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Research Article

The Use of Pumpkin and Melon Seeds Milk in The Field of Gastronomy

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Abstract

Consumers today want food that is not only natural, nutritious, and tasty but also produced with respect for the environment. Today, researchers are focusing on the development of alternative milk and dairy products from plant-based sources, as there are not enough milk sources, consumers have different dietary preferences (vegan/vegetarian diets) and allergens and sensitivities to dairy products (lactose intolerance). Vegetable milk products are products obtained by extracting fruit, vegetable, cereal or seeds with water. These products are rich in vitamins, minerals and fiber and are also known as functional foods. The seeds are a source of vitamins, minerals and proteins, which can make them a good substitute for milk, especially in areas with food shortages. In this study, it was aimed at obtaining milk from freeze-dried melon and pumpkin seeds, producing pudding with the obtained milk, and determining the sensory quality characteristics of the pudding. The total phenolic content and antioxidant activity values of the powder, milk and pudding samples were also determined. The highest antioxidant activity (45.11%) and the highest total phenolic content (1232 mg GAE/100 g) were found in melon seed powder. The pudding samples prepared from melon and pumpkin seed milk were rated as moderately/good acceptable products according to the score scale.

Keywords: Vegetable Milk, Melon Seed Powder, Pumpkin Seed Powder, Pudding

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Introduction

Population growth and environmental pollution have begun to limit access to food. Studies on the utilization of waste in food production have gained importance today. Food waste, which is primarily used as fertilizer or animal feed, has recently been increasingly used to produce food. The most economical and beneficial solution to avoid environmental damage, especially by reducing the carbon footprint, is to use food waste for food fortification [26]. With their highly effective nutrient composition, seeds contain sources such as protein, iron, fiber, vitamins, and omega 3, which are necessary for maintaining a healthy life. The nutritional properties of seeds have made them an important food in the diet [14].

In our country, pumpkin seeds are generally preferred to be consumed as salty nuts and are also used for variety in breakfast bars, baked goods, salads, and cakes. The oil extracted from pumpkin seeds is preferred as edible oil as well as nutraceuticals (nutrients and nutritional components prepared in the form of medicines and used for therapeutic purposes) [26]. Pumpkin seeds are rich in proteins, phytosterols, polyunsaturated fatty acids, antioxidants, vitamins (especially carotenoids and tocopherol), and minerals (potassium and magnesium) [17, 22, 28].

The melon, a member of the genus Cucumis from the Cucurbitaceae family, is a round or oval, fragrant, richly juicy fruit, usually yellow or orange in color. The first production of melons dates back 5000 years [16]. In the studies on the origin of the melon, some researchers refer to the cultivation areas as those of Central Asian Turks [13]. It is stated that melon seeds contain 30–40% fat, 15–25% protein, 15% fiber and the minerals potassium, calcium, magnesium, iron, copper, zinc and phosphorus [2]. In West Africa and Nigeria, it is consumed as a thickener, egusi soup, melon ball snacks and ogiri, a fermented condiment. In our country, melon seed milk, called sübye (pepitada), is traditionally consumed in Izmir [27]. It is also known that this plant milk is consumed as "melon milk" in Nigeria and Iran and as a "melon seed drink" in South America [24].

Plant-based milk production from legumes and seeds with a high oil content has been used since the 13th century. Today, with the realization of its nutritional richness, plant-based milk production has been developed and offered to consumers as a substitute for milk and dairy products. Vegetable milk, also called vegan mil, is a definition for products derived from plants that resemble milk but do not contain milk fat or important components of milk. Although these products do not have the content of dairy products, they are defined as an alternative product with similar sensory and functional properties, especially for people with lactose intolerance. These products are described as healthy alternative products with healthy fatty acids and carbohydrates as well as vitamins and antioxidants [23, 11].

There is no study in the literature on the use of powdered products obtained by freeze-drying pumpkin and melon seeds as a substitute for milk in a traditional product, the pudding dessert. In this study, it was aimed at obtaining milk from freeze-dried melon and pumpkin seeds, producing pudding with the obtained milk, and determining the sensory quality characteristics of the pudding.

Materials and Methods

Materials

Melon (*C. melo* subsp. *melo* cv. Kırkağaç) and pumpkin (*Cucurbita Moschata*) were obtained from a supermarket in Adana, Turkey. The seeds of the products obtained were sorted. Pumpkin seeds and melon seeds were stored at -24˚C. All drying experiments were completed within the 3 days. All solvents and chemicals were obtained from Sigma Aldrich (St. Louis, MO, USA).

