

RESEARCH PAPER

Development of Muffins from Dried Cashew Apple Flour and its Quality Characteristics

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ABSTRACT

Bakery products are an important part of a balanced diet and today, a wide variety of such products can be found on supermarket shelves. Muffins were prepared from dough's containing refined wheat flour and dried cashew apple powder composite as C1 (95:05%), C2 (90:10%), C3 (85:15%), C4 (80:20%) and C5 (75:25%). And using various temperature, i.e., T1 (180 °), T2(200 °) and T3(220 °). Muffins prepared from dried cashew apple powder of the best treatment (90:10) (Refined wheat flour: cashew apple powder), baked at a temperature 180°C and baking time is 20 minutes. The quality parameters i.e., moisture content % (db.) 13.557±0.02 %, fat content % 4.860±0.04 %, protein content 6.040±0.07 %, ash content 0.510±0.05%, fiber content % 8.650±0.04%, carbohydrate % 66.383±0.06%, Browning Index 150.521 was found to be best. The muffins of treatment C3 i.e.15% dried cashew apple powder obtained highest score in all sensory attributes. i.e., colour (8.180±0.01), flavour (8.100±0.02), Texture (8.240±0.10), Taste (8.260±0.01), and overall acceptability (8.180±0.12).

Keywords: Cashew apple powder, Quality parameters, Varied temperature, Muffins, physicochemical

The cashew tree or (*Anacardium occidentale*) belongs to the *Anacardiaceae* family, characterized by tropical and sub-tropical trees and shrubs that have branches always provided with channels that produce resin and altered leaves. There are more than sixty genera and four hundred species related to the genus *Anacardium*, which produce similar and also edible fruits (Moreira, 2002). Cashew is a native of tropical America from Mexico to Peru and Brazil and also the West Indies. The first introduction of cashew into India was made in Goa from where it spread to other parts of the country's west and east coasts, especially in the states of Kerala, Tamil Nadu, Karnataka and Andhra Pradesh (Singh *et al.* 1963).

World cashew nut production currently stands at 3.8 million MT, and Ghana produces about 170,000 MT of raw nuts and 15,30,000 MT of cashew apples which currently are of low economic value and thus, a majority goes to waste (Catarino *et al.* 2015). The cashew fruit consists of the cashew nut (the true fruit) and the cashew apple (pseudofruit), has excellent nutritional and sensory properties. It is very juicy, sweet, spongy, and nutritious compared with many

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other tropical fruits. The apple has been potential for utilization for the development of value-added products like juice, syrup, jam, jelly, alcohol, dietary fiber extract (Das and Arora, 2017).

Cashew apple juice is the major product obtained from cashew apple. The cashew apple is five times richer in vitamin C than orange juice and ten times richer than pineapple juice (Akinwale 2000). The sugar content of cashew apple was observed to vary between 10 and 30% and this high sugar content has made it useful as a suitable source of reducing sugars for fermentative and enzymatic processes aimed at producing lactic acid, dextran, and oligosaccharides. Moreover, the apple contains a considerable level of minerals, mainly calcium and phosphorus. It also contains small proportions of tannins (up to 0.35%) (Nair, 2010). The development of dried cashew apple powder which maintains the sensory properties and it also can contribute to the development of value-added products from cashew apple, which would be acceptable to the consumers (Ogunjobi and Ogunwolu, 2010). Variety of fruit and vegetable pomaces are used in wide array of bakery products like biscuits, buns, cookies, crackers, cakes, muffins, wheat rolls and scones. The excellent qualities of cashew apple offer immense opportunities for its processing to various value-added products. Commercial exploitation of cashew apple is the need of the hour considering its vast potential in enhancing the income from cashew plantations. It is one of the prime areas of utilizing the indigenous fruit and opens up wider market possibilities and hence tremendous scope for commercialization (Sobhana, 2019).

The bakery industries are a developing market sector in India. Among bakery products, muffins are less sweet than other bakery products such as cakes and generally have a somewhat more open crumb structure. In the final product of muffin, principal ingredients which play an important role in its appearance, structural and eating quality are flour, sugar, fat and an egg (Singh *et al.* 2020). Muffins are a type of sweet or Savory bread, baked in small portions that usually look like small cakes or cupcakes in shape. Muffins are popular breakfast foods, and

their quality can be assessed by studying structural characteristics through rheometry, microscopy, image analysis, and texture analysis (Martinez *et al.* 2012). In recent years, bakery and confectionary products are fortified with various nutrients to enrich them to become a complete food with all necessary nutrients. The base material used for the preparation confectionary products of bakery and confectionery products. 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. Reducing or omitting egg yolks can result in less tenderness. Reducing or omitting egg whites can result in less volume. Cakes made without the emulsifying action from the egg yolk may not have a uniform flavour and texture (Ramya and Anitha 2020).

Drying of cashew apple and converting dried apple successfully into powder is an excellent alternative to increase its shelf life. It allows conversion of perishable materials into stabilized products by lowering the water activity into appropriate levels (Uchoa *et al.* 2009). This helps in preventing microbial spoilage and quality deterioration due to undesirable biochemical reactions.

This present study was thus undertaken with the objective of utilizing dried cashew apple flour for the development of muffins from it and to study its quality evaluation.

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 0.71% 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 of varied levels (5%, 10%, 15%, 20%, 25%) and refined wheat flour of varied levels (95%, 90%, 85%, 80%, 75%) were used as per treatment combination to make flour composition, and baking powder (0.7 %), powdered sugar (24%) and milk powder (7 %). 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°, 200° and 220° for 20-30 min. depending upon the temperature condition. The flour combination concentration C1 to C5 i.e. 5:95, 10:90, 15:85, 20:80, 25:75 at varied baking temperature T1 to T3 180°, 200° and 220° are present in Fig. 2 shows the muffins prepared from various concentration.

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

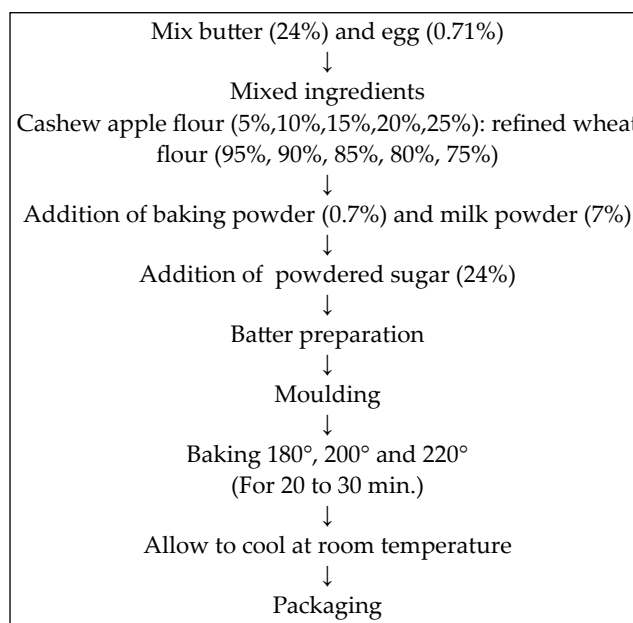
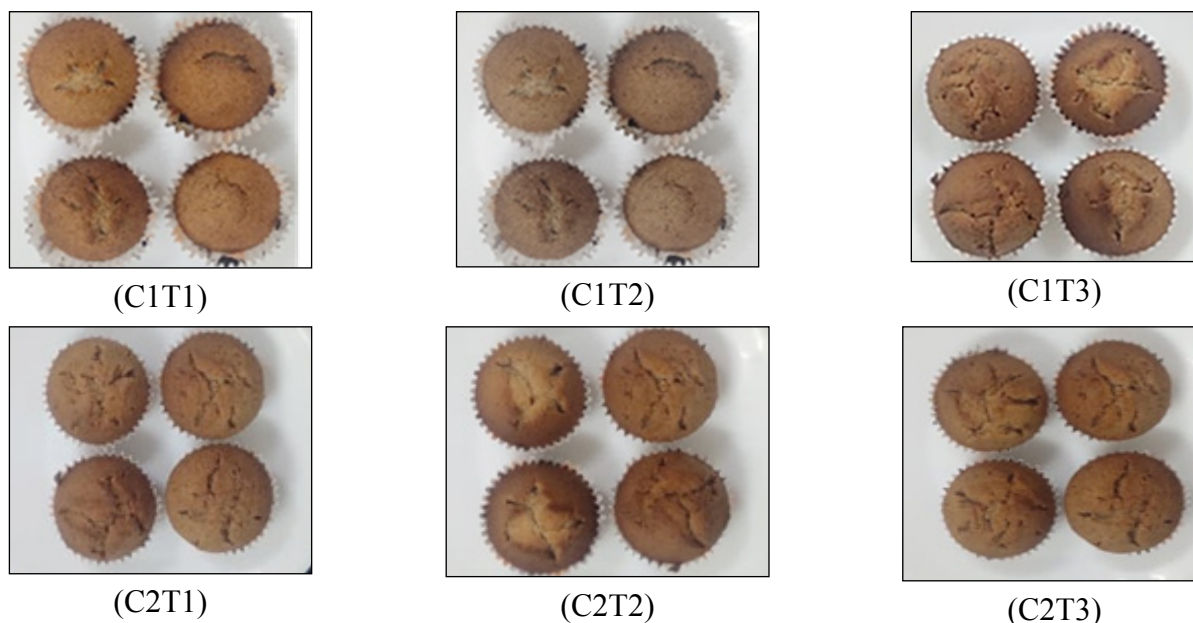


