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RESEARCH PAPER

Investigation of the Mineral and Heavy Metal Contents of Propolis Additive Ice Cream

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Abstract

In this study, it was aimed to add a functional food property to the ice cream, which is a popular food, by adding propolis. At the same time, study aims to provide a widespread consumption potential to propolis which is impossible to be consumed in raw form and whose benefits and functional properties not known by consumers. 6 groups of ice cream containing control group and 0.1%, 0.2%, 0.3%, 0.4%, and 0.5% propolis powder were obtained from prepared ice cream mix. Mineral substance analysis to propolis sample and ice cream mix groups applied. According to the results, the addition of propolis had no effect on mineral and heavy metal amounts of ice cream mix groups. Propolis-added ice cream is thought to have the potential to offer new functional food to consumers of all ages.

Introduction

Propolis is a natural resinous substance created by bees by collecting from some parts of plants, plant buds and plant secretions (Ghisalberti, 1979). It has a unique aromatic fragrance and different colors that vary according to its source and maturity (Brown, 1989). More than 300 different compounds have been identified in propolis, which has a very complex chemical structure. Its chemical composition is 50% resin, 30% wax, 10% essential oils, 5% pollen and 5% other organic components. Compounds such as phenolic compounds, esters, flavonoids, terpenes, beta-steroids, aromatic aldehydes, alcohols, sesquiterpenes, stilbene terpenes, and caffeic acid phenyl ester (CAPE) are some of the organic components that propolis contains (Yucel et al., 2017). B1, B2, B6, C and E vitamins and silver, cesium, mercury, lanthanum, antimony, copper, manganese, iron, calcium, aluminum, and vanadium elements were detected in propolis (Deblock-Bostyn, 1982). Components of propolis change depending on factors such as climate, secretion source, environmental factors (Chen & Wong, 1996).

In recent years, the positive properties of propolis in terms of human health have been a popular field of study. It has been reported in the literature that propolis has antibacterial, antiviral, antifungal, antitumor, anti-inflammatory, cytostatic effect, and antioxidant activity. In addition, many studies have shown the benefits of using propolis against some conditions such as dermatological, ear nose throat, gynecological and stomach diseases etc. (Marcucci, 1994). In this study, the effect of adding propolis powder to ice cream in terms of heavy metal and mineral content was investigated.

Materials and Methods

Material

Raw propolis that used in this study was collected from apiaries of Apiculture Research Institute. It was extracted with 70:30 (V:V) ethanol: water solution and was lyophilized for obtaining propolis powder.

63.07% milk, 16% sucrose, 15.17% cream, 5.17% skimmed milk powder, 0.3% emulsifier, and 0.3%

stabilizer were used for preparing ice cream mix. Control, ICM1 (0.1% propolis powder containing ice cream mix), ICM2 (0.2% propolis powder containing ice cream mix), ICM3 (0.3% propolis powder containing ice cream mix), ICM4 (0.4% propolis powder containing ice cream mix) and ICM5 (0.5% propolis powder containing ice cream mix) ice cream mixes were prepared for analysis.

Methods

1- Mineral and Heavy Metal Analysis

Propolis samples and ice cream mix samples were weighed 0.2-0.5 g according to Nordic Committee on Food Analysis (NMKL 186:2007). 2 mL nitric acid (65%) and 0.5 mL hydrogen peroxide (30%) were added and wet combustion was performed in the Milestone Ethos Easy microwave digestion system. The solution obtained after wet burning was completed to 5 mL with distilled water and heavy metal and mineral matter analysis was performed in ICP-MS (Thermo Scientific IcapQ).

2- Statistical Analysis

Analysis data were analyzed statistically using SPSS statistical software and the results were presented as "mean ± standard deviation". Analysis of variance was performed (ANOVA) for determination of statistical differences between ice cream types.

Results and Discussion

In the study, mineral substance and heavy metal contents of powder propolis added to ice cream types were investigated. The mineral content, a feature of propolis that has not been studied much, contributes to its healing effects (González-Martín et al., 2015). The heavy metal content of propolis can increase through the solvents used and the contamination during the extraction procedure (Tosic et al., 2017). Heavy metal and mineral substance analysis results of propolis are given in Table 1.

Ice cream, like other dairy products, is a food product rich in mineral content. Minerals have important functions in the human body. Dairy products present a particularly significant amount of Ca element to the human body in a form that can be used in biological functions (Erkaya et al., 2012). Heavy metals can easily contaminate food through water, air and soil. For this reason, their involvement in the food chain has negative effects on human health (Conficoni et al., 2017). In the study, the effect of the difference in propolis ratio between ice cream mix groups on the element content was investigated.

