The Pharma Innovation Journal 2022; 11(5): 173-179

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(5): 173-179

www.thepharmajournal.com
Received: 11-02-2022
Accepted: 17-03-2022

Rigzin Safal
Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST) Kashmir, Shalimar, Jammu & Kashmir, India

Mushtaq Beigh
Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST) Kashmir, Shalimar, Jammu & Kashmir, India

Tahiya Qadri
Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST) Kashmir, Shalimar, Jammu & Kashmir, India

Bazila Naseer
Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST) Kashmir, Shalimar, Jammu & Kashmir, India

Syed Zameer Hussain
Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST) Kashmir, Shalimar, Jammu & Kashmir, India

Monica Reshi
Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST) Kashmir, Shalimar, Jammu & Kashmir, India

Tashooq Ahmed
Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST) Kashmir, Shalimar, Jammu & Kashmir, India

Gazafnar Gani
Division of Floriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST) Kashmir, Shalimar, Jammu & Kashmir, India

Raiz Ahmed Lone
Division of Floriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST) Kashmir, Shalimar, Jammu & Kashmir, India

Corresponding Author:
Tahiya Qadri
Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST) Kashmir, Shalimar, Jammu & Kashmir, India

Effect of cultivars and preservation techniques on storage stability of apricot sauce

Rigzin Safal, Mushtaq Beigh, Tahiya Qadri, Bazila Naseer, Syed Zameer Hussain, Monica Reshi, Tashooq Ahmed, Gazafnar Gani and Raiz Ahmed Lone

Abstract
A study was conducted to establish a process and variety for development of apricot sauce. Five different cultivars of apricot grown in Ladakh region were selected *viz* Yerevani, Sateni, Raktse Karpo, Khamchuchan and Karazangi. Physical properties, proximate composition and physico-chemical properties were in these cultivars. Khamchuchan recorded highest stone weight (28.88/100g) and lowest pulp yield (71.12%). Highest acidity was recorded by Karazangi (0.75% citric acid) while highest β-carotene content (19.04%) and sugar content (15.8%) was recorded by Raktse Karpo. On the basis of processing traits like pulp ratio, soluble solid content, acidity and the pH the two cultivars *viz* Raktse Karpo and Karazangi were selected for making sauce. The sauce developed from both the varieties was evaluated for various physico-chemical quality parameters and organoleptic evaluation. Raktse Karpo sauces (RAS) recorded higher sugar content (22.4%), TSS (28.3^{o}Brix), β-carotene content (23.16%) and lower acidity (1.02% citric acid) in comparison to sauce developed from Karazangi (KAS). On the basis of sensory evaluation overall acceptability of the sauce made from Raktse Karpo and Karazangi was found to be 8.6 and 8.5 respectively. Frequency sweep test recorded higher storage modulus as compared to loss modulus confirming gel-like behaviour of sauces. Flow curve depicted shear-thinning behaviour of both sauce samples. The sauces made from both the varieties was packed in pre-sterilized (200g) glass bottles and preserved by pasteurization (85 ^{0}C for 20 minutes) and by the addition of sodium benzoate (600ppm). The product was stored under ambient conditions and evaluated for quality attributes *viz* Total titratable acidity (Acetic acid %), Water activity (a_w), Colour values (L*a*b*) and Microbial quality (TPC) at 0th day and 180th day of storage. Storage period negatively influenced the quality of sauces irrespective of cultivar used and preservation treatment applied. Pasteurization had pronounced deleterious effects on quality of sauces as compared to sodium benzoate. The results of the study deduced that sodium benzoate at 600ppm is better suitable preservative treatment for long term storage and keeping quality of sauces.

Keywords: Raktse Karpo, β-carotene, storage modulus, shear thinning, sodium benzoate, storage

