Mysore J. Agric. Sci., 57 (3) : 227-237 (2023)

Effect of Amla (*Phyllanthus emblica*) Pomace Powder Incorporation on Nutritional and Organoleptic Attributes of *Chutney* Powder

C. A. Raju and S. Shamshad Begum
Department of Food Science and Nutrition, College of Agriculture, UAS, GKVK, Bengaluru - 560 065
e-Mail : rajuca80@gmail.com

Authors Contribution

C. A. Raju :
Planning, execution, compilation, tabulation of data and wrote the manuscript;
S. Shamshad Begum :
Technical guidance, supervision and drafting correction

Corresponding Author :
C. A. Raju
Department of Food Science and Nutrition, College of Agriculture, UAS, GKVK, Bengaluru

Received : February 2023
Accepted : March 2023

Abstract

Currently, the fruit processing industry generates a high volume of waste in fruits that have not reached a quality standard for consumption or by-products generated throughout the production process. To reduce this waste, mitigating measures, such as reuse in food formulations, have been proposed. In this work the amla pomace was produced and incorporated into flax seed chutney powder formulations in different proportions (10, 15 and 20%) evaluating its acceptability. The amla pomace incorporated chutney powder T2 (10% amla pomace) had higher overall acceptability (7.59) compared to other variations. The nutrient composition of best accepted *chutney* powder had dietary fibre (22.9g) and ascorbic acid (43.6mg). Storage studies (45 days) revealed that increase in moisture, peroxide value and decrease in sensory scores, ascorbic acid content of the chutney powder. The microbiological examinations are within acceptable limits according to regulation. Hence, it can be concluded that dehydrated amla pomace powder can be successfully incorporated into food products and thus nutritional and health benefits of amla pomace can be exploited for value addition contributing from waste to health.

Keywords : Amla pomace, Chutney powder, Microbial load, Nutritional, Organoleptic, Peroxide value

The production, commercialization and consumption of tropical fruits have increased significantly in the international market due to their sensory, nutritional and the therapeutic properties; however, the food industry generates high amount of residues from these fruits. According to a recent survey by the Food and Agriculture Organization of the United Nations (Anonymous, 2018), about 1.3 billion tons of foods are wasted worldwide each year, which accounts for one-third of total food industry production. Allied to this fact, the fruit processing industry deals with a large percentage of by-products such as peel, seeds and bagasse, which increase the proportion of residues at the end of processing (Souza *et al.,* 2018). The fruits and its by-products are underutilized due to a lack of awareness about their complete utility (Ray *et al.,* 2021).

Amla fruits are fleshy, spherical, attractive, deeply ribbed, yellowish-green in colour and have six vague perpendicular furrows enclosing seeds. The amla fruit is well known across the world for its nutritional, commercial and medicinal benefits. Amla is a rich source of ascorbic acid, amino acids, minerals and phytochemicals such as polyphenols, tannins, emblicol, linoleic acid, corilagin, phyllemblin and rutin. It has 89 to 94 per cent pulp, 0.8 to 2 per cent fibre, 10 to 14 per cent total soluble solids, 1.4 to 2.4 acidity, 700 to 900 mg vitamin C per 100g, 2.4 to 3.1 per cent pectin and 2 to 3 per cent phenols make up the amla fruit (Parveen and Khatkar, 2015). In India, the amla fruit is prized for its medicinal properties. Fruit is acrid, cooling, refrigerant, diuretic and laxative and as a result, it's utilised to cure a variety of ailments such as chronic dysentery, bronchitis, diabetes, fever, diarrhoea, jaundice,

dyspepsia, cough and others. The dried fruits of amla, which are high in gallic acid, are a definite treatment for blood dysentery, piles and illnesses connected with piles and blood (Singh *et al.,* 2016).

Amla pomace as it is having nutritional, nutraceutical and functional properties that can address significant commercial capacity and various uses as nutraceuticals in the food and biopharmaceutical sectors. Various dehydration technologies can be used to convert amla pomace into powders, which can then be used as a food supplement or as an ingredient in daily dietary or to enrich bakery products like cakes and biscuits too (Shamshad and Suresha, 2016).

In India, a variety of chutneys and pickles in large volumes based on vegetables, pulses and spices are consumed along with rice and breakfast items like chapatti, idly, dosa and vada. Literature is available on development and standardization of several food adjuncts namely traditional chutneys instant chutneys and chutney powders based on the various raw materials available during different seasons (Balaswamy *et al.,* 2005; Satyanarayana *et al.,* 2001; Balaswamy *et al*., 2004; Prabhakara Rao *et al.,* 2005; Jyothirmayi *et al.,* 2006 and Narsing Rao *et al*., 2008).

Fruit residues provide significant nutritional value and in response to customer preferences for healthier products, several food manufactures are actively exploring methods to incorporate functional ingredients to their products (*Ashoka et al.,* 2021). In this way, the development of new products or food formulations through the incorporation of these residues becomes an alternative to minimize losses during the processing of fruits. Hence, the main objective of the present study was to prepare amla pomace chutney powder with considerable quantities of dietary ingredients and evaluated for sensory quality, shelf stability of the product in metallised polypropylene pouches.