Table 1. Results of heavy metal and mineral content analysis of propolis

Elements	(mg/kg)	Elements	(mg/kg)
B	4.119±0.014	Ni	0.515±0.003
Na	32.77±0.112	Cu	0.711±0.007
Mg	215.9±6.856	Zn	9.372±0.037
Al	2.245±0.006	As	0.035±0.000
Si	63.46±0.123	Se	0.016±0.000
K	1250.5±33.62	Sr	0.423±0.011
Ca	201.9±3.802	Mo	0.025±0.000
V	0.036±0.000	Sb	0.008±0.000
Cr	0.303±0.003	Ba	0.089±0.002
Mn	1.958±0.018	Pb	0.041±0.001
Fe	11.90±0.231		

Macro element quantities of ice cream mixes are as shown in Table 2. Because of the statistical analysis, it was determined that there was no significant difference between the groups in terms of the amount of macro elements ($P > 0.05$).

Table 2. Macro element values in ice cream mix

	Macro Elements (mg/kg)			
Ice Cream Types	Na	Mg	K	Ca
Control	768.8±11.0	148.8±5.80	1318.0±27.8	1286.9±64.8
DM1	794.8±42,7	158.7±33.8	1181.9±60.4	1374.4±33.2
DM2	724.4±23.2	141.1±39.1	1072.7±63.6	1253.2±32.6
DM3	724.1±36.4	164.7±20.1	964.4±54.7	1406.7±54.2
DM4	774.4±37.7	162.0±11.4	1242.1±43.9	1389.1±89.6
DM5	798.9±12.8	176.32±5.1	1333.2±41.2	1511.0±13.9

Trace element amounts of ice cream mix groups are shown in Table 3. It was determined that there was no statistically significant difference between the trace element values of the groups (P>0.05).

Heavy metal contents of ice cream mixes are as shown in Table 4. There was no statistically significant difference between the heavy metal contents of the groups (P>0.05).

Table 3. Trace element values in ice cream mix

Element	Trace Element (mg/kg)					
	Ice Cream Types					
	Control	DM1	DM2	DM3	DM4	DM5
B	1.10±0.20	1.30±0.00	1.10±0.50	1.10±0.10	1.20±0.10	1.20±0.08
Si	69.7±0.40	67.9±6.60	66.7±12.2	57.4±9.70	62.5±2.90	64.8±5.01
V	0.05±0.00	0.04±0.00	0.04±0.02	0.03±0.00	0.03±0.00	0.03±0.01
Se	0.04±0.00	0.04±0.01	0.03±0.01	0.03±0.01	0.04±0.00	0.04±0.00
Sr	0.42±0.04	0.42±0.02	0.41±0.09	0.36±0.00	0.33±0.00	0.36±0.03
Mo	0.08±0.03	0.07±0.01	0.08±0.04	0.08±0.01	0.07±0.03	0.08±0.01
Sb	0.01±0.00	0.004±0.0	0.01±0.00	0.004±0.0	0.002±0.0	0.003±0.0
Ba	0.08±0.00	0.09±0.01	0.08±0.02	0.09±0.01	0.09±0.00	0.10±0.11

Table 4. Heavy metal contents of ice cream mixes

Element	Heavy Metal (mg/kg)					
	Ice Cream Types					
	Control	DM1	DM2	DM3	DM4	DM5
Al	0.76±0.07	0.54±0.02	0.73±0.39	0.62±0.28	0.71±0.07	0.88±0.30
Cr	0.23±0.05	0.17±0.01	0.17±0.11	0.17±0.02	0.15±0.01	0.20±0.06
Mn	0.07±0.00	0.07±0.01	0.09±0.03	0.10±0.01	0.01±0.01	0.15±0.03
Fe	13.8±1.26	14.2±2.18	13.7±3.84	12.1±3.53	15.0±0.12	13.4±3.07
Cu	0.07±0.01	0.08±0.00	0.09±0.01	0.08±0.01	0.08±0.01	0.09±0.00
Zn	2.11±1.13	1.57±0.73	1.29±0.20	2.30±0.02	1.83±0.12	2.59±0.70
As	0.003±0.0	0.003±0.0	0.003±0.0	0.003±0.0	0.003±0.0	0.003±0.0
Pb	0.012±0.0	0.013±0.0	0.019±0.0	0.015±0.0	0.011±0.0	0.015±0.0
Ni	0.05±0.00	0.048±0.0	0.048±0.0	0.052±0.0	0.046±0.0	0.048±0.0

The determination of Na and Ca values of the macro elements of propolis powder used in the study was determined by Tosic et al. (2017) lower than the values were found to be high. When the trace element contents of propolis powder were compared with the results obtained by Tosic et al. (2017), conducted a similar study, Fe, Zn, Cu, B, Mn, Ni, Cr and Se contents were found to be lower, while the Si content was found to be higher. Considering the heavy metal contents, the Fe, Zn, Cu, Cr, Ni and Pb values of the propolis powder are compared to the values obtained by González-Martín et al. (2015) in their study with 91 propolis samples was found to be low. Since the composition of propolis is affected by many factors such as the source from which it is obtained, seasonal effects, and extraction method, it is thought that there are great differences between the element values in the studies.

