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DEVELOPMENT OF SOME INNOVATIVE BAKERY PRODUCTS BASED ON WHEAT FLOUR ENRICHED IN BIOACTIVE COMPOUNDS WITH FUNCTIONAL ROLE

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Abstract

In this work an extensive analysis of the composition of Cannabis sativa L., has been done in order to further exploit the functionality of it in bakery products based on wheat flour.
*Cannabis sativa L., is already known, (*J. C. Callaway, 2002*,) as an excellent source of unsaturated fatty acids (omega 3 and omega 6 - in an optimum ratio), fiber, amino acids (lysine, alanine, arginine), and high content of mineral which should recommend it as an important functional ingredient in food.*
In this study, partially Cannabis sativa L. skimmed flour has been used in different proportions for enrichment of wheat flour with functional ingredients such as: bioactive carbohydrates (dietary fiber), bioactive protein, essential fatty acids and minerals.
Fatty acid composition was determined by ^{1}H-NMR and minerals evaluation was done by using ICP analysis.
The results demonstrated that Cannabis sativa L, partially skimmed, should be used in food industry, especially in bakery processing, as additional valuable source of bioactive compounds.

Key words*: hemp, bread, fatty acids, dietary fiber.*

INTRODUCTION

Hemp *(Cannabis sativa* L.) is one of the first plants cultivated by humans for use in the manufacture of various fabrics, rope and paper. Later it was used widely in food and medicinal purposes (Fitzpatric, 2007).
Currently, industrial hemp and marijuana are both classified as *Cannabis sativa*, a species with hundreds of different varieties. Industrial hemp is bred to maximize fiber, seed and/or oil, while marijuana varieties seek to high content of THC (9-tetrahydro-cannabinol; the primary psychoactive component). In the European Union, only cultivars containing less than 0.3% THC in their flower portions are permitted as commercial crops (Ivan Svec, Marie Hruskova, 2015). Hemp seed oil has a high content of polyunsaturated fatty acids and the ratio of omega-3 and omega-6 (1:2 and 1:3) is optimal for human health (S. Rezapour-Firouzi et al., 2013).
With a valuable nutritional content, hemp seed is an excellent source of protein, dietary fiber, vitamins (A, C and E) and minerals (JC Callaway, 2002, 2004).
The hemp seed proteins have a good potential to be used as a valuable source of protein in nutrition. (X.-S. Wang et al., 2008)
Currently there are few works that reveal valuable potential of hemp seed flour partially defatted. X.-S. Wang et al., have obtained and studied a protein isolate from defatted flour hemp seed. The findings of this study were that the proportion of essential amino acids to the total amino acids for hemp seed protein isolate and their in vitro pepsin plus trypsin digestibility was significantly higher, as

compared to that of soy protein isolate. "Thus, hemp proteins can be suitable for human consumption as a more superior source of protein nutrition, relative to widely recognized soy proteins" (X.-S. Wang et al., 2008).
Therefore, the main objective of this study was to evaluate the content of valuable compounds from wheat flour enriched with different percentages of hemp seed flour, partially defatted, for use in bakery
Adding partially defatted hemp flour in bakery products improves the dietary intake of most micronutrients and fiber. Daily consumption of these products is recommended to help prevent major non-communicable diseases such as cardiovascular diseases and certain cancers (OMS, 2003). Therefore, evaluation of the minerals and other chemicals elements contained of these mixtures these two flours are important.

MATERIALS AND METHODS

2.1. Materials

Partially defatted hemp seed flour, a byproduct during manufacture of the hemp seed oil, was kindly supplied by SC Hofigal Export Import SA, (Bucharest, Romania). This meal has been obtained from hemp (*C. sativa* L.) seeds on a large scale through dehulling, grinding and degreasing at low temperatures of less than 45^0C. The degree of damage to the components of this material may be considered to be low because all steps were performed at low temperature.
550 type wheat flour used in the study was provided by Titan S.A. (Bucharest, Romania).

2.2. Preparation of wheat flour types enriched in bioactive compounds

We have manufactured 6 samples of wheat flour type 550, obtained by addition of different percentages of partially defatted hemp seed flour. The types of mixtures of flours used in this study is: P1 - 100 % wheat flour type 550; P2 - 95% wheat flour + 5% defatted hemp seed flour; P3 - 90% wheat flour + 10% defatted hemp seed flour; P4 - 85% wheat flour + 15% defatted hemp seed flour; P5 - 80% wheat flour + 20 defatted hemp seed flour; - P6 - 100% defatted hemp seed flour.

2.3. Chemical analysis

Moisture was determined at 103 ^{0}C (±2 ^{0}C) until constant weight (ICC Standard No. 110/1). The ash content was determined by incineration at 525 ± 25^0C (ICC No 104/1). Total fat was determined by extracting 10 g of sample with petroleum ether 40-65^0C, using a semi-automatic Soxhlet Foss Extraction System 2055 (Foss, Sweden); Total nitrogen (N) and crude protein content (N · 6.50, conversion factor) was estimated by the Macro Kjeldahl Method (Kjeltec System, FOSS, Sweden). Total fiber was measured using the enzymatic gravimetric method, Mes-Tris buffer, AOAC (1995) method 991.43. The determination was performed using Fibertec 1023 system (FOSS Sweden). Carbohydrate contents were calculated as the difference of 100 - (ash + protein + fat + moisture). Using ^{1}H-NMR spectral technique was determined the fatty acids composition, especially the concentrations of short-chain saturated fatty acids (C_4-C_8), di-unsaturated fatty acids, mono-unsaturated fatty acids and long-chain saturated fatty acids (>C8).
The mineral contents were determined with inductively coupled plasma-mass spectrometer equipment (ICP-MS; Perkin Elmer NexION 300Q). Total ash was determined by incineration at 550 °C in a muffle. Quantitation was performed using external standards (Merck, multi element standard solution) and all the standard curves were obtained at 6 different concentrations. Total mineral content was measured using their most abundant isotopes. The dried samples were digested in a mixture of concentrated HCl.
All experiments were performed in triplicate.