Material and Methods

The present investigation was carried out at Department of Food Science and Nutrition, University of Agricultural Sciences, Bangalore.

Selection and Collection of Sample

The fresh and matured amla fruits were procured from the local market in Bengaluru, Karnataka, India.

Processing and Dehydration

The Amla fruits were washed under running tap water and they were wiped using a clean dry cloth. Amla fruits were cut into pieces by using a stainless-steel knife and the seeds were separated by slicing the pulp into small pieces. Then, the amla pieces were ground into pulp in the laboratory mixer, after that the juice was extracted from the pulp and the residue (pomace) was separated. Dehydration was carried out by weighing fresh pomace sample and subjected to dehydration in a laboratory model ezidri ULTRAFD1000 tray dryer at 45°C for 4 hours. The dried pomace was ground to fine powder and sieved through a scientific sieve and stored in the air tight zip lock covers in refrigerated temperature conditions for further use.

Formulation of Amla Pomace *chutney* Powder

The *chutney* powder was prepared by using amla pomace powder with flax seeds, black gram dhal, bengal gram dhal and other ingredients. Three variations of *chutney* powder were developed by incorporating amla pomace powder at different variations like (10, 15 and 20%) and they were compared with control.

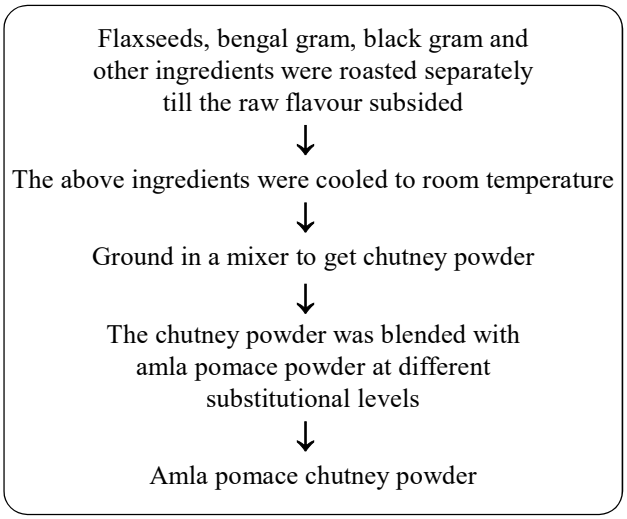

Fig. 1: Flow chart for the preparation of amla pomace *chutney* powder

Organoleptic Evaluation of the Developed Products

The products were subjected to sensory evaluation to evaluate the sensory quality attributes like appearance, colour, texture, flavour, taste and overall acceptability by a semi-trained panel of 21 members on a nine-point hedonic scale (Amerine *et al.*, 1965).

Microbiological Enumeration

The microbial load of the stored samples was enumerated by dilution plate method. The media used for bacteria was nutrient agar media, for moulds and fungi Martin's rose bengal agar and for yeast, yeast extract mannitol agar medium (Tate, 1995).

Storage Studies

The shelf life study was conducted for a period of 45 days. The amla pomace *chutney powder* was prepared and stored in metallised polypropylene pouches. Then, the products were kept at both room/ ambient and refrigerated conditions. The products were evaluated on initial, 15th, 30th and 45th day for sensory attributes and biochemical parameters (moisture, ascorbic acid and peroxide value).

Consumer Acceptability of the Developed Products

The consumer acceptability of flax seed *chutney* powder incorporated with amla pomace was assessed by using the FACT scale (Deepa, 2015) by the consumers (n=50).

Cost Estimation of the Developed Products

Cost of the best-accepted *chutney* powder was calculated by considering the cost of the raw material purchased from the local market, 30 per cent overhead costs which included labour charge, electricity, machinery, packaging cost, etc. and 25 per cent profit. The total price was calculated for 100 g of the products.

Computation of Nutritional Composition for Best Accepted Chutney Powder

The nutrient composition for the best accepted products was computed by using Indian food composition table Longvah *et al.* (2017).

Statistical Analysis

The data obtained were subjected to Complete Randomised Design (CRD) analysis to find out the impact of treatments, storage periods and packaging materials on the quality of the samples during storage of amla pomace powder by using the statistics *i.e.,* software Statistical Package for Social Sciences (SPSS) version 12.0 (Sabine and Brian, 2004).

Results and Discussion

Sensory Evaluation of the *chutney* Powder

The mean sensory scores of *chutney* powder is indicated in Table 1. The results revealed that the

Table 1

Sensory parameters of *chutney* powder incorporated with amla pomace powder

Treatments	Sensory parameters					
	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
Control	8.09 ± 0.75	8.13 ± 0.7	17.86 ± 1.08	8.00 ± 0.92	7.95 ± 0.89	7.95 ± 0.78
T_1	7.59 ± 0.66	7.40 ± 0.59	7.59 ± 0.73	7.68 ± 0.77	7.50 ± 0.67	7.59 ± 0.59
T_2	7.31 ± 0.71	7.04 ± 0.65	7.09 ± 0.75	7.25 ± 0.68	7.00 ± 0.75	7.27 ± 0.63
T_3	7.22 ± 0.81	7.00 ± 0.87	7.18 ± 0.79	7.13 ± 0.56	7.00 ± 0.75	7.09 ± 0.61
F value	*	*	*	*	*	*
S.Em±	0.15	0.15	0.18	0.16	0.16	0.14
CD@5%	0.44	0.42	0.51	0.45	0.46	0.39

T_1 = 10% Amla pomace powder, T_2 = 15% Amla pomace powder, T_3 = 20% Amla pomace powder,
NS = Non-significant and * = Significant at 5%.

control *chutney* powder had high scores for all sensory attributes when compared to amla pomace *chutney* powder.

