

A research of the chemical and sensory properties of carob molasses- and carob powder-added peanut butter

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Abstract

In this study, the effects of using carob molasses (2.5%, 5%, 10% and 20%) and carob powder (2.5%, 5%, 10% and 20%) on the chemical and sensory properties of peanut butter were investigated. The amount of phenolic compounds and antioxidant activity values of the samples, on the other hand, increased in line with the addition of carob molasses or carob powder as well as with the increased amount of peanut butter. From the sensory point of view, the sample in which 5% carob molasses was added was chosen from among the samples involving carob molasses, while the sample in which 5% carob powder was added was chosen from among the samples involving carob powder. As a result, the peanut butter sample with a maximum of 5% carob molasses was preferred, and may, therefore, be suggested for production.

Keywords: Peanut butter, Carob, Chemical and Sensory Properties

1.INTRODUCTION

Peanut (*Arachis hypogaea*) is an annual and summer oil plant from the legume family. Peanuts are consumed in many countries as they contribute to the diet. Peanut is a good source of protein, lipids and fatty acids for human nutrition (Grosso et al., 1997; Bozdogan et al., 2017). In addition, peanut (*Arachis hypogaea*) is a highly nutritious food as it contains plenty of monounsaturated fatty acids, dietary fiber, minerals and antioxidants (Esche et al., 2013). Peanuts reduce the risk of coronary heart disease, cancer and Alzheimer's disease when included in a healthy diet (Shin et al., 2009).

Peanut butter is solid particles suspended in a continuous oil phase in a thick suspension (Norazatul et al., 2016). Peanut butter is typically produced by roasting and crushing raw peanuts. It has a distinctive taste and has many beneficial properties for health (Hashemian et al., 2017; Gong

et al., 2018). Since peanuts are the raw material of peanut butter, the quality of peanuts to be used in production has a significant impact on the quality of the final peanut butter. It contains peanut butter, dry roasted peanuts, salt, sugar, sweetener, emulsifier, and additional ingredients that alter its flavor and texture (Burks and Sampson, 1993).

Peanut butter is a nutritious food in terms of its rich composition and its composition, functional properties and quality need to be improved in order to make it healthier and increase its consumption. Carob is used in various industries. Carob powder contains 45% carbohydrate, 7% protein, 0.6% fat, 19 mg/g phenol compounds, 2.75 mg tannin/g. Carob contains minerals such as Fe, Ca, Na, K, P and S and vitamins such as E, C, B6 and folic acid (Avallone et al., 1997). Also, the total amount of

sugar is 46% and 14% of the total sugar is reducing sugar (Cepo et al., 2014).

Carob powder, which is produced from the fruit of carob, is used as an additive in the food industry or instead of cocoa powder due to some advantages such as the absence of caffeine and theobromine and its low cost (Cepo et al., 2014). Carob is a valuable fruit because it is rich in carbohydrates, dietary fibers and phenol compounds. In addition, it has biological effects such as antibacterial, antidiarrheal, antidiabetic, antihypercholesterolemic (Frag and El-Kersh 2017).

One of the evaluation methods of carob is molasses production. Carob fruit is extracted with water and this extract is directly concentrated and turned into molasses (Batu, 2005). In addition, the product obtained by grinding carob into powder is called carob powder or carob flour.

The aim of this study is to examine the effects of using carob molasses and carob powder on the chemical and sensory properties of peanut butter in peanut butter production.

2. MATERIALS AND METHODS

2.1. Materials

Peanuts for the production of peanut butter were obtained from a peanut shop in Osmaniye. Carob powder (CP) and Carob molasses were purchased (CM) from Şitoğlu Gıda San. ve Ltd. (Malatya). Refined peanut oil (Oilo brand) was purchased from a grocery store. A food processor (Arçelik, Turkey) was used in the production of peanut butter.

