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Utilization of vegetable raw materials as alternatives to cow's milk

J. Ouhrabková[1], D. Gabrovská[1], J. Rysová[1], S. Vavreinová[1], I. Paulíčková[1], I. Němečková[2], P. Roubal[2] and M. Pechačová[2]

[1] Food Research Institute Prague, Radiová 7, 102 31 Praha10, Czech Republic; e-mail: Dana.Gabrovska@vupp.cz
[2] MILCOM, Ltd., Ke Dvoru 12a, 160 00 Praha 6, Czech Republic

Abstract. Non-dairy spreads from vegetable raw materials based mainly on millet, buckwheat, amaranth, oat and chickpea were developed. Other components of the spreads were root vegetables, sunflower seeds, seaweed, dietary fibre, tofu, vegetable oil. The spreads are suitable especially for patients suffering from milk protein allergy, lactose intolerance and celiac disease. The spreads are rich in soluble and insoluble dietary fibre. Nutritional and sensory evaluation of the spreads was carried out. The spreads were also well appreciated by the public at the Gastronomic fair held at Karlštejn castle in April 2008. The developed spreads may enrich the assortment of foods suitable for patients suffering from milk protein allergy or lactose intolerance.

Key words: vegetable raw material, non-dairy spread, milk protein allergy, lactose intolerance

INTRODUCTION

Proteins of cow milk are the most frequent cause of food allergy in infants (Ah-Leung *et al*., 2007). Hypersensitivity to these proteins may persist through adulthood and can be severe. Studies on large populations of allergic patients showed that most of the patients were sensitized to β-lactoglobulin (Bos d 5), casein (Bos d 8), α-lactalbumin (Bos d 4) and bovine serum albumin (Bos d 6) (Kaiser *et al*., 1990, Host *et al*., 1992, Wal *et al*., 1995). Different clinical symptoms of the milk protein allergy have been established (El- Algamy, 2007). Data on prevalence of the milk protein allergy differ (depending on the country), while about 1% of the general adult population or 2–3% of children being considered as approximate figures (The EFSA Journal, 2004). Lactose intolerance is neither an allergic nor an immune-mediated disease. It results from a reduced capacity to digest lactose which may affect the quality of diet, e.g. low calcium intake. The maldigestion of lactose is due to a reduced lactase activity in the small intestine. Lactose intolerance is very common among Asian, South American, and African people. Of the world's population, 75% is estimated to be lactose-deficient, with the most common form primarily affecting adults. Lactase activity naturally falls from infantile level to adult levels between the age of 3 and 5 years in 75% of the world's population, while 25% of the population

appears to maintain infantile levels of lactase in adulthood (Scrimshaw & Murray, 1988).

There is no unambiguous relation between milk protein allergenicity and its heat processing: Boiling milk for a few minutes (2.5 or 10 minutes) results either in no difference or in a reduction of about 50–66 % of the positive reactions as compared to raw milk (The EFSA Journal, 2004). This situation led to an effort to find new ways of food production in order to offer suitable foods to patients suffering from milk protein allergy or lactose intolerance, and whose choice of food is restricted. One possibility is to use vegetable raw materials (cereals, legumes) in the production of dairy-like foods, e.g. non-dairy spreads.

MATERIAL AND METHODS

The raw materials for the preparation of spreads were purchased in the common supermarket (chickpea, millet, buckwheat, amaranth, oat, seaweed, root vegetables, spice) or at food ingredient manufacturers. Marinol (a concentrate of fish oil), Lactoval (a source of calcium, phosphorus and magnesium), guar gum and psyllium were added to some spreads, as well.

Nutritional evaluation. Dry matter was determined by drying the sample to a constant weight at 105°C, proteins by the Kjeldahl method, ash by dry ashing at 520°C, fat by chloroform extraction after acidic hydrolysis, total dietary fibre (TDF) by the AOAC enzymogravimetric method.

Sensory analysis. Sensory analysis of spreads was performed in the specialised FRIP laboratory under conditions as specified by ISO 6658 and 8589. A trained panel of twelve assessors was used in this study.