1. Introduction
Sauce, derived from latin word, "Salsas" which means salted, is liquid or-semi liquid food ingredient added to meat, poultry, fish, vegetables and desserts in order to garnish food product and increase their moistness, richness, appeal and nutritive value (Ozolina *et al*., 2019) [13]. Sauce is differentiated from ketchup on the basis of TSS and acidity. According to FPO fruit sauce should have minimum of 25 ^{0}Brix and 1% acidity. Thus, fruit sauces have become essential food ingredient and its importance is increasing day by day due to its greater impact on enhancing the functional properties of the food products (Levent and Alpaslan, 2018).
Apricot (*Prunus armeniaca*), also known as golden fruit, is an important temperate fruit of Rosaceae family. Turkey is the largest producer of apricot producer followed by Italy, Greece, Spain, USA and France. Apricots are cultivated at an altitude of 2000-2500m above sea level in parts of North-western parts of China-Tibet and Northern parts of India -J&K, Uttarakhand and Himachal Pradesh. Mature apricot fruit is round to oblong in shape. When fully ripe, the fruit is either yellow or yellowish orange in colour and have fine hair-like structure over surface (Leccese *et al*., 2007) [8].
Apricots are known to exert anti-diarrhoeal, anti-pyretic, anti-oxidant effect among many other health benefits. However, fresh consumption of apricot is limited due to high acid, low sugar content and poor acceptability. The major portion of fresh produce is utilized for oil extraction, and leftover cakes are used for fuel purpose and in distilleries. Some of the fruit is dried and marketed. In addition, pulp of the fruit is sometimes incorporated in other fruit in order to

produce different products like jams, jellies, nectar etc (Fatima *et al*., 2018) [5]. However, apricot fruit have not yet been fully used in development of any value added product yet. Therefore, the present research focused on development of apricot sauce for the purpose of apricot preservation and value-addition.

2. Material and Methods

2.1 Raw material

Healthy and mature Apricot fruits from five cultivars (Yerevani, Sateni, Raktse Karpo, Karazangi, Khamchuchan) were selected for this study. Freshly harvested mature apricots were transported in wooden crates to the Krishi Vigyan Kendra Leh and washed thoroughly before pulp extraction.

2.2 Production of apricot sauce

Apricot fruits (1kg) were washed, deseeded and mashed using a kitchen type blender (Braun, MR570, Klonberg, Germany). The mash was processed to apricot pulps by a pulper (JMS Steel pulper machine). The resultant pulp was blanched at 85ºC for 5 min using a blanching boiler. The boiler was double jacketed and was equipped with a digital thermometer. Hot vinegar extract of spices was prepared by boiling different spices in vinegar. The prepared mixture was filtered and added to blanched apricot pulp. The final mixture was prepared by adding 96.1% apricot pulp, 0.3% red pepper, 0.2% cinnamon, 0.3% clove, 2% glucose syrup, 1% vinegar and 0.1% salt. After blanching process, two batches of samples were separated. Batch one was pasteurised at 100ºC and held at the same temperature for 3 min and immediately cooled in an ice bath. Batch second was stored after adding 600ppm of sodium benzoate. Afterwards, sauces were filled in glass jar (200ml) and stored at 4 °C for further analysis.

2.3 Screening of the apricot cultivars for various quality attributes favourable for processing.

2.3.1 Physical attributes

Fresh fruit weight and dimensions (Length, width and thickness) of apricots were determined using digital analytical top pan balance (model FA 2104N by Celtac, China) and digital vernier calliper (Generic LSHAZI03590) respectively. Fruits were individually measured for their longitudinal and transverse diameters with a digital stainless hardened calliper (Shan, China) to determine shape (Lopes, 1982). Pulp yield was calculated by difference between total fruit mass and that of the different constituents (Sarmento *et al*., 2015). The measurements were taken in triplicates and results were averaged.

2.3.1.1 Water activity and TSS

Water activity of the sample was analyzed using a water activity analyzer (Pre-Aqua Lab, Water Activity Analyzer). The method provided by AOAC (2005) [3] were used for determining total soluble solids (TSS) of the sample. TSS was obtained directly by digital refractometer (Atago RX-1000).

2.3.2 Chemical properties

2.3.2.1 Proximate composition

The procedures laid down by AOAC (2005) [3] were pursued for estimation of moisture, crude protein, crude fiber, volatile ash, and crude lipid content. Carbohydrate content was determined by subtraction method.

2.3.2.2 Mineral content, total sugar, reducing sugar and non-reducing sugar content

Standard AOAC (2005) [3] procedures were followed for determination of mineral content of sample using atomic absorption spectrometer (AAS). Total sugar content and reducing sugars were determined by following Fehling's titration method (ICUMSA, 1994). Non-reducing sugar content was obtained by calculating the difference between total sugar and reducing sugar contents.

2.3.2.3 Titrable acidity

The percentage of acidity was estimated by titration method laid down by AOAC (2005) [3]. Sample titration was carried out against 0.1N NaOH with phenolphthalein as indicator.

