Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(4): 943-949
Received: 18-05-2018
Accepted: 23-06-2018

Anju K Dhiman
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Babu Ng
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Surekha Attri
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Preethi Ramachandran
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Correspondence
Preethi Ramachandran
Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Preparation of pumpkin pulp and effect of different preservation methods on chemical and sensory properties during storage

Anju K Dhiman, Babu NG, Surekha Attri and Preethi Ramachandran

Abstract
The main objectives of the study was to develop pulp from ripe pumpkin using different combination of water per cent and cooking time and to evaluate best preservation method for storage of pulp. Among different combinations of water and cooking time tried to standardize the method of preparation of ripe pumpkin pulp, the combination comprising of 5 per cent water for 5 minutes cooking (C_2) was selected superior on the basis of chemical characteristics and sensory attributes for conducting further studies *i.e.* preservation of pulp by heat and chemical methods. The pulp of T_2 (pulp+KMS @ 2000 ppm in glass bottles) treatment retained the highest *β*-carotene (6.52 mg/100 g) as well as ascorbic acid (10.86 mg/100 g) contents followed by T_6 (Pulp + sodium benzoate (1000 ppm) + KMS (1000 ppm) in glass bottles) during six months of storage. Hence, it can be revealed from the study that nutritionally rich pumpkin pulp can be prepared which could be further utilized for the preparation of various other value added products.

Keywords: ripe pumpkin, pulp, hot extraction, *β*-carotene, preservation, KMS, sodium benzoate, canning

Introduction
Ripe pumpkin (*Cucurbita moschata* Duch ex Poir) is commonly known as '*Sitaphal*', '*Kashiphal*' or '*Lal Kaddu*' in India and belongs to the family Cucurbitaceae and the genus *Cucurbita*. Worldwide, there are three main types of pumpkin, namely *Cucurbita maxima, C. moschata* and *C. pepo* (Lee *et al.*, 2003) [16]. Out of these, *C. moschata* is a leading crop coming from tropical and subtropical zones such as Mexico and South America with higher consumption in the local market. The world production of pumpkins, squashes and gourds is estimated to be 25.19 million tonnes from an area of 2 million ha with 1,25,729 hg/ha yield (FAO, 2014) [11]. India is the second largest producer of pumpkin next to China and together they account for two-third of world production (FAO, 2014) [11]. The total production of pumpkin and other squashes in India is 1,197 million tonnes from an area of 54,000 ha (NHB, 2016) [22]. Recent figures on the area and production of pumpkin in Himachal Pradesh are not available due to sporadic cultivation. However, the production reported in the year 2013 was 62,169 metric tonnes from an area of 2,436 ha (NHB, 2013) [21].
Pumpkin is a seasonal crop and is best cultivated in the warm season in good well drained soil. The fruit is very sensitive to heat and highly perishable in warm conditions. Pumpkin is one of the rich sources of phytonutrients, which performs many functions in overall health. They are valuable source of functional components mainly carotenoids, zeaxanthin, vitamin E, ascorbic acids, phytosterols, selenium and linoleic acid, which acts as antioxidant in human nutrition (Sirohi *et al.*, 1991) [26]. Besides high nutritional value, pumpkin possesses many medicinal properties. Pumpkin is rich source of biologically active compounds and is recommended for arthrosclerosis and helps to reduce the cholesterol in people suffering from obesity (Danilchenko *et al.*, 2000) [5]. Despite the enormous health benefits of pumpkins, they are grown on a low scale because of the lack of knowledge on its nutritional value and market prospective. Pumpkin has vast scope of diversification for its application in the production of commercial products. Pumpkin can be profitably converted into a variety of value added products such as jam, jelly, marmalades, puree, sauces, chutney, pickle and *halwa* (Dhiman *et al.*, 2009) [10], cookies and weaning mix (Bavita, 2013) [4], instant food mixes (Dhiman *et al.*, 2017a) [7] such as instant *halwa* mix (Dhiman *et al.*, 2017b) [8] and instant soup mix (Dhiman *et al.*, 2017c) [9] and beverages (Dhiman *et al.*, 2017) [6]. For the preparation of these value added products in many cases we need pumpkin pulp. Preparation and preservation of pumpkin pulp by using different methods in not available yet. There are various preservation methods such as chemical and heat preservation.

