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RESEARCH PAPER

Effect of Different Packaging Material and Storage Duration on Quality of Dried Cashew Apple Flour Muffins

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ABSTRACT

This study was conducted to effect of different packaging material and storage duration on dried cashew apple flour muffins. Muffins were prepared using from dried cashew apple flour, baked at a temperature 180°C and baking time is 20 minutes muffins can be stored up to 8 days. For storage duration Polyethylene terephthalate (PET), and Paperboard box packaging material are used. In comparison to the different packaging materials, it was observed that PET box followed by best packaging material during the 8th days of storage studies. As the storage duration increases, the moisture content% and carbohydrate content% continues to increase and fat, protein, ash, fiber content% was decreased. Also results shows, effect of different packaging material and storage duration on various sensory attributes. It was observed that as the storage duration increases the sensory score for colour, flavour, taste, texture and overall acceptability goes on decreasing.

Keywords: Cashew apple powder, Muffins, Shelf-life, Packaging material, Sensory attributes

Cashew apple is in a *Anacardiaceae* family, (*Anacardium occidentale* L.) species, which plentifully found in the tropical regions due to the humidity and warm. The cashew apple can be abundantly found in the southern part of Africa. It is native to Brazil and is now being grown extensively in India, East Africa, Vietnam and West Africa among which Nigeria is included (Adegunwa *et al.* 2020). Since a cashew apple is tender and juicy with a sour taste, it is normally used as a food ingredient (Preethi *et al.* 2021). Through the cashew apple is very juicy, sweet, spongy somewhat fibrous having a unique smell with thin waxy skin is not consumed fresh owing to its astringency and acrid principles. Cashew apple can be utilized for value added products such as juice, syrup, canned fruits, pickles, jam, chutney, candy, etc (Salvi *et al.* 2016).

Muffins are wheat-based bakery product, sweet in taste, calorie dense and usually consumed throughout the day due to its soft texture and characteristic taste. But muffins are perishable in nature due to high moisture and having short shelf life (Giri *et al.* 2024). Muffin is a popular bakery product relished by all age groups. Fungi, yeasts, and bacteria are the main causes for the spoilage in bakery products. They cause

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a substantial economic loss in bakery industry, which might also cause public health problems due to the production of toxins (Earle and Putt, 1984). There is a need to develop safe and efficient strategies to reduce mould growth in bakery products (Ryan *et al.* 2011).

Eggs serve many functions in baked goods. They add flavour and colour, contribute to structure, incorporate air when beaten, provide liquid, fat, and protein, and emulsify fat with liquid ingredients (Ramya and Anitha, 2020). Muffin composition is a fat in water emulsion obtained from an egg-sugar-water-fat mixture as a continuous phase, and air bubbles represent a discontinuous phase where the flour is dispersed. Muffins are generally associated with a high porous spongy texture. Traditionally, a muffin recipe is composed of wheat flour, vegetable oil, eggs and milk. For this reason, many people with celiac disease are unable to consume this type of product since they are made with wheat flour. The demand for low gluten and gluten-free products is increasing because it is well known that celiac disease is a common lifelong disorder, affecting 1% of the world's population (Croitoru *et al.* 2018).

Development of muffins from dried cashew apple flour, it may be important potential cashew apple products in India. For longer shelf-life and powder quality, moisture content is the most important factor as far as storage stability is concerned. Dried powder will be free from bacterial growth. The visual colour is the major quality criterion for determining the commercial quality with respect to consumer's preferences and cost of the powder. Packaging and storage condition are the most important quality control factors of muffins preservation. Good packaging and storage condition extend the storage duration of muffins.

The present study was thus undertaken with the objective of quality and shelf-life of dried cashew apple flour supplemented muffins stored under different set of conditions.

MATERIALS AND METHODS

Materials

Cashew apple required for experimentation was collected from the Vengurla, Tal. Vengurla, Dist. Sindhudurg. The cashew apple was cleaned, washed with water and the damaged, infected apples were removed before beginning of experiments. The cashew apple slices of 'Vengurla-4' variety having 5 mm thickness, were dried in the convective hot air dryer at 50° up to 210 min. were grounded by using hammer mill (Make: M/S. Sagar Engineering Works Pvt. Ltd, Kudal) and pass through the 0.150 mm sieve to obtain dried cashew apple powder. The experimental work was carried out in Department of Post harvest Engineering of Post Graduate Institute of Post Harvest Technology and Management, Killa Roha.

Methods

1. Muffins Making

Fig 1. Shows the process technology for preparation of muffins from dried cashew apple flour. The 24% of butter and 0.76 % eggs were mixed together. Mixed well up to foam formation, which was defected through visual observation. The mixture was added with the dried cashew apple flour (15 %), Dried cashew apple flour of best treatment C3(15 %) and refined wheat flour of level (85 %) were used as per treatment combination to make flour composition, refined wheat flour (30 %), baking powder (0.7 %), powdered sugar (24 %) and milk powder (7 %). Was added according to the treatment, and it was added according to the treatment, and it was added into the earlier batter mass and the mixture was thoroughly mixed to a homogeneous mixture to form a dough. The dough poured into mould with butter paper for giving shape to the muffins. The muffins were placed in baking tray and baked in oven at about 180° for 20 min. depending upon the temperature condition. The flour combination concentration C3 at baking temperature is 180° are present in Fig. 2 shows the muffins prepared from best concentration/treatment (C1T1).

Fig. 1 Shows the process flow chart for preparation of muffins from cashew apple flour.

Mix butter (24%) and egg (0.71%)

↓

Addition of dried cashew apple flour (15%) + Refined wheat flour

↓

Addition of baking powder (0.7%) and milk powder (7%)

↓

Mixed well

↓

Addition of powdered sugar (24%)

↓

Mix mixture properly

↓

Baking (180 for 20 min.)

↓

Allow to cool at room temperature

↓

Packaging

Fig. 1: Process flow chart for preparation of muffins from dried cashew apple flour

(a) Polyethylene terephthalate

(b) Paperboard box

Fig. 2: Packaging material used for storage and packaging of muffins

Storage studies

The muffins from cashew apple flour packed in P1= Polyethylene terephthalate and P2 = Paperboard boxes samples were subjected to storage studies at ambient temperature (30±1°). The sample stored at ambient temperature were analysed 0,2,4,6 and 8 days for physico-chemical properties Moisture (%), Protein (%), Fat (%), Fiber (%), Ash (%), Carbohydrate (%), Browning index and sensory qualities like colour, flavour, texture, taste and overall acceptability.

Evaluation of Quality Parameter for development of muffins from dried cashew apple flour

1. Moisture content (%)

Initial moisture content of the sample dried cashew apple flour muffin packed in polyethylene terephthalate and paperboard boxes at 0,2,4,6 and 8 days storage duration were determined by AOAC (2010). 5 g of muffin sample taken into the moisture box with lid. The initial weight of moisture box was recorded. The sample were exposed to 105°C ±1°C for 24 hr in a hot air oven (Make M/s: Aditi Associate, Mumbai. Model: ALO-136). The final weight was recorded. The moisture content of sample was determined by equation (1);

$$\text{Moisture content (\% db.)} = \frac{W2 - W1}{W3 - W1} \times 100 \quad \ldots(1)$$

Where,

W_1 = Weight of moisture box, g

W_2 = Weight of moisture box + sample g

W_3 = Weight of moisture box + oven dried sample g

Table 1: Shows the details of Packaging materials used for storage studies

Sl. No.	Name of Packaging material	Size of packaging material	Thickness of packaging material	Capacity
1	Polyethylene terephthalate	22 × 16 × 7.5 cm	200 (GSM), 0.2 mm	6 Pieces
2	Paperboard box	21.5 × 15 × 9 cm	300 (GSM)	6 Pieces

2. Fat content (%)

Fat content of muffin sample prepared by dried cashew apple flour muffin packed in polyethylene terephthalate and paperboard boxes at 0,2,4,6 and 8 days storage duration were determined using Soxhlet fat extraction system (AOAC, 2010). In this method, initially weight of empty flask was weighted. 2 g of muffin sample was wrapped in filter paper and was kept in siphoning tube and condenser fix above it and siphoned for 9 to 12 times with the petroleum ether was allowed by heating round bottom flask. Residue reminder at the bottom of the flask and was reweighted with flask. The quantity of residue was determined as fat content of muffin. Fat content was calculated by using equation (2);

$$\% \text{ Fat} = \frac{\text{Final weight (g)} - \text{Initial weight (g)}}{\text{Weight of sample (g)}} \times 100 \quad \ldots(2)$$

Where,

W_1 = Weight of oven dried thimble,

W_2 = Weight of sample used,

W_3 = Weight of round bottom flask,

3. Ash content

The ash content of muffin sample prepared by dried cashew apple flour muffin packed in polyethylene terephthalate and paperboard boxes at 0,2,4,6 and 8 days storage duration were calculated using muffle furnace. 5 gram of muffin sample was taken in crucible. Weight of crucible and sample was recorded and kept in muffle furnace at 525 °C for 4-5 hrs till constant weight was achieved. The crucible was cooled in desiccators and final weight of ash and crucible was recorded. Ash content was calculated by using equation (3);

$$\text{Ash content \%} = \frac{(W2 - W1)}{(\text{Weight of sample})} \times 100 \quad \ldots(3)$$

