

Original Research Article

<https://doi.org/10.20546/ijcmas.2018.702.140>

Effect of Storage on the Quality of Value Added Snacks Developed Using Partially Defatted Peanut Cake Flour and Fenugreek Leaves Powder

T. Bindhya Dhanesh^{1*}, Anita Kochhar¹ and M. Javed²

¹Department of Food and Nutrition, College of Home Science, Punjab Agricultural University, Ludhiana, Punjab, India

²Department of Stat, Math and Physics, College of Basic Sciences, Punjab Agricultural University, Ludhiana, Punjab, India

*Corresponding author

ABSTRACT

Traditional Indian snacks namely *Matthi* and *Seviya* using partially defatted peanut cake flour at 10 per cent level and powdered fenugreek leaves powder at 1 per cent level were developed with an aim to eradicate malnutrition. The freshly prepared products were analysed for their nutritional parameters. The products were stored in three different packaging materials like glass jars, aluminium zip pouch + glass jar and plastic zip pouch + glass jar for a period of 90 days at ambient temperature. They were analysed for their nutritional parameters after 90 days of storage and microbial quality every fortnightly. Shelf life studies revealed that the although the proximate and mineral composition of all the products reduced in all three packaging materials, the composition was better retained in glass jars, aluminium zip pouch + glass jar when compared to the products stored in plastic zip lock pouch + glass jar. Aflatoxin was also not detected in any of the products. The microbial quality of the products reduced after 60 days of storage. Total plate count and fungal counts were higher for products stored in plastic zip lock pouch + glass jar. However, pathogenic micro-organisms like *E. coli* and *Staphylococcus spp.* were not detected.

Keywords

Partially defatted peanut cake flour, Nutritional parameters, Microbial quality, Aflatoxin, Total plate count, Fungal count

Article Info

Accepted:

10 January 2018

Available Online:

10 February 2018

Introduction

Partially defatted peanut cake flour is an underutilized by products obtained after the extraction of oil. It has rich nutritional profile with 45-60 per cent protein, 22-30 per cent carbohydrate, 3.8-7.5 per cent fiber and 4-6 per cent minerals (Desai *et al.*, 1999). This nutritious by products is indigenously used as cattle feed and manure in most parts of the world. It is gluten-free and can be substituted

in various products as a beneficial ingredient. Although it has been used as a food ingredient, many are not aware of its nutritional potentials. India is one among those countries where partially defatted peanut cake flour is still used as a cattle feed or manure. India is also a country with a high prevalence rate of undernourished children. Utilization of partially defatted peanut cake flour in various traditional recipes and bakery products can enhance the protein content of the products

and serve as an excellent vehicle for enhancing the utilization of groundnut protein in the diets of malnourished people in most of the developing countries. Other than its nutritional potentials, it is low in fat and thus can be used in weight watch diets. Utilization of defatted groundnut meal with mild processing treatment is becoming increasingly popular in other countries. However, in India because of the unhygienic processing conditions that prevail in many small-scale oilseeds processing factories/units the residual cake/meal is generally not fit for human consumption, but is only suitable for animal feed or as an ingredient of nitrogenous fertilizer (Ali, 1995).

Food packaging is one of the most important aspects while storing partially defatted peanut cake flour or products prepared from the same as some amount of oil remains in the cake after the oil extraction. Appropriate food packaging materials should be used as it can retard product deterioration, retain the beneficial effects of processing, extend shelf-life, and maintain or increase the quality and safety of food (Kenneth and Betty, 2007). Food packages provide protection from 3 major classes of external influences: chemical, biological, and physical (Hotchkins, 1997). Chemical protection minimizes compositional changes triggered by environmental influences such as exposure to gases (typically oxygen), moisture (gain or loss), or light (visible, infrared, or ultraviolet). Glass and metals are ones among that provide chemical and physical barriers. Closure devices may contain materials that allow minimal levels of permeability. For example, plastic caps have some permeability to gases and vapors, as do the gasket materials used in caps to facilitate closure and in metal can lids to allow sealing after filling (APC, 2004). Plastic packaging offers a large range of barrier properties but is generally more permeable than glass or metal. Biological protection prevents the entry of

pathogenic and spoilage microorganisms, insects, rodents, and other animals, thereby preventing disease and spoilage.