Among experimental variations T_1 had highest sensory scores for appearance (7.59), colour (7.40), texture (7.59), flavour (7.68), taste (7.50) and overall acceptability (7.59). The variation T_3 (*chutney* powder with 20 per cent amla pomace powder) incorporation had a comparatively lower score for appearance (7.22), colour (7.00), texture (7.18), flavour (7.13), taste (7.00) and overall acceptability (7.09). However, overall acceptability of amla pomace *chutney* powder revealed that among experimental variations, T_1 (10 per cent amla pomace powder incorporation) with a score of 7.59 for overall acceptability. Statistically there was significant difference at 5 per cent level between the variations and all the sensory parameters.

Similar results were obtained by Netravati (2013) for flaxseed *chutney* powder substituted with flaxseeds in different ratios, received best overall acceptability and the scores are 7.67 for 50 per cent flaxseed incorporation and 7.33 for 100 per cent flaxseed incorporation.

Storage Studies

Changes in Sensory Scores of *Chutney* Powder Incorporated with Amla Pomace Powder during Storage at Room Temperature

The data regarding mean sensory scores of amla pomace powder incorporated *chutney powder* stored at room temperature (25±2°C) is presented in Table 2. It was observed that a significant difference was found between control and best accepted *chutney* variation T_1 (10%). As the storage period increased, gradual decrease in the sensory parameters was observed from initial period to the end of the storage period. Control sample had mean sensory scores of 7.50, 7.54, 7.36, 7.50, 7.50 and 7.50 for appearance, colour, texture, flavour, taste and overall acceptability, respectively. Whereas, the experimental variation T_1 had scores of 7.09 for appearance, 7.18 for colour,

TABLE 2

Sensory scores of *chutney* powder during storage at room temperature

Product	Duration	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
Control	Initial	8.09 ± 0.75	8.13 ± 0.71	7.86 ± 1.08	8.00 ± 0.92	7.95 ± 0.89	7.95 ± 0.78
	15th day	7.81 ± 0.58	7.77 ± 0.61	7.59 ± 0.85	7.63 ± 0.90	7.68 ± 0.83	7.86 ± 0.71
	30th day	7.59 ± 0.50	7.68 ± 0.47	7.45 ± 0.67	7.59 ± 0.66	7.68 ± 0.77	7.68 ± 0.47
	45th day	7.50 ± 0.51	7.54 ± 0.50	7.36 ± 0.58	7.50 ± 0.67	7.50 ± 0.74	7.5 0± 0.51
	F value	*	*	NS	NS	NS	NS
	SEm±	0.12	0.12	0.17	0.17	0.17	0.13
	CD@5%	0.35	0.35	-	-	-	-
T_1	Initial	7.59 ± 0.66	7.40 ± 0.59	7.59 ± 0.73	7.68 ± 0.77	7.50 ± 0.67	7.59 ± 0.59
	15th day	7.31 ± 0.56	7.36 ± 0.58	7.54 ± 0.50	7.54 ± 0.73	7.45 ± 0.59	7.54 ± 0.50
	30th day	7.22 ± 0.68	7.31 ± 0.47	7.13 ± 0.71	7.50 ± 0.51	7.36 ± 0.49	7.45 ± 0.50
	45th day	7.09 ± 0.68	7.18 ± 0.50	7.00 ± 0.61	7.31 ± 0.56	7.09 ± 0.68	7.40 ± 0.59
	F value	NS	NS	*	NS	NS	NS
	SEm±	0.13	0.11	0.13	0.14	0.13	0.11
	CD@5%	-	-	0.39	-	-	-

T_1 = 10% Amla pomace powder, NS = Non-significant and * = Significant at 5%.

7.0 for texture, 7.31 for flavour, 7.09 for taste and 7.40 for overall acceptability at 45th day of storage. Statistically there was significant difference at 5 per cent level for sensory attributes like texture, flavour, taste and overall acceptability for control sample and appearance, colour, flavour, taste and overall acceptability for experimental (T_1) sample. However, it was observed that the sensory parameters like appearance and colour of control sample and texture of experimental T_1 sample was found to be non-significant. It was evident from sensory scores that even at 45th day of storage period, T_1 sample was moderately liked by the panel members when compared with control sample.

