Indian Journal of Traditional Knowledge
Vol. 16(1), January 2017, pp. 146-152

Standardization and quality evaluation of Vitamin C enriched poppy seed syrup

Meenakshisundaram Selvamuthukumaran* & Chinnaiah Chowdary

Microbiology & Food Science and Technology Department, GITAM University, Rushikonda, Visakhapatnam–530045, Andhra Pradesh, India

E-mail: selkuma@hotmail.com

Received 09 December 2015, revised 17 June 2016

The vitamin C enriched poppy seed syrup was developed by incorporating poppy seed slurry at 5-25% with addition of lemon juice. The sensory evaluation of developed products shows that the syrup was found to be acceptable upto 10% incorporation of poppy seed slurry. The syrup found to contains significantly enormous amount of dietary fibres, vitamin C and vitamin E, when compared to commercial samples. The standardized product was subjected to shelf stability evaluation at 23 ± 4 and 37 ℃. The physico-chemical evaluation of stored syrup shows that the TSS, total, reducing sugars and colour intensity significantly increased during the entire storage period; while protein, vitamin contents, viz. C and E significantly decreased at above temperature conditions. Slight reduction in acidity and dietary fibre content was notice during storage. Vitamin C enriched poppy seed syrup was found to be acceptable up to 6 months at room temperature and 2 months at 37˚C. The microbial population of stored samples was found to be non detectable.

Keywords: Vitamin C enriched, Poppy seed, Syrup, Storage study, Lemon juice, Dietary fibre

IPC Int. Cl.[8]: A61K 31/00, C07D 307/62, C12N, C12P, A23B 9/28, A23L 29/30, A23L 33/125

Poppy plant (*Papaver somniferum* L.), a biennial herb, commonly known Opium Poppy, is growing in Asian and Mediterranean countries, which require fertile soil and bright sunlight for their growth. The plant bears fruit, which is known as capsule and it contains small kidney shaped minute seeds and their colour varies from gray to black and bluish based on the cultivar from where it is growing[1]. Poppy seeds of superior quality are harvested when they are ripe, after the seed pod has dried. It is used as food and also as a source of fatty oil. It is widely used for culinary purposes. Because of its highly nutritive nature it is used in breads, cakes, cookies, pastries, curries, sweets and confectionary. The seeds are used as a spice, a condiment, a decorative garnish, a thickener and also as a main ingredient. In Indian traditional medicine (*Ayurveda*), soaked poppy seeds are ground into a fine paste with milk and being applied on the skin as a moisturizer. Poppy seeds contain many plant derived chemical compounds that are known to have anti-oxidant, disease preventing and health promoting properties. The seeds are pressed to form poppy seed oil, valuable commercial oil that has multiple culinary, industrial, and medicinal uses. The seeds are especially rich in oleic and linoleic acids. Oleic acid, a mono-unsaturated fatty acid, helps lower LDL or bad cholesterol and increase HDL or good cholesterol levels in the blood[2]. Poppy seeds outer coat is a good source of dietary fibre, 100 gm raw seeds provide around 19.5 gm, i.e., 51% of recommended daily levels (RDA) of fibre. The seeds are excellent source of B-complex vitamins such as thiamin, pantothenic acid, pyridoxine, riboflavin, niacin, and folic acid. They also contain good levels of minerals like iron, copper, calcium, potassium, manganese, zinc and magnesium[3]. Poppy seed found to contain plenty of nutrients especially fibre and minerals and they also found to possess several health benefits. At present this seed is only being used for culinary preparations as a spice, and the products available by utilizing poppy seed is meager, the seed lacks particularly vitamin C content and therefore, the objective of this study was to standardize formulation conditions for developing vitamin C enriched poppy seed syrup and also further to assess their quality during storage period by exposing the products to various temperatures.

Methodology

Raw materials

Poppy seeds, lemon fruits, citric acid and sugar were purchased from local market. All chemicals and

*Corresponding author

reagents utilized for investigation, which are brought from Himedia Laboratories Pvt Ltd., Mumbai, India and they were of AR grade.

