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NUTRITIONAL QUALITY OF MUSTARD PROTEIN CONCENTRATE

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Enzymic treatment followed by steeping in 4% NaCl solution at pH 5 reduced the glucosinolate content to traces and eliminated 85.7% of phytic acid content of mustard meal. Low fibre, low phytate, glucosinolate free mustard protein concentrate (MPC) contained 53.5% protein, 6.1% crude fibre, 5.8% ash and 0.4% phytic acid. The nutritional quality of protein in MPC was assessed by rat bioassay. PER (2.4), NPU (68.5%), TD (87.0%) and BV (78.4%) of the mustard protein was found comparable to casein . The results suggest that MPC could be incorporated in foodstuffs.

Key words: Glucosinolates, Phytic acid, Protein.

Introduction

Protein malnutrition is a serious health problem for people in many developing countries. The high cost and limited availability of animal proteins in deficient areas has directed interest towards oil seed crops as potential sources of vegetable protein for food use [1]. The residual cakes left after oil extraction of soy bean, cotton seed, mustard-rape and peanut seeds are excellent source of concentrated high quality protein [2]. Mustard/rape seed cake contains 35-40% protein [3] which could be a very useful for animal and human consumption, considering the good amino acid profile [4] of its protein and the large tonnage (250,000 metric tonnes/ annum) available in Pakistan [5]. The cake has limited use in feed and food formulation due to the presence of toxic and antinutritive factors i.e. glucosinolates, phytic acid and high fibre [6-8].

Removal of hull fraction would increase the digestible and metabolizable energy and protein content of the mustard/ rape meal. Like wise elimination of glucosinolates and phytic acid from mustard/rape flour would certainly improve its nutritional value and thus yield a potential protein rich food ingredient. Different procedures have been reported for preparation of mustard/rape protein concentrates and isolates [2,6-10].

The studies reported here pertain to the preparation and nutritional evaluation of low fibre, low phytate and glucosinolate free mustard protein concentrate.

Materials and Methods

Mustard seeds (*Brassica juncea)* variety RL-18 were cleaned and ground in hand mill. The kernels and hulls were separated by air classification [10]. The kernels were refluxed in a soxhlet extractor with *n* -hexane for 20 hrs to reduce the oil content to minimum (2%). The mustard meal (MM) i.e. defatted kernels were dried at 60° ± 2° and ground to 60 mesh size. The glucosinolates and phytic acid contents of MM were reduced by the procedure reported elsewhere [11] and outlined in Fig.1. Low fibre, low phytate, glucosinolate free mustard protein concentrate (MPC) was ground to 80 mesh size.

Biological evaluation. The biological evaluation of MPC was done by conducting feeding trials on 21 days old albino rats (Sprague Dawley strain) weighing 30-32 g each. The basal diet contained in g/100 g total solids: corn starch, 78: glucose, 5; corn oil, 5; vitamins, 5; minerals, 5; cellulose, 2[10]. Experimental diets were prepared by replacing corn starch in basal diet by 19.4, 18.7 and 11.2 g of MM (diet 1),

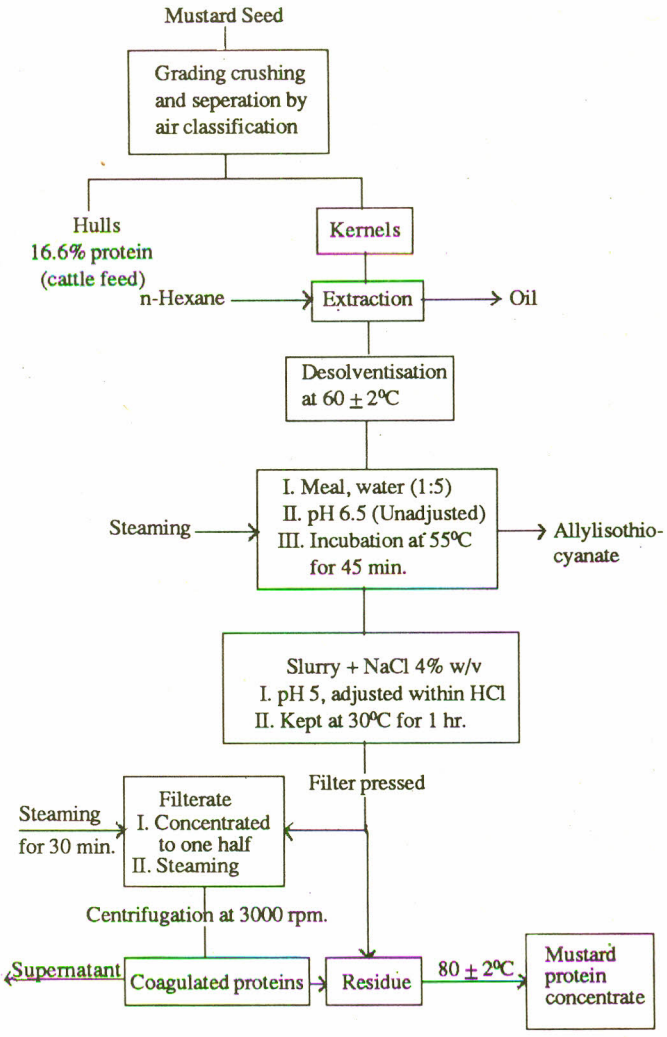

Fig. 1. Flow sheet of mustard seed processing for edible meal.