The findings were on par with the study investigated by Deepak (2016) on niger seed *chutney* powder incorporated with dehydrated tamarind leaf powder and the results revealed that as the number of days increased, the sensory scores of all sensory parameters decreased. It was observed that from initial day up to 30th day, there was significant difference found in colour ranged between (7.60 to 6.20), taste (7.65 to 5.80) and overall acceptability ranged between (7.75 to 5.45). Similar findings were reported by Khedkar *et al.* (2019) sensory scores for curry leaf *chutney* powder 7 (excellent) to 8.2 (very good) for overall acceptance, 8.8 to 8.1 for flavour, 8.7 to 8.2 for taste, 8.8 to 8.3 for colour, respectively. The results were found on par with the study conducted by Rao *et al.* (2013) on storage of flax seed *chutney* powder. Overall sensory quality of flax seed *chutney* powder scored good (7.4) even after 6 months of storage. Hence, as per the above-mentioned studies, the mean scores were declined with the increase in the storage period in the present study too.

Changes in Sensory Scores of *chutney* Powder Incorporated with Amla Pomace Powder During Storage at Refrigerated Temperature

As indicated in Table 3, it was observed that control sample had scores of 7.40 for appearance, 7.45 for colour, 7.27 for texture, 7.40 for flavour, 7.40 for taste and 7.40 for overall acceptability. Among

TABLE 3

Sensory scores of *chutney* powder during storage at refrigerated temperature

Product	Duration	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
Control	Initial	8.09 ± 0.75	8.13 ± 0.71	7.86 ± 1.08	8.00 ± 0.92	7.95 ± 0.89	7.95 ± 0.78
	15th day	7.72 ± 0.63	7.72 ± 0.63	7.54 ± 0.85	7.54 ± 0.59	7.59 ± 0.79	7.77 ± 0.61
	30th day	7.50 ± 0.51	7.59 ± 0.50	7.40 ± 0.66	7.50 ± 0.59	7.54 ± 0.67	7.59 ± 0.50
	45th day	7.40 ± 0.50	7.45 ± 0.50	7.27 ± 0.55	7.40 ± 0.79	7.40 ± 0.66	7.40 ± 0.50
	F. value	*	*	NS	NS	NS	*
	S.Em ±	0.13	0.12	0.17	0.16	0.16	0.13
	CD@5%	0.36	0.35	-	-	-	0.36
T_1	Initial	7.59 ± 0.66	7.40 ± 0.59	7.59 ± 0.73	7.68 ± 0.77	7.50 ± 0.67	7.59 ± 0.59
	15th day	7.50 ± 0.51	7.36 ± 0.49	7.45 ± 0.50	7.50 ± 0.51	7.36 ± 0.65	7.40 ± 0.50
	30th day	7.27 ± 0.63	7.18 ± 0.66	7.18 ± 0.50	7.18 ± 0.50	7.22 ± 0.68	7.13 ± 0.56
	45th day	7.04 ± 0.65	7.04 ± 0.48	6.95 ± 0.48	7.04 ± 0.48	7.04 ± 0.48	7.0 4± 0.37
	F. value	*	NS	*	*	NS	*
	S.Em ±	0.13	0.12	0.12	0.12	0.13	0.11
	CD @ 5%	0.37	-	0.34	0.35	-	0.30

T_1 = 10% Amla pomace powder, NS = Non-significant and * = Significant at 5%.

experimental samples it was observed that, T_1 sample had scores of 7.04 for appearance, 7.04 for colour, 6.95 for texture, 7.04 for flavour, 7.04 for taste and 7.04 for overall acceptability at the end of the 45th day. It was observed that T_1 was acceptable even at 45th day of storage period when compared to control. This amla pomace *chutney* powder which is having 10 per cent amla pomace powder can be a good functional adjunct in the daily dietary as it is good source of dietary fibre and as the major ingredient of *chutney* powder is flax seed (45%) that can be a good source of omega-3 fatty acid and dietary fibre also. Statistically there was significant difference at five per cent level for sensory attributes like appearance, colour and overall acceptability for control sample and appearance, texture, flavour and overall acceptability for experimental (T_1) sample. However, it was observed that the sensory parameters like texture, flavour and taste of control sample and colour, taste of experimental T_1 sample was found to be non-significant. Hence, as the storage period increased sensory scores of the amla pomace *chutney* powder decreased.

Effect of Storage on Moisture, Peroxide Value and Ascorbic Acid Content of *chutney* Powder

The best accepted *chutney* powder with 10 per cent amla pomace powder was analyzed for moisture, peroxide value and ascorbic acid during storage period at both room temperature (25±2°C) and refrigerated temperatures (4°C) and the results indicated in Fig. 2.