Where,

W_2 = Weight of crucible + ash,

W_1 = Weight of empty crucible

4. Protein content

Protein content of muffin sample prepared by dried cashew apple flour muffin packed in polyethylene terephthalate and paperboard boxes at 0,2,4,6 and 8 days storage duration were determined by a micro-Kjeldahl distillation method (AOAC, 1990). The sample were digested by heating with concentrated sulphuric acid (H_2SO_4) in the presence of digestion mixture, potassium sulphate (K_2SO_4) and copper sulphate ($CUSO_4$). The mixture was made alkaline with 40% NaOH. Ammonium sulphate thus formed. Released ammonia which collected in 4% boric acid solution and titrated again with standard HCL. The percent nitrogen content of the sample was calculated by the formula given below. Protein content was calculated by using equation (4);

$$\% \text{ (N)} = 1.4 \times (\text{ml HCL} - \text{ml blank}) \times \text{Conc. of } \frac{HCL}{Weight} \text{ of sample (g)} \quad \ldots(4)$$

$$\% \text{ Protein} = \% \text{ N} \times \text{Factor (6.25).} \quad \ldots(5)$$

5. Fiber content (%)

Fiber content of muffin sample prepared by dried cashew apple flour muffin packed in polyethylene terephthalate and paperboard boxes at 0,2,4,6 and 8 days storage duration were determined using about 2-5 g of moisture and fat free sample was weighted into a 500 ml beaker and a 200 ml of boiling 0.25 N sulphuric acid was added to the mixture and boiled for 30 min keeping the volume constant by addition of water at frequent intervals. The mixture was filtered through a muslin cloth and then transferred to the same beaker and 200 ml of boiling 0.31 N (1.25 %) NaOH was added. After boiling for 30 min, the mixture was filtered through muslin cloth. The residue was washed with hot water till it is free alkali, followed by washing with alcohol and ether. It was then transferred to crucible, dried overnight at 80° to 100° and weighted. The crucible was heated in muffle furnace at 525° for 2-3 hrs, cooled and weighted again. Fiber content was calculated by using equation (5);

$$\text{Crude Fiber}\left(\frac{g}{100g}\right) = \frac{100 - (\text{Moisture} + \text{Fat}) \times \frac{\text{Weight of Fiber weight}}{\text{Weight of sample taken}}}{(\text{Moisture} + \text{Fat free sample})} \times 100 \quad \ldots(6)$$

6. Carbohydrate content (%)

The carbohydrate content of muffin sample prepared by dried cashew apple flour muffin packed in polyethylene terephthalate and paperboard boxes at 0,2,4,6 and 8 days storage duration were calculated from protein, fat, fiber, ash and moisture content (Adegunwa *et al.* 2012).

$$\text{Carbohydrate} = 100 - (\text{Protein} + \text{fat} + \text{fiber} + \text{ash} + \text{moisture}) \quad \ldots(7)$$

7. Colour

The muffins were used to measure the colour value using a colorimeter (M/s Konika Minolta, Japan Model- Meter CR -400). The equipment was calibrated against standard white tile. Muffin were taken in the petri dish, the petri dish was placed at the aperture of the instrument. The colour was recorded in term '*L*' value lightness (100) to darkness (0); *a* = redness (+60) to Greenness (-60); *b* = yellowness (+60) to blueness (-60). The browning index of the muffins determined from the *L*, *a*, and *b* values as per the equation (7) reported by (Perez *et al.* 2006). The brown index (*BI*) was determined using following equation.

$$BI = \frac{[100(x - 0.31)]}{0.171} \quad \ldots(8)$$

Where,

$$X = \frac{(a* + 1.75L*)}{5.645L* + a* - 3.012b}$$

Where,

L = lightness (100) to darkness (0)

a = redness (+60) to Greenness (-60)

b = yellowness (+60) to blueness (-60)

Sensory Evaluation

Sensory evaluation of dried cashew apple flour muffins baked at 180°C temperature for 25 min. baking time and stored in different packaging materials for 8 days of storage duration with the interval of 0, 2, 4, 6 and 8 days from storage day was conducted.

RESULTS AND DISCUSSION

Effect of different packaging material and storage duration on moisture content (%) of dried cashew apple flour muffins during 8 days storage duration

Fig. 3 Shows the effect of packaging material and storage duration (0, 2, 4, 6, 8) and on Moisture content (%) of muffins from dried cashew apple flour. The moisture (%) of muffins prepared from dried cashew apple flour and which was packed in PET boxes increase from 8.349**±0.03** to 11.191±0.11 % for 0 to 8 days of storage period and for paperboard box moisture content (%) increases from 8.349±0.07 to 11.094±0.03 % for 0 to 8 days of storage period respectively. And muffins which was control sample increase from 11.959**±0.17** to 14.393±0.02 %. From Fig. 3 it is clear that as storage period increases, the moisture (%) of muffin prepared from dried cashew apple flour packed in PET transparent boxes and paperboard boxes increases.

Table 2 Shows the ANOVA for the effect of packaging material and storage duration on moisture content (%) of muffins prepared from dried cashew apple flour w.r.t packaging material, storage duration and their interaction. From Table 2 muffins prepared from dried cashew apple flour at p≤ 0.05 and storage duration had significant influence on moisture (%) of muffins prepared from dried cashew apple flour at p≤ 0.05. The interaction of packaging material and storage duration showed the non-significant influence on moisture content of muffins prepared from dried cashew apple flour significant at p ≤ 0.05. During the storage duration microbial growth in the product occurs that improves the moisture absorption. Migration of moisture from surrounding to the muffins occurs. Also, due to change in relative

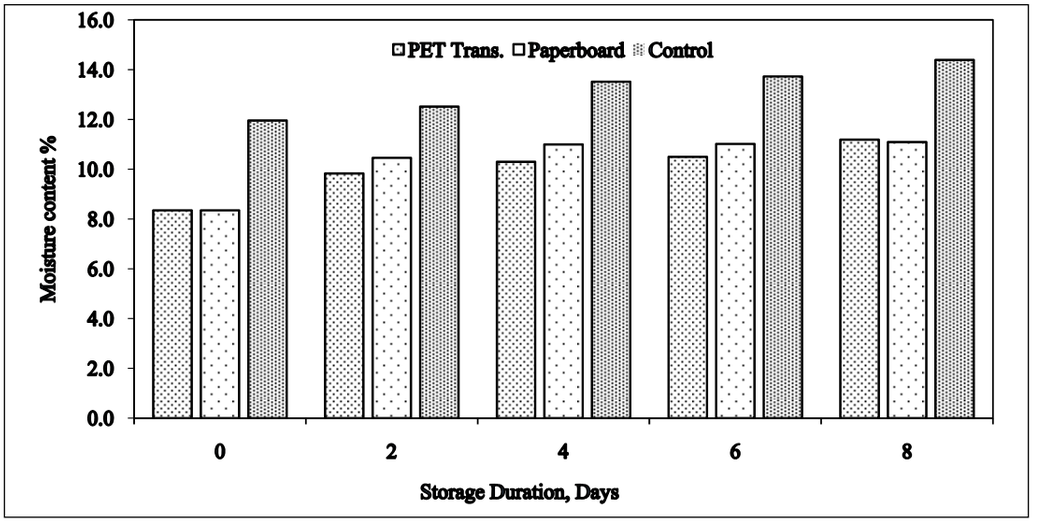

Fig. 2: Effect of various Packaging materials (PET=Polyethylene terephthalate; Paperboard box; C=Paper bag) on moisture content % of dried cashew apple flour muffins during eight days storage duration

Table 2: Effect of different packaging material (PET=Polyethylene terephthalate; Paperboard box; C=Paper bag) and storage duration (0, 2, 4, 6 and 8 Days) on moisture content (%) of stored dried cashew flour muffins, during 8 days of storage duration

Packaging Material (A)	**Storage Duration (Days) (B)**					
	Moisture Content (%)					
	0	**2**	**4**	**6**	**8**	**Mean A**
PET Trans.	8.349±0.03	9.830±0.02	10.300±0.04	10.502±0.07	11.191±0.11	10.034
Paperboard Box	8.349±0.07	10.458±0.03	10.998±0.05	11.020±0.04	11.094±0.03	10.383
Control	11.959±0.17	12.520±0.13	13.520±0.03	13.730±0.01	14.393±0.02	13.224
Mean B	9.552	10.936	11.606	11.750	12.226	
Factors		**C.D.**			**SE(m)**	
Factor (A)		0.021			0.007	
Factor (B)		0.026			0.009	
Factor (A × B)		0.045			0.015	

humidity can improve the moisture absorption. The water vapour permeability of the packaging material also plays an important role in moisture migration from the surrounding to the packed products.

Similarly, Bulut and Ertas 2024 reported that the muffins prepare from sugar, butter and refined wheat i.e. product increases moisture content from 25.85 to 31.55% during 7 days storage period. Karim *et al.* 2012 reported that the cake prepared from potato – carrot flour moisture content increase from 24.43 to 27.69% during 7 days storage period.