Development of vitamin C enriched poppy seed syrup

The vitamin C enriched poppy seed syrup was developed as per the standard procedure[4]. Poppy seed was slightly roasted at mild temperature (60 °C) and they were ground to a fine paste with addition of desired quantities of water in a mixer grinder. Acidified sugar syrup was prepared by dissolving known amount of sugar (600 gm) and water (200 ml). Desired amount of citric acid, i.e., 6 gm was added in order to prevent crystallization during preparation of sugar syrup. Poppy seed slurry was added to the acidified syrup at different levels, i.e., from 50-250 ml/ l formulation. The prepared syrup is then fortified with desired quantity of lemon juice at 100 ml followed by addition of food grade lemon yellow colour (200 ppm) and essence (optional). The syrup is then packed in sterilized glass bottles, sealed and kept for further analysis.

Physico-chemical analysis

Proximate composition, i.e., moisture, carbohydrate, fat, protein, fibre and ash were determined as per the standard procedure[5]. Total soluble solids were determined using hand refractrometer (Erma, Tokyo, Japan). The titrable acidity was estimated as per the standard method[6]. The method of Lane and Eynon was followed for the determination of total and reducing sugar[6]. The total dietary fibre content was determined according to a gravimetric enzymatic method[7] and 2, 6-dichlorophenol-indophenol titration method[6] was used for the estimation of ascorbic acid content. The total carotenoids were determined using an ultra violet – visible recording spectrophotometer at 450 nm[6] (UV 1601, Shimadzu Corp., Columbia, USA). The degree of browning in the syrup sample was estimated as per the standard method[6].

Sensory evaluation

A panel with 15 trained judges, aged 30-55 yrs, with sensory evaluation experience in beverage products, evaluated the different vitamin C enriched poppy seed syrup after its dilution at 1:3 ratio's. The coded (3 digit) samples were presented one at a time in random order to the judges. The judges were asked to evaluate for colour, taste, aroma, body and overall acceptability of the given products. A common Hedonic quality assurance scale with 9 for like extremely to one for dislike extremely was used for evaluation[6].

Microbiological evaluation

For determining the total viable count, coliform, yeast & moulds and spores count in different samples, the 10^{-1} dilution was made by diluting 10 ml of products with 90 ml of physiological saline. Further, ten fold serial dilutions, ranging from 10^{-2} to 10^{-7} were prepared and the microbial counts were determined according to the pour plate method[8]. Total viable counts were determined using plate count agar incubated at 30 °C for 2 days. Counts of spores were determined using dextrose tryptone agar incubated at 37 °C for 2 days. The counts of yeasts and moulds were determined using potato dextrose agar (PDA), acidified to *p*H 3.5 with tartaric acid and incubated at 25 °C for 5 days. Coliforms were determined using violet red bile agar incubated at 37 °C for 2 days.

Statistical analysis

All experiments were run in triplicate. The results of stored sample data's were subjected to analysis of variance (ANOVA) using Microsoft Excel 2000 (Microsoft Corporation, Washington, USA) and their significant levels were determined at $p<0.05$. The paired comparisons of means of developed products for its nutritional and sensory evaluations were performed using Duncan's test[9].

Results

Proximate composition of poppy seed

The results of proximate composition of poppy seed shows that the seed recorded higher fat content (40.86%) followed by crude fibre (22.12%), carbohydrate (14.79%) and protein (12.24%). The recorded moisture content was 4.62% and ash content was 5.37%.

Sensory evaluation of vitamin C enriched poppy seed syrups

The Table 1 shows the sensory evaluation of various vitamin C enriched poppy seed syrups prepared by incorporating poppy seed slurry at 5-25%. The results shows that syrup was found to be acceptable with the poppy seed slurry incorporation upto a level of 10% in the finished product, in this case the S_1 and S_2 samples recorded higher organoleptic attributes when compared to other

samples. No significant organoleptic characteristics were noticed for S_1 & S_2 samples, while other samples exhibited significant organoleptic variations.

Nutritional evaluation of vitamin C enriched poppy seed syrup

The Table 2 shows the nutritional evaluation of vitamin C enriched poppy seed syrup in comparison with commercial samples. The result shows that the poppy seed syrup found to contain significantly ($p<0.05$) enormous amount of dietary fibres, vitamin C & vitamin E, when compared to pineapple and grape fruit syrup samples. The TSS and acidity of the different syrup samples ranges from 70-71 ° brix and 1.02-1.16%, which were found to be within the limit range of FSSAI[10] specifications. Significant difference ($p<0.05$) in contents of total and reducing sugars were found among various samples, which are being analyzed.