Fig. 1: Process Flow chart for Muffins processing



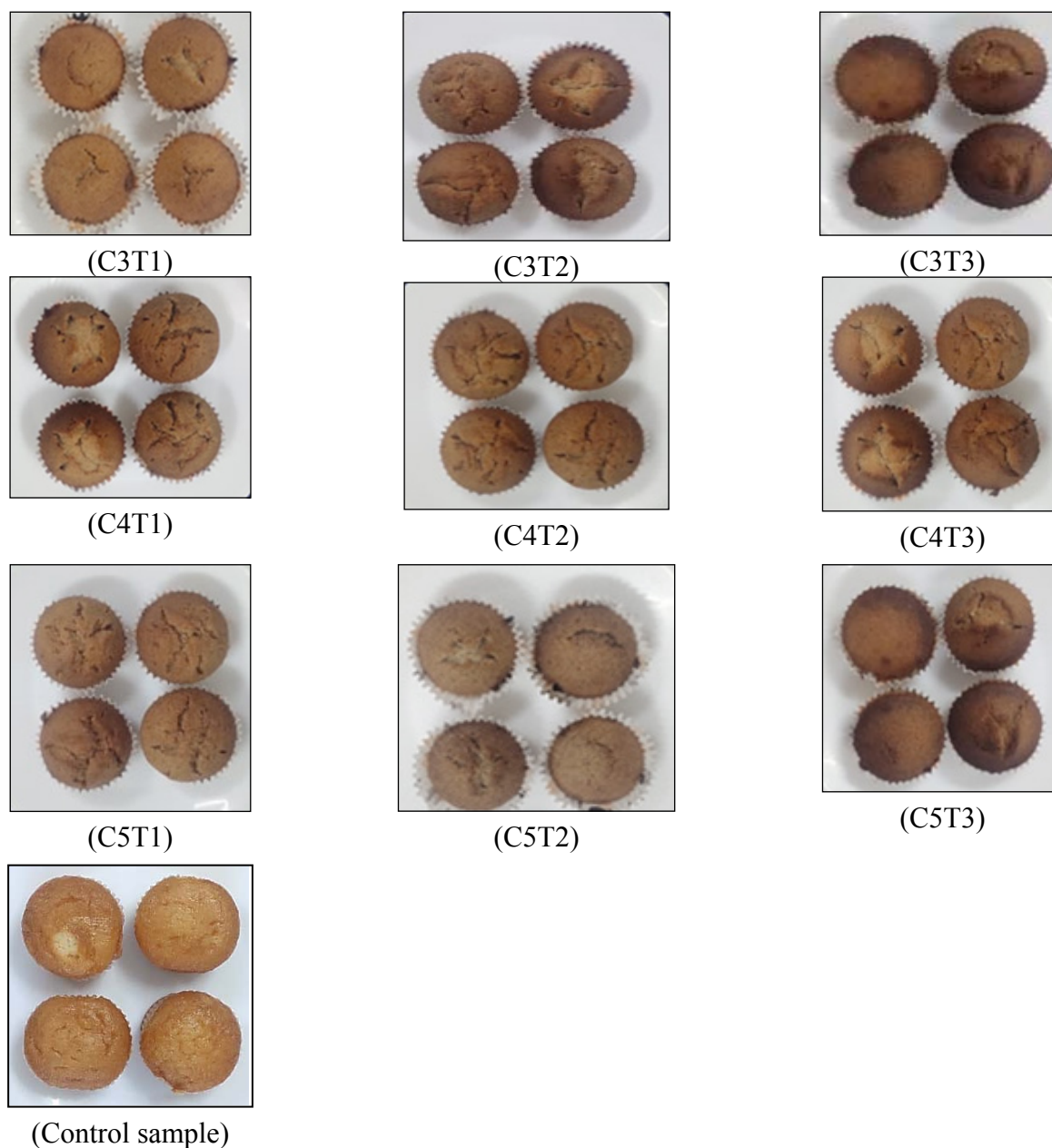


Fig. 2: Dried cashew apple flour muffins in various concentrations and different baking temperatures; (C1 = 5 % Cashew apple flour; C2 = 10 % Cashew apple flour; C3 = 15% Cashew apple flour; C4 = 20% Cashew apple flour, C5 = 25 % Cashew apple flour). T1 = 180°; T2 = 200°; T3 = 220°)

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

1 Moisture content (%)

Initial moisture content of the muffin sample from dried cashew apple flour composition C1 to C5 and

temperature T1 to T3 determined by AOAC (2010). 5 g of muffin sample were taken into the moisture box with lid. The initial weight of moisture box was recorded. The sample were exposed to 105°C \pm 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);

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

Where,

W1 = Weight of moisture box, g

W2 = Weight of moisture box + sample g

W3 = Weight of moisture box + oven dried sample g

2. Fat content (%)

Fat content of muffin sample prepared from dried cashew apple flour of treatment composition C1 to C5 and temperature T1 to T3 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 remainder 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);

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

Where,

W1 = Weight of oven dried thimble,

W2 = Weight of sample used,

W3 = Weight of round bottom flask,

3. Protein content (%)

Protein content of muffin sample prepared from dried cashew apple flour of treatment composition C1 to C5 and temperature T1 to T3 were determined by 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 (3);

$$\% (\text{N}) = 1.04 \times (\text{ml HCL} - \text{ml blank}) \times \text{Conc. of } \frac{\text{HCL}}{\text{Weight}} \text{ of sample (g)} \quad \dots(3)$$

$$\% \text{ Protein} = \% \text{ N} \times \text{Factor (6.25)} \quad \dots(4)$$

4. Ash content (%)

The ash content of muffin sample prepared from dried cashew apple flour of treatment composition C1 to C5 and temperature T1 to T3 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 (5);

$$\text{Ash content \%} = \frac{(W2 - W1)}{(\text{Weight of sample})} \times 100 \quad \dots(5)$$

Where,

W2 = Weight of crucible + ash,

W1 = Weight of empty crucible

5. Fiber content (%)

Fiber content of muffin sample prepared by dried cashew apple flour of treatment composition C1 to C5 and temperature T1 to T3 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);

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

6. Carbohydrate content (%)

The carbohydrate content of muffin sample prepared by dried cashew apple flour of treatment composition C1 to C5 and temperature T1 to T3 were calculated from protein, fat, fiber, ash and moisture content (Adegunwa *et al.* 2012).

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

6. 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.

$$BI = \frac{[100(x-0.31)]}{0.171} \quad \dots(7)$$

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

Muffins baked at three different temperatures 170 °C, 180 °C and 190 °C were served in plate after cooling at ambient temperature to trained panelists (i.e. students and staff members of Post-Graduate Institute of Post-harvest Technology and Management Killa Roha, Raigad). The Trained panel of student and staff evaluated the samples at different aspects such as color, flavour, texture and appearance using 9-point hedonic scale. All samples were blindly coded with alphabets and numbers.

STATISTICAL ANALYSIS

All the analysis reported in this study was performed in triplicate and data obtained is reported as mean ± standard deviation. The data obtained was analysed statistically to determine statistical significance of treatments. Completely Randomized Design (CRD) was used to test the significance of results. The analysis of variance revealed at significance of S.E and C.D. at 5 percent level. The research data was statistically analysed by following method described by Panse and Sukhatme (1967).

To identify the best treatment for muffins, the quality characteristics of muffins having sweetness with maximum sensory score of colour and appearance, taste, texture and overall acceptability is considered.

RESULTS AND DISCUSSION

Effect of concentrations(%) of Dried Cashew apple flour and baking temperature(°) on Moisture content of Muffins.

Fig. 3 shows the effect of various concentrations of cashew apple flours (i.e. 5%, 10%, 15%, 20% and 25%) and baking temperatures (i.e. 180°C, 200°C, 220°C) on the moisture content % of dried cashew apple

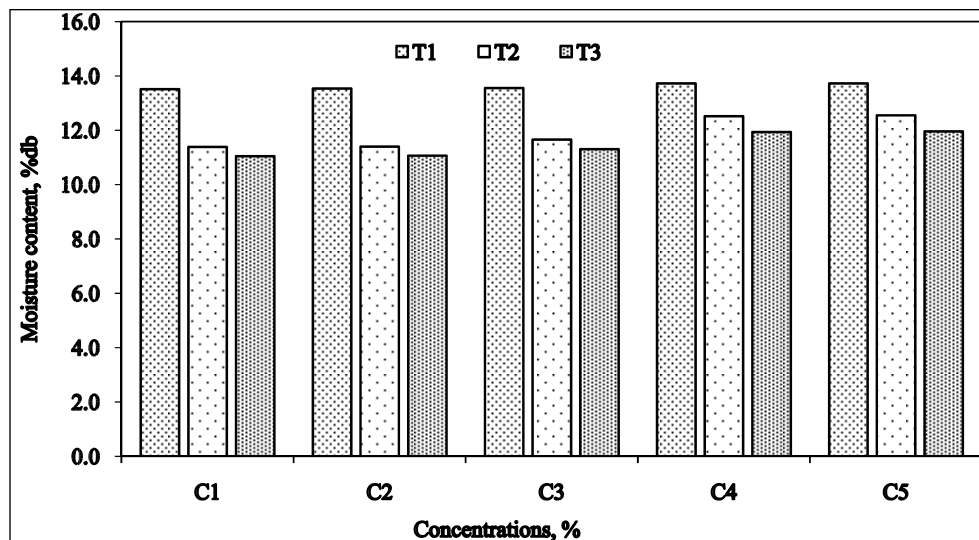


Fig. 3: Effect of concentrations (%) of Dried Cashew apple flour and temperature(°C) on Moisture content of Muffins. (C1 = 5 % Cashew apple flour; C2 = 10 % Cashew apple flour; C3 = 15% Cashew apple flour, C4 = 20% Cashew apple flour, C5 = 25 % Cashew apple flour). T1 = 180°; T2 = 200°; T3 = 220°)

Table 1: Effect of concentrations (%) of Dried Cashew apple flour and baking temperature on Moisture content of Muffins

Concentrations Temperature	T1	T2	T3	Mean A
C1	13.520±0.03	11.390±0.01	11.050±0.01	11.986
C2	13.540±0.07	11.400±0.04	11.070±0.08	12.003
C3	13.557±0.09	11.660±0.01	11.307±0.03	12.174
C4	13.730±0.02	12.520±0.08	11.940±0.07	12.730
C5	13.748±0.08	12.553±0.06	11.960±0.09	12.753
Mean B	13.619	11.904	11.465	
Control	13.518±0.01			
Factors	C.D.			SE(m)
Factor(A)	0.291			0.100
Factor(B)	0.234			0.078
Factor (A × B)	0.519			0.173

Cashew apple flour: Refined Wheat Flour (C1=5:95, C2=10:90, C3=15:85, C4=20:80, C5=25:75) Baking Temperature (T1;180°, T2;200°, T3;220°)

flour muffins. The moisture content for muffins for all the concentration were range of 11.050±0.01 to 13.748±0.08. As the concentrations increases, the moisture content increases 11.050±0.01 to 13.748±0.08 and baking temperature increases from 180°C to 220°C the moisture content of dried cashew apple flour muffins decreases from 13.748±0.08% to 11.050±0.01% respectively. The moisture content of the control sample was 13.518±0.01%. As both the

dried cashew apple flour (%) and baking temperature (°C) increases the combined effect of these two shows that the moisture content of the muffins shows the increasing and decreasing trend.