MPC (diet 2) and casein (diet 3). All diets were isonitrogenous i.e. they contained 10% protein.

(a) *Net protein utilization (NPU)*. NPU of the experimental diets was determined according to the procedure of Miller and Bender [12].

(b) *Protein efficiency ratio (PER)*. PER of diets was determined from weight gain and protein intake ratio [13], i.e. PER=gain in weight/protein intake.

(c) *True digestibility (TD)*. TD was calculated from the following formula.

$$\% \text{ TD} = \frac{\text{I- (F-FK)}}{\text{I}} \times 100$$

where I = dietary nitrogen intake of test group,

F = faecal nitrogen of test group , FK = faecal nitrogen of protein free group.

(d) *Biological value (BV)* BV was calculated by applying the following formula:

$$\text{BV} = \frac{\text{NPU}}{\text{TD}} \times 100$$

Analytical methods. The methods for the estimation of moisture, ash, crude protein, crude fibre, fat, allyl isothiocyanate (AIT) and phytic acid have been reported elsewhere [14-16]

Results and Discussion

Mustard and rape seed meals i.e. defatted seed cakes, contained 40.9 - 45.1% protein, 10.7 - 13.5% crude fibre, 0.78- 1.22% AIT and 2.3 - 2.8% phytic acid as reported earlier [11,17]. With crude fibre level of 10.7 - 13.5%, dehulling of the whole seeds and detoxification would be necessary for the production food grade mustard protein concentrate (MPC).

Proximate composition of mustard meal (MM) and mustard protein concentrate (MPC) prepared from MM during the present investigations is presented in Table 1. Enzymic treatment of MM followed by leaching with 4% NaCl solution at pH 5 [11] reduced the toxic AIT to traces, eliminated 85.7% of antinutritive phytic acid (PA) and increased protein content in MPC by 3.7%. The increase in protein seemed to be due to loss of soluble materials.

The feeding trials showed that presence of higher amounts of AIT and PA in MM adversely affected the feed intake and weight gain of albino rats. Elimination of AIT and PA from MM significantly improved its PER, NPU, TD and BV. The investigations showed that protein quality of MPC was comparable to that of casein on basis of weight gain, feed intake, PER, NPU, TD and BV for growing rats (Table 2) Shah *et. al.* [10, 18] reported that reduction in AIT contents followed by elimination of 85.7% phytic acid further improved the quality of MPC. The vital organs of rats i.e. liver, heart, thyroid and kidneys, fed on diet containing MM (diet 1) showed mild damage whereas those fed on MPC (diet 2) were histologically normal.

Niazi and Shah [19] reported that 50% of total animal protein in the standard ration could be replaced by low phytate-detoxified mustard seed meal without affecting the thyroid glands and growth of broilers. Thus it can be safely concluded from the results that reduction of phytic acid and complete elimination of glucosinolates was essential for production of food grade mustard protein concentrate and its incorporation in foodstuffs.

TABLE 1. PROXIMATE COMPOSITION* OF MUSTARD MEAL AND MUSTARD PROTEIN CONCENTRATE.

Constituents analysed (%)	Mustard meal	Mustard protein concentrate(MPC)
Protein	51.6 (± 1.72)	53.5 (± 1.48)
Fat	2.3 (± 0.15)	2.6 (± 0.13)
Ash	6.6 (± 0.32)	5.8 (± 0.28)
Crude fibre	5.7 (± 0.35)	6.1 (± 0.25)
Allyl isothiocyanate	1.9 (± 0.12)	Traces
Phytic acid	2.8 (± 0.22)	0.4 (± 0.05)
NE F**	33.8 (± 1.61)	31. 6 (± 1.35)

* On dry matter basis. ** Nitrogen free extract (by difference). - Average of three replicates with standard deviations.

TABLE2. NUTRITIVE VALUE OF DIETS CONTAINING CASEIN AND MUSTARD PROTEINCONCENTRATE.

Dietary protein sources	Weight gain* (g)	Protein intake* (g)	PER (%)	NPU (%)	TD (%)	BV (%)
Mustard meal (Diet 1)	2.4	7.9	0.3	47.5	70.2	67.6
Mustard protein concentrate (Diet 2)	78.4	32.8	2.4	68.5	87.0	78.7
Casein (Diet 3)	84.5	3.4	2.5	73.2	93.0	78.7

* Per group after 10 days. - Average of three replicates.

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