These preservation methods are used to prevent the food spoilage caused by microorganism and therefore are effectively used in combination for better preservation. Chemical such as sodium benzoate and potassium metabisulphite (KMS) are commonly used as preservatives for long term storage of fruit pulp because of their better antimicrobial activity (Akhtar *et al*., 2010) [1]. Keeping in view the above facts, the efforts have been made in the present investigation in order to prepare and improve the shelf life of ripe pumpkin pulp by using the various safe preservation methods with their safe concentration.

Materials and Methods

Procurement of raw materials

Ripe pumpkin (*Cucurbita moschata*) for conducting the study were procured from local market of Solan and brought to the Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan (HP). The chemicals such as Sodium benzoate ($NaC_6H_5CO_2$) and Potassium metabisulphite ($K_2S_2O_5$) were purchased from local supplier.

Preparation of pumpkin pulp

Ripe pumpkins were thoroughly washed and cut into halves. After removing the seeds and fluffy portion (fibrous strains/brains), pumpkins were cut into slices. The slices were peeled, washed and cut into small pieces. To standardize the method of preparation of pulp, pumpkin pieces (1 kg) were heated in a pressure cooker of five kg capacity by using domestic gas stove with varied water proportions (5 and 10 %) and cooking time duration of 3, 5 and 10 min (Table 1). The whole mass was then converted into pulp by grinding in mixer cum grinder (Model MX-1155). The pulp thus obtained was analysed for different chemical parameters and the best combination on the basis of higher retention of nutrients as well as sensory scores was selected for further studies.

Table 1: Standardization of water proportion and cooking time duration for preparation of ripe pumpkin pulp

Treatment (C)	Water (%)	Cooking time duration (min)
C_1	5	3
C_2	5	5
C_3	5	10
C_4	10	3
C_5	10	5
C_6	10	10

Preservation of ripe pumpkin pulp

The obtained ripe pumpkin pulp by using best combination of water per cent and cooking time was acidified with citric acid to a level of 0.3 per cent and preserved by using different methods such as chemical and heat preservation. As per preservation method, the pulp was packed in cans, glass bottles and PET jars (Table 2). The packed pulp was kept at ambient temperature for storage. The quality evaluation studies of the pulp were conducted at 0, 3 and 6 months.

Table 2: Treatment detail for preservation of ripe pumpkin pulp

Treatment (T)	Description
T_1	Canning
T_2	Pulp + potassium metabisulphite (2000 ppm) in glass bottles
T_3	Pulp + potassium metabisulphite (2000 ppm) in PET jars
T_4	Pulp + sodium benzoate (2000 ppm) in glass bottles
T_5	Pulp + sodium benzoate (2000 ppm) in PET jars
T_6	Pulp + sodium benzoate (1000 ppm) + potassium metabisulphite (1000 ppm) in glass bottles
T_7	Pulp + sodium benzoate (1000 ppm) + potassium metabisulphite (1000 ppm) in PET jars
T_8	Pulp + pasteurization in glass bottles
T_9	Pulp + potassium metabisulphite (1000 ppm) + pasteurization in glass bottles
T_{10}	Pulp + sodium benzoate (1000 ppm) + pasteurization in glass bottles

Physico-chemical analysis

Pumpkin fruit and pulp was analyzed for different parameters. The weight of fruit was taken on top pan balance while length and width of ripe pumpkin were measured by using thread and scale. Recovery of pulp was calculated by subtracting the weight of peel/seed/core/fluffy portions from the fruit. The colour of the flesh of pumpkin was evaluated visually. Moisture content was determined by measuring the weight loss due to evaporation of water (AOAC, 2012) [3]. Titrable acidity was estimated by titrating known volume of sample against standard 0.1 N NaOH using phenolphthalein as an indicator (Ranganna, 2009) [23]. Total Soluble solids (TSS) of the samples were measured by hand refractometer of 0-32 °Brix (AOAC, 2012) [3]. The pH was determined by using a digital pH meter (CRISON Instrument, Ltd Spain). The method as described by Ranganna (2009) [23] was followed for the estimation of pectin. Ascorbic acid content was determined by using 2-6 dichlorophenol indophenols dye (AOAC, 2012) [3]. Sugars, ash content and *β*-carotene was estimated by as per the method described by Ranganna (2009) [23].

