

Evaluation of several Quality Criteria of Low Calorie Pumpkin Dessert

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Abstract

The aim of this study was to decrease the sugar concentration of the pumpkin dessert which is a Turkish traditional food using artificial sweeteners. Therefore, its energy content was reduced. As a result it was expected that this product can be consumed by diabetics and overweight people who do not prefer high calorie products. The design included constraints to permit sweetener addition according to the limits of Turkish food legislation. Physical and chemical properties of pumpkin desserts and the effects of sweeteners on sensory properties were investigated. According to the physical, chemical and sensory analyses it can be seen that, by using aspartame and acesulfame K additives, low calorie pumpkin dessert could be produced.

Keywords: sweeteners, aspartame, acesulfam K, pumpkin dessert

Introduction

Determination of strategies to reduce energy intake is important for effective weight management (Flood-Obbagy and Rolls, 2009). Reduced sugar and reduced calorie preparation are made for overweight persons and diabetics suffering from lack of suitable food in their diets. Several food have been produced for this purpose (Demirağ *et al.*, 1999). Food formulated for diabetics and/or weight reduction tends to replace bulk caloric sweeteners with high intensity sweeteners (Iop *et al.*, 1999). Verdi and Hood (1993) described the ideal sweetener as a substance that would duplicate the sensory properties of sucrose with no aftertaste or non-sweet side tastes, provide the functional properties of sucrose, be chemically stable, have low caloric density on a sweetness basis and be nontoxic, non carcinogenic, readily soluble, and economically feasible. None of the commercially available intense sweeteners combine all these characteristics, but limitations can be partially overcome by the use of sweetener blends (Iop *et al.*, 1999). Hanger *et al.* (1996) reported that blends of high intensity sweeteners provide flavor profiles that more closely match sucrose and that flavor, bitter, or sweet after-taste attributes of single sweeteners are minimized in a blend of two or more sweeteners. Other advantages are cost-reduction due to synergistic enhancement of sweetening power, an increased stability in aqueous systems and reduced exposure to a single chemical substance.

Aspartame (N-(L- α -Aspartyl)-L-phenylalanine, 1-methyl ester) is a methyl ester of a dipeptide used as a synthetic nonnutritive sweetener in over 90 countries worldwide in over 6000 products. Although aspartame yields the same caloric intake as sugar on a weight to weight basis (i.e. 4 kcal/g), it can be added at almost 200 times lower

levels and achieve the same sweetness, thereby providing a far lower net caloric intake. This attribute has resulted in the use of aspartame as a low calorie or nonnutritive sweetener in foods and beverages worldwide. In an update on the safety in use of aspartame, the European Union's Scientific Committee on Food maintained the established acceptable daily intake (ADI) of aspartame by a person at 40 mg/kg body weight. The U.S. Food and Drug Administration (FDA) established an ADI of 50 mg/kg body weight for aspartame. Recently, the European Food Safety Authority evaluated a new long-term carcinogenicity study on aspartame and confirmed the previously established ADI for aspartame of 40 mg/kg body weight/day. There are no countries known in which approval of aspartame for food use was requested and denied (Magnuson *et al.*, 2007).

Acesulfame K is a name utilized for the potassium salt of 6-methyl-1,2,3-oxathiazine-4(3)-one-2,2-dioxide. At room temperature acesulfame K is an intensely sweet (150-200 times sweeter than sucrose), white, odorless, crystalline powder. Studies showed that acesulfame K is not mutagenic and not carcinogenic in the rat. The present toxicological information appears to be complete and the safety of acesulfame K established (Salminen and Hallikainen, 2002). FDA approved for ADI of 15 mg/kg body weight expected to be sufficient to allow almost complete replacement of all sugar in the diet of the average person (Smith and Hong-Shum, 2003).

