

Production and quality evaluation of dates-pumpkin jam for pre-school children

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Abstract

The main goal of this study was to develop a well-balanced jam with high quality and nutritional value from dates fruits and pumpkin for pre-school children to improve their health and nutritional status. The developed product was subjected to physicochemical, chemical, color, nutritional, sensory and statistical evaluations. From the main results obtained in this study, the newly developed jam product was found to have high quality and appreciable amounts of minerals (650.56 K, 126.06 Ca, 4.21 Fe and 1.24 Zn mg/100 g), beta-carotene (175.4 µg/100 g) and energy contents (307.26 kcal/100 g) to meet partially the daily-recommended nutrients for young children. In addition to that, the product was found within the recommended levels of total soluble solids (70.19%), pH (3.33), acidity (0.79%) and viscosity (1806 Cp) of jam specifications and was highly preferred by the panelists. Therefore, it can be concluded that the newly developed jam product could be used as a healthy food for young children to reduce their energy, minerals and vitamin deficiencies in young children, especially in the Kingdom and other Gulf countries.

1. Introduction

Date palm (*Phoenix dactylifera* L.) is one of the oldest fruit crops grown in the arid regions of the Arabian Peninsula, North Africa, and the Middle East, where it is considered as staple food. The Kingdom of Saudi Arabia in 2019 was considered the third largest date producer worldwide (FAOSTAT, 2019), producing approximately 1.5 million tons. However, there are more than 400 date palm varieties (*Phoenix dactylifera* L.) in the Kingdom, of which only about 40 varieties with an economic value, spread in 7 Saudi provinces: Al-Riyadh, Qassim, Eastern province, and Medina which are the most famous production areas in the Kingdom. Sukkary, Saqee, Ekhlash, Ajwa, Barhee, Anbara, Safawi, Rothana, Rashodya, and Khedry are the most well-known cultivars in the KSA (Al-Redhaiman, 2014). According to Assirey (2015) and Chao and Krueger (2016), date fruit contains a wide range of essential nutrients, such as sugars (44-88%), fibers (6.4-11.5%), proteins (2.3-5.6%) and minerals. Moreover, it is very rich in different bioactive compounds, such as phenols, sterols, vitamins, carotenoids, and natural pigments, such as chlorophyll, anthocyanin and flavonoids. Moreover,

fruit is considered a reasonable source of vitamins, such as thiamin, riboflavin, niacin, ascorbic acid, pyridoxine and provitamin A (Beta-carotene).

On the other hand, pumpkin vegetables, which are members of the *Cucurbitaceae* family, are usually eaten fresh, cooked as vegetables or used as ingredients in pies, soups, sweets, marmalades, beverages or in children's foods. Pumpkin and its squash are also considered excellent sources of carotenoids (vitamin A), flavonoids, polyphenols, antioxidants and minerals, such as Ca, K, P, Zn and Fe (Rachel and Kabelka, 2009; Yadav *et al.*, 2010). Ahmed *et al.* (2022) investigated a comparative study of jam processing from pumpkin with sugarcane and pumpkin with date juice. The author stated that the chemical composition of the pumpkin and its antioxidant content makes it an important food product for human consumption. The carotenoids content in pumpkin vegetables give them their distinctive yellow-orange hue. In general, fruits and vegetables are very important healthy foods, as they provide the body with essential needs, such as vitamins, polyphenols, antioxidants, sterols, minerals and other substances that

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boost the immune system and prevent faster aging, cell damage and diseases (Dror and Allen, 2011; Chambial *et al.*, 2013; Jones *et al.*, 2018). In fact, polyphenols also play significant roles in keeping blood vessels flexible to provide excellent health, promoting blood and nutrient circulation throughout the body (Cory *et al.*, 2018). Cory *et al.* (2018) also stated that polyphenols have anticancer, anti-obesity and antioxidant functions. In addition, they reduce chronic swelling and regulate blood pressure and sugar in the human body. Accordingly, the supplementation of staple fruit crops with vegetables can be as a new public health approach to control vitamins, minerals and energy deficiencies among young children.

