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Preliminary research on some nutritional parameters of homemade chocolate with added spices

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Abstract

This paper aims to determine the proximate composition of some varieties of homemade chocolate based on cocoa, milk, sugar and butter, with additions of spices.

To carry out this preliminary study, were prepared three assortments of homemade chocolate with the addition of cinnamon, ginger and chili pepper, which were analyzed in terms of the protein, carbohydrates and fats contents.

Preliminary results (average values) obtained, using the analysis methods recommended by the quality standards: 8.15 - 8.62% protein; 51.94 – 74.50% carbohydrates and 22.03 – 22.51% fats shows that the chocolate assortments studied contain significant amounts of nutritional facts.

In addition, these chocolates are distinguished by a pleasant taste, slightly spicy and a special flavor.

Also, due to the addition of spices, these chocolates could have superior antioxidant properties to traditional chocolates.

Keywords: homemade chocolate with spices, nutritional values, cinnamon, ginger, chili pepper.

1. Introduction

Chocolate, a product obtained from cocoa, milk, sugar and other ingredients (flavors, emulsifiers, etc.) is the dessert highly appreciated by consumers of all ages [1]. Served in the form of a tablet, bar, praline, ice cream or other sweet products, it occupies a leading place among foods with a global spread [1, 2]. Chocolates can be classified according to several criteria, which depend on the amounts of ingredients present in their composition [1, 3]. Thus, dark chocolate contains mainly cocoa powder (up to 80% of the total weight) and cocoa butter. Gianduja chocolate is a combination of hazelnuts, cocoa and sugar. Milk chocolate contains cocoa butter, sugar, milk powder, lecithin and cocoa (the latter not less than 20 - 25%).

White chocolate contains cocoa butter, milk and sugar without cocoa solids.

Due to its obvious organoleptic properties (special taste and aroma), comforting effects (removal of fatigue, restoration of well-being and comfort), chocolate is one of the most appreciated foods [2]. In addition, chocolate is an important source of nutrients and antioxidants: carbohydrates, fats, proteins, but also vitamins (A, complex B, E, K), minerals (Ca, K, P, Na, Mg, Fe, Mn, Zn), theobromine, cholesterol, caffeine [2, 3, 4, 5, 6]. Chocolate contains over 300-500 known chemical compounds such as: phenylethylamine, anandamide, theobromine, caffeine, serotonin, phenolic, xanthene, histamine, but also components such as cocoa butter, sugar, milk powder [1].

Both chocolate and cocoa beans used as raw materials are rich sources of biologically active compounds [7], so chocolate acts as a functional food, as both contain a number of substances that contribute to beneficial effects on health.

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Chocolate combines some organoleptic characteristics with aphrodisiac and antidepressant properties, extending its effects beyond the cardiovascular system, metabolic diseases, diseases of the central nervous system and psychological profiles [3, 2, 8, 9]. Despite the possible benefits, excessive chocolate consumption can promote obesity and diabetes or a predisposition to allergies, addiction, anxiety, etc. [3]. It should be noted that chocolate is one of the main potentially allergenic foods, capable of causing hypersensitivity reactions, manifesting various clinical symptoms (fatigue, irritability, insomnia, headache, asthma and diarrhea) that occur within hours or days after consuming chocolate [10]. The interest in knowing the composition of chocolate is due to its beneficial effects on the physiological processes in the body: blood pressure regulation, insulin level, vascular functions, oxidation processes, prebiotic effects, carbohydrate and lipid metabolism.

The nutritional composition of chocolate is mainly determined by the nature and nutritional value of the ingredients from which it is obtained and has different values, depending on the type of chocolate, how to obtain it, etc. [6,11].

Analyzing proximate composition of two types of chocolate, Montagna et al., obtained the following values: 6.6 g/100g protein, 33,6 g/100g lipid, 49.7 g/100g carbohidrate, 50.5 g/100g sugar, the energy value was 515 kcal/100g, respectively 2155 kj - for dark chocolate and 7.3 g/100g protein, 36.3 g/100g lipid, 50.7 g/100g carbohydrate, 49.7 g/100g sugar, the energy value was 545 kcal/100g respectively 228 kj -for milk chocolate [3].

