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PROPERTIES AND NUTRITIONAL VALUE OF WHEAT BREAD ENRICHED BY HEMP PRODUCTS

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ABSTRACT

Hemp (*Cannabis sativa)* is annual plant that is native to China and remained as important material for food, industrial and medical purposes. As source of cannabinoids belongs to controversial, but due to its excellent nutritional profile, non-gluten protein, fat and fibre it has potential in bakery products. Addition of 5% – 20% of hemp press cake fine flour and fine wholemeal significantly increased dietary fibre content, but their influence on volume of laboratory baked bread was different. Reflecting actual dosage, both types of hemp press cake flour diminished bun sizes about 6% – 33%; volumes of bread containing hulled wholemeal were comparable to standard (mean 310 mL/100 g vs. 333 ml/100 g, respectively. Only dehulled wholemeal hemp form increased the bread specific volume (6% – 30%), especially as 10% fortification (434 mL/100 g). Six Canadian hemp products were added as 10% and 20% on wheat flour base, comprising fine hemp flour and coarse hemp powder, dehulled whole seeds, hulled hemp seeds with sea salt as well as 50% and 43% hemp protein concentrates (KP1-KP6, respectively). The higher level of KP1, KP2, KP5 and KP6, the lower bread specific volumes were determined (decrease about 9% – 48%). Soft increase in buns size caused by 10% and 20% KP3 (323 and 319 ml/100 g vs. 296 mL/100 g) was insignificant. The effect of KP4 was reversely verifiable, magnifying the parameter about 25% and 17%, respectively. In terms of protein content in bread, a level 11.75% in wheat bread has risen to approx. 14.5% and 18.0% when 10% and 20% of KP3 and KP5, respectively, was included into bread recipe. All six Canadian hemp products increased dietary fibre content in bread, mainly owing to KP4 and both protein concentrates (up to 4 and 3 times, respectively). Incorporation of hemp flour up to the level of 10% positively affected bread sensorial properties.

Keywords: hemp flour; protein concentrates; food usage; dietary fibre; bread

INTRODUCTION

Nowadays, the Czech society has knowledge about hemp due to its procedure of marihuana legalization for medicine purposes. In general, hemp is perceived mostly as dangerous drug threatening human health. Similarly to the fact, that poppy is not opium, hemp is not marihuana. It belongs to utility plant, known and used by mankind for thousand years. Within the Czech Republic, end of hemp planting and hemp seeds usage is dated at 1936 – consecutively to the Marihuana tax law adoption, hemp breeding was forbidden.

Within temperate latitudes, hemp specie *Cannabis sativa culta* is the most spread and bred botanical variant, and all parts of plant could be economically utilized. From year 1999, hemp varieties Juso and Beniko are permitted, and these sorts conform to the Law 167/1998 Sb. about addictive substances. Both varieties are planted for production of hemp thread, dry organic matter used for technic or energetic purposes as well as for seeds production to gain technic or food oil.

Fibre is the part of plant-based foods (grains, fruits, vegetables, nuts, and beans) that the body cannot break down. It passes through the body undigested, keeping digestive system clean and healthy, easing bowel movements, and flushing cholesterol and harmful carcinogens out of the body.

Insoluble fibre does not dissolve in water and helps to prevent constipation, and is found in whole grains, wheat cereals, and vegetables. Soluble fibre dissolves in water and helps control blood sugar levels and reduce cholesterol.

In general, the more natural and unprocessed the food, the higher it is in fibre. Refined or "white" foods, such as white flour and bread, have had all or most of their fibre removed. Good sources include barley, oatmeal, beans, nuts, and fruits. Many seeds as hemp, chia, quinoa and teff contain both soluble and insoluble fibre and can be good source for fortification of cereal foods.

Usage of hemp seed in food industry

In past times, food prepared from hemp belonged to diet of low and middle society. By seeds roasting or milling, thick porridge was prepared, and later hemp oil was pressed. Hemp seed proteins and dietary fibre support sensation of satiation, so hemp food was served to hardly working people. Hemp flour is suitable for celiatics, because here's a lack of gluten fractions of protein. Whole seeds can be used as component of cereal sticks, biscuits and purees, or they could be consumed after roasting

or dehulling treatment. Seed skin softens after heating, thus hulled seeds may season cooked dishes as pasta, rice or sausages. Dehulled seeds could also be included into non-cooked dishes. Mixed with water, 'hemp milk' is prepared suitable for taste emphasizing of chips, pasta and tortillas **(Heroudková, 2013)**. In amount between 10% and 15%, hemp flour could be added into bakery products **(Ruman, 2014)**. Incorporated into cut off cookies, pleasant coffee brown colour and specific by-taste could be reached **(Hrušková et al., 2011)**. Pasta containing hemp products from hulled and dehulled seeds were characterised by up to four times higher fibre content compared to wheat ones **(Hrušková and Švec, 2012)**.

