

Vicia faba: a cheap and sustainable source of protein and its application in beef products

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Health and environmental concerns associated with meat consumption has led to an increase in the demand for alternative sources of protein. Blending beef with non-animal proteins (30 % w/w) could reduce calorific intake and reduce greenhouse gas emissions significantly^(1,2). *Vicia faba* is a legume species widely grown across the world and it is rich in protein and fibre, though its application to human nutrition has been limited due to presence of anti-nutrients such as vicine and convicine^(2,3).

The aim of this study is to optimise the preparation of *Vicia faba* protein isolate (VFPI) and characterise its nutritional and functional properties when combined with beef mince to make patties. Protein was extracted from ground bean using in 0.25 % (w/v) sodium sulphite at pH 7.6 for 1 hour at room temperature. The protein and fibre content of the recovered isolate were compared to commercial legume extracts (Table 1). VFPI showed lower protein content and higher fibre content compared to commercial legumes. Proteins in VFPI were characterised by SDS-PAGE and LC-MS of digested proteins. Peptide alignment against Uniprot databases identified the most abundant proteins as legumins (LEB4 and 7), vicilin and favin. Analytical LC-MS analysis showed significantly lower levels ($p < 0.05$) of vicine (0.2 %) and convicine (0.13 %) in VFPI, compared to the original raw material (0.7 % vicine and 0.3 % convicine).

Table 1. Total protein and dietary fibre content of VFPI (values show mean of 3 independent extractions), commercial soya and pea protein isolates (PI). *values from the product label, ND = not determined.

Samples	Protein (%)	SD	Fibre (%)	SD
VFPI	42.7	1.0	17.6	3.8
Soya PI	70.5	7.3	1.0*	ND
Pea PI	69.2	4.7	2.5*	ND
Beef	19.7*	ND	0.0*	ND

Table 2. Calculated protein and fibre content of beef patties and experimental product yield (values show mean of 3 independent preparations). The values with different letter superscripts are significantly different ($p < 0.05$).

Samples	Protein (%)	Fibre (%)	Product yield (%)
Beef patty	19.7	0.0	82.3 ^a
Beef + VFPI patty	24.3	3.5	91.0 ^b
Beef + Soya PI patty	29.9	0.2	91.1 ^b
Beef + Pea PI patty	29.6	0.5	90.9 ^b

Addition of 20 % (w/w) VFPI to beef mince (15 % fat) improved product yield significantly ($p < 0.05$) and higher fibre content compared to beef patties made with 100 % beef (Table 2). The cost of the patty reduced by 17 % and the carbon footprint could theoretically reduce by 16 % from 26.6 kg CO₂/kg to 22.3 kg CO₂/kg of produce⁽⁴⁾. Future work will focus on the sensory evaluation and consumer acceptance of beef patties enriched with plant proteins using human volunteers.

In conclusion, *Vicia faba* could be used as an alternative source of protein to replace 20 % of meat with potential positive implications for health and the environment.

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