The moisture and peroxide values were found to be increased during storage period, whereas the ascorbic acid content is decreased as the storage period extended. The moisture content in both room and refrigerated *chutney* powder ranged between 4.50 to 5.18 and 4.50 to 5.06 per cent, respectively and peroxide values ranged between 2.38 to 6.35 and 2.38 to 5.43 meq/kg, respectively. Whereas the ascorbic content is ranged between 42.60 to 35.91 and 42.60 to 39.55 mg, respectively during 45 days of storage. There is a tendency of increase in moisture content, peroxide value and decrease in ascorbic acid content at the end of storage period and the reason can be attributed to increase in oxidation, variation in temperature and time. Results obtained in the present study is lower than the study conducted by Netravati (2013) wherein the peroxide value in control *chutney* powder ranged from 5.89 to 22.58 meq/kg, same increasing trend was observed for flaxseed *chutney* powder and the values ranged from 4.81 to 20.08 meq/kg during 90 days of storage period. Also, increased peroxide value (12.3 to 18.3 meq/kg) was reported by Rajiv *et al.* (2012) from the first day of storage to 90th day of storage for cookies prepared with 15 per cent incorporation of flaxseed flour with wheat flour. In present study, developed products had lower peroxide value.

Microbial Load of *chutney* Powder on Storage

The microbial load of bacteria, yeast and mold for best accepted *chutney* powder with 10 per cent amla pomace powder is presented in Table 4. The microbial load was estimated at the intervals of the initial, 15th, 30th and 45th day of storage. Initially, there were no microbial counts of bacteria, yeast and mold. However, as the storage period increased the bacteria, yeast and mold counts also increased simultaneously. At the end of the storage period, there was a significant increase in all the microbial counts. The bacteria, yeast and mold count were (2.33×10^5 cfu/g), (1.66×10^2 cfu/g), (2.33×10^3 cfu/g) at room temperature and microbial counts were (2×10^5 cfu/g), (1.33×10^2 cfu/g) (1.66×10^3 cfu/g) at refrigerated temperature, respectively. Though the microbial counts were increased, it was observed to be within the permissible limits and *chutney* powder was good for consumption. Statistically significant difference at five per cent level was observed during storage period at different time intervals.

The study conducted by Khedkar *et al.* (2019) are in line with the present results wherein there was no microbial growth was observed on initial day in curry leaf *chutney* powder. However, at the end of storage period growth of aerobic microorganisms 2.5 x 10^3 cfu/g as well as yeast and mold 2.3 x 10^3 cfu/g was observed. Another study conducted by Deepak (2016)

