

SENSORY EVALUATION OF NEW BEAN SPREADS FOR VEGETARIANS

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Abstract

Vegetarianism is a growing trend in Latvia but there is a lack of spread-like products for vegetarians. There are about 10 plant protein spreads commercially available in Latvia that differ very much in nutritional value and ingredients. Common beans (*Phaseolus vulgaris* L.) which are popular among Latvian consumers and rich in important macro- and micronutrients could be a great source of protein for vegetarians in spread-like products, however, are not represented in foreign or Latvian food company products yet. The aim of this research is to develop new vegetarian spreads using commercially available beans in Latvia and to subject the newly developed bean spreads to sensory evaluation. Four bean spreads were developed using white beans: classic, with basil, with curry, and with sun-dried tomatoes. Samples of bean spreads were packed in 200 g polypropylene (PP) containers and after 12 h storage in a refrigerator (3 ± 1 °C) subjected to sensory evaluation. Sensory evaluation was carried out in 3 different groups of panellists using hedonic scale and line scale. The hedonic evaluation showed that bean spread with sun-dried tomatoes has the highest overall preference compared to other bean spreads ($p < 0.05$). Significant differences among four bean spread samples in the intensity of their sensory properties – acidity, bean flavour, saltiness, and colour – were found ($p < 0.05$). Based on sensory evaluation data further research should be continued with classic bean spread and bean spread with sun-dried tomatoes.

Key words: vegetarianism, beans, bean spreads, sensory evaluation.

Introduction

Vegetarianism is the practice of abstaining from the consumption of meat – red meat, poultry, seafood and the flesh of any other animal; it may also include abstention from by-products of animal slaughter, such as animal-derived rennet, gelatine, and animal fat. Vegetarianism can be adopted for different reasons: health-related, religious, ethical, political, environmental, cultural, aesthetic or economic (Craig, 2010; Marsh et al., 2012). The number of people turning to vegetarianism is increasing every year. According to the latest estimates about 3 to 5% of Latvian population identify themselves as vegetarians (Mazlovskis, 2012). A properly planned vegetarian diet is healthful, nutritionally adequate, and provides health benefits in the prevention and treatment for such diseases as diabetes, cancer and coronary heart disease (McEvoy et al., 2012; Rizzo et al., 2011).

European Food Declaration of the New Common Food and Agriculture Policy points out the need to promote healthy eating patterns, moving towards plant-based diets and a reduced consumption of meat, energy-dense and highly processed foods, and saturated fats, while respecting the regional cultural dietary habits and traditions. Over recent years the impact of meat in our diets has been studied. The main problem appears to be that the modern meat-eaters diet includes a greater proportion of meat than that of our ancestors. This increase can cause health problems for a variety of reasons. Vegetarian diets offer lower levels of saturated fat, cholesterol and animal protein, and higher levels of carbohydrates, fibre, magnesium, potassium, foliate, and antioxidants

such as vitamins C and E and phytochemicals, compared to an omnivorous diet (Craig, 2010; Sabate and Blix, 2001).

Legumes (*Leguminosae*) are the most important source of protein for vegetarians (Messina et al., 2004). Common beans (*Phaseolus vulgaris* L.) are the most significant legume in human nutrition, accounting for more than 90% of the world's total bean production. Common beans are a rich and fairly inexpensive source of protein, carbohydrates, dietary fibre, minerals and vitamins, especially iron, potassium, selenium, thiamine, pyridoxine, and folic acid (Fageria et al., 2010; Gepts, 2008). When compared to other sources of protein e.g. meat (Van Heerden et al., 2004) beans are reasonably cheap (Osorio-Diaz et al., 2003), and easy to store with a longer shelf life than most fruits, vegetables and animal products (Sathe et al., 2003). Legumes play a key role in the acceptability of monotonous diets in many parts of the world. Beans have always been a part of the traditional Latvian diet.