Pumpkin is a very important food as part of a diet and as a medicinal therapeutic (Kowalska *et al.*, 2008). It is believed that pumpkin is a healthy and functional vegetable because it is rich in phenolics, flavonoids, vitamins (including β -carotene, vitamin A, vitamin B₆, α -tocopherol, vitamin C, vitamin E), amino acids, carbohydrates and minerals (especially potassium) and has low energy con-

tent (about 17 Kcal at 100 g of pumpkin flesh) and a large amount of fiber. Pumpkin might also be an excellent source of provitamin A carotenoids for preventing vitamin A deficiency (Seo *et al.*, 2005; Garcia *et al.*, 2007). Besides the provitamin A activity the special physiological functionality of several carotenoids as well as the prevention of cancer made it necessary to increase the knowledge about the content of carotenoids in foods (Murkovic *et al.*, 2002; Kowalska *et al.*, 2008; Gliemmo *et al.*, 2009).

It is generally utilized during the immature and mature stages as a culinary vegetable. Its use allows producing different foods as pumpkin in syrup, jam, jelly and purees (Gliemmo *et al.*, 2009). There are many traditional pumpkin foods, like pumpkin cake, pumpkin congee and dessert. Because of its good functional properties, foods produced from pumpkin should be diversified.

The aim of this study was to decrease the sugar and energy content of the pumpkin dessert by using aspartame and acesulfame K and also determine the effects of sweeteners on sensory properties. It was expected that this product can be consumed by diabetics and overweight people.

Materials and methods

For one jar of the canned pumpkin dessert, 285 g washed, peeled and cut fresh pumpkin was used. Pumpkins were boiled in syrup (8° brix) for 10 minutes in an open kettle. After draining, jars were filled with pumpkins and 125 ml hot syrup which had already been prepared was added. As an alternative processing, pumpkin desserts were pasteurized at 85°C for 30 minutes for shelf life prolongation. The formulation included constraints to permit sweetener addition according to the limits of Turkish food legislation that explains the maximum amounts of aspartame and acesulfame K permitted for fruit and vegetable based low energy containing or sugar included desserts as 350 mg/kg and 1000 mg/kg respectively (Anonymous, 2006 a). According to the recipes, syrups contained different amount of saccharose, glucose syrup, aspartame and acesulfame-K (Tab. 1).

Sweetness value of saccharose, glucose, aspartame and acesulfame-K were accepted as 1.0, 0.5, 200 and 200 respectively. Because the sugar concentration was decreased, aspartame and acesulfame-K concentrations were increased to give the same sweet taste. For example, the control sample (A) contained 63.15 g saccharose and 7 g glucose

syrup, so its sweetness value was determined as $(63.15 \times 1) + (7 \times 0.5) = 66.65$. Since sample B had 25% low calorie, its sweetness value was calculated as $(47.36 \times 1) + (5.25 \times 0.5) = 49.985$. In order to give the same sweetness, $(66.65 - 49.985) / 200 = 0.0833$ g sweetener was needed. Aspartame and acesulfame-K were used 1:1 ratio then 41.66 mg aspartame and 41.66 mg acesulfame-K were added to the syrup.

Chemicals

Folin-Ciocalteu's reagent was from Fluka (Buchs, Switzerland). Methanol, 2,2-diphenyl-2-picrylhydrazyl radical (DPPH), gallic acid, petroleum ether (analytical grade), 2,6-dichlorophenol indophenol and acetone were purchased from Sigma Chemical Co. (St. Louis, MO). Oxalic acid and sodium carbonate were obtained from Merck (Darmstadt, Germany).