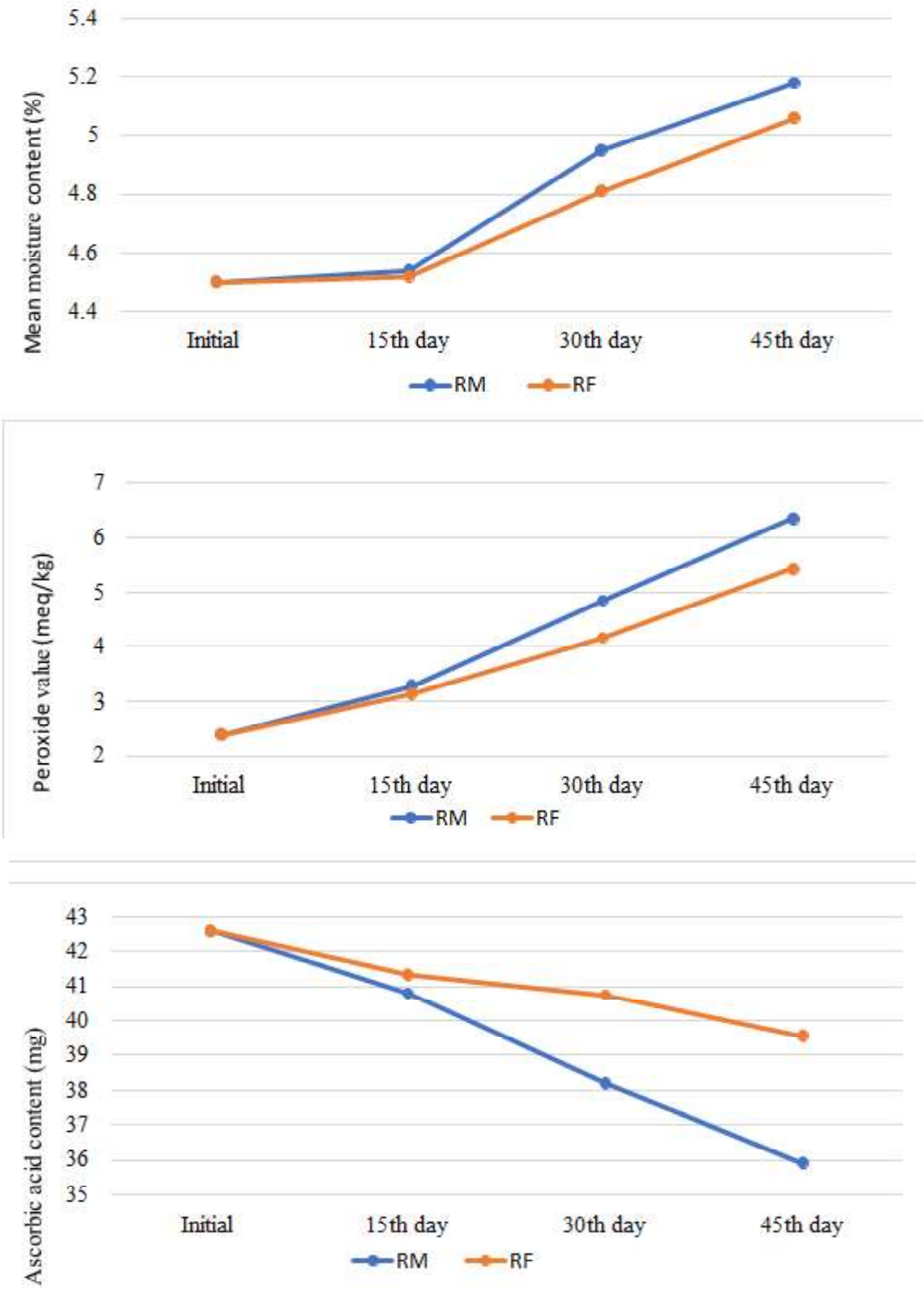

Fig. 2: Effect of storage on moisture, peroxide value and ascorbic acid content of *chutney* powder at room temperature (RM) and refrigerated temperature (RF)

TABLE 4

Microbial load of *chutney* powder on storage

Storage condition	Duration	Bacteria ($\times 10^5$cfu/g)	Yeast ($\times 10^2$ cfu/g)	Mold ($\times 10^3$cfu/g)
Room temperature	Initial	Nil	Nil	Nil
	15th day	0.66	0.33	0.66
	30th day	1.66	1.33	1.66
	45th day	2.33	1.66	2.33
	F value	*	*	*
	SEm±	0.28	0.28	0.40
	CD@5%	0.95	0.95	1.35
Refrigerated temperature	Initial	Nil	Nil	Nil
	15th day	0.33	0.33	Nil
	30th day	1	1.33	1
	45th day	2	1.33	1.66
	F value	*	*	*
	SEm±	0.16	0.28	0.16
	CD@5%	0.55	0.95	0.52

NS = Non-significant, * = Significant at 5% and TBC = Total bacterial count

on the storage of dehydrated tamarind leaf *chutney* powder indicated increased bacterial growth of 5.33 x 10^4 cfu/g at the end of 30th day of storage study which is higher than the present study. Statistically, it was observed that there was significant difference at 5 per cent level for total bacterial, yeast and mold count.

Consumer Acceptability of *chutney* Powder

The best accepted amla pomace powder incorporated *chutney* powder (T_1) was subjected to consumer acceptance for respondents (n=50) to know the extent of likability and dislikability. Table 5, represents the consumer acceptability using FACT scale. Nine statements were provided to test the acceptability, the results indicated that 38 per cent of the consumers 'would eat every opportunity they had', 16 per cent of the consumers 'would eat this very often' and then 12 per cent of consumers 'would frequently eat this'. Also, it was observed that 14 per cent liked the product and would eat it now and then and 6 per cent respondents didn't like but would eat this on an occasion, 6 per cent would eat if available but would not go out of their way, 4 per cent would eat this if there were no other food choices and 4 per cent felt they would hardly ever eat this.

The results of the present investigation were higher than the study conducted by Singh and Kulshrestha (2008) who incorporated carrot pomace powder into different products and out of all products, enriched halwa showed (10%) liked extremely, (50%) liked very much, (20%) liked slightly. Results were on par with study conducted by Nagi *et al.* (2012) reported that biscuits containing (20%) wheat bran for mass consumer acceptability, (51%) consumers rated the product as excellent whereas (39%) and (10%) rated it as very good and good, respectively.

Nutritional Content of Best Accepted *chutney* Powder (Per 100g)

The nutritional composition for the best accepted products was computed as per the guidelines of Indian Food Composition Tables, NIN, ICMR Hyderabad (Longvah *et al*., 2017). The nutritional composition of best accepted *chutney* powder

TABLE 5

Consumer acceptability of *chutney* powder by using FACT Scale

Opinion	No.	Per cent
I would eat every opportunity that I had	19	38
I would eat this very often	8	16
I would frequently eat this	6	12
I like this and would eat it now and then	7	14
I would eat if available but would not go out of my way	3	6
I don't like this but would eat this on an occasion	3	6
I would hardly ever eat this	2	4
I would eat this if there were no other food choices	2	4
I would eat this only if forced	0	0
Total	50	100

was presented in Table 6. The best accepted amla pomace *chutney* powder had protein and fat content of 16.5 g and 17.6 g per 100g which is slightly lower than the control *chutney* powder with values being 17.6 g and 18 g for protein and fat respectively. The calorific value and carbohydrate content were found to be 322 Kcal and 23 g per 100g which is lower than the control *chutney* powder with energy (347 Kcal) and carbohydrate (27g). The dietary fibre fractions, *viz.*, total dietary fibre, insoluble dietary fibre and soluble dietary fibre was found to be 22.9, 17.8 and 4.9g, respectively which is higher than that of control *chutney* powder with values of dietary fibre fractions being total dietary fibre (20.1g), insoluble dietary fibre (16.8g) and soluble dietary fibre (3.8g) per 100g. The ash was found to be similar in both the control (3g/100g) and experimental (3g/100g) variations. The ascorbic acid content was 43.6 mg /100g of *chutney* powder with 10 per cent of amla pomace powder where as it is 0.4 mg/100g in the control *chutney* powder. Hence, there is a strikable difference with respect to fibre composition and ascorbic acid content.