Storage stability of vitamin C enriched poppy seed syrup

The standardized product of vitamin C enriched poppy seed syrup, i.e., S_2 was developed and hot filled into presterilized glass bottles, sealed and subjected for shelf stability assessment at room temperature (23 ± 4 ˚C) and 37 ˚C.

Physico–chemical evaluation of stored syrup

The physico-chemical evaluation of vitamin C enriched poppy seed syrup samples stored at different temperature was given in Table 3. The initial total soluble solids of the syrup 71.0˚ brix significantly increased ($P<0.05$) to 74.0 and 74.5˚ brix, after 6 months of storage at room temperature (23 ± 4 ˚C) and at 37˚C, respectively. The acidity of the syrup was 1.02% at beginning and this slightly decreased to 0.99 and 0.97%, after 6 months of storage at room temperature and 37 ˚C. The slight decrease in acidity was found to be non significant at level of ($P>0.05$). The initial total sugar content of the syrup (56.48 %) increased to 64.37 and 66.19% after six months of storage at room temperature and at 37 ˚C. The reducing sugar content of the syrup was 17.64% at earlier period and this increased to 22.48 and 24.06% after 6 months of storage at room temperature and at 37 ˚C. The increase in total sugar and reducing sugar content of the stored samples were significant at level

Table 1—Sensory evaluation* of different vitamin C enriched poppy seed syrups

Type of syrup	Colour	Aroma	Taste	Body	Overall acceptability
S_1	8.62 ±0.65[a]	8.34 ± 0.53[a]	8.51 ± 0.78[a]	8.40 ± 0.49[a]	8.46 ± 0.57[a]
S_2	8.82 ± 0.45[a]	8.65 ± 0.86[a]	8.92 ± 0.56[a]	8.75 ± 0.71[a]	8.78 ± 0.52[a]
S_3	7.41 ± 0.55[b]	7.17 ± 0.71[b]	7.24 ± 0.68[b]	7.03 ± 0.49[b]	7.21 ± 0.60[b]
S_4	6.73 ± 0.79[c]	6.36 ± 0.63[c]	6.15 ± 0.77[c]	6.40 ± 0.69[c]	6.41 ± 0.59[c]
S_5	5.72 ± 0.91[d]	5.54 ± 0.48[d]	5.21 ± 0.80[d]	5.37 ± 0.93[d]	5.46 ± 0.85[d]

S_1: 5% poppy seed slurry incorporated vitamin C enriched syrup; S_2: 10 % poppy seed slurry incorporated vitamin C enriched syrup; S_3: 15% poppy seed slurry incorporated vitamin C enriched syrup; S_4: 20 % poppy seed slurry incorporated vitamin C enriched syrup. S_5: 25% poppy seed slurry incorporated vitamin C enriched syrup.

*Mean ± SD of triplicate analysis.

[a,b,c,d] Mean values in the same column bearing the common superscript do not differ significantly ($p>0.05$).

Table 2—Nutritional evaluation* of vitamin C enriched poppy seed syrup in comparison with commercial samples

Parameters	Vitamin C rich poppy seed syrup	Pineapple syrup**	Grape syrup**
Total soluble solids (°brix)	71.0 ± 0.00[a]	70.0 ± 0.00[b]	71.0 ± 0.00[a]
Acidity (%)	1.02 ± 0.02[a]	1.16 ± 0.04[a]	1.09 ± 0.03[a]
Total sugars (%)	56.48 ± 0.56[a]	60.67 ± 0.72[b]	66.32 ± 0.81[c]
Reducing sugars (%)	17.64 ± 0.59[a]	21.32 ± 0.41[b]	25.86 ± 0.74[c]
Dietary fibre (gm/100 gm)	2.04 ± 0.39[a]	0.53 ± 0.21[b]	0.16 ± 0.10[b]
Protein (gm/100 gm)	1.73 ± 0.26[a]	0.31 ± 0.12[b]	0.21 ± 0.11[b]
Vitamin C (mg/100 gm)	4.51 ± 0.41[a]	3.10 ± 0.57[b]	3.62 ± 0.38[b]
Vitamin E (mg/100 gm)	0.25 ± 0.11[a]	ND	0.02 ± 0.01[b]

*Mean ± SD of triplicate analysis.

**Commercial samples.

[a,b,c] Mean values in the same column bearing the common superscript do not differ significantly ($p>0.05$).