Table 1 shows the ANOVA for effect of various concentrations (C1=5%, C2=10%, C3=15%, C4=20%, C5=25%) and baking temperature(°C) on moisture content % of dried cashew apple flour muffins was

significant at $p \leq 0.05$. Similarly, the effect of baking temperatures (i.e., $T_1=180^\circ\text{C}$, $T_2=200^\circ\text{C}$, $T_3=220^\circ\text{C}$) on moisture content % of dried cashew apple flour muffins has significant at $p \leq 0.05$. The interactive effect of concentrations (%) and temperature ($^\circ\text{C}$) of baking on moisture content % was also significant at $p \leq 0.05$. Moisture content of dried cashew apple flour muffins increases in incorporation of cashew apple flour from 5 % to 25 % respectively, because cashew apple flour has a high-water absorption capacity, which means it can retain more water during the baking and mixing process. This property helps in increasing the moisture content of the final product. Ureta *et al.* 2014 reported that higher baking temperatures can influence the texture and structure of muffins, they do not necessarily lead to a significant decrease in moisture content.

Similar result was observed by Chetana *et al.* 2010 for flaxseed roasted powder muffins. As the concentration of flaxseed roasted powder increases 10 % to 40 % the moisture content of the muffins increased from 17.9 % to 20.5 %. Sehgal and Kawarta, 2008 reported that in banana cupcake prepared from pearl millet flour, refined wheat flour and green gram flour, as the concentration of pearl millet flour increases from 20 % to 30 % the moisture content in cupcake increases from 28.02 to 28.13%.

Similarly, Ureta *et al.* 2014 reported the effect of baking temperature 140°C - 220°C on moisture content of muffins, as the baking temperature increases from 140°C - 220°C the moisture content of muffins decreases from 19 % to 9 %. Shrivastava *et al.* 2015 reported the moisture content 19.13 % to 22.20 % in cupcake prepared from jackfruit seed flour up to 5-15% with replacement of wheat flour and cake was baked at 190°C . David, 2016 reported the moisture content in cupcake ranges from 19.13% to 22.20 % with increase incorporation of jackfruit seed flour 5 to 15 % which was baked at 190°C .

Effect of concentrations (%) of Dried Cashew apple flour and baking temperature($^\circ\text{C}$) on Fat content of Muffins

Fig. 4 shows the effect of various concentrations of

cashew apple flours (i.e. 5%, 10%, 15%, 20% and 25%) and baking temperatures (i.e. 180°C , 200°C , 220°C) on the fat content % of dried cashew apple flour muffins. The fat content for muffins for all the concentration were range of 2.280 ± 0.04 to $5.063 \pm 0.01\%$. As the concentrations of cashew flour increases the fat content increases from 2.280 ± 0.04 to $5.063 \pm 0.01\%$ and baking temperature increases from 180°C to 220°C the fat content of dried cashew apple flour muffins decreases from $5.063 \pm 0.01\%$ to $2.280 \pm 0.04\%$ respectively. The fat content of the control sample was $3.710 \pm 0.02\%$. As both the dried cashew apple flour (%) and baking temperature ($^\circ\text{C}$) increase the combined effect of these two shows that the fat content of the muffins shows the increasing and decreasing trend.

Table 2 shows the ANOVA for effect of various concentrations ($C_1=5\%$, $C_2=10\%$, $C_3=15\%$, $C_4=20\%$, $C_5=25\%$) and baking temperature($^\circ\text{C}$) on fat content % of dried cashew apple flour muffins was significant at $p \leq 0.05$. Similarly, the effect of baking temperatures (i.e., $T_1=180^\circ\text{C}$, $T_2=200^\circ\text{C}$, $T_3=220^\circ\text{C}$) on fat content % of dried cashew apple flour muffins has significant at $p \leq 0.05$. The interactive effect of concentrations (%) and temperature ($^\circ\text{C}$) of baking on fat content % was also significant at $p \leq 0.05$. Fat content of dried cashew apple flour muffins increases in incorporation of cashew apple flour from 5 % to 25 % respectively, because during baking process water evaporates, reducing the overall moisture content of muffins since fat does not evaporate, the relative proportion of fat increase (Ureta *et al.* 2014).

Akinwale *et al.* 2014 reported that higher temperatures, fats within the muffin batter melt and migrate towards the surface. This migration can result in the loss of fat from the interior to the exterior of the muffin.

David, 2016 reported that the fat content in cupcake was in the range from 12.57 to 14.86 % with increase in incorporation of jackfruit seed flour 5 % to 15 % which was baked at 190°C .

Similarly, Ureta *et al.* 2014 reported the effect of baking temperature 140°C - 220°C on fat content of muffins, as the baking temperature increases from

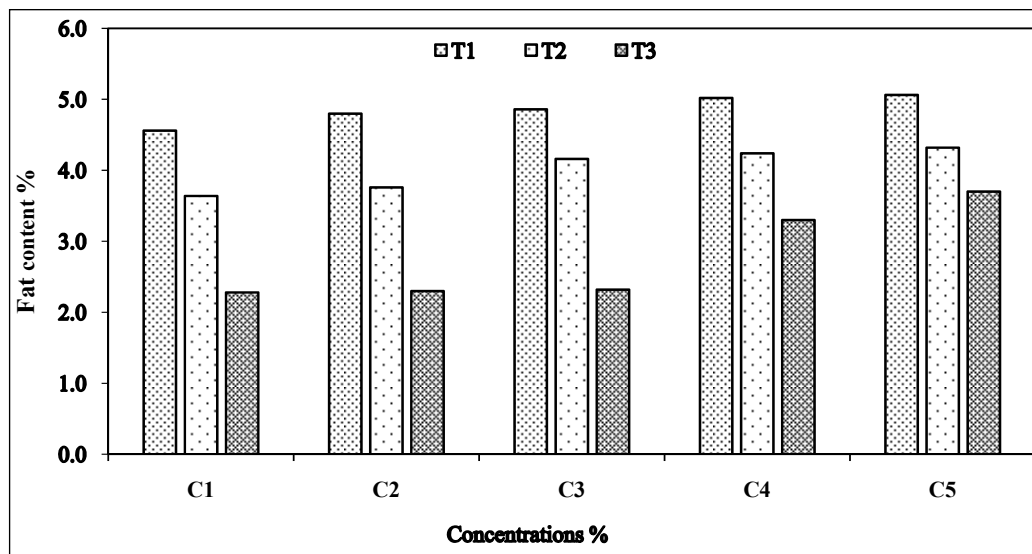


Fig. 4: Effect of concentrations (%) of Dried Cashew apple flour and temperature(°C) on Fat content of Muffins. (C1 = 5 % Cashew apple flour; C2 = 10 % Cashew apple flour; C3 = 15% Cashew apple flour; C4 = 20% Cashew apple flour, C5 = 25 % Cashew apple flour). T1 = 180°; T2 = 200°; T3 = 220°)

Table 2: Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on Fat content of Muffins

Concentrations Temperature	T1	T2	T3	Mean A
C1	4.560±0.03	3.640±0.05	2.280±0.04	3.493
C2	4.800±0.01	3.760±0.04	2.300±0.02	3.620
C3	4.860±0.04	4.160±0.02	2.320±0.03	3.780
C4	5.020±0.01	4.240±0.01	3.300±0.01	4.186
C5	5.063±0.01	4.320±0.03	3.700±0.04	4.361
Control	3.710±0.02			
Mean B	4.860	4.024	2.780	
Factors	C.D.			SE(m)
Factor(A)	0.453			0.151
Factor(B)	0.351			0.117
Factor (A × B)	0.783			0.261

Cashew apple flour: Refined Wheat Flour (C1=5:95, C2=10:90, C3=15:85, C4=20:80, C5=25:75) Baking Temperature (T1;180°, T2;200°, T3;220°)

140°C-220 °C the fat content of muffins decreases from 5.07 % to 2.79 %.

Shrivastava *et al.* 2015 reported the fat content 12.57 % to 14.86 % in cupcake prepared from jackfruit seed flour up to 5-15% with replacement of wheat flour and cake was baked at 190°C. Aigal *et al.* 2017 reported that the fat content in cake prepared by various

composition Foxtail millet, Rice flakes, Oat flakes which was 0.53%, 1.39% and 8.41% respectively.

Effect of concentrations (%) of Dried Cashew apple flour and baking temperature(°C) on Fat content of Muffins

Fig. 5 shows the effect of various concentrations of

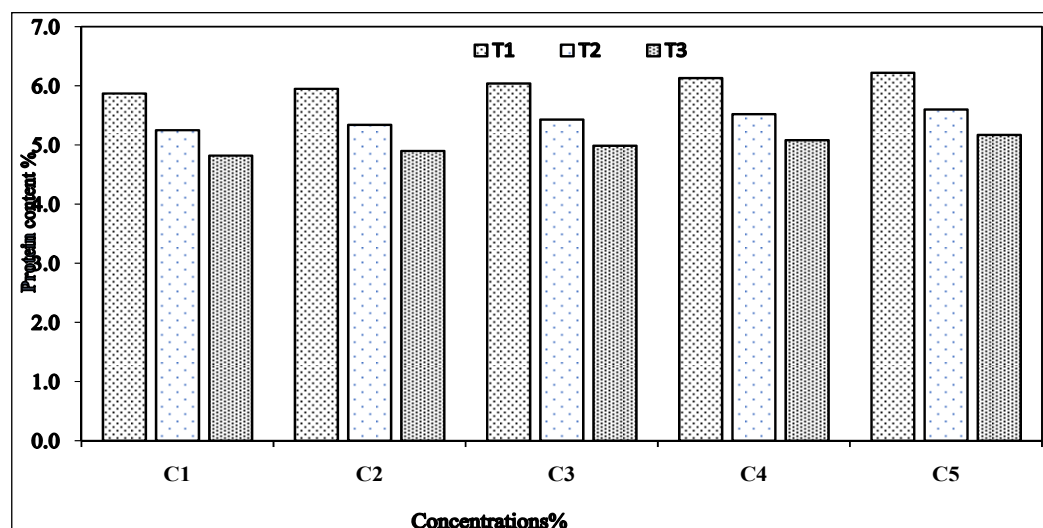


Fig. 5: Effect of concentrations (%) of Dried Cashew apple flour and temperature(°C) on Protein content of Muffins. (C1 = 5 % Cashew apple flour; C2 = 10 % Cashew apple flour; C3 = 15% Cashew apple flour; C4 = 20% Cashew apple flour, C5 = 25 % Cashew apple flour). T1 = 180°; T2 = 200°; T3 = 220°)

Table 3: Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on Protein content of Muffins

Temperature	Concentrations			Mean A
	T1	T2	T3	
C1	5.870±0.08	5.250±0.08	4.820±0.03	5.313
C2	5.950±0.03	5.340±0.01	4.900±0.07	5.396
C3	6.040±0.07	5.430±0.03	4.987±0.01	5.485
C4	6.130±0.03	5.520±0.09	5.080±0.09	5.576
C5	6.220±0.01	5.600±0.01	5.170±0.07	5.663
Control	6.302±0.02			
Mean B	6.042	5.428	4.991	
Factors	C.D.			SE(m)
Factor(A)	0.017			0.006
Factor(B)	0.015			0.005
Factor (A × B)	0.029			0.010

Cashew apple flour: Refined Wheat Flour (C1=5:95, C2=10:90, C3=15:85, C4=20:80, C5=25:75) Baking Temperature (T1;180°, T2;200°, T3;220°)

cashew apple flour (i.e. 5%, 10%, 15%, 20% and 25%) and baking temperatures (i.e. 180°C, 200°C, 220°C) on the protein content % of dried cashew apple flour muffins. The protein content for muffins for all the concentration were range of 4.820±0.03 to 6.220±0.01%. As the concentrations increases, the protein content increases 4.820±0.03 to 6.220±0.01%. and baking temperature increases from 180°C to 220°C the protein content of dried cashew apple flour

muffins decreases from 6.220±0.01 % to 4.820±0.03% respectively. The protein content of the control sample was 6.302±0.02%. As both the dried cashew apple flour (%) and baking temperature (°C) increase the combined effect of these two shows that the protein content of the muffins shows the increasing and decreasing trend.

