03 c	1.90±0.02b	1.66±0.06b	1.85±0.08b	11.56±0.03b	10.37±0.36b	9.71±0.43b	9.52±0.53b
T ₃	0.51±0.01 d	1.71±0.20b	1.78±0.03b	1.76±0.05b	11.23±0.07b	10.16±0.17b	10.53±0.45a	9.35±0.19b
T ₄	3.50±0.07 b	1.77±0.04b	1.71±0.03b	1.89±0.04b	11.05±0.08b	10.23±0.40b	9.14±0.05b	9.93±0.07ab
T ₅	0.32±0.01 e	0.98±0.04c	1.94±0.06a	1.72±0.05b	9.08±0.08c	7.08±0.28c	7.64±0.18c	8.18±0.06c

Values are Mean ± SD (n=3); Means followed by different lowercase letters in each differed significantly (P<0.05) among the treatments. Note: T₁=Control; T₂=5% maltodextrin; T₃= 10% maltodextrin; T₄= 15% maltodextrin; and T₅= 40% sugar.

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EFFICACY OF CLOVE ESSENTIAL OIL AND CARNAUBA WAX IN EXTENDING SHELF LIFE OF MANGO

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Abstract

The current experiment examined the effects of clove essential oil and carnauba wax coating for controlling stem end rot and anthracnose caused by *Botryodiplodia theobromae* and *Colletotrichum gloeosporioides*, respectively of mango to extend shelf life. Clove essential oil at 1 mL⁻¹ premixed with ethanol (1 mL L⁻¹) as stabilizer and Triton-X100 (40 mg L⁻¹) as surfactant in combination with carnauba wax has shown potential inhibition of the fungi with shelf life extension of mango. This experiment needs more trials for confrontation.

Introduction

Mango (*Mangifera indica* L.) is one of the most important fruits and termed as the “King of fruits” in Bangladesh. It possesses superior eating characteristics while consumed in fresh and ripe. It contains different phytochemicals and nutrients such as vitamin C, provitamin A, carotenoids, various polyphenols and dietary fibers. Recently in Bangladesh many entrepreneurs started to export mangoes in developed countries meeting the national demands but significant quantities are spoiled due to poor postharvest handling practices as well as microbial activities during storage and transit. Stem end rot and anthracnose caused by *Botryodiplodia theobromae* and *Colletotrichum gloeosporioides*, respectively have been reported to be the major postharvest fungal diseases causing substantial losses. Chemical fungicides are used for control despite health and environmental concerns. The constant use of synthetic fungicides also leads to development of resistant to the fungicides (Eckert et al., 1994). These have led to interest in finding natural plant compounds that have antifungal activity. The exploitation of natural products such as essential oils (EO) to control decay and prolong storage life of fruits has received attention (Tripathi and Dubey, 2004). Plant EOs are mostly terpenoids derived from units of isoprene (2-methyl-1,3-butadiene) with further structural diversification achieved through the inclusion of heteroatom functional groups such as alcohols, aldehydes, ketones, esters, and ethers (Bakkali et al., 2008). These essential oils are thought to play a role in plant defence mechanisms against phytopathogenic microorganisms. However, the *in vivo* efficacy and practical applicability of only few of the essential oils have been studied (Rahman et al., 2022). Respiration and transpiration are the major factors contributing to the postharvest deterioration in fruits. Mangoes have about 70 per cent water which is lost to its surroundings due to water pressure deficit. Coating fruits with wax compensates for the lost natural wax. And provides a barrier to water and gas diffusion by reducing the number and/or the size of lenticels. This leads to water saturation inside the fruit, reducing oxygen diffusion and carbon dioxide leaving the fruit, thereby slowing down transpiration water loss and respiration. Carnauba wax is a natural wax derived from the leaves of the carnauba palm, a Brazilian plant. It can be used to coat mangoes to slow down their water loss and respiration, and prolong their shelf-life (<https://smartfarmerkenya.com/about-smartfarmer/>). Keeping all these information into consideration, the present investigation was proposed to investigate the essential oils of clove (*Syzygium aromaticum*) as botanical fungicides and carnauba wax in the management of stem end rot and anthracnose, and shelf life of mango fruits.

Materials and Methods

Plant Materials

BARI Aam-3 (Amrapali) was collected from farmers’ orchard in Naogaon District and transported to the laboratory of Postharvest Technology Division (PHTD), BARI. No fruits had been treated with a fungicide after harvest. For all experiment, the required number of fruits were sanitized with calcinated calcium (1gmL⁻¹) and air dried for about 60 min. Each batch of fruit was then randomly distributed into the required number of treatment units with 30 fruit per unit with three units/replicates assigned to each treatment. Each replicate was prepared and treated separately.

