Middle East Journal of Applied Sciences
Volume: 14 | Issue: 04| Oct. – Dec. | 2024

EISSN: 2706 -7947 ISSN: 2077- 4613
DOI: 10.36632/mejas/2024.14.4.44
Journal homepage: www.curresweb.com
Pages: 615-633

Technological, Chemical and Sensory Evaluation of Low Calorie Pear Jam Enhanced with Ginger and Cinnamon

Dalia M.A. Hassan, Dalia M. El Sheikh and A. E. Abd El-Gawad

Department of Special Food and Nutrition, Food Technology Research Institute, Agricultural Research Center, Giza, Egypt.

Received: 11 August 2024 **Accepted:** 20 Sept. 2024 **Published:** 10 Oct. 2024

ABSTRACT
Low-calorie foods high in phytochemical compounds have recently received a lot of attention for their potential beneficial effects. This study was carried out in order to produce low-calorie pear jam utilizing fructose as a sweetener and enhancing the jam with ginger and cinnamon as enhancement. The jam samples were stored for 90 days before being tested physico-chemically (moisture, ash, pH, acidity, TSS, total sugars, reducing sugars, and ascorbic acid), phytochemically (total phenols and DPPH), and organoleptically (colour, taste, appearance, flavour, texture, and overall acceptability). During storage, a decrease was observed in moisture content (55.55 to 52.70%), ash content (4.135to 2.728%), pH (4.51 to 3.05), ascorbic acid content (18.47 to 14.37%) Non reducing sugars (12.79 to 8.86%) Total phenolic content (101.87 to 70.97 mg GAE/100 g) and Antioxidant activity (DPPH) (94.74 to 77.25%) while an increase was recorded in TSS (67.91to 70.07 °B), titratable acidity (0.59 to 0.72%), total sugars (32.62to 36.95%) and reducing sugars (19.93to 28.09%). The physico-chemical and sensory features of pear jam enhanced with ginger and cinnamon were significantly influenced ($p<0.05$) by storage intervals, according to statistical analysis of jam samples.

Keywords: Jam, pear, fructose, ginger, cinnamon

1. Introduction

In recent years, there has been an increasing trend in use of natural phytochemicals and diets derived from plants to restore metabolic homeostasis. (Huang *et al.,* 2005). 3Numerous natural plants, active components derived from plants (e.g., fibres, phytochemicals, and unsaturated fatty acids), as well as other natural dietary compounds, have been employed to help combat metabolic dysfunction brought on by obesity (Sun *et al.,* 2016).

Pears (*Pyrus communis*) are among man's oldest cultivated plants. Fresh pears fruits (Pyrus species) are eaten all around the world, and they're also common in processed foods including drinks, sweets, preserved fruits, and jam. Pears have been implemented as a traditional folk medicine in China for over two thousand years due to their anti-inflammatory, anti-hyperglycemic, and diuretic properties. Pears have also been used in the past to treat alcohol hangovers, coughs, and constipation (Slavin & Lloyd, 2012).

Compared to other fruits, pears have the highest percentage of fiber, fructose, and sorbitol, these three substances that help regulate digestion. Pears, peel, are rich in phytonutrients, especially phenolic acids, which have been connected to health effects on some disease including diabetes, cardiovascular, and obesity. pears may have a significant impact on the regulation of bowel function because of the particular fibre, Sorbitol and fructose content in these fruits. According to one small intervention study, adding pears to a weight-loss diet may help to lose weight by reducing the calorie intake due to their low energy density (James-Martin *et al.,* 2015).

Kolniak-Ostek *et al.,* (2020) found that, the antioxidant and anti-inflammatory efficacy of the pears extracts studied was impressive. Furthermore, substantial antiproliferative effect against bladder cancer has been demonstrated in all kinds. The extracts could be employed as a potential new source of

Corresponding Author: A. E. Abd El-Gawad, Department of Special Food and Nutrition, Food Technology Research Institute, Agricultural Research Center, Giza, Egypt.

bioactive polyphenols with applications in the creation of functional food due to their high amount of bioactive components, great health-promoting action, and minimal cytotoxicity. Pear fruit is high in iron, ascorbic acid. Fruit's high fructose content decreases blood sugar levels when consumed (Hussain *et al.,* 2021).

Pear fruit which can be eaten raw, pureed, poached, canned, or baked. It can be also added to salads and can be used to make jams and jellies as well. Pears might lessen the likelihood of getting inflammatory illnesses like diabetes, obesity, cancer, and heart disease. Additionally, it lowers the levels of triglycerides, LDL, and VLDL, which, by lowering the amounts of these lipids, ultimately lowers the risk of cholesterol. Pectin helps the gastrointestinal tract expel fatty particles by binding to them. And in this way pears assist in weight loss. Blood sugar regulation is aided by the fruit's high fiber content. Also, levulose, low fructose, and low sucrose found in pears are tolerated by diabetic patients. Dietary recommendations universally include a wide variety of fruits, including pears. It's an excellent natural antioxidant and a fantastic nutritional fiber provider. Pears are a great source of antioxidants. Like other fruits, pears provide a lot of fructose and sorbitol as well as potassium for the diet. When paired with dietary fibre, eating pears should improve gut health and prevent constipation (Gupta *et al.,* 2023).

The pear of Petrucina is a worthy contender for the functional food category because of its high concentration of vitamins, antioxidant, absorbable nutrients, and other secondary metabolites. Consuming these compounds is directly associated with a longer lifetime and a decreased risk of getting certain ailments (Frontini *et al.,* 2024).

One of the most popular spices and/or medicinal herbs in the world is ginger (Zingiber officinale Roscoe, Zingiberaceae) (White, 2007). Since its origins in Southeast Asia and introduction to Europe, ginger has been used as a herbal treatment for a multitude of diseases. Other phytochemicals and physiologically active substances found in ginger include phenolics and flavonoids (Ghasemzadeh & Jaafar, 2012).

The principal bioactive chemicals in ginger are gingerols and shogaols, which were discovered among the identified components (Ghasemzadeh & Jaafar, 2012). Gingerol is the most common gingerol, although it also contains many gingerols with different chain lengths (n6–n10) are present in ginger, with the most abundant being 6-gingerol. These compounds have antioxidant and anti-inflammatory activities (Zick *et al.,* 2008). Shogaols, or dehydrated gingerols, are a breakdown byproduct of the thermally labile gingerols that are mostly found in semi-dried and thermally processed ginger (Roufogalis, 2014).

Ginger offers special advantages for enhancing the flavor of food, from preparing the main course at home to the level of the food industry level (Abebe *et al.,* 2018). Furthermore, because food preservatives impede or delay lipid oxidation, ginger is employed in food preservation methods. During processing and preservation, ginger can enhance food quality by preventing oxidation processes (Khan *et al.,* 2019). Nowadays, a variety of food sectors employ artificial antioxidants like butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) extensively to stop food from spoiling. For consumers who prefer natural preservatives, ginger can be used in replace of these chemical ones for preserving food. When used in large amounts may be dangerous for consumers, such as, nitrates, benzoates, sulfites, sorbates, BHA, and BHT (Anwar *et al.,* 2013).

In addition to extending product shelf life and preventing spoiling, ginger adds value to food by giving items texture and organoleptic qualities. Ginger can be used in place of artificial coloring. Ginger adds also taste to every cuisine and culinary culture across the globe. In order to satisfy consumer demand, ginger is added to food goods to increase their value (Unuofin and Lebelo, 2020).

Cinnamomum verum (previously *C. zeylanicum*) is a Lauraceae medicinal plant commonly known as "genuine cinnamon tree" or "Ceylon cinnamon tree (Shu *et al.,* 2008; Jayaprakasha & Rao, 2011). Cinnamon has a wide range of resinous chemicals in its leaves, bark, root bark, and fruits. The primary resinous components found in cinnamon are cinnamonaldehyde, cinnamate, and cinnamic acid, which increase in number as cinnamon ages .Its spicy flavour and smell are due to cinnamaldehyde. Cinnamon contains essential oils such as trans-cinnamaldehyde, cinnamyl acetate, and eugeno (Senanayake *et al.,* 1978 ; Singh *et al.,* 2007). Cinnamon has been used in traditional medicine as an antitussive, antiarthritis, antibacterial, antifungal, anti-oxidant, anti-inflammatory, and anti-tussive agent, as well as in the treatment of sore discomfort and dental problems. Cinnamon may help to prevent or delay diabetes, colon cancer, and bleeding time, according to current research (Ranasinghe *et al.,* 2013; Rao &Gan, 2014).

Jam is a medium-moisture food that is created by heating fruit pulp with sugar (sucrose), pectin, acid, and other ingredients such as preservatives, colouring agents, and flavouring components until the mixture has a gel-like consistency and is firm enough to hold the tissues of the fruit in place. (Khan *et al.,* 2015). Jam should have a total soluble solid (TSS) level of at least 68.5 percent and fruit pulp content of at least 45 percent. Jams are typically made with a huge percentage of sugars, mainly sucrose (WHO/FAO, 2003).

On the other hand, large amounts of sucrose consumption, have been linked to health problems like obesity, diabetes, cardiovascular disease, and hypertension (Mendonca *et al.,* 2005).

As a result, low-calorie sweeteners have been tested as a sucrose substitute. Because it is the sweetest natural sugar, fructose is a crucial sugar in the food sector (Bean & Setser, 1993) and has a lower glucogenicity than glucose or sucrose (Lima *et al.,* 2011).

Because of these 2 factors, it produces less amount of energy of sugar than the other sugars, and because of this, less may be used to get the same sweetness. Also, when combined with other natural and synthetic sweeteners, fructose creates a synergistic sweetness (Van *et al.,* 1983; Davis, 1995).

When utilized in products like dry mix beverages, crystalline fructose's low volume to high sweetness ratio is usually taken advantage of. Another usage for crystalline fructose is in the production of low-calorie foods, where its sweetness synergy with other sweeteners and its low energy compared to sweetness can be taken advantage of Hanover & White, (1993).

Fructose gave a greater solubility and sweetness. Furthermore and compared to sucrose syrups, fructose is less prone to microbial deterioration. Due to these factors, fructose is frequently utilised in dairy products including ice cream, flavoured milks, and yoghurt. Additionally, fructose helps preserve the colour of jams and jellies (Hanover & White, 1993).