Table 3 shows the ANOVA for effect of various concentrations (C1=5%, C2=10%, C3=15%, C4=20%,

C5=25%) and baking temperature(°C) on protein content % of dried cashew apple flour muffins was significant at $p \leq 0.05$. Similarly, the effect of baking temperatures (i.e., T1=180°C, T2=200°C, T3=220°C) on protein content % of dried cashew apple flour muffins has significant at $p \leq 0.05$. The interactive effect of concentrations (%) and temperature (°C) of baking on protein content % was also significant at $p \leq 0.05$. Protein content of dried cashew apple flour muffins increases in incorporation of cashew apple flour from 5 % to 25 % respectively, because dried cashew apple flour replaces a portion of the wheat flour in muffin formulations, the overall protein content of the composite flour blend increases (Ureta *et al.* 2014).

Similar result was observed by Ramaya and Anitha., 2020 for coconut flour muffins. As the concentration of coconut flour increases 0 % to 25 % the protein content of the muffins increased from 8.80 % to 10.90 %. Similarly, Yilmazer *et al.* 2013 reported the effect of baking temperature 145°C-175 °C on protein content of muffins, as the baking temperature increases from 145°C-175 °C the protein content of muffins decreases from 8.07 % to 5.46 %.

Khan *et al.* 2016 reported the protein content in jackfruit seed flour increased from 6.21 to 8.32 % with increase in level of jackfruit seed flour in cupcake. This might be due to presence of higher protein content in jackfruit seed flour. David, 2016 reported that the protein content in cupcake was range from 7.71 to 8.48 % with increase in incorporation of jackfruit seed flour 5 % to 15 % which was baked at 190 °C.

Yildiz *et al.* 2014 reported that the protein content of wheat and chesnutflour-based cupcakes was found 9.38 and 5.40% which was baked at 175°C to 180 °C.

Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on Ash content of Muffins

Fig. 6 shows the effect of various concentrations of cashew apple flour (i.e. 5%, 10%, 15%, 20% and 25%) and baking temperatures (i.e. 180°C, 200°C, 220°C) on the ash content % of dried cashew apple flour muffins. The ash content for muffins for all the concentration were range of 0.374 to 0.660±0.05%. As the concentrations increases, the ash content increases 0.374 to 0.660±0.05 %. and baking temperature increases from 180°C to 220°C the ash content of dried cashew apple flour muffins decreases from

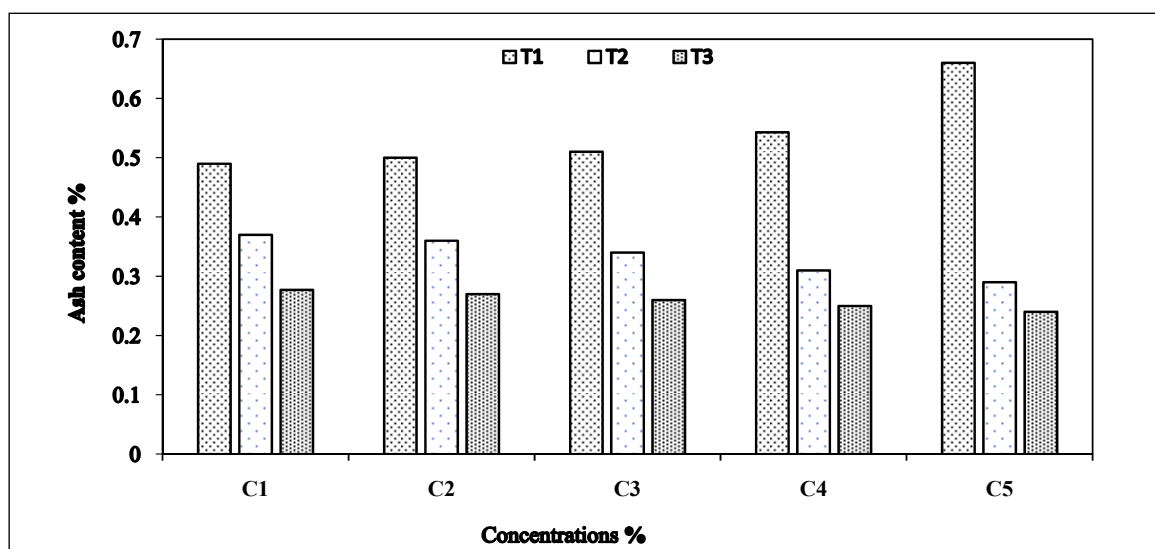


Fig. 6: Effect of concentrations (%) of Dried Cashew apple flour and temperature(°C) on Ash content of Muffins. (C1 = 5 % Cashew apple flour; C2 = 10 % Cashew apple flour; C3 = 15% Cashew apple flour; C4 = 20% Cashew apple flour, C5 = 25 % Cashew apple flour). T1 = 180°; T2 = 200°; T3 = 220°)

Table 4: Table4Effect of concentrations (%) of Dried Cashew apple flour and baking temperature(°C) on Ash content of Muffins

Temperature	Concentrations			Mean A
	T1	T2	T3	
C1	0.490±0.02	0.389±0.07	0.374±0.09	0.417
C2	0.500±0.05	0.410±0.06	0.396±0.04	0.435
C3	0.510±0.05	0.457±0.03	0.407±0.06	0.458
C4	0.543±0.05	0.525±0.01	0.512±0.03	0.526
C5	0.660±0.05	0.570±0.07	0.501±0.07	
Control		0.503±0.04		
Mean B	0.540	0.470	0.438	
Factors	C.D.			SE(m)
Factor(A)	0.021			0.007
Factor(B)	0.017			0.006
Factor (A × B)	0.038			0.013

Cashew apple flour: Refined Wheat Flour (C1=5:95, C2=10:90, C3=15:85, C4=20:80, C5=25:75) Baking Temperature (T1;180°, T2;200°, T3;220°)

0.660±0.05 % to 0.374% respectively. The ash content of the control sample was 0.503±0.04 As both the dried cashew apple flour (%) and baking temperature (°C) increase the combined effect of these two shows that the ash content of the muffins shows the increasing and decreasing trend.

Table 4 shows the ANOVA for effect of various concentrations (C1=5%, C2=10%, C3=15%, C4=20%, C5=25%) and baking temperature(°C) on ash content % of dried cashew apple flour muffins was significant at $p \leq 0.05$. Similarly, the effect of baking temperatures (i.e., T1=180°C, T2=200°C, T3=220°C) on ash content % of dried cashew apple flour muffins has significant at $p \leq 0.05$. The interactive effect of concentrations (%) and temperature (°C) of baking on ash content % was also significant at $p \leq 0.05$. The higher content of dried cashew apple flour muffins decreases with increasing baking temperature because thermal degradation and denaturation of protein content during baking process. Excessive heat can cause the Maillard reaction and thermal degradation (Akinwale *et al.* 2014).

Similar result was observed by Ramaya and Anitha., 2020 for coconut flour muffins. As the concentration of coconut flour increases 0 % to 25 % the ash content of

the muffins increased from 1.62 % to 1.77 %. Similarly, Ramaya and Anitha., 2020 reported the effect of baking temperature 140°C-180 °C on ash content of muffins, as the baking temperature increases from 140°C-180 °C the ash content of muffins decreases from 0.96 % to 1.46 %.

David, 2016 reported that the fat content in cupcake was range from 1.43 to 2.43 % with increase in incorporation of jackfruit seed flour 5 % to 15 % which was baked at 190 °C.

Khalifa *et al.* 2015 reported the ash content as 1.45 to 1.72 % in cupcake from potato peels residue with wheat flour. Salunkhe *et al.* 2015 reported the ash content ranges from 1.54 to 1.87 % in cake formulated by *ragi* flour and wheat flour with peanut butter combination ratio was (10:90, 20:80, 30:70). Aigal *et al.* 2022 reported that the ash content in cake prepared by various composition Foxtail millet, Rice flakes, Oat flakes which was 1.23 %, 2.47 % and 2.49 % respectively.