Sensory evaluation

Nine point hedonic scale method given by Amerine *et al.* (1965) [2] was followed for conducting the sensory evaluation of pumpkin pulp. The panel of ten judges comprising of faculty members and post graduate students were selected with care to evaluate the products for various sensory parameters such as colour, body, texture, flavour and overall acceptability depending upon the type of product. Efforts were made to keep the same panel for sensory evaluation throughout the entire period of study. Plain water was given to the judges to rinse their mouth in between the evaluation of samples.

Microbial examination

Total plate count was calculated by aseptically inoculating 0.1 g of serially diluted samples in total plate count/ standard plate count agar medium prepared according to Ranganna (2009) [23]. One ml of sample after serial dilution (10^{-2}, 10^{-4}, 10^{-6} and 10^{-8}) was aseptically inoculated in pre sterilized plates, followed by pouring total plate count agar (10-15 ml) under sterilized environment of laminar air flow. The plates

were then incubated at 37ºC for 72 hrs prior counting of microbes. The results of total plate count (TPC) were expressed as x 10^{-2} CFU/g of sample.

Statistical analysis

The data on physico-chemical characteristics of pumpkin fruits and pulp were analysed by using Completely Randomized Design (CRD) before and during storage. The data pertaining to sensory evaluation of pumpkin pulp was analyzed by using Randomized Block Design (RBD) as described by Mahony (1985) [17].

Results and Discussion

The aim of the present experiment was to prepare pulp from ripe pumpkin and study its storage stability during storage by using various preservation methods. The physico-chemical analysis of ripe pumpkin fruit is presented in Table 3.

Table 3: Physico-chemical characteristics of ripe pumpkin fruits

Characteristics	Pumpkin (Mean ± SD)
Length (cm)	30.20±0.84
Diameter(cm)	22.38±1.78
Weight (g)	3260±505
Edible portion (%)	64.98±0.65
Pulp/juice/extract recovery (%)	81.20±0.65
Visual colour	Pale yellow to orange
Moisture (%)	87.80±1.15
TSS (ºB)	8.00±0.05
Titrable acidity (%)	0.064±0.001
Ascorbic acid (mg/100 g)	14.52±0.29
Reducing sugars (%)	2.17±0.139
Total sugars (%)	3.76±0.01
β-carotene (mg/100 g)	12.27±0.577
pH	4.40±0.05
Crude fibre (%)	0.62±0.011
Ash (%)	0.54±0.15

Standardization of method for preparation of ripe pumpkin pulp

The data pertaining to chemical characteristics of ripe pumpkin pulp extracted by hot pulping method is presented in Table 4. After going through the data it is revealed that, there were significant differences with respect to all chemical characteristics of pumpkin pulp extracted by six different combinations of water and cooking time duration. The recovery of pulp was found to range between 82.30 and 89.88 per cent (w/w) with maximum value for C_5 (10 % water for 5 min) and minimum for C_1 (5 % water for 3 min). The fruit to water ratio brought a significant effect on the yield of pulp, with increase in water content the yield of pulp also increased. Mandhyan *et al*. (2000) [18] and Sandhu *et al*. (2001) [24] recorded an increase in yield of guava pulp with increase in proportion of water. The total soluble solids (TSS) of extracted pulp ranged from 5.42 to 7.10 ºB. The treatment C_3 (5 % water for 10 min) exhibited the highest TSS which was statistically at par (7.05 ºB) with C_2 (5 % water for 5 min) while C_4 (10 % water for 3 min) showed the lowest level. With the increase in proportion of water in fruit, the TSS of pulp exhibited significant decrease. Further, with increase in cooking time, the TSS of resultant pulp showed a slight increase. The increase in TSS in hot break method might be due to loss of moisture and better extraction of soluble components (Kaushal, 2004) [15].

Table 4: Physico-chemical characteristics of ripe pumpkin pulp extracted by using different combinations of water and cooking time duration

Treatment (C)	Water (%)	Cooking time duration (min)	Yield (%)	TSS (ºB)	Titrable acidity (%)	pH	Reducing sugars (%)	Total sugars (%)	Ascorbic acid (mg/100 g)	*β*- carotene (mg/100 g)	Pectin (%)
C_1	5	3	82.30	7.00	0.052	4.64	2.23	3.87	10.06	7.04	0.22
C_2	5	5	83.40	7.05	0.048	4.65	2.27	3.91	10.01	7.01	0.29
C_3	5	10	82.40	7.10	0.044	4.68	2.31	3.98	9.62	6.62	0.31
C_4	10	3	88.50	5.42	0.036	5.12	2.15	3.12	7.90	6.22	0.12
C_5	10	5	89.88	5.60	0.034	5.36	2.17	3.14	7.33	5.91	0.13
C_6	10	10	89.00	5.80	0.031	5.38	2.20	3.20	6.32	5.31	0.17
$CD_{0.05}$			0.17	0.08	0.01	0.04	0.06	0.05	0.14	0.16	0.03

