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RESEARCH PAPER

Effect of Packaging Material and Storage Duration on Quality of Jackfruit Seed and Finger Millet Flour Cupcake

Sayali Sunil Kamble and Shrikant Baslingappa Swami*

Department of Post-Harvest Engineering, Post-Graduate Institute of Post-Harvest Technology and Management, Killa-Roha. Dist: Raigad (Maharashtra State) (Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli-Campus Roha) India

*Corresponding author: swami_shrikant1975@yahoo.co.in

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ABSTRACT

In present study the Cupcake prepared from Jackfruit seed and Finger millet flour stored in packaging material i.e. polythene bag (gauge 375) and Plastic tray (gauge 400). The stored cupcake was observed during each day from 0 day to 7 days. Nutritional analysis indicated that both cupcake packed packaging material and during storage period moisture content increases from 24.055 to 9.6%, protein content decreases from 4.59 to 2.27%, fat decreases 11.55 to3.41%, fiber content decreases from 2.25 to 1.05%, ash content decreases from 1.67 to 0.63% carbohydrate increases from 55.95 to 83.02% and Browning index 72.26 to 59.15 and microbiological study depicted. The cupcake prepared from Jackfruit seed and Finger millet flour can be packed at stored in plastic trays for 6 to 7 days.

Keywords: Packaging, Polythene bag and Plastic tray

Bakery products are widely consumed and are becoming a major component of the international food market (Kotsianis *et al.* 2002). Demand for bakery product is increasing at the rate of 10.07% per annum (Khan *et al.* 2016). The annual production of bread, buns and cakes in the country is estimated around 15.2 lakh tonnes (Jyotsna *et al.* 2007). Among the bakery products, cakes being very popular occupy a special place in Indian bakeries.

Cakes are important confectionary and are enjoyed socially within groups. Cupcake is a small cake designed to serve one person. This may be baked in a small thin paper with aluminium cup. Cakes are chemically or mechanically leavened bakery product that is loved by all ages. Wheat flour, eggs, sugar and fat are the major ingredients for making cakes. Among them, egg is the vital ingredient and has high nutritional value and multifunctional properties. Egg yolk provides emulsification, colouring, flavour, and egg gives coagulation, foaming ability and foaming stability (Yang *et al*. 1995). The size distribution of foam bubbles affect the appearance and texture of foamed foods. High-quality cakes have various attributes, including tenderness, high volume, uniform crumb structure, shelf-life (Gelinas *et al.* 1999).

Packaging requirements and storage characteristics of dehydrated foods are determined by Equilibrium Relative Humidity (ERH) of the product (Rai *et al.* 2009). The choice of materials for packaging depends on the nature of the product, storage duration and handling conditions (temperature, humidity, risk of physical deterioration) and other environmental factors (Daramola *et al.* 2010).

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Packaging plays critical role in the food supply chain. The primary function of packaging is to serve as a container for the food enabling efficient transport within the whole supply chain, preventing any physical damage, and protecting against manipulation and theft. Packaging also meets the fundamental need to maintain food quality and safety from production to final consumption by preventing any unwanted chemical and biological changes. Hence, the packaging acts as a barrier to protect the food from environmental influences such as oxygen, moisture, light, dust, pests, volatiles, and both chemical and microbiological contamination (Yildirim, 2011). The protective role of the packaging is primarily passive, acting as a barrier between the food, the atmosphere surrounding the food, and the external environment.

The use of plastic packaging materials is desirable because they are cheaper and easier to handle than cans and glass containers; however, their oxygen and water permeability properties often result in reduced product shelf life (Fernandes and McLellan, 1992). Polyethylene is widely used as a packaging material because of its good mechanical properties and low cost. However, these qualities have been overshadowed by its high non-biodegradable nature, leading to waste disposal problems, particularly in short-term packaging applications (Sailaja and Chanda, 2001).

Cupcake has shelf -life of 7- 8 days. Shelf life of bakery product is mostly characterized by onset of staling and ropiness formed by microbial spoilage. The purpose of the present study was to study effect of two different packaging materials i.e. polythene bag and Plastic tray and storage duration up to 0, 1, 2, 3, 4, 5, 6, and 7 days on developed Cupcake from Jackfruit seed flour and Finger millet flour storage at ambient temperature and its physicochemical and sensorial characteristics.

MATERIALS AND METHODS

Preparation of Cupcake from Jackfruit seed flour and Finger miller flour

Fig. 1 shows the process technology for preparation of Cupcake from Jackfruit seed and Finger millet flour. The 28g of sugar and 21g of water were mixed together and prepared a (4:3) sugar solution. Then egg replacer 4g was added in the sugar solution and mixed well up to foam formation, which was detected through visual observation. The mixture was added with the refined wheat flour (12%), Jackfruit seed flour (14%) and Finger millet flour (10%) as per the treatments to make the flour composition (36%) baking powder and baking soda 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 was poured into mould with butter paper for giving shape to the cupcake. The cupcake were placed in a baking tray and baked in oven at about 170°C for 25-30 min depending upon the temperature condition. The flour combination treatment T_4 is present in Table 1.

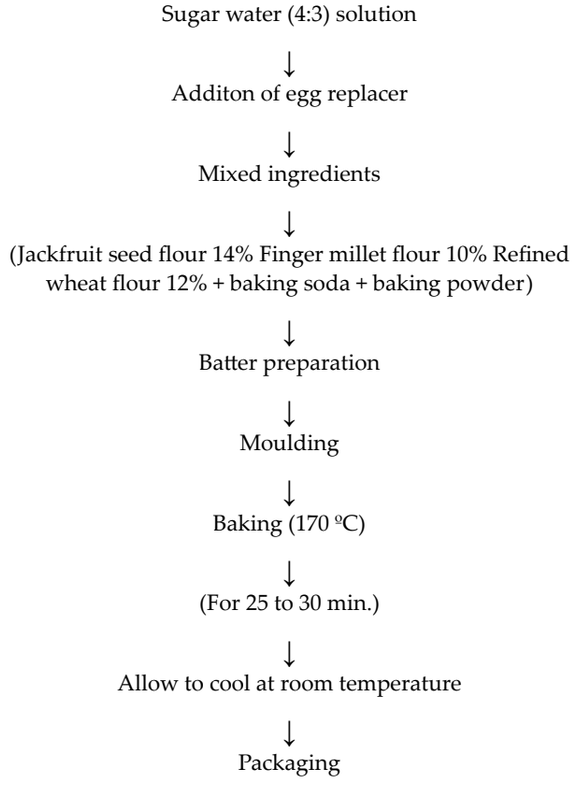

Fig. 1: Process flow chart for preparation of cupcake from Jackfruit seed flour and Finger millet flour

Packaging and storage study of Jackfruit seed and Finger millet Flour

The best treatment of cupcake from Jackfruit seed and Finger millet flour was prepared with the Jackfruit seed flour (14%) and Finger millet flour (10%) was used for the packaging and storage study. The cupcake was prepared as discussed above and taken in two different packaging material i.e. polythene bags and Plastic trays the details of the packaging material are given in Table 1. Fig. 2 (a) and 2 (b) shows the packaging material i.e. polythene bags and plastic tray used for packaging and storage of the cupcake for 7 days duration.

