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Broad bean hull as a functional ingredient for the development of high-fibre bread

Q.Q. Ni, V. Ranawana, H.E. Hayes, N.J. Hayward and V. Raikos
Rowett Institute, University of Aberdeen, Aberdeen, AB25 2ZD, UK

Research indicates that diets high in fibre (DF) reduces risks of cardiovascular diseases, diabetes and cancers [1]. There is an increasing emphasis on incorporation of plant-based natural products in diets for improving nutrition and health [2]. Broad bean (*Vicia faba*) is an important dietary legume (family Fabaceae) that is consumed in many countries. During its processing the seed testa representing 12–14% of seed weight is removed. This broad bean hull (BBH) is underutilised although it is high in DF (80%) and phytochemicals. Research also shows that BBH attenuates digestive enzyme activity and the glycaemic potential of foods *in vitro* [3]. The aim of this study was to determine the potential of incorporating BBH in food formulations using bread as a model, specifically its impact on nutritional and physical properties.

Breads were formulated replacing 0% (control), 11%, 21% and 31% of white flour with BBH, and analysed for proximates and physical properties. Data was analysed by one-way ANOVA with post-hoc Tukey's tests (ver.25.0; SPSS Inc).

Proximate compositions were determined by standard Association of Official Analytical Chemists methods. Compared to control bread, energy reduced by 9%, 17% and 22% in 11%, 21% and 31% BBH breads respectively. Protein reduced by 9%, 19% and 25%; available carbohydrates (sugars and starches) reduced by 13%, 28% and 37% with increasing fortification levels of BBH. Those nutritional factors significantly reduced with increasing fortification ($p < 0.05$). The DF content was significantly higher in the BBH breads compared to the control ($p < 0.05$) (2.4%, 5.6%, 9.4% and 12.4% DF in control, 11%, 21% and 31% BBH breads respectively).

Bread specific volume was determined by the rapeseed displacement method. Bread volume decreased with increasing fortification and a significant reduction seen at 11% (4.11 ± 0.08, 3.65 ± 0.07, 2.30 ± 0.03 and 1.65 ± 0.05 ml/g for control, 11%, 21% and 31% respectively). This is possible due to DF interfering with gluten structure causing a decrease in gas retention.

Texture profile analysis was assessed using a CT3 Texture Analyser. Hardness is usually used as the index of the total textural properties which reflects bread quality. There was no clear effect on hardness between control and 11% BBH breads, however it was significantly increased at fortification level of 21% and above ($p < 0.05$). This probably indicated that DF might interacted with gluten resulting thickening of the crumb walls.

The study showed that breads fortified with 11% BBH had minimum effects on bread quality but 31% had the maximum effect. BBH can help increase the DF content of breads but addition above certain levels sacrifice bread quality. Further work is required to assess the acceptability of BBH fortification level by sensory evaluation.

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