2.2. Methods

2.2.1. Peanut Butter Making

Peanut butter was made in the laboratories of Osmaniye Korkut Ata University, Department of Food Engineering. The amount of raw materials used in the production of peanut butter is shown in Table 3.1. For each sample, 400 g of roasted peanuts, 3 g of salt, 20 g of peanut oil and different proportions of carob molasses (2.5%, 5%, 10%,

20%) and carob powder (2.5%, 5%, 10%, 20%) were added and ground in a blender until it reached a spreadable consistency. Also, a control sample was produced without adding any carob molasses or carob powder. A total of 9 different peanut butter samples were produced and coded as 1 (control), 2 (2.5% CM), 3 (5% CM), 4 (10% CM), 5 (20% CM), 6 (2.5% CP), 7 (5% CP), 8 (10% CP), and 9 (20% CP).

Peanut butter samples were made in duplicate and stored at + 4 C° until analysed.

2.2.2. pH Values

The pH values of the peanut butter samples were measured with the Orion Star™ A211 pH Benchtop Meter digital pH meter (Inolab, Weilhem, Germany).

2.2.3. Total Soluble Solid Contents

The total soluble solid content (TSS) in peanut butter samples was determined, they were constantly measured until the sample weight remained unchanged at 110 C° in the oven according to the AOAC method (Anon, 1990).

2.2.4. Total Amount of Phenolic Compounds

The total amount of phenolic compounds was found using the Folin-Ciocalteu's reagent. Results were presented as gallic acid equivalents (Singleton and Rossi, 1965).

2.2.5 The DPPH Method for the Antioxidant Activity Assay

Antioxidant activity values in peanuts were determined by the DPPH method. In the process, 3.9 ml of 60 mM DPPH solution prepared in methanol was added into 0.1 ml of phenolic extract, which was kept under dark room conditions for an hour, after which the samples were measured at 517 nm in a spectrophotometer against methanol (Shimadzu, 1201, Japan). The formula below was used to calculate the results (Yorulmaz et al., 2013).

$$\% \text{ DPPH Removal Activity} = (A_{\text{control}} - A_{\text{sample}}) \div A_{\text{control}} \times 100$$

Table 1. The Amounts of Raw Materials in Peanut Butter Composition

Raw Materials	Peanut Butter Samples								
	1	2	3	4	5	6	7	8	9
Peanut Butter (g)	400	400	400	400	400	400	400	400	400
Peanut Butter Oil (g)	20	20	20	20	20	20	20	20	20
Salt (g)	3	3	3	3	3	3	3	3	3
Carob Molasses (g)	-	10	20	40	80	-	-	-	-
Carob Powder (g)	-	-	-	-	-	10	20	40	80

2.2.6. Sensory Analyses

The samples of peanut butter were evaluated with respect to sensory properties such as oiliness, viscosity, texture, stickiness, taste and overall impression. A panellist group of 9 people was formed from Osmaniye Korkut Ata University, Faculty of Engineering, Department of Food Engineering for sensory evaluation. Panel members scored the samples independently of each other in a comparative fashion (1 very poor, 10 very good).

2.2.7. Sensory Analyses

Analysis of variance was performed to investigate the chemical analysis results and the difference between groups was evaluated according to Duncan's multiple comparison test. Also, Data were calculated using SPSS 18.0 (SPSS Inc., Chicago, IL, USA) statistical software.

3. RESULTS AND DISCUSSION

3.1. Chemical Composition of Peanut Butters

Table 2 presents the chemical composition of the peanut butter samples obtained by adding different proportions of carob molasses (2.5%, 5%, 10%, and 20%) and carob powder (2.5%, 5%, 10%, and 20%), and of the control peanut butter sample (0%). No statistical significance was found in pH between the peanut butter samples.

Phenolic compounds show antioxidant activity and help prevent various types of cancer and cardiovascular diseases. There is a positive

correlation between phenolic compounds and antioxidant activity (Mazza, 2000; Cervantes et al., 2020). Adding carob molasses and carob powder was found to be significantly ($p < 0.05$) effective on the total phenolic compounds and antioxidant activity values of peanut butter, since it increased such compounds and values.