The United Food and Drug Administration (FDA) considers fructose to be "generally recognised as safe" (Duffy & Sigman-Grant, 2004). Fructose-specific transporters move fructose from the enterocytes to the portal circulation and ultimately to the liver, where it is absorbed more slowly than glucose in the intestine (Lustig, 2010).

When compared to other natural sweeteners, fructose has a lower glycaemic index (Schved & Hassidov, 2008). Additionally, fructose causes less insulin to be released than if a meal high in glucose is consumed since it does not stimulate pancreatic cells to secrete insulin. As a result, since the late 17th century, it has been regarded as a valuable sugar substitute for diabetics (Hallfrisch, 1990). Since fructose does not cause the release of insulin and does not require the transportation and metabolization of insulin, it has been recommended for those with type 2 diabetes and insulin resistance (Henry *et al.,* 1991).

The present study was conducted with the above facts in mind to produce pears jam with fructose and some herbs for diabetics, obese people. As well as during weight-loss programmes and people who want to keep their weight.

2. Material and Methods

Optimum mature and sound pear and ginger Cinnamon were purchased from the local market. pear fruits, after washing, sorting, and without peeling, were cut to slices with stainless steel knives then submerged in a pre-prepared 0.2 percent citric acid solution to prevent browning and seeds were removed.

2.1. Preparation of jam

Various materials for making low-calorie pear jam were weighed according to specifications (1 kilo gram whole pear fruit, 400 gram fructose, 1% cinnamon powder of the total weight of the mixture, and 5% ginger fresh of the total weight of the mixture). And jam was cooked till it passed the sheet flake test. TSS of the mixture was measured with a hand refractrometer at this point,which the cooking was came to an end. The completed mixture was poured into sterilised glass jars that had been cleaned and dried. The product was then allowed to cool upon being capped. The complete product was preserved in a cold, dry environment. The pears jam formuls are shown in Table 1.

Table 1: Formulation of pears jams.

Treatments	Pear	Sucrose	Fructose	Ginger	Cinnamon
T_1	1 kg	1 kg			
T_2	1 kg		400 g	--------------------	-------------------
T_3	1 kg		400 g	5% fresh	-------------------
T_4	1 kg		400g	--------------------	1% powder
T_5	1 kg		400 g	5% fresh	1%powder

During three months of storage at room temperature. The product was investigated for sensory evaluation, antioxidant and physico-chemical at 0, 15, 30, 45, 60, 75 and 90 days of storage period.

2.2. Chemical analysis

The pH was determined using an Inolab digital pH metre according to Association of Official Analytical Chemists methods (AOAC, 2019). Also moisture content, protein, fat, fiber, ash content, and titratable acidity were determined according to AOAC, (2019) Carbohydrate content were calculated by difference. Total Soluble Solids (TSS) was determined using a hand refractometer at room temperature, according to Ranganna, (2008). Ascorbic acid and Vitamin A were determined using (AOAC, 2007) method. Sugars Reducing, non-reducing and total, sugars were determined by Lane and Eynon method as described by Ranganna (2008).

Mineral determination

Mineral contents of samples were determined by atomic absorption spectrometry, flame photometry and spectrophotometry according to the methods of AOAC, (2019).

Phenolic content

Determination and identification of phenolic and flavonoids compounds were done by High Performance Liquid Chromatography (HPLC) according to Ali *et al.* (2013).

The total phenolic content was calculated using the Folin-Ciocalteu reagent, and the absorbance was measured at 765 nm using a spectrophotometer (CECIL CE7200) according to Singleton *et al.* (1999).

Antioxidant activity

DPPH radical scavenging activity was evaluated by measuring absorbance at 517 nm using spectrophotometer (CECIL CE7200) according to the method of Shimada *et al.* (1992).

Microbiological analysis

The pour plate method was used to estimate the total viable count, yeasts and moulds of jam samples according to Harrigan, (1998).

Sensory evaluation

A team of judges were assessed the pear jam for colour, flavour, taste, mouth feel, and overall acceptability, as described by Meilgaard *et al.* (2007) after a storage interval of 15 days for 3 months. When the group arrived at the test location, the score sheet and method of evaluation were described to them using a 9-point hedonic scale.

Statistical analysis

The data collected for each parameter were statistically evaluated to determine the level of significance according to Steel *et al.* (1997).

3. Result and Discussion

Optimization of fructose level in jam:

Jam's fructose optimal level was assessed using sensory analysis by a panel of 10 judges using a 9-point hedonic scale (Table 2). Different amounts of fructose (25, 30, 35, and 40%) were added. The results showed that jam made with 0.40 fructose extract outperformed the other samples in terms of sensory evaluation across the board. As tasty as the control jam, it was. As a result, 0.40 fructose extract was chosen to make low-calorie pear jam.

Table 2: Optimization of fructose levels in jam.

Parameters	Concentration				
	Control	**25%**	**30%**	**35%**	**40%**
Sweetness	8.60±0.02^{e}	5.95±0.02^{a}	7.40±0.01^{b}	7.50±0.02^{c}	7.70±0.02^{d}
Colour	8.20±0.02^{e}	6.60±0.02^{a}	6.70±0.02^{b}	6.90±0.01^{c}	7.50±0.02^{d}
Flavour	8.30±0.01^{e}	6.50±0.02^{a}	6.90±0.02^{b}	7.20±0.01^{c}	7.50±0.02^{d}
Texture	8.70±0.01^{e}	6.40±0.02^{a}	7.80±0.02^{b}	7.90±0.01^{c}	7.95±0.02^{d}
Appearance	8.30±0.02^{e}	6.50±0.01^{a}	6.85±0.01^{b}	7.40±0.02^{c}	7.88±0.02^{d}
Overall acceptability	8.60±0.01^{e}	6.67±0.01^{a}	6.95±0.01^{b}	7.45±0.01^{c}	7.65±0.02^{d}

Values having different alphabetical letters in a row are significantly different ($p<0.05$). The values are expressed as the mean ±SD of three replications.

Data given in table (3) showed the Nutrition facts in pear jam formula per 100 gram. There was significant decreased in energy level in T_2, T_3, T_4, T_5 compared with T_1 respectively.

Table 3: Nutrition facts in pear jam formula per 100 gram.

Sample	P (gm)	F (gm)	Fiber (gm)	Carb(gm)	Energy (KCAL)	CHO (mg)	V.A(IU)	Ca (mg)	K(mg)	Mg(mg)
T_1	1.541	0.01	3.01	48.45	200.054	0.000	8.500	5.725	57.25	3.000
T_2	1.562	0.01	2.98	40.45	168.138	0.000	12.143	7.464	80.357	4.286
T_3	1.535	0.01	3.21	33.60	140.63	0.000	6.939	5.449	54.388	3.735
T_4	1.500	0.02	3.01	26.83	113.50	0.000	13.901	16.124	83.333	4.649
T_5	1.561	0.03	3.18	29.11	122.954	0.000	7.967	10.421	56.199	3.945

P=Protein, F=Fat, Carb=Carbohydrate CHO= Cholesterol, V=Vitamin, Ca=Calcium, K= Potassium, Mg=Magnesium.

Data presented in Table (4) cleared out that a total number of 15 different phenolic compounds were estimated in diet pear Jam samples. The highest phenolic content (3195.71 ppm) was found in treatment No 5 (pear jam with ginger and cinnamon).

The data in tables 4 and 5 are consistent with the findings of Wang *et al.* (2021) who discovered that pears grown in Australia may be an optimal source of phenolic chemicals that are good for human health. The five types of Australian-grown pears that were the subject of the study contained a total of 73 phenolic compounds. Chlorogenic acid and catechin are the two most prevalent phenolic chemicals. Akagić *et al.* (2022) illustrated that arbutin and chlorogenic acid were the two most prevalent phenolic components in pear fruit samples. demonstrates their significance for usage as a source of fresh fruit and as a starting point for processing. These traditional pear cultivars can be utilised to enhance the nutritional value of various fruit products made from commercial pear cultivars, as well as their sensory qualities. The insights collected can help the pharmaceutical, food, and nutraceutical businesses develop new strategies and products.

Table 4: Phenolic compound of diet pear Jam (ppm).

Phenolic compounds	T_1	T_2	T_3	T_4	T_5
Pyrogallol	177.01	176.02	206.49	412.99	498.47
Gallic	10.98	11.60	10.33	25.72	22.83
3-OH Tyrosol	15.31	15.33	17.25	30.84	13.31
Catechol	201.56	203.70	92.35	468.36	630.45
4-Amino-benzoic	6.07	6.51	11.77	8.22	16.31
Catechein	76.34	74.77	88.90	217.14	152.23
Chlorogenic	44.99	44.58	197.26	107.80	679.13
P-OH- benzoic	-	-	-	334.27	353.19
Benzoic	86.51	86.68	41.83	147.38	171.57
Caffeic	31.02	30.25	28.45	162.52	13.31
Vanillic	22.19	21.99	65.29	83.79	71.62
Caffeine	25.89	25.90	16.26	25.47	35.44
Ellagic	76.92	76.91	359.02	94.24	318.76
Coumarin	43.09	39.03	41.48	44.12	107.59
Ferulic	63.54	67.11	77.69	40.93	111.50
Total	881.42	880.38	1254.37	2203.79	3195.71

Where, T_1: (control). T2: (40% fructose). T3: (40% fructose + 5%ginger fresh). T4: (40% fructose + 1% cinnamon powder). T5: (40% fructose + 1% cinnamon powder + 5%ginger fresh).

Data given in Table (5) showed a total number of 11 different flavonoids compounds were estimated in the prepared diet pear Jam (ppm) T_1, T_2, T_3, T_4 and T_5. The highest flavonoids content were in treatment 5, (3195.71 ppm), followed by treatment 4, (2203.79 ppm) and treatment 3, (1254.37 ppm).

Table 5: Flavonoids compound of diet pear Jam (ppm).