2.3.2.4 β-carotene content

β-carotene content of apricot was determined by following the procedure of Nagata and Yamashita (1992). Ten ml of acetone-hexane mixture (2:3) was added to 1g of apricot pulp was the mixture were homogenised for 5 minutes to obtain uniform mass. The resultant homogenised mixture was centrifuged at 5000 rpm for 10 minutes at 20 °C and the clear liquid was syphoned out and used for estimation of β-carotene content spectrophotometrically at 645nm against acetone-hexane mixture as blank. β-carotene content was calculated as per the formula

$$\beta\text{-carotene (mg/100ml)} = 0.216A_{663} - 1.22A_{645} - 0.304A_{505} - 0.452A_{453} \quad (1)$$

where A = absorbance

2.3.3 Rheological behaviour

Steady and dynamic rheological properties of the apricot sauces were determined using stress/strain-controlled rheometer (Anton Paar, MCR 301, Germany) equipped with parallel plate configuration and peltier heating/cooling system. The method reported by Tonon *et al*. (2009) [17] was applied to determine rheological characteristics. The rheological measurements were performed at + 4 °C. The gap between the plates was set to be 1 mm during measurement. Regarding the steady shear measurements, shear rate was applied within the range of 0–100 s^{-1}.

2.3.4 Organoleptic evaluation of fresh apricots

A panel of semi-trained judges were selected on the basis of their ability to differentiate between wide range of sensory attributes. Sensory evaluation was carried out on 9-point hedonic scale (1-dislike extremely to 9-like extremely). Each panellists performed sensory test in a separate booth which was completely free of dust, foods, chemicals, odour, unnecessary lights and sounds. Before commencement of the test, judges were acquainted with the use of rating method, terminology for each attribute and sensory characteristics. Each sample were coded randomly and were evaluated by judges on the basis of terms of appearance, flavour, mouthfeel, texture, consistency and overall acceptability.

2.3.5 Colour attributes

Colour (L*, a* and b*) of apricot pulp and apricot sauce samples were measured using Hunter lab colorimeter (Hunter Lab Color Flex Reston, VA, USA). L* depicts lightness to darkness, a* value gives redness to greenness while b* represents yellowness to blueness.

2.3.6 Microbial load
Standard serial dilution method using nutrient agar as growth medium was employed for determining the total plate count (TPC) (Anonymous, 1957) [2].

2.4 Storage studies
The sauces made from both the varieties was packed in pre-sterilized (200g) glass bottles. Before storage, one batch of sauces were pasteurized while another was preserved by addition of sodium benzoate (600ppm). Effect of pasteurization and preservative incorporation were evaluated on storage stability of developed apricot sauce during 6 months of storage. Apricot sauce was analysed for water activity, microbial load, and colour parameters at beginning and end of storage period.

2.5 Statistical Analysis
In the study, all samples were produced in duplicate and all the analyses were carried out in triplicate for each sample. Statistical analyses were performed using a SPSS (version 16) package program and data was analyzed using design factorial in Completely Randomized Design (CRD) as suggested by Snedecor and Cochran (1967). Significant differences between the data were tested using Duncan multiple comparison method at the significance level of 95%For storage experiment, one factorial CRD was used to analyze the data and to test the significance at 5% level of significance.

3. Results and Discussion
3.1 Physical characteristics

Table 1a depicts the weight, colour and dimensional properties of five apricot cultivars. Average weight of all the five varieties of apricot varied from 13.89 to 28.88g. Weight of all the varied was recorded significantly ($p < 0.05$) different was each other. Lower stone weight was recorded in Karazangi variety (13.89/100g) while higher stone weight was observed in Khamchuchan variety (28.88/100g). Length, width and thickness of all the varieties varied significantly ($p < 0.05$). All the physical dimensional properties *viz* length, width and thickness were found highest in Raktse Carpo variety followed by Karazangi and it may be attributed to the superior inherent genetic makeup of these two varieties (Singh, 2016).

Colour is an important attribute directly related to the acceptability of any fruit. Out of different colour coordinates, L* value demonstrates the brightness, a* when positive indicates redness, when negative a indicates greenness, positive b* indicates yellowness while negative value of b* represents blue. L*, a* and b* value of all the apricot cultivars varied significantly ($p < 0.05$). Maximum L*(68.75), a* value (23.62) and b* (48.91) was recorded by Raktse Karpo followed by Karazangi (65.64), (21.89) (47.38). The highest colour values of Raktse Karpo and Karazangi might be due to presence of profuse amount of carotenoids in these varieties (Table 1b) (Leccese *et al.*, 2011) [9].