For bakery usage, different commercial product could be applied, to which fine or wholemeal flour gained by disintegration of hulled of dehulled seeds could be counted, or protein concentrates of domestic or foreign origin. From technological point of view, chemical composition limits their potential usage as their presence in recipe affects bread dough machinability in terms of dilution of wheat gluten proteins.

The goal of the pilot study, supported by the grant NEW FOOD, was to compare different hemp products and their effect on consumer and nutritional value of wheat bread manufactured in laboratory scale.

MATERIAL AND METHODOLOGY

For all rheological and laboratory baking proofs, commercial type of bright fine wheat flour was used as a base (mill Delta Prague). Flour composites were blended from wheat flour and 5% – 20% of the Czech samples of fine hemp press cake flour (K1, K2, respectively) and fine wholemeals K4 and K5 (from dehulled and hulled seeds; Hemp Production, Chraštice). Hulled seeds represent a hemp seed in its nature form, while dehulled ones are soft hearts of the seed (i.e. peeled with hard cover layers removed). Within further experimental set, six composite flours contained 10% and 20% of Canadian hemp products of the Hemp Oil Canada Inc. Specimens of fine hemp flour and coarse hemp powder (KP1, KP2, respectively), dehulled whole seeds (KP3), hulled hemp seeds with sea salt (KP4) as well as 50% and 43% hemp protein concentrates (KP5 and KP6, respectively). According to inner method of the Cereal laboratory of the UCT Prague, baking trial concerned on leavened bread evaluation was performed. For standard dough preparation of consistency 600 units, the Farinograph Brabender was employed. Manufactured buns quality as volume and shape was described objectively after two hours cooling at room conditions. Also their sensorial profiles were evaluated by three skilled panellists, using intense sensorial model of the Cereal laboratory. The profiling comprises bread shape, crust and crumb properties and represents overall quality depicted by 9 attributes of sensorial acceptability. Following the standards ČSN 56 05 12-11 and AOAC 985.29, nutritional score was quantified in terms of protein and dietary fibre contents, respectively.

RESULTS AND DISCUSSION

Compared to wheat flour, flour composites involving hemp products of the Czech origin used for laboratory bread preparation were characterised by higher content of all dietary fibre forms. Contrasted hemp products K1, K2, K4 and K5 together, any significant difference was not determined (Figure 1).

Considering dough machinability, hemp products addition did not led to verifiable increase of water absorption, but they softly affected stability after optimal dough development during the farinograph test. According to mixolab test results, impact of non-gluten proteins of prolamin groups was revealed out **(Hrušková and Švec, 2012)**. Regardless to tested hemp type, specific volumes and shapes of breads enhanced by four domestic hemp products (K1 - K2, K4 - K5) could be considered as comparable to standard (Figure 2). Products containing 5% addition were characteristic by pleasant coffee brown colour, which intensified to dark brown correspondingly to actual dosage. Sensorial scores confirmed acceptability of such fortified bread recipes for common consumers

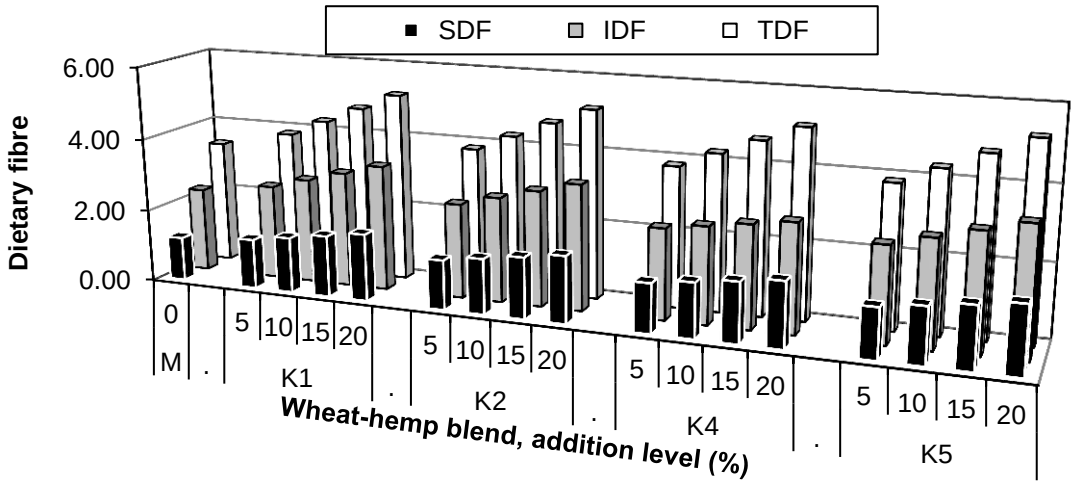

Figure 1 Dietary fibre content in blends of wheat and hemp flour (IDF, SDF, TDF: insoluble, soluble and total dietary fibre contents, respectively).