Flavonoids compounds	T_1	T_2	T_3	T_4	T_5
Rutin	13.26	13.10	15.90	8.43	240.86
Naringin	79.81	79.86	333.26	87.97	351.63
Rosmarinic	10.39	11.00	26.31	17.97	31.44
Quercetrin	27.55	27.57	103.14	8.06	53.20
Apigenin-7-glucose	4.19	3.92	18.81	54.28	88.76
Quercetin	47.66	47.19	43.39	40.41	102.26
Naringenin	25.33	25.31	6.43	11.26	79.17
Kaemp.3-(2-p-comaroyl) glucose	68.36	67.66	33.23	48.27	342.88
Kampferol	12.50	12.43	6.46	7.47	32.75
Acacetin7 neo.rutinoside	25.88	25.48	31.24	108.81	158.50
Apigenin	3.01	2.46	42.22	18.53	19.85
Total	317.94	315.98	660.39	411.46	1501.3

Where, T_1: (control). T2: (40% fructose). T3: (40% fructose + 5%ginger fresh). T4: (40% fructose + 1% cinnamon powder). T5: (40% fructose + 1% cinnamon powder + 5%ginger fresh).

The data in table (6) showed the moisture, ash content and pH value in the prepared pear jam.

Moisture content.

The shelf life and freshness of items are both impacted by moisture, which is a significant influence. Food items that contain a lot of moisture have a limited shelf life. During the 90-day storage period, it was noted that the moisture content of all samples reduced and ranged from 42.16% for T_1 to 63.13% for T_4. The statistical analysis showed that the storage effect on each sample's moisture content varied significantly ($p<0.05$). During storage, the average moisture content value for all samples declined significantly ($p<0.05$) from 55.55% to 52.70%.

Table 6: Effect of treatment and storage intervals on moisture (%), ASH (%) and PH of diet pear Jam.

Parameter	Storage intervals	Treatments					
		T_1	T_2	T_3	T_4	T_5	Means
Moisture(%)	Initial	43.174±0.03	51.094±0.31	57.111±0.24	64.908±0.62	61.429±0.81	55.55^g
	15	43.01±0.11	50.88±0.39	57.01±0.44	64.00±0.15	60.91±0.12	55.16^f
	30	42.98±0. 23	50.41±0.34	56.71±0.128	63.61±0.41	60.48±0.49	54.84^e
	45	42.32±0.06	50.02±0.09	56.18±0.31	63.15±0.35	60.13±0.36	54.36^d
	60	41.71±0.18	48.90±0.22	55.84±0.63	62.38±0.41	59.48±0.09	53.66^c
	75	41.21±0.32	48.49±0.11	55.28±0.38	62.10±0.14	58.77±0.91	53.17^b
	90	40.67±0.15	47.81±0.25	55.00±0.29	61.18±0.71	58.22±0.53	52.70^a
	Means	42.16^a	49.66^b	56.16^c	63.13^e	59.92^d	
ASH (%)	Initial	3.815±0.01	3.904±0.1	4.534±0.03	3.732±0.01	4.690±0.02	4.135^g
	15	3.673±0.01	3.558±0.02	3.995±0.01	3.543±0.02	4.281±0.00	3.810^f
	30	3.552±0.01	3.143±0.01	3.926±0.00	3.384±0.05	4.113±0.01	3.624^e
	45	2.813±0.02	2.824±0.02	3.641±0.01	3.153±0.02	3.783±0.01	3.243^d
	60	2.693±0.01	2.695±0.02	3.571±0.02	2.887±0.01	3.633±0.01	3.096^c
	75	2.603±0.01	2.583±0.2	3.233±0.02	2.662±0.01	3.345±0.01	2.885^b
	90	2.572±0.01	2.302±0.00	3.018±0.02	2.552±0.01	3.193±0.01	2.728^a
	Means	3.103^b	3.001^a	3.703^d	3.131^c	3.863^e	
pH	Initial	4.57±0.23	4.65±0.23	4.35±0.13	4.44±0.13	4.51±0.23	4.51^g
	15	4.42±0.34	4.53±0.29	4.17±0.14	4.19±0.14	4.38±0.14	4.34^f
	30	4.23±0.13	4.32±0.14	4.07±0.14	4.04±0.04	4.13±0.14	4.16^e
	45	4.11±0.08	4.14±0.08	3.85±0.10	3.72±0.10	3.48±0.10	3.86^d
	60	3.86±0.12	3.91±0.12	3.57±0.12	3.30±0.12	3.37±0.12	3.60^c
	75	3.54±0.12	3.58±0.12	3.16±0.11	3.11±0.15	3.18±0.15	3.32^b
	90	3.13±0.11	3.34±0.15	3.05±0.15	2.89±0.11	2.84±0.11	3.05^a
	Means	3.98^d	4.07^e	3.75^c	3.67^a	3.70^b	

Values having different alphabetical letters in a row and column are significantly different ($p<0.05$). The values are expressed as the mean ±SD of three replications.

Increases in total soluble solids and total sugars that bind water may also be responsible for a decrease in moisture content, resulting in a reduction in water activity these findings agree with (Menezes *et al.,* 2011) who obtained comparable findings in their studies, showing that the water activity and moisture value of guava jam were not significantly affected by storage. Also, this decrease of moisture content could be resulted in reopening the same pack for evaluation during storage. The outcomes corroborated (Anjum *et al.,* 2000) findings, who demonstrated the reduction in moisture from 79% to 77% over the course of 60 days in dried apricot diet jam. In roselle jam similar observations were found by (Ashaye & Adeleke 2009). Our results also agree with Ehsan *et al.* (2003) investigated apple marmalade with grape fruit and found a significant decline in percent moisture. Sutwal *et al.* (2019) found a decrease in moisture during 28 days of storage apple diet jam.

Ash content

Ash content indicates the mineral content of food (Ashaye & Adeleke, 2009). The ash content represents the inorganic substance that remains after organic matter has been destroyed (Ranganna, 1986). Sample T_5 had the maximum mean value among the treatments (3.863%), whereas sample T_2 had the minimum (3.001%). During storage, the mean ash content value for all samples reduced significantly ($p<0.05$) from 4.135% to 2.728%. This decrease in ash content could be related to increased microbial activity, which uses minerals for growth, resulting in mineral content reduction. (Ashaye & Adeleke, 2009) who indicated a decrease in ash content of rosella jam during storage and (Sutwal *et al.,* 2019) identified decrease in Ash of apple diet jam.

pH

In order to achieve the best gel state in jam, the pH must be modified. During storage, the pH of all samples had reduced. The pH of the pear jam was measured throughout the course of three months of storage. The initial pH value was reported 4.57,4.65, 4.35,4.44 and 4.51 for T_1, T_2, T_3, T_4 and T_5 respectively which decreased gradually to 3.13, 3.34, 3.05, 2.89 and 2.84 for (Table 6). The mean pH values cleared considerable decrease from 4.34 to 3.05 during storage. The statistical study showed that the storage effect on the pH of control jam (T_1) differed considerably from enhanced jam (T_2, T_3, T_4, and T_5) ($p<0.05$). The increase in acidic content brought on by sugar degradation or pectin hydrolysis may be the reason for the pH drop that occurs during storage. Similar findings were made in mixed jam made from watermelon and lemon, whereas (Ehsan *et al.,* 2002) observed a decreasing trend in pH of all samples after storage. Likewise, two different mango jams without sugar had been made by Torezan (2002), who also noted a reduction in pH throughout the course of storage. A decrease was recorded in PH from (4.34 to 3.01) in a research prepared by Mohamed *et al.* (2008). A study Sutwal *et al.* (2019) found that the pH of diet jam was trending decreasing.

The data in table (7) showed the total soluble solids, ascorbic acid content and Titratable acidity for the prepared pear jam.

Total soluble solids (TSS) content

Data in Table (7) showed that, maximum mean value of TSS was recorded for sample T_1 (69.92 B°) as compared to another samples, this could be due to the high sugar concentration in the control jam, which elevated TSS as indicated. While minimum value of TSS was recorded for sample T_4 (68.45 B°). The mean TSS content value significantly ($p<0.05$) increased from 68.30% to 70.07% during storage. The meaning of "total soluble solids" (TSS) refers to the soluble form of specific chemical components found in fruit and fruit products. According to Table (7), the TSS of each sample of jam increased as it was being stored, also Acid hydrolysis of polysaccharides, TSS may rise when pectin is converted to simple sugar in the presence of acid while being stored. These findings support that of the (Riaz *et al.,* 1999) who revealed that strawberry jam's TSS increased following storage. Another study (Ehsan *et al.,* 2002 and 2003) discovered that the TSS of grape fruit marmalade developed from 70 to 70.8 after 60 days of storage and the TSS of watermelon lemon jam increased from 68.6 to 68.9. Likewise, our findings are in agreement with the results of Muhammad *et al.* (2008) who measured the TSS of diet apple jam after 90 days of storage and found that it ranged from 11.54 to 17.70. According to a different study (Khan *et al.,* 2012), strawberry jam's TSS increased during storage. Similar to this, (Safdar *et al.,* 2012) found that over the course of 150 days of storage, the total soluble solids content of mango jam gradually increased.

Ascorbic acid

Due to its low thermal stability and low stability, ascorbic acid decreases in the product during storage. Ascorbic acid is the vitamin that is especially to preserve when kept in storage. Both the enhanced and control pear jams, ascorbic acid levels lowered while they were in storage. The content of ascorbic acid at zero time was noted 18.38, 18.41, 18.55, 18.43 and 18.59 mg/ 100g, while was gradually decreased during storage to 14.26, 14.16, 14.76, 14.50 and 14.17mg/100g for T1, T_2, T_3, T_4 and T_5 respectively .The highest mean ascorbic acid content was found in sample T_3 (16.68 mg/100g), While the lowest mean value was found in sample T_2 (16.32 mg/100g). During storage, the mean ascorbic acid content decreased significantly ($p<0.05$) from 18.47 to 14.37 mg/100g. This might be due to oxidising to dehydro ascorbic acid.

Table 7: Effect of storage period and treatments on, TSS (ºB), Ascorbic acid(mg/100g) and Acidity (%) of diet pear Jam.