In a study conducted on proximate analysis and microbial analysis of probiotic chocolate, Kharat and Deshpande showed that the probiotic chocolate analyzed contains 5.64 % moisture, 31.73% crude fat, 6.82% crude protein, 2.43% crude fiber, 2.12% ash and 51.27% carbohydrate. Relatively close values of proximate composition for milk chocolate were determined by S. O. Aroyeun1 et. al, 2019: 6.3% protein, 33.58% fat, 2.68% crude fiber, 2.35% ash, 5.74% moisture, 48.81 % carbohydrates [12].

Referring to proximate composition of chocolate, Padovani et al. reported that milk chocolate presents nutritional values between the following limits: 11.02 - 14.88% water, 1383 -1427 kj/100g energy, 21.34 – 21.60% protein, 1.24 – 1.42% fat, 60.46 – 62.36% carbohydrates, 15.2 – 21.8% dietary and 3.60 – 3.79% ash [13].

The beneficial effects of chocolate consumption on the body are mainly due to the high content of dietary polyphenols derived from cocoa, the basic component of most chocolates. Because dark chocolate contains higher concentrations of cocoa, this type of chocolate has superior beneficial effects compared to normal chocolate or milk chocolate [14]. In addition, regular milk chocolate could be associated with side effects due to its sugar content. The nutritional and therapeutic quality of milk chocolates can be improved by incorporating in its mass some compounds with high content of nutrients and antioxidants, such as some fruits, vegetables, legumes and some spices, such as garlic, clove, cinnamon, turmeric, anise, ginger, hot pepper, chili or lemon peel [15, 16, 17, 18].

The literature provides data on the proximal composition and sensory analysis of chocolate with the addition of spices. The use of spices in chocolate has been reported by Fatma and Ali [15] who made some assortments of functional chocolate with spices (cinnamon, aniseed and ginger) and lemon peel powder. Proximate composition of of these chocolates is the following: 0.52 (dark chocolate) - 0.96% (aniseed chocolate) for moisture; 30.70 (in cinnamon chocolate) - 34.71% (in ginger chocolate) for fats; 8.42 (in dark chocolate) - 9.47% (in aniseed chocolate), for protein; 1.73 (in dark chocolate) - 2.15% (in cinnamon chocolate), for ash; 52.49 (in dark chocolate) - 57.80 (in cinnamon chocolate), for carbohydrate.

A study that can fill some gaps regarding the obtaining and nutritional and sensory profile of functional chocolates obtained by adding spices was developed by Aroyeun et al., 2019 [19]. The authors of this study prepared spicy chocolates with specific flavors obtained by partial replacement of cocoa nibs with different selected spice powders of: ginger, garlic, clove, cinnamon, turmeric, Aframomum danielli, Aframomum melegueta, thyme, black pepper and Clappertonia. Milk chocolate without spices served as control. The range of values obtained for the proximate compositions were (%): protein (6.34, for black pepper - 7.44, for ginger); fat (31.53, for ginger - 34.42. for Aframomum danielli), ash (2.27, for blacl pepper - 2.81, for ginger), moisture content (5.06, for black pepper - 5.86, for clove), crude fiber (2.35, for Aframomum melegueta - 2.68, for milk chocolate) and carbohydrate (47.83, for Aframomum danielli - 51.63, for black pepper) respectively.

In a study on the identification of antioxidants compounds from dark chocolate with the addition of some spices and herbs, Mira Suprayatmi et al. [18], found that the addition of ground ginger, cinnamon powder, red chili powder, powdered mint leaf, powdered green tea leaf and powdered linden leaf, increases the antioxidant content of chocolate. Moreover, in another study, Mira Suprayatmi et al., obtained three types of dark chocolate with the addition of powdered mint leaves, powdered green tea leaves, and powdered lime leaves, each at 4% (w/w) [20]. The study authors found that the chocolate products with the addition of powdered mint leaves, powdered green tea leaves and the powdered lime leaf were experiencing an increase in the number of types of antioxidant.