Therefore, this study was to develop a well-balanced jam with high quality and nutritional value from dates fruits and pumpkin for pre-schoolchildren to improve their health and nutritional status. Moreover, it can be of great help for young children suffering from mineral, vitamin and energy deficiencies. In fact, local production of date-based children food from local raw materials in the Kingdom will not only encourage the industrial utilization of date fruits for the production of different date-based food products inside the Kingdom but also save funds that are typically spent importing these food products from outside the country. In addition, it makes the product more available with a low price to be affordable for families of all young children inside the Kingdom. In particular, available nutritional data have confirmed that nutritional anemia, vitamin-A and vitamin-D deficiencies, in addition to inadequate intakes of calcium, zinc, and folic acid, and high intakes of fat, saturated fatty acids and sugars have been recorded among children in the Kingdom and Gulf region (Nasreddine *et al.*, 2018).

2. Materials and methods

2.1 Materials

Samples of sound ripe dates (*Phoenix dactylifera* L.), the Sukary cultivar, were obtained from the Farm of Date Palm Research Center of Excellence, King Faisal University, during the harvesting season (2020/2021). The pumpkin vegetable sample was purchased from a Central Market in Al-Hassa Governorate, Eastern Province, Saudi Arabia Kingdom. The two samples were tightly kept in polyethylene bags and stored at -18°C until they were required for different investigations.

2.2 Experimental jam processing

After cleaning and washing the dates and pumpkin, 2 kg of dates were boiled in water (5 L) for 30 mins in a steel kettle, blended with an electric blender and filtered

to remove date peels and seeds. On the other hand, 1 kg of peeled pumpkin was boiled at 100°C in 2 L of water for 30 mins, blended with an electric blender and added to the previously prepared date fruit blend. Then, the pH value and the total soluble solids (TSS) of the mixed blend were checked to calculate the required amounts of citric acid, pectin and sugar for jam processing. Afterwards, the dates-pumpkin was mixed and blended (6.40 kg) with the required amount of sugar (7.68 kg) and placed in a steel kettle. The mixture was quickly cooked until the TSS reached 64°Brix . Then, citric acid (64 g) and pectin (91 g) were added and mixed under continuous agitation and cooking until the percentage of the mix reached 68°Brix . The final dates-pumpkin hot mixture was divided into two parts. The first part was hot filled without adding any flavor into sterilized dried glass jars (200 g) and defined as dates-pumpkin jam product without flavor, while the second part was filled hot after adding pineapple flavor and defined as dates-pumpkin jam product with pineapple flavor. Both two jam products were tightly closed, left to cool at room temperature and stored in a refrigerator until further investigation. Table 1 shows the dates-pumpkin jam recipe while Figure 1 indicates its processing method and conditions used in this study.

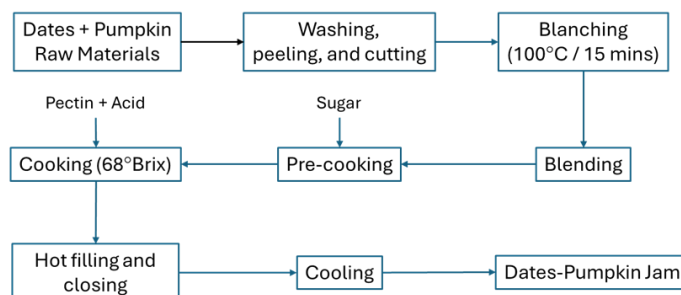


Figure 1. Flow processing chart of dates-pumpkin jam product.

Table 1. Dates-pumpkin jam recipe.