Parameter	Storage intervals	Treatment					
		T_1	T_2	T_3	T_4	T_5	means
TSS (ºB)	Initial	68.17±0.04	68.27±0.14	68.01±0.01	67.11±0.23	68.00±0.10	67.91^{d}
	15	68.37±0.03	68.91±0.03	68.21±0.03	67.88±0.03	68.10±0.03	68.30^{cd}
	30	68.99±0.12	69.00±0.02	68.50±0.02	68.05±0.05	68.22±0.05	68.55^{c}
	45	69.54±0.02	69.11±0.11	68.87±0.25	68.44±0.05	68.73±0.15	68.94^{bc}
	60	71.00±0.01	69.55±0.01	69.00±0.01	68.81±0.34	68.89±0.04	69.47^{b}
	75	71.15±0.21	70.00±0.02	69.12±0.02	69.31±0.21	68.95±0.23	69.71^{ab}
	90	71.83±0.10	70.09±0.25	69.81±0.25	69.57±0.24	69.03±0.22	70.07^{a}
	means	69.92^{e}	69.28^{d}	68.79^{c}	68.45^{a}	68.56^{b}	
Ascorbic acid (mg/100g)	Initial	18.38±1.62	18.41±1.15	18.55±1.53	18.43±1.17	18.59±1.83	18.47^{g}
	15	17.89±1.18	17.70±1.81	18.00±1.72	17.53±1.42	17.99±39	17.82^{f}
	30	17.21±1.33	16.99±1.29	17.31±1.31	17.10±1.27	17.23±1.67	17.17^{e}
	45	16.45±1.66	16.29±1.23	16.81±1.38	16.56±1.53	16.39±1.55	16.50^{d}
	60	15.99±1.19	15.79±1.15	16.15±1.09	15.98±1.36	15.84±1.48	15.95^{c}
	75	15.03±1.09	14.88±1.37	15.20±1.14	15.11±1.19	15.01±1.90	15.05^{b}
	90	14.26±1.57	14.16±1.22	14.76±1.49	14.50±1.00	14.17±1.61	14.37^{a}
	means	16.46^{bc}	16.32^{a}	16.68^{d}	16.45^{b}	16.46^{bc}	
Acidity (%)	Initial	0.58±0.01	0.60±0.03	0.61±0.01	0.59±0.02	0.57±0.02	0.59^{a}
	15	0.59±0.00	0.62±0.01	0.63±0.01	0.62±0.05	0.60±0.03	0.61^{b}
	30	0.61±0.04	0.65±0.03	0.65±0.02	0.64±0.01	0.62±0.03	0.64^{c}
	45	0.64±0.01	0.67±0.03	0.67±0.02	0.65±0.01	0.65±0.01	0.66^{d}
	60	0.66±0.01	0.69±0.01	0.69±0.02	0.67±0.05	0.68±0.02	0.68^{e}
	75	0.68±0.02	0.71±0.01	0.71±0.01	0.69±0.02	0.70±0.02	0.70^{f}
	90	0.71±0.01	0.73±0.03	0.72±0.01	0.71±0.02	0.74±0.02	0.72^{g}
	means	0.64^{a}	0.67^{c}	0.67^{c}	0.65^{b}	0.65^{b}	

Values having different alphabetical letters in a row and column are significantly different ($p<0.05$). The values are expressed as the mean ±SD of three replications.

Temperature also has a major impact on how quickly ascorbic acid is lost. Where the loss of vitamin C increases as the temperature rises., On the contrary Shakir *et al.* (2007) discovered that the mean ascorbic acid level of apple and pear mixed fruit jam increased significantly from 12.38 on the first day to 14.86 after 90 days. Likewise, (Sutwal *et al.,* 2019) illustrated that a decrease in ascorbic acid content (6.96 to 6.85%).

Titratable acidity

Table (7) also shown the results of the storage effect on the titratable acidity of jam samples. The stability and shelf life of a food product are determined by its acidity. The organic acids found naturally in fruits, as well as those added during the jam-making process, contribute to the jam's acidity. Acidity of all treatments of pear jam was increased through storage from 0.59 at initial day to 0.72at 90 days. The initial acidity of T_1, T_2, T_3, T_4 and T_5 were 0.58, 0.60, 0.61, 0.59 and 0.57%. But, Acidity values was increased to 0.71, 0.73, 0.72, 0.71 and 0.74% respectively during storage. According to the statistical analysis, the storage effect on titratable acidity of all samples was significantly different ($p<0.05$). The increase of organic acids as a result of the breaking of pectic bodies and the breakdown of polysaccharides could explain the rise in acidity or oxidation of reducing sugars. These findings support (Shah *et al.,* 2015) indicated that an increasing trend in acidity in apple and olive blended jam throughout storage. On the other hand, (Hussain and Shakir, 2010) found that the mean value for acidity of apricot and apple jam after storage increased from 0.650 on the first day to 0.650 on the 60th day (0.743). likewise, (Kanwal *et al.,* 2017) recorded that an increasing in acidity content of guava jam (0.662 to 0.668). Similar results had found by Sutwal *et al.* (2019) an increasing in titratable acidity (0.49 to 0.66%) in diet jam.

The data in table (8) showed the effect of treatment and storage intervals on the total sugars, reducing sugars, and non-reducing sugars.

Total sugar

The most significant component of fruit products is sugar, where is play a vital factor in the formation of flavour in food products and as a natural preservative. The initial total sugar content of sample T_1, T_2, T_3, T_4 and T_5 was noted as 45.44, 37.49, 30.39, 23.82 and 25.93%. However total sugar values was gradually increased to 53.56, 39.91, 36.43, 26.52 and 28.30 during storage respectively. Sample T_1 had the maximum mean value among the samples (48.54%), while sample T4 had the minimum mean value (25.57%). Control sample exhibited a higher mean value for total sugar content than optimized treatments, which was to be expected given that sucrose was added to the control sample. The mean total sugar concentration considerably ($p<0.05$) rose during storage, rising from 32.62% to 36.95. A possible explanation for the increase in total sugars is the conversion of starch and other insoluble carbs into sugars. The results of this investigation concur with those of Muhammad *et al.* (2008) who found that diet apricot jam's total sugar content increased during storage. Also, (Vidhya and Narain, 2011) observed a rise in the amount of wood apple sugar overall in preserved goods.

Reducing sugar

A significant difference ($p<0.05$) was presented in Table 8. The reducing sugar content of sample T_1, T_2, T_3, T_4 and T_5 was increased from 17.33to 34.00, from 22.95 to 27.74, from 23.12 to 30.09, from 19.49 to 22.81 and from 16.74 to 25.79 respectively during storage. Sample T_3 recorded the highest mean value (26.26) while sample T_5 recorded the lowest (20.84). During the storage time, the mean reducing sugar increased significantly ($p<0.05$) from 19.93 to 28.09.

The rise in reducing sugar may be caused by the environment's acidity, elevated temperatures, hydrolysis of sugars, decrease in pH and long storage period, where sucrose convert into reducing sugar (glucose + fructose). Our findings are in keeping with Riaz *et al.* (1999), who found that strawberry jam's reducing sugars increased in direction during the course of three months of storage. Anjum *et al.* (2000) while studying on apricot diet jam indicated an increase in reducing sugar. The outcomes of study work are in agreement with those of Shakir *et al.* (2007) who discovered an increasing the sugar content in apple and pear mixed fruit jam during a 90-day storage term. On the other hand, Hussain and Shakir, (2010) reported that mean values for reducing sugar content of apricot jam increased from 28.37 to 29.41.likewise, (Kanwal *et al.,* 2017) recorded that an increasing in reducing sugar content of guava jam.

Non reducing sugars

There was a decreasing trend shown on reducing sugars of all the pear jam samples during storage. A significant difference ($p<0.05$) was presented in Table 8. The reducing sugar content of T_1, T_2, T_3, T_4 and T_5 decreased from 28.11, 14.54, 7.78, 4.33 and 9.19 to 19.56, 12.17, 6.34, 3.71 and 2.51 respectively during storage. Maximum mean value was noted for sample T_1 (23.76) while minimum value was obtained for sample T_5 (6.36). The mean reducing sugar significantly ($p<0.05$) decreased to 12.79, 12.10, 11.55, 10.95, 10.42, 9.34 and 8.86 during storage intervals. This Decrease in non-reducing sugar may be due to the conversion of non-reducing sugar to reducing sugar. This facts in our research agree with (Riaz *et al.,* 1999) who observed decrease in non-reducing sugars from 44.64 to 32.35 % in strawberry jam. Ehsan *et al.,* (2003) observed a decrease in nonreducing sugars of grape fruit apple marmalade. From 49.41 to 34.85 %. Also, Muhammad *et al.* (2008) found significant decreasing in non-reducing sugar from (7.33 to 3.46). According to Hussain and Shakir (2010), the non-reducing sugar concentration decreased from 43.20 on the first day to 19.46 on the 60th.