6 sample of cupcakes developed sample having weight around 120g of was filled separately in polythene pouches sealed properly and plastic trays closed carefully. These packets and trays were kept at ambient temperature up to 7 days. The stored samples were analysed at every day up to 7 days. The observations for the sensory analysis Moisture (%), Protein (%), Fat (%), Fibre (%), Ash (%), Carbohydrates (%), Browning index and microbial analysis of stored sample where 8 duration (0, 1, 2, 3, 4, 5, 6 and 7 days) i.e. total no. of samples for all the trials were, 8 duration × 2 packaging material × 3 replication = 48 samples of cupcake prepared from Jackfruit seed and Finger millet flour were kept for storage study. The sensory analysis i.e. colour, flavor, texture, Taste and Overall acceptability and microbial analysis i.e. colony forming unit (CFU/g of sample) for the stored samples were determined for each storage duration i.e. 0, 1, 2, 3, 4, 5, 6, and 7days.

Storage studies

The cupcake from Jackfruit seed and Finger millet packed in polythene and aluminium laminated pouches samples were subjected to storage studies at ambient (30±1°C). The samples stored at ambient temperature were analysed at 0, 1, 2, 3, 4, 5, 6 and 7 days for physico-chemical properties Moisture(%), Protein (%), Fat (%), Fibre (%), Ash (%), Carbohydrates (%), Browning index and microbial analysis and sensory qualities like colour, flavour, texture, taste and daily analysis for microbial count i.e. standard plate counts (SPC).

Table 1: Specifications of packaging material for storage of cupcake

Sl. No.	Packaging Material	Code	Size	Gauge	Capacity
1	Polythene pouches	P_1	15 cm × 9 cm	375	120g
2	Plastic trays	P_2	22 cm×16 cm	400	120g

(a) **(b)**

Fig. 2: Packaging material used for packaging of cupcake **(a)** Polythene pouches **(b)** Plastic trays

Evaluation of Quality Parameter for the Cupcake

1. Moisture content

The moisture content of Cupcake from Jackfruit seed flour and Finger millet flour for treatment P_1 and P_2 for 0, 1, 2, 3, 4, 5, 6, and 7 days were determined by using (AOAC, 2010) The samples were exposed to 105°C ± 1°C for 24 hr in a hot air oven (Make M/s: Aditi Associate, Mumbai. Model: ALO-136) as per the procedure. The experiment were repeated three times and average value was reported.

$$\textit{Moisture content}\ (\%\ \text{db}) = \frac{W_2 - W_1}{W_3 - W_1} \times 100 \qquad \ldots(1)$$

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*

2. Protein

Protein content in the Cupcake from Jackfruit seed flour and Finger millet flour for treatment P_1 and P_2 for 0, 1, 2, 3, 4, 5, 6 and 7 days were determined by using micro-Kjeldahl distillation method (AOAC 1990). The samples 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 was collected in 4% boric acid solution and titrated again with standard HCL. The experiment was repeated three times and average value was reported.

$$\%\ (N) = 1.4 \times (\text{ml HCl} - \text{ml blank}) \times \text{Conc. of } \frac{HCL}{Weight} \text{ of sample (g)} \qquad \ldots (2)$$

% Protein = % N × Factor (6.25).

3. Fat (%)

Fat contain in the cupcake from Jackfruit seed flour and Finger millet flour for treatment P_1 and P_2 for 0, 1, 2, 3, 4, 5, 6 and 7 days were determined using soxhlet fat extraction system (AOAC, 2010). In this method, initially weight of empty flask was weighed. 2g of sample was wrapped in filter paper. It was kept in siphoning tube and condenser was fixed above it and siphoned for 9 to 12 times with the petroleum ether in soxhlet apparatus. After removing assembly, evaporation of petroleum ether was allowed by heating round bottom flask. Residue reminder at the bottom of the flask and was reweighed with flask. The quantity of residue was determined as fat content of cupcake. The experiment was repeated three times and average ready was reported.

$$\%\ \text{Fat} = \frac{\text{Final weigh} - \text{Initial weight}}{\text{Weight of sample}} \times 100 \qquad \ldots(3)$$

Where:

W_1 = weight of oven dried thimble,

W_2 = weight of sample used,

W_3= weight of round bottom flask,

W_4 = weight of round bottom flask with fat residue.

4. Fibre (%)

Fibre contain in the cupcake from Jackfruit seed flour and Finger millet flour for treatment P_1 and P_2 for 0, 1, 2, 3, 4, 5, 6 and 7 days were determined using about 2–5 g of moisture and fat free sample was weighed 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 0.313 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 free from alkali, followed by washing with alcohol and ether. It was then transferred to crucible, dried overnight at 80°C to 100°C and weighed. The crucible was heated in muffle furnace at 525°C for 2 – 3 hrs. Cooled and weighed again. The difference in the weights represented the weight of crude fibre equation (4)

Rangana (1986). The experiment was repeated three times and average ready was reported.

$$\text{Crude Fiber}\left(\frac{g}{100g}\right) = \frac{100 - (\text{Moisture} + \text{Fat}) \times \text{Weight of Fiber Weight}}{\text{Weight of sample taken}} \times 100 \quad \ldots (4)$$

(Moisture + Fat free sample)

Where,

W_1 = Weight of material before ashing (g)

W_2 = Weight of material after ashing (g)

5. Ash (%)

Ash content of Cupcake from Jackfruit seed flour and Finger millet flour for treatment P_1 and P_2 for 0, 1, 2, 3, 4, 5, 6 and 7 days were determined using muffle furnance. 5 g. of Cupcake sample was taken in crucible. Weight of crucible and sample was recorded and kept in muffle furnace at 525 ºC 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). The experiment was repeated three times the average ash content was reported.

$$\text{Ash content (\%)} = \frac{(W_2 - W_1)}{(\text{Weight of sample})} \times 100 \quad \ldots(5)$$

Where,

W_2 = weight of crucible + ash,

W_1 = weight of empty crucible.