Table 3—Physico-chemical evaluation* of stored vitamin C enriched poppy seed syrup

Storage period in months	TSS (°brix)		Acidity (%)		Total sugars (%)		Reducing sugars (%)		Protein (gm/100g)	
	23 ± 4˚C	37˚C	23 ± 4˚C	37˚C	23 ± 4˚C	37˚C	23 ± 4˚C	37˚C	23 ± 4˚C	37˚C
0	71.00 ± 0.00	71.00 ± 0.00	1.02 ± 0.06	1.02 ± 0.06	56.48± 0.48	56.48± 0.48	17.64 ± 0.61	17.64 ± 0.61	1.74 ± 0.40	1.74 ± 0.40
1	71.00 ± 0.47	71.68 ± 0.42	1.02 ± 0.06	1.02 ± 0.06	56.48± 0.48	57.80± 0.69	18.01 ± 0.37	18.93 ± 0.61	1.63 ± 0.67	1.52 ± 0.55
2	71.52 ± 0.65	72.34. ± 0.29	1.02 ± 0.06	1.00 ± 0.05	57.88± 0.76	59.71± 0.40	18.75 ± 0.70	19.78 ± 0.43	1.59 ± 0.44	1.41 ± 0.39
3	72.06 ± 0.38	72.99 ± 0.68	1.01 ± 0.04	1.00 ± 0.05	58.48± 0.39	61.13± 0.52	19.52 ± 0.88	21.45 ± 0.72	1.46 ± 0.35	1.32 ± 0.50
4	72.89 ± 0.40	73.58 ± 0.80	1.01 ± 0.04	0.99 ± 0.03	60.13± 0.52	63.77± 0.70	20.26 ± 0.65	22.90 ± 0.49	1.39 ± 0.40	1.25 ± 0.81
5	73.50 ± 0.55	74.13 ± 0.51	1.00 ± 0.05	0.98 ± 0.04	62.99± 0.77	65.09± 0.36	21.88 ± 0.90	23.41 ± 0.87	1.31 ± 0.53	1.19 ± 0.75
6	74.00 ± 0.60	74.50 ± 0.51	0.99 ± 0.03	0.97 ± 0.02	64.37± 0.65	66.19± 0.82	22.48 ± 0.65	24.06 ± 0.77	1.22 ± 0.41	1.12 ± 0.51

Storage period in months	Dietary fibre (gm/100 gm)		Vitamin C (mg/100 gm)		Vitamin E (mg/100 gm)		Colour intensity (OD)	
	23 ± 4˚C	37˚C	23 ± 4˚C	37˚C	23 ± 4˚C	37˚C	23 ± 4˚C	37˚C
0	2.04± 0.37	2.04± 0.37	4.51± 0.44	4.51± 0.44	0.25± 0.10	0.25± 0.10	0.14 ± 0.06	0.14 ± 0.06
1	2.04± 0.37	2.04± 0.37	4.06± 0.61	3.54± 0.52	0.25± 0.10	0.25± 0.10	0.21 ± 0.04	0.39 ± 0.07
2	2.04± 0.37	1.96± 0.41	3.71± 0.69	2.86± 0.40	0.25± 0.10	0.23± 0.12	0.26 ± 0.09	0.50 ± 0.09
3	1.94± 0.62	1.90± 0.57	3.11± 0.82	2.04± 0.66	0.20± 0.16	0.19± 0.11	0.33 ± 0.06	0.71 ± 0.05
4	1.91± 0.53	1.84± 0.59	2.74± 0.59	1.47± 0.60	0.18± 0.10	0.17± 0.13	0.38 ± 0.05	0.83 ± 0.04
5	1.87± 0.40	1.79± 0.61	2.30± 0.77	0.86± 0.29	0.16± 0.13	0.15± 0.10	0.40 ± 0.07	0.92 ± 0.07
6	1.84± 0.47	1.74± 0.50	1.90± 0.21	0.19± 0.12	0.15± 0.12	0.13± 0.11	0.43 ± 0.04	1.07 ± 0.09

*Values are mean ± SD of triplicate analysis.

OD: Optical density.

of P<0.05. The protein content of the syrup, i.e., 1.74 gm/100 gm, significantly decreased (p<0.05) from 1.22 and 1.12 gm/100 gm after 6 months of storage at room temperature and 37 ˚C. The dietary fibre content of syrup was 2.04 gm/100gm initially, which slightly decreased (p>0.05) to 1.84 and 1.74 gm/100 gm after 6 months of storage at room temperature and at 37 ˚C.