2.4. Statistical analysis

All the measurements were performed at least in triplicate. The values of different parameters were expressed as the mean ± standard deviation (s_r), to a confidence interval of 95%.

RESULTS AND DISCUSSIONS

The composition of wheat flour, partially defatted hemp seed flour, and mixtures of the two flours is shown in Table 1 from where it can be observed that P2 sample (95% wheat

flour+5% partially defatted hemp seed) contains more than 3 grams of dietary fiber per 100 g total, which allow the provision of nutritional term "source of fiber".

Table 1. Physicochemical characterization of samples

Composition % d.m.	Sample					
	P1	P2	P3	P4	P5	P6
Protein	12.9±0.24	13.8±0.25	14.7±0.25	15.61±0.21	16.56±0.20	31.26±0.21
Ash	0.55±0.01	0.89±0.02	1.27±0.02	1.63±0.03	1.987±0.04	7.84±0.06
Total Fat	1.03±0.07	1.51±0.06	2.03±0.07	2.59±0.07	3.11± 0.08	11.63±0.08
Carbohydrate	85.52±0.12	83.8±0.12	82±0.11	80.17±0.11	78.34±0.11	49.27±0.12
Dietary Fiber	1.9±0.12	4.01±0.35	6.2±0.38	8.39±0.56	10.59±0.78	45.87±0.98

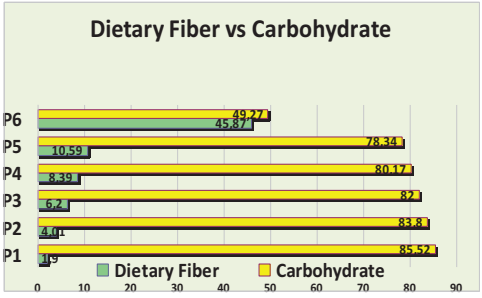

Fig. 1. Dietary fiber and carbohydrate content in mixtures flours

These data confirm that partially defatted hemp seed flour is a good source of bio-compounds, especially total fibers (45.87%, d.m). Partially defatted hemp seed should be considered a source of interesting added value carbohydrate compounds with potential known prebiotic properties, useful to formulate functional foods as well as nutraceuticals.

In the present study, the contents of four biologically essential mineral elements were analysed: calcium (Ca), potassium (K), magnesium (Mg) and sodium (Na), and two essential trace elements: copper (Cu) and zinc (Zn).

Table 2. Minerals contents of wheat flour and thereof mixtures

Sample	Minerals (mg/100g)					
	Ca	Mg	Na	K	Cu	Zn
P1	43.8±0.59	47.9±0.95	30.6±0.26	187.8±0.35	0.77±0.01	5.43±0.02
P2	76.13±0.96	76.13±0.98	31.31±0.26	243.41±0.35	0.83±0.01	5.5±0.02
P3	68.06±0.98	104.37±1.04	32.01±0.28	299.02±0.45	0.89±0.02	5.58±0.03
P4	80.19±1.01	122.52±1.09	32.72±0.29	354.63±0.45	0.94±0.01	5.65±0.03
P5	92.32±1.02	132.6±1.10	33.42±0.30	410.24±0.43	1±0.01	5.72±0.02
P6	286.42±1.19	612.58±1.14	44.7±0.32	1300±0.44	1.93±0.01	6.9±0.03

From performed analyses regarding minerals content it can be observed that partially defatted hemp seed is a material having important minerals content.

It is noticed that, compared to the low mineral content of wheat flour sample, (P1), mixtures of wheat flour and partially defatted hemp seed have a higher content of minerals as percentage increases flour mixtures.

In Fig. 2 is presented the fatty acids profile of samples. The addition of partially defatted hemp seed in mixtures flours modifies the lipid profile of samples compared to the control sample P1.

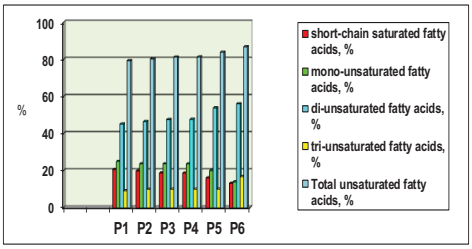

Fig. 2. *Fatty acids content in fresh sample*

In short, study of the food potential of hemp seed are not yet available in the scientific literature. Taking into accout that consumers are more and more aware about the food quality, especially from the nutritive point of view, the new food resources rich in bioactive compounds are necessary to be found. In this respect, hemp seeds meet the expectations of such consumers.

CONCLUSIONS

The aim of this study was to evaluate the functional potential of partially defatted hemp seed flour in order to be used for getting bakery products rich in valuable biocompounds.

Chemical composition of some four mixtures flours using both classical and spectral methods was analyzed.

The increasing the content of partially defatted hemp flour lead to the increasing of dietary fiber, minerals, protein, ash, and total fat content.

The chemical characterization performed in this study proved that the partially defatted hemp flour is a valuable source of nutritional components as well as a "source of fiber", according the Nutritional Claims approved by EFSA.

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