Thus, Package design and construction play a significant role in determining the shelf life of a food product. The selection of appropriate packaging materials and technologies for food maintains product quality and freshness during distribution and storage. Materials that have traditionally been used in food packaging include glass, metals (aluminum, foils and laminates, tinplate, and tin-free steel), paper and paperboards, and plastics (Kenneth and Betty, 2007). In the recent years, food packaging involves combining several materials to effectively utilise each material's functional or aesthetic properties. Hence, the purpose of this study was to compare the shelf life on the nutritional and microbial quality of value added products prepared using partially defatted peanut cake flour in three different packages and to select which ever be appropriate.

Materials and Methods

Procurement and processing of raw materials

Ingredients required for the development of value added products like Wheat flour, Chick pea flour, Raw peanuts, fenugreek leaves as well as other ingredients like oil, ghee, salt, carom seeds etc. were procured from the local market of Ludhiana in a single lot.

Peanuts were purchased and checked for any infestation or damage. They were then roasted, de-skinned. Oil was extracted by using oil extraction machine. The residual cake was collected and dried in the oven at 65 °C for half an hour. Dried cake was ground to fine powder. Green leafy vegetable like spinach and fenugreek leaves were procured dried in a tray drier at 60°C for 5-6 hours (constant

weight was achieved in this time). The dried spinach and fenugreek leaves were ground to fine powder stored in separate airtight containers.

Formulation and development of the products

Two traditional Indian *namkeens* namely *Matthi* and *Seviyan* were developed keeping the basic ingredient used for all the products as cereal-pulse mix flour. Pulse flour was taken in one-third amount of cereal flour.

This mix was replaced for the main ingredient listed in the standard procedure. Wheat flour was used as a cereal source and chickpea flour was used as a pulse source. The standard procedures used for product development were as follows:

Matthi

Ingredients

Wheat flour- 66.5g
Chick pea flour – 22.5g
Dalda – 7g
Fenugreek leaves powder- 1g
Carom seeds and salt as required

Procedure

Wheat flour, chick pea flour, fenugreek leaves powder, carom seeds and salt (1/2 tsp) is mixed with 7g of dalda thoroughly. Stiff dough is prepared using water. Small balls are rolled out from the dough and flattened. They are then pricked with fork and deep fried in oil

Seviyan

Ingredients

Chick pea flour- 66.5g
Wheat flour – 22.5g

Fenugreek leaves powder- 1g
Oil – 5 ml
Salt for taste

Procedure

Chick pea flour, wheat flour and fenugreek leaves powder is mixed with salt and soft dough is prepared using water and 5ml of oil. It is then filled into a *Seviyan* machine. The dough is then extruded out into hot oil and deep fried.

Storage of the products

The developed value added products were then storage separately in three packaging materials namely glass jars, aluminium zip lock pouch + glass jar and plastic zip lock pouch + glass jar to compare the shelf life quality of the products at (30±2⁰C) for a periods of 90 days.

Nutritional analysis of the value added products

The developed value added products were then subjected to nutritional analysis for proximate and mineral using standard procedures. *In vitro* protein digestibility was also analysed. The analysis was conducted before and after storage of the products in different packaging materials

Proximate composition

Proximate composites like Moisture, Crude Protein, Crude Fat, Crude Fiber, Crude Ash, Carbohydrates and Energy were analysed using standard procedures suggested by AOAC (2000).

Minerals

Elements namely iron and calcium were estimated using atomic absorption

spectrophotometer (AAS, Varian model) after wet digestion (Piper, 1950).

***In vitro* protein digestibility**

It was carried out by the by macro kjeldahl method (Akeson and Stachman, 1964).

Aflatoxins

The samples were extracted by using the method of Barabalok *et al.*, (1974) and further detected using the Pressure Mini Column methods (PCM) Sashidhar *et al.*, (1989).