up to 10% of hemp added. Higher hemp product dosages led to less acceptable scores, mainly owing to taste difference (partially bitter taste). Disagreeable sensory perception of weaker extent was noticed in case of dehulled hemp wholemeal K4 testing (Figure 3) and it can be suppressed by e.g. higher sugar content like in case of biscuits. Worse sensorial profile was observed for product containing K2 addition, depending on tested dosage.

Canadian hemp products influenced bread volumes dependently on used type and addition level. Compared to non-fortified wheat flour, 10% of fine hemp flour KP1 did not change bread volume, whilst 20% did (a decrease about 100 mL/100 g; Figure 4). Similar trend was recorded during coarse hemp powder KP2 examination; however, ca 15% diminishing was determined already by 10% KP2 in recipe. Lower bread volumes resulted also from protein concentrates KP5 and KP6 testing, when the lowest bun size corresponds to 20% enhancement. Positive effect in terms of volumes increase was measured as a result of whole seed hemp products (KP3 and KP4) addition. During sensorial scoring, a worse point rating obtained samples with 20% of hemp products in recipe in relation to ones containing lower dosage (10%). Bread items richer

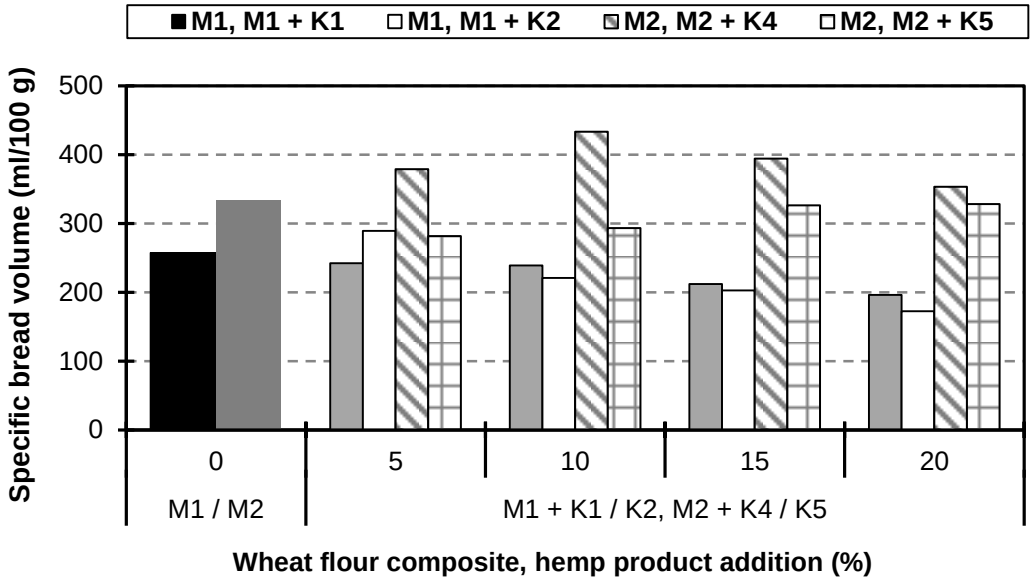

Figure 2 Specific volumes of bread with hemp products K1, K2, K4 and K5 (5% – 20%).