Freeze Drying

Freeze drying of seeds was carried out at −55 °C for 48 h using a freeze dryer (FreeZone 6, Labconco, USA). After drying, the samples were grinded, packaged and stored.

Preparation of the seed milk

Melon and pumpkin seed milk was prepared according to the method described by [5], with some modifications to obtain a higher dry matter content, which was desirable for the drying process. 50 g of seeds were crushed in an electric blender (Sinbo, SCM2934, Türkiye) for one minute without adding water. Then 150 ml of tap water was added to the crushed seeds to mix them a second time. After adding water, the powder product was kept for 2 hours, and the mixture was filtered into a glass container using a sieve (212 µm). Then the residue was removed by adding 75 ml of tap water for mixing. The slurry was filtered again through a 212 µm sieve. After the fifth mixing and the third filtration process, the milk was finally obtained.

Production of Pudding

The pudding (muhallebi in Turkish) was made using traditional methods. The control pudding consisted of 200 mL of cow's milk, 34 g sugar, 5 g wheat starch, 8 g flour, and 2 g butter. Cow's milk was used for the formulation of the control pudding. Instead of cow's milk, 200 mL of melon seed milk was used for melon seed milk pudding and 200 mL of pumpkin seed milk for pumpkin seed milk pudding. The cooking time was set at 20 minutes.

Analysis

Moisture contents of freeze-dried powders and vegetable milks were determined by infrared moisture analyzer at 105˚C. A colorimeter (3NH colorimeter, China) was used for color measurements of (CIE L^*, a^* and b^* values). The bulk density (ρ_b) and tapped density (ρ_t) and porosity (ε) of samples were determined using the method reported by [15]. In addition, the particle density (ρ_p) of the powders was analyzed by a pycnometric technique with 2-propanol as previously reported by [4]. The flow characteristics of the powder samples were described as Carr index (CI) and Hausner ratio (HR) using equations (1) and (2), respectively [9,12]. The wettability and dispersibility of the powders were determined as reported by [15]. The solubility of the powders was performed as specified by [8]. Solubility (%) was calculated using the mass difference (after drying/initial weight).

$$CI = \frac{(\rho_t - \rho_b)}{\rho_t} \times 100. \quad (1)$$

$$HR = \frac{\rho_t}{\rho_b} \quad (2)$$

Samples (1 g) were extracted with 80% methanol (10 mL) in a shaking incubator (Mikrotest, MSC-30, Turkey) at 37 °C for 1 h. The mixtures were then centrifuged (PCE Instruments, CFE100, Germany) at 6000 rpm for 10 min, and the supernatants were collected. The total phenolic content (TPC) in the methanol extract of the samples was determined by the Folin–Ciocalteau method and the procedure reported by [1]. All spectrometric measurements were performed in triplicate. The calibration curve was prepared using gallic acid, and the results were expressed as gallic acid equivalents (mg GAE/ g dry weight). The antioxidant activity of the samples was measured using the DPPH (1,1-diphenyl-2-picrylhydrazyl) radical-scavenging method according to [7] with some modifications. The extracts (0.1 mL) were added to a 2.9 mL DPPH solution (100 ppm). The mixture was shaken vigorously and left in the dark at room temperature for 30 min. Then, the absorbance was measured at 517 nm. Percent inhibition of DPPH radical was calculated as follows:

$$Percent\ Inhibition\ (I\%) = \frac{A_{control} - A_{sample}}{A_{control}} \times 100 \quad (3)$$

A panel of 10 semi-trained panelists, consisting of staff and students, evaluated the sensory characteristics of the pudding samples. The sensory evaluation of the samples gave grades using a 5-point hedonic scale according to appearance, taste and flavor, consistency, and overall liking. The degree of preference was determined using an acceptance test on a 5-point hedonic scale (5 = like extremely; 3 = neither like nor dislike; 1 = dislike extremely).

Statistical Analysis

The presented results are an average of triplicate observations. The statistical analysis was carried out using SPSS Statics 24.0 (SPSS Inc., Chicago, USA). One-way ANOVA was conducted to define the effect of drying methods on quality parameters of avocado powder. Duncan multiple range test was used at 95 % significance level to see the significant differences.