From the presented data it is obvious the interest for knowing the nutritional and therapeutic profile of chocolate with added spices. This paper aims to determine the proximate composition of some varieties of homemade chocolate based on cocoa, milk, sugar and butter, with additions of spices. Proteins, fats and carbohydrates content were determinated from three varieties of homemade chocolate with the addition of chili peppers, cinnamon and ginger.

2.Materials and methods

Materials

The basic ingredients: sugar, milk powder, cocoa powder and butter, as well as the three spices: cinnamon, ginger and chili pepper used to prepare chocolate assortments were purchased from the local market. Sugar, butter and powdered milk are Romanian products. Cocoa, cinnamon, ginger and chili pepper, all in powder form, are imported products. Homemade chocolate (HC), considered the control sample, was obtained according to a recipe used to prepare homemade chocolate, with the mention that larger amounts of cocoa powder and smaller amounts of sugar and butter were used. The following ingredients were used to prepare homemade chocolate: sugar (32.5%), butter (17.5%), powdered milk (25%), 15% cocoa, water (10%) and spice (5%). Chocolates with added spices: cinnamon chocolate (CC), ginger chocolate (GC) and chili pepper chocolate (ChC) were obtained from control chocolate (MC), in the composition of which were added 5g spice (cinnamon, ginger or chili pepper)/100g control chocolate.

Equal amounts of spices were used to differentiate between homemade milk chocolate and the chocolate with spices. The spices were added under continuous mixing, in the last step (fluid phase) of chocolates obtaining.

Proximate analysis

Determination of the nutritional composition of all the chocolate samples were carried out according to the recommendations of Aroyeun et al. and Albak and Tekin [15,19]. Protein content was determined by the Kjeldahl method, using a nitrogen conversion factor of 6.25. Crude fat was determined using the Soxhlet method with hexane as solvent. The carbohydrate contents were obtained by difference. For each physicochemical determination, five replicates were established.

Statistical analysis

All the data was statistically analyzed for variance (ANOVA) using STATISTICA10. The comparisons for means were done using Duncan's Multiple Range Tests (DMRT). Duncan's Multiple Range Tests or Duncan's new multiple range test, provides significance levels for the difference between any pair of means, regardless of whether a significant F resulted from an initial analysis of variance [21].

3. Results and Discussion

The objective of our work was to evaluate some variables (fat, protein, carbohydrates) that are influencing nutritional value for several types of homemade chocolate. For the sake of simplicity in our statistical analysis, we used some abbreviations: (HC) for homemade chocolate, (ChC) for chilli chocolate, (CC) for cinnamon chocolate and (GC) for ginger chocolate. The preliminary results obtained in determining the nutritional parameters: carbohydrates, proteins and lipids from the analyzed chocolate assortments are presented in table 1 and graphically illustrated in figures 1-3.

These results revealed statistically significant differences between some nutritional characteristics of the analyzed homemade chocolate types, using Duncan's test for multiple comparisons ($p<0.05$ were considered as significant). The nutritional parameters of chocolate with added spices have different values depending on the determined parameter and the type of chocolate (see Tab. 1 and Fig.1-3).

Table 1. Nutritional values (mean±SD) of some chocolate types

Chocolate tipes	Nutritional parameters, %		
	Proteine	**Carbohydrates**	**Fats**
Homemade chocolate (HC)	7.93±0.11	48.32±1.78	21.43±1.20
Cinnamon chocolate (CC)	8.15±0.11	52.41±0.91	22.03±0.97
Ginger chocolate (GC)	8.38±0.14	51.94±1.07	22.19±0.97
Chili pepper chocolate (ChC)	8.62±0.09	74.50±1.49	22.51±0.87

The protein content shows values between 8.08 - 8.22% in cinnamon chocolate, 8.19 - 8.55% in ginger chocolate and 8.48 - 8.71% in chili pepper chocolate (see Fig. 1). If we consider the average values of protein content in chocolates with added spices, we can see that chocolate with added chili pepper is the richest in protein (8.62%).

