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Technical Note

Extractability and Functionality of Rice Proteins and Their Application as Meat Extenders

ABSTRACT

Two protein isolates were produced from broken rice—protein isoelectric precipitate (PIP) and partially hydrolyzed protein preparation (PHP). Isolates and rice flour (RF) were compared with regard to proximate chemical composition and functional properties. Also, PIP was compared with RF as a meat extender of sausage at the 20%, 30% and 40% levels. The PIP was found to be preferable to RF at all substitution levels.

INTRODUCTION

Rice is processed industrially for its starch extraction and the protein residue is used as