Chemical analyses

The amount of water-soluble dry matter content (brix) of the samples was determined using an Abbe refractometer. Total dry matter was analyzed with oven-dry method. Ascorbic acid content was determined by spectrophotometry using 2,6-dichlorophenol indophenol dye (Cemeroğlu, 2007). Antioxidant activity was measured spectrophotometrically using the 2,2-diphenylpicrylhydrazyl (DPPH) radical. According to this method, extracted samples, which were made to react with the radical solution and rest for 30 minutes at room temperature, were measured for absorbance at 517 nm, and the inhibition percentage of DPPH free radical was calculated (Zhang and Hamauzu, 2004). The method employed for the total phenolics was based on Folin-Ciocalteu's phenol reagent and spectrophotometric determination (Spanos and Wrolstad, 1990). The spectrophotometric measurements were carried out at 452 nm using a Shimadzu UV 1208 spectrophotometer, and the results were calculated as gallic acid equivalent. Total carotenoids were determined using spectrophotometric method (Kılıç *et al.*, 1991). The color of the raw material and pumpkin desserts (reflectance values) were measured using D 25APC2Δ model Hunterlab colorimeter and expressed as L, a and b values (Bakker *et al.*, 1986). Hydroxymethylfurfural (HMF) was identified by measuring the absorbance variation of the samples by barbituric acid and p-toluidine, spectrophotometrically (Kılıç *et al.*, 1991).

Sensory analyses

The pumpkin desserts were organoleptically evaluated for their quality attributes, such as color, odor, taste and texture, by using a ranking test with 6 panelists (Altuğ, 1993). Panelists granted points to the samples from the best preferred to least preferred dessert. Due to number of the panelists and the desserts, samples were statistically evaluated. According to this evaluation method, the sample taken below 11 point was accepted as preferred, above

Tab. 1. Composition of the syrup of the pumpkin desserts

Recipes	A	B	C	D	E
Sugar (g)	63.15	47.36	41.05	34.73	28.42
Glucose syrup (g)	7.00	5.25	4.55	3.85	3.15
Water (ml)	54.85	72.39	79.40	86.42	93.43
Aspartame (mg)	-	41.66	58.41	74.99	91.64
Acesulfame K (mg)	-	41.66	58.41	74.99	91.64

A: control, B: 25% reduced calorie, C: 35% reduced calorie, D: 45% reduced calorie, E: 55% reduced calorie

31 point were accepted as rejected and when the sample was granted points between 11-31, this means there was no statistically significant difference ($P < 0.05$).

Results and discussion

Analytical criteria determined in fresh pumpkin were given in Tab. 2. According to Günay (1984) and Mercan (2000), total dry matter of pumpkin was between 60-100 g/kg and 70.1-138.5 g/kg, respectively. Besides, USDA National Nutrient Database for Standard Reference declared this value as 84.0 g/kg (Anonymous, 2006 b). Gliemmo *et al.* (2009) reported the total soluble solids content of the pumpkin puree as 10.5 °brix. The difference between total dry matter (12.81 ± 0.04) and water soluble dry matter contents (7.50 ± 0.00) of the samples might be due to variety, harvesting maturity and storage conditions.

Tab. 2. Physical and chemical properties of fresh pumpkin

Total dry matter (g/100 g)	12.81±0.04
Water soluble dry matter (g/100 g)	7.50±0.00
Total phenolics* (mg GAE/100g)	476.63±0.91
Total carotenoids (mg/kg)	254.55±0.16
Antioxidant activity (%)	41.66±0.12
pH	5.80±0.15
Color	
L	49.6±0.00
a	21.9±0.00
b	31.0±0.00

*: Gallic acid equivalents

Total phenolic matter content of the raw material was determined as 476.63 ± 0.91 mg GAE/100g. Phenolics in green tea, fruits and vegetables, grapes have been recognized as natural antioxidants and have been extensively studied by many investigators for their health promoting effects, such as cancer and cardiovascular disease prevention, and anti-inflammatory activities. However, very few if any studies are available on the health promoting phenolics in pumpkin (Que *et al.*, 2008).

The amount of total carotenoids of the pumpkin was determined as 254.55 ± 0.16 mg/kg. Kandlakunta *et al.* (2008) reported that total carotenoids amount of yellow pumpkin (*Cucurbita maxima*) as $2120 \mu\text{g}/100\text{g}$. Squashes and pumpkins are important dietary sources of carotenoids worldwide. The carotenoid composition has been highly variable, both qualitatively and quantitatively (Azevedo-Meleiro and Rodriguez-Amaya, 2007). It is well known that the climate has a significant influence on the content of carotenoids in vegetables (Murkovic *et al.*, 2002).