Table 8: Effect of treatment and storage intervals on the (total sugars, reducing sugars, and non-reducing sugars) of diet pear Jam

Parameter	Storage intervals	Treatment					
		T_1	T_2	T_3	T_4	T_5	Means
Total sugar (%)	Initial	45.44±1.22	37.49±1.84	30.39±2.96	23.82±0.25	25.93±1.64	32.62^{a}
	15	46.38±0.98	37.61±1.42	31.14±1.29	24.76±1.00	26.37±1.28	33.25^{b}
	30	46.91±1.67	38.67±0.18	31.58±1.11	25.58±1.47	26.85±1.35	33.92^{c}
	45	47.83±2.99	39.15±1.69	33.62±1.57	25.84±1.22	27.15±1.73	34.72^{d}
	60	49.37±2.84	39.41±2.33	33.88±2.16	26.13±1.39	27.67±1.06	35.29^{e}
	75	50.16±0.79	39.53±1.39	35.88±2.00	26.43±1.96	28.11±1.17	36.02^{f}
	90	53.56±1.55	39.91±0.76	36.43±1.63	26.52±1.88	28.30±1.10	36.95^{g}
	means	48.54^{e}	38.83^{d}	33.28^{c}	25.58^{a}	27.20^{b}	
Reducing sugar (%)	Initial	17.33±0.34	22.95±0.46	23.12±0.15	19.49±0.53	16.74±0.73	19.93a
	15	19.49±0.68	24.41±0.66	23.59±0.27	20.59±0.13	17.68±0.89	21.15^{b}
	30	22.33±0.98	24.97±0.38	24.39±0.63	21.47±0.48	18.71±0.16	22.38^{c}
	45	25.18±0.75	26.07±0.64	26.61±0.57	21.79±0.39	19.28±1.47	23.79^{d}
	60	25.87±1.24	26.83±0.56	27.00±1.10	22.12±1.64	22.55±1.24	24.88^{e}
	75	29.14±1.27	27.29±0.24	29.00±0.48	22.65±1.35	25.15±0.20	26.65^{f}
	90	34.00±0.99	27.74±0.18	30.09±0.29	22.81±0.59	25.79±0.02	28.09^{g}
	Means	24.76^{c}	25.75^{d}	26.26f	21.56^{b}	20.84^{a}	
Non reducing sugars (%)	Initial	28.11±0.14	14.54±0.25	7.78±0.54	4.33±0.21	9.19±0.59	12.79^{g}
	15	26.89±0.81	13.20±0.34	7.55±0.52	4.17±0.00	8.69±0.87	12.10^{f}
	30	24.58±0.92	13.70±0.39	7.19±0.49	4.11±0.11	8.14±0.31	11.55^{e}
	45	22.65±0.31	13.08±0.98	7.11±0.21	4.05±0.08	7.87±0.47	10.95^{d}
	60	23.50±0.09	12.58±0.54	6.88±0.18	4.01±0.87	5.12±0.02	10.42^{c}
	75	21.02±0.55	12.24±0.27	6.67±0.30	3.78±0.54	2.96±0.46	9.34^{b}
	90	19.56±0.33	12.17±0.29	6.34±0.47	3.71±0.33	2.51±0.19	8.86^{a}
	Means	23.76^{e}	13.07^{d}	7.08^{c}	4.02^{a}	6.36^{b}	

Values having different alphabetical letters in a row/column are significantly different ($p<0.05$). The values are expressed as the mean ±SD of three replications.

Effect of treatments and storage on total phenolic and antioxidant activity of pear jam.

Data in Table (9) is demonstrated the effects of treatments and storage on the total phenolic content (TPC) of all pear jam treatments. The total phenolic content of pear jam treatments was significantly affected by various treatments and storage period. The mean values were 70.71, 81.54, 91.01, 97.26, and 102.77 for T_1, T_2, T_3, T_4 and T_5 respectively. The mean values of total phenolic content dropped throughout storage from 101.87 at day 0 to 70.97 at day 90. Because of the disruption of the fruit's cell structure during manufacturing, the total phenolic content of the jam may have decreased. Fresh fruit's bioactive component content is also impacted by the jam-making process. These results were according to Kanwal *et al.* (2017) who found decreasing in TPC in guava jam from 78.92 to 59.66 during storage period.

Table 9: Effect of treatment and storage intervals on the total phenolic and antioxidant activity of pear jam.

Parameter	Storage intervals	Treatment					
		T_1	T_2	T_3	T_4	T_5	Means
Total phenolic content(mg GAE/100 g)	Initial	82.22±0.28	82.49±0.37	108.77±1.73	113.34±1.24	122.51±0.23	101.87^{g}
	15	80.37±0.86	77.94±0.55	102.79±1.44	106.21±0.73	112.87±0.84	96.04^{f}
	30	76.38±2.94	75.46±0.22	97.51±0.14	101.76±2.11	108.86±2.72	92.00^{e}
	45	73.24±0.99	71.72±0.69	93.13±0.28	97.27±0.93	102.47±0.89	87.57^{d}
	60	65.78±0.85	67.92±0.76	87.15±1.17	92.33±1.39	96.94±0.46	82.03^{c}
	75	60.47±1.64	63.54±0.37	77.34±1.07	87.52±0.58	90.53±0.26	75.88^{b}
	90	56.50±1.14	60.39±0.39	70.34±0.98	82.41±1.24	85.19±1.31	70.97^{a}
	Means	70.71^{a}	81.54^{b}	91.01^{c}	97.26^{d}	102.77^{e}	
Antioxidant activity(DPPH)%	Initial	97.51±0.03	96.89±0.08	98.06±0.58	89.93±0.32	91.28±0.10	94.74^{g}
	15	94.85±0.77	93.13±0.17	97.13±1.29	86.41±1.12	88.67±0. 18	92.04^{f}
	30	93.06±0.12	91.01±0.55	93.42±1.08	84.73±1.51	85.49±0.52	89.54^{e}
	45	89.77±1.41	88.35±0.73	92.36±0.87	79.66±0.89	83.25±016	86.68^{d}
	60	87.66±0.51	84.45±1.38	89.66±1.25	74.83±0.46	80.50±0.05	83.42^{c}
	75	84.35±0.72	82.02±1.19	86.17±0.06	70.74±1.16	76.48±0.28	79.95^{b}
	90	79.73±0.09	80.54±0.42	84.57±1.02	66.59±0.20	74.81±1.02	77.25^{a}
	Means	86.99^{c}	88.06^{d}	91.63^{e}	78.99^{a}	82.93^{b}	

Values having different alphabetical letters in a row/column are significantly different ($p<0.05$). The values are expressed as the mean ±SD of three replications.

In methanol or aqueous solution, Antioxidant activity (DPPH) is a free stable radical that receives an electron or hydrogen ion to transfer into a stable free radical and then accepts an electron or hydrogen radical to change into a stable atom or molecule. Table (9) evaluated the dependence of treatments and storage on antioxidant activity in all pear jam treatments. According to statistical analysis, the results are highly significant between treatments and storage period. The mean values were 86.99, 88.06, 91.63, 78.99, and 82.93 for T1, T2, T3, T4 and T5, respectively. The mean antioxidant activity over the storage period declined from 94.74 at the beginning to 77.25 at the end. According to Scibisz and Mitek (2007), jam production loses 13-19% of the antioxidant content of fruits, and According to Rababah *et al.* (2011a,2011b), the strawberry fruit has the highest antioxidant activity (84.91 %), followed by strawberry jam after processing (59.38 %), and jams stored for 15 days at 25°C (55.13 %), 35°C (32.05 %), 45°C (29.82 %), and 55°C (29.82 %) (16.95 %). Also, results were according to Kanwal *et al.* (2017) who observed decreasing in DPPH in guava jam from 41.29 to 31.09 during (0- 90) days of storage period.

Effect of storage period on sensory quality characteristics of the prepared pear jam.

Low calorie pear jam was examined organoleptically by a panel of 9 judges to study the different qualitative characters on the basis of 9-points hedonic scale.

During storage, all of the sensory qualities were reduced as shown in Table (10).

Colour

The colour degree of pear jam samples for T_1, T_2, T_3, T_4 and T_5 were 8.99, 8.36, 8.19, 7.33 and 6.93 which was gradually decreased to 8.15, 7.67, 7.33, 6.77 and 6.30 during the 90 days of storage, respectively. The maximum mean value was denoted in T_1 (8.85) While minimum value was observed in T_5 (6.64). The effect of storage on the colour for T_1 was significantly different from T2, T3, T4, and T5 samples ($p<0.05$). Because control pear jam had sucrose sugar, that gives the jam glossiness, it scored higher on colour than other treatments. On the other hand pear jams contain fructose were acceptable in colour and this acceptable might be the ability of fructose to keep colour of jam. When the sample was stored, the mean colour value reduced significantly ($p<0.05$) from 7.96 to 7.25. This may be due to ascorbic acid degradation, colour pigment polymerization with other phenolic compounds. Fructose also helps preserve the colour of jams and jellies according to Hanover & White, (1993). These findings concurred with those of Patel and Naik (2013) who studied banana-pineapple blended jam. Similar findings were reported by Khan *et al.* (2015), who noted a color-diminishing trend in various apple jams after storage. Also, Sutwal *et al.* (2019) found decreasing in sensory characteristics.

Taste

Samples T_1, T_2, T_3, T_4, and T_5 had a taste score of 9.00, 8.65, 7.95, 8.00, and 7.47 at zero-time, but this lowered to 8.46, 8.40, 7.73, 7.33, and 7.21 respectively at the end of storage (Table 10). During storage, the mean taste value declined significantly ($p<0.05$) from 8.23 to 7.83. Sample T_1 (8.80) had the highest mean value, whereas sample T_5 had the lowest mean value (7.37). Changes in acidity, pH, and sweet material content brought on by the addition of ginger, cinnamon, or a mixture of ginger and cinnamon, as well as component degradation during storage that affects changes in sweetness and acidity. Could all contribute to a lower taste score. Relekar *et al.* (2011) indicated decrease in taste of in sapota jam. These results according to Shah *et al.* (2015) showed a declining tendency in the taste of apple and olive blended jam throughout storage. Also, these observations are in alignment with (Sutwal *et al.,* 2019) that discovered a loss of taste in low-calorie jam made by substituting the natural sweetener stevia for sugar.

Flavor

During storage, the flavour of control sample and fructose jam samples reduced as shown in (Table 10). T_1 recorded the greatest mean value (8.65), While minimum value had observed in sample T_5 (7.59). The statistical analysis demonstrated that the flavour of T_1, T_2, T_3, T_4, and T_5 was affected by storage ($p<0.05$). Because sucrose and fructose have a pleasant flavour, the control jam and sample 2 received the highest flavour score. During storage, the mean flavour value declined significantly ($p<0.05$) from 8.50 to 7.72. Flavor loss during storage could be caused by oxidative changes in sugars, enzymatic phenol degradation. These findings support Patel and Naik's (2013) observation of a decreasing tendency in the flavour of banana pineapple mixed jam after storage. Priya *et al.* (2010) discovered similar results in mixed fruit jam. Likewise, (Sutwal *et al.,* 2019) who observed decreasing in flavor during storage period in diet jam.