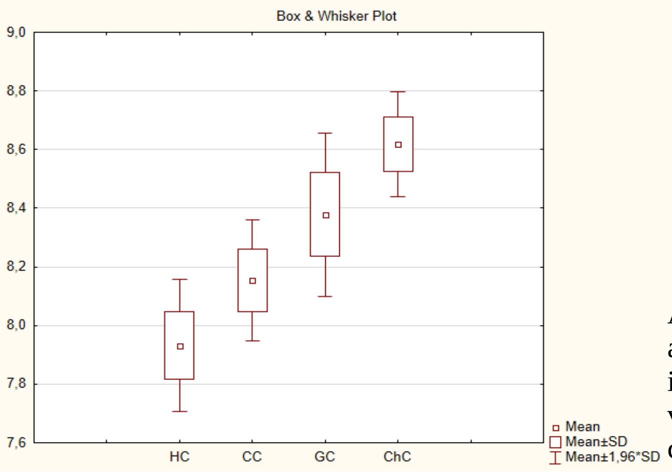

Figure 1. Box and whisker plot for the protein content distributions of different type of homemade chocolate

Statistically significant differences ($p<0.05$) were determined in the case of chocolate with added cinnamon (8.15%) and ginger (8.38%). Comparing the average value of the protein content determined in the chocolates with added spices with that determined in the control sample (7.93%), it is observed that there are statistically significant differences ($p<0.05$) between the control chocolate and the types of chocolates with added spices analyzed. These differences can be explained by the amount of protein contained in the spice addition.

The concentration of carbohydrates varies depending on the type of chocolate with the addition of spices and has values between 51.38 – 53.78% in cinnamon chocolate, 50.81 – 53.54% in ginger chocolate and 72.54 – 76.03% in chili pepper chocolate (see Fig. 2).

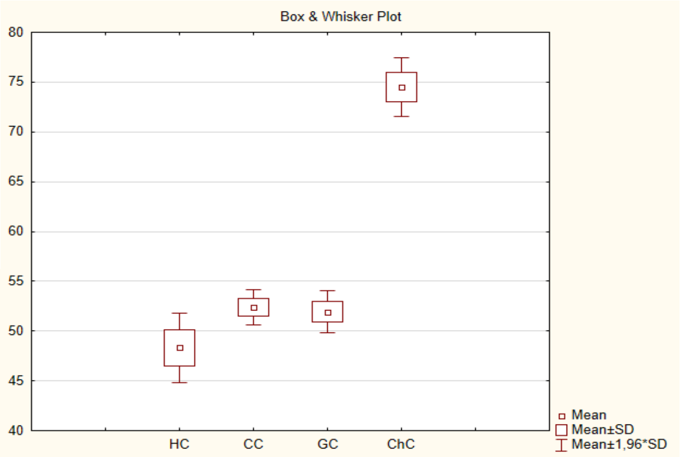

Figure 2. Box and whisker plot for the carbohydrates content distributions of different type of homemade chocolate

As can be seen from the data presented in Table 1 and Figure 2, the highest carbohydrate content was identified in chili pepper chocolate (74.50% - mean value). Lower but close concentrations of carbohydrates were identified in cinnamon chocolate (52.41%) and ginger chocolate (51.94%). From a statistical point of view ($p<0.05$) it can be stated that there are notable differences between the concentration of carbohydrates in chili pepper chocolate and that of cinnamon and ginger chocolate. Carbohydrate concentrations in cinnamon and ginger chocolate can be considered statistically equal ($p<0.05$). Comparing the average values of the carbohydrate content in the control chocolate (48.32%) with those determined in the chocolates with added spices, statistically significant differences are observed ($p<0.05$). The largest difference between carbohydrate concentrations is reported between chili pepper chocolate (74.50%) and the control sample (48.32%); smaller differences in carbohydrate content are reported between ginger chocolate, cinnamon chocolate and control chocolate. These differences can be explained by the higher carbohydrate content of chili pepper chocolate.