The vitamin C content of the syrup was 4.51 mg/ 100 gm initially, which significantly decreased (P<0.05) to 1.90 and 0.19 mg/ 100 gm at room and 37 ˚C temperature conditions, respectively, after 6 months of storage period. The vitamin C loss accounted to 58% at room temperature and 96 % at 37 ˚C after 6 months of storage period. The vitamin E content of syrup was 0.25 mg/ 100 gm at initial period which significantly decreased (p<0.05) to 0.15 and 0.13 mg/ 100 gm at room and 37 ˚C temperature conditions, respectively, after 6 months of storage period. The loss was accounted to 40 and 51% under room temperature and 37˚C, respectively, after 6 months of storage. Colour intensity, i.e., browning increased significantly (P<0.05) from 0.14 OD to 0.43 and 1.079 OD, after 6 months of storage at room temperature and at 37 ˚C.

Sensory evaluation of stored syrup

The sensory scores of syrup samples stored at room temperature (23 ± 4°C) and at 37˚C were presented in Table 4. The vitamin C enriched poppy seed syrup had an overall acceptability score of initially 8.78, on

Table 4—Sensory evaluation* of stored vitamin C enriched poppy seed syrup (n=15)

Storage period in months	Colour		Body		Taste		Aroma		Overall acceptability	
	23 ± 4˚C	37˚C	23 ± 4˚C	37˚C	23 ± 4˚C	37˚C	23 ± 4˚C	37˚C	23 ± 4˚C	37˚C
0	8.82 ± 0.45	8.82 ± 0.45	8.75 ± 0.71	8.75 ± 0.71	8.92 ± 0.56	8.92 ± 0.56	8.65± 0.86	8.65 ± 0.86	8.78 ± 0.52	8.78 ± 0.52
1	8.42 ± 0.47	7.17 ± 0.42	8.29 ± 0.29	7.31 ± 0.85	8.18 ± 0.36	7.22 ± 0.38	7.97 ± 0.52	7.33 ± 0.45	8.21 ± 0.39	7.25 ± 0.73
2	8.09 ± 0.65	6.35 ± 0.29	7.61 ± 0.50	6.46 ± 0.37	7.94 ± 0.67	6.36 ± 0.47	7.41 ± 0.28	6.21 ± 0.90	7.76 ± 0.60	6.34 ± 0.57
3	7.65 ± 0.38	5.64 ± 0.68	7.33 ± 0.55	5.91 ± 0.56	7.51 ± 0.60	5.77 ± 0.29	7.18 ± 0.65	5.87 ± 0.49	7.41 ± 0.57	5.79 ± 0.38
4	7.31 ± 0.40	4.81 ± 0.80	7.00 ± 0.67	5.47 ± 0.25	7.12 ± 0.34	5.39 ± 0.70	6.91 ± 0.80	5.26 ± 0.27	7.08 ± 0.47	5.23 ± 0.61
5	6.72 ± 0.55	4.33 ± 0.51	6.89 ± 0.23	5.11 ± 0.34	6.71 ± 0.41	5.07 ± 0.48	6.43 ± 0.72	4.88 ± 0.50	6.68 ± 0.65	4.84 ± 0.45
6	6.10 ± 0.60	4.08 ± 0.51	6.03 ± 0.41	4.70 ± 0.91	6.24 ± 0.29	4.75 ± 0.52	6.23 ± 0.36	4.27 ± 0.61	6.15 ± 0.39	4.45 ± 0.62

*Values are mean ± standard deviation.

a nine-point Hedonic scale and a score of 6.1 at the end of the storage period was taken as the limit for assessing the shelf stability of the stored product. Vitamin C enriched poppy seed syrup was found to be acceptable up to 6 months of storage at room temperature and 2 months at 37 ˚C. However, colour, aroma, taste, body and overall acceptability were found to reduce after 2 months of storage at 37 ˚C. Changes in the vitamin C enriched poppy seed syrup had a significant effect ($p < 0.05$) on sensory attributes during storage period for 6 months at above temperature conditions.

Microbial evaluation of stored syrup

The microbial population of fresh as well as vitamin C enriched poppy seed syrup samples stored at room temperature (23 ± 4 ˚C) and at 37 ˚C for a period of 6 months was found to be non detectable.

Discussion

The proximate analysis shows that the poppy seed, which is a good source of fats especially PUFA (poly unsaturated fatty acids) and fibres[11-13], so they can be successfully utilized for developing several health oriented food products. Özcan & Atalay[1] were also reported similar results of proximate constituents in poppy seed cultivars from Turkey.