The data (Table 4) indicated that titrable acidity of pumpkin pulp was highest (0.052 %) in C_1 (5 % water for 3 min) which was statistically at par with treatment C_2 (5 % water for 5 min) having a value of 0.048 per cent and C_3 (5 % water for 10 min) with a value of 0.044 per cent. With the increase in water to fruit dilution, the acidity of resultant pulp experienced a significant decrease. The maximum (5.38) pH value was recorded in C_6 (10 % water for 10 min) and minimum (4.64) in C_1 (5 % water for 3 min). With the increase in proportion of water in fruit, there was a significant increase in pH. The total sugars in pumpkin pulp showed the highest mean value of 3.98 per cent for C_3 (5 % water for 10 min) while the lowest total sugars (3.12 %) were observed in C_4 (10 % water for 3 min). As far as reducing sugars are concerned, the maximum value of 2.31 per cent for C_3 (5 % water for 10 min). Further, with the increase in proportion of water, total sugars as well as reducing sugars showed a significant decrease. With the increase in cooking time duration, total and reducing sugars were found to increase

during pulp preparation while a significant decrease was observed with enhancement of proportion of water.

Table 4 also highlights the ascorbic acid content of pumpkin pulp extracted by using various combinations of water and cooking time. The data clearly indicate that ascorbic acid ranged between 6.32 and 10.06 mg/100 g. A critical look at the data revealed that heating of fruit for varied cooking time as well as increasing water proportion, exhibited a significant reduction in the ascorbic acid of extracted pulp. Ascorbic acid is the least stable of all the vitamins and is highly sensitive to oxidation and leach into water-soluble media during processing, storage and cooking (Franke *et al.,* 2004) [12]. The results are in conformation with the findings of Murari and Verma (1989) [20] who recorded only 61.00 per cent retention in ascorbic acid of guava pulp extracted by hot break method.

The data (Table 4) elucidate that *β*- carotene content ranged from 5.31 to 7.04 mg/100 g in pumpkin pulp extracted by using different cooking time and water combinations. The highest *β*- carotene was recorded in C_1 (5 % water for 3 min) which was statistically at par with C_2 (5 % water for 5 min) while lowest value) was observed in C_6 (10 % water for 10 min). Degradation of carotenoids can be accelerated by higher temperature, light and metal ions (Sundaram *et al.,* 2013). The heating of fruit had a significant increase in pectin content of extracted pulp. The mean values for pectin (calcium pectate) were found to vary from 0.12 to 0.31 per cent. C_3 (5 % water for 10 min) showed the highest pectin while the lowest was observed in C_4 (10 % water for 3 min). An appraisal of data (Table 5) revealed that maximum colour score (8.00) was obtained by C_1 (5 % water for 3 min) which was statistically at par with C_2 (5 % water for 5 min). Maximum mean scores for taste (7.40), aroma (8.50) and overall acceptability (7.80) was awarded to C_2 (5 % water for 5 min).

It is concluded from the Table 4 the treatment C_1 retained highest nutritional composition which was at par with treatment C_2 but on the basis of sensory evaluation (Table 5), it was observed that although treatment C_1 received highest scores for colour but due to its raw flavour (as per the feedback from panellists) treatment C_2 was awarded maximum score for taste, aroma and overall acceptability. Therefore, C_2 was selected for further preservation and storage studies.