Microbial estimation of the value added products

The products from different packaging materials were estimated for their microbial quality every fortnightly using standard procedures (David and Frankhausar 2010). The parameters analysed and respective media used are as follows:

Statistical Analysis

The nutritional attributes were analysed using paired t-test for fresh and stored samples. While to compare the quality of the products between the packaging materials, one-way anova was applied. The values are expressed as Mean \pm SE (Standard error)

Results and Discussion

The effect of storage on the value added products developed incorporating partially defatted peanut cake flour and fenugreek leaves powder packed in different packaging materials namely glass jars, aluminium zip lock pouch + glass jar and plastic zip lock pouch + glass jar was studied and a reduction in the proximate and mineral content was observed for all three packaging materials. Significant reduction was observed for all the

nutrient composition for products stored in plastic zip lock pouch + glass jar.

Effect of storage on the proximate composition of the value added products

The results of proximate composition of all the five products are presented from Table 2 and 3. As Table 2 depicts, the moisture content of *matthi* showed an increase after being stored in all the packaging materials.

Statistically significant increase was observed for *matthi* stored in plastic zip lock pouch + glass jar which was observed to be 3.44 per cent in fresh to 4.23 per cent in stored. Similar was the case in the crude protein and crude fiber of *matthi* when stored in plastic zip lock pouch + glass jar, a significant reduction was observed while for the *matthi* stored in glass jars and aluminium zip lock pouch + glass jar although a reduction was observed, it was not significant. Significant reduction in the crude fiber content was not observed while a significant reduction was observed in *matthi* stored in all three packages. Saha and Dunkwal (2009) also evaluation the shelf life quality with respect to nutritional composition of instant mixes used for the preparation of traditional Indian recipes like *mathri* and *pakoda*. They observed that the mixes stored in 200 gauge polythene for 3 months retained their nutritional composition but the fatty acid and free fatty acid content increased after 90 days of storage. Kalra *et al.*, (1998) also observed an increase in the moisture content from 3.95 per cent to 57.48 per cent in *matthi* after 3 months of storage.

The effect of storage on the proximate composition of *seviyan* in different packaging materials has been depicted in Table 3. Though an increase was observed in the moisture (2.53 to 3.10 per cent) and total ash content of *seviyan* stored in all packaging material, a significant increase was observed

for those stored in plastic zip lock pouch + glass jar. Reduction in the crude protein and fat content was not statistically significant but better retention was observed for *seviyan* stored in glass jars and aluminium zip lock pouch + glass jar. Crude fiber showed no significant decrease in *seviyan* after storage.

Waghray and Gulla (2010) studied the shelf life of *sev* and *boondi* made incorporating bengal gram flour and butylated hydroxyanisole as an antioxidant packed in polypropylene cover for 4 months. They observed an increase in moisture content in *Sev* (2.2% to 3.7%), and in *boondi* (3.3% to 4.1%). Peroxide value of *Sev* (6.6 to 32.7 meq) and *boondi* (8.5 to 33.2 meq) also increased during storage.

Ambient storage behavior for *sev* packed in two different packaging materials viz. samples packed in high-density polyethylene (HDPE) and the samples stored in combination film (CF) with atmospheric packaging (APS) was studied by Saurabh *et al.*, (2013). They found that samples stored in combination film retained most nutrients during the storage when compared to those stored in HDPE. Kumari and Prakash (2009) observed that soy incorporated sorghum based *seviyan* stored in PET (polyethylene terephthalate) container was definitely better than steel, which was attributed to its low moisture and air ingress.

Effect of storage on the mineral composition of the value added products

The calcium and mineral content of the value added products stored in the different packaging materials were affected significantly after a period of 90 days storage as presented in Table 4. A significant reduction in the mineral content in both the products was observed. The most reduction in calcium and iron was observed in *matthi* stored in Plastic zip pouch+glass jar. Whereas

the reduction in iron content of *matthi* was retained better in both glass jar and Al zip pouch+glass jar. In the case of *seviyan*, calcium was retained mostly in both glass jar and Al zip pouch+glass jar and iron was mostly retained in Al zip pouch+glass jar followed by glass jar.

Effect of storage on the *in-vitro* protein digestibility of the value added products

The *in-vitro* protein digestibility decreased in both the developed products after storage period of three months as shown in Table 5.