6. Carbohydrates (%)

The carbohydrate content of cupcake from Jackfruit seed flour and Finger millet flour for treatment P_1 and P_2 for 0, 1, 2, 3, 4, 5, 6 and 7 days were calculated by substremely moisture content, protein, fat, fibre and ash content from 100 (Adegunwa *et al*. 2012)

$$\textit{Carbohydrates} = 100 - (\textit{moisture content} + \textit{protein} + \textit{fat} + \textit{fiber} + \textit{ash}) \quad \ldots(6)$$

7. Colour

The colour of cupcake from Jackfruit seed and Finger millet flour for treatment P_1 and P_2 for 0, 1, 2, 3, 4, 5, 6, 7 days were determined by used to measure the colour value using a colorimeter (M/S Konica Minolta, Japan Model- Meter CR-400). The equipment was calibrated against standard white tile. Cupcake were taken in the petri dish, the petri dish was placed at the aperture of the instrument. The colour was recorded in terms of *L*= lightness (100) to darkness (0); *a* = Redness (+60) to Greenness (-60); *b* = yellowness (+60) to blueness (-60). The browning index of the Cupcake was 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 the following equation (7).

$$B_I = \left(\frac{100 \times (x - 0.31)}{0.172}\right) \quad \ldots(7)$$

$$x = \frac{a * + 1.75L}{5.645L + a - 3.012b} \quad \ldots(8)$$

Where,

L = lightness (100) to darkness (0)

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

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

8. Sensory analysis

The sensory attribute of cupcake from Jackfruit seed and Finger miller flour were for Treatment packaging material P_1, P_2 for 0, 1, 2, 3, 4, 5, 6, 7 and 8 days with trained panelists as per nine point hedonic scale. The Panelists were trained for the product testing and were familiar with product sensory evaluation. The cupcake samples were placed into plastic dish. The cupcake samples packed in polythene pouches and plastic trays were coded as A and B for Treatment P_1 and P_2 evaluation of sensory parameter i.e. colour, flavor, texture, and taste attribute 09 scale for texture attribute were summed up for total score 36 for each panelist for each treatment. The 14 panel member divided into three groups as five, five and four members. The data were analysed statistically for the significance of each attributes by ANOVA.

Microbial analysis

The microbial analysis of cupcake prepared from Jackfruit seed and Finger millet flour packed in polythene pouches and plastic trays was determined for storage period of 1, 2, 3, 4, 5, 6 and 7 days i.e. daily analysis as per the procedure of APHA (1992). The cupcake samples were analyzed for standard plate counts (SPC) and yeast and mould counts (YMC) using nutrient agar medium and potato dextrose agar medium (Himedia Laboratories Pvt. Ltd. Bombay).

The sample was crushed finely in mortar and pestle. 1g of sample was mixed thoroughly in 10 ml autoclaved distilled water and mixed thoroughly by vortexing. Serial dilutions from the above suspension were prepared up to 10^{-6}. 1 ml serially diluted sample was plated by pour plate technique on nutrient agar (for total viable count), Potato Dextrose Agar (for yeast and mold count. All plates were incubated at 37°C for 24-48 hrs. After 24-48 hours of incubation the plates were observed for typical colonies of each microorganism and colonies were counted with the help of colony counter. The results were recorded as CFU/g methods prescribed by Bureau of Indian Standards, (1989).

Formula for calculating CFU/g:

$$CFU = \frac{\text{Average plate count} \times \text{Dilution}}{\text{Weight of sample}} \quad \ldots(9)$$

Statistical analysis

Statistical analysis was performed using Factorial completely randomized design (FCRD) for stored sample properties of Moisture (%), Protein (%), Fat (%), Fibre (%), Ash (%), Carbohydrates (%), Browning index, microbial analysis and sensory qualities like colour, flavour, texture, taste and Overall acceptability and microbial analysis packed in polythene pouches and plastic trays for 0, 1, 2, 3, 4, 5, 6 and 7 days was carried out by Microsoft Excel 2007.

RESULTS AND DISCUSSION

Moisture content

Fig. 3 shows the effect of packaging material and storage duration (0, 1, 2, 3, 4, 5, 6, and 7 days) and packaging material on Moisture content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour. The Moisture content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour which was packed in polythene pouches (P_1) was increases from 23.61 to 25.90 (%) for 0 to 7 days of storage period respectively and for plastic tray (P_2) moisture content (%) was increases from 23.55 to 26.02 (%) for 0 to 7 days of storage period respectively. From Fig. 3 it is clear that as storage period increases, the Moisture content (%) of cupcake prepared from Jackfruit flour and Finger millet flour packed in polythene pouches (P_1) and plastic trays (P_2) increases.

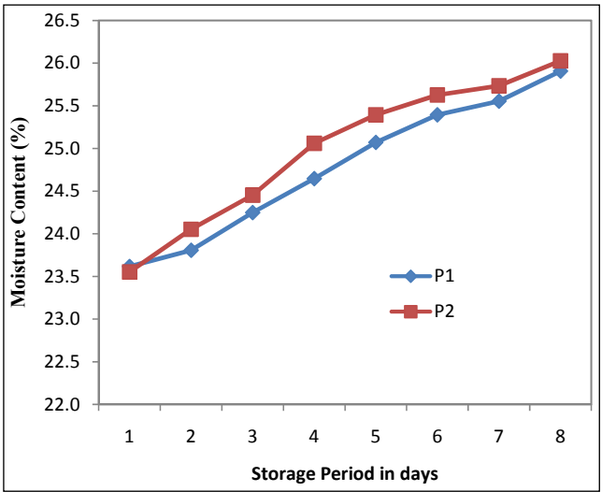

Fig. 3: Effect of packaging material and storage duration on moisture content of Cupcake from Jackfruit seed flour and Finger millet flour

Table 3 shows the effect of packaging material on moisture content indicated that the better retention of 110.49 % was observed in P_2 followed by P_1 109.69%. The Table 3 shows the ANOVA for the effect of packaging material and storage duration on moisture content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour w.r.t. packaging material, storage duration and their interaction. From Table 3 it is indicated that packaging material had non-significant influence on moisture content (%) of cupcake prepared from Jackfruit seed and

Table 3: f– test for effect of moisture content on storage life of cupcake packed in different packaging material

Treatment	Storage duration (days)									% retention
	0 day	1 day	2 days	3 days	4 days	5 days	6 days	7 days	Avg.	
P_1	24.05 ± 0.683	21.67 ± 1.357	20.85. ± 0.150	19.72 ± 0.335	17.66 ± 0.320	15.12 ± 0.601	11.92 ± 0.837	9.60 ± 0.049	17.674	39.908
P_2	24.22 ± 0.523	22.91 ± 0.234	21.63 ± 0.223	20.56 ± 0.477	18.96 ± 0.500	16.86 ± 0.678	15.29 ± 0.401	11.78 ± 0.660	18.981	48.660
Mean	24.13	22.29	21.64	19.93	18.31	15.99	13.60	10.69	18.328	
		SEm(±)			$CD_{at\ 5\%}$					
Treatment (T)		0.118			0.338					
Storage Duration (S)		0.236			0.676					
Interaction (T×S)		0.334			0.956					