Method. Sensory parameters were evaluated by means of graphical unstructured scales.

Descriptors: flavour, appearance, taste, aftertaste, texture or final impression.

Normality test: Shapiro-Wilk test.

Outliers test: Dean-Dixon test($\alpha = 0{,}05$, $Q_{krit} = 0{,}392$).

RESULTS AND DISCUSSION

Nutritional evaluation (Tables 1–3) revealed lower content of proteins, fat and energy value in non-dairy spreads in comparison with dairy products. Only the spread 1c had higher protein content than dairy product 3a and 3b. Non-dairy spreads could be a good source of total dietary fibre. The highest content of TDF was found in the spread 1c (chickpea, sunflower, spice Chant). Also the spreads with psyllium, and oat with fibre may have higher content of fibre (the content was not determined).

Sensory evaluation of spreads based on millet and chickpea shows the differences among these spreads (Fig. 1) depending upon the ingredients used. The worst taste, aftertaste and final impression were found in spread 1b (millet, olives, almonds) resulting probably from the taste of olives. The best result was found in spread 1c, where the combination of root vegetables and seaweed gave a good final impression.

Table 1. Nutritional evaluation of non-dairy spreads (g 100 g^{-1}).

Nutrient/Sample	**1a**	**1b**	**1c**	**1d**
Dry matter	25.4	37.2	37.8	28.4
Proteins	3.1	6.7	8.7	5.2
Fat	6.8	14.9	7.7	5.1
Saccharides	9.3	1.2	6.7	6.9
Ash	1.2	2.5	1.8	1.5
Total dietary fibre	5.1	11.9	12.9	9.8
Insoluble fibre	4.1	8.8	11.4	4.3
Soluble fibre	1.0	3.1	1.6	5.5
Energy value (kJ 100 g^{-1})	460	687	547	392

1a – millet, root vegetables, seaweed
1b – millet, olives, almonds
1c – chickpea, sunflower, spice Chant
1d – chickpea, root vegetables, seaweed

Table 2. Nutritional evaluation of non-dairy spreads (g 100 g^{-1}).

Nutrient/Sample	**2a**	**2b**	**2c**	**2d**	**2e**
Dry matter	22.1	24.6	22.1	21	13.3
Proteins	4.3	5	6.8	4.5	3.1
Fat	1.7	2.5	6.8	3.3	2.6
Saccharides	9.7	11.8	5.5	10.7	7.5
Ash	1.7	3.1	1.5	2.5	0.2
Energy value (kJ 100 g^{-1})	328	376	461	380	274

2a – amaranth spread with psyllium and guar gum
2b – chickpea spread with Marinol and Lactoval
2c – spread with tofu, Marinol and guar gum
2d – spread from lupin and oat with fibre and Lactoval
2e – light buckwheat spread with seaweed Wakame

Table 3. Nutritional evaluation of dairy products (g 100 g^{-1}).

Nutrient/Sample	**3a**	**3b**	**3c**	**3d**	**3e**
Dry matter	34.0	34.0	31.7	45.5	25.0
Protein	7.0	7.7	12.6	9.4	17.2
Fat	23.5	22.0	15.4	33.5	2.5
Saccharides	3.1	1.6	1.7	1.4	4.5
Ash	-	0.6	0.9	0.7	0.8
Energy value (kJ 100 g^{-1})	1041	971	811	1424	462

3a – fresh cheese with vegetables
3b – Gervais
3c – fresh cheese Imperial
3d – fresh cheese Lucina
3e – cottage cheese