Laboratory Extraction of EO and Chemicals: Clove essential oil was extracted in the laboratory of PHTD using steam-distillation apparatus. Firstly required amount of clove was ground. Then, the ground clove powder mixed with distilled water was placed in the distillation set. After distillation the clove oil was separated and collected using separating funnel. The extracted EO were stored in dark colored bottle at -20 °C until required. Ethanol (Absolute GR, Merck), TritonX-100 and Calcinated calcium (EcoWash[®]) was collected from Pioneer Scientific store, Dhaka. Carnauba coating (Endura Fresh [®]TM 9000) was collected from USA. Carbendazim fungicide was purchased from local market.

Fruit Treatment

Surface sterilized fruits were arranged in rotating wax coating machine. Clove EO 1 mL L⁻¹ premix with ethanol (1 mL L⁻¹) as stabilizer and Triton-X100 (40 mg L⁻¹) as surfactant was applied by hand spraying on

the rotating fruits and at the same time Carnauba wax coating (Recommended dose) was also sprayed after the spraying of EO. Then, the treated fruits were placed in the plastic foam packaging cup liner covered with HDPE packets and kept in 24 °C.

Results and Discussions

Clove EO extracted in the laboratory by steam-distillation method yielded approximately 5% oil. According to Ratri et al. (2020) eugenol (85%), caryophyllene (1.14%) and humulene (0.18%) are the main compounds in clove oil. The mango treated with the combination of clove EO and carnauba was found to have highest shelf life as rotting occurred only 7 and 43 percent after storage of 7 and 14 days followed by treating only with the clove EO (Table 1). The Table 1 also shows that chemical fungicide treated mango has highest rotting percentage throughout the storage periods indicating its resistance to the fungicide (Carbendazim). The EOs treated mango also shows a better firmness and comparatively low TSS indicating its slow sugar conversion (Table 2).

Conclusions

This study implies that clove EO in combination with carnauba coating has potential to extend the shelf life of mango. However, this is a first year trial and some more treatments will be added to the current treatments in the next year. To identify the exact causal component of clove EO for inhibiting stem end rot and anthracnose of mango the *in vitro* test also will be included and need to be performed.

Table 1. Rotting of mango following different postharvest treatments during storage at 24 °C

Treatments	Percent rotting	
	7 days	14 days
Control	47	100
Fungicide treated	67	100
Clove EO + Carnauba wax	7	43
Clove Essential Oil only	20	73
Hot Water Treatment	37	100
<i>LSD</i> [‡]	2.1	1.1

Values are the mean of 3 units of 30 fruits 3 (1 batch x 3 replicates). [‡] Least significant difference between mean values in each column at $p = 0.05$.

Table 2. Firmness & TSS of mango following different postharvest treatments during storage at 24 °C

Treatments	Firmness (kgf)			TSS		
	Initial	7 days	14 days	Initial	7 days	14 days
Control		10.1	0		21.0	0
Fungicide treated		12.0	0		21.4	0
Clove EO + Carnauba wax	13.8	12.1	9.0	15.4	20.7	21.1
Clove Essential Oil only		11.7	8.8		20.9	21.3
Hot Water Treatment		11.3	0		22.3	0

Values are the mean of 5 units of 5 fruits.

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Additional works performed by the division (2022-2023)

SL No.	Date	Name of Institute/ Person	Name of Sample	No. of Sample	No. of Parameter
01.	07.07.2022	HRC, BARI, Gazipur	Jackfruit	02	06
02.	15.07.2022	Entomology Division, BARI	Mango	11	08
03.	27.07.2022	HRC, BARI, Gazipur	Jackfruit	03	06
04.	12.08.2022	BIRTAN, Dhaka	Groundnut	12	06
05.	12.08.2022	BIRTAN, Dhaka	Capsicum	06	06
06.	17.08.2022	HRC, BARI, Gazipur	Burmese Grape	01	09
07.	02.10.2022	RARS, Hathajari, Chotogram	Malta	01	07
08.	04.12.2022	RARS, Hathajari, Chotogram	Coffee Seed	06	06
09.	02.01.2023	HRC, BARI, Gazipur	Jackfruit	01	12
10.	30.03.2023	HRC, BARI, Gazipur	Tomato	23	06
11.	30.03.2023	HRC, BARI, Gazipur	Capsicum	05	06
12.	04.04.2023	SSD, BARI, Gazipur	Sweet Gourd	03	03
13.	09.04.2023	TCRC, BARI, Gazipur	Potato	40	07
14.	09.04.2023	BSPC, Panchagar	Jabutikaba	01	05
15.	08.05.2023	OFRD, Sylhet, BARI	Mint	04	07
16.	09.05.2023	SSD, BARI, Gazipur	Onion	18	01
17.	09.05.2023	Md. Faruque Hossain, SSO, RARS, Iswardi, Pabna	Carrot	120	03
18.	28.05.2023	TCRC, BARI, Gazipur	Yam	05	02
19.	21.06.2023	BAU, Mymensingh	Green Chili	27	04
Total number of sample analyzed				289	



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