The *in-vitro* protein digestibility of *matthi* showed significant decrease when stored in all three packaging materials after three months storage. A significant difference was found in case of *in-vitro* protein digestibility of *seviyan* stored in glass container + aluminium zip lock pouch as well as glass container + plastic zip lock pouch as compared to those stored in glass containers in which the decrease was not significant. Nicole and coworkers (2010) also reported a decrease in the *in-vitro* protein digestibility Ready-to-Eat composite porridge flours made by Soy-Maize-Sorghum-Wheat when stored in plastic pouches for 6 months. Preethi and Chimmad (2010) showed decrease in *in-vitro* protein digestibility of supplementary foods packed in ordinary zip lock packet after storage period of 45 days.

Aflatoxin in the developed products

Aflatoxins were not detected in any of the samples before and after the storage period. Aflatoxin B1 were not detected in the fresh samples of peanut flour based value added products like fryums, chutney powder, extruded snacks and noodles (Purohit and Rajyalakshmi 2011). Soher *et al.*, (2013) studied the contamination of peanut samples by aflatoxins as well as in chicken burgers incorporated with deoiled peanut flour.

Table.1 Microbial parameters analysed and specific media used

Test performed for	Media Used
Aerobic Plate Count /Total Plate count (TPC)	Nutrient Agar
Yeast count	Glucose Yeast Extract Agar
Mold count	Potato Dextrose Agar
Total coliforms	Urinary Tract Infections Media
<i>Staphylococcus aureus</i>	Urinary Tract Infections Media
<i>Escherichia coli</i>	Urinary Tract Infections Media

Table.2 Proximate composition of *Matthi* after storage in different packaging material (Dry weight basis)

Proximate composition (g / 100 g)	Packaging Material		
	Glass jar	Aluminum zip lock pouch+ Glass jar	Plastic zip lock pouch + Glass jar
Moisture (BS)	3.44±0.014	3.44±0.014	3.44±0.014
(AS)	3.87 ^b ±0.015	3.92 ^b ±0.030	4.23 ^a ±0.015
Paired t-value	6.82*	8.74*	10.94**
Crude protein (BS)	16.58±0.014	16.58±0.014	16.58±0.014
(AS)	16.35 ^a ±0.020	16.25 ^b ±0.023	15.99 ^c ±0.017
Paired t-value	4.33 ^{NS}	2.65 ^{NS}	6.95*
Crude Fat (BS)	20.92±0.040	20.92±0.040	20.92±0.040
(AS)	19.61 ^a ±0.020	19.66 ^a ±0.016	19.20 ^b ±0.027
Paired t-value	4.15 ^{NS}	1.96 ^{NS}	7.49*
Crude Fiber (BS)	1.43±0.161	1.43±0.161	1.43±0.161
(AS)	1.39 ^a ±0.178	1.40 ^a ±0.015	1.36 ^a ±0.040
Paired t-value	3.2 ^{NS}	4.28 ^{NS}	2.91 ^{NS}
Total ash (BS)	0.88±0.017	0.88±0.017	0.88±0.017
(AS)	0.85 ^a ±0.017	0.83 ^a ±0.008	0.81 ^a ±0.010
Paired t-value	10.00*	8.59*	10.00*
Carbohydrates (BS)	60.47±0.056	60.47±0.056	60.47±0.056
(by differences) (AS)	59.86±0.021	59.88±0.028	58.98±0.034

Figures with different superscripts are significantly different ($p < 0.05$), * ($p < 0.05$)
BS- Before storage AS- After storage NS- Not significant

Table.3 Proximate composition of *Seviyan* after storage in different packaging material (Dry weight basis)