3.2 Chemical properties
Proximate and chemical composition of different apricot varieties is presented in Table 1b. Significant ($p < 0.05$) difference in carbohydrate, moisture, fat and protein content was recorded in all the five varieties. Highest moisture (86.58%) and lowest protein (1.98%), fat (1.02%) and fibre (1.18%) content was observed in Khamchuchan variety which consequently have resulted in its lowest pulp yield (71.12%). Karazangi (86.11%) recorded highest pulp yield followed by Raktse Karpo (81.7%). Raktse Karpo also reported highest carbohydrate content (12.02%) which eventually have resulted in increased its total sugar content (15.8%), soluble solids content (SSC) (19.3%) and reduced acidity (0.71% citric acid). β-carotene content of Raktse Karpo was also found to be highest (19.04%) followed by Karazangi variety (18.34%).

3.3 Sensory Evaluation
Table 2 lists sensory scores for different varieties of apricots. Yerevani variety received lowest score for all the sensory parameters consequently resulting in lowest overall acceptability. Higher L* value together with lower a* and b* value might have resulted in lower colour and appearance score of this variety. Highest overall acceptability score was recorded by Karazangi followed by Raktse Karpo. High sugar, SSC content and colour attributes and lower acidity might have yielded higher sensory scores for Karazangi and Raktse Karpo variety.

Based on physico-chemical, dimensional and sensory studies of five varieties of apricots, Raktse Karpo and Karazangi variety was found suitable for development of apricot sauce.

3.4 Physicochemical analysis of apricot sauce developed from two selected cultivars

Physico-chemical constituents of apricot sauces prepared from two cultivars are depicted in Table 3. A non-significant difference in protein, ash, fat, fibre content, titrable acidity, a_w and pH of both sauces were reported. Carbohydrate, total sugar content and TSS of Karazangi apricot sauce (KAS) and Raktse Karpo apricot sauce (RAS) were recorded as 24.46%, 20.9% and 27.4ºBrix and 25.26%, 22.4% and 28.3ºBrix respectively. Moisture content of KAS was significantly higher which might have led to significant ($p < 0.05$) decrease in its total carbohydrate content, total sugar content and TSS. RAS recorded significantly ($p < 0.05$) higher β-carotene content as compared to KAS due to higher amount of β-carotene initially. Colour attributes observed in RAS were slightly better as compared to KAS. Higher a value (redness) and lower b value (yellowness) was recorded in RAS possibly due to presence of higher amount of β-carotene. Increase in redness resulted in decreased lightness of RAS which in reflected in lower L* values. Thus, apricot sauce developed from Raktse Karpo variety has better physico-chemical composition and colour attributes.

3.5 Sensory Evaluation
The developed sauces were tested for different sensory attributes the results of which are depicted in Table 4. RAS recorded higher colour score. Presence of higher amount of β-carotene might have resulted in desirable visual colour of RAS. Higher score for visual colour obtained by RAS validated higher a value of RAS. Flavour and mouthfeel of RAS was also considered better as compared to KAS probably due to presence of profuse amount of sugars in RAS. In addition, slightly higher pH of Ras might have also contributed to its desirable flavour. Sensory characteristics revealed that apricot sauce developed from Raktse Karpo were superior organoleptically.

3.6 Rheological behaviour

Figure 1 illustrates the rheological behaviour of RAS and KAS. Frequency sweep test obtained by plotting storage modulus (G′) and loss modulus (G″) revealed that with increasing frequency, a linear increase in G′ as well as G″ was observed. A higher G′ was recorded in both sauces confirming viscoelastic (gel like) behaviour of sauces contrary to results reported by Levent and Alpaslan (2018). He reported higher G″ in sauces and concluded higher G″ resulted in weaker gel structure thus confirming higher G′ yields gel structure of sauces.

From rheogram (Fig 1), it was revealed that storage modulus for RAS was slightly higher as compared to KAS for all the frequencies applied. A lower storage modulus is desirable for easy gulping of sauces while higher G′ is suitable for long term storage which is a desirable trait for sauces (Muzaffar *et al*., 2016) [11]. Presence of higher amount of fibre, sugars and acids together might have formed a well organised structure which is responsible for viscoelastic gel like behaviour of sauces.