Table 5: Sensory evaluation (on 9 point hedonic scale) of ripe pumpkin pulp extracted by using different combinations of water and cooking time duration

Treatment (C)	Colour	Taste	Aroma	Overall acceptability
C_1 (5 % water for 3 min)	8.00	6.50	8.40	7.65
C_2 (5 % water for 5 min)	7.70	7.40	8.50	7.80
C_3 (5 % water for 10 min)	7.50	6.47	7.90	7.50
C_4 (10 % water for 3 min)	7.70	6.00	8.20	7.40
C_5 (10 % water for 5 min)	7.77	6.50	8.00	7.60
C_6 (10 % water for 10 min)	7.10	6.00	7.70	6.90
$CD_{0.05}$	0.26	0.53	0.23	0.17

Change in chemical and microbial parameters of pumpkin preserved by different methods during storage

Total soluble solids (TSS)

The effect of storage on TSS of ripe pumpkin pulp is presented in Table 6. The data indicated a gradual increase in the TSS of pulp of different treatments with the advancement of storage. The mean TSS during storage up to 6 months ranged from 7.17 to 7.93 ºB. The mean maximum value was observed in T_1 (Canning) while mean minimum was recorded in T_2 (Pulp+KMS @ 2000 ppm in glass bottles). Statistically, significant differences were found among all the treatments. The highest value of 8.44 ºB was recorded in T_6 (Pulp+sodium benzoate @ 1000 ppm+KMS @ 1000 ppm in glass bottles) at 6 month of storage and the lowest of 7.01 ºB was noticed in T_2 (Pulp+KMS @ 2000 ppm in glass bottles) at 0 month. Increase in TSS during storage may be due to breakdown of polysaccharides into monosaccharides. Hussain *et al.* (2014) [13] found a significant increase of TSS in chemically preserved apricot pulp during 2 months of storage and accredited this change to the higher temperature and inversion of sucrose into glucose and fructose.

Table 6: Effect of different treatments and storage on total soluble solids (ºB) of ripe pumpkin pulp

Treatments (T)	Storage interval (S) (months)			
	0	3	6	**Mean**
T_1	8.10	8.12	8.20	8.13
T_2	7.01	7.10	7.30	7.14
T_3	7.04	7.70	8.33	7.70
T_4	7.04	7.20	7.40	7.21
T_5	7.04	7.51	7.92	7.49
T_6	7.05	8.00	8.44	7.85
T_7	7.05	7.82	8.18	7.70
T_8	7.10	7.20	7.30	7.20
T_9	7.10	7.60	8.20	7.63
T_{10}	7.10	7.57	8.00	7.56
Mean	7.17	7.58	7.93	

$CD_{0.05}$

T (Treatments) = 0.07

S (Storage interval) = 0.04

TxS = 0.12

Titrable acidity

Table 7 elucidate that treatments as well as storage period had a significant effect on titrable acidity of pumpkin pulp. Among the treatments, mean maximum value (0.36 %) was observed in T_5 (Pulp+sodium benzoate @ 2000 ppm in PET jars), whereas, mean minimum (0.26 %) was noticed in T_1 (Canning). Significant differences were found among all the treatments during storage, however, the interaction between storage intervals and treatments was found to be non-significant. The maximum value (0.40 %) was recorded in T_5 (Pulp+sodium benzoate @ 2000 ppm in PET jars) at 6 month of storage and minimum (0.25 %) in T_1 (Canning) at 0 month. Increase in acidity may be due to breakdown of pectin into pectinic acid or due to the formation of acid by the breakdown of polysaccharides or oxidation of reducing sugars.

Table 7: Effect of different treatments and storage on titrable acidity (%) of ripe pumpkin pulp

Treatments (T)	Storage interval (S) (months)			
	0	3	6	**Mean**
T_1	0.25	0.26	0.27	0.26
T_2	0.30	0.31	0.32	0.31
T_3	0.30	0.33	0.35	0.33
T_4	0.30	0.32	0.34	0.32
T_5	0.30	0.36	0.40	0.36
T_6	0.30	0.32	0.33	0.32
T_7	0.30	0.33	0.35	0.33
T_8	0.27	0.29	0.30	0.29
T_9	0.29	0.33	0.36	0.33
T_{10}	0.29	0.34	0.38	0.34
Mean	0.29	0.30	0.31	

$CD_{0.05}$

T (Treatments) = 0.02

S (Storage interval) = 0.01

TxS = NS

Total sugars

Results obtained (Table 8) for changes in total sugars of pumpkin pulp during storage reflected an increasing trend in all the treatments except for treatment T_8 (Pulp + pasteurization in glass bottles) where a slight decrease is recorded. Mean value of total sugars increased from 5.13 to 5.89 per cent during 6 months of storage. Mean maximum of 6.59 per cent was observed in T_1 (Canning) and mean minimum of 5.10 per cent was recorded in T_5 (Pulp+sodium benzoate @ 2000 ppm in PET jars). Statistically, significant differences were found among all the treatments and the interaction between storage intervals and treatments was also found to be significant. While decreasing trend in total sugars might be due to inversion of sugars to monosaccharides by acid hydrolysis (Muralikrishnan *et al.,* 1969) [19] and reaction of sucrose with amino acids and other reactions which leads to non enzymatic browning (Singh, 2002) [25].