One of the main objectives for vegetarians is to provide the body with optimal amounts of protein. For diversification of vegetarian diet there is a variety of plant-derived protein products available in the world: tofu, Tofurky (a vegetarian turkey replacement), soy-based vegetarian meat substitutes, peanut butter, bean and pea flour (as thickening agents for soups, stews and sauces), seitan (wheat gluten), tempeh and hummus. Meat alternative ingredients are nutritious with some offering specific health benefits. As well as increasing consumer choice, such products therefore have the potential to contribute to overall public health

(Van Roost, 2003). The main plant protein spread-like product is hummus which is very popular in Israel, Egypt, the Middle East and Mediterranean countries (Zubaida, 2001).

There are about 10 plant protein spreads commercially available in Latvia that differ very much in nutritional value and ingredients. Common beans which are popular among Latvian consumers and could be a great source of protein for vegetarians in spread-like products are not represented in foreign or Latvian food company products.

One main objective of sensory evaluation is the measurement of sensory attributes and the quantification of the influence of these attributes on consumer acceptance. Sensory attributes are directly linked to the concept of quality and thereby ultimately contribute to the success or failure of a product (Carbonell et al., 2009). Sensory attributes that influence acceptance of cooked beans and bean products are general visual appearance, texture and flavour (Ghasemlou et al., 2013; Sanzi et al., 1999).

The suitability of common beans for vegetarian food products has not been studied in Latvia, therefore, the aim of this research is to develop new vegetarian spreads using commercially available beans in Latvia and to subject the newly developed bean spreads to sensory evaluation.

Materials and Methods

Experiments were carried out at the Latvia University of Agriculture at Faculty of Food Technology and Paul Stradins Clinical University laboratories.

Preparation of bean spreads

For classic bean spread production the following materials were used: white beans (Ltd. *Voldemārs*, Kazakhstan, harvested in 2012), *Extra virgin* canola oil (Ltd. *Iecavnieks*, Latvia), 5% citric acid solution (Ltd. *Valezs*, Lithuania), drinking water, and salt (Ltd. *Voldemārs*, Latvia). Additional additives were used for other bean spread production – frozen fresh basil (local market), curry powder (Ltd. *Valezs*, Lithuania), and sun-dried tomatoes (Ltd. *Gemoss*, Turkey).

Bean spreads were prepared according to the vegetarian spread preparation technology in RL patent *Vegetarian bean spread production method* application (Kirse A., Karklina D. RL patent application No. P-13-59 with priority date 03.05.2013.). Dry white beans were soaked in water at 18 ± 2 °C for 15 h, then rinsed and boiled until tender (about 110 ± 5 minutes). Cooked beans were then grinded in a food processor and the homogeneous bean paste cooled to 60 ± 5 °C.

Other ingredients were added to the bean paste; oil and salt were added at the end of mixing in the food processor. Vegetarian bean spreads were packed in 200 ± 5 g polypropylene cups and stored at 3 ± 1 °C for 12 h prior to sensory evaluation.

Vegetarian bean spreads were made using common white beans (75.0 - 89.0%), water (5.0 - 7.0%), unsaturated canola oil (4.0 - 7.0%), 5% citric acid solution (2.0 - 2.5%), basil (0.8 - 1.5%), curry powder (0.5 - 1.1%), sun-dried tomatoes (5.5 - 8.5%), and salt (0.03 - 0.08%).

Four different kinds of bean spreads were developed: classic bean spread, bean spread with basil, bean spread with curry, and bean spread with sun-dried tomatoes.

Sensory evaluation

Sensory evaluation of bean spreads for vegetarians was carried out in 3 different groups of panellists (n = 110), i.e., vegetarians (n = 50), semi-vegetarians (n = 30), and omnivores (n = 30). The average age in each group was 35 with gender distribution 80% female and 20% male. Because no significant differences between sensory evaluation results in groups were found ($p < 0.05$), all results are given as the overall average.

Each panellist was served 4 samples of bean spreads in a randomized serving sequence: classic bean spread (sample A), bean spread with basil (sample B), bean spread with curry (sample C), and bean spread with sun-dried tomatoes (sample D). Classic bean spread was used as a conditioned control sample. Sensory evaluation was carried out using the nine point hedonic scale and line scale. The nine point hedonic scale was used in order to determine the degree of overall preference of the given samples (9 – extremely like and 1 – extremely dislike). The line scale was used for the intensity evaluation of sensory properties (acidity, bean flavour, saltiness, creamy texture, and colour) (ISO 4121:2003).