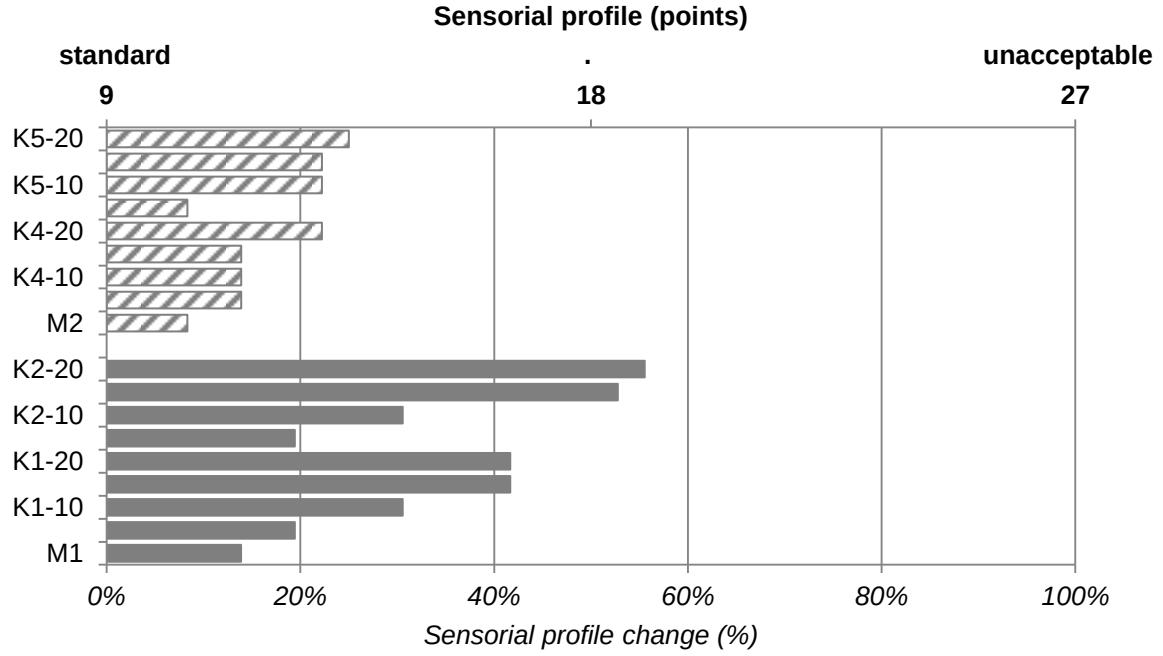

Figure 3 Sensorial profile of bread containing hemp products K1, K2, K4 and K5 (5% – 20%).

in KP were appraised as worse mainly due to lower vaulting of buns and non-typical taste. Bread enhancement by dehulled seeds (KP3) on both levels tested end in satisfying consumer's properties similarly to application of domestic dehulled hemp wholemeal K4. Mentioned components have also positive effect on taste perceptions masking in case of e.g. barley flour supplied in bread recipe **(Hrušková and Švec, 2014)**.

In case of Canadian hemp products, bread nutritional value is higher compared to non-fortified one. Protein content, determined according to Kjeldahl's method (ČSN 56 0116) as well as proportions of single dietary fibre forms (AOAC 985.29) are illustrated on Figures 5 and 6.

The greatest protein rate was analytically confirmed in bread enhanced by 50% hemp protein concentrate,

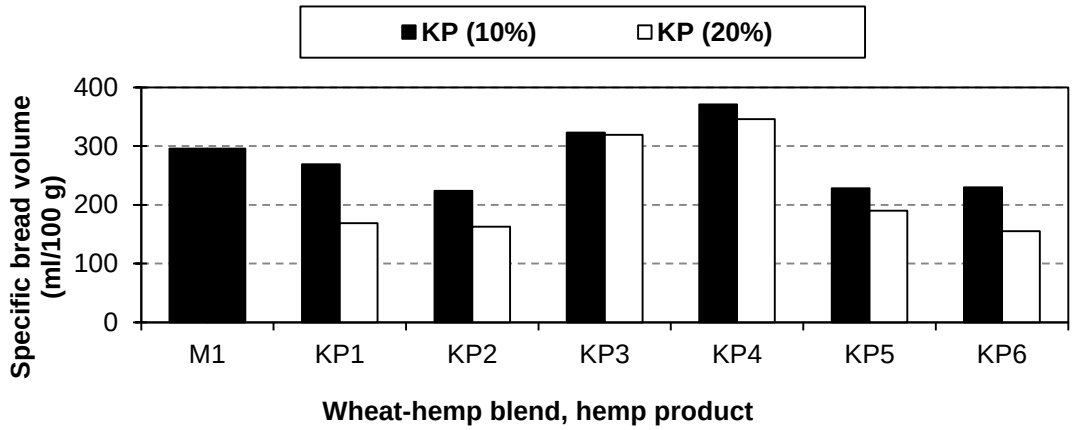

Figure 4 Specific volumes of bread with the Canadian hemp products in recipe.

