

Development, processing, and acceptance of a faba bean (*Vicia faba*) based porridge

Jazmín Osorio Perez¹, Carla S. Santos¹, Marta W. Vasconcelos¹

Abstract: The development of legume-based food products allows the promotion of healthy and nutritious plant-based alternatives, which are also environmentally sustainable. Porridges are often healthy, simple to prepare and suitable for various segments of the population, constituting a good option for food innovation. In this study a faba bean-based porridge was developed, using freeze-dried faba bean flour. A randomised sensorial analysis was performed. In terms of colour, 43% of panellists indicated that they “like it to some extent”, while the texture was the most appreciated characteristic which was evaluated. Results showed that overall appreciation of the porridge was 40%.

¹ Universidade Católica Portuguesa, CBQF - Centro de Biotecnologia e Química Fina, Laboratório Associado, Escola Superior de Biotecnologia, Porto, Portugal

Introduction

The necessary dietary shift to achieve the SDGs by 2050 can be leveraged by increased plant-derived sources of protein intake, such as that of legumes (1). The market for meat and dairy alternatives is particularly promising, with a growth of 49% in the last two years (2). Legumes contain a very rich fibre, micronutrient, and amino acid profile that complements that profile offered by cereals and other small (non-legume) grains (3). Legumes can positively impact human health (4) and have environmental benefits since they can help fix atmospheric nitrogen and reduce the need for chemical fertilisation (5).

The development of plant-based products with traditional and innovative uses of food legumes, represents a high interest for the food market sector, which aims to develop food products that meet the consumer's

requests for healthful and more environmentally sustainable diets. Literature shows that novel food products which promote more sustainable production locally and European food traditions are determining factors for consumer preference (6). Faba bean (*Vicia faba* L.) holds the capacity to grow in the winter and spring seasons indistinctly and can be used for both human and animal consumption (7). Nutritionally, they have a high content in minerals and vitamins, being rich sources of phosphorus, iron, potassium, and some vitamins from the B complex (8). Faba bean cultivation in Europe is slowly beginning to expand and in 2017 this crop was given the third largest area for legumes in Europe, and it was the seventh most produced legume in the continent that year (9). Countries with the highest yield are France, followed by Italy, Spain, and Belgium (FAOSTAT, 2018, accessed on 29 July 2018).

Processing legume grains enhances their digestibility and overall sensorial qualities by creating new aromas, textures, and visual appeals. Amongst these methods, freeze-drying is a processing technique employed for water removal in food products. It combines freezing and vacuum mechanisms that can preserve heat-sensitive nutrients such as vitamins and minerals (10). This research aimed to exploit the potential of freeze-dried faba bean flours for the development of a new food product that could increase consumer interest in consumption of locally grown legumes.

Methods

Five hundred grams of green de-hulled faba beans were freeze-dried in a lyophiliser (SP VirTis BenchTop Pro with Omnitronics®) at -85 °C for 72 h. Afterwards, beans were milled into flour using a kitchen robot (Kenwood Robot kCook Multi CCL401WH®) at the highest speed for 5 minutes. The porridge was prepared by bringing 500 mL of water, two cinnamon sticks and 10 g of sugar to a boil. The faba bean flour was added to the boiling mixture and cooked to the desired texture (Figure 1). A sensorial analysis evaluation took place with 60 participants, ranging from 18 to 52 years of age. A total of 35 participants were women while 25 were men. Participants assessed the colour, texture, flavour, and odour of 30 mL of the faba bean porridge at 20 °C, using a nine point-hedonic scale where 1 corresponded to 'dislike extremely' and 9 to 'like extremely'.

Results and Discussion

Given that faba beans in Europe are often consumed in their fresh (not dried) state, the green colour on the beans and on the porridge is relatable to the consumer. In the present study, 43% of the participants

Table 1. Results for colour, flavour, and texture of the sensorial analysis of the faba bean-based porridge.

Colour		Flavour		Texture	
Dislike at different levels % (95% CI)	Like at different levels % (95% CI)	Dislike at different levels % (95% CI)	Like at different levels % (95% CI)	Dislike at different levels % (95% CI)	Like at different levels % (95% CI)
56,7 (43,2; 69,4)	43,3 (30,5; 56,7)	46,6 (33,6; 60,0)	53,3 (40,0; 66,3)	38,3 (26,0; 51,7)	61,6 (48,2; 73,9)

CI – Confidence Interval

reported to like the colour of the product (Table 1). This is a valuable result given that earlier research has shown that 85% of consumers' food purchasing decisions are influenced strongly by product colour (11). Also, a recent study also links consumers' perception of product colour-saturation with that of flavour perception, or expectation (12). Here too both traits were correlated, and higher scores given for flavour were matched by those given for colour.

The texture was found to have the highest average scores on the porridge's attribute evaluation, which presented a consistency that remained constant through the temperature variations of the product (Table 1). This trait relates to the homogeneity of the flour obtained through freeze-drying, producing a very high-quality ingredient (13). The results seem to indicate that this is an effective method for processing the faba bean flour, adding the advantage of preserving the structure of the ingredient and nutrient content alike, while eliminating water content (14).