Effect of concentrations (%) of Dried Cashew apple flour and baking temperature(°C) on Carbohydrate content of Muffins

Fig. 7 shows the effect of various concentrations of

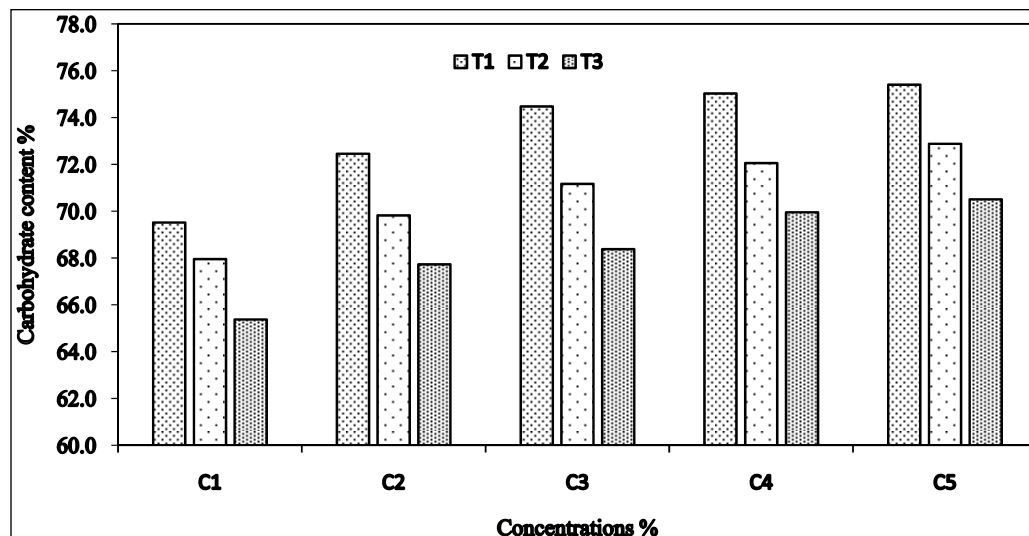


Fig. 7: Effect of concentrations (%) of Dried Cashew apple flour and temperature(°C) on Carbohydrate content of Muffins. (C1= 5 % Cashew apple flour; C2 = 10 % Cashew apple flour; C3 = 15% Cashew apple flour; C4 = 20% Cashew apple flour, C5 = 25 % Cashew apple flour). T1 = 180°; T2 = 200°; T3 = 220°)

cashew apple flour (i.e. 5%, 10%, 15%, 20% and 25%) and baking temperatures (i.e. 180°C, 200°C, 220°C) on the carbohydrate content % of dried cashew apple flour muffins. The carbohydrate content for muffins for all the concentration were range of 65.380 ± 0.04 to 75.410 ± 0.02 %. As the concentrations increases, the carbohydrate content increases and baking temperature increases from 180°C to 220°C the carbohydrate content of dried cashew apple flour muffins decreases from 75.410 ± 0.02 % to 65.380 ± 0.04 respectively. The carbohydrate content of the control sample was 58.31 ± 0.01 %. As both the dried cashew apple flour (%) and baking temperature (°C) increase the combined effect of these two shows that the carbohydrate content of the muffins shows the increasing and decreasing trend.

Table 5 shows the ANOVA for effect of various concentrations (C1 = 5%, C2 = 10%, C3 = 15%, C4 = 20%, C5 = 25%) and baking temperature(°C) on carbohydrate content % of dried cashew apple flour muffins was significant at $p \leq 0.05$. Similarly, the effect of baking temperatures (i.e., T1=180°C, T2=200°C, T3=220°C) on carbohydrate content % of dried cashew apple flour muffins has significant at $p \leq 0.05$. The interactive effect of concentrations (%) and temperature (°c) of baking on carbohydrate content %

was also significant at $p \leq 0.05$. Carbohydrate content of dried cashew apple flour muffins increases in incorporation of cashew apple flour from 5 % to 25 % respectively, because baking process removes water through evaporation as water lost, the dry matter concentration increase, including carbohydrates like sugar, starches and fiber content (Ureta *et al.* 2014).

Similar result was observed by Ramaya and Anitha., 2020 for coconut flour muffins. As the concentration of coconut flour increases 0 % to 25 % the carbohydrate content of the muffins increased from 55.15 to 79.50%. Similarly, Ureta *et al.* 2014 reported the effect of baking temperature 140°C-220°C on carbohydrate content of muffins, as the baking temperature increases from 140°C-220 °C the carbohydrate content of muffins decreases from 67.45% to 59.04 %.

David, 2016 reported that the carbohydrate content in cupcake was range from to 54.31 % to 56.87 %. with increase in incorporation of jackfruit seed flour 5 % to 15 % which was baked at 190 °C.

Similarly, Shrivastava *et al.* 2015 reported the effect of baking temperature 170°C-190°C on carbohydrate content of muffins, as the baking temperature increases from 170°C-190°C the carbohydrate content of muffins decreases from 67.45% to 59.04 %.

Table 5: Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on Carbohydrate content of Muffins

Temperature	Treatments			Mean A
	T1	T2	T3	
C1	69.520±0.01	67.960±0.02	65.380±0.03	67.620
C2	72.460±0.02	69.820±0.04	67.730±0.07	70.00
C3	74.480±0.01	71.170±0.03	68.383±0.06	71.344
C4	75.030±0.06	72.060±0.05	69.960±0.08	72.350
C5	75.410±0.07	72.880±0.06	70.510±0.09	72.933
Control	68.31±0.01			
Mean B	73.380	70.778	68.392	
Factors	C.D.			SE(m)
Factor(A)	0.033			0.011
Factor(B)	0.026			0.009
Factor (A × B)	0.060			0.020

Cashew apple flour: Refined Wheat Flour (C1=5:95, C2=10:90, C3=15:85, C4=20:80, C5=25:75) Baking Temperature (T1;180°, T2;200°, T3;220°)

Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on Fiber content of Muffins

Fig. 8 shows the effect of various concentrations of cashew apple flour (i.e. 5%, 10%, 15%, 20% and 25%) and baking temperatures (i.e. 180°C, 200°C, 220°C) on the fiber content % of dried cashew apple flour muffins. The fiber content for muffins for all the concentration were range of 6.200±0.02 to 8.953±0.02%. As the concentrations increases, the fiber content increases 6.200±0.02 to 8.953±0.02% and baking temperature increases from 180°C to 220°C the fiber content of dried cashew apple flour muffins decreases from 8.953±0.02% to 6.200±0.02% respectively. The fiber content of the control sample was 8.45±0.05 %. As both the dried cashew apple flour (%) and baking temperature (°C) increase the combined effect of these two shows that the fiber content of the muffins shows the increasing and decreasing trend.

Table 6 shows the ANOVA for effect of various concentrations (C1=5%, C2=10%, C3=15%, C4=20%, C5=25%) and baking temperature(°C) on fiber content % of dried cashew apple flour muffins was significant at $p \leq 0.05$. Similarly, the effect of baking temperatures (i.e., T1=180°C, T2=200°C, T3=220°C) on

fiber content % of dried cashew apple flour muffins has significant at $p \leq 0.05$. The interactive effect of concentrations (%) and temperature (°c) of baking on fiber content % was also significant at $p \leq 0.05$. Fiber content of dried cashew apple flour muffins increases in incorporation of cashew apple flour from 5 % to 25 % respectively, because most dietary fibers, especially insoluble fibers like cellulose, hemicellulose and lignin from cashew apple are thermally stable and do not degrade scientifically during baking process (Akyereko *et al.* 2023).

Similar result was observed by Chetana *et al.* 2010 for flaxseed roasted powder muffins. As the concentration offlaxseed roasted powder increases 10 % to 40 % the fiber content of the muffins increased from 3.1 to 15.8%. Khan *et al.* 2016 reported that the fiber content of muffin sample increase with increasing the percentage of jackfruit seed flour from 0.2% to 1.27 % respectively.

David, 2016 reported that the fiber content in cupcake was range from to 2.01 to 5.12%. with increase in incorporation of jackfruit seed flour 5 % to 15 % which was baked at 190 °C.

Salunkhe *et al.* 2015 reported the fiber content ranges from 2.03 to 4.13% in cake formulated by *ragi* flour

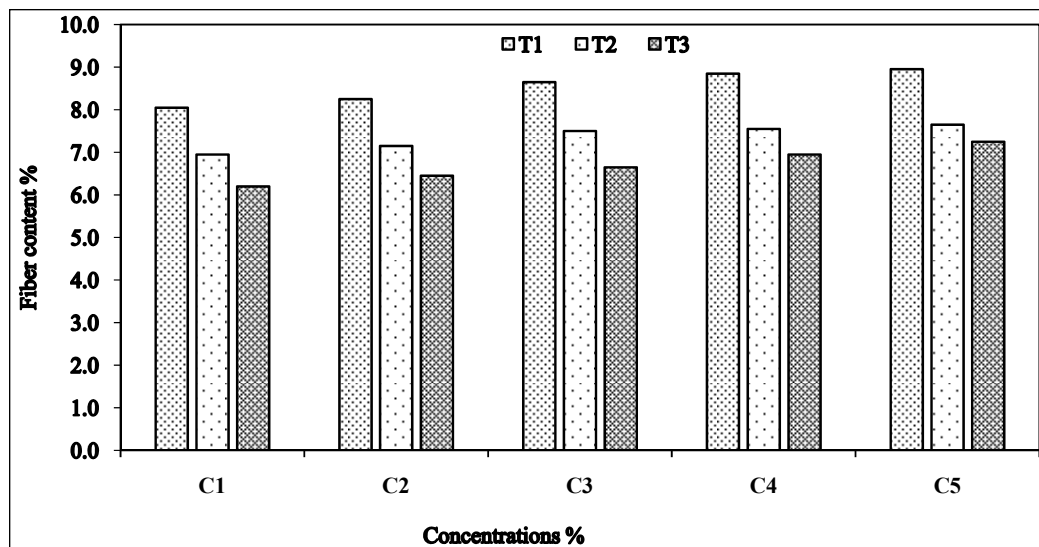


Fig. 8: Effect of concentrations (%) of Dried Cashew apple flour and temperature(°C) on Fiber content of Muffins. C1 = 5 % Cashew apple flour; C2 = 10 % Cashew apple flour; C3 = 15% Cashew apple flour; C4 = 20% Cashew apple flour, C5 = 25 % Cashew apple flour). T1 = 180°; T2 = 200°; T3 = 220°)

Table 6: Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on Fiber content of Muffins

Temperature	Concentrations			Mean A
	T1	T2	T3	
C1	8.050±0.04	6.950±0.08	6.200±0.07	7.066
C2	8.250±0.01	7.150±0.03	6.450±0.09	7.283
C3	8.650±0.06	7.500±0.07	6.650±0.06	7.600
C4	8.847±0.07	7.550±0.06	6.950±0.08	7.782
C5	8.953±0.02	7.650±0.03	7.250±0.09	7.95
Control	8.45±0.05			
Mean B	8.500	7.360	6.700	
Factors	C.D.			SE(m)
Factor(A)	0.030			0.010
Factor(B)	0.023			0.008
Factor (A × B)	0.052			0.018

Cashew apple flour: Refined Wheat Flour (C1=5:95, C2=10:90, C3=15:85, C4=20:80, C5=25:75) Baking Temperature (T1;180°, T2;200°, T3;220°)

and wheat flour with peanut butter combination ratio was (10:90, 20:80, 30:70).

Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on browning index of Muffins

Fig. 9 shows the effect of various concentrations of

cashew apple flour (i.e. 5%, 10%, 15%, 20% and 25%) and baking temperatures (i.e. 180°C, 200°C, 220°C) on the browning index of dried cashew apple flour muffins. The browning index for muffins for all the concentration were range of 96.262 to 216.628%. As the concentrations increases, the browning index increases and baking temperature increases from

180°C to 220°C the browning index of dried cashew apple flour muffins increases from 96.262 to 216.628% respectively. The BI of the control sample was 243.51%. As both the dried cashew apple flour (%) and baking temperature (°C) increase the combined effect of these two shows that the Browning index of the muffins shows the increasing trend.