Proximate composition (g / 100 g)	Packaging Material		
	Glass jar	Aluminum zip lock pouch + Glass jar	Plastic zip lock pouch + Glass jar
Moisture (BS)	2.53±0.018	2.53±0.018	2.53±0.018
(AS)	2.72 ^c ±0.012	2.81 ^b ±0.005	3.10 ^a ±0.017
Paired t-value	5.49*	9.50*	13.12**
Crude protein (BS)	23.49±0.280	23.49±0.280	23.49±0.280
(AS)	23.25 ^a ±0.014	23.35 ^a ±0.049	23.29 ^b ±0.023
Paired t-value	4.60 ^{NS}	2.32 ^{NS}	10.94 ^{NS}
Crude Fat (BS)	18.06±0.029	18.06±0.029	18.06±0.029
(AS)	17.93 ^a ±0.008	17.95 ^a ±0.012	17.88 ^b ±0.020
Paired t-value	4.67 ^{NS}	3.07 ^{NS}	13.05 ^{NS}
Crude Fiber (BS)	2.94±0.020	2.94±0.020	2.94±0.020
(AS)	2.85 ^a ±0.020	2.87 ^b ±0.010	2.88 ^b ±0.008
Paired t-value	2.93 ^{NS}	0.18 ^{NS}	1.78 ^{NS}
Total ash (BS)	1.79±0.012	1.79±0.012	1.79±0.012
(AS)	1.73 ^a ±0.012	1.75 ^{ab} ±0.016	1.71 ^b ±0.025
Paired t-value	5.27*	10.06*	9.87*
Carbohydrates (BS)	54.23±0.153	54.23±0.153	54.23±0.153
(by differences) (AS)	53.88±0.031	53.72±0.089	53.08±0.223

Figures with different superscripts are significantly different ($p < 0.05$), * ($p < 0.05$)
BS- Before storage AS- After storage NS- Not significant

Table.4 Mineral composition of the value added products after storage in different packaging material (dry weight basis)

Value added products in different packaging materials	Calcium			Iron		
	BS	AS	t-value	BS	AS	t-value
<i>Matthi</i> Glass Jar	29.13±0.110	25.23 ^b ±0.026	5.21*	4.18±0.008	3.99 ^a ±0.128	8.51*
Al zip pouch+glass jar	29.13±0.110	25.59 ^a ±0.336	6.93*	4.18±0.008	4.02 ^a ±0.023	5.56*
Plastic zip pouch+glass jar	29.13±0.110	20.45 ^c ±0.017	4.18**	4.18±0.008	3.52 ^b ±0.066	2.43*
<i>Seviyan</i> Glass Jar	55.05±0.336	53.17 ^a ±0.026	5.21*	4.98±0.032	4.81 ^b ±0.017	5.21*
Al zip pouch+glass jar	55.05±0.336	53.25 ^a ±0.210	4.28*	4.98±0.032	4.92 ^a ±0.010	4.28*
Plastic zip pouch+glass jar	55.05±0.336	52.18 ^b ±0.082	6.23*	4.98±0.032	4.66 ^c ±0.120	6.23*

Figures with different superscripts are significantly different ($p < 0.05$), * ($p < 0.05$)
 BS- Before storage AS- After storage NS- Not significant

Table.5 *In-vitro* protein digestibility of the value added products after storage in different packaging material (dry weight basis)

Value added products in different packaging materials	<i>In-vitro</i> digestibility		
	BS	AS	t-value
<i>Matthi</i> Glass Jar	60.22±0.28	58.98 ^a ±0.06	4.55*
Al zip pouch+glass jar	60.22±0.28	59.09 ^a ±0.11	8.04*
Plastic zip pouch+glass jar	60.22±0.28	58.77 ^b ±0.20	8.50*
<i>Seviyan</i> Glass Jar	68.68±0.05	67.66 ^b ±0.02	2.12 ^{NS}
Al zip pouch+glass jar	68.68±0.05	66.98 ^a ±0.03	4.58*
Plastic zip pouch+glass jar	68.68±0.05	66.80 ^c ±0.07	7.23*

Figures with different superscripts are significantly different ($p < 0.05$), * ($p < 0.05$)
 BS- Before storage AS- After storage NS- Not significant

They noticed that aflatoxin G1 (AFG1) was absent in all peanut samples; whereas, trace amounts of aflatoxin G2 (AFG2) was detected and recorded 0.170, 0.905 and 0.760 µg/kg, respectively for three samples out of five of the burger which was contributed by the growth in chicken meat.