Flow behaviour curve of both sauces are illustrated in Figure 2. From figure, it can be deduced that both sauces followed shear thinning (pseudoplastic behaviour) i.e. viscosity decreased with increasing shear rate. Levent and Alpaslan (2018) also reported shear thinning behaviour for sauces. However, a rapid thinning behaviour was reported by KAS as compared to RAS which inferred that a large decrease in viscosity is observed on slight increase in stress.

3.7 Effect of preservation technique on storage stability of apricot sauces

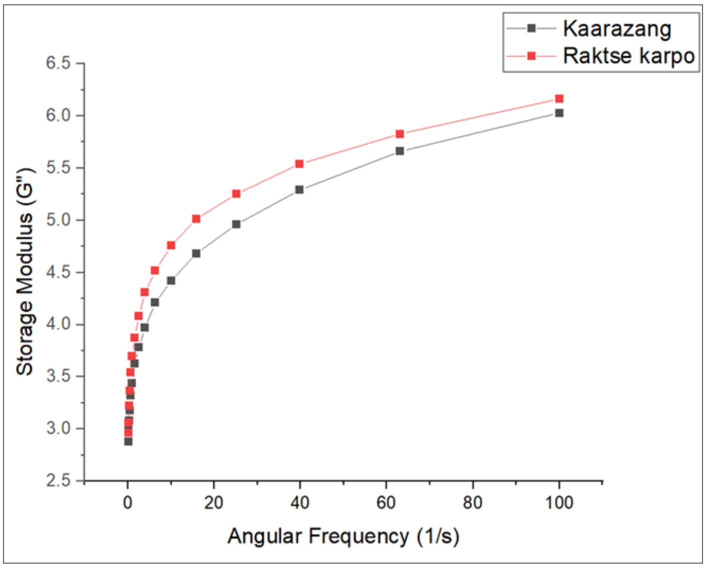
Effect of pasteurization, incorporation of sodium benzoate and storage time on titrable acidity, microbial load, water activity and colour attributes has been illustrated in Table 5. Storage had a significant ($p< 0.05$) effect on all the parameters under observation. Irrespective of the preservation treatment, titrable acidity, b* and L* value decreased while water activity, microbial load and a* increased. At 0th day of storage acidity in RAS (control) was recorded as 1.02% which decreased to 0.98% while KAS (control) recorded 1.04% titrable acidity at the beginning of storage which decreased to 1.02% at the end of storage period. Acids facilitate breakdown of sugars and non-enzymatic browning subsequently resulting in decreased percent acidity during storage (Sharma *et al*., 2003) [15].

Water activity of sauces is the quality parameter as it drastically affects its shelf life. The results revealed that water activity of all sauce samples gradually increased during storage period of 6 months. This increase in water activity may be attributed to degradation and hydrolysis of protein and carbohydrate during storage (Dagadkhair and Pakhare, 2016) [4]. Significant ($p< 0.05$) increase in water activity of samples have led to a significant ($p< 0.05$) increase in microbial load of sauces.

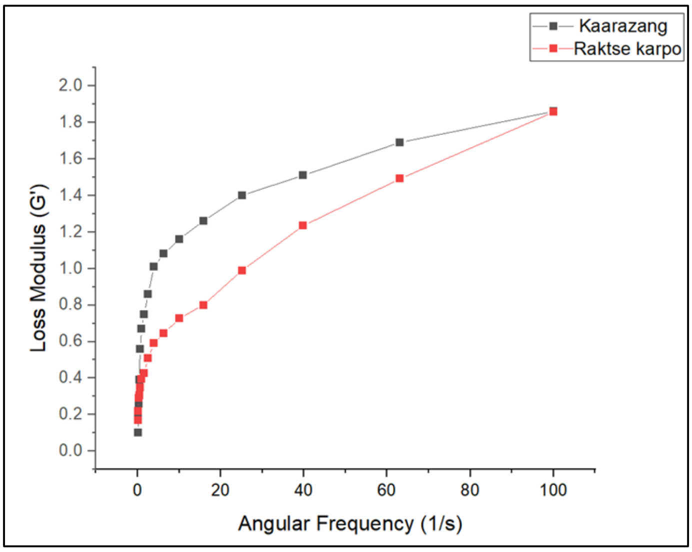
Initially, RAS and KAS recorded higher L* and b* values as 22.85 and 59.85 and 23.45 and 69.05 respectively which decreased to 18.79 and 55.78 and 17.33 and 61.08. Decrease in the L* value with storage may be attributed to the darkening of the sauce due to presence of ginger in sauce (Jayashree *et al*., 2012) [7]. From table, it was clear that a significant ($p< 0.05$) enhancement in redness (a* value) of the apricot sauce was noted irrespective of the cultivars and preservation technique employed during 180 days of ambient storage. During storage, non-enzymatic browning takes place which may contribute to increased redness of sauces. Increased redness might have negatively affected b* value of developed sauces. Similar results for colour attributes have been reported by Low *et al*. (2009) for pepper sauce.