Shanthala and Prakash (2005) reported dried curry leaf powder (CLP) incorporated product (chapati) contained protein (12.5g), ash (9.7g), fat (5.4g), insoluble fibre (55.6g), soluble fibre (4.4g). The protein and fat content were lower, whereas total ash and insoluble fibre are higher and soluble fibre is similar, compared with present study. The results obtained in the present study was lower than that recorded by Singh *et al.* (2013) for beta-Carotene rich *laddu* using rice bran, except for beta-carotene content. The protein, fat, ash, carbohydrate, crude fibre, vitamin C and beta carotene was 7.80 g, 19.42 g, 1.18 g, 66 g, 1.14 g, 1 mg and 1.89 mg.

TABLE 6

Nutrient computation of best accepted *chutney* powder (Per 100g)

Nutrients	Control	Best Accepted product (T_1)
Protein (g)	17.6	16.5
Fat (g)	18	17.6
Ash (g)	3	3
TDF (g)	20.1	22.9
IDF (g)	16.8	17.8
SDF (g)	3.8	4.9
Carbohydrates (g)	27	23
Energy (kcal)	347	322
Ascorbic acid (mg)	0.4	43.6

T_1 = 10% Amla pomace powder, IDF = Insoluble dietary fibre, SDF = Soluble dietary fibre and TDF = Total dietary fibre

Cost Estimation for the Developed Products

The cost of production is an important consideration for commercialization and successful marketing. The

TABLE 7

Production cost of *chutney* powder

Ingredients	Quantity (g)	Rate (Rs.)	Cost (Rs.)
Flax seed	45	170/kg	7.65
Black gram dhal	15	132/kg	1.98
Bengal gram dhal	15	89/kg	1.33
Red chilly	08	120/kg	0.96
Curry leaves	02	100/kg	0.2
Garlic	02	140/kg	0.28
Salt	03	18/kg	0.05
Amla pomace powder	10	-	-
Total	100		12.45
Overhead charges @ 30%			3.73
Profit (25%)			3.11
Cost of the product			19.29
		Round off to Rs.	19

cost of any product depends upon a number of variable factors like cost of raw materials, cost of processing and packaging of the product, *etc*. Here, an approximate cost of the best accepted products (Per 100gm) indicated. Overhead charges at 30 per cent of expenditure on manufacturing, which includes labour cost, depreciation cost on machinery, equipment, building *etc*. and profit at 25 per cent was included. The product cost of *chutney* powder incorporated with amla pomace powder is presented in Table 7. The results revealed that the cost of the product was found to be Rs.19 per 100g which is lesser than the cost calculated by Fathima (2018) for banana blossom *chutney* powder with cost of Rs.30 per 100g. Hence, it can be concluded that the production cost of *chikki* and *chutney* powder were found to be economical when compared to other studies.

The study revealed that the preparation of amla pomace chutney powder can be scaled up to small scale level and can be used as nutritional and functional food adjunct. The product had high dietary fibre, protein, fat, energy and considerable amounts of ascorbic acid along with minerals. The product was shelf stable for 45 days in metallised polypropylene pouches at refrigerated and ambient temperatures with good sensory attributes. The results indicate that amla pomace powder can be incorporated in food formulations to improve nutritional properties, being an alternative to add value to the foods and to minimize losses along the production chain.

REFERENCES

AMERINE, M. A., PANGBORN, R. M. AND ROSELLER, E. B., 1965, Principles of sensory evaluation of food. Academic press, New york.

ANONYMOUS, 2018, Statistics from Food and Agricultural Organization of United Nations: Economic and Social Department : The Statistical Division. UN Food and Agricultural Organization Corporate Statistical Database.

AOAC, 1980, Official methods of analysis, 13th edition, Association of Official Analytical Chemists, Washington. DC.

ASHOKA, S., BEGUM, S. S. AND RAY, B. R. M., 2021, Effect of watermelon (*Citrullus lanatus*) rind flour incorporation on nutritional and organoleptic attributes of cakes. *Mysore J. Agric. Sci.*, **55** (3) : 31 - 35.

BALASWAMY, K., JYOTHIRMAYI, T. AND RAO, D. G., 2004, Studies on preparation of curry leaf (*Murraya koenigii* L.) chutney powder. *Food serv. Res. Int.,* **14** : 175 - 187.

BALASWAMY, K., SATYANARAYANA, A. AND RAO, D. G., 2005, Studies on preparation and storage characteristics of onion (*Allium cepa* L.) - chilly (*Capsicum annum*) chutney. *Food serv. Res. Int.,* **15** (3-4) : 140 - 146.

DEEPA MADALAGERI, M., 2015, Bio-waste of fruits: a potential source of nutraceuticals for health and nutrition security. *Ph.D. Thesis* (Unpub.), Univ. Agric. Sci., Dharwad.

DEEPAK., 2016, Development of value-added tender leaf tamarind (*Tamarindus indica* L.). *M.Sc. Thesis* (Pub.), Univ. Agric. Sci., Bangalore.