Conficoni et al. (2017) investigated the heavy metal content of industrial production ice cream and ice cream samples produced by small-scale producers. They found the amount of As below 0.02 mg/kg in all their samples. It coincides with the As values obtained in this study. Cr and Pb heavy metal values in small-scale producer ice cream samples were 0.128 and <0.02 mg/kg, respectively; found it to be 0.179 and 0.056 mg/kg, respectively, in industrial production ice cream. The Cr element values found in our study correspond to these values. Industrial production ice cream Pb value is higher than the values obtained in our study.

Erkaya et al. (2012) produced ice creams by adding ground cherries in different concentrations to the formulation and investigated the element content of the ice creams they produced in their studies. In their elemental analysis, the quantities of Ca, K, Mg, Na, Fe, Mn, Ni and Zn elements were determined as 1200-1900, 1600-2100, 600-700, 150-200, 9.78-23.77, 0.23-0.42, 1.05-1.64 and 59.54 mg/kg, respectively. The amount of Ca and Fe calculated in this study corresponds to the amounts calculated in our study. The amounts of K, Mg, Ni and Zn are higher than the amounts we found, while the amounts of Na and Mn are higher in the ice creams we produce. When the element analysis was examined in general, it was seen that the addition of propolis did not have a statistically significant effect on the mineral and heavy metal content of ice creams. The reason for this is that the powdered propolis was added at a low rate.

Conclusion

The addition of propolis powder to ice cream had no significant effect on the mineral contents of ice cream due to propolis added at very low concentrations. Also there was no negative effect of propolis addition regarding to heavy metal content. Propolis content varies depending on region and sessional conditions. By adding propolis at different concentrations and from different sources to ice cream, obtaining a new functional food can be possible in future works.

Ethical Statement

Not applicable.

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Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Author 1: Methodology; Investigation; Analysis; Original Draft, Formal Analysis

Author 2: Conceptualization; Supervision.

Author 3: Analysis; Conceptualization

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References

Brown, R. (1989). Hive products: pollen, propolis and royal jelly. *Bee World*, *70*, 109- 117.

Chen, P. C., & Wong, G. (1996). Honey bee propolis: prospects in medicine. *Bee World, 77*, 8– 15.

Conficoni, D., Alberghini, L., Bissacco, E., Ferioli, M., & Giaccone, V. (2017). Heavy Metal Presence in Two Different Types of Ice Cream: Artisanal Ice Cream (Italian Gelato) and Industrial Ice Cream. *Journal of Food Protection*, *80*(3), 443–446.

Deblock-Bostyn, G. (1982). L'Abeille et ses produits. *Bull Soc Pharm Lille*, *38*, 181- 203.

Erkaya, T., Dağdemir, E., & Şengül, M. (2012). Influence of Cape gooseberry (*Physalis peruviana* L.) addition on the chemical and sensory characteristics and mineral concentrations of ice cream. *Food Research International*, *45*(1), 331–335.

Ghisalberti, E. L. (1979). Propolis: a review. *Bee World*, *60*, 59-84.

González-Martín, M., Escuredo, O., Revilla, I., Vivar-Quintana, A., Coello, M., Riocerezo, C., & Moncada, G. (2015). Determination of the Mineral Composition and Toxic Element Contents of Propolis by Near Infrared Spectroscopy. *Sensors, 15*(11), 27854–27868.

Marcucci. M. C. (1994). Propolis: chemical composition, biological properties and therapeutic activity. *Apidologie*, *26*, 83-99.

NMKL 186 (2007). Trace elements - As, Cd, Hg, Pb and other elements. Determination by ICP- MS after pressure digestion.

Tosic, S., Stojanovic, G., Mitic, S., Pavlovic, A., & Alagic, S. (2017). Mineral Composition of Selected Serbian Propolis Samples. *Journal of Apicultural Science*, *61*(1), 5-15.

Yucel, B., Topal, E., & Kosoğlu, M. (2017). Bee Products as Functional Food -An Overview of Their Processing and Utilization. In N. Shiomi (Ed.), *Superfood and Functional Food-An Overview of Their Processing and Utilization* (pp.15-33). InTech.