Similarly, Singh *et al.* 2019 reported that the muffins prepared from watermelon seeds, sunflower seeds and sesame seeds i.e. product increases moisture content from to 29.5 to 40.0 % during 7 days storage period. According to Tiimub, (2013) reported that the muffins prepare from sugar, butter and wheat i.e. product increases moisture content during 10 days storage period.

Effect of different packaging material and storage duration on fat content (%) of dried cashew apple flour muffins during 8 days storage duration

Fig. 3 Shows the effect of packaging material and storage duration (0, 2, 4, 6, 8) and on Fat content (%) of muffins from dried cashew apple flour. The fat (%) of muffins prepared from dried cashew apple flour and which was packed in PET boxes decrease from 11.51±0.28 to 8.94±0.19%. for 0 to 8 days of storage period and for Paperboard box fat content (%) decreases from 11.51±0.16 to 7.96±0.67 % for 0 to 8 days of storage period respectively. And muffins which was control sample decrease from 11.52±0.17 to 8.84±0.13%. From Fig. 3 it is clear that as storage period increases, the fat (%) of muffin prepared from dried cashew apple flour packed in PET transparent boxes and paperboard boxes decreases.

Table 3 Shows the ANOVA for the effect of packaging material and storage duration on fat content (%) of muffins prepared from dried cashew apple flour w.r.t packaging material, storage duration and their interaction. From Table 3 muffins prepared from dried cashew apple flour at p≤ 0.05 and storage duration had significant influence on fat (%) of muffins prepared from dried cashew apple flour at p≤ 0.05. The interaction of packaging material and storage duration showed the non-significant influence on fat content of muffins prepared from dried cashew apple flour significant at p ≤ 0.05.

According to Tiimub, (2013) reported that the muffins prepare from sugar, butter and wheat i.e. product decreases fat content during 10 days storage period. Similarly, Singh *et al.* 2019 reported that the muffins prepared from watermelon seeds, sunflower seeds and sesame seeds i.e. product decreases fat content from 5.8 to 5.2% during 7 days storage period.

Similar result observed that the muffins prepared from combination of different levels of erythritol and orange peel powder i.e. product decreases fat content from 6.10 to 6.5 % during 15 days storage period (Bhise *et al.* 2020). Similarly, Bulut and Ertas 2024 reported that the muffins prepare from sugar, butter and refined wheat i.e. product decreases fat content from 4.07 to 3.56 % during 7 days storage period.

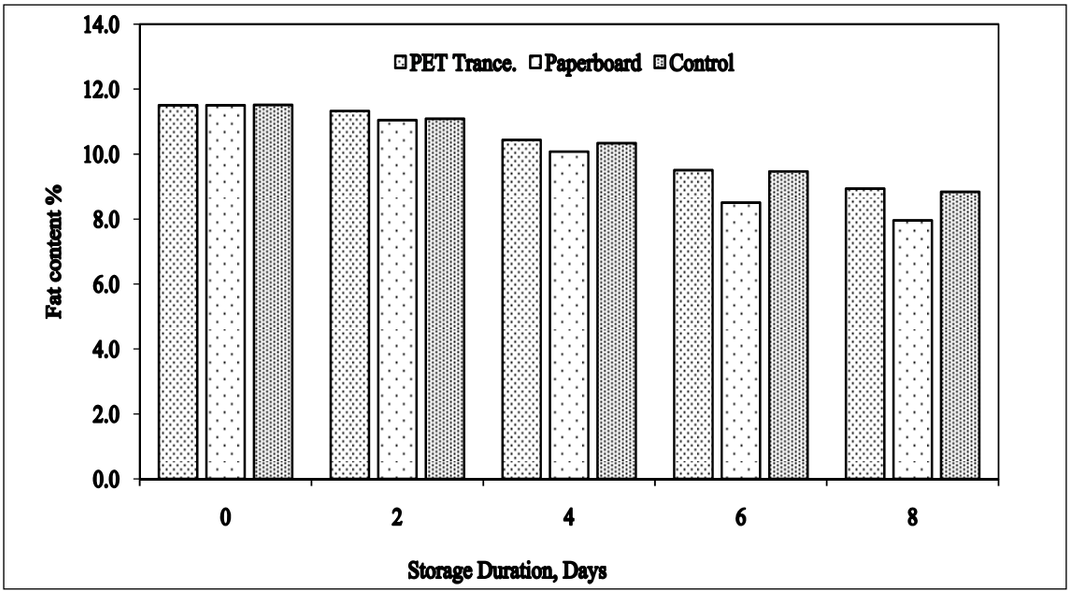

Fig. 3: Effect of various Packaging materials (PET=Polyethylene terephthalate; Paperboard box; C=Paper bag) on fat % content of dried cashew apple flour muffins during eight days storage duration

Table 3: Effect of different packaging material (PET=Polyethylene terephthalate; Paperboard box; C=Paper bag) and storage duration (0, 2, 4, 6 and 8 Days) on fat content (%) of stored dried cashew flour muffins, during 8 days of storage duration

Packaging Material (A)	Storage Duration (Days) (B)					
	Fat Content (%)					
	0	2	4	6	8	Mean A
PET Trans.	11.51±0.28	11.33±0.19	10.44±0.13	9.51±0.34	8.94±0.19	10.346
Paperboard Box	11.51±0.16	11.05±0.25	10.08±0.18	8.51±0.19	7.96±0.67	9.822
Control	11.52±0.17	11.09±0.13	10.34±0.19	9.47±0.18	8.84±0.13	10.25
Mean B	11.51	11.15	10.28	9.16		
Factors		**C.D.**			**SE(m)**	
Factor (A)		0.024			0.008	
Factor (B)		0.029			0.010	
Factor (A × B)		0.050			0.017	

Effect of different packaging material and storage duration on protein content (%) of dried cashew apple flour muffins during 8 days storage duration.

Fig. 4 Shows the effect of packaging material and storage duration (0, 2, 4, 6, 8) and on Protein content (%) of muffins from dried cashew apple flour. The protein (%) of muffins prepared from dried cashew apple flour and which was packed in PET boxes decrease from 4.78±0.10 to 3.90±0.10 % for 0 to 8 days of storage period and for Paperboard box protein content (%) decreases from 4.78±0.03 to 3.66±0.09 % for 0 to 8 days of storage period respectively. And muffins which was control sample decrease from 4.57±0.14 to 3.59±0.10 %. From Fig. 4 it is clear that as storage period increases, the protein (%) of muffin prepared from dried cashew apple flour packed in PET transparent boxes and paperboard boxes decreases.

Table 4 Shows the ANOVA for the effect of packaging material and storage duration on protein content (%) of muffins prepared from dried cashew apple flour w.r.t packaging material, storage duration and their interaction. From Table 4 muffins prepared from dried cashew apple flour at $p \leq 0.05$ and storage duration had significant influence on protein (%) of muffins prepared from dried cashew apple flour at $p \leq 0.05$. The interaction of packaging material and storage duration showed the non-significant influence on protein content of muffins prepared from dried cashew apple flour significant at $p \leq 0.05$.

According to Tiimub, (2013) reported that the muffins prepare from sugar, butter and wheat i.e. product decreases protein content during 10 days storage period. Similar result observed that the muffins prepared from combination of different levels of erythritol and orange peel powder i.e. product decreases protein content from 8.41 to 8.36% during 15 days storage period (Bhise *et al.* 2020).

Shih, (2020) reported that the muffins were packed into transparent PET boxes i.e. product decreases protein content during 8 days storage period. Similarly, Kurek *et al.* 2017 reported that the muffins were packed into transparent PET boxes the result shows that storage duration increases, the protein content continues to decreases.

Effect of different packaging material and storage duration on Ash content (%) of dried cashew apple flour muffins during 8 days storage duration

Fig. 5 Shows the effect of packaging material and storage duration (0, 2, 4, 6, 8) and on Ash content (%) of muffins from dried cashew apple flour. The ash (%) of muffins prepared from dried cashew apple flour and which was packed in PET boxes decrease from 1.59±0.04 to 1.52±0.13 % for 0 to 8 days of storage period and for Paperboard box ash content

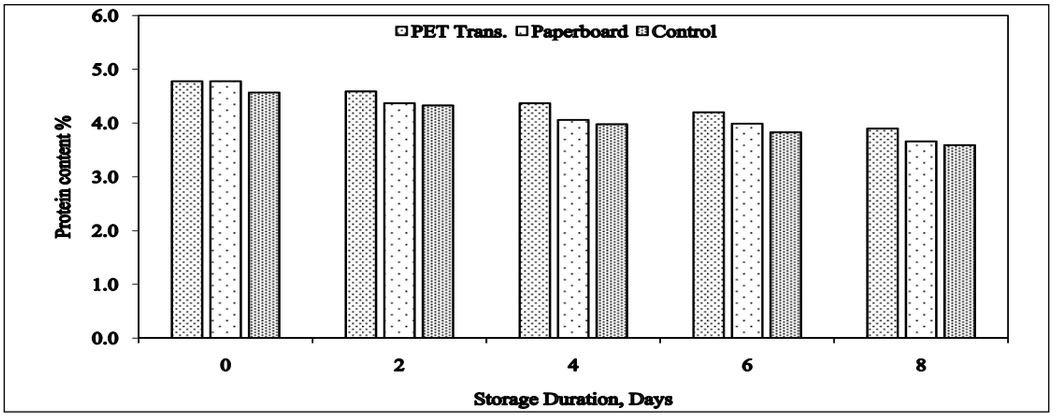

Fig. 4: Effect of various Packaging materials (PET=Polyethylene terephthalate; Paperboard box; C= Paper bag) on protein % content of dried cashew apple flour muffins during eight days storage duration