The obtained data processing was performed using mathematical and statistical methods with IBM SPSS Statistics 21.0 and Microsoft Excel 14 for Windows; differences among results are considered significant if p -value $< \alpha_{0.05}$. For the interpretation of the results it is assumed that $\alpha = 0.05$ with 95% confidence (Næs et al., 2011). The data was analysed using analysis of variance (ANOVA) and Tukey's test.

Results and Discussion

The results of the variance analysis of new vegetarian bean spread hedonic evaluation are given in Table 1.

Table 1

Results of analysis of variance of bean spreads using hedonic scale (p<0.05)

Source of Variation	Sum of squares, SS	Degree of freedom, df	Mean squares, MS	Variance ratio, F	F critical value, F crit
Between Groups	286.44	3.00	95.48	47.72	2.63
Within Groups	872.45	436.00	2.00		
Total	1,158.89	439.00			

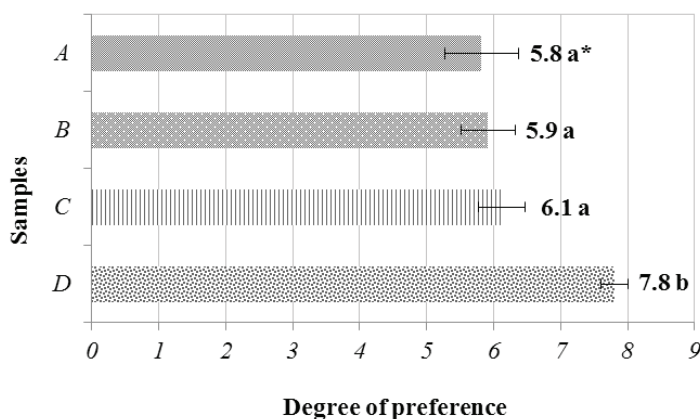


Figure 1. Results of hedonic evaluation of beans spreads.

A – classic bean spread, B – bean spread with basil, C – bean spread with curry, D – bean spread with sun-dried tomatoes.

* – values, marked with the same letters, are not significantly different (p<0.05).

The results of the variance analysis demonstrate that $F_{cal} = 47.72 > F_{crit} = 2.63$ ($n_1=3, n_2=327, \alpha=0.05$), that indicates significant differences among four samples of bean spreads in the degree of preference. Tukey’s test shows which samples panellists prefer more and the ranking according to the degree of preference. The results of hedonic evaluation of bean spreads are given in Figure 1.

The overall preference of bean spread samples range from 5.8 – „like slightly” to 7.8 – „like very much”. According to Tukey’s test, sample D (7.8) has the highest degree of preference compared to samples A, B, and C. This assessment of bean spreads suggests that the bean spread with sun-dried tomatoes has a very pleasant taste.

Line scale was used to evaluate the most important sensory characteristics - acidity, bean flavour, saltiness, creamy texture and colour intensity. The obtained results of the variance analysis of intensity of bean spread sensory properties show that there are significant differences among acidity ($F_{cal} = 20.81 > F_{crit} = 2.63$), bean flavour ($F_{cal} = 14.34 > F_{crit} = 2.63$), saltiness ($F_{cal} = 12.16 > F_{crit} = 2.63$), and colour ($F_{cal} = 88.71 > F_{crit} = 2.63$) of four bean spread samples. No significant differences among creamy texture ($F_{cal} = 0.22 < F_{crit} = 2.63$) of four bean spread samples were

found (p<0.05). Tukey’s test was used to understand the differences between samples’ acidity, bean flavour, saltiness and colour and their ranking according to the intensity of sensory properties.

The diagram given in Figure 2 illustrates the differences between the sensory properties of bean spreads.

According to the obtained results, sample D has the most acidic taste while sample A has the lowest acidity intensity. The pronounced acidic taste in sample D can be accounted for the added sun-dried tomatoes.