Preservation techniques significantly ($p< 0.05$) affected the quality parameters of developed sauces during storage period of 6 months (Table 5). A significant ($p< 0.05$) decrease in titrable acidity from 1.02% to 1.01% in RAS and from 1.04% to 1.02% in KAS preserved through pasteurization was recorded while incorporation of sodium benzoate at 600ppm significantly increased titrable acidity from 1.02% to 1.04% in RAS and 1.04% to 1.06% in KAS. Thermal treatment is known to degrade heat liable organic acids which might explain decrease in total acidity due to pasteurization (Winarno, 2002) [18]. Sodium benzoate exerts preservative affect by transferring to benzoic acid in the process raising acidity of sauces (Adeola and Aworh, 2013) [1]. Sodium benzoate incorporation had a pronounced effect on water activity and microbial of sauces from different cultivars as compared to pasteurization. Sodium benzoate reacts with water forming benzoic acid thereby trapping water molecules and hindering there interfering in other reactions while pasteurization decreases the microbial load of sauces without affect the water activity of samples (Adeola and Aworh, 2013) [1]. However, less pronounced effect of pasteurization over sodium benzoate was reported by Adeola and Aworh (2013) [1] for Tamarind sauce. This contradiction in results might be due to difference in storage condition.

Higher a* and lower L* and b* values were recorded in pasteurised RAS and KAS as compared to sodium benzoate preserved sauces. High temperature facilitate reaction between different components within sauce which might have yielded increased redness and reduced lightness and yellowness of sauce. The results for colour attributes of both sauce samples are in concomitance with those reported by Adeola and Aworh (2013) [1] for Tamarind sauce.