Ingredients	(%)
Dates-pumpkin blend	44.96
Sugar	53.95
Pectin	0.65
Citric acid	0.45
Total	100

2.3 Physiochemical analysis

The hydrogen ion concentration (pH) of the different samples was measured using a pH meter (No.478530, Hanna, India), while their total soluble solids were determined by using a hand refract meter (No. 002603, BS-eclipse, UK) as described by Ranganna (2001). The apparent viscosity as centipoises (CP) of the different samples was determined by using a Brookfield viscometer (Visco-Basic plus R, Spain) as mentioned by Quinn *et al.* (1975).

The colors of the dates-pumpkin jam were

determined by using a Hunter color meter (Hunter Lab Reston Mini Scan EZ, USA). The instrument was calibrated by using standard black and white tiles. Then, the sample was placed in a standard cup, and the color values were recorded as L^* , a^* , b^* . The L^* value is the lightness factor that gives values ranging from (0) for black to (100) for white color. The (a^*) value indicates the degree of greenness-redness (ranging from -60 to 0 for green and from 0 to +60 for red), and the b^* value indicates the blueness-yellowness (ranging from - 60 to 0.0 for blue and from 0.0 to + 60 for yellow). Five readings of each sample were taken from different sides according to Al-Jasass *et al.* (2015).

2.4 Proximate composition analysis methods

Moisture, protein, fat, ash, total sugar, reducing sugar, non-reducing sugars, and acidity in the different samples were determined in accordance with the standard methods of the Association of Official Analytical Chemists (AOAC) (2010). Vitamin A was determined in the jam ether extract by using a UV spectrophotometer (Model CPS-2404, CAT No206-23760-34, Japan) at a wavelength of 325 nm as described by the ASEAN (2011).

2.5 Minerals analysis

The trace elements ferrous (Fe^{++}) and zinc (Zn) were determined according to Barnes (1997) by using atomic absorbance spectroscopy (JENWAY 3110, UK). Sodium (Na) and potassium (K) were determined by using a flame photometer (Model PEP7 JENWAY). Calcium (Ca) was determined as described by Chapman and Parratt (1961).

2.6 Food energy value

The energy value of dates-pumpkin jam products was calculated based on Atwater factors as mentioned by Leung (1968).

2.7 Sensory evaluation

In this method, dates-pumpkin jam products were sensory evaluated by using fourteen children's mothers as panelists from the Department of Food and Nutrition Sciences, College of Agricultural and Food Sciences, King Faisal University. The panelists were asked to evaluate the jam products with respect to their taste, flavor, consistency, color, appearance and overall quality, following 5 quality Hedonic scales ranging from 1 (dislike very much) to 5 (like very much).

2.8 Statistical analysis

The results obtained in this study were subjected to Statistical Analysis System (SAS) by using One-way

Analysis of Variance (ANOVA) to compare means of sensory characteristics of dates-pumpkin jam samples at a 5% significant level. The mean values were also tested and separated by using Minitab®19.2020.1 software.

3. Results and discussion

3.1 Processing of dates-pumpkin jams

Jam processing is considered a fruit preservation method (Kansci *et al.*, 2003). It is usually produced as a solid gel made by cooking fruit or vegetable pulps or in combination with sugar and pectin in the presence of citric acid. In mixed fruit jams, the first-named fruit should be at least 50% of the total fruit added, and the jam sugar content should be not less than 68% according to the International Center for Underutilized Crops (ICUC) (2004). After production of the dates-pumpkin jam by using the recipe in Table 1, the product was immediately subjected to the following evaluation analyses.

3.2 Physicochemical characteristics

Table 2 shows the physicochemical characteristics of the dates-pumpkin jams obtained in this study. From the results, the total soluble solids (TSS %), hydrogen ions (pH), acidity as citric acid and viscosity as centipoises (CP) were found to be 70.19%, 3.33, 0.07 and 1806 (CP), respectively. Javanmard (2010) reported that a good jam should contain total soluble solids, pH and acidity of 67 - 70%, 3.2-3.4 and 0.3-0.8%, respectively. The results obtained in this study also agree well with those reported by Onsa (2007) and ICUC (2004).

Table 2. Physicochemical characteristics of the dates-pumpkin jam in comparison with the recommended standard specifications.