Texture

During the 90-day storage period, the texture of all samples reduced. During storage, the texture values of all samples deteriorated. where these values decreased from 8.98, 8.82, 8.64,8.17, and 7.88 to 8.00, 7.91, 7.68, 7.39, and 7.03 for T1, T2, T3, T4, and T5 respectively. Sample T_1 (8.46) recorded the highest value, while sample T_5 recorded the lowest (7.46). Pectin composition is frequently credited with the jam's textural qualities. Pectin's job is to create a network or thickening effect in order for jam to set. Pectin, when combined with sugar and acid, makes a gel. Because fructose could not create a strong gel with pectin, the texture of T_2, T_3, T_4, and T_5 was not good as T_1. During storage, the mean texture value declined significantly ($p<0.05$) from 8.50 to 7.60. The hydrolysis of pectin during storage might lead to a decrease in texture quality. Similar findings with mixed fruit jam were made by Priya *et al.,* (2010). These results are in line with those of Abolila *et al.* (2015) who discovered that low-calorie orange jam's texture changed during storage.

Overall acceptability

In the creation of novel products, overall acceptability is played an important role. During the 90-day storage period, the general acceptability of control and low-calorie jams decreased. Samples T_1, T_2, T_3, T_4, and T_5 had an overall acceptability of 8.95, 8.93, 8.34, 7.82, and 7.50 at zero-time., but it gradually decreased to 8.39, 8.74, 8.09, 7.59, and 7.17 at the end of storage (Table 10). During storage,

EISSN: 2706 -7947 ISSN: 2077- 4613 DOI: 10.36632/mejas/2024.14.4.44

the mean overall acceptability decreased significantly ($p<0.05$) from 8.31 to 8.00. Sample T_1 (8.71) had the maximum value, while sample T_5 had the minimum value (7.35).

Table 10: Mean score of judges for color, taste, texture and overall acceptability of diet pear Jam

Parameter	Storage intervals	Treatment					
		T_1	T_2	T_3	T_4	T_5	Means
Colour	Initial	8.99±0.23	8.36±0.31	8.19±0.26	7.33±0.10	6.93±0.05	7.96^g
	15	8.84±0.11	8.23±0.35	8.09±0.52	7.25±0.18	6.87±0.15	7.86^f
	30	8.64±0.25	8.17±0.34	7.99±0.19	7.14±0.24	6.75±0.33	7.74^e
	45	8.56±0.35	8.01±0.31	7.87±0.11	7.03±0.16	6.64±0.08	7.62^d
	60	8.51±0.13	7.91±0.38	7.61±0.20	6.96±0.61	6.53±0.62	7.51^c
	75	8.34±0.21	7.84±0.17	7.49±0.47	6.83±0.51	6.45±0.062	7.39^b
	90	8.15±0.25	7.67±0.39	7.33±0.58	6.77±0.45	6.30±0.75	7.25^a
	Means	8.85^e	8.03^d	7.80^c	7.05^b	6.64^a	
Taste	Initial	9.00±0.35	8.65±0.64	7.95±0.54	8.00±0.09	7.47±0.41	8.23^g
	15	8.97±0.014	8.64±0.35	7.95±0.50	7.70±0.10	7.55±0.25	8.16^f
	30	8.91±0.19	8.61±0.48	7.91±0.23	7.69±0.21	7.43±0.32	8.11^e
	45	8.83±0.32	8.59±0.43	7.89±0.22	7.55±0.28	7.36±0.36	8.05^d
	60	8.73±0.29	8.55±0.37	7.85±0.13	7.49±0.52	7.28±0.53	7.98^c
	75	8.69±0.36	8.49±0.36	7.80±0.39	7.37±0.57	7.27±0.20	7.93^b
	90	8.46±0.39	8.40±0.23	7.73±0.30	7.33±0.17	7.21±0.71	7.83^a
	Means	8.80^e	8.56^d	7.87^c	7.59^b	7.37^a	
Texture	Initial	8.98±0.38	8.82±0.16	8.64±0.61	8.17±0.13	7.88±0.02	8.50^g
	15	8.71±0.33	8.63±0.33	8.55±0.54	8.04±0.28	7.64±0.18	8.32^f
	30	8.63±0.32	8.41±0.68	8.40±0.45	7.98±0.27	7.59±0.16	8.20^e
	45	8.47±0.29	8.27±0.57	8.22±0.09	7.83±0.11	7.47±0.25	8.05^d
	60	8.31±0.42	8.19±0.07	8.08±0.35	7.79±0.34	7.36±0.31	7.95^c
	75	8.11±0.15	8.05±0.18	7.93±0.12	7.58±0.65	7.22±0.62	7.78^b
	90	8.00±0.65	7.91±0.20	7.68±0.24	7.39±0.55	7.03±0.19	7.60^a
	Means	8.46^e	8.33^d	8.22^c	7.83^b	7.46^a	
Flavor	Initial	9.00±0.22	8.88±0.29	8.45±0.24	8.17±0.29	8.00±0.26	8.50^g
	15	8.88±0.64	8.75±0.22	8.31±0.26	8.00±	70..91±0.31	8.37^f
	30	8.73±0.31	8.61±0.23	8.16±0.06	7.87±	7.79±0.53	8.23^e
	45	8.67±0.25	8.57±0.31	8.05±0.24	7.72±	7.58±0.63	8.12^d
	60	8.54±35	8.46±0.36	7.95±0.15	7.55±	7.41±0.17	7.98^c
	75	8.41±0.32	8.37±0.27	7.80±0.21	7.48±	7.26±	7.87^b
	90	8.29±0.13	8.28±0.30	7.69±0.25	7.19±	7.14±0.27	7.72^a
	Means	8.65^e	8.56^d	8.06^c	7.71^b	7.59^a	
Overall acceptability	Initial	8.95±0.46	8.93±0.27	8.34±	7.82±49	7.50±57	8.31^g
	15	8.93±0.16	8.90±0.32	8.30±0.55	7.80±0.33	7.51±0.78	8.29^f
	30	8.81±0.35	8.86±0.31	8.27±0.49	7.76±0.45	7.41±0.55	8.22^e
	45	8.74±0.52	8.82±0.26	8.20±0.46	7.70±0.75	7.35±0.61	8.16^d
	60	8.63±0.18	8.00±0.13	8.15±0.33	7.69±0.15	7.29±0.26	7.95^c
	75	8.55±0.11	8.78±0.24	8.11±0.25	7.64±0.63	7.23±0.41	8.06^b
	90	8.39±0.23	8.74±0.30	8.09±0.19	7.59±42	7.17±0.31	8.00^a
	Means	8.71^d	8.72^e	8.21^c	7.72^b	7.35^a	

Values having different alphabetical letters in a row/column are significantly different ($p<0.05$). The values are expressed as the mean ±SD of three replications.

The decline in overall acceptability during 90 days of storage was related to decreasing in colour, texture, flavour, and taste. These findings agree with those of Khan *et al.* (2012), who found a decrease in overall acceptability of strawberry jam after storage. Muhammad *et al.* (2008) discovered similar findings in diet apple jam. Similar results had shown by Sutwal *et al.* (2019) in diet jam.

The effect of storage on the microbiological quality features of pear jam.

Total number of viable cells:

Table (11) showed the findings of the total viable count of various jam samples during the storage period. The total viable count varied from 1×10^3 to 33×10^3, from 1×10^3 to 48×10^3,from 1×10^3 to 35×10^3, from 1×10^3 to 45×10^3 and from 1×10^3 to 41×10^3(cfu/gm) for treatments T_1 ,T_2, T_3, T_4 and T_5, respectively. This meant that the jam was manufactured in a sanitary environment and was safe to eat (Priya *et al.,* 2010). Because sugar binds water molecules and renders them inaccessible to microorganisms, the lowest viable count was achieved by T_1. During storage, the overall viable count got up., but no product deterioration was observed. The overall plate count in jam must not exceed 40% of the total plate count in the field inspection. Vidya and Narain (2011) discovered similar results in wood apple jam.

Yeast and mould count

Table (11) shown also the total count of yeast and mould. It was observed that the yeast and mould count ranged from 0 to 125× 103 , from 0 to 101× 103 , from 0 to 77× 103 from 0 to 98× 103 and from 0 to71 × 103 (cfu/gm) for treatments T1, T2, T3, T4 and T5, respectively at the initial and the end of storage period.The minimum value of total yeast and mould was achieved by T_5 .

Table 11: Effect of storage periods and treatments on total viable count and yeast and mould count (cfu/gm) of jam.

Parameter	Storage intervals	Treatment				
		T_1	T_2	T_3	T_4	T_5
Total viable count (cfu/gm) of jam	Initial	1×10^3	1×10^3	1×10^3	1×10^3	1×10^3
	15	5×10^3	6×10^3	3×10^3	3×10^3	7×10^3
	30	9×10^3	9×10^3	9×10^3	11×10^3	11×10^3
	45	16×10^3	19×10^3	15×10^3	14×10^3	17×10^3
	60	21×10^3	28×10^3	22×10^3	23×10^3	29×10^3
	75	27×10^3	39×10^3	29×10^3	34×10^3	38×10^3
	90	33×10^3	48×10^3	35×10^3	45×10^3	41×10^3
Yeast and mould count (cfu/gm) of jam	Initial	0	0	0	0	0
	15	8×103	5×103	2×103	6×103	1×103
	30	17×103	13×103	22×103	24×103	9×103
	45	41×103	37×103	31×103	48×103	21×103
	60	63×103	58×103	47×103	68×103	43×103
	75	97×103	75×103	64×103	79×103	55×103
	90	125×103	101×103	77×103	98×103	71×103

Where, T1 : (1 kg pear whole fruit, 1 kg sucrose). T2: (1 kg pear whole fruit, 400 gram fructose). T3: (1 kg pear whole fruit, 400 gram fructose and 5%ginger fresh). T4: (1 kg pear whole fruit, 400 gram fructose and 1% cinnamon powder). T5: (1 kg pear whole fruit, 400 gram fructose, 1% cinnamon powder and 5%ginger fresh).