Reducing sugars

Table 9 highlights the changes in reducing sugars of pumpkin pulp during storage. The mean value was found to increase from 2.45 to 3.09 per cent during a storage period of 6 months. The mean maximum value (3.72 %) was observed in T_1 (Canning) while mean minimum (2.50 %) in T_8 (Pulp+pasteurisation in glass bottles). The intermediate value of 2.88, 2.86, 2.81, 2.66, 2.63, 2.57, 2.54 and 2.52 per cent, respectively have recorded in T_3, $T5$, T_7, T_4, T_6, T_9, T_{10} and T_2. Significant variation was found among all the treatments. The interaction between storage intervals and treatments was also noticed to be significant. The increase in reducing sugars during storage might be due to the rapid hydrolysis of polysaccharides and their subsequent conversion to reducing sugars.

Table 8: Effect of different treatments and storage on total sugars (%) of ripe pumpkin pulp

Treatments (T)	Storage interval (S) (months)			
	0	3	6	**Mean**
T_1	5.67	6.77	7.33	6.59
T_2	5.03	5.45	5.66	5.38
T_3	4.99	5.22	5.50	5.24
T_4	4.99	5.31	5.62	5.31
T_5	4.98	5.12	5.21	5.10
T_6	5.09	5.61	6.49	5.73
T_7	5.02	6.50	7.04	6.19
T_8	5.21	5.20	5.19	5.20
T_9	5.20	5.69	6.02	5.64
T_{10}	5.09	5.62	5.85	5.52
Mean	5.13	5.60	5.89	

$CD_{0.05}$

T (Treatments) = 0.10

S (Storage interval) = 0.01

TxS = 0.17

Table 9: Effect of different treatments and storage on reducing sugars (%) of ripe pumpkin pulp

Treatments (T)	Storage interval (S) (months)			
	0	3	6	**Mean**
T_1	2.95	3.97	4.24	3.72
T_2	2.37	2.56	2.64	2.52
T_3	2.35	2.90	3.39	2.88
T_4	2.36	2.63	3.00	2.66
T_5	2.35	2.90	3.32	2.86
T_6	2.37	2.52	3.01	2.63
T_7	2.36	2.67	3.40	2.81
T_8	2.44	2.53	2.54	2.50
T_9	2.45	2.52	2.72	2.57
T_{10}	2.46	2.50	2.65	2.54
Mean	2.45	2.77	3.09	

$CD_{0.05}$

T (Treatments) = 0.05

S (Storage interval) = 0.03

TxS = 0.08

Ascorbic acid

A critical look at the data (Table 10) showed that ascorbic acid content of pumpkin pulp ranged from 7.08 to 10.86 mg/100 g. There was a significant decrease in ascorbic acid content of all the treatments during a storage period of 6 months and the mean value was found to decrease from 11.55 to 6.52 mg/100 g. Mean maximum ascorbic acid was noticed in T_2 (Pulp+KMS @ 2000 ppm in glass bottles) while mean minimum was observed in T_8 (Pulp+pasteurization in glass bottles). The interaction between storage intervals and treatments was found to be significant. The loss in ascorbic acid might be due to the oxidation of irreversible conversion of L-ascorbic acid into dehydroascorbic acid oxidase caused by trapped or residual oxygen in the glass bottles (Jaiswal *et al.,* 2008) [14].

Table 10: Effect of different treatments and storage on ascorbic acid content (mg/100 g) of ripe pumpkin pulp

Treatments (T)	Storage interval (S) (months)			
	0	3	6	**Mean**
T_1	8.22	8.03	7.75	8.00
T_2	13.03	10.49	9.04	10.86
T_3	13.01	8.76	4.30	8.69
T_4	13.00	7.89	6.46	9.12
T_5	13.03	6.59	3.26	7.63
T_6	13.01	10.05	7.70	10.30
T_7	13.07	8.45	5.33	8.95
T_8	9.65	6.86	4.73	7.08
T_9	9.65	9.32	8.96	9.31
T_{10}	9.64	8.55	7.67	8.62
Mean	11.55	8.50	6.52	

