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ASSESSMENT OF PHISICOCHEMICAL AND SENSORY PROPERTIES OF CHOCOLATE WITH HEMP PRODUCTS ADDITION

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Abstract: *Chocolate is one of the most consumed delights in the world. Cocoa bean is well recognized for its chemical composition containing more phenolic antioxidants – flavonoids comparing to other food products. The properties of Cannabis sativa flour and seeds were investigated as addition to a popular product – chocolate. It was observed that the hemp products added improved the sensorial properties and the content in fibers and in the final product. The chocolate with hemp products could be a good functional food.*

Keywords: *chocolate, hemp, row fiber, mineral*

INTRODUCTION

There are many studies on ways of creating special foods necessary not only to make up for micronutrient deficiency in the diet and support the functions of the human body, but also to protect it from many diseases caused by environmental impact (immune, cardiovascular, respiratory and oncology diseases and aging) [1]. Chocolate is known for its good taste and proposed health effects. The recent discovery of biologically active compounds in this food stimulated research on its effects in ageing, oxidative stress, blood pressure regulation, and atherosclerosis. Today, chocolate is lauded for its antioxidant potential and many countries of the world (United Kingdom, Norway, Finland, USA and others) have large scale programs for population health improvement that include different food as a solution [2].

Hemp flour contains all minerals required by the human body: calcium, magnesium, iron, potassium and a record amount of - magnesium, which has a positive effect on the body's stress resistance

- row dietary fibers that aid the regulation of the gastrointestinal tract.

The goal of this research work was to present the advantages presented by the use of the hemp (*Canabis sativa* L.) seeds in chocolate obtaining and the influence of these ingredients addition on several final product quality indicators.

Chocolate is one of the most appreciated human food product, being needful for daily feed because its nutritive value and energizing substances content. Researcher target concerns to improve the quality of this kind of food, to obtain products with high nutritive value, with pleasant taste and. Moreover, the orientation of food producers to natural and healthy products is known and present in food technology research [3]. In this regard, the goal of this paper was to obtain several high nutritional value chocolate products, improving the bioactive compounds content by addition of hemp seeds (material with high level of dietary fiber content and micronutrients). The use of these adjuvants in chocolate preparing could be justified because the complex composition in nutrients: sugars, proteins, microelements (calcium, potassium, potassium) and essential fatty acids [4].

A lot of benefits give to the hemp seeds and flour the qualities of an additive-enricher in foods. Hemp flour also contains:

- 20 amino acids essential for the human body.
- more fiber than other flour
- more protein than short patent wheat flour
- high level of valuable lipids, including essential fatty acids (omega-3 and omega-6).
- vitamins and deficient mineral elements [4]

The most important health benefits of hemp seeds and flour are explained by the fact that they contain a high amount of insoluble and soluble dietary fiber, or row dietary fiber, which aid the body to remove wastes [5].

The experimental studies in this work research aimed to evaluate the effects of hemp seeds addition in different chocolate variants on the quality, on their chemical composition (particular on the level of row fibers and several mineral elements calcium, magnesium, potassium). So, by changing the classical chocolate recipe, these experiments aimed to verify if beside a better nutritive compounds contribution, the hemp seeds used contribute or not to obtaining a product with a special taste and flavor.

1. MATERIAL AND METHODS

Ash weight percentage was calculated by burning the grounded sample weight of the product until the substance is completely burned, followed by a quantitative measurement of the residue. Fiber was measured through a step-by-step application of acid solution, alkali solution and ashing the sample weight of the trial sample and a quantitative measurement of the organic residue by weight. Acidity was calculated through titration of the suspension of a sample weight of re grounded product in a 0.1 N solution of sodium hydrate with the addition of 5 drops of 1% phenolphthalein solution until it turns pink and remains pink for 1 minute. The samples of hemp were

tested for evaluation the total content of dietary fibers and content of minerals (calcium, magnesium and potassium). Similar compounds content were tested in chocolate products.

Chocolates were produced in laboratory ball mill at 55 °C with speed of mixing 60 rpm and mixing time 3 h. Cocoa was added at the beginning with cocoa butter and after 30 min cocoa mass and sugar were added. Lecithin was added 1 h, vanillin 30 min and the hemp seeds 10 min of mixing before the end. Table 1 shows the recipes of all samples. Chocolate mass was tempered (temper index 4-7), moulded and cooled (8 °C/30).

Table1. Recipes of chocolate variants tested

Ingredients*	ID samples according to hemp addition			
	C (control)	H5% (5% adition)	H10% (10% adition)	H15% (15% adition)
Cocoa mass (%)	25	20	15	10
Cocoa butter (%)	25	25	25	25
Sugar (%)	45	45	45	45
Milk powder (%)	5	5	5	5
Hemp (%)	-	5	10	15

*In all samples 0.4% of lecithin and 0.03% of vanillin was added.