FATHIMA ZEHLA, P., 2018, Processing of banana peel and blossom and its application. *M.Sc. Thesis* (Unpub.), Univ. Agric. Sci., Bangalore.

Jyothirmayi, T., Narsing Rao, G. and Rao, D. G., 2006, Studies on instant raw tamarind chutney powder. *J. Food serv.,* **17** : 119 - 123.

Khedkar, R., Shastri, P. and Bawa, A. S., 2019, Standardization, characterization and storage stability of curry leaf chutney. *Carpathian J. Food Sci. Technol.,* **11** (3).

Longvah, T., Anantan, I., Bhaskarachary, K. and Venkaiah, K., 2017, Indian food composition tables. Hyderabad: National Institute of Nutrition, Indian Council of Medical Research.

Nagi, H. S., Kaur, J., Dar, B. N. and Sharma, S., 2012, Effect of storage period and packaging on the shelf life of cereal bran incorporate biscuits. *Am. J. Food Technol.,***7** (5) : 301 - 310.

Narsing Rao, G., Prabhakara Rao, P. G., Jyothirmayi, T. and Rao, D. G., 2008, Chemical composition, standardisation and storage studies on raw mango *chutney* powder. *J. Food Sci. Technol.,* **45** (5) : 436 - 438.

Netravati Hiremath, 2013, Evaluation of flaxseed (*Linum usitatissimum* L.) for nutrients and phytochemical composition. *M.Sc. Thesis* (Unpub.), Univ. Agric. Sci., Bangalore.

Parveen, K. and Khatkar, B. S., 2015, Physico-chemical properties of aonla (*Emblica officinalis*) varieties. *Int. Food Res. J.,* **22** (6) : 2358.

Prabhakara Rao, P. G., Narsing Rao, G., Satyanarayana, A. and Rao, D. G., 2005, Studies on chutney powders based on tamarind (*Tamarindus indica* L.) leaves. *Food serv. Res. Int.,* **15** (1) : 13 - 24.

Raghuramulu, N., Madhavan Nair, K. and Kalyana Sundaran, S., 2003, A laboratory techniques, NIN, *ICMR publications*, Hyderabad.

Rajiv, J., Indrani, D., Prabhasankar, P. and Rao, G. V., 2012, Rheology, fatty acid profile and storage characteristics of cookies as influenced by flax seed (*Linum usitatissimum*). *J. Sci. Food Agric.,* **43** : 1775 - 1782.

Ranganna, S., 2005, Hand book of analysis and quality control for fruit and vegetable products, Tata Mc Graw Hill. Third edition: 868 - 925.

Rao, P. P., Galla, N. R., Kripanand, S. M., Karakala, B. and Akula, S., 2013, Preparation and storage stability of flax seed chutney powder, a functional food adjunct. *J. Food Sci. Technol.,* **51** (1) : 129 - 134.

Ray, B. R., Suresh, C. and Narasaiah, T., 2021, Jackfruit waste to wealth-confectionery chews. *Mysore J. Agric. Sci.*, **55** (4) : 48 -60.

Sabine, L. and Brian, S. E., 2004, A hand book of statistical analysis using SPSS.

Satyanarayana, A., Giridhar, N., Balaswamy, K., Shivaswamy, R. and Rao, D. G., 2001, Studies on development of instant chutneys from Pudina (Mint, *Mentha spicata*) and Gongura (*Hibiscus* sp). *J. Food Sci. Technol.,* **38** (5) : 512 - 514.

Shanthala, M. and Prakash, J., 2005, Acceptability of curry leaf (*Murraya koenigii*) incorporated products and attitude toward consumption. *J. Food Process. Pres.*, **29** (1) : 33 - 44.

Singh, G. and Awasthi, P., 2003, Sensory and nutritional quality evaluation of green leafy vegetable powder incorporated food products. *Int. J. Food Sci. Tech.,* **15** (8) : 07 - 11.

Singh, P. and Kulshrestha, K., 2008, Nutritional quality of food supplements based on carrot powder and grits. *J. Food Sci. Technol.,* **45** (1) : 99 - 101.

Singh, P., Yadav, N., Mishra, P. K. and Sheikh, S., 2013, Utilization of rice bran for the development of value added Indian Sweet. *Int. J. Res. Agric. Food sci.*, **3** (2) : 76 - 79.

Singh, V., Verma, S., Yadav, A. and Gopal, R., 2016, Studies of physico-chemical characteristics f various cultivars of aonla (*Emblica officinalis* G.) under semi-arid conditions of eastern Uttar Pradesh. *Int. J. Plant Sci.,* **11** (2) : 237 - 239.

Souza, F. T. C., Santos, E. R., Silva, J. D. C., Valentim, I. B., Rabelo, T. C. B., Andrade, N. R. F. D. and Silva, L. K. D. S., 2018, Production of nutritious flour from residue custard apple (*Annona squamosa* L.) for the development of new products. *J. Food Qual.*

Tate, R. L., 1995, Soil Microbiology. John Wiley and Sons, New York, pp. : 228 - 232.