$CD_{0.05}$
T (Treatments) = 0.08
S (Storage interval) = 0.04
TxS = 0.13

***β*- Carotene**

Data given in Table 11 reveal a decreasing trend of *β*-carotene in pumpkin pulp during storage period of 6 months and the mean value was found to decrease significantly from 6.71 to 4.71 mg/100 g. It is clear from the data that the mean maximum value of 6.52 mg/100 g was recorded in T_2 (Pulp+KMS @ 2000 ppm in glass bottles) while the mean minimum of 4.87 mg/100 g in T_8 (Pulp+pasteurization in glass bottles). The interaction of storage intervals and treatments also indicated a significant effect on *β*-carotene of pumpkin pulp. The highest value (7.06 mg/100 g) was noticed in T_2, T_3, T_4, T_5, T_6 and T_7 at 0 months of storage and the lowest value (3.74 mg/100 g) in T_8 at 6 month. A loss in carotenoid content of products during storage might be due to oxidative breakdown, isomerization or enzymatic destruction of the pigments.

Table 11: Effect of different treatments and storage on *β*- Carotene content (mg/100 g) of ripe pumpkin pulp

Treatments (T)	Storage interval (S) (months)			
	0	**3**	**6**	**Mean**
T_1	5.74	4.79	4.26	4.93
T_2	7.06	6.61	5.88	6.52
T_3	7.06	5.31	4.82	5.73
T_4	7.06	6.03	4.60	5.90
T_5	7.06	6.13	4.17	5.79
T_6	7.06	6.83	5.39	6.43
T_7	7.06	5.90	5.00	5.99
T_8	6.31	4.57	3.74	4.87
T_9	6.31	5.67	5.23	5.74
T_{10}	6.31	4.56	3.98	4.96
Mean	6.71	5.64	4.71	

$CD_{0.05}$
T (Treatments) = 0.10
S (Storage interval) = 0.06
TxS = 0.18

Changes in microbial population (1 x 10^2 cfu/ml) of ripe pumpkin pulp during storage

The data for microbial count of ripe pumpkin pulp stored under ambient temperature for a period of 6 months depicted in Table 12 reveal that there was no microbial growth observed at 0 month in all the treatments. However, the count for microbial growth was observed during storage but the count was found to be safe limits as specified by FSSAI. Therefore, the product was safe for consumption.

Table 12: Microbial population (1 × 10^2 cfu/ml) of ripe pumpkin pulp during storage

Treatments (T)	Storage interval (S) (months)		
	0	**3**	**6**
T_1	0.00	0.00	0.00
T_2	0.00	0.02	0.04
T_3	0.00	0.04	0.16
T_4	0.00	0.05	0.24
T_5	0.00	0.06	0.30
T_6	0.00	0.03	0.09
T_7	0.00	0.03	0.12
T_8	0.00	0.06	0.35
T_9	0.00	0.02	0.04
T_{10}	0.00	0.04	0.16

Conclusion

Henceforth, the study demonstrates the effect of cooking time and varied water concentration on the nutritional quality of pumpkin pulp prepared by hot break method. Further, it was also seen during the storage that various preservation methods had significantly affected the physico-chemical profile of the pulp along with microbial count. This work can be a major contribution that can help to develop a nutritionally rich pumpkin pulp that has safer and viable storage to be used at industrial scale.

Acknowledgement

Authors are sincerely thankful to Department of Science and Technology (DST), New Delhi, India, through their Project "Development of low cost value added processed products from ripe pumpkin (*Curcurbita moschata*) and dissemination of technology to the farm women of Himachal Pradesh" for providing all kind of support to facilitate this experiment.