Table 4: f– test for effect of protein content on storage life of cupcake packed in different packaging material

Treatment	Storage duration (days)									% retention
	0 day	1 day	2 days	3 days	4 days	5 days	6 days	7 days	Avg.	
P_1	4.59 ± 0.036	4.37 ± 0.030	4.06 ± 0.113	3.99 ± 0.128	3.66 ± 0.090	3.27 ± 0.145	2.96 ± 0.350	2.27 ± 0.175	3.650	49.564
P_2	4.78 ± 0.101	4.59 ± 0.162	4.37 ± 0.175	4.20 ± 0.175	3.90 ± 0.101	3.50 ± 0.175	3.13 ± 0.200	2.56 ± 0.267	3.883	53.658
Mean	4.68	4.48	4.22	4.09	3.78	3.38	3.04		3.766	
		SEm(±)			**$CD_{at\ 5\%}$**					
Treatment (T)		0.034			0.099					
Storage Duration (S)		0.069			0.198					
Interaction (T×S)		0.098			0.281					

finger millet flour at p≤0.05. The storage duration had significant influence on moisture content (%) of cupcake from Jackfruit seed and finger millet flour at p≤0.05. The interaction effect of packaging material and storage duration also shows the non-significant influence on Moisture content of cupcake prepared from Jackfruit seed and Finger millet flour significant at p≤0.05.

Karim *et al.* (2012). Reported that the cake prepared from potato-carrot flour moisture content increases from 24.43 to 27.69 % during 7 days storage period. Tiimub (2013) reported that the unleavened bread prepared from sugar, butter and wheat increase moisture content during 10 days period.

Protein

Fig. 4 shows the effect of packaging material and storage duration (0, 1, 2, 3, 4, 5, 6, and 7 days) and on protein content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour. The protein (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour which was packed in polythene pouches (P_1) decreases from 4.59 to 2.27 (%) for 0 to 7 days of storage period and for plastic tray (P_2) protein content (%) decreases from 4.78 to 2.56 (%) for 0 to 7 days of storage period respectively. From Fig. 3 it is clear that as storage period increases, the protein content (%) of cupcake prepared from Jackfruit flour and Finger millet flour packed in polythene pouches (P_1) and plastic trays (P_2) decreases.

Table 4 Shows the effect of packaging material on protein content indicated that the better retention of 53.65% was observed in P_2 followed by P_1 49.56 %. The Table 4 shows the ANOVA for the effect of packaging

material and storage duration on protein content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour w.r.t. packaging material, storage duration and their interaction. From Table 3 it indicated that packaging material had significant influence on protein content (%) of cupcake prepared from Jackfruit seed and finger millet flour at p≤0.05 and storage duration had significant influence on protein content (%) of cupcake from Jackfruit seed and finger millet flour at p≤0.05. The interaction of packaging material and storage duration showd the non-significant influence on protein content of cupcake prepared from Jackfruit seed and Finger millet flour significant at p≤0.05.

Tiimub (2013) reported that the bread prepared from sugar, butter and wheat i.e., unleavened bread decrease the protein content during 10 days storage. In order bakery product i.e., biscuit and cookies it was observed that the protein content decreases from 8.41 to 8.36 % in biscuit by Towseef *et al.* (2013). Similar results observed that the cookies storage period increases protein decreases by Sujitha and Thevaki, (2015).

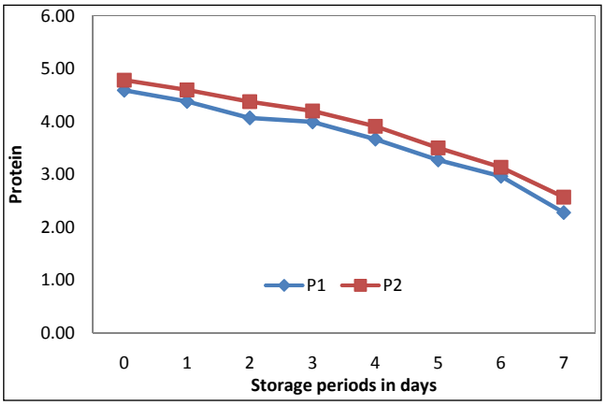

Fig. 4: Effect of packaging material and storage duration on Protein content of Cupcake from Jackfruit seed flour and Finger millet flour

Fat

Fig. 5 shows the effect of packaging material and storage duration (0, 1, 2, 3, 4, 5, 6, and 7 days) on fat content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour. The fat content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour which was packed in polythene pouches (P_1), fat was decrease from 11.55 to 3.41 (%) for 0 to 7 days of storage period respectively and for plastic tray (P_2) fat content (%) was decreases from 11.51 to 3.99 (%) for 0 to 7 days of storage period respectively. From Fig. 3 it is clear that as storage period increases, the Fat content (%) of cupcake prepared from Jackfruit flour and Finger millet flour packed in polythene pouches (P_1) and plastic trays (P_2) decreases.

Table 5 Shows the effect of packaging material on fat content indicated that the better retention of 34.64 % was observed in P_2 followed by P_1 29.57 %. The Table shows the ANOVA for the effect of packaging material and storage duration on fat content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour w.r.t. packaging material, storage duration and their interaction. From Table 5 it is indicated that packaging material had significant influence on fat content (%) of cupcake prepared from Jackfruit seed and finger millet flour at p≤0.05. The storage duration had significant influence on fat content (%) of cupcake from Jackfruit seed and finger millet flour at p≤0.05. The interaction effect of both packaging material and storage duration shows the non-significant influence on fat content of cupcake prepared from Jackfruit seed and Finger millet flour significant at p≤0.05.