The most intense bean flavour was found in sample B, followed by sample A with a less intense bean flavour. It is implied that the added basil in sample B makes the bean flavour stand out.

Panellists rated samples A and D as bean spread samples with more intense saltiness than sample B, followed by sample C. No significant difference was established between saltiness intensity of samples A and D. A stronger salt taste in sample D can be explained with the sun-dried tomato additive which has extra salty flavour. In sample A saltiness could be the only pronounced flavour other than bean flavour because no other additives were added, also basil and curry in samples B and C, respectively, reduces the

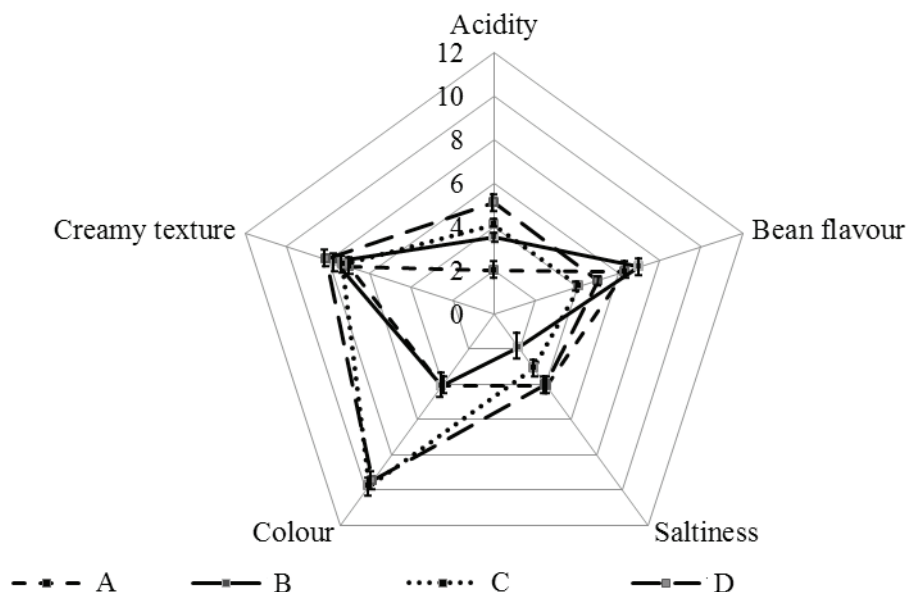


Figure 2. The assessment results of the intensity of bean spread sensory properties.
A – classic bean spread, B – bean spread with basil, C – bean spread with curry,
D – bean spread with sun-dried tomatoes.

saltiness of bean spreads because of possibly toned down sensory activity of one's palate accounted by additional solid flavours.

Consumer appetite for food is stimulated or dampened by its colour. This is because the colour of food indicates the flavour of food (Downham et al., 2000). Samples B and D were evaluated as having the most intense colour, whereas bean spread samples A and C had less intense colour. No significant differences were found between samples within these two bean spread sample pairs. Colour intensity of bean spread samples can be referred to curry powder giving sample B its intense yellow colour and sun-dried tomatoes giving sample D a soft red colour.

Acidity, saltiness and colour are possibly the main sensory attributes that influence acceptance of new bean spreads. Classic bean spread has a somewhat bland taste but it has enough saltiness so it could be satisfactory for consumers who like adding different spices to their food themselves. Bean spread with sun-dried tomatoes has a very pleasant taste and colour and is highly appreciated both by vegetarians and omnivores.

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Conclusions

1. Overall preference of new bean spreads for vegetarians range from "like slightly" to "like very much" (5.8-7.8). Panellists prefer the bean spread with sun-dried tomatoes ("like very much" – 7.8) most ($p < 0.05$).
2. There are significant differences among four bean spread samples in the intensity of their sensory properties: acidity, bean flavour, saltiness, and colour. No significant differences among creamy texture of four bean spread samples were found ($p \leq 0.05$).
3. Based on sensory evaluation data further research should be continued with classic bean spread and bean spread sun-dried tomatoes.

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