The pH of the fresh sample was 5.80 ± 0.15 and very close to the result (6.10 ± 0.02) of the Gliemmo *et al.* (2009).

Color related parameters L (lightness), a (+: red, -: green), b (+: yellow, -: blue) of pumpkin were determined

as 49.6, 21.9 and 31.0 respectively. Seroczyńska *et al.* (2006) determined the L values for pumpkin flesh ranged from 56.5 to 85.6, a values from 5.7 to 40.3 and b values from 24.3 to 80.1. Differences between the results could be due to geographical or varietal differences. Gliemmo *et al.* (2009) reported that the increment of storage time produced a decrease in a and b values of pumpkin purees.

Results of physical and chemical analyses of the pumpkin desserts were presented in Tab. 3. Total dry matter content of the fresh pumpkin was determined as 12.81 ± 0.04 g/100g. After dessert processing, the total dry matter content of the samples increased due to the syrup addition and heating. Initially water-soluble solid content of the raw pumpkin was 7.50 ± 0.00 g/100g. After syrup addition and by heating, water-soluble solid content of the dessert samples were reached between 12.88 ± 0.18 ; 19.63 ± 0.18 g/100g. The differences in brix of the dessert samples affected from brix of syrup added and absorption of the syrup. Incedayı *et al.* (2009) examined physical and chemical properties of pumpkin desserts produced from modified atmosphere packaged pumpkins. They reported that initially water-soluble solid content (brix) of the pumpkins were between 8.25 ± 0.00 and 8.63 ± 0.18 . After sugar addition, brix was aimed to reach 55° by heating for dessert production. For samples stored at room temperature for 15 days to reach mass balance, brix values were between 45.25° and 54.75°, and total dry matter contents between 512.7 ± 0.32 and 623.8 ± 0.40 g/kg. The differences in brix of the dessert samples may depend on textural differences of the pumpkins and absorption of syrup.

As the sugar content of the syrup decreased, total sugar content of the desserts also decreased.

Total phenolic compounds content of the raw material was 476.63 ± 0.91 mg/100 g. Total phenolic compounds and total carotenoid contents of the desserts decreased due to the process applied. When compared to the raw material, the antioxidant activity of the dessert samples decreased as between 13.63-69.95% due to processing. Heating and oxidation caused a decrease in antioxidant activity (Veda *et al.*, 2006). It was noteworthy that the dessert (E) had higher amount of antioxidant compounds such as phenolics (234.14 ± 7.47 mg GAE/100g) and carotenoids (64.88 ± 0.71 mg/kg). When the lowest antioxidant activity was determined in the control sample (A) (12.52 ± 2.06 %), sample E had the highest antioxidant activity (35.98 ± 0.70 %).

Dutta *et al.* (2006) determined the total carotenoid content of pumpkin pieces thermally treated for different blanch times. They reported that at temperatures of 85°C and 95°C, a 4.13-13.35% decrease in the total carotenoid content was observed when compared with the control. This is because prolonged blanching at high temperatures leads to leaching of the water-soluble carotene-bound protein molecules in the form of globules into the water solution. According to our result, as processing temperature and time were more longer and carotenoid compound loss