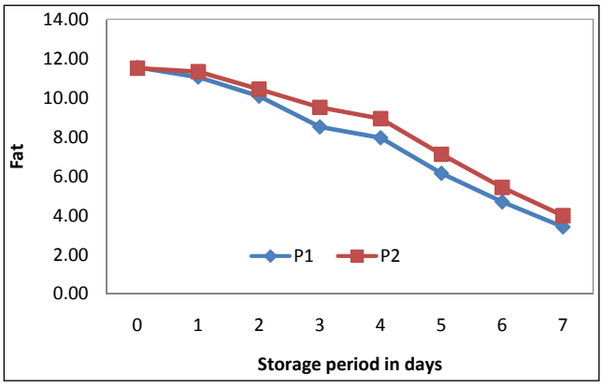

Fig. 5: Effect of packaging material and storage duration on Fat content of Cupcake from Jackfruit seed flour and Finger millet flour

Table 5: f– test for effect of fat content on storage life of cupcake packed in different packaging material

Treatment	Storage duration (days)									% retention
	0 day	1 day	2 days	3 days	4 days	5 days	6 days	7 days	Avg.	
P_1	11.55 ± 0.160	11.05 ± 0.250	10.08 ± 0.180	8.51 ± 0.950	7.96 ± 0.670	6.15 ± 0.760	4.69 ± 0.170	3.41 ± 0.610	7.92	29.57
P_2	11.51 ± 0.280	11.33 ± 0.190	10.44 ± 0.130	9.51 ± 0.340	8.94 ± 0.19	7.12 ± 0.70	5.43 ± 0.490	3.99 ± 0.130	8.53	34.64
Mean	11.53	11.19	10.26	9.018.45	8.45	6.63	5.06	3.70	8.23	
		SEm(±)			**$CD_{at\ 5\%}$**					
Treatment (T)		0.157			0.449					
Storage Duration (S)		0.314			0.899					
Interaction (T×S)		0.444			1.271					

Table 6: f– test for effect of fibre content on storage life of cupcake packed in different packaging material

Treatment	Storage duration (days)									% retention
	0 day	1 day	2 days	3 days	4 days	5 days	6 days	7 days	Avg.	
P_1	2.25 ± 0.016	2.14 ± 0.032	1.95 ± 0.017	1.85 ± 0.011	1.65 ± 0.031	1.50 ± 0.061	1.366 ± 0.090	1.054 ± 0.164	1.723	46.673
P_2	2.35 ± 0.049	2.24 ± 0.062	2.170 ± 0.016	1.94 ± 0.017	1.76 ± 0.020	1.57 ± 0.046	1.468 ± 0.013	1.29 ± 0.025	1.852	54.911
Mean	2.30	2.19	2.06	1.90	1.70	1.53	1.41	1.17	1.787	
		SEm(±)			**$CD_{at\ 5\%}$**					
Treatment (T)		0.157			0.449					
Storage Duration (S)		0.314			0.899					
Interaction (T×S)		0.444			1.271					

Tiimub (2013) reported that the bread prepared from sugar, butter and wheat i.e. unleavened bread decrease the fat content during 10 days storage. In order bakery product i.e. biscuit and cookies it was observed that the fat content decreases from 21.46 to 20.20% in biscuit by Towseef *et al.* (2013). Similar results observed that the cookies storage period increases fat decreases by Sujitha and Thevaki, (2015).

Fibre

Fig. 6 shows the effect of packaging material and storage duration (0, 1, 2, 3, 4, 5, 6, and 7 days) on fibre content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour. The fibre content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour which was packed in polythene pouches (P_1) was decrease from 2.25 to 1.05 (%) for 0 to 7 days of storage period, and for plastic tray (P_2) fibre content (%) decreases from 2.35 to 1.29 (%) for 0 to 7 days of storage period, respectively. From Fig. 6 it is clear that as storage period increases, the fibre content (%) of cupcake prepared from Jackfruit flour and Finger millet flour packed in polythene pouches (P_1) and plastic trays (P_2) decreases.

Table 6 Shows effect of packaging material on fibre content indicated that the better retention of fibre was 54.91 % observed in P_2 followed by P_1 46.67%. The Table 6 shows the ANOVA for the effect of packaging material and storage duration on fibre content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour w.r.t. packaging material, storage duration and their interaction. From Table 6 it is indicated that packaging material had significant influence on fibre content (%) of cupcake prepared from Jackfruit seed and finger millet flour at $p \leq 0.05$ and storage duration had significant influence on fibre content (%) of cupcake from Jackfruit seed and finger millet flour at $p \leq 0.05$. The interaction effect of

packaging material and storage duration shows the non-significant influence on fibre content of cupcake prepared from Jackfruit seed and Finger millet flour significant at p≤0.05.

Tiimub (2013) reported that the bread prepared from sugar, butter and wheat i.e unleavened bread decrease the fibre content during 10 days storage. In order bakery product i.e. biscuit and cookies it was observed that the fibre content decreases from 9.66 to 9.22% in biscuit by Towseef *et al.* (2013). Similar results observed that the cookies storage period increases fibre decreases by Sujitha and Thevaki, (2015).

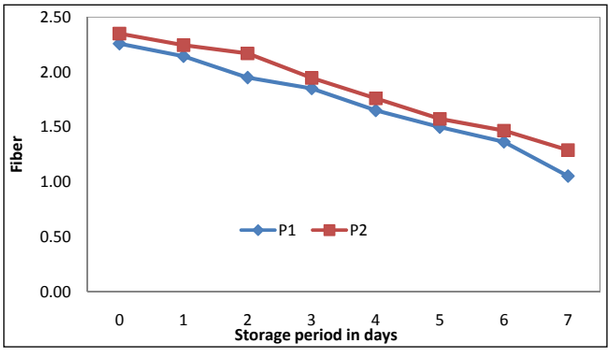

Fig. 6: Effect of packaging material and storage duration on Fibre content of Cupcake from Jackfruit seed flour and Finger millet flour

Ash

Fig. 7 shows the effect of packaging material and storage duration (0, 1, 2, 3, 4, 5, 6, and 7 days) on ash content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour. The ash content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour which was packed in polythene pouches (P_1) decreases from 2.25 to 1.05 (%) for 0 to 7 days of storage period, and for plastic tray (P_2) ash content (%) was decreases from 2.35 to 1.29 (%) for 0 to 7 days of storage period respectively. From Fig. 7 it is clear that as storage period increases, the ash content (%) of cupcake prepared from Jackfruit flour and Finger millet flour packed in polythene pouches (P_1) and plastic trays (P_2) decreases.

Table 7 Shows effect of packaging material on ash content indicated that the better retention of 47.02% was observed in P_2 followed by P_1 39.70 %. The Table 7 shows the ANOVA for the effect of packaging material and storage duration on ash content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour w.r.t. packaging material, storage duration and their interaction. From Table 7 it is indicated that packaging material had significant influence on ash content (%) of cupcake prepared from Jackfruit seed and finger millet flour at p≤0.05, and storage duration had significant influence on ash content (%) of cupcake from Jackfruit seed and finger millet flour at p≤0.05. The interaction shows the non-significant influence on ash content of cupcake prepared from Jackfruit seed and Finger millet flour significant at p≤0.05.

Tiimub (2013) reported that the bread prepared from sugar, butter and wheat i.e. unleavened bread decrease the ash content during 10 days storage. In order bakery product i.e. biscuit and cookies it was observed that the ash content decreases from 1.30 to 1.17 % in biscuit by Towseef *et al.* (2013). Similar results observed that the cookies storage period increases ash decreases by Sujitha and Thevaki, (2015).