a. Storage modulus of apricot sauces produced from different varieties



b. Loss modulus of apricot sauces produced from different varieties

Fig 1: Frequency sweep test depicting rheological behaviour of different sauces

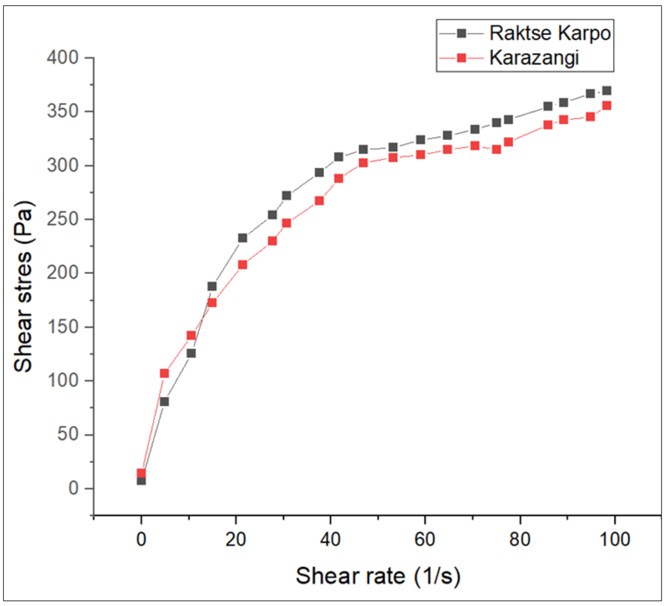


Fig 2: Flow curve depicting shear thinning behaviour of apricot sauces

Table 1: Physico chemical analysis of different apricot varieties

Apricot varieties	Stone weight (per 100g)	Pulp yield (%)	Proximate composition						Total Sugars (%)	pH	SSC (ºBrix)	Acidity (% citric acid)	β-Carotene content (mg/100g)
			Moisture (%)	Carbohydrates (%)	Crude Protein (%)	Crude Fat (%)	Ash (%)	Crude Fibre (%)					
Yerevani	27.5	72.5	84.14	9.01	2.31	1.11	2.01	1.42	11.2	4.36	14.9	0.63	16.43
Sateni	25.07	75.0	82.36	10.77	2.20	1.20	2.11	1.36	13.5	4.24	16.1	0.68	17.39
Raktse Karpo	18.30	81.7	79.42	12.02	2.83	1.76	2.16	1.81	15.8	3.92	19.3	0.71	19.04
Karazangi	13.89	86.11	81.95	9.33	2.79	1.84	2.13	1.96	13.7	3.95	17.8	0.75	18.34
Khamchuchan	28.88	71.12	86.58	7.17	1.98	1.02	2.07	1.18	9.2	4.18	11.3	0.70	17.81
CD	3.98	5.31	3.55	1.51	0.34	0.14	NS	0.09	N.S.	0.23	0.31	0.04	0.31

Table 2: Sensory quality of different apricot varieties

Apricot varieties	Colour	Texture	Flavour	Appearance	Overall acceptability
Yerevani	7.0	7.3	7.0	7.3	7.0
Sateni	8.0	7.4	7.8	7.8	8.0
Raktse Karpo	8.0	7.8	7.8	8.0	8.0
Karazangi	8.2	7.8	7.9	8.0	8.2
Khamchuchan	7.0	7.8	7.5	7.7	7.0

Table 3: Quality evaluation of the apricot sauce

Apricot varieties	Proximate Composition							Total Sugars (%)	TSS (ºBrix)	Water activity (a_w)	pH	Total titratable acidity (% citric acid)	β-Carotene content (mg/100g)
	Carbohydrates (%)	Moisture (%)	Crude Protein (%)	Crude Fat (%)	Ash (%)	Crude Fibre (%)	Energy (Kcal/100g)						
Raktse Karpo	25.26	66.40	2.60	1.50	2.40	1.83	124.94	22.4	28.3	0.84	3.10	1.02	23.16
Karazangi	24.46	67.25	2.52	1.59	2.39	1.79	122.23	20.9	27.4	0.86	3.12	1.04	21.57
C.D ($p<$ 0.05)	3.98	5.31	3.55	1.51	0.34	0.14	0.22	0.09	0.10	0.23	0.31	0.04	0.31
Sed	0.05	0.04	0.01	0.02	0.01	0.03	0.02	0.01	0.11	0.05	0.04	0.05	0.01

Table 4a: Sensory evaluation and instrumental colour of the apricot sauces

Apricot sauce	Colour	Flavour	Mouthfeel	Consistency	Over all acceptability
Raktse Karpo	8.7	8.5	8.7	8.6	8.6
Karazangi	8.5	8.3	8.8	8.7	8.5

Table 4b: Colour attributes of different sauces

Apricot sauce	Instrumental colour		
	L*	a*	b*
Raktse Karpo	22.85	22.67	59.85
Karazangi	23.45	18.35	65.05

Table 5: Effect of storage conditions on quality of apricot sauce

Apricot sauce	Total titratable acidity (% citric acid)		Water activity (aw)		Microbial quality TPC (cfu/ml) × 10^2		a* value		b* value		L* value	
	0-DAS	180-DAS	0-DAS	180-DAS	0-DAS	180-DAS	0-DAS	180-DAS	0-DAS	180-DAS	0-DAS	180-DAS
Control (Raktse Karpo)	1.02	0.98	0.84	0.89	N.D	4.5	22.67	26.47	59.85	55.78	22.85	18.79
Raktse Karpo (Pasteurized)	1.01	0.97	0.83	0.88	N.D	3.9	27.86	30.44	55.05	53.07	21.72	16.42
Raktse Karpo (Sodium benzoate 600ppm)	1.04	1.00	0.82	0.87	N.D	TFTC	25.36	27.41	57.15	51.19	23.31	17.39
Control (Karazangi)	1.04	1.02	0.86	0.90	N.D	4.8	18.35	23.38	65.05	61.08	23.45	17.33
Karazangi (Pasteurized)	1.02	0.99	0.84	0.87	N.D	3.8	20.36	27.56	63.31	63.67	21.78	18.45
Karazangi (Sodium benzoate 600ppm)	1.06	0.97	0.83	0.86	N.D	TFTC	19.71	25.12	61.25	62.87	22.93	20.06
CD	0.015	0.028	0.051	0.026	-	0.418	0.0242	0.0242	0.0516	0.0467	0.0579	0.0115

4. Conclusion

Apricot was explored as raw material for development of sauces. Five varieties *viz* Yerevani, Sateni, Raktse Karpo, Karazangi, Khamchuchan were selected for development of apricot sauce. Out of the five cultivars, Raktse Karpo and Karazangi varieties proved to b superior in terms of physico-chemical attributes and sensory characteristics. Raktse Karpo and Karazangi were further used for development of sauces.