Microbial quality of the value added products

Matthi and *Seviyan* developed and stored in three different packaging materials like glass jars, aluminium zip lock pouch + glass jar and plastic zip lock pouch + glass jar at (30±2°C) for a periods of 90 days were of good microbial quality till 60 days of storage. An increase in the total plate count and fungal count was observed after 60 days of storage and it increased after 75 and 90 days of storage. The

counts were lower in those products which were stored in glass jars and aluminium zip lock pouch + glass jar compared to those stored in plastic zip pouch + glass jar. The increase in the total plate count in *matthi* stored in different packaging materials after 75 days of storage was observed to be 1x10⁴ cfu/g in glass jars as well as aluminium zip pouch + glass jar while it was 3x10⁴ cfu/g for *matthi* stored in plastic zip lock pouch + glass jar.

The count increased to 2, 2 and 3x10⁴ cfu/g after 90 days of storage in for *matthi* stored in glass jar, aluminium zip pouch + glass jar and plastic zip lock pouch + glass jar respectively. The TPC counts ranged from 1-2x10⁴cfu/g and 2-3x10⁴cfu/g in *seviyan* stored in different packing materials after 75 and 90 days of storage respectively.

The fungal count increased after 75 days of storage from $3-5 \times 10^5$ cfu/g and $2-5 \times 10^5$ cfu/g in *matthi* and *seviyan* respectively. The increase varied from $3-7 \times 10^5$ cfu/g in *matthi* and $3-5 \times 10^5$ cfu/g in *seviyan*, after 90 days of storage. The highest increase in the TPC as well as fungal counts was found for the products stored in plastic zip pouch + glass jar. However, *E.coli* and *Staphylococcus spp.* were not detected in any of the samples. *Escherichia coli* and *Staphylococcus aureus* counts were detected in chicken burger and chicken burger supplemented with 20% roasted defatted peanut flour (R-DPF) as 5.00 and 6.20 log₁₀ CFU/g respectively by Soher *et al.*, (2013); however, only *E coli* was decreased significantly in burger supplemented with 10% unroasted DPF and 20% R-DPF. The authors also observed that the total fungal count decreased in burger supplemented with 10% R-DPF. A decrease was observed in both total bacterial and fungal counts after storage at -20°C for 60 days. Raja *et al.*, (2014) observed a significantly ($p < 0.05$) increasing trend in the total plate count (log cfu/g) and yeast and mould count (log cfu/g) for the control as well as treatment samples of fish curls incorporated with corn flour, black gram flour and peanut flour on storage in LDPE pouches. Coliform counts (log cfu/g) were not detected until day 28 in all the products. The mean values for all the quality as well as the storage parameters were in the acceptable limits up to the day 21 of the storage.

The nutritional and microbial evaluation of the products namely *Matthi* and *Seviyan* developed and stored in three different packaging materials like glass jars, aluminium zip lock pouch + glass jar and plastic zip lock pouch + glass jar at ($30 \pm 2^\circ\text{C}$) for a periods of 90 days showed a reduction in all the proximate and mineral composition. An increase in the moisture content and growth of microorganism were observed after 90 days and 60 days of storage respectively. But the reduction in their nutritional profile and increase in the microbial load was significant in the products stored in plastic zip pouch + glass jar. Nutrients were better retained in glass jars and aluminium zip

pouch + glass jar. Aflatoxin contamination was not detected in any of the samples. Hence, the present study reveals that glass jars and aluminium zip pouch + glass jar are the good packaging materials to store products prepared using partially defatted peanut cake flour and the products retained good microbial quality up to 60 days that is two months of storage.

Acknowledgement

I acknowledge Dr. Anita Kochhar for her immense support in designing the experiment as well as for providing all the necessary needed to conduct the experiment. I also acknowledge Dr. M. Javed for his guidance with the statistical analysis of the experimental data.

References

- Akeson, W.R. and Stachmann, M.A. 1964. A pepsin pancreatin digest index of protein quality evaluation. *J Nutr* 83: 257-261.
- Ali, N.1995. Post-harvest technologies for production of oilseed derivatives and value added products. Oilseed quality and value added products. Directorate of Oilseeds Research (ICAR), Progressive Press Pvt Ltd, New Delhi, pp 35–36
- AOAC. 2000 Official Method of Analysis Association of Official Analytical Chemist, 17th ed. Washington DC.
- APC (American Plastics Council). 2004. Resin identification codes—plastic recycling codes. Arlington, Va.: American Plastics Council. Available from: http://americanplasticscouncil.org/s_apc/sec.asp.
- Barabalok, R., Colbarn, C. R. and Smith, R. J. 1974 Rapid screening method for examining corn and corn derived products for possible aflatoxin contamination. *J Assoc off Anal Chem* 57:764-66
- David, B. and Frankhausar. 2010. Pour plate technique for bacterial enumeration (Cited from http://biology.clc.uc.edu/frankhauser/Labs/Microbiology/Meat_Milk/Pour_Plate.html)
- Desai, B.B., Kotecha, P.M., Salunkhe, D.K.