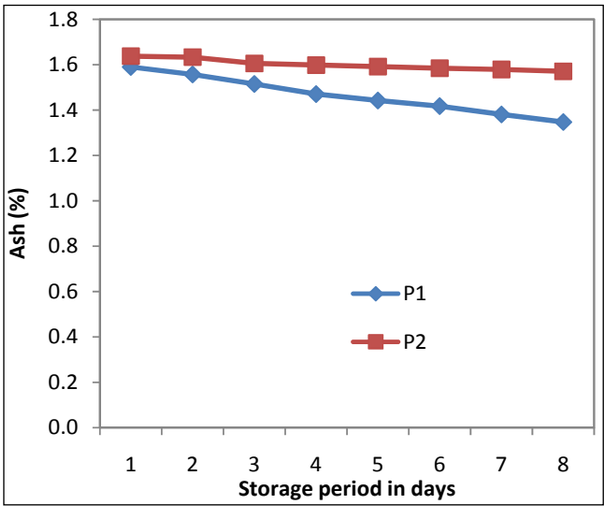

Fig. 7: Effect of packaging material and storage duration on Ash content of Cupcake from Jackfruit seed flour and Finger millet flour

Table 7: f– test for effect of Ash content on storage life of cupcake packed in different packaging material

Treatment	Storage duration (days)									% retention
	0 day	1 day	2 days	3 days	4 days	5 days	6 days	7 days	Avg.	
P_1	1.59±0.006	1.55±0.015	1.51±0.019	1.47±0.055	1.44±0.074	1.41±0.099	1.38±0.148	1.34±0.155	1.465	84.75
P_2	1.63±0.045	1.63±0.049	1.60±0.019	1.59±0.019	1.59±0.020	1.58±0.019	1.57±0.020	1.57±0.020	1.600	95.92
Mean	1.614	1.59	1.56	1.53	1.51	1.50	1.48	1.45	1.533	
		SEm(±)			$CD_{at\ 5\%}$					
Treatment (T)		0.013			0.039					
Storage Duration (S)		0.027			0.078					
Interaction (T×S)		0.038			0.110					

Table 8: f– test for effect of carbohydrate content on storage life of cupcake packed in different packaging material

Treatment	Storage duration (days)									% retention
	0 day	1 day	2 days	3 days	4 days	5 days	6 days	7 days	Avg.	
P_1	56.39±0.145	57.14±0.163	58.13±0.145	59.18±0.935	59.67±0.460	61.55±0.574	65.84±0.715	64.68±1.076	59.95	148.37
P_2	55.49±0.774	55.35±0.510	56.67±0.560	57.58±0.913	58.25±0.307	60.53±0.883	62.52±0.845	64.531±0.398	58.83	145.83
Mean	55.94	56.25	57.25	58.38	58.96	61.04	62.68	64.609	59.49	
		SEm(±)			$CD_{at\ 5\%}$					
Treatment (T)		0.134			0.383					
Storage Duration (S)		0.268			0.767					
Interaction (T×S)		0.379			1.084					

Carbohydrate

Fig. 8 shows the effect of packaging material and storage duration (0, 1, 2, 3, 4, 5, 6, and 7 days) and on carbohydrate content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour. The carbohydrate content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour which was packed in polythene pouches (P_1) was increases from 56.39 to 64.68 (%) for 0 to 7 days of storage period, and for plastic tray (P_2), the carbohydrate content (%) was increases from 55.49 to 64.63 (%) for 0 to 7 days of storage period respectively. From Fig. 8 it is clear that as storage period increases, the carbohydrate content (%) of cupcake prepared from Jackfruit flour and Finger millet flour packed in polythene pouches (P_1) and plastic trays (P_2) increases.

Table 8 Shows effect of packaging material on carbohydrate content indicated that the better retention 148.37% was observed in P_2 followed by P_1 145.83 %. The Table 8 shows the ANOVA for the effect of packaging material and storage duration on carbohydrate content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour w.r.t. packaging material, storage duration and their interaction. From Table 8 it is indicated that packaging material had significant influence on carbohydrate content (%) of cupcake prepared from Jackfruit seed and finger millet flour at $p \leq 0.05$, and storage duration had significant influence on carbohydrate content (%) of cupcake from Jackfruit seed and finger millet flour at $p \leq 0.05$. The interaction effect of packaging material and storage duration shows the non-significant influence on carbohydrates content of cupcake prepared from Jackfruit seed and Finger millet flour significant at $p \leq 0.05$.

Tiimub (2013) reported that the bread prepare from sugar, butter and wheat i.e. unlevend bread increase the carbohydrate during 10 days period.

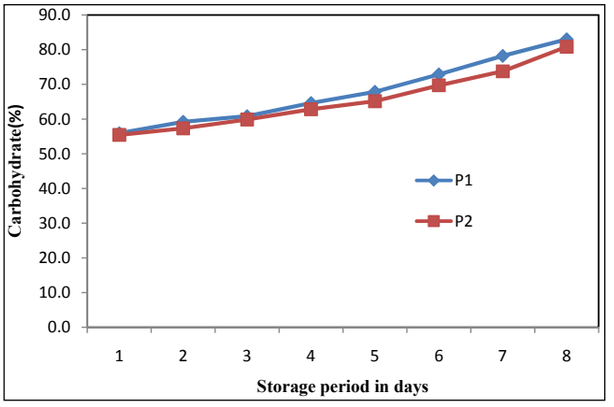

Fig. 8: Effect of packaging material and storage duration on Carbohydrates content of Cupcake from Jackfruit seed flour and Finger millet flour

Browning Index

Fig. 9 shows the effect of packaging material and storage duration (0, 1, 2, 3, 4, 5, 6, and 7 days) and on Browning Index of cupcake prepared from Jackfruit seed flour and Finger millet flour Browning Index. The cupcake prepared from Jackfruit seed flour and Finger millet flour which was packed in polythene pouches (P_1) to browning index decreases from 69.35 to 59.15 for 0 to 7 days of storage period, and for plastic tray (P_2) Browning Index decreases 72.26 to 65.44 from for 0 to 7 days of storage period respectively. From Fig. 9 it is clear that as storage period increases, the Browning Index of cupcake prepared from Jackfruit flour and Finger millet flour packed in polythene pouches (P_1) and plastic trays (P_2) decreases.

Table 8 Shows effect of packaging material on Browning Index indicated that the better retention of 90.50% was observed in P_2, followed by P_1 85.2%. The Table shows the ANOVA for the effect of packaging material and storage duration on carbohydrate content (%) of cupcake prepared from Jackfruit seed flour and Finger millet flour w.r.t. packaging material, storage duration and their interaction. From Table 9 it indicated that packaging material had significant influence on Browning Index of cupcake prepared from Jackfruit seed and finger millet flour at $p \leq 0.05$ and storage duration had significant influence on Browning Index of cupcake from Jackfruit seed and finger millet flour at $p \leq 0.05$. The interaction effect of packaging material and storage duration shows the significant influence on Browning Index of cupcake prepared from Jackfruit seed and Finger millet flour significant at $p \leq 0.05$.