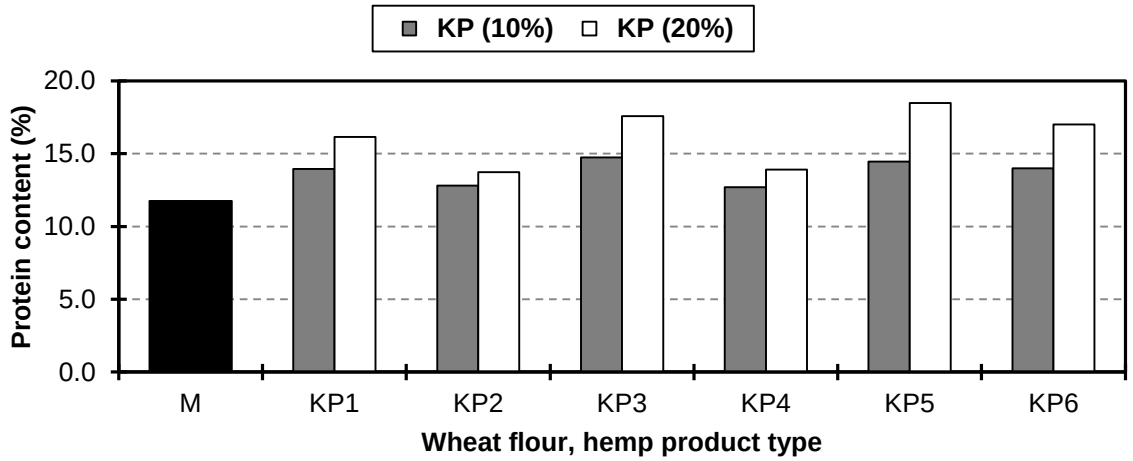

Figure 5 Protein content in bread with the Canadian hemp products in recipe.

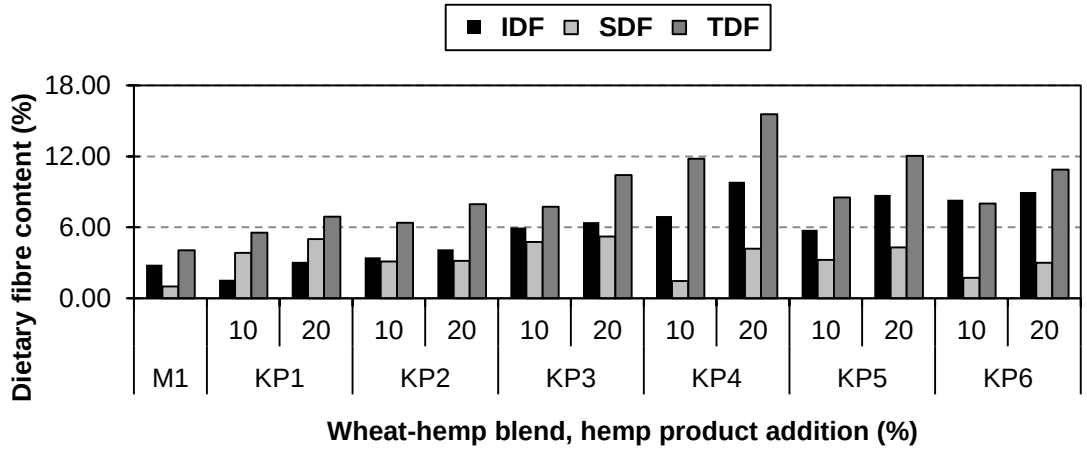

Figure 6 Dietary fibre content in bread with the Canadian hemp products in recipe (IDF, SDF, TDF: insoluble, soluble and total dietary fibre contents, respectively).

and in relation to wheat bread, that increase represents ca 45% of value in standard. Magnified content of total as well as insoluble fibre (TDF and SDF respectively) was measured in bread involving hulled hemp seeds with sea salt. In case of its 20% dosage, TDF level was high (15.55%) and protein content overcomes an average (13.91%). Added at lower level, bread reached better sensorial score due to the greatest volume, optimal shape and high crumb elasticity. Supplement of KP3 (dehulled hemp seed) could be recommended also on base satisfying SDF portion (5.23%).

CONCLUSION

Hemp is categorised among utility plants and it has a nutritional potential for usage in food industry. Common hemp seeds render higher protein and dietary fibre content to leavened bread, and also supply indispensable essential fatty acids presented in hemp oil. For bakery products, different forms of hemp constitute a source of fortification and innovation of offered assortment. Results of the pilot study could be concluded by statement, that higher dosage of hemp components into bakery products affects differently specific volume, shape and sensorial score of leavened bread. Also they verifiably contribute to higher contents of proteins and dietary fibre. Commercial hemp products but vary in their effect on consumer's quality and according to type, a supplement between 5% and 10% could be recommended.

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