The total phenolic compounds and antioxidant activity values of the samples were found to be higher in the samples in which carob molasses was added compared to those with carob powder. This may result from the increase in the value of phenolic compounds during carob production due to the increased temperature. In addition, Maillard reaction products are known to behave like phenolic compounds in total phenolic matter analysis (Hwang et al., 2001). At high temperatures, the total amount of phenolic substances and related antioxidant activity values are also high (Oliviera et al., 2012). Also, Ayala-Zavala et al., (2004) reported that as the total amount of phenolic compounds increased, the antioxidant activity value increased, and likewise, as the intensity of the heat treatment increased, the total amount of phenolic substances increased.

3.2. Chemical Composition of Peanut Butters

Table 2 presents the chemical composition of the peanut butter samples obtained by adding different proportions of carob molasses (2.5%, 5%, 10%, and 20%) and carob powder (2.5%, 5%, 10%, and 20%), and.

Table 2. Chemical Composition of Peanut Butter

Peanut Butter Samples	pH	Total phenolic compounds (mg/kg)	Antioxidant activity (%)
Control ^x	7.01±0	611.30 ^{cde} ±40	14.02 ^f ±2.3
%2.5 CM	6.87±0	938.60 ^b ±7.1	55.90 ^c ±0.26
%5 CM	6.76±0	1020.75 ^b ±43	61.72 ^b ±1.95
%10 CM	6.46±0	1054.10 ^b ±132	93.45 ^a ±0.4
%20 CM	6.11±0	1676.90 ^a ±51	94.00 ^a ±0.1
%2.5 CP	6.90±0	585.20 ^{de} ±8.6	12.08 ^f ±1.4
%5 CP	7.08±1	566.35 ^e ±3.9	25.18 ^e ±1.2
%10 CP	6.45±0	703.00 ^{cd} ±8.6	41.42 ^d ±4.6
%20 CP	6.39±0	723.55 ^c ±4.7	61.43 ^b ±2.1

The difference between the values shown with different letters in the same column is statistically significant ($p < 0.05$). Control^x: 0%, CM: Carob molasses, CP: Carob powder

of the control peanut butter sample (0%). No statistical significance was found in pH between the peanut butter samples. Phenolic compounds show antioxidant activity and help prevent various types of cancer and cardiovascular diseases. There is a positive correlation between phenolic compounds and antioxidant activity (Mazza, 2000; Cervantes et al., 2020). Adding carob molasses and carob powder was found to be significantly ($p < 0.05$) effective on the total phenolic compounds and antioxidant activity values of peanut butter, since it increased such compounds and values. The total phenolic compounds and antioxidant activity values of the samples were found to be higher in the samples in which carob molasses was added compared to those with carob powder. This may result from the increase in the value of phenolic compounds during carob production due to the increased temperature. In addition, Maillard reaction products are known to behave like phenolic compounds in total phenolic matter analysis (Hwang et al., 2001). At high temperatures, the total amount of phenolic substances and related antioxidant activity values are also high (Olivieira et al., 2012). Also, Ayala-Zavala et al., (2004) reported that as the total amount of phenolic compounds increased, the antioxidant activity value increased, and

likewise, as the intensity of the heat treatment increased, the total amount of phenolic substances increased.

3.3. Sensory Profiles of Peanut Butters

The samples of peanut butter were evaluated with respect to sensory properties such as oiliness, viscosity, texture, stickiness, taste and overall impression, and the results are presented in Table 3. Except for oiliness, the difference between the peanut butter samples was found to be significant in terms of viscosity, texture, stickiness, and overall impression ($p < 0.05$). The highest value in terms of viscosity was observed in the 5% CM sample, though the difference between that sample and those samples involving 2.5% CM, 10% CM, 2.5% CP, 5% CP, and 10% CP was found insignificant. The lowest value was detected in the 20% CM sample. The highest scores in terms of texture were given to the samples of 2.5% CM and 5% CM, and the difference between those samples and the control sample as well as those involving 10% CM and 2.5% CM turned out to be insignificant. The highest score was given to the 5% CM sample in terms of stickiness.