Browning index of dried cashew apple flour muffins increases in incorporation of cashew apple flour from 5 % to 25 % and baking temperature

from 180°C, 200°C, 220°C respectively, because the baking process alters the surface properties of the food and subsequently changes light reflection and product colour. Moreover, heat and oxidation that occur during the baking procedure causes chemical changes. It means changes in colour parameters from lighter yellow to darker yellow (Hortuz *et al.* 2017).

Table 7 shows the ANOVA for effect of various concentrations (C1=5%, C2=10%, C3=15%, C4=20%, C5=25%) and baking temperature(°C) on BI of dried

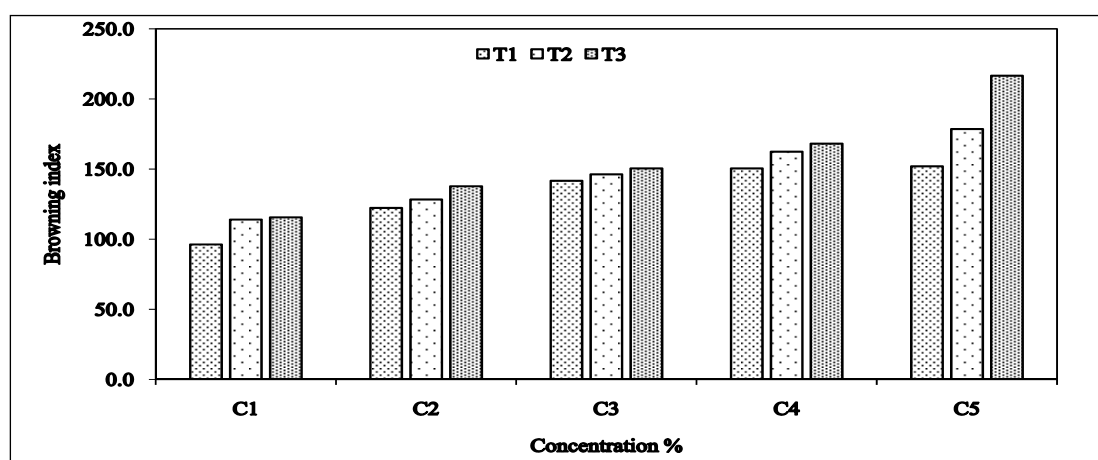


Fig. 9: Effect of concentrations (%) of Dried Cashew apple flour and temperature(°C) on Browning index of Muffins. C1 = 5 % Cashew apple flour; C2 = 10 % Cashew apple flour; C3 = 15%Cashew apple flour; C4 = 20% Cashew apple flour, C5 = 25 % Cashew apple flour). T1 = 180°; T2 = 200°; T3 = 220°)

Table 7: Effect of concentrations (%) of Dried Cashew apple flour and baking temperature(°C) on browning index of Muffins

Temperature	Treatments			Mean A
	T1	T2	T3	
C1	96.262±0.02	114.017±0.07	115.641±0.12	108.64
C2	122.318±0.09	128.403±0.17	137.823±0.06	129.51
C3	141.724±0.07	146.270±0.15	150.521±0.11	146.17
C4	150.585±0.13	162.428±0.11	168.243±0.07	160.41
C5	152.005±0.09	178.622±0.07	216.628±0.13	182.44
Control	143.51±0.13			
Mean B	132.56	146.00	157.80	
Factors	C.D.			SE(m)
Factor(A)	12.801			4.514
Factor(B)	9.916			3.496
Factor (A × B)	22.172			7.818

Cashew apple flour: Refined Wheat Flour (C1=5:95, C2=10:90, C3=15:85, C4=20:80, C5=25:75) Baking Temperature (T1;180°, T2;200°, T3;220°)

cashew apple flour muffins was significant at $p \leq 0.05$. Similarly, the effect of baking temperatures (i.e., T1=180°C, T2=200°C, T3=220°C) on BI of dried cashew apple flour muffins has significant at $p \leq 0.05$. The interactive effect of concentrations (%) and temperature (°C) of baking on BI content % was also significant at $p \leq 0.05$.

Similarly, Ureta *et al.* 2014 reported the effect of baking temperature 140°C-220 °C on Browning index of muffins, as the baking temperature increases from 140°C-220 °C the BI of muffins increases from 105 to 180 %. Similarly, Kumar *et al.* 2021 reported the effect of baking temperature 170°C-190°C on browning index of encapsulated squalene enriched muffins, as the baking temperature increases from 170°C-190°C the BI of muffins increases from 112.51 to 136.97 % respectively.

Aigal *et al.* reported that the value for the browning index for cake prepared by various composition foxtail millet, rice flakes, oat flakes which was 13.73-31.39 %.

Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on sensory colour of Muffins

Fig. 10 shows the effect of various concentrations

of cashew apple flour (i.e., 5%, 10%, 15%, 25%) and baking temperatures (i.e. 180°C, 200°C, 220°C) on the sensory colour of dried cashew apple flour muffins. It was observed that the range of sensory colour for all concentrations and baking temperatures was from 6.640 ± 0.07 to 8.180 ± 0.15 .

Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 5% (C1) had received sensory color score of, 7.820, 7.980 and 7.040, respectively. Muffins baked at temperatures of 180°C(T1), 200°C(T2) and 220°C(T3) and used concentration percentage is 10% (C2) had received sensory color score of, 7.480, 7.920 and 7.520. Muffins baked at temperatures of 180°C(T1), 200°C(T2) and 220°C(T3) and used concentration percentage is 15% (C3) had received sensory color score of, 8.180, 7.980 and 7.800, respectively. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 20% (C4) had received sensory color score of, 6.720, 7.720 and 6.640. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 25% (C5) had received sensory color score of 7.020, 7.740 and 7.880, respectively. From all five concentrations and three baking temperatures at 180°C, Treatment

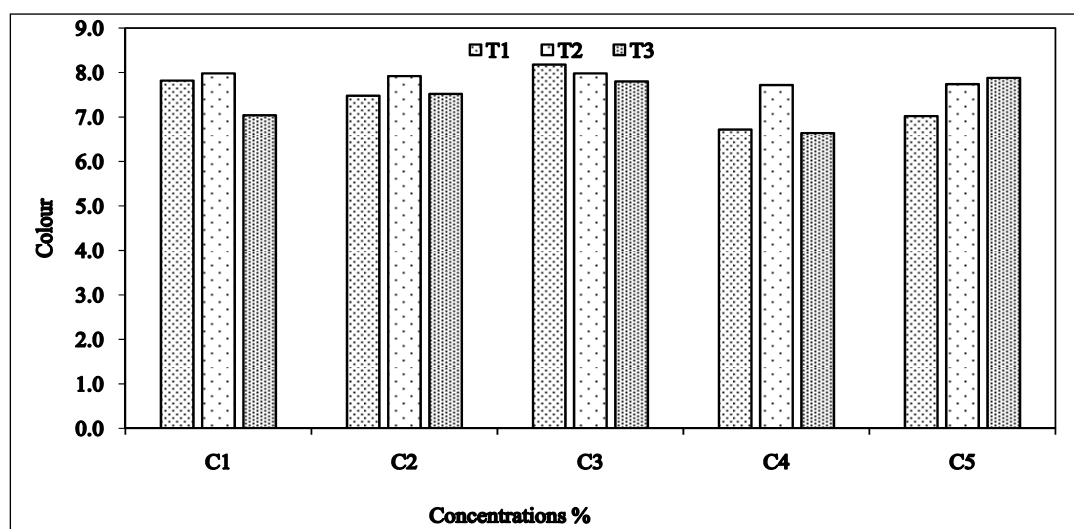


Fig. 10: Effect of concentrations (%) of Dried Cashew apple flour and temperature(°C) on sensory Colour of Muffins. C1 = 5 % Cashew apple flour; C2 = 10 % Cashew apple flour; C3 = 15% Cashew apple flour; C4 = 20% Cashew apple flour, C5 = 25 % Cashew apple flour). T1 = 180°; T2 = 200°; T3 = 220°)

Table 8: Effect of concentrations (%) of Dried Cashew apple flour and baking temperature on sensory colour of Muffins

Temperature	Concentrations			Mean A
	T1	T2	T3	
C1	7.820±0.12	7.980±0.07	7.040±0.10	7.613
C2	7.480±0.07	7.920±0.02	7.520±0.07	7.640
C3	8.180±0.15	7.980±0.07	7.800±0.09	7.987
C4	6.720±0.13	7.720±0.12	6.640±0.14	7.027
C5	7.020±0.07	7.740±0.12	7.880±0.07	7.547
Control	8.02±0.12			
Mean B	7.444	7.868	7.376	
Factors	C.D.			SE(m)
Factor(A)	0.084			0.030
Factor(B)	0.069			0.023
Factor (A × B)	0.153			0.051

Cashew apple flour: Refined Wheat Flour (C1=5:95, C2=10:90, C3=15:85, C4=20:80, C5=25:75) Baking Temperature (T1;180°, T2;200°, T3;220°)

C3T1 gives higher sensory score. The sensory score for the control sample was 8.02. Colour of treatment C3T1 was liked by sensory panel.

Table 8 shows that the effect of concentrations (%) of Dried Cashew apple flour and temperature on Colour of Muffins was significant at $p \leq 0.05$.

Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on sensory flavour of Muffins

Fig. 11 shows the effect of various concentrations of cashew apple flour (i.e., 5%, 10%, 15%, 25%) and baking temperatures (i.e. 180°C, 200°C, 220°C) on the sensory colour of dried cashew apple flour muffins. It was observed that the range of sensory flavour for all concentrations and baking temperatures was from 6.700±0.14 to 8.100±0.11.

Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 5% (C1) had received sensory flavour score of, 7.540, 7.920 and 7.460, respectively. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 10% (C2) had received sensory flavour score of, 6.700, 7.960 and 7.500. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used

concentration percentage is 15% (C3) had received sensory flavour score of, 8.100, 7.820 and 6.740, respectively. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 20% (C4) had received sensory flavour score of 7.060, 6.840 and 7.100. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 25% (C5) had received sensory flavour score of, 6.820, 7.980 and 7.580, respectively. From all five concentrations and three baking temperatures at 180°C, Treatment C3T1 gives higher sensory score. The sensory score for the control sample was 8.00. Flavour of treatment C3T1 was liked by sensory panel.

Table 9 shows that the effect of concentrations (%) of Dried Cashew apple flour and temperature on flavour of Muffins was significant at $p \leq 0.05$.

Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on sensory taste of Muffins

Fig. 12 shows the effect of various concentrations of cashew apple flour (i.e., 5%, 10%, 15%, 25%) and baking temperatures (i.e. 180°C, 200°C, 220°C) on the sensory taste of dried cashew apple flour muffins is shown in Fig. 10. It was observed that the range

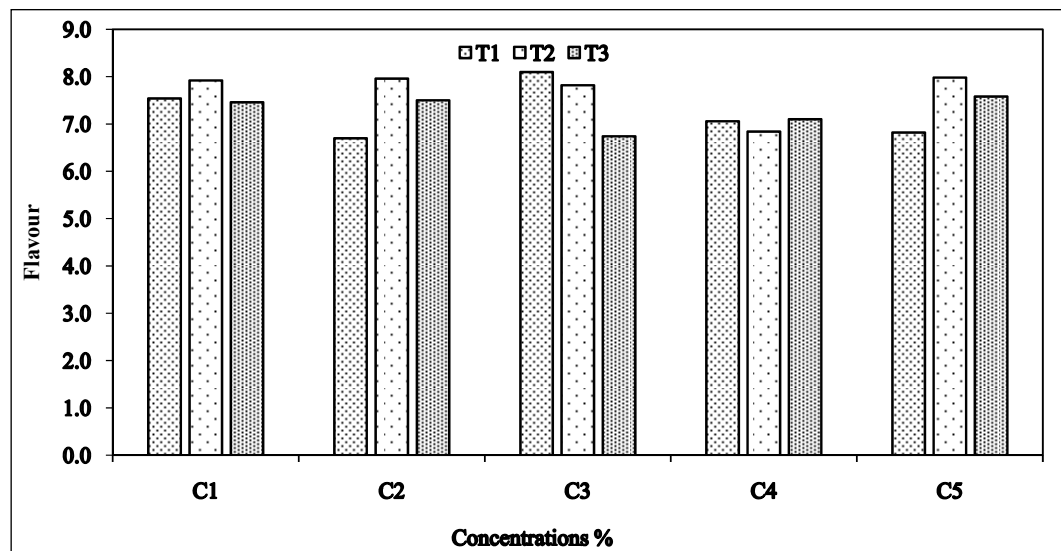


Fig. 11: Effect of concentrations (%) of Dried Cashew apple flour and temperature(°C) on sensory flavour of Muffins. C1 = 5 % Cashew apple flour; C2 = 10 % Cashew apple flour; C3 = 15% Cashew apple flour; C4 = 20% Cashew apple flour, C5 = 25 % Cashew apple flour). T1 = 180°; T2 = 200°; T3 = 220°)

Table 9: Effect of concentrations (%) of Dried Cashew apple flour and temperature on sensory flavour of Muffins

Temperature	Concentrations			Mean A
	T1	T2	T3	
C1	7.540±0.10	7.920±0.07	7.460±0.10	7.640
C2	6.700±0.14	7.960±0.10	7.500±0.09	7.387
C3	8.100±0.11	7.820±0.07	6.740±0.14	7.553
C4	7.060±0.08	6.840±0.10	7.100±0.11	7.000
C5	6.820±0.07	7.980±0.07	7.580±0.12	7.460
Control	8.00±0.09			
Mean B	7.244	7.704	7.276	
Factors	C.D.			SE(m)
Factor(A)	0.087			0.029
Factor(B)	0.064			0.023
Factor (A × B)	0.153			0.051

Cashew apple flour: Refined Wheat Flour (C1=5:95, C2=10:90, C3=15:85, C4=20:80, C5=25:75) Baking Temperature (T1;180°, T2;200°, T3;220°)

of sensory taste for all concentrations and baking temperatures was from 6.700±0.11 to 8.260±0.10.

Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 5% (C1) had received sensory taste score of, 7.800, 6.900 and, 7.580 respectively. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C

(T3) and used concentration percentage is 10% (C2) had received sensory taste score of, 7.960, 7.820 and 6.760. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 15% (C3) had received sensory taste score of, 8.260, 7.080 and 7.740 respectively. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and

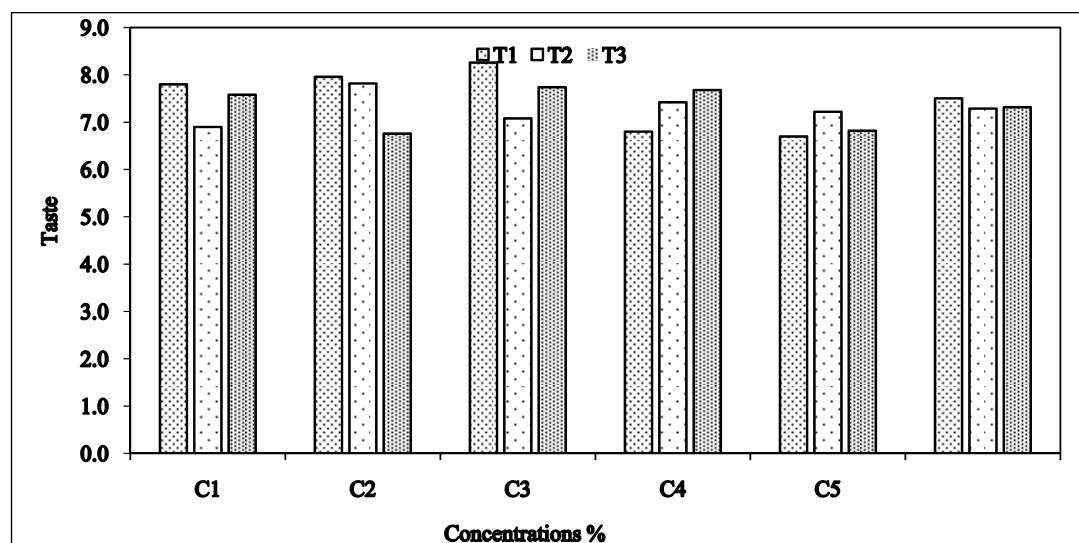


Fig. 12: Effect of concentrations (%) of Dried Cashew apple flour and temperature(°C) on sensory taste of Muffins. C1 = 5 % Cashew apple flour; C2 = 10 % Cashew apple flour; C3 = 15% Cashew apple flour; C4 = 20% Cashew apple flour, C5 = 25 % Cashew apple flour). T1 = 180°; T2 = 200°; T3 = 220°)

Table 10: Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on sensorytaste of Muffins

Concentrations Temperature	Concentrations			Mean A
	T1	T2	T3	
C1	7.800±0.11	6.900±0.09	7.580±0.15	7.427
C2	7.960±0.10	7.820±0.07	6.760±0.12	7.513
C3	8.260±0.10	7.080±0.09	7.740±0.12	7.693
C4	6.800±0.11	7.420±0.07	7.680±0.09	7.300
C5	6.700±0.11	7.220±0.12	6.820±0.07	6.913
Control	8.14±0.14			
Mean B	7.504	7.288	7.316	
Factors	C.D.			SE(m)
Factor(A)	0.084			0.030
Factor(B)	0.065			0.023
Factor (A × B)	0.153			0.051

Cashew apple flour: Refined Wheat Flour (C1=5:95, C2=10:90, C3=15:85, C4=20:80, C5=25:75) Baking Temperature (T1;180°, T2;200°, T3;220°)

220°C (T3) and used concentration percentage is 20% (C4) had received sensory taste score of, 6.800, 7.420, 7.680. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 25% (C5) had received sensory taste score of, 6.700, 7.220 and 6.820 respectively. From all five concentrations and three baking temperatures at

180°C, Treatment C3T1 gives higher sensory score. The sensory score for the control sample was 8.14. Taste of treatment C3T1 was liked by sensory panel.

Table 10 shows that the effect of concentrations (%) of Dried Cashew apple flour and temperature on Taste of Muffins was significant at $p \leq 0.05$.

Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on sensory texture of Muffins

Fig. 13 shows the effect of various concentrations of cashew apple flour (i.e., 5%, 10%, 15%, 25%) and baking temperatures (i.e. 180°C, 200°C, 220°C) on the sensory texture of dried cashew apple flour muffins. It was observed that the range of sensory texture for all concentrations and baking temperatures was from 6.660 ± 0.15 to 8.240 ± 0.12 .

Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 5% (C1) had received sensory texture score of, 7.920, 7.520 and 7.260 respectively. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 10% (C2) had received sensory texture score of, 6.780, 6.980 and 7.620. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 15% (C3) had received

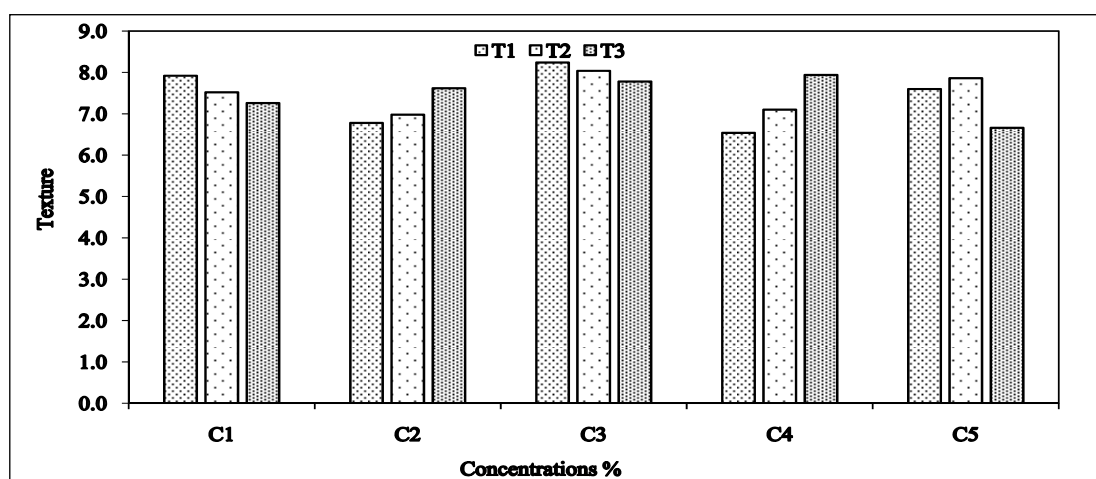


Fig. 13: Effect of concentrations (%) of Dried Cashew apple flour and temperature (°C) on sensory texture of Muffins. C1 = 5 % Cashew apple flour; C2 = 10 % Cashew apple flour; C3 = 15% Cashew apple flour; C4 = 20% Cashew apple flour, C5 = 25 % Cashew apple flour). T1 = 180°; T2 = 200°; T3 = 220°)

Table 11: Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on sensory texture of Muffins

Concentrations	Temperature			Mean A
	T1	T2	T3	
C1	7.920±0.07	7.520±0.06	7.260±0.14	7.567
C2	6.780±0.07	6.980±0.09	7.620±0.12	7.127
C3	8.240±0.12	8.040±0.14	7.780±0.12	8.020
C4	6.540±0.10	7.100±0.09	7.940±0.11	7.193
C5	7.600±0.17	7.860±0.14	6.660±0.15	7.373
Control	8.08±0.07			
Mean B	7.416	7.500	7.452	
Factors	C.D.			SE(m)
Factor(A)	0.099			0.033
Factor(B)	0.078			0.026
Factor (A × B)	0.174			0.058

Cashew apple flour: Refined Wheat Flour (C1=5:95, C2=10:90, C3=15:85, C4=20:80, C5=25:75) Baking Temperature (T1;180°, T2;200°, T3;220°)

sensory texture score of, 8.240, 8.040 and 7.780 respectively. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 20% (C4) had received sensory texture score of, 6.540, 7.100 and 7.940. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 25% (C5) had received sensory texture score of, 7.600, 7.860, 6.660 respectively. From all five concentrations and three baking temperatures at 180°C, Treatment C3T1 gives higher sensory score. The sensory score for the control sample was 8.080. Texture of treatment C3T1 was liked by sensory panel.

