Evaluation of mustard (Brassica juncea) protein isolate prepared by steam injection heating for reduction of antinutritional factors

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Abstract

A process for the preparation of mustard protein isolate, comprising steps such as dispersion of defatted meal in 0.1 mol/l NaCl solution, incubation, extraction at alkaline pH, followed by treatment of the protein solution with activated carbon was developed. The protein, coagulated by steam injection, was subjected to separation by centrifugation, washing and spray drying. The parameters evaluated were protein yield, purity, presence of antinutritional factors and nutritional quality of proteins. The protein yield was 58–60%. The purity of the protein isolate was 95%. The hydrolysed products of glucosinolates like isothiocyanates and oxazolidine thione levels, phenolics and phytic acid levels were low in the protein isolate. The in vitro digestibility of the protein isolate was 92.4% compared to 80.6% of the meal. Chemical score of the meal and protein isolate were similar; isoleucine was the first limiting amino acid. The calculated nutritional indices, essential amino acid index, biological value, nutritional index and C-PER of protein isolate were higher compared to meal. The protein quality as indicated by amino acid profile and PDCAAS scores for 10–12-years old and adults were 100.

Keywords: Mustard seed; Protein isolate; Antinutritional factors; Nutritional quality

1. Introduction

Mustard (Brassica juncea) is one of the major oilseed crops of India with an annual production of 5.0 million tonnes (FAO, 2003). The meal is rich in protein (38%). The protein is of excellent nutritional quality being rich in lysine with adequate amount of sulphur containing amino acids—limiting amino acids in most of the cereals and oilseed proteins (Tzeng, Diosady, & Rubin, 1988a). The presence of toxic and antinutritional constituents such as glucosinolates, phytates, phenolics and hulls limits the use of rapeseed/mustard as a source of protein in food products. The glucosinolates are hydrolysed by the endogenous enzyme myrosinase to various toxic compounds that interfere with thyroid function and cause liver and kidney damage (VanEtten, Dazenbicher, & Wolff, 1969). Phytates are strong chelating agents that bind to polyvalent metal ions in the body including iron, calcium, magnesium and zinc rendering them unavailable for metabolism (Rutkowski & Kozlowska, 1979). Phenolic compounds impart bitter taste and dark color to the protein and its products. Tannins are the polyphenolics that complex with proteins suppressing the availability of essential amino acids (Sosulki, 1979). The use of rapeseed/mustard meal is limited in the diets of monogastric animals due to high content of indigestible fibre (Stominski, Campbell, & Guenter, 1994). Several detoxification methods including steaming, toasting, wet heating, water washing, microbial degradation and chemical treatment have been reported in the literature (Maheswari, Stanley, & Gray, 1981; Rozan et al., 1996; Woyewoda & Nakai, 1978). Membrane processing, dialysis, ultrafiltration, diafiltration, ion-exchange and protein micellar mass (PMM)