Raktse Karpo sauce (RAS) recorded higher fibre content, carbohydrates, sugar content, titrable acidity and β-carotene content. In addition, higher sensory scores for taste, flavour and colour were scored by RAS in comparison to KAS. The results inferred from rheological studies confirmed gel-like behaviour of RAS with higher storage modulus than KAS. Effect of preservative treatments of both sauce samples concluded that pasteurization had more decadence on quality parameters of both sauces measured during storage of 6 months. Storage studies deduced that sodium benzoate at 600ppm concentration was preferably in maintaining the shelf stability of sauces over a period of 6 months. These results however are obtained on pilot scale. Further investigations on preparation of sauce on commercial scale and acceptability by consumer studies need to be undertaken for better utilization of apricot for making sauce and improving nutrition of people. This will open new avenue for commercial utilization of over ripened apricots.

5. References

1. Asnate Kirse-Ozolina, Evalds Raits, Inga Ciprovic Adeola AA, Aworh OC. Effects of sodium benzoate on storage stability of previously improved beverage from tamarind (*Tamarindus indica* L.) Food Sci. Nutr. 2014;2(1):17-27.
2. Anonymous. Manual of Microbiological Methods. McGraw Hill Book Co., New York, 1957, 125-279.
3. AOAC. Official Methods of Analysis (18th edition) Association of Official Analytical Chemists, 2005.
4. Dagadkhair AC, Pakhare KN. Effect of Storage on Physicochemical Properties of Spiced Fish Sauce. J. Nutri. Food Sci. 2016;6(4). doi:10.4172/2155-9600.1000520
5. Fatima T, Bashir O, Gani G, Bhat TA, Jan N. Nutritional and health benefits of apricots. Int. J. Unani Integ. Medi. 2018;2(2):5-9.
6. ICMSF. International Commission on Microbiological Specification for foods. USDA information office. 2010.
7. Jayashree E, Zachariah TJ, Evangelin FPP, Bhai RS. Qualitative Changes during Storage of Different Ginger-Based Spice Sauces. J Horti. Sci. 2012;7(2):174-179.
8. Leccese A, Bartolini S, Viti R. Total antioxidant capacity and phenolics content in apricot fruits. Int. J. Fruit Sci. 2007;7(2):3-16.
9. Leccese A, Viti R, Bartolini S. The effect of solvent extraction on antioxidant properties of apricot fruit. Cen. Euro. J. Bio. 2011;6(2):199-204.
10. Low KH, Zain SM, Abas MR., Khan RA. Characterization of commercial chili sauce varieties according to their chemical and physical properties using chemometric methods. Sens. Instrumen. Food Qual. 2003;3(4):203-210.
11. Muzaffar K, Dar BN, Kumar P. Assessment of nutritional, physicochemical, antioxidant, structural and rheological properties of spray dried tamarind pulp powder. Food Measure. Charac. 2016. DOI 10.1007/s11694-016-9444-7.
12. Nagata M, Yamashita I. Simple method for simultaneous determination of chlorophyll and carotenoids in tomato fruit. Nippon Shakuhin Kogyo Gakkaish. 1992;39:925-928.
13. Ozolina AK, RAits E, Ciprovica I. Designing of thermal treatment parameters for tomato sauces. Engg. for Rural Develop. 2019;22:1140-1146.
14. Sarmento JDA, Morais PLD, Souza FI, Miranda MRA. Physical-chemical characteristics and anti-oxidant potential of seed and pulp of *Ximenia americana L.* from the semi-arid regions of Brazil. Afr. J. Biotechnol. 2015;14(20):1744-1752.
15. Sharma KD, Alkesh A, Lal Kaushal BB. Quality of Apple Powder as Affected by Packaging Material During Storage. JSIR. 2003;62:609-615.
16. Singh A. Fruit Physiology and Production. Kalyani Publishers, 2016.
17. Tonon RV, Alexandre D, Hubinger MD, Cunha RL. Steady and dynamic rheological properties of acai (Euterpe oleraceace Mart). J. Food Eng. 2009;92:425-431.
18. Winarno FK. "Pangan, Gizi", Jakarta: PT. Gramedia Pustaka Utama, 2002, 106-109.