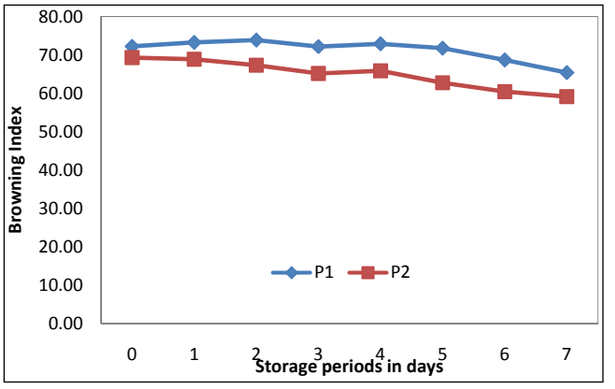

Fig. 9: Effect of packaging material and storage duration on Browning index content of Cupcake from Jackfruit seed flour and Finger millet flour

Table 9: f– test for effect of Browning index content on storage life of cupcake packed in different packaging material

Treatment	Storage duration (days)									% retention
	0 day	1 day	2 days	3 days	4 days	5 days	6 days	7 days	Avg.	
P_1	69.35±0.120	68.92±1.150	67.35±0.266	65.19±1.050	65.89±0.440	62.76±0.321	60.45±0.202	59.15±0.304	1.852	85.292
P_2	72.26±0.637	73.30±0.376	73.90±0.990	72.20±1.363	72.93±0.502	71.79±0.359	68.73±0.294	65.44±0.497	1.723	90.563
Mean	70.80	71.11	70.63	68.70	69.41	67.28	64.59	62.29	68.10	
		SEm(±)			$CD_{at\ 5\%}$					
Treatment (T)		0.135			0.387					
Storage Duration (S)		0.270			0.774					
Interaction (T×S)		0.383			1.095					

MICROBIAL ANALYSIS

Standard Plate Count

Microbial analysis is the perfect quality assessment protocol performed in food products quality analysis. In the study of microbial quality of cupcake from Jackfruit seed and Finger millet flour, the study was undertaken examination of the total plate count (TPC) and yeast and mould count or fungal count. The effect of packaging material polytehne bag (P_1) and plastic tray (P_2) and storage duration on microbial characteristics of cupcake prepared from Jackfruit seed and Finger millet flour stored at ambient temperature were recorded and presented in Table 3. Out of total storage duration i.e. 0, 1, 2, 3, 4, 5, 6 and 7 days, the microbial analysis was carried out after each day. Bacterial growth was detected for 7th day of analysis for both the packaging material i.e. polythene bag (P_1) and plastic tray (P_2). At 7 days analysis the standard plate count observed for cupcake packed in polythene bag and plastic tray were and 2.16×10^2 CFU/g and 1.73×10^2 CFU/g respectively.

Table 10: Effect of packaging material and storage duration of Cupcake from Jackfruit seeed and Finger millet flour on **standard plate count**

Duration	Polythene bag	Plastic tray	
0 Day	Not Detected	Not detected	
1 Days	Not Detected	Not Detected	
2 Days	Not Detected	Not Detected	
3 Days	Not Detected	Not Detected	
4 Days	Not Detected	Not Detected	
5 Days	Not Detected	Not Detected	
6 Days	Not Detected	Not Detected	
7 Days	2.16×10^2 CFU/g	1.73×10^2 CFU/g	
SEm(±)	**Packaging material (P)**	**Storage Duration (S)**	**Interaction (P×S)**
	0.035	0.070	0.099
CD $_{at\ 5\%}$	0.100	0.201	0.284
Result	NON SIG	SIG 5%	NON SIG

It was seen from Table 10 shows the ANOVA for the effect of packaging treatments and storage duration on standard plate count of cupcake from Jackfruit seed and Finger millet flour had non-significant influence on standard plate count of cupcake at $p\leq0.05$. Packaging material and storage duration had significant influence on standard plate count of cupcake at $p\leq0.05$. The interaction also shows non-significant influence on standard plate count of slice cupcake prepared from Jackfruit seed and Finger millet flour at $p\leq0.05$.

Saranraj and Geetha (2012) reported that the bakery products found total fungal count ranged from 2.5×10^5 to 3.0×10^5.

According to Dun Lin and Ching Lee (2005), the total plate count in breads stored at 25°C increased from 2.4×10^5 cfu/g to 3.4×10^5 cfu/g after three days of storage

Yeast and Mould Count

The effect of packaging material polythene bag (P_1) and plastic tray (P_2) and storage duration on microbial characteristics of cupcake prepared from Jackfruit seed and finger millet flour, stored at ambient temperature were recorded and presented in Table 11. Out of total storage duration i.e. 0, 1, 2, 3, 4, 5, 6 and 7 days, the microbial analysis was carried out each day. No yeast and mould growth was detected up to analysis of 5 days for both the packaging material i.e. polythene bag (P_1) and plastic tray (P_2) at 7 days analysis the yeast and mould count observed for cupcake from Jackfruit seed and finger millet flour observed were 1.6×10^2 CFU/g and 2.4×10^2 CFU/g for polythene bag (P_1) and 1.4×10^2 CFU/g and 1.8×10^2 CFU/g respectively,

It was seen from Table 11 shows the ANOVA for the effect of packaging material and storage duration on yeast and mould count of cupcake prepared from Jackfruit seed and Fingr miilet flour. It indicated that packaging materials and storage duration had non-significant influence on yeast and mould count of cupcake prepared from Jackfruit seed and finger millet flour at $p\leq0.05$. The interaction also had non-significant influence on Yeast and mould count of cupcake prepared from Jackfruit seed and finger millet flour at $p\leq0.05$.

Table 11: Effect of packaging material and storage duration of cupcake on yeast and mould count

Duration	Polythene bag	Plastic Tray	
0 Days	Not Detected	Not detected	
1Days	Not Detected	Not detected	
2 Days	Not Detected	Not detected	
3 Days	Not Detected	Not Detected	
4 Days	Not Detected	Not Detected	
5 Days	Not Detected	Not Detected	
6 Days	1.6×10^2 CFU/g	1.4×10^2 CFU/g	
7 Days	2.4×10^2 CFU/g	1.8×10^2 CFU/g	
SEm(±)	**Packaging material (P)**	**Storage Duration (S)**	**Interaction (P×S)**
	0.041	0.083	0.117
CD $_{at\ 5\%}$	0.119	0.238	0.336
Result	NON SIG	SIG 5%	NON SIG

Adjou *et al.* (2012) reported that the peanut cake products were analyzed. The results showed that the total coliform count ranged between 1.6×10^1 and 14.0×10^2 CFU/ g^{-1}, while the fungal count was ranged from 1.0 to 8.1×10^2 CFU/ g^{-1} and total bacteria count was between from 5.4×10^4 to 1.4×10^6 CFU g/.