Table 4: Effect of different packaging material (PET=Polyethylene terephthalate; Paperboard box; C= Paper bag) and storage duration (0, 2, 4, 6 and 8 Days) on protein content (%) of stored dried cashew flour muffins, during 8 days of storage duration

Packaging Material (A)	**Storage Duration (Days) (B)**					
	Protein Content (%)					
	0	**2**	**4**	**6**	**8**	**Mean A**
PET Trans.	4.78±0.10	4.59±0.16	4.37±0.17	4.20±0.17	3.90±0.10	4.368
Paperboard Box	4.78±0.03	4.37±0.04	4.06±0.11	3.99±0.12	3.66±0.09	4.172
Control	4.57±0.14	4.33±0.17	3.98±0.26	3.83±0.17	3.59±0.10	4.06
Mean B	4.71	4.43	4.13	4.00	3.71	
Factors		**C.D.**			**SE(m)**	
Factor (A)		0.015			0.005	
Factor (B)		0.021			0.007	
Factor (A × B)		0.034			0.012	

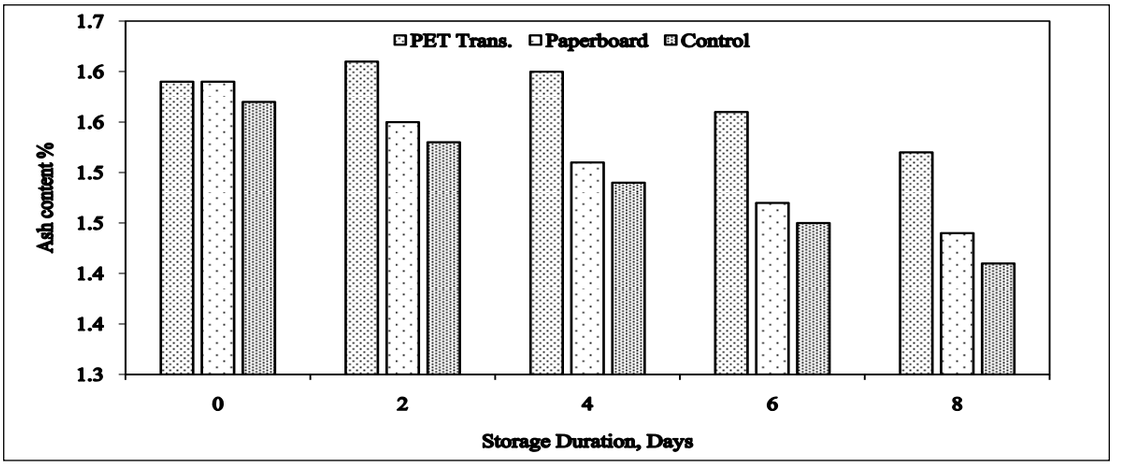

Fig. 5: Effect of various Packaging materials (PET=Polyethylene terephthalate; Paperboard box; C=Paper bag) on ash % content of dried cashew apple flour muffins during eight days storage duration

Table 5: Effect of different packaging material (PET=Polyethylene terephthalate; Paperboard box; C= Paper bag) and storage duration (0, 2, 4, 6 and 8 Days) on ash content (%) of stored dried cashew flour muffins, during 8 days of storage duration

Packaging Material (A)	Storage Duration (Days) (B)					
	Ash Content (%)					
	0	**2**	**4**	**6**	**8**	**Mean A**
PET Trans.	1.59±0.04	1.61±0.05	1.60±0.01	1.56±0.01	1.52±0.13	1.576
Paperboard Box	1.59±0.06	1.55±0.01	1.51±0.10	1.47±0.05	1.44±0.07	1.512
Control	1.57±0.02	1.53±0.15	1.49±0.14	1.45±0.09	1.41±0.01	1.490
Mean B	1.58	1.56	1.53	1.49	1.45	
Factors		**C.D.**			**SE(m)**	
Factor (A)		0.024			0.008	
Factor (B)		0.033			0.011	
Factor (A × B)		0.053			0.018	

(%) decreases from 1.59±0.06 to 1.44±0.07 % for 0 to 8 days of storage period respectively. And muffins which was control sample decrease from 1.57±0.02 to 1.41±0.01%. From Fig. 5 it is clear that as storage period increases, the ash (%) of muffin prepared from dried cashew apple flour packed in PET transparent boxes and paperboard boxes decreases.

Table 5 Shows the ANOVA for the effect of packaging material and storage duration on ash content (%) of muffins prepared from dried cashew apple flour w.r.t packaging material, storage duration and their interaction. From Table 5 muffins prepared from dried cashew apple flour at $p \leq 0.05$ and storage duration had significant influence on ash (%) of muffins prepared from dried cashew apple flour at $p \leq 0.05$. The interaction of packaging material and storage duration showed the non-significant influence on ash content of muffins prepared from dried cashew apple flour significant at $p \leq 0.05$.

Karim *et al.* 2012 reported that the cake prepared from potato – carrot flour ash content decrease from 1.42 to 0.94% during 7 days storage period. Similarly, Bulut and Ertas 2024 reported that the muffins prepare from sugar, butter and refined wheat i.e. product decreases ash content from to 1.55 to 0.40% during 7 days storage period.

Similar result observed that the muffins prepared from combination of different levels of erythritol and orange peel powder i.e. product decreases ash content from 1.30 to 1.17% during 15 days storage period (Bhise *et al.* 2020). Similarly, Singh *et al.* 2019 reported that the muffins prepared from watermelon seeds, sunflower seeds and sesame seeds i.e. product decreases ash content from 1.79 to 1.55 % during 7 days storage period.

In other bakery product i.e. biscuits and cookies it was observed that the ash content decreases from 1.33 to 1.14 % in biscuit by Towseef *et al.* 2013.

Effect of different packaging material and storage duration on Fiber content (%) of dried cashew apple flour muffins during 8 days storage duration

Fig. 6 Shows the effect of packaging material and storage duration (0, 2, 4, 6, 8) and on Fiber content (%) of muffins from dried cashew apple flour. The fiber (%) of muffins prepared from dried cashew apple flour and which was packed in PET boxes decrease from 2.25±0.04 to 1.76±0.02 for 0 to 8 days of storage period and for Paperboard box fiber content (%) decreases from 2.25±0.16 to 1.65±0.06 % for 0 to 8 days of storage period respectively. And muffins which was control sample decrease from 2.23±0.09 to 1.63±0.013%. From Fig. 6 it is clear that as storage period increases, the fiber (%) of muffin prepared from dried cashew apple flour packed in PET transparent boxes and Paperboard boxes decreases.

Table 6 Shows the ANOVA for the effect of packaging material and storage duration on fiber content (%)

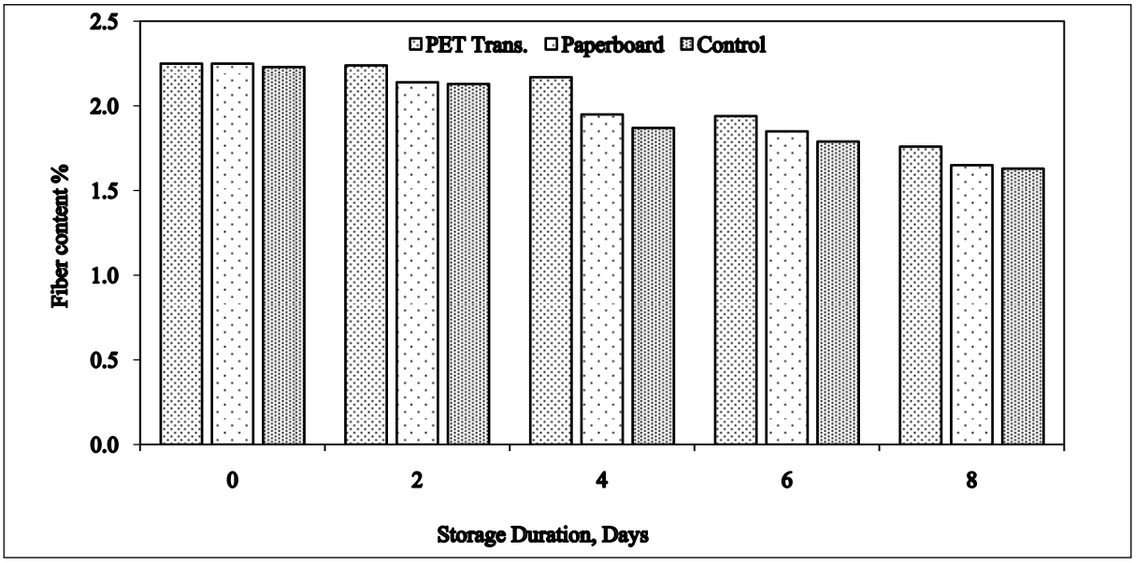

Fig. 6: Effect of various Packaging materials (PET=Polyethylene terephthalate; Paperboard box; C=Paper bag) on fiber % content of dried cashew apple flour muffins during eight days storage duration.