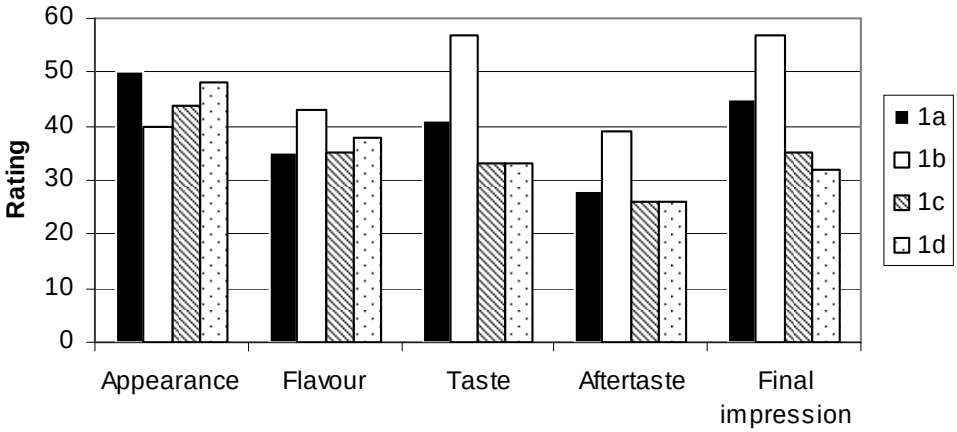

Figure 1. Sensory evaluation of non-dairy spreads 1a – 1c (appearance, flavour, taste, aftertaste, final impression: 0 – the best and 100 – the worst; aftertaste 0 – absent and 100 – very strong).

The ingredients influenced the sensory evaluation in the case of the second group of spreads as well (Fig. 2). The worst taste and aftertaste were found with spread 2c, where Marinol, tofu and guar gum were used. The second worst evaluation was determined with spreads 2a and 2e (taste and aftertaste). Seaweed Wakame was used in spread 2e and this ingredient with its special taste may also influence the sensory quality of the product.

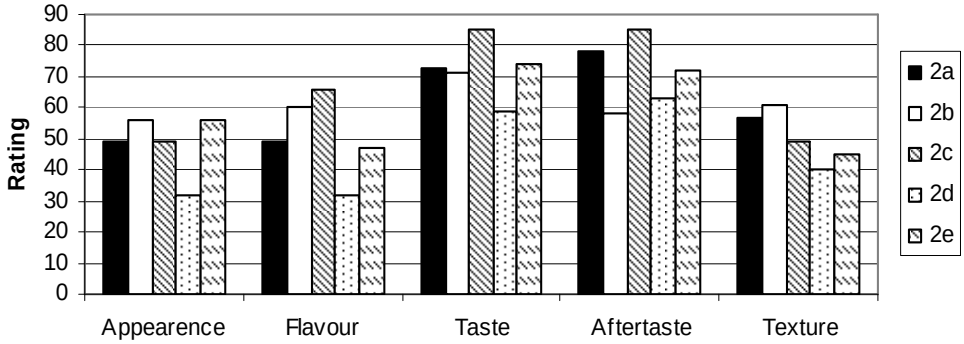

Figure 2. Sensory evaluation of non-dairy spreads 2a – 2e (appearance, flavour, taste, aftertaste, texture: 0 – the best and 100 – the worst; aftertaste: 0 – absent and 100 – very strong).

CONCLUSION

Nutritional evaluation of non-dairy spreads based on vegetable raw materials proved the lower content of fat and energy value in this type of spread in comparison with common dairy products (Tables 1–3). Sensory parameters seem to be acceptable

for all samples. The spreads based on chickpea 1c and 1d were of higher sensory quality (Table 1 and Fig. 1). The spread 1b had too strong an intensity of salt taste (caused by the olives). The spreads from 2a to 2e had the worse taste and stronger aftertaste, probably resulting from the addition of Marinol and seaweed Wakame (Table 2 and Fig. 2). Substitutions of other ingredients that have better sensory quality could be made.

The work proved a general possibility of vegetable raw material utilization as alternatives to cow's milk for the production of non-dairy spreads. The products could be used as an alternative for people suffering from milk protein allergy, lactose intolerance and celiac disease. Sensory evaluation revealed a good quality of the products. Nevertheless it will be necessary to optimize some recipes and substitute several ingredients with other ingredients that do not have a strong taste or aftertaste. The developed formulas will be offered to the producers.

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