SENSORY ANALYSIS

Table 12 (a) shows the sensory colour of cupcake prepared from Jackfruit seed and finger millet flour stored during for 0, 1, 2, 3, 4, 5, 6 and 7days duration in polythene bag (P_1) and plastic trays (P_2). The colour score of P_1 and P_2 decreases from 8.62 to. 6.30 The highest colour score was 8.62 observed for (P_2). The effect of packaging treatment had significant effect on colour of the cupcake at The effect of storage duration also had significant effect on the colour of cupcake at $p \leq 0.05$. The interaction of packaging material and storage duration had also a significant effect and the colour of cupcake prepared from Jackfruit seed and finger millet flour at $p \leq 0.05$.

Table 12: Effect of packaging material and storage duration of cupcake on sensory attribute and its ANOVA

Source of Variance	Storage duration (days)								
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Mean**
(a) Colour									
P_1	8.52±0.245	8.30±0.175	7.99±0.385	7.75±0.287	7.27±0.185	7.24±0.358	6.64±0.438	6.30±0.246	7.50
P_2	8.62±0.142	8.59±0.221	8.08±0.221	8.05±0.237	7.81±0.305	7.50±0.209	6.6±0.292	6.39±0.252	7.70
Mean	8.57	8.44	8.03	7.90	7.54	7.37	6.63	7.78	7.60
	Packaging material (P)			**Storage duration (S)**			**Interaction (P×S)**		
SEm(±)	0.032			0.050			0.071		
CD $_{at\ 5\%}$	0.091			0.145			0.200		
(b) Flavour									
P_1	8.30±0.286	8.28±0.234	7.97±0.368	7.73±0.310	7.45±0.317	7.35±0.332	6.44±0.379	6.07±0.167	7.45
P_2	8.6±0.151	8.55±0.240	8.02±0.272	8.0±0.189	7.91±0.403	7.41±0.377	6.48±0.457	6.35±0.308	7.67
Mean	8.45	8.42	8.007	7.90	7.68	7.38	6.46	6.21	7.56
	Packaging material (P)			**Storage duration (S)**			**Interaction (P×S)**		
SEm(±)	0.037			0.058			0.083		
CD $_{at\ 5\%}$	0.106			0.167			0.231		
(c) Texture									
P_1	8.25±0.273	8.14±0.206	8.11±0.384	7.75±0.287	7.45±0.317	6.76±0.522	5.87±0.157	5.76±0.240	7.26
P_2	8.57±0.167	8.55±0.187	8.10±0.297	8.06±0.259	8.03±0.270	7.63±0.253	7.37±0.362	6±0.143	7.79
Mean	8.41	8.34	8.11	7.91	7.74	7.20	6.62	5.88	7.53
	Packaging material (P)			**Storage duration (S)**			**Interaction (P×S)**		
SEm(±)	0.033			0.053			0.075		
CD $_{at\ 5\%}$	0.096			0.153			0.211		

(d)Taste									
P_1	8.41±0.265	8.30±0.240	7.97±0.421	7.72±0.299	7.40±0.251	7.33±0.329	6.96±0.387	6.38±0.247	7.56
P_2	8.45±0.308	8.39±0.406	8.04±0.198	8.±0.235	7.93±0.317	7.63±0.253	7.37±0.362	6.48±0.285	7.79
Mean	8.43	8.35	8	7.86	7.67	7.48	7.17	6.43	7.67
	Packaging material (P)			**Storage duration (S)**			**Interaction (P×S)**		
SEm(±)	0.036			0.057			0.081		
$CD_{at\ 5\%}$	0.104			0.164			0.227		

Table 12 (b) shows the sensory flavour of cupcake prepared from Jackfruit seed and finger millet flour for 0, 1, 2, 3, 4, 5, 6 and 7days duration in polythene bag (P_1) and plastic trays (P_2). The flavour score of P_1 and P_2 decreases from 8.62 to 6.30. The highest flavour score was observed 8.62 for (P_2). The effect of packaging treatment had significant effect on flavour of the cupcake at The effect of storage duration also had significant effect on the flavour of cupcake at p≤0.05. The interaction of packaging material and storage duration had also a significant effect and the flavour of cupcake prepared from Jackfruit seed and finger millet flour at p≤0.05.

Table 12 (c) shows the sensory Texture of cupcake prepared from Jackfruit seed and finger millet flour for 0, 1, 2, 3, 4, 5, 6 and 7days duration in polythene bag (P_1) and plastic trays (P_2). The score Texture of P_1 and P_2 decreases from 8.6 to. 6.07. The highest Texture score was observed 8.6. The effect of storage duration had significant effect on Texture of the cupcake at The effect of packaging materials also had significant effect on the Texture of cupcake at p≤0.05. The interaction of packaging material and storage duration had also a significant effect and the Texture of cupcake prepared from Jackfruit seed and finger millet flour at p≤0.05.

Table 12 (d) shows the sensory taste score of cupcake prepared from Jackfruit seed and finger millet flour stored during for 0, 1, 2, 3, 4, 5, 6 and 7days duration in polythene bag (P_1) and plastic trays (P_2). The Taste score of P_1 and P_2 decreases from 8.45 to 6.38. The highest taste score was observed 8.45 for (P_2). The effect of packaging treatment had significant effect on colour of the cupcake at The effect of storage duration also had significant effect on the colour of cupcake at p≤0.05. The interaction of packaging material and storage duration had also a significant effect and the colour of cupcake prepared from Jackfruit seed and finger millet flour at p≤0.05.

CONCLUSION

During the storage period from the 0 to 7th days moisture content increases 23.61 from to 25.90 %. The stored cupcake was observed during each day from 0 day to 7 days. Nutritional analysis indicated that both packaging material and storage period had Significant effect on moisture content increases, protein content decreases from 4.59 to 2.27%, fat decreases 11.55 to 3.41%, fiber content decreases from 2.25 to 1.05%, ash content decreases from 1.63 to 1.57 % carbohydrate increases from 55.49 to 64.63% and Browning index 72.26 to 59.15 and microbiological study depicted that standard plate count was observed after 6 days, the yeast and mould count was observed afer 5 days of storage of cupcake. The cupcake prepared from Jackfruit seed and Finger millet flour can be packed at stored in plastic trays for 5 days. The best quality of Cupcake from Jackfruit seed and finger millet flour can be stored for 5 days in plastic tray packaging material in good condition.

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