However, the maximum value of total yeast and mould was obtained by T_1. Data in table(11) revealed that total count of yeast and mould for different treatments took the following desending order: T_1, T_2, T_4, T_3 and T_5. These findings agreement with Vidya and Narain (2011) who indicated similar results in wood apple jam. Also, in table (11) this results is likely due to the presence of ginger and cinnamon, which act as a natural preservative for the jam in T_4, T_3 and T_5 according to Djikeng *et al.* (2022) who found that ginger root extract's ability to preserve food makes it a perfect substitute for the artificial antioxidants used in palm olein. Owing to its nutritional and biofunctional qualities, ginger (*Zingier* *officinale*) is a spice that is used extensively around the world. The primary constituents of ginger that contribute to its nutritional value and biofunctional qualities are gingerols, zingerones, and shogaols. Ginger gives meals flavor and perfume and increases the absorption of nutrients. It is an natural preservative that enhances the food's organoleptic qualities and adds visual appeal. Many bioactive phytochemicals, including flavonoids, phenolic acid, terpenes, lipids, organic acids, vitamins, and fiber, are found in ginger. The various biological effects of ginger, including its anti-inflammatory, antibacterial, anticancer, neuroprotective, cardiovascular, respiratory, anti-obesity, antidiabetic, antinausea, and antiemetic qualities, are attributed to these substances (Ersedo *et al.,* 2023). The results of this study also demonstrated the impact that products with high cinnamon powder ratios had on microbial development during storage, indicating that they can be utilized as a preservative against microbial contamination. It can therefore be used in place of conventional food preservatives (Saber, 2019). Antioxidants shield cells from harm and play a significant role in preventing undesirable changes in food flavor and nutritional quality (Alezandro *et al.,* 2011& Kaskatepe *et al.,* 2016).

Conclusion

The utilization of fructose, ginger, and cinnamon in the production of pear jam was proven to be efficient, producing jam-filled final product properties a taste and flavour similar to conventional jam while being low in calories. Low-calorie values may be satisfying for diabetics or persons on a limited diet, as well as people who are trying to maintain their weight.

The statistical analysis revealed that storage intervals and treatments significantly ($p<0.05$) influenced on pH, moisture, TSS, reducing and non-reducing sugars, ascorbic acid, and general acceptability of diet pear jam.

References

Abebe, P., Z. Asfaw, T. Bekele, M. Agize, 2018. Diversity, Use and Conservation of Spices and Condiments in the Home Gardens (Derkuwa) of Konta Special District (Woreda), Southern Ethiopia. Int. J. Curr. Res. Acad. Rev. 6(3): 27–42. DOI: 10.20546/ijcrar.2018.603.006.

Abolila, R.M., H. Barakar, H.A. El-Tanary, and H. El-Mansy, 2015. Chemical, nutritional and organoleptical characteristics of orange-based formulated low-calorie jams. Food Nutr. Sci., 6:1229-44.

Akagić, A., A. Oras, F. Gaši, M. Meland, P. Drkenda, S. Memić, N. Spaho, S.O. Žuljević, I. Jerković, O. Musić, and M. Hudina, 2022. A Comparative Study of Ten Pear (*Pyrus commun*is L.) Cultivars in Relation to the Content of Sugars, Organic Acids, and Polyphenol Compounds. Foods (Basel, Switzerland), 11(19): 3031. https://doi.org/10.3390/foods11193031

Alezandro, M. R., M. C. Y. Lui and F. M. Lajolo and M. I. Genovese, 2011. Commercial spices and industrial ingredients: evaluation of antioxidant capacity and flavonoids content for functional foods development. Cienc. Tecnol. Food, 31 (2): 527-533.

Ali, K., A. Meredith and H. Thomas, 2013. Techniques for analysis of plant phenolic compounds. Molecules, 18: 2328-2375.

Anjum F.M., I.A. Maqam-ud-din and A.R. Pasha, 2000. Preparation and evaluation of diet apricot jam. Pak. J. Food Sci., 10(3-4): 21-23.

Anwar, F., U. Kalsoom, B. Sultana, M. Mushtaq, T. Mehmood, and H.A. Arshad, 2013. Effect of Drying Method and Extraction Solvent on the Total Phenolics and Antioxidant Activity of Cauliflower (*Brassica Oleracea* L.) Extracts. Int. Food Res. J., 20(2): 653–659

Association of Official Analytical Chemists (AOAC). 2007. Official methods of analysis. 18th ed. Gaithersburg, MD: Association of Official Analytical Chemists.

AOAC., 2019. Official methods of analysis. 21st Ed., Gaithersburg, MD: Association of Official Analytical Chemists. ISBN: 0-935584-89-7

Ashaye, O.A. and T.O. Adeleke, 2009. Quality Attributes of Stored Roselle Jam. Int Food Res J, 16: 363-71.

Bean, M.M. and C.S. Setser, 1992. Polysaccharides, sugars, and sweeteners in Bowers J. (ed), Food theory and applications. Macmillan Publishing, New York, 69- 198.

Davis, E., 1995. Functionality of Sugars: Physicochemical Interactions in Foods. Am J. Clin. Nutr., 62: S170- S177.

Djikeng, F.T., H.M. Womeni, M.S.L. Karuna, B. Tiencheu, A.U. Achidi, M. Linder, and R.B.N. Prasad, 2022. Preservative Effect of Ginger Root (*Zingiber officinale* R.) Extract in Refined Palm Olein Subjected to Accelerated Thermal Oxidation. Journal of Food Quality. https://doi.org/10.1155/2022/3388201

Duffy, V. and M. Sigman-Grant, 2004. Position of the American Dietetic Association: Use of nutritive and nonnutritive sweeteners. J. Am. Diet. Assoc., 104: 255- 275.

Ehsan, E.B., Z.P. Naeem, A. Javed, and A. Nazir, 2003. Development, standardization and storage studies on grape fruit apple marmalade. Pak. J. Food Sci., 13 (3-4): 11-15.

Ehsan, E.B., Z.P. Naeem, A. Ghafoor, and M.S. Bahtti, 2002. Development, standardization and storage studies on watermelon lemon jam. *Pak. J. Food Sci., 12 (3-4): 21-24.*

Ersedo, T.L., A. Tilahun, T.A. Tekab, S.F. Forsidob, E. Dessalegnc, J.A. Adebod, M. Tamirue, and T. Astatkie, 2023. Food flavor enhancement, preservation, and bio-functionality of ginger (*Zingiber officinale*): a review. International Journal of Food Properties, 26(01): 928–951. https://doi.org/10.1080/10942912.2023.2194576.

Frontini, A., C. Negro, R. Accogli, F. Minonne, A. Luvisi and L. De Bellis, 2024. Valorization of a Local Italian Pear (*Pyrus communis* L. cv. 'Petrucina'). Foods. 13(10):1528. https://doi.org/10.3390/foods13101528

Ghasemzadeh, A. and H.Z.E. Jaafar, 2012. Effect of salicylic acid application on biochemical changes in ginger (*Zingiber officinale* Roscoe) J. Med. Plants Res, 6:790–795.

Gupta, S., N. Gupta, and D.P. Kour, 2023. Nutritional Profile, Uses and Health Enhancing Properties of Pears. Article ID: 40003. Agriculture and food E-Newsletter, 5(1): 8-10.

Hallfrisch, J., 1990. Metabolic effects of dietary fructose. FASEB J, 4: 2652-2660.

Hanover, L. and J. White, 1993. Manufacturing, Composition, and Applications of Fructose. Am. J. Clin. Nutr., 58: S724-S732.

Harrigan, W.F., 1998. Laboratory Methods in Food Microbiology-3rd Edition. London. Academic Press Limited, 532.

Henry, R., P. Crapo, and A. Thorburn, 1991. Current issues in fructose metabolism. Annu. Rev. Nutr., 11: 21-39 .

Huang, T.H.B.P., V. Kota, V. Razmovski, and B.D. Roufogalis, 2005. Herbal or natural medicines as modulators of peroxisome proliferator-activated receptors and related nuclear receptors for therapy of metabolic syndrome. Basic Clin. Pharmacol. Toxicol. 96(1):3-14. doi: 10.1111/j.1742-7843.2005.pto960102.x. PMID: 15667590.

Hussain, I. and I. Shakir, 2010. Chemical and organoleptic characteristics of jam prepared from indigenous verities of apricot and apple. World Journal of Dairy and Food Sciences, 5(1): 73-78.

Hussain, S.Z., B. Naseer, T. Qadri, T. Fatima, and T.A. Bhat, 2021. Pear (*Pyrus communis*) Morphology, taxonomy, composition and health benefits. , Fruits grown in highland regions of the Himalayas (35–48). *Springer International Publishing*.https://doi.org/10.1007/978-3-030-75502-7_3.

James-Martin, G., G. Williams, W. Stonehouse, N. O'Callaghan, and M. Noakes, 2015. Health and nutritional properties of pears (pyrus) : a Literature review. Food and nutrition flagship. www.csiro.au.

Jayaprakasha, G.K. and L.J. Rao, 2011. Chemistry, biogenesis, and biological activities of *Cinnamomum zeylanicum*. Crit. Rev. Food Sci. Nutr. , 51: 547-562.

Kanwal, N., M.A. Randhawa and Z. Iqbal, 2017. Influence of processing methods and storage on physico-chemical and antioxidant properties of guava jam. International Food Research Journal (IFRJ), 24(5): 2017-2027.

Kaskatepe, B., M. E. Kiymaci, S., Suzuk, S.A., Erdem, S., Cesur, and S. Yildiz, 2016. Antibacterial effects of cinnamon oil against carbapenem resistant nosocomial Acinetobacter baumannii and Pseudomonas aeruginosa isolates. Industrial Crops and Products. 81 : 191–194. doi: 10.1016/j.indcrop.2015.11.058

Khan, R.U., R. Afridi, I. Muhammad, S. Muhammad, and A. Hamida, 2012. Development of strawberry jam and its quality evaluation during storage. Pak J Biochem. Mol. Biol., 45: 23-5. https://api.semanticscholar.org/CorpusID:114701793.

Khan, S.H., A.S. Shah, M. Bilal, A. Khan, M.U. Ali, S. Rani, F.N. Shah, and R. Naz, 2015. Comparative studies on the shelf stability of different types of apple jams. Pak. J. Food Sci., 25: 37-42.

Khan, R.S., W. Asghar, N. Khalid, W. Nazir, M. Farooq, I. Ahmed, and Q.A. Syed, 2019. Phalsa (*Grewia asiatica* L) Fruit Berry a Promising Functional Food Ingredient: A Comprehensive Review. J. Berry Res. 9(2): 179–193. DOI: 10.3233/JBR-180332.