Results and Discussion

Physical Properties of Powder

The physical properties of freeze-dried melon seed powder (MSP) and freeze-dried pumpkin seed powder (PSP) are shown in Table 1. Bulk density and tapped density were important characteristics for the classification of the final product obtained by freeze-drying [4]. Low bulk density of food powder was not desirable due to the possibility of product oxidation [25]. The bulk densities of melon seed powder and pumpkin seed powder were 406.5 kg/m^3 and 330 kg/m^3, respectively. The high moisture content of powder products can affect factors such as flowability and stickiness. Good flowability and non-stickiness of the products are particularly important for the processing, storage and packaging of powder products [6]. The flowability indicator is the Carr index and the stickiness ratio is the Hausner ratio. [9] classified the flowability of powders as very poor, poor, fair, good and very good for Carr Index values above 45, 35–45, 20–35, 15–20 and below 15 respectively. In addition, flowability is described as good if the Hausner ratio is below 1.2, medium if it is between 1.2 and

1.4 and poor if it is above 1.4 [12]. In addition, if the Hausner ratio is less than 1.25, it is interpreted as free-flowing, and if it is greater, it is interpreted as an indicator of poor flowability [10]. In this study, both products were found to have poor flow properties with Hausner Ratio and Carr Index values.

The reconstitution properties of powders are also listed in Table 1. These properties were very important quality parameters for ready-to-dilute beverages. The wettability of the powders was a critical step of the redispersing process; the wetting time was used to study the instantaneous behavior of the product [18]. The wettability time was 2.96 s and 5.63 s for MSP and PSP powders, respectively. According to these results, MSP and PSP powders exhibited a low degree of solubility and dispersibility in water.

Color

The values L^*, a^*, and b^* of freeze-dried melon seed powder (MSP), freeze-dried pumpkin seed powder (PSP), melon seed milk (MSM), and pumpkin seed milk (PSM) are given in Table 2.

Among the powdered products, melon seed powder had the highest lightness value. The a* and b* values of melon seed powder are higher than those of pumpkin seed powder. The b* values of melon seed powder and pumpkin seed powder were close to each other. In the melon milk and pumpkin milk samples, the pumpkin milk was found to have the highest lightness value, while the lightness values of these products were close to each other. When the a^* and b^* values of melon and pumpkin seed milk were analyzed, it was found that the a^* values of pumpkin and melon seed milk were close to each other, but there was a difference between the b^* values, and the pumpkin seed milk was more yellowish. In a study on the use of melon seed powder in the production of gluten-free tulumba dessert, the results of the color analysis of melon seed powder L^*, a^*, and b^* values were found to be 56.76, 1.73, and 15.25, respectively [20]. In the study conducted by [2] on the quality characteristics and shelf life of melon seed milk, L^*, a^*, and b^* values of 75.56, 1.24, and 2.44, respectively, were determined. It is assumed that the main reason why the studies in the literature differ from each other and from this study is due to the different drying methods. In addition, the differences in the raw materials (melon and pumpkin) and the different methods used in the production of milk are responsible for these deviations.

Total Phenolic Content and Antioxidant Activity

The total phenolic content and antioxidant activity of melon seed powder (MSP), pumpkin seed powder (PSP), melon seed milk (MSM), pumpkin seed milk (PSM), cow's milk, MSM pudding, PSM pudding, and cow's milk pudding are given in Table 3. The highest antioxidant activity and the highest total phenolic content were found in melon seed powder. The values for total phenolic content and antioxidant activity of the control cow's milk were higher than those of the melon and pumpkin seed milks. It was found that the values of antioxidant activity and total phenolic content of the milk obtained from melon seeds and pumpkin seeds were close to each other. The total phenolic values of the pudding made with plant milk were close to the total phenolic values of the plant milk, but the antioxidant activity values

decreased by half. In addition, the levels of total phenolic content and antioxidant activity of pudding made from plant milk are significantly higher than those obtained from cow's milk. [19] determined that the total phenolic content of plant milk produced from pumpkin seeds was between 212.6-423.2 mg GAE/L, and [21] determined that the total phenolic content of melon seeds was 304.10 mg/100 g. The levels of total phenolic content determined in this study were consistent with the studies in the literature.