The fat content of chocolate samples with added spices presents relatively close values that are between 20.97 - 23.17% in cinnamon chocolate, 21.07 - 23.27% in ginger chocolate and 21.48 - 23.67% in chili pepper chocolate (see figure 3). The fat content of the control chocolate has values close (20.63 – 22.78%) to those determined in chocolates with added spices. After processing the data, for the fats content not been observed statistically significant differences ($p<0.05$) between the protein content in case of all 4 chocolate types that we analyzed (see Fig. 3). The explanation is due to the low fat content in the mass of spices used to prepare the three types of chocolates.

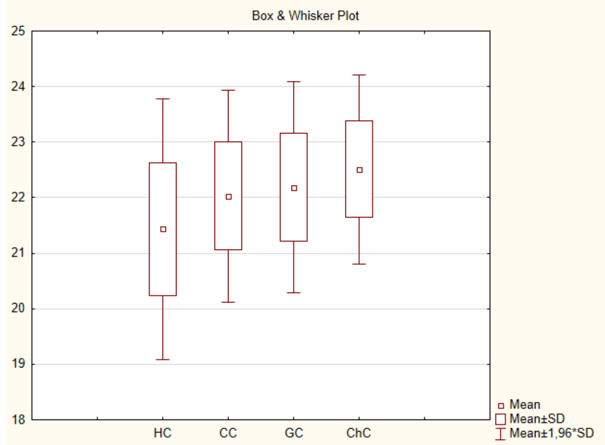

Figure 3. Box and whisker plot for the lipid content distributions of different type of homemade chocolate

A comparison of the results obtained in the analysis of proteins, carbohydrates and fats from the three types of chocolate with the addition of spices, with the data obtained by other researchers is quite difficult, because the literature consulted does not abound in such data. However, it can be seen that the results obtained generally fall within the range of values reported by different authors (see to introduction) following the analysis of relatively similar varieties of chocolate.

From the above it can be seen that, in general, chocolates with added spices are nutritionally richer than homemade chocolate (control). In addition, if we consider the total content of polyphenols present in the mass of spices used in the preparation of the three types of chocolate, (in mg GAE/g): 14.5 - for ginger, 155.1 - for cinnamon and 7.1 - for chili pepper [22], it can be deduced that the chocolate assortments with the addition of cinnamon, ginger and chili pepper, would have an antioxidant effect superior to the control chocolate.

Therefore, the antioxidant activities corresponding to the three types of chocolate would show the following decreasing trend: cinnamon chocolate > ginger chocolate > chili chocolate. This statement is to be proved in a subsequent study that will aim to evaluate the content of polyphenols and the antioxidant capacity of some types of homemade chocolates with added spices.

4. Conclusions

The assortments of homemade chocolate and those with added spices that have been prepared and analyzed for this study, contain significant amounts of protein (7.93 - 8.62%), carbohydrates (48.32 - 74.50%) and fats (21.43 - 22.51%). The types of chocolate with the addition of cinnamon, ginger and hot peppers contain significantly higher amounts of nutrients than homemade chocolate. In addition, chocolates with the addition of spices are distinguished by a more pleasant taste, slightly spicy and a special aroma. Also, due to the addition of: cinnamon, ginger and pepper, there are definite (reasonable) indications that spice-added chocolates have superior antioxidant properties to traditional homemade chocolate. This is to be proven in a subsequent study that will aim to determine the antioxidant capacity of homemade chocolate with the addition of spices

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human or animal subjects (if exist) respect the specific regulation and standards.

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