Tab. 3. Physical and chemical properties of pumpkin desserts

Analyses	A	B	C	D	E
Total dry matter (g/100 g)	22.02±0.13	21.75±0.04	19.33±0.52	18.05±0.03	15,22±0,03
Water soluble dry matter (g/100 g)	19.63±0.18	19.38±0.18	17.5±0.00	15.50±0.00	12.88±0.18
Total sugar(g/100 g)	16.26±0.49	15.16±0.00	14.86±0.14	5.95±0.54	5.10±0.11
Total phenolics* (mg GAE/100g)	111.64±1.16	140.34±8.03	141.90±0.67	145.00±3.51	234.14±7.47
Total carotenoids (mg/kg)	42.72±2.26	48.15±0.75	54.32±1.54	52.35±1.54	64.88±0.71
Antioxidant activity (%)	12.52±2.06	16.90±0.39	17.55±0.76	13.56±0.58	35.98±0.70
HMF (mg/kg)	125.12±1.05	29.44±2.08	30.91±0.00	32.75±0.52	32.75±0.52
pH	4.72±0.01	4.37±0.01	4.60±0.02	4.68±0.04	4.74±0.02
Color					
L	43.05±0.07	42.55±0.21	43.25±0.35	43.50±0.00	46.35±0.07
a	16.40±0.00	17.90±0.14	17.00±0.28	17.95±0.07	17.50±0.00
b	26.90±0.00	27.05±0.07	27.20±0.14	27.60±0.00	29,00±0.00

*: Gallic acid equivalents; Mean±standard deviation

was very significant (74.51 %-83.22 %) when compared to the raw material. Heat treatment, especially in the presence of light and oxygen, causes isomerization of carotene, as well as its oxidative destruction, thus decreasing its biological activity (Veda *et al.*, 2006).

There was a significant reduction of the hydroxymethylfurfural (HMF) value of the low calorie samples when compared to control sample due to the decrease of the sugar content.

The pHs of the all samples were very close to each other and changed between 4.37±0.01; 4.74±0.02.

When the sample E had the highest lightness (L) (46.35±0.07) and b (yellowness) value (29.00±0.00), the control sample had the lowest a (redness) value (16.40±0.00).

The result of the sensory analyses was depicted in Fig. 1.

Samples were tested for color (it should have bright, orange color), odor (it should have typical pumpkin dessert odor and not have any strange odor), taste (it should have typical pumpkin dessert taste and not have any strange taste) and texture (it should not be soften and parted). According to the ranking test although there were no statistically significant difference of odor, taste and texture of the samples; the control sample was the most favorite one

especially for color and texture, and the sample E was statistically rejected for color attribute ($P<0.05$). While the most favorite one was sample D for odor, it was the least favorite one for taste. Even so sample B was the most favorite one for taste; it was the least favorite one for texture.

Conclusions

Generally, pumpkin which is a good source of nutrients is not a very common processed food, but its consumption has increased during recent years. Availability of data about pumpkin dessert is very limited.

Current work was focused on the use of artificial sweeteners for the production of low calorie pumpkin dessert. The study also provided information on the nutritional value of the products. The results showed that it was possible to use aspartame and acesulfame-K in the preparation of low calorie pumpkin dessert. Without sensory (odor, taste and texture) rejection, calorie value of the product could be reduced up to 55%. Despite the fact that there were no statistically significant differences of odor, taste and texture of the samples; especially 25% reduced calorie sample (B) was the most favorite one for taste between the low calorie samples. Also hydroxymethylfurfural (HMF) content of the low calorie samples was significantly reduced due to the decrease of the sugar content.

The manufacture of diabetic-friendly, low calorie traditional pumpkin products would provide an alternative assortment to health-conscious consumers.

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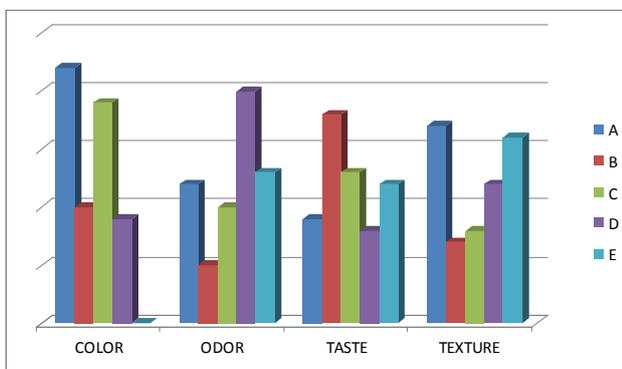


Fig. 1. The result of the sensory analyses of low calorie pumpkin desserts

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