Table 6: Effect of different packaging material (PET=Polyethylene terephthalate; Paperboard box; C=Paper bag) and storage duration (0, 2, 4, 6 and 8 Days) on fiber content (%) of stored dried cashew flour muffins, during 8 days of storage duration

Packaging Material (A)	**Storage Duration (Days) (B)**					
	Fiber Content (%)					
	0	**2**	**4**	**6**	**8**	**Mean A**
PET Trans.	2.25±0.04	2.24±0.06	2.17±0.01	1.94±0.17	1.76±0.02	2.072
Paperboard Box	2.25±0.16	2.14±0.03	1.95±0.07	1.85±0.01	1.65±0.06	1.968
Control	2.23±0.09	2.13±0.16	1.87±0.01	1.79±0.07	1.63±0.013	1.93
Mean B	2.24	2.17	1.99	1.86	1.68	
Factors		**C.D.**			**SE(m)**	
Factor (A)		0.024			0.008	
Factor (B)		0.029			0.010	
Factor (A × B)		0.051			0.017	

of muffins prepared from dried cashew apple flour w.r.t packaging material, storage duration and their interaction. From Table 6 muffins prepared from dried cashew apple flour at $p \leq 0.05$ and storage duration had significant influence on fiber (%) of muffins prepared from dried cashew apple flour at $p \leq 0.05$. The interaction of packaging material and storage duration showed the non-significant influence on fiber content of muffins prepared from dried cashew apple flour significant at $p \leq 0.05$.

Similarly, Singh *et al.* 2019 reported that the muffins prepared from watermelon seeds, sunflower seeds and sesame seeds i.e. product decreases fiber content from 1.40 to 1.23% during 7 days storage period. According to Tiimub, (2013) reported that the muffins prepare from sugar, butter and wheat i.e. product decreases fiber content during 10 days storage period.

Similar result observed that the muffins prepared from combination of different levels of erythritol

and orange peel powder i.e. product decreases fiber content from 1.86 to 1.05% during 15 days storage period (Bhise *et al.* 2020). Similarly, Bulut and Ertas, 2024 reported that the muffins prepare from sugar, butter and refined wheat i.e. product decreases fiber content from 1.55 to 0.40% during 7 days storage period.

Effect of different packaging material and storage duration on Carbohydrate content (%) of dried cashew apple flour muffins during 8 days storage duration

Fig. 7 Shows the effect of packaging material and storage duration (0, 2, 4, 6, 8) and on carbohydrate content (%) of muffins from dried cashew apple flour. The carbohydrate (%) of muffins prepared from dried cashew apple flour and which was packed in PET boxes increase from 55.08±0.02 to 59.67±0.05 % for 0 to 8 days of storage period and for Paperboard box carbohydrate content (%) increases from 55.08±0.01 to 59.00±0.07% for 0 to 8 days of storage period respectively. And muffins which was control sample increase from 54.04±0.06 to 58.98±0.03%. From Fig. 7 it is clear that as storage period increases, the carbohydrate (%) of muffin prepared from dried cashew apple flour packed in PET transparent boxes and paperboard boxes increases.

Table 7 Shows the ANOVA for the effect of packaging material and storage duration on carbohydrate content (%) of muffins prepared from dried cashew apple flour w.r.t packaging material, storage duration and their interaction. From Table 7 muffins prepared from dried cashew apple flour at $p \leq 0.05$ and storage duration had significant influence on carbohydrate (%) of muffins prepared from dried cashew apple flour at $p \leq 0.05$. The interaction of packaging material and storage duration showed the non-significant influence on carbohydrate content of muffins prepared from dried cashew apple flour significant at $p \leq 0.05$.

Similarly, Singh *et al.* 2019 reported that the muffins prepared from watermelon seeds, sunflower seeds and sesame seeds i.e. product increases carbohydrate content from 50.5 to 55.40 % during 7 days storage period. Similarly, Bulut and Ertas, 2024 reported that the muffins prepare from sugar, butter and refined wheat i.e. product increases carbohydrate content from 57.14 to 65.84 % during 7 days storage period.

Similar result observed that the muffins prepared from combination of different levels of erythritol and orange peel powder i.e. product decreases carbohydrate content from 58.13 to 64.68 % during 15

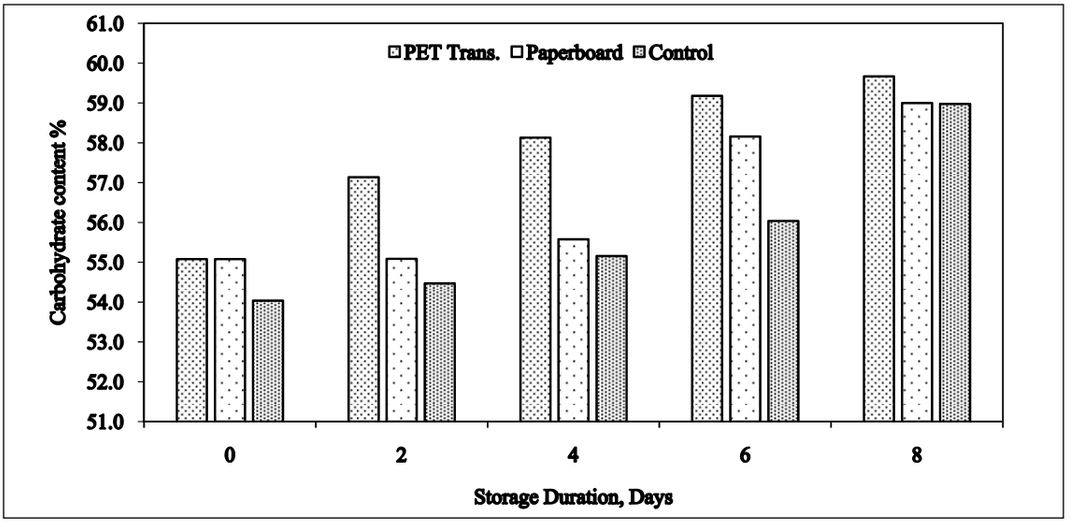

Fig. 7: Effect of various Packaging materials (PET=Polyethylene terephthalate; paperboard box; C=Paper bag) on protein % content of dried cashew apple flour muffins during eight days storage duration

Table 7: Effect of different packaging material (PET=Polyethylene terephthalate; Paperboard box; C=Paper bag) and storage duration (0, 2, 4, 6 and 8 Days) on Carbohydrate content (%) of stored dried cashew flour muffins, during 8 days of storage duration

Packaging Material (A)	Storage Duration (Days) (B)					
	Carbohydrate Content (%)					
	0	2	4	6	8	Mean A
PET Trans.	55.08±0.02	57.14±0.03	58.13±0.01	59.18±0.07	59.67±0.05	57.840
Paperboard Box	55.08±0.01	55.09±0.03	55.58±0.07	58.16±0.06	59.00±0.07	56.582
Control	54.04±0.06	54.47±0.05	55.16±0.04	56.04±0.01	58.98±0.03	55.730
Mean B	55.06	55.56	56.29	57.79	59.553	
Factors		**C.D.**			**SE(m)**	
Factor (A)		0.402			0.134	
Factor (B)		0.804			0.268	
Factor (A × B)		1.137			0.379	

days storage period (Bhise *et al.* 2020). Tiimub, (2013) reported that the product prepared from sugar, butter and wheat i.e., increased the carbohydrate content during 10 days storage period.

Effect of different packaging material and storage duration on browning index of dried cashew apple flour muffins during 8 days storage duration

Fig. 8 Shows the effect of packaging material and storage duration (0, 2, 4, 6, 8) and on Browning index (%) of muffins from dried cashew apple flour. The BI (%) of muffins prepared from dried cashew apple flour and which was packed in PET boxes decrease from 69.350±0.12 to 65.190 ±0.11 % for 0 to 8 days of storage period and for Paperboard box BI (%) decreases from 69.350±0.09 to 67.260±0.10 % for 0 to 8 days of storage period respectively. And muffins which was control sample decrease from 72.257±0.07 to 71.008±0.09%. From Fig. 8 it is clear that as storage period increases, the browning index (%) of muffin prepared from dried cashew apple flour packed in PET transparent boxes and paperboard boxes decreases.