Parameter	Value	* Recommended levels
Total soluble solids (%)	70.19 0.64	67-70%
Hydrogen ions concentration (pH)	03.33±0 07	3.2 - 3.4
Acidity% (as citric acid)	0.7 9±0.03	0.3 - 0.8
Viscosity (CP)	1806	-

*Javanmard (2010).

On the other hand, the color of jam products is an important quality parameter for consumer acceptability and one of the main factors that reflect the concentration of jam raw materials and their physical and chemical characteristics. Table 3 shows the values of the Hunter Lab color meter parameters of the dates-pumpkin jam, which were expressed as $L^*a^*b^*$. Five replicate measurements were taken from the sample from different directions.

In fact, the instrumental color measurements showed that the dates-pumpkin jam had positive values of L* (22.73), a* (29.36) and b* (39.13), classifying the product as slightly red with intensive yellow coloration. The yellow color may be due to the pumpkin color, which is very rich in carotenoid pigments.

Table 3. Color determination of dates-pumpkin jam

Sample	L*	a*	b*
Dates-pumpkin Jam	22.73±2.83	29.36±1.30	39.13±4.76

Values are presented as mean±SD of 5 replicates.

3.3 Chemical composition and energy value of dates-pumpkin jam

Table 4 presents the chemical composition and energy value of the dates-pumpkin jam product produced in this study. The product was found to have high levels of total sugars (70.19%), non-reducing sugars (49.57%) and reducing sugars (20.62%) but low levels of protein (03.76%), fat (00.91%) and ash (00.27%), on a wet basis. The ratio of its reducing sugars to its total sugars was approximately 29.4%, as recommended by Onsa (2007), who mentioned that good quality jams should have reducing sugars between 20-28% or 28-2%, in comparison to their total sugar content. In addition, the product was found to provide an adequate energy value (307.26 kcal/100 g), which represents approximately 24-17.1% of the daily energy required for children between 3 and 6 years old, which was recommended by the USA Institute of Medicine (2001) to be between 1300 and 1800 kcal/day.

Table 4. Chemical composition and energy value of the dates-pumpkin jam.

Chemical composition and energy value	Dates-pumpkin jam
Moisture content (%)	22.81±0.24
Protein (%)	03.76±0.01
Fat (%)	00.91±0.01
Total sugars (%)	70.19±0.88
Reducing sugars (%)	20.62±0.22
Non-reducing sugars (%)	49.57±0.68
Ash (%)	00.27±0.01
Energy value (kcal/100 g)	307.26
Energy value (kJ/100 g)	1285.58

Values are presented as mean±SD of 3 replicates.

3.4 Minerals and vitamins

Table 5 indicates the mineral and vitamin content of the dates-pumpkin jam product in comparison with the recommended daily intake of nutrients for preschool children suggested by the USA Institute of Medicine (2001). The jam produced in this study was found to provide adequate amounts of potassium (650.56 mg), calcium (126.06 mg), iron (4.21 mg), zinc (1.24 mg), manganese (1.15 mg) and vitamin A, per 100 g. Which

represents approximately 81.32%, 21.0 - 25.21%, 42.10 - 60.14%, 24.8-41.33, 50.0 - 62.5%, and 43.85 - 58.47%, respectively, in comparison with the recommended daily intake of nutrients suggested by the USA Institute of Medicine (2001). Also, Booth (2001) reported the recommended daily allowance of vitamin A for infants and young children between 350-400 µg. /day. In fact, vitamin A is a very important vitamin for normal growth, vision, gene expression, reproduction, embryonic development and immune function. The current dates-pumpkin jam product appears to provide a sufficient amount of vitamin A (175.4 µg /100 g) to help in preventing vitamin A deficiency symptoms, such as night blindness. According to the USA Institute of Medicine (2005), supplementation with vitamin A reduces the risk of mortality among young children in developing countries.