The chocolate variants obtained were subjected to sensorial examination: form, aspect, consistency comparison, smell, taste) and to the physic chemical exam, testing the moist and acidity of the samples.

The mineral content (calcium, magnesium and potassium) in chocolate samples were determined using an inductively coupled plasma mass (ICP-MS; Perkin Elmer NexION 300q) [6]. For calculate the sample minerals concentration (mg/100g) the following formula (1) was used:

$$C = \frac{(A - A_0) \cdot V}{b \cdot M \cdot 10} \quad (1)$$

A = absorbance of the sample solution;

A₀ = absorbance of the blank solution;

b = slope of the calibration curve (L/mg);

M = sample weight (g);

V = volume of the sample solution (mL).

The total row fiber content was measured through a step-by-step application of acid solution, alkali solution and ash the sample weight of the trial sample and a quantitative measurement of the organic residue by weight [7]. The samples were dissolved using an acid detergent fiber ADF solution (20 g of N- acetyl -N, N, N – methyl ammonium bromide diluted in 1 liter of sulfuric acid, 0.5 mol / L) and special fiber sacks (Fiber bags). A Foss Fibertec Dietary Fibre Analysis System (Fibertec™1023, Denmark) was used for evaluate the total dietary fiber content.

2. RESULTS AND DISCUSSION

3.1. Physicochemical features and sensory evaluation

Points scale method was used. The sensory features of the chocolate products obtained according to the recipe (described in material and method) are presented in Table 2.

In all the experimental variants, the chocolate was well done, the shape was a correct one excepting the variant H15% (addition hemp flour 15% with and without seeds). For the variants with hemp seeds addition, the color was with little light spots (Fig. 1). The taste and the smell were pleasant, more intense for the chocolate with hemp seeds addition (variants H15% and H10%). The best values of the sensorial properties were obtained for the chocolate variants H10% (with 10% hemp flour addition in the drought).

Table 2. Sensorial analysis for the chocolate products supplemented with hemp products

Sensorial indicator	Samples tested			
	C (control)	H5% (5% addition)	H10% (10% addition)	H15% (15% addition)
Form, aspect	2	3	3	2
Consistency	1.5	2.5	4	1
Chewing comparison	1.5	2.5	4	1
Smell	2	2	3	3
Taste	1.5	2	3	3
Points	8.5	12	17	10
Qualification	Satisfactory	Good	Very good	Good

The physicochemical features for all chocolate variants products are presented in Table 3. In all cases in which hemp products were added, the products were proportional, specific to assortment, the products were not excessively modified concerning the sensorial properties.

The moisture of the samples with hemp products addition was higher than the control, between 35.61 ± 0.326 (chocolate with 5% hemp flour addition) and $37.95 \pm 0.899\%$ (chocolate with 15% hemp flour addition). This increase was because on the one hand of the colloidal processes (the coagulation of hemp protein substances) from preparation.

Table 3. Physicochemical parameters, row dietary fiber and minerals content for the chocolate products supplemented with hemp products

Parameter tested	Samples tested			
	C (control)	H5% (5% addition)	H10% (10% addition)	H15% (15% addition)
Moisture (%)	34.12 ± 1.225	35.61 ± 0.326	36.83 ± 0.158	37.95 ± 0.899
Acidity (acidity degrees /100g product)	1.41 ± 0.080	1.58 ± 0.020	1.68 ± 0.040	2.25 ± 0.045
Row fiber weight percentage (%)	1.24 ± 0.182	3.78 ± 0.612	4.54 ± 1.072	6.14 ± 1.081
Calcium ($\mu\text{g}/100\text{g}$)	63.61 ± 4.482	74.92 ± 3.394	80.68 ± 7.208	89.88 ± 3.208
Magnesium ($\mu\text{g}/100\text{g}$)	87.00 ± 5.802	100.84 ± 5.782	124.16 ± 9.253	133.08 ± 14.122
Potassium ($\mu\text{g}/100\text{g}$)	187.70 ± 9.506	268.12 ± 18.184	274.26 ± 15.297	301.05 ± 23.116

*The values in the table represent mean of 3 repetitions \pm standard deviation

The acidity of samples with hemp products addition was higher comparing with the control, varying between 1.58 ± 0.020 (chocolate with 5% hemp flour addition) to 2.25 ± 0.045 (variant with hemp flour addition 15%) maybe because of the presence of the organic acids (fatty acids from oils and from the other hemp products).