The sensory evaluation study shows that among the various syrup prepared, the samples S_1 and S_2 recorded higher organoleptic attributes with poppy seed slurry incorporation upto a level of 10% in the finished product. The S_3, S_4 and S_5 samples recorded lesser colour score, this may be because of presence of more amount of brownish particles which might have reduced the intensity of colour and body score, presence of oily substances might have affected score of aroma and taste and this finally greatly reduced the overall acceptability score of these particular samples to a greater extent. The physico-chemical evaluation of stored product shows that the increase in total soluble solids, which could be due to the conversion of polysaccharides into simple sugars during storage. Selvamuthukumaran & Farhath Khanum[14] also reported an increasing trend in total soluble solids of spiced seabuckthorn mixed fruit squash during a period of 6 months storage at above temperature conditions. Acidity of the product exhibited slight variation only during entire period of storage. The rise in total sugars might be due to the partial hydrolysis of complex carbohydrates which could contribute towards increase in the total content for the stored product and similarly, increase in reducing sugars might be due to hydrolysis or inversion of non-reducing sugars to reducing sugars. Selvamuthukumaran & Farhath Khanum[14] also reported an increasing trend of both total and reducing sugars for spiced seabuckthorn mixed fruit squash during a period of six months storage at ambient temperature and 37 ˚C.

The protein got reduced and this may be due to degradation of proteins at above temperatures might have reduced the content during storage period at above temperature conditions. Hamedani *et al.*[15] and Saci & Louaileche[16] were also reported similar

decrease in protein content in blood orange juice, commercial carrot and mango beverages during storage at 22 ˚C and 35 ˚C for 3 months. The slight reduction in dietary fibre may be due to degradation of soluble fibres at above temperature conditions, which might have reduced the total dietary fibre content of the product during storage.

The reduction in vitamin C could be due to oxidation or degradation of the thermolabile ascorbic acid into dehydroascorbic acid upon storage and reduction in vitamin E might be due to its degradation, susceptibility to lipid auto oxidation, sensitive to oxidation and heat might have contributed to the depletion of vitamin E content in stored product at above temperatures. Barwal *et al*.[17] who have also reported a decreasing trend of vitamin C in plum seasoned squash at room temperature during period of 6 months storage; Selvamuthukumaran and Farhath Khanum[14] also reported similar losses in the concentration of tocopherols during the storage of spiced seabuckthorn mixed fruit squash at ambient temperature and 37 ˚C after 6 months.

The increase in optical density indicated browning with advancement of storage period, which could be ascribed to oxidation and development of non-enzymatic browning (an amino acid sugar interaction) resulting in the formation of the dark pigment. Selvamuthukumaran & Farhath Khanum[14] also observed an increase in optical density, i.e., browning of different fruit squashes during the period of 12 months storage at ambient temperature and 37 ˚C.

The sensory evaluation study of stored products at 37ºC shows that the product was found to be acceptable upto a period of 2 months only, this might be due to chemical reactions which leads to the formation of brown pigments which might have decreased the color score, loss of volatile aromatic substances during storage period under these conditions might have decreased the aroma and taste score. The decrease in colour and body score during storage might be due to copolymerization, interaction between phenolics and proteins as well as the formation of cation complexes during storage. All these changes could collectively decrease the overall acceptability of the stored products at above conditions. Kannan & Susheela Thirumaran[18], Singh *et al*.[19] and Sogi & Singh[20] were also reported similar results of decrease in sensory scores of squash as a result of time advancement for the jamun squash, barhal squash and kinnow fruit squash during a storage period of 6 and 4 months at room temperature and 37 ˚C, respectively. The stored product exhibited nil microbial growth, the absence of microbial population in the stored product directly reflects the hygiene during handling and storage. The study further reveals that the product is safe for consumption. These findings are in conformity with the reported results of Kannan & Susheela Thirumaran[18], who have also observed nil microbial growth for fresh and stored *jamun* fruit squash sample upto a period of 6 months at room temperature condition.

Significance of study

The poppy seed is traditionally used only as a seasoning ingredient in India and their incorporation into the foods are very scanty. The seed is found to possess enormous amount of dietary fibres, vitamin E and proteins and the beverages made out of poppy seed is nutritionally beatable when compared to commercial products. The products available by utilizing such seed is also nil in Indian markets, therefore this study will help the entrepreneur to commercially explore this seed for further value addition.