- 1999b Groundnut protein product. In: Introduction science and technology of groundnut: biology, production, processing and utilization. Naya Prokash Publ, New Delhi, India, pp 546–582
- Hotchkiss, J.J. 1997. Food-packaging interactions influencing quality and safety. *Food Addit Contam* 14(6-7):601–7.
- Kalra, C.L., Sehgal, R.C., Nagender, A., Mohan, L. and Berry, S.K. 1998. Preparation, quality standards and storage of *matthi*- a traditional savoury product. *J Food Sci. Technol* 35(1): 25-29
- Kenneth, M. and Betty, B. 2007 Food Packaging—Roles, Materials, and Environmental Issues. Scientific status summary, Institute of Food technologists. The Society of Food Science and Technology. *J Food Sci.* 72 (3): 33-55
- Kumari, R.K.R. and Prakash, J. 2009. Influence of soy protein incorporation on acceptability and shelf-stability of sorghum based ‘*seviya*’. *Indian J Sci Technol.* 2(4): 53-59
- Nicole M., Fei H.Y. and Claver I.P. 2010. Characterization of Ready-to-Eat Composite Porridge Flours Made by Soy-Maize-Sorghum-Wheat Extrusion Cooking Process. *Pakistan J. Nutr.* 9 (2): 171-178
- Piper, C.S. 1950 Soil and plant analysis. Interscience Publication, Inc. New York. Pp: 212
- Preethi B. and Chimmad B. 2010. Utilization of linseed for value addition to supplementary food. *Karnataka J Agric Sci* 23(5):765-68.
- Purohit, C. and Rajyalakshmi, P. 2011 Quality of products containing defatted groundnut cake flour. *J Food Sci Technol* 48:26-35
- Raja, W.H., Kumar, S., Bhat, Z.F. and Kumar, P. 2014. Effect of ambient storage on the quality characteristics of aerobically packaged fish curls incorporated with different flours. *Springer Plus.* 3:106
- Saha, R. and Dunkwal, V. 2009. Development and Nutritional Analysis of Value Added Spread Instant Mix. *J Hum Ecol.* 28(3): 187-190
- Sashidhar, R.B., Bhat, R.V. and Vasanthi, S. 1989. Non-competitive Enzyme Linked Immuno-Sorbent Assay for detection of aflatoxin B₁. *Indian J Exp Biol* 26:984-89.
- Saurabh, S., Jyoti, J., Genitha, T.R. and Vikas, T.P.R. 2013. Studies on Development, Quality Evaluation and Packaging Materials on the Storage Stability of Snack Food (*SEV*). *Intl J Agric Food Sci Technol* 4(6): 515-522
- Soher, E.A., Faham, S.E., Ibrahim, M.A., Hathout, A.S. and Sabry, B.A. 2013. Characterization and microbiological quality of low-fat chicken burger containing defatted peanut flour. *J Applied Sci. Res.* 9(11): 5599-5608
- Waghay, K. and Gulla, S. 2010. Butylated Hydroxyanisole (BHA) to Maximize the Oxidative Stability of Snacks: A Case Study with *Sev* and *Boondi*. *J Hum Ecol.* 32(2): 97-99

How to cite this article:

Bindhya Dhanesh, T., Anita Kochhar and Javed, M. 2018. Effect of Storage on the Quality of Value Added Snacks Developed Using Partially Defatted Peanut Cake Flour and Fenugreek Leaves Powder. *Int.J.Curr.Microbiol.App.Sci.* 7(02): 1127-1135.
doi: <https://doi.org/10.20546/ijcmas.2018.702.140>