References

1. Akhta S, Riaz M, Ahmad A, Nisar A. Physico-chemical, microbiological and sensory stability of chemically preserved mango pulp. Pakistan Journal of Botany. 2010; 42(2):853-862.
2. Amerine MA, Pangborn RM, Roessler EB. Principles of sensory evaluation of food. Academic Press: London, 1965, 236-268.
3. AOAC. Official Methods of Analysis. 19th Edition, Association of offical Analytical chemists. Washington DC, 2012.
4. Bavita K. Utilization of dehydrated pumpkin (*Cucurbita moschata* Duch ex Poir) and its seeds for development of value added products. M.Sc Thesis. Department of Food Science & Technolgy, Dr Y S Parmar UHF, Nauni, 2013.
5. Danilchenko H, Paulauskiene A, Dris R, Niskanen R. Biochemical composition and composition and processability of pumpkin cultivars. Acta Horticulture. 2000; 510:493-97.
6. Dhiman AK, Babu GN, Attri S, Ramachandran P. Development and Standardization of Ripe Pumpkin Based Squash and its Stability during Storage. International Journal of Current Microbiology and Applied Sciences. 2017; 6:821-831.
7. Dhiman AK, Negi V, Attri S, Ramachandran P. Development and Standardization of Instant Food Mixes from Dehydrated Pumpkin and Pumpkin Seed Powder (*Cucurbita moschata* Duch ex Poir). International Journal of Bio-Resource & Stress Management. 2017a; 8(2):213-219.
8. Dhiman AK, Negi V, Attri S, Ramachandran P. Optimization of Instant Halwa Mix from Dehydrated Pumpkin and its Stability during Storage. International Journal of Agriculture Sciences. 2017b; 9(11):4026-4030.
9. Dhiman AK, Negi V, Attri S, Ramachandran P. Studies on development and storage stability of dehydrated pumpkin based instant soup mix. Journal of Applied and Natural Sciences. 2017c; 9(3):1815 -1820.
10. Dhiman AK, Sharma KD, Attri S. Functional constituent and processing of pumpkin-a review. Journal of Food Science and Technology. 2009; 46:411-17.
11. FAO. FAO statistical database. Food and Agriculture Organisation. 2014. http://www.fao.org. (Accession Date: 24/05/2015)
12. Franke AA, Custer LJ, Arakaki C, Murphy SP. Vitamin C and flavonoid levels of fruits and vegetables consumed in Hawaii. Journal of Food Comp Anal. 2004; 17:1-35.
13. Hussain A, Hussain A, Ahmad B, Rehman M. Analysis of physicochemical stability of apricot pulp stored with chemical preservatives. International Journal of Novel Research in Life Sciences. 2014; 1(2):17-23.
14. Jaiswal R, Singh G, Singh AK. Evaluation of aonla (*Emblica officinalis* G.) cultivars for squash making. Progressive Agriculture. 2008; 8(1):29-31.
15. Kaushal M. Utilisation of seabuckthorn (Hippophae sp.) for preparation and evaluation of some value added products. PhD Thesis. DR YSPUHF, Nauni, Solan (HP), 2004.
16. Lee YK, Chung WI, Ezura H. Efficient plant regenerating via organogenesis in winter squash (*Cucurbita maxima*). Plant Science. 2003; 164:413-18
17. Mahony MO. Sensory evaluation of food. In: Statistical methods and procedures. Marcel Dekker Inc., New York, 1985.
18. Mandhyan BL, Pariher P, Agarwal R. Studies on the development of process for guava squash. Journal of Food Science and Technology. 2000; 37(6):636-638.
19. Muralikrishna M, Nanjudaswamy M, Sidappa GS. Guava powder preparation, packaging and storage studies. Journal of Food science and Technology. 1969; 6:93-98.
20. Murari K, Verma RA. Studies on the effect of varieties and pulp extraction methods on the quality of guava nectar. Indian Food Packer. 1989; 43(5):11-15.
21. NHB. National Horticulture Board. Directorate of Horticulture, Navbahar, Shimla, 2013.
22. NHB. National Horticulture Board. Directorate of Horticulture, Navbahar, Shimla, 2016.
23. Ranganna S. Handbook of analysis and quality control for fruit and vegetable products. Tata Mc-Graw Hill publishing company Ltd: New Delhi, 2009.
24. Sandhu KS, Singh M, Ahluwalia P. Studies on processing of guava into pulp and leather. Journal of Food Science and Technology. 2001; 38(6):622-624.
25. Singh TK. Processing of bitter gourd for the production of diabetic beverages. M.Sc Thesis, Dr Y S Parmar university of Horticulture and Forestry, Nauni, Solan (H.P.), 2002.
26. Sirohi PS, Choudhury B, Kalda TS. Pumpkin 'Pusa vishwas' for tropical and subtropical region. Indian Horticulture. 1991; 36:24-26.
27. Sundaram MS, Iarahath K, Bawa AS. Development of seabuckthorn mixed fruit jelly. International Journal of Food Science and Technology. 2007; 42(4):403-410.