Preliminary experimental data obtained for sensorial and physical-chemical analysis for chocolate with hemp products added suggested that this hemp products addition could be used in chocolate process. Figure 1 presents types of chocolate obtained with hemp products (Fig. 1).



Figure 1: Chocolate with hemp products.

3.2. Total row fiber content and minerals microelements evaluation

The hemp flour was rich in dietary fiber and registered high levels of fatty and proteins compounds (functional compounds, because of their content in essential fatty acids, respectively essential amino acids). Overall, the preparation techniques and the level of hemp flour additions were responsible for a significant decrease in the amount of row dietary fiber content (expressed as weight percentage) when compared with the ingredient used (hemp flour). It should be noted, however, that the level of dietary fiber in products was significantly different to the content present in raw hemp flour used. As seen in Table 3, the losses were significantly specially for the total fiber content in case of the highest level of hemp flour addition (15%) (change relative to raw hemp flour). A positive effect of hemp flour on the row dietary fiber content values of chocolate was observed. In all variants, compared with the control, the level of this nutritional indicator was higher. And the technological parameters were improved in all the experimental variants, too. Maybe, the fiber from hemp flour expands the gelatinized mass, increases the active surface, traps air bubbles caught when kneading, which increases the product property. The fat contained in the hemp products also increases the gas-retaining capacity and improves the crumb's structural and mechanical properties.

The mineral content of the control and chocolate samples is presented in Table 3. A positive effect of hemp flour on the minerals content values of chocolate was observed. All chocolate samples prepared with hemp flour addition contain increased amount in micronutrients compared with the control: calcium (1.7-2.07 times), potassium (1.44-1.60 times) and magnesium (2.17-2.83 times).

The hemp products used in the experiments allows us to make chocolate variants with increased nutritional value, containing between 132.2-395.2% more fiber compared with the control. The new chocolate variants had higher mineral content: calcium content increased by 107.2%, potassium by 60.4% and magnesium by 183.1% (Table 3).

Chocolate obtained using hemp flour contain minerals required by the human diet: calcium, magnesium, potassium and high amount in dietary fibers (important compounds because they aid the regulation of the gastrointestinal tract). Thus, the presence of these compounds in the products with hemp products addition could be useful for the consumers, opposite to the opinion create regarding the psychoactive and narcotic properties of cannabis (which really are present, but only in the stems and leaves of the plant). As reported by another research work [6, 8], hemp products made from the seeds are completely safe and could be used as addition in food and the chocolate is a valuable and health food [9].

3. CONCLUSIONS

Using hemp products (flour, seeds) supplement in the chocolate obtained with a classical method, results assortments with high nutritional value. In this way proteins, essential fatty acids, mineral and dietary fibers were added to the chocolate products, improving their quality.

Beside improving the nutritional value, another advantage of hemp products addition (particular for the variants supplemented with 10% hemp flour) was an interesting color of the product as result of the natural sugars, organic acids content. Also, 10% hemp products addition has the best influence on the chocolate features.

Thus, the preliminary experimental data suggest that hemp products addition could be used for obtain special and challenge chocolate products.

REFERENCES

- [1] Terry P., Terry J.B., Wolk A., Fruit and vegetable consumption in the prevention of cancer: An update, *International Journal Medicine* 250(4), 2001, 280-290
- [2] R. Latif, Chocolate/cocoa and human health: a review, *The Nederland Journal of Medicine* 71 (2), 2013, 63-68
- [3] Bădărău C.L., C.M. Canja, F. Damşa, A. Mărgean, Effects of Several Purple Potato Additions on Bread Quality. *International Journal of Engineering Research and Applications*, 6(4), 2016, 1-10
- [4] Leson G., Hemp foods in North America, *Journal of Industrial Hemp*, 11(1), 2006, 87-93
- [5] Lukin A. and Bitiutskikh K., On potential use of hemp flour in bread production, *Bulletin of the Transilvania University of Braşov Series II: Forestry • Wood Industry • Agricultural Food Engineering*, 10 (59) No.1, 2017, 113-118
- [6] Skurikhin I.M., V.A. Tutelyan, A guide to the methods of analysis of food quality and safety. In: Brandes, Medicine, Moskow 1998, 223-240
- [7] Cui S.W., K.T. Roberts, *Modern Biopolymer Science (Elsevier Publish, 2009)*
- [8] Lukin A. and K. Bitiutskikh, Investigation on the use of hemp flour in cookie production. *Bulgarian Journal of Agricultural Science*, 23 (4), 2017, 664-667
- [9] Vinson JA, Proch J, Bose P, et al, Chocolate is a powerful ex vivo and in vivo antioxidant, an anti-atherosclerotic agent in an animal model, and significant