Table 11 shows that the effect of concentrations (%) of Dried Cashew apple flour and temperature on Texture of Muffins was significant at $p \leq 0.05$.

Effect of concentrations (%) of Dried Cashew apple flour and baking temperature (°C) on sensory overall acceptability of Muffins

Fig. 14 shows the effect of various concentrations of cashew apple flour (i.e., 5%, 10%, 15%, 25%) and baking temperatures (i.e. 180°C, 200°C, 220°C) on the sensory overall acceptability of dried cashew

apple flour muffins. It was observed that the range of sensory overall acceptability for all concentrations and baking temperatures was from 6.680 ± 0.16 to 8.180 ± 0.06 .

Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 5% (C1) had received sensory overall acceptability score of, 7.780, 7.900 and 7.740 respectively. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 10% (C2) had received sensory overall acceptability score of, 7.880, 7.720, 7.920. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 15% (C3) had received sensory overall acceptability score of, 8.180, 7.820, 7.800 respectively. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 20% (C4) had received sensory overall acceptability score of, 6.800, 7.260, 7.440. Muffins baked at temperatures of 180°C (T1), 200°C (T2) and 220°C (T3) and used concentration percentage is 25% (C5) had received sensory overall acceptability score of, 7.940, 6.680 and 7.740 respectively. From all five concentrations

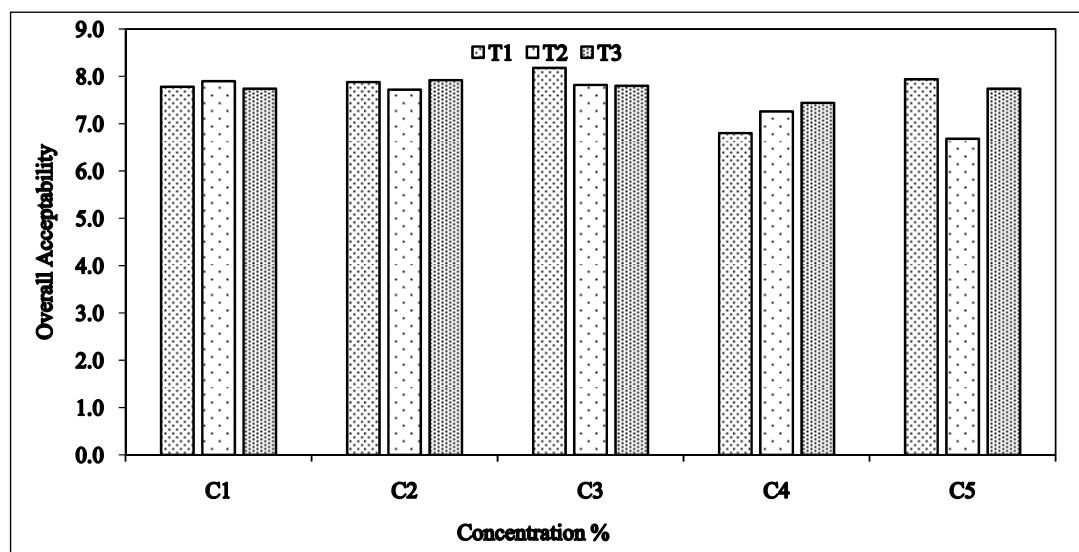


Fig. 14: Effect of concentrations (%) of Dried Cashew apple flour and temperature on sensory overall acceptability of Muffins. C1 = 5 % Cashew apple flour; C2 = 10 % Cashew apple flour; C3 = 15% Cashew apple flour; C4 = 20% Cashew apple flour, C5 = 25 % Cashew apple flour). T1 = 180°; T2 = 200°; T3 = 220°)

Table 12: Effect of concentrations (%) of Dried Cashew apple flour and baking temperature °C on sensory overall acceptability of Muffins

Temperature \ Concentrations	T1	T2	T3	Mean A
C1	7.780±0.12	7.900±0.09	7.740±0.10	7.807
C2	7.880±0.07	7.720±0.15	7.920±0.07	7.840
C3	8.180±0.06	7.820±0.09	7.800±0.09	7.933
C4	6.800±0.09	7.260±0.22	7.440±0.14	7.167
C5	7.940±0.10	6.680±0.16	7.740±0.12	7.453
Control	8.12±0.12			
Mean B	7.716	7.476	7.728	
Factors	C.D.			SE(m)
Factor(A)	0.102			0.034
Factor(B)	0.081			0.027
Factor (A × B)	0.177			0.059

Cashew apple flour: Refined Wheat Flour (C1=5:95, C2=10:90, C3=15:85, C4=20:80, C5=25:75) Baking Temperature (T1;180°, T2;200°, T3;220°)

and three baking temperatures at 180°C, Treatment C3T1 gives higher sensory score. The sensory score for the control sample was 8.12. overall acceptability of treatment C3T1 was liked by sensory panel.

Table 12 shows that the effect of concentrations (%) of Dried Cashew apple flour and temperature on overall acceptability of Muffins was significant at $p \leq 0.05$.

Best Treatment from the concentration and baking temperature of dried cashew apple flour muffins

The desirable properties of dried cashew apple flour muffins i.e., moisture content, protein content, fat content, ash content, fiber and carbohydrate content,

browning index has been achieved at concentration of flour (C3T1): 85%:15% (refined wheat flour and dried cashew apple flour) and baking temperature at 180° as discussed in table 13.

Similarly, the best sensory scores for sensory colour, sensory flavour, sensory taste, sensory texture and sensory overall acceptability have been observed as dried cashew apple flour muffins Concentration (85%:15%); Baking Temperature (180°C) and as shown in Fig. 15. Therefore all these proportion at the best treatment are given in Table 13 and Fig. 15 respectively.

Table 13: Various parameters for the best treatment for dried cashew apple flour muffins Concentration (85%:15%); Baking Temperature (180°C)

Objective Parameters							Sensory Parameters				
MC (%)	Protein (%)	Fat (%)	Ash (%)	Fiber (%)	Carbohydrate (%)	BI	Colour	Flavour	Taste	Texture	OA
13.557	6.040	4.860	0.510	8.650	74.480	141.724	8.180	8.100	8.260	8.240	8.180

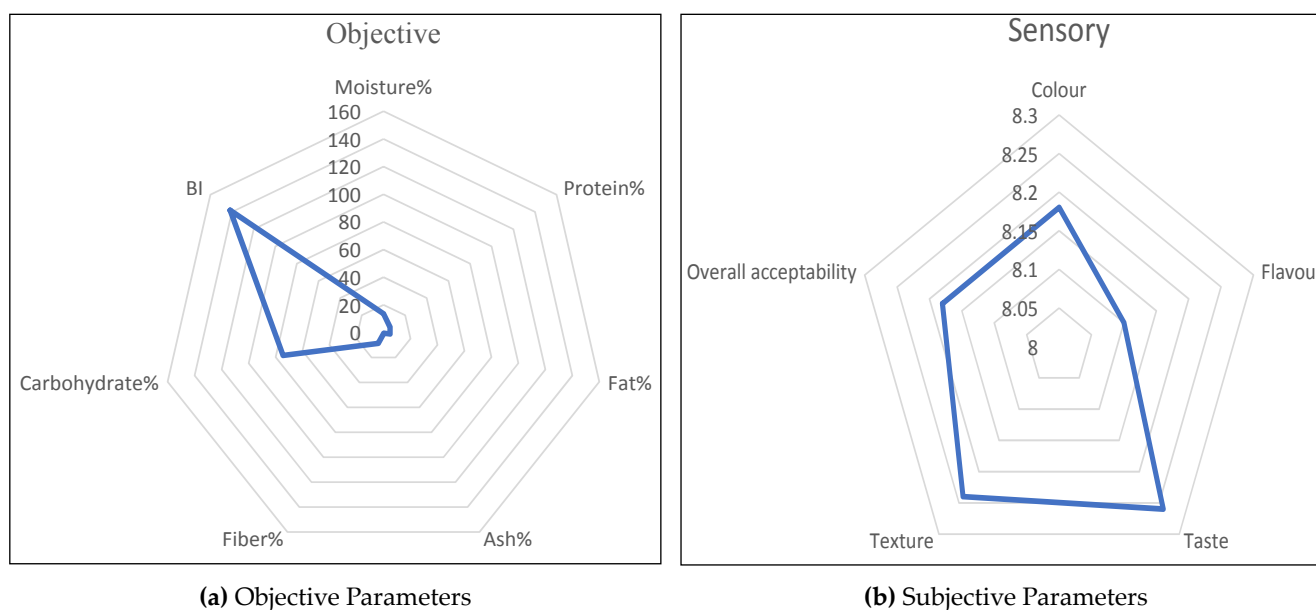


Fig. 15 (a) Objective and (b) Subjective Parameters for Best Treatment. Concentration of flour (C3T1): 85%:15% (refined wheat flour and cashew apple flour) and Baking Temperature: 180°C

CONCLUSION

The muffins prepared from dried cashew apple flour and its quality evaluation revealed that the treatment C3T1 i.e., 85:15% (refined wheat flour and cashew apple flour) and baked at 180°, it is appropriate to prepared muffins having good Moisture content is 13.557 ± 0.02 %, Fat content is 4.860 ± 0.04 %, Protein content is 6.040 ± 0.07 %, Ash content is 0.510 ± 0.05 %, Fiber content is 8.650 ± 0.04 %, and Carbohydrate content is 74.480 ± 0.01 %, Browning index is 141.724 ± 0.09 and with the best sensory properties i.e., Colour (8.180 ± 0.15), Flavour (8.100 ± 0.11), Taste (8.260 ± 0.10), Texture (8.240 ± 0.12) and Overall acceptability (8.180 ± 0.06) respectively.

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