Kolniak-Ostek, J., D. Klopotowska, K. Rutkowski, A. Skorupińska, and D. Kruczynska, 2020. Bioactive Compounds and Health-Promoting Properties of Pear (*Pyrus communis* L.) Fruits. Molecules. 25(19):4444. DOI:10.3390/molecules25194444

Lima, D.M., P. Fernandes, D.S. Nascimento, R.C.L.F. Ribeiro, and S.A.D. Assis, 2011. Fructose syrup: A biotechnology asset. Food Technol Biotech, 49: 424-434.

Lustig, R.H., 2010. Fructose: Metabolic, hedonic, and societal parallels with ethanol. J. Am. Diet. Assoc., 110: 1307-1321.

Meilgaard, M.C., G.V. Civille, and B.T. Carr, 2007. Sensory evaluation techniques. 4th ed. eBook ISBN:9780429195143, New York: C.R.C. Press. doi: https://doi.org/10.1201/b16452

Mendonca, C.R., R.C. Zambiazi, M.A. Gularte, and G.G. Granada, 2005. Caracterısticassensoriais de compotas de pessego light elaboradas com sucralose e acesulfame-k. Ciencia e Tecnologia de Alimentos, 25: 401–407.

Menezes, C.C., S.V. Borges, F.Q. Ferrua, C.P. Vilela, and J.D.S. Carneiro, 2011. Influence of packaging and potassium sorbate on the physical, physicochemical and microbiological alterations of guava preserves. J. Food Science and Technology, 31(3): 674-680.
DOI: 10.1590/S0101-20612011000300019.

Muhammad, A., Y. Durrani, A. Zeb, M. Ayub, and J. Ullah, 2008. Development of diet jam from apple grown in swat (NWFP). Sarhad Journal of Agriculture, 24(3): 461-467.

Patel, N.V. and A.G. Naik, 2013. Studies on standardization of pulp proportion for banana-pineapple blended jam during storage. Int. J. Processing Post harvest Technol., 4: 63-9.

Priya, B., Shankar and R. Murari, 2010. Optimization of process for mixed fruit jam using sweeteners. Beverage and Food World, 37: 56-8.

Rababah, T.M., M.A. Al-Mahasneh, I. Kilani, W. Yang, M.N. Alhamad, and K. Ereifej, 2011a. Effect of jam processing and storage on total phenolics, antioxidant activity and anthocyanins of different fruits. Journal of the Science of Food and Agriculture, 91(6): 1096- 1102.
doi: 10.1002/jsfa.4289. Epub 2011 Jan 19. PMID: 21254073.

Rababah, T.M., M.H. Al-u'datt, M.A. Al-Mahasneh, H. Feng, M. Abdulaziz, A. Alothman, W. Almajwal-Yang, I. Kilani, M.N. Alhamad, K. Ereifej, and M. Abu-Darwish, 2011b. Effect of storage on the physicochemical properties, total phenolic, anthocyanin, and antioxidant capacity of strawberry jam. Journal of Food Agriculture and Environment, 9(2): 101-105.

Ranasinghe, P., S. Pigera, G.A. Premakumara, P. Galappaththy, G.R. Constantine, and P. Katulanda, 2013. Medicinal properties of 'true' cinnamon (*Cinnamomum zeylanicum*): a systematic review. BMC Complement Altern Med, 13:275. doi: 10.1186/1472-6882-13-275.

Rangana, S., 2008. Hand book of analysis and quality control for fruit and vegetable products. 2nd ed. New Delhi: Tata McGraw Hill Pub. Co. Ltd.

Ranganna, S., 1986. Handbook of Analysis and Quality control of fruit and vegetable product (2nd edition). Tata McGraw Hill Publication Corporation limited, New Delhi, 1112.

Rao, P.V. and S.H. Gan, 2014. Cinnamon: a multifaceted medicinal plant. Evidence-based complementary and alternative medicine : https://doi.org/10.1155/2014/642942.

Relekar, P.P., A.G. Naik and B.V. Padhiar, 2011. Qualitative changes in value added product of sapota (Manilkaraachras) CV. Kalipatti during storage. Indian J Horti, 68:413-8.

Riaz, M.N., G. Mohyuddin and M.I. Al Haq, 1999. Physical chemical and sensory characteristics of jams made from fresh and frozen strawberries. *Pak. J. Arid. Agric., 2 (1): 51-60.*

Roufogalis, B.D., 2014. *Zingiber officinale* (ginger): a futureoutlook on its potential in prevention and treatment of diabetes and pre diabetic states. New J. Sci. https://doi.org/10.1155/2014/674684.

Saber, J.I., 2019. Utilization of Cinnamon in Preparation and Preservation of Food Products from Microbial Contamination. Alexandria Science Exchange Journal, 40(January- March), 82-89. doi: 10.21608/asejaiqjsae.2019.28598.

Safdar, M.N., A. Mumtaz, T. Hameed, N. Siddiqui, S. Khalil, and M. Amjad, 2012. Storage studies of jam prepared from different mango verities. Pakistan Journal of Nutrition, 11(7): 555-561.

Schved, F. and B. Hassidov, 2008. Fructose: a high quality sweetener - Flavour enhancing, calorie-reduction and impact on glycemic load. Agro Food Ind Hi Tec., 19: 26-28.

Senanayake, U.M., T.H. Lee, and R.B.H. Wills, 1978. Volatile constituents of cinnamon (*Cinnamomum zeylanicum*) oils. J. Agric Food Chem., 26:822–824.

Shah, W., A. Khan, Z. Alam, M.A. Khan, F.N. Shah, M. Ali, N.U. Amin, M. Ayub, W. Wahab, A. Muhammad, and S.H. Khan, 2015. Global Journal of Medical Research:L Nutrition & Food Science, Global Journal of Medicinal Research: L Nutrition and Food Science, 15:15-21.

Shakir, I., Y. Durrani, I. Hussainm, I.M. Qazi, and A. Zeb, 2007. Physicochemical analysis of apple and pear mixed fruit jam prepared from varieties grown in azad Jammu and Kashmir. Pakistan Journal of Nutrition, 7(1): 177-180.

Shimada, K., K. Fujikawa, K. Yahara, and T. Nakamura, 1992. Antioxidative properties of xanthan on the autoxidation of soybean oil in cyclodextrin emulsion. Journal of Agricultural and Food Chemistry, 40 (6): 945–948.

Shu, Z., L. Xiwen, L. Jie, and H. Van-der Werff, 2008. Cinnamomum Schaeffer, Bot. Exped., 74. 1760, nom. cons. Flora. China.7:166–187.

Singh, G., S. Maurya, M.P. De-Lampasona, and C.A. Catalan, 2007. A comparison of chemical, antioxidant and antimicrobial studies of cinnamon leaf and bark volatile oils, oleoresins and their constituents. Food Chem. Toxicol., 45:1650–1661.

Singleton, V.L., R. Orthofer, and R.M. Lamuela-Raventons, 1999. Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin- Ciocalteu reagent. Methods in Enzymology, 299: 152- 178. http://dx.doi.org/10.1016/S0076-6879(99)99017-1.

Slavin, J.L. and B. Lloyd, 2012. Health benefits of fruits and vegetables. Advances in nutrition (Bethesda, Md.), 3(4): 506–516. https://doi.org/10.3945/an.112.002154.

Steel, R.G.D., J.H. Torrie, and D.A. Dicky, 1997. Principles and Procedures of Statistics, A Biometrical Approach. 3rd Edition, McGraw Hill, Inc. Book Co., New York, 352-358.

Sun, N.N., T.Y. Wu, and C.F. Chau, 2016. Natural Dietary and Herbal Products in Anti-Obesity Treatment. Molecules, 11, 21(10):1351. doi: 10.3390/molecules21101351.

Sutwal, R., J. Dhankhar, P. Kindu, and R. Mehla, 2019. Development of Low Calorie Jam by Replacement of Sugar with Natural Sweetener Stevia. Int. J. Cur. Res. Rev., 11: 04.

Torezan, G.A.P., 2002. Comparison between mango Jam with no sugar addition obtained by a continuous process and conventional jam processed in open vats. Dept. of Food Tech. Univ. of Compinas 13083970, Brazil.

Unuofin, J.O., and S.L. Lebelo, 2020. Antioxidant Effects and Mechanisms of Medicinal Plants and Their Bioactive Compounds for the Prevention and Treatment of Type 2 Diabetes: An Updated Review. Oxid. Med. Cell Longev. 1356893. DOI:10.1155/2020/1356893.

Van der Heijden, A., L. Brussel, J. Heidema, J. Kosmeijer, and H. Peer, 1983. Interrelationships among synergism, potentiation, enhancement and expanded perceived intensity vs concentration. J Food Sci., 48: 1192-1196 and 1207.

Vidhyam, R. and A. Narain, 2011. Development of preserved products using exploited fruits, wood apple (*Limonia acidissima*). Americ. J. Food Technol., 6: 279-88.

Wang, Z., C.J. Barrow, F.R. Dunshea, and H. Suleria, 2021. A Comparative Investigation on Phenolic Composition, Characterization and Antioxidant Potentials of Five Different Australian Grown Pear Varieties. Antioxidants (Basel, Switzerland), 10(2), 151.
https://doi.org/10.3390/antiox10020151.

White, B., 2007. Ginger: an overview.Am.Fam.Phys.75:1689–1691.

WHO and FAO., 2003. Diet, nutrition and the prevention of chronic diseases. Report of a Joint WHO/FAO Expert Consultation, World Health Organization, Geneva, Switzerland.

Zick, S.M., Z. Djuric, M.T. Ruffin, A.J. Litzinger, D.P. Normolle, S. Alrawi, M.R. Feng and D.E. Brenner, 2008. Pharmacokinetics of 6-gingerol, 8-gingerol, 10-gingerol, and 6-shogaol and conjugate metabolites in healthy human subjects. Cancer Epidemiol. Biomarkers Prevent, 17(8):1930-1936. doi: 10.1158/1055-9965.EPI-07-2934.