Conclusion

The vitamin C enriched poppy seed syrup can be prepared by incorporating poppy seed slurry at 10% with addition of lemon juice. The developed product contains more amounts of dietary fibres, vitamin C and vitamin E, when compared to commercial samples. This type of product significantly contribute a greater role to the consumers by improving blood sugar and weight control, providing protection against immune system deficiencies and it also helps in reducing the risk of coronary heart diseases. The product had the good stability upto a period of 6 months at 23 ± 4 °C. Therefore the consumer can reap benefits by augmenting vitamins and fibres to their body by incorporating such type of drinks in their daily life.

References

1 Özcan M & Atalay Ç, Determination of seed and oil properties of some poppy (*Papaver somniferum* L.) varieties, *Grasas Y Aceites*, 57 (2006) 169-174.

2 WWW. Buzzle.com, Poppy Seed Nutrition Facts, Retrieved on Feb 18, 2011.

3 Lifestyle and strength.com, Food Facts: Poppy Seed, Retrieved on Oct 13, 2013.

4 Girdharilal G, Sidappa S & Tandon G L, Preservation of Fruits and Vegetables,(Indian Council of Agricultural Research Publications, New Delhi), 1998.

5 AOAC, Official Methods of Analysis of AOAC International, (Association of Official Analytical Chemists, Washington, DC), 2016.
6 Ranganna S, Hand Book of Analysis of Quality Control for Fruit and Vegetable Products, (Tata McGraw Hill, New Delhi), 2004.
7 Prosky L, Asp N G, Schweizer T F, Devries J W & Furda I, Determination of insoluble, soluble and total dietary fibre in foods and food products, *J AOAC Int*, 71 (1998) 1017-1023.
8 Harrigan W F & McCance M E, Laboratory Methods in Food and Dairy Microbiology, (Academic Press, London), 2007, 214-215.
9 Steel R D & Torrie J H, Principles and Procedures of Statistics: A Biometrical Approach. (McGraw Hill, New York), 1997, 633.
10 FSSAI, Food Safety and Standard Authority of India, (Ministry of Health and Family Welfare, Govt of India, New Delhi), 2013.
11 Erinç H, Tekin A & Özcan MM, Determination of fatty acid, tocopherol and phytosterol contents of the oils of various poppy (*Papaver somniferum* L.) seeds, *Grasas y Aceites*, 60 (2009) 375-381.
12 İnan Ö, Özcan MM & Al Juhaimi F, Antioxidant effect of mint, laurel and myrtle leaves essential oils on pomegranate kernel, poppy, grape and linseed oils, *J Cleaner Prod*, 27 (2012) 151-154.
13 Bozan B & Temelli F, Extraction of poppy seed oil using supercritical CO_2, *J Food Sci*, 68 (2003) 422-426.
14 Selvamuthukumaran M & Farhath Khanum, Development of spiced seabuckthorn [*Elaeagnus rhamnoides* (L.) A. Nelson syn. *Hippophae rhamnoides* L.] mixed fruit squash, *Indian J Tradit Knowle*, 13 (2014) 132-141.
15 Hamedani M, Rabiei V, Moradi H, Ghanbari A & Azimi M R, Determination of storage duration and temperature effects on fruit quality parameters of blood orange (Citrus sinensis cv. Tarocco), *Biharean Biologist*, 6 (2012) 10-13.
16 Saci F & Louaileche H, Effect of storage on the nutritional quality, carotenoid and ascorbic acid contents of two commercial beverages, *Int J Chem Biomol Sci*, 1 (2015) 49-53.
17 Barwal V S, Sharma R & Lal B B, Use of sorbitol for the preparation of plum seasoned squash, *J Food Sci Technol*, 39 (2002) 413 – 417.
18 Kannan S & Susheela Thirumaran, Studies on the storage life of jamun (Syzygium cuminii Rom.) fruit products, *J Food Sci Technol*, 41 (2004) 186 – 188.
19 Singh I J, Singh H K & Chopra C S, Studies on storage stability of barhal (Artocarpus lakoocha) products, *Beverage Food World*, 31 (2004) 29-30.
20 Sogi D S & Singh S, Studies on bitterness development in kinnow juice, ready–to–serve beverage, squash, jam and candy, *J Food Sci Technol*, 38 (2001) 433-438.