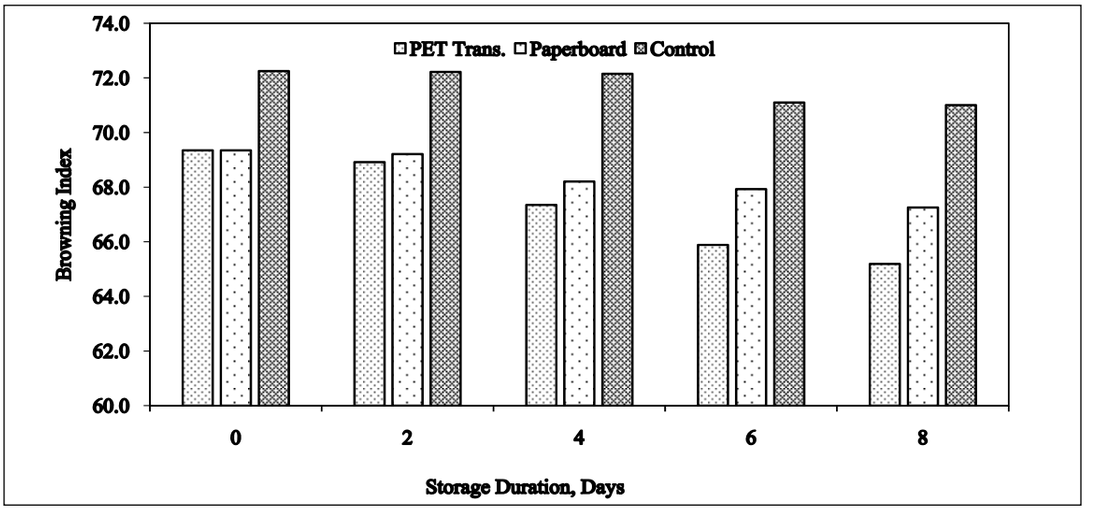

Fig. 8: Effect of various Packaging materials (PET=Polyethylene terephthalate; Paperboard box; C= Paper bag) on browning index of dried cashew apple flour muffins during eight days storage duration

Table 8: Effect of different packaging material (PET=Polyethylene terephthalate; Paperboard box; C=Paper bag) and storage duration (0, 2, 4, 6 and 8 Days) on browning index of stored dried cashew flour muffins, during 8 days of storage duration

Packaging Material (A)	Storage Duration (Days) (B)					
	Browning Index					
	0	**2**	**4**	**6**	**8**	**Mean A**
PET Trans.	69.350±0.12	68.921±1.15	67.352±0.10	65.889 ±0.11	65.190 ±0.11	67.340
Paperboard Box	69.350±0.09	69.211±0.12	68.209±0.11	67.931±0.13	67.260±0.10	68.392
Control	72.257±0.08	72.218±0.09	72.157±0.17	71.104±0.12	71.008±0.09	71.748
Mean B	70.319	70.116	69.239	68.308	67.819	
Factors		**C.D.**			**SE(m)**	
Factor (A)		0.405			0.135	
Factor (B)		0.810			0.270	
Factor (A × B)		1.149			0.383	

Table 8 Shows the ANOVA for the effect of packaging material and storage duration on BI (%) of muffins prepared from dried cashew apple flour w.r.t packaging material, storage duration and their interaction. From Table 8 muffins prepared from dried cashew apple flour at $p \leq 0.05$ and storage duration had significant influence on BI (%) of muffins prepared from dried cashew apple flour at $p \leq 0.05$. The interaction of packaging material and storage duration showed the non-significant influence on BI of muffins prepared from dried cashew apple flour significant at $p \leq 0.05$.

Similarly, Ureta *et al.* 2014 reported that the muffins browning index decreases from 157 to 113 % during 10 days storage period. According to Kumar *et al.* 2021 reported that the muffins browning index decreases during 7 days storage period.

Result shows that the muffins may appear lighter or less brown as time passes, especially if stored in dry or cool conditions. It was observed as storage time increases; the browning index of muffins usually decreases. Browning index potentially extends shelf life of muffins; However, it can also lead to a drier texture.

Effect of different packaging material and storage duration on sensory colour of dried cashew apple flour muffins stored for 8 days.

Fig. 9 shows the effect of different packaging material PET Trans.; Paperboard box and, (C= Control) and storage duration (0, 2, 4,6 and 8 days) on sensory colour of dried cashew apple flour muffins stored for 8 days storage duration. Highest colour score was observed at PET trans. box and lowest was control sample. The average colour scores for dried cashew apple flour muffins stored in PET transparent box for 0, 2, 4, 6 and 8 days was 8.72, 8.59, 8.08, 8.05 to 7.81 respectively, and paperboard box for 0, 2, 4, 6 and 8 days were 8.49, 8.20, 7.99, 7.75 to 7.16 and control sample for 0, 2, 4, 6 and 8 days were 8.32, 8.02, 7.84, 7.67 to 7.13 respectively.

Table 9 shows ANOVA for colour of sensory analysis. It was observed that as the storage duration increases the sensory score for colour goes on decreasing. The range of sensory colour was from 7.13±0.07 to 8.72±0.12. The sensory colour was in range of 8.72±0.12 to 7.81±0.06 for PET box, from 8.49±0.15 to 7.16±0.07 for paperboard box, from 8.32±0.13 to 7.13±0.07 for control sample for all storage duration of 8^{th} days storage. The highest colour score was observed 8.72 for PET box. The effect of packaging treatment had significant effect on colour of the muffins at $p \leq 0.05$. The effect of storage duration also had significant effect on colour of the muffins at $p \leq 0.05$. The interaction of packaging material and storage duration had also a significant effect and the colour of muffins prepared from dried cashew apple flour.

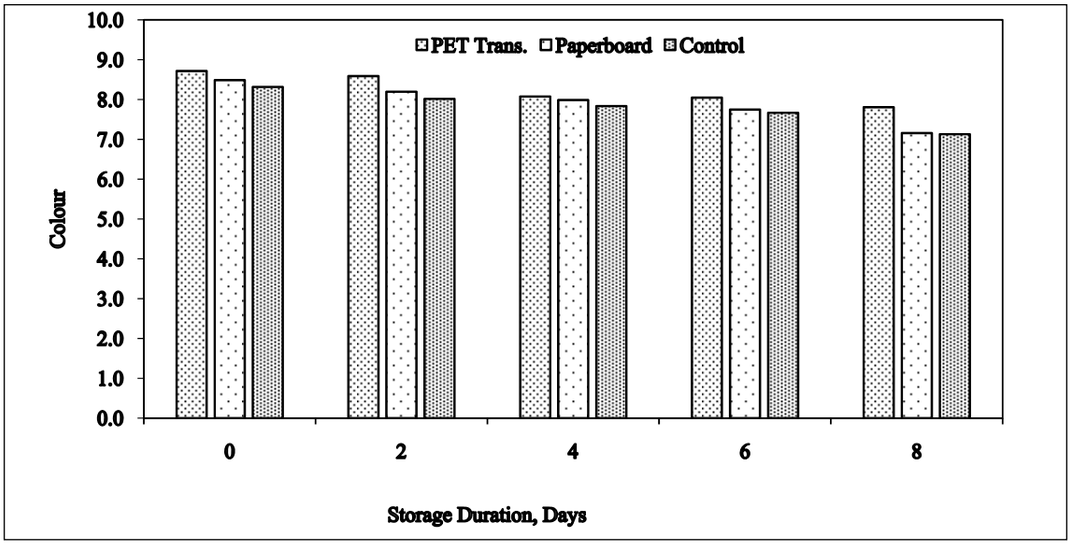

Fig. 9: Effect of various Packaging materials (PET=Polyethylene terephthalate; Paperboard box; C=Paper bag) on sensory colour of dried cashew apple flour muffins during eight days storage duration

Table 9: Effect of different packaging material PET Trans.; Paperboard box and, C=paper bag and storage duration (0, 2, 4,6 and 8 days) on sensory colour of dried cashew apple flour muffins stored for 8 days storage duration

Packaging Material (A)	Days (B)					
	0	2	4	6	8	Mean A
PET Trans.	8.72±0.12	8.59±0.07	8.08±0.10	8.05±0.07	7.81±0.06	8.250
Paperboard Box	8.49±0.15	8.20±0.07	7.99±0.09	7.75±0.13	7.16±0.07	7.918
Control	8.32±0.13	8.02±0.09	7.84±0.14	7.67±0.12	7.13±0.07	7.596
Mean B	8.510	8.270	7.970	7.823	7.366	
Factors		**C.D.**		**SE(m)**		
Factor (A)	0.198			0.066		
Factor (B)	0.255			0.085		
Factor (A× B)	0.441			0.147		

Effect of different packaging material and storage duration on sensory flavour of cashew apple flour muffins stored for 8 days

Fig. 10 shows the effect of different packaging material PET Trans.; Paperboard box and, (C= Control) and storage duration (0, 2, 4,6 and 8 days) on sensory flavour of dried cashew apple flour muffins stored for 8 days storage duration. Highest flavour score was observed at PET trans. box and lowest was control sample. The average flavour scores for dried cashew apple flour muffins stored in PET transparent box for 0, 2, 4, 6 and 8 days was 8.60,8.55, 8.02,8.0 to 7.91 respectively, and paperboard box for 0, 2, 4, 6 and 8 days were 8.30,8.28,7.97,7.73 to 7.45 respectively and control sample for 0, 2, 4, 6 and 8 days were 8.24,8.03,7.86,7.66 to 7.35 respectively.