Table 3. Chemical Composition of Peanut Butter

	Oiliness	Viscosity	Texture	Stickiness	Taste	General Impression
Control ^x	6.0±1.7	4.89 ^{ab} ±1.8	6.56 ^a ±1.7	5.22 ^{ab} ±1.5	5.33 ^{ab} ±1.3	5.78 ^a ±1.1
%2.5 CM	6.56±1.8	5.33 ^a ±1.6	7.0 ^a ±2	6.0 ^a ±2.2	6.56 ^a ±2.1	6.56 ^a ±1.9
%5 CM	6.66±1.7	6.11 ^a ±1.8	7.0 ^a ±1.6	6.22 ^a ±1.8	7.0 ^a ±1.7	6.67 ^a ±1.4
%10 CM	6.11±1.6	5.22 ^a ±1.6	6.33 ^a ±1.8	5.67 ^a ±1.6	6.33 ^a ±1.6	6.22 ^a ±1.3
%20 CM	4.78±1.4	3.0 ^b ±1.5	4.56 ^b ±1.1	3.78 ^b ±1.7	4.22 ^b ±1.6	4.33 ^b ±1.5
%2.5 CP	6.44±1.2	5.67 ^a ±1.8	6.44 ^a ±1.4	6.11 ^a ±1.6	5.33 ^{ab} ±1.6	5.89 ^a ±1.3
%5 CP	6.33±1.6	5.67 ^a ±1.9	6.22 ^{ab} ±1.9	6.0 ^a ±1.9	6.44 ^a ±2.1	6.33 ^a ±1.6
%10 CP	5.89±0.9	5.11 ^a ±1.6	6.11 ^{ab} ±1.4	5.67 ^a ±1.5	5.89 ^{ab} ±1.5	6.0 ^a ±1.3
%20 CP	5.11±0.8	4.67 ^{ab} ±1.3	5.78 ^{ab} ±1.6	5.0 ^{ab} ±1.5	5.44 ^{ab} ±1.6	5.44 ^{ab} ±1.4

The difference between values shown with different letters in the same column is statistically significant ($p < 0.05$). Control: 0%, CM: Carob molasses, CP: Carob powder

However, it was noted that the difference between that sample and those involving 2.5% CM, 10% CM, 2.5% CP, 5% CP, and 10% CP was insignificant. The lowest score was given to the 20% CM sample. The highest score in terms of taste was given to the 5% CM sample. The difference between that sample and the samples involving 2.5% CM, 10% CM, and 5% CP was found to be insignificant. In terms of general impression, the highest score was given to the 5% CM sample. The difference between that sample and other samples, except for those involving 20% CM and 20% CP, was found to be insignificant, and the lowest score was given to the 20% CM sample. In general, the sample in which 5% carob molasses was added was chosen from among the samples involving carob molasses, while the sample in which 5% carob powder was added was chosen from among the samples involving carob powder. Also, it appeared that the sample with the highest score and the most preferred one turned out to be the sample with 5% CM.

4. CONCLUSION

The effects of using carob molasses and carob powder on the chemical and sensory properties

of peanut butter were investigated. It was determined that the use of carob molasses and/or carob powder increased the phenolic compounds and antioxidant activity values of the samples. The peanut butter samples were evaluated with respect to sensory properties such as oiliness, viscosity, texture, stickiness, taste and overall impression, and the panellists preferred the sample with a maximum of 5% carob molasses in the first place and the one with 2.5% carob molasses in the second. As a conclusion, it can be suggested that the peanut butter involving 5% carob molasses be produced.

CONFLICT OF INTEREST STATEMENT

No potential conflict of interest was reported by the authors.

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