Lastly, 40% of the panellists indicated to like the porridge at different levels of the overall 'global appreciation' categories (Figure 2), which align to scores given to porridge traits which were scored. Similar results were obtained during another

sensorial evaluation of porridge prepared with faba bean flour (15). A very important attribute of the porridge developed here is also mentioned in other studies and concerns the ability to 'mask' or 'eliminate' the characteristic 'beany' flavour which is often associated with food products formulated with legume grain-based flours. Historically, these aspects have negatively affected the sensorial analysis scores of such products (16,17).

Legume-based beverages represent an important market sector to explore, since there is a wide range of processing methods that can further improve the nutritional quality of the final product (18). A novel food product prepared with fermented faba bean flour resulted in greater scores than the ones given to this porridge, a result that the authors attributed to the fermentation of the faba beans before turning them into flour (data not shown). This method seemed to improve the final taste in the product while increasing the protein and fibre content (19).

Pre-treatments, or contrasting processing methods other than the ones employed for this formulation, are an interesting path to explore during further porridge-focused experimentation. Supplementary analysis on the nutritional composition of this porridge could be of interest as well once the sensorial

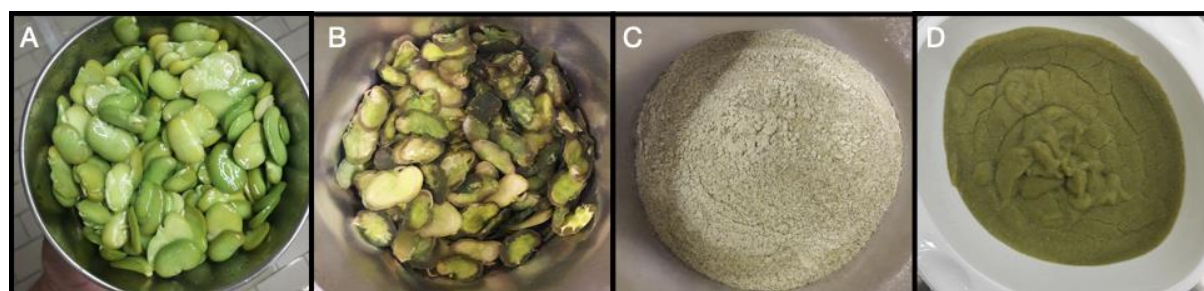


Figure 1. Processing thread of faba beans into porridge: A) fresh de-hulled faba beans; B) lyophilised faba beans; C) faba bean flour, prepared with lyophilised faba beans; D) faba bean porridge.

parameters are optimised to provide more positive results. Research shows that acceptability of drinks, specifically, can be influenced by the amount of information that is given to the subject prior to the tasting, and that by removing the ingredient information from the evaluation, higher scores are usually obtained (20). This suggests that different results could have been attributed to the porridge if the main ingredient had not been disclosed.

A replicate of this sensorial evaluation, with the participation of a specific segment of the population (*e.g.*, vegetarians, flexitarians), could also lead to different scores, since subjects with specific dietary patterns tend to be already familiar with the palatability of legumes, as well as be more sensitive of the health and environmental benefits associated to legume consumption (21).

Conclusion

The idea of an eco-friendly diet that is high in plant-protein utilising faba bean products is attractive. But not every segment of the population is equally motivated to consume such products. Adding flavourings, or more effective marketing of this porridge as light textured and an easy-to-drink beverage could potentially attract more consumers, contributing to the increased interest of European consumers for faba beans, and legumes in general.



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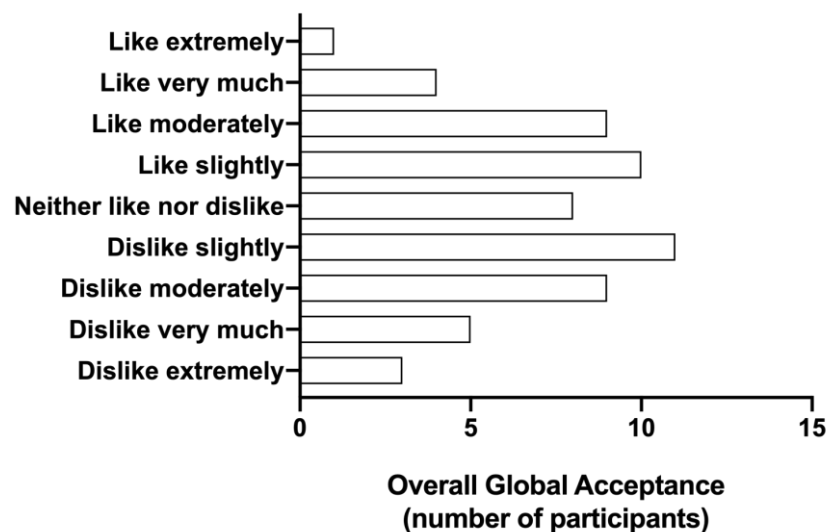


Figure 2. Sensorial analysis results for the overall global acceptance of the faba bean-based porridge.

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