Sensory Quality Characteristics of Pudding

Pudding is a very well-known dairy dessert characterized by its semi-solid form, creamy texture, and the possibility of adding various flavored products [3]. The results of the sensory evaluation of the MSM pudding, PSM pudding, and cow's milk pudding are shown in Table 4. In terms of appearance characteristics, the pudding made with melon seed milk was liked more than the pudding made with pumpkin seed milk, with no significant difference found between them, but a significant difference was found compared to the pudding made with cow's milk. Although no undesirable foreign or sour odor or taste was detected in any of the samples, the PSM pudding, with its flavor characteristics, was more liked than the MSM pudding. There was no statistically significant difference between pudding made from MSM and pudding made from PSM in terms of the flavor criterion, while there was a statistically significant difference with pudding made from cow's milk. It was found that the melon flavor was intense in the MSM pudding sample, but the pumpkin seed flavor was less intense in the PSM pudding. While there was a statistically significant difference between the overall liking scores of the samples. The pudding samples prepared from melon and pumpkin seed milk were rated as moderately/good acceptable products according to the score scale

Conclusion

In this study, pumpkin seed milk and melon seed milk were obtained from freeze-dried melon and pumpkin seed powders. The resulting plant milk was used to produce pudding and compared with pudding made from cow's milk in terms of sensory quality characteristics. The sensory analysis showed that the sensory quality of the pudding made with melon seed milk was higher than that of the pudding made with pumpkin seed milk, but the scores were close to each other. The pudding made with cow's milk achieved the highest score. When comparing the total phenolic values and antioxidant activity of the pudding samples, pudding samples obtained from melon and pumpkin seed milk were higher than those of the pudding made with cow's milk. In this study, it was found that the milk obtained from melon and pumpkin seeds can be used making desserts.

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Table 1. Physical Properties of Powder

Properties/Sample	MSP	PSP
Moisture Content	8,63±0.37	7.49±0.58
Bulk density (kg/m^3)	406.5±4.85	330.22±11.10
Tapped density (kg/m^3)	526.2±5.17	483.97±13.35
Particle density (kg/m^3)	1352.64±8.99	817.20±90.66
Carr Indeks	22.75±1.29	24.72±3.39
Hausner Ratio	1.29±0.02	1.33±0.06
Wettability (s)	2.96±0.57	5.63±0.11
Dispersability (%)	31.83±3.04	34.25±3.06
Solubility (%)	16.00±5.9	17.91±0.65

* MSP, Melon seed powder, PSP, pumpkin seed powder

Table 2. Color Values of Melon Seed Powder (MSP), Pumpkin Seed Powder (PSP), Melon Seed Milk (MSM) and Pumpkin Seed Milk (PSM)

Sample	*L*	*a*	*b*
MSP	71.33±0.69	11.71 ±0.15	34.53 ±0.38
PSP	66.33 ±0.35	6.57 ±0.33	33.99 ±0.20
MSM	55.46 ±0.18	-1.94 ±0.14	1.63 ±0.05
PSM	56.56 ±0.16	-2.78±0.30	11.77 ±0.34

* MSP, Melon seed powder, PSP, pumpkin seed powder, MSM, melon seed milk and PSM, pumpkin seed milk

Table 3. Antioxidant Activity and Total Phenolic Content of Samples

Sample	Total Phenolic Content (mg GAE/100 g)	Antioxidant Activity (Inhibition %)
MSP	1232.78±28.48	45.11 0.08
PSP	1100.26±3.99	28.85±1.16
MSM	459.96±14.23	10.43 1.35
PSM	442.21±6.85	12.85 0.16
Milk	655.23±10.65	14.82 0.25
MSM Pudding	464.50±15.36	6.45 0.15
PSM Pudding	398.04±14.90	7.04 0.83
Milk Pudding	37.63±9.56	2.66 0.43

* MSP, Melon seed powder, PSP, pumpkin seed powder, MSM, melon seed milk and PSM, pumpkin seed milk

Table 4. Results of Sensory Analysis of Pudding

Sensory Characteristics	MSM Pudding	PSM Pudding	Milk Pudding
Appearance	3.55 ^{b}±1.15	3.10 ^{b}±1.55	4.50 ^{a}±0.89
Taste and Flavor	3.16 ^{a}±1.21	3.37 ^{a}±1.46	4.47 ^{b}±0.61
Consistency	3.70 ^{a}±1.30	3.40 ^{a}±1.14	4.10 ^{a}±1.02
Overall Liking	3.47 ^{b}±0.84	2.84 ^{a}±1.07	4.89 ^{c}±0.32

* MSP, Melon seed powder, PSP, pumpkin seed powder, MSM, melon seed milk and PSM, pumpkin seed milk