On the other hand, Elleuch *et al.* (2008) reported that the high potassium and low sodium contents in date fruits are useful for people suffering from hypertension. The results of the mineral contents in the current jam product agree well with those reported by Assirey (2015), who reported that date fruits have high concentrations of potassium (289.60 - 512.00 mg), calcium (123.00 -187.00 mg), and low concentrations of sodium (4.90 - 8.90 mg) per 100 g of date fruit pulp.

Table 5. Minerals and vitamins content of the dates-pumpkin jam in comparison with the recommended daily allowances for preschool children.

Minerals	Concentration (mg/100 g)	Recommended daily allowance (mg/day)*
Sodium (Na)	5.44	-
Potassium (K)	650.56	800
Calcium (Ca)	126.06	500 - 600
Iron (Fe)	4.21	7 - 6
Zinc (Zn)	1.24	3 - 5
Manganese (Mn)	0.75	1.2 - 1.5
B- Carotene (µg /100 g) (Pro-vitamin A)	175.4	300 - 400/day

*USA Institute of Medicine (2001).

3.5 Sensory evaluation

Table 6 and Figure 2 indicate the quality characteristics of two dates-pumpkin jams (with and without pineapple flavor) produced in this study. The sensory evaluation tests were conducted by 14 children's mothers as panelists from the Department of Food and Nutrition Sciences, College of Agricultural and Food Sciences, King Faisal University, KSA. The panelists were asked to evaluate the two dates-jam products with respect to their taste, flavor, consistency, color, appearance and overall quality. The results obtained in this study confirmed no significant differences between the two samples with respect to their quality attributes,

Table 6. Sensory evaluation of dates-pumpkin jams.

Dates-pumpkin Jam	Taste	Flavor	Texture	Color	Appearance	Overall
Flavorless	4.3±0.10 ^a	4.4±0.63 ^a	4.4±0.74 ^a	4.7±0.47 ^a	4.6±0.63 ^a	4.4±0.63 ^a
With Pineapple Flavor	4.6±0.76 ^a	4.5±0.76 ^a	4.6±0.50 ^a	4.7±0.47 ^a	4.5±0.76 ^a	4.4±0.93 ^a
T-value	1.10	0.54	1.19	0.00	-0.54	0.00
F-value	1.21	0.29	1.42	0.00	0.29	0.00
P-value	0.282	0.593	0.243	1.000	0.593	1.000

Values are presented as mean±SD of 14 replicates. Values with different superscripts within the same column are statistically significantly different ($p < 0.05$).

but the dates-pumpkin jam with pineapple flavor was highly preferred by the panelists, especially for its taste and flavor.

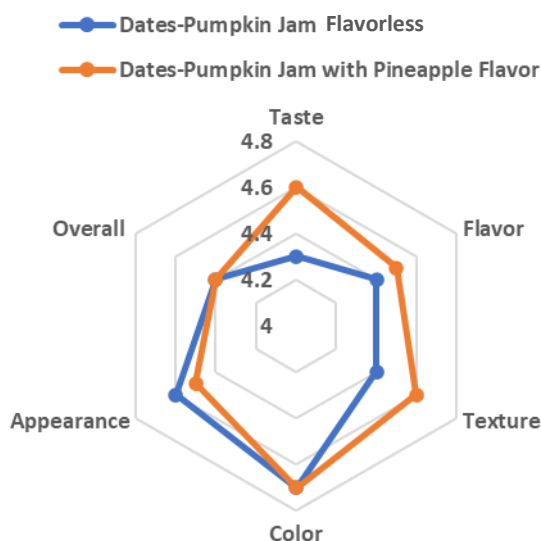


Figure 2. Sensory profile of dates-pumpkin jam

4. Conclusion

The results obtained in this study indicate that supplementation of date with pumpkin for the production of jam products, not only improves the nutritional and quality characteristics of the product but also renders the product to meet the recommended standard specification of jam products. Therefore, the product could be used as a healthy breakfast food for young children to improve their health and nutritional situation.

Conflict of interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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