Table 10 shows ANOVA for flavour of sensory analysis. It was observed that as the storage duration increases the sensory score for flavour goes on decreasing. The range of sensory flavour was from 7.35±0.09 to 8.60±0.10. The sensory flavour was in range of 8.60±0.10 to 7.91±0.10 for PET box, from

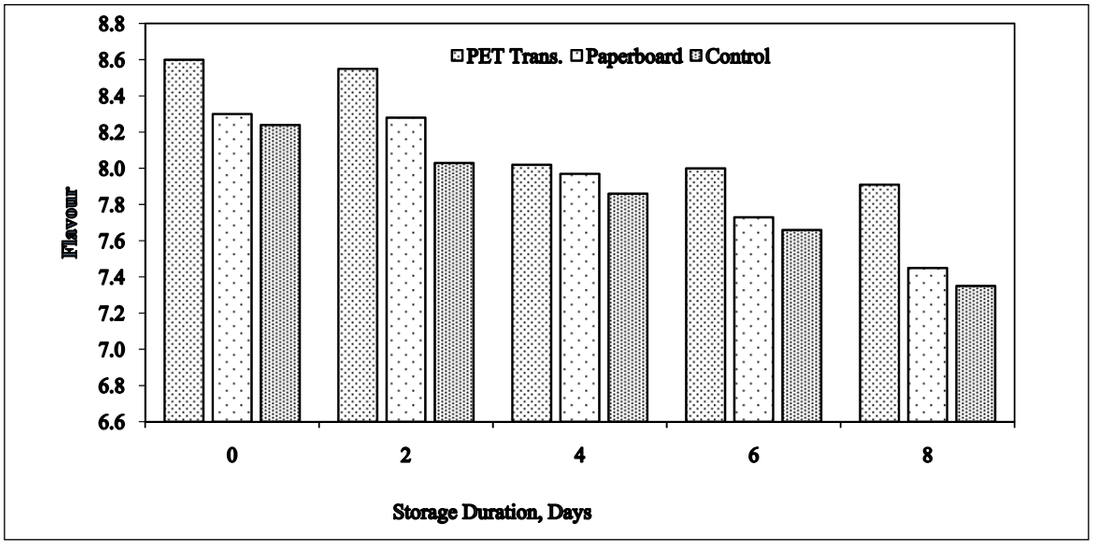

Fig. 10: Effect of various Packaging materials (PET=Polyethylene terephthalate; paperboard box; C= Control) on sensory flavour of dried cashew apple flour muffins during eight days storage duration

Table 10: Effect of different packaging material PET Trans.; paperboard box and, C= Paper bag and storage duration (0, 2, 4,6 and 8 days) on sensory flavour of dried cashew apple flour muffins stored for 8 days storage duration

Packaging Material (A)	**Days (B)**					
	0	**2**	**4**	**6**	**8**	**Mean A**
PET Trans.	8.60±0.10	8.55±0.07	8.02±0.10	8.0±0.14	7.91±0.10	8.216
Paperboard Box	8.30±0.09	8.28±0.11	7.97±0.07	7.73±0.09	7.45±007	7.946
Control	8.24±0.12	8.03±0.09	7.86±0.12	7.66±0.11	7.35±0.09	7.828
Mean B	8.380	8.286	7.950	7.796	7.570	
Factors		**C.D.**		**SE(m)**		
Factor (A)	0.114			0.038		
Factor (B)	0.147			0.049		
Factor (A× B)	0.258			0.086		

8.30±0.09 to 7.45±007 for Combo box, from 8.24±0.12 to 7.35±0.09 for control sample for all storage duration of 8th days storage. The highest colour score was observed 8.60 for PET box. The effect of packaging treatment had significant effect on flavour of the muffins at $p \leq 0.05$. The effect of storage duration also had significant effect on flavour of the muffins at $p \leq 0.05$. The interaction of packaging material and storage duration had also a significant effect and the flavour of muffins prepared from dried cashew apple flour.

Effect of different packaging material and storage duration on sensory taste of cashew apple flour muffins stored for 8 days

Fig. 11 shows the effect of different packaging material PET Trans.; Paperboard box and, (C= Control) and storage duration (0, 2, 4,6 and 8 days) on sensory taste of dried cashew apple flour muffins stored for 8 days storage duration. Highest taste score was observed at PET trans. box and lowest was control sample. The average taste scores for dried cashew apple flour muffins stored in PET transparent box for 0, 2, 4, 6

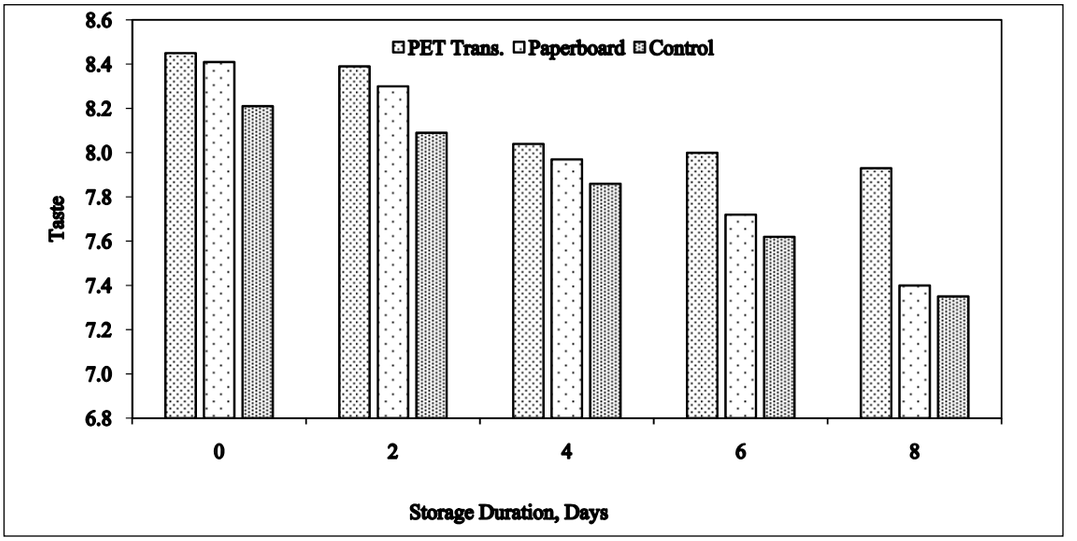

Fig. 11: Effect of various Packaging materials (PET=Polyethylene terephthalate; Paperboard box; C= Paper bag) on sensory taste of dried cashew apple flour muffins during eight days storage duration

Table 11: Effect of different packaging material PET Trans.; Paperboard box and, C=Paper bag and storage duration (0, 2, 4,6 and 8 days) on sensory taste of dried cashew apple flour muffins stored for 8 days storage duration

Packaging Material (A)	**Days (B)**					
	0	**2**	**4**	**6**	**8**	**Mean A**
PET Trans.	8.45±0.10	8.39±0.07	8.04±0.10	8.0±0.14	7.93±0.10	8.162
Paperboard Box	8.41±0.09	8.30±0.11	7.97±0.07	7.72±0.12	7.40±0.09	7.960
Control	8.21±0.12	8.09±0.10	7.86±0.11	7.62±0.09	7.35±0.07	7.826
Mean B	8.356	8.260	7.956	7.780	7.560	
Factors		**C.D.**		**SE(m)**		
Factor (A)	0.135			0.045		
Factor (B)	0.105			0.035		
Factor (A× B)	0.237			0.079		

and 8 days was 8.45,8.39,8.04,8.0 to 7.93 respectively, and combo box for 0, 2, 4, 6 and 8 days were 8.41, 8.30,7.97,7.72 to 7.40 respectively, and control sample for 0, 2, 4, 6 and 8 days were 8.21,8.09,7.86,7.62 to 7.35 respectively.

Table 11 shows ANOVA for taste of sensory analysis. It was observed that as the storage duration increases the sensory score for taste goes on decreasing. The range of sensory taste was from 7.35±0.07 to 8.45±0.10. The sensory taste was in range of for PET box, from 8.41±0.09 to 7.40±0.09 for paperboard box, from 8.21±0.12 to 7.35±0.07 for control sample for all storage duration of 8th days storage. The highest taste score was observed 8.45 for PET box. The effect of packaging treatment had significant effect on taste of the muffins at $p \leq 0.05$. The effect of storage duration also had significant effect on taste of the muffins at $p \leq 0.05$. The interaction of packaging material and storage duration had also a significant effect and the taste of muffins prepared from dried cashew apple flour.

Effect of different packaging material and storage duration on sensory texture of cashew apple flour muffins stored for 8 days

Fig. 12 shows the effect of different packaging material PET Trans.; Paperboard box and, (C= Control) and storage duration (0, 2, 4,6 and 8 days) on sensory texture of dried cashew apple flour muffins stored for 8 days storage duration. Highest texture score was observed at PET trans. box and lowest was control sample. The average texture scores for dried cashew apple flour muffins stored in PET transparent box for 0, 2, 4, 6 and 8 days was 8.57,8.55,8.10,8.06, to 8.03 respectively, and paperboard box for 0, 2, 4, 6 and 8 days were 8.25,8.14,8.11,7.75 to 7.45 respectively and control sample for 0, 2, 4, 6 and 8 days were 8.13,8.05,7.90,7.68 to 7.32 respectively.

Table 12 shows ANOVA for texture of sensory analysis. It was observed that as the storage duration increases the sensory score for texture goes on decreasing. The range of sensory texture was from 7.32±0.11 to 8.57±0.11. The sensory texture was in range of for PET box, from 8.57±0.11 to 8.03±0.07 for paperboard box, from 8.13±0.11 to 7.32±0.11 for control sample from 8.13±0.11 to 7.32±0.11. For all storage duration of 8th days storage. The highest texture score was observed 8.57 for PET box. The effect of packaging treatment had significant effect on texture of the muffins at $p \leq 0.05$. The effect of storage duration also had significant effect on texture of the muffins at $p \leq 0.05$. The interaction of packaging material and storage duration had also a significant effect and the texture of muffins prepared from dried cashew apple flour.

Effect of different packaging material and storage duration on sensory overall acceptability of cashew apple flour muffins stored for 8 days

Fig. 13 shows the effect of different packaging material PET Trans.=; Combo box and, (C= Control) and storage duration (0, 2, 4,6 and 8 days) on sensory overall acceptability of dried cashew apple flour muffins stored for 8 days storage duration. Highest overall acceptability score was observed at PET trans. Box and lowest was control sample. The average overall acceptability scores for dried cashew apple flour muffins stored in PET transparent box for 0, 2, 4, 6 and 8 days was 8.56,8.38,7.75,7.26 to 7.08 respectively,, and combo box for 0, 2, 4, 6 and 8 days were 8.27,8.05,7.61,7.30 to 6.98 respectively, and control sample for 0, 2, 4, 6 and 8 days were 8.07,7.85,7.53,6.87 to 6.55 respectively.

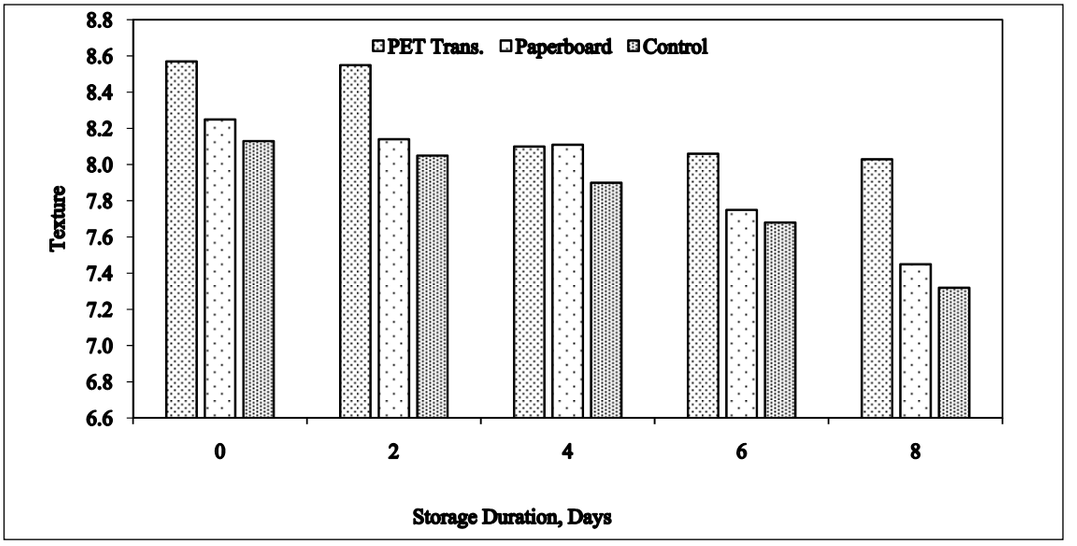

Fig. 12: Effect of various Packaging materials (PET = Polyethylene terephthalate; Combo box; C = Control) on sensory texture of dried cashew apple flour muffins during eight days storage duration

Table 12: Effect of different packaging material PET Trans.=; Paperboard box and, C= Paper bag and storage duration (0, 2, 4,6 and 8 days) on sensory texture of dried cashew apple flour muffins stored for 8 days storage duration

Packaging Material (A)	Days (B)					
	0	2	4	6	8	Mean A
PET Trans.	8.57±0.11	8.55±0.09	8.10±0.15	8.06±0.10	8.03±0.07	8.262
Paperboard Box	8.25±0.12	8.14±0.11	8.11±0.07	7.75±0.08	7.45±0.09	7.940
Control	8.13±0.11	8.05±0.07	7.90±0.14	7.68±0.07	7.32±0.11	7.816
Mean B	8.316	8.246	8.036	7.830	7.600	
Factors		**C.D.**		**SE(m)**		
Factor (A)	0.132			0.044		
Factor (B)	0.102			0.034		
Factor (A×B)	0.227			0.076		

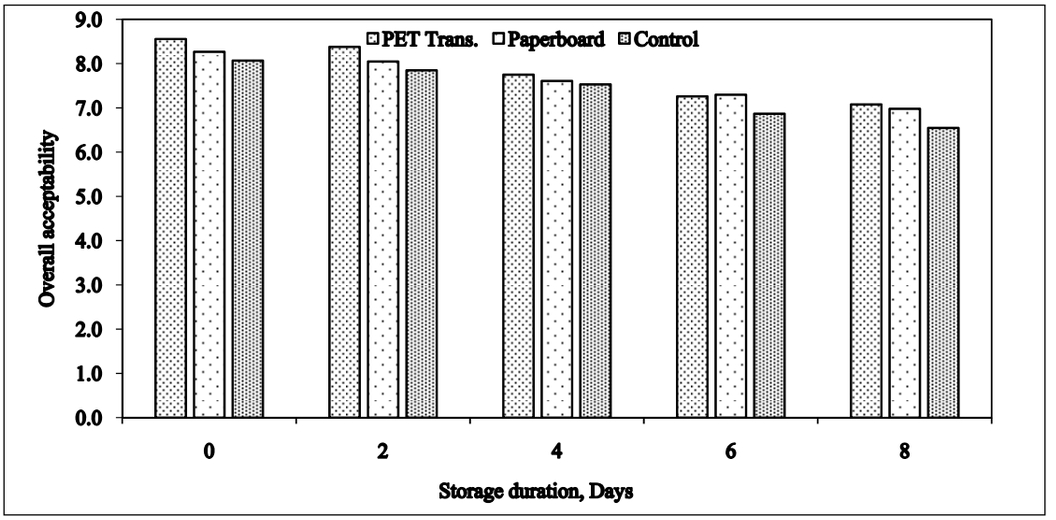

Fig. 13: Effect of various Packaging materials (PET=Polyethylene terephthalate; Paperboard box; C= Paper bag) on sensory overall acceptability of dried cashew apple flour muffins during eight days storage duration

Table 13: Effect of different packaging material PET Trans.=; Paperboard box and, C=Paper bag and storage duration (0, 2, 4,6 and 8 days) on sensory overall acceptability of dried cashew apple flour muffins stored for 8 days storage duration

Packaging Material (A)	Days (B)					
	0	2	4	6	8	Mean A
PET Trans.	8.56±0.12	8.38±0.09	7.75±0.10	7.26±0.07	7.08±0.09	7.806
Paperboard Box	8.27±0.07	8.05±0.11	7.61±0.13	7.30±0.09	6.98±0.15	7.642
Control	8.07±0.10	7.85±0.14	7.53±0.10	6.87±0.12	6.55±0.11	7.374
Mean B	8.300	8.093	7.630	7.143	6.87	
Factors		**C.D.**		**SE(m)**		
Factor (A)	0.101			0.036		
Factor (B)	0.138			0.046		
Factor (A× B)	0.240			0.080		

Table 13 shows ANOVA for overall acceptability of sensory analysis. It was observed that as the storage duration increases the sensory score for overall acceptability goes on decreasing. The range of sensory overall acceptability was from 6.55±0.11 to 8.56±0.12. The sensory overall acceptability was in range of for PET box, from 8.56±0.12 to7.08±0.09 for Combo box, from 8.27±0.07 to 6.98±0.15 for control sample from 8.07±0.10 to 6.55±0.11 for all storage duration of 8th days storage. The highest overall acceptability score was observed 8.56 for PET box. The effect of packaging treatment had significant effect on overall acceptability of the muffins at $p \leq 0.05$. The effect of storage duration also had significant effect on overall acceptability of the muffins at $p \leq 0.05$. The interaction of packaging material and storage duration had also a significant effect and the overall acceptability of muffins prepared from dried cashew apple flour.

CONCLUSION

Effect of different packaging material and storage duration on dried cashew apple flour muffins, the dried cashew apple flour muffins baked at 180° for 20 minutes and the treatment was C3T1 i.e., 85:15% (refined wheat flour and cashew apple flour) gives best fluffy muffins. In comparison to all the packaging materials it was observed that PET box (Polyethylene terephthalate) contains best physicochemical properties followed by other packaging material during the 8th days of storage studies. It contains good amount of Fat content 8.940±0.04%, Protein content is 3.900±0.01%, Ash content is 1.520±0.02, Fiber content is 1.760±0.01% and carbohydrate content is 59.671±0.05%, Browning index was 65.190 ±0.11 as compare to other packaging material. And it also gives the best sensory properties i.e., Colour 7.81±0.06, Flavour 7.91±0.10, Taste 7.93±0.10, Texture 8.03±0.07, Overall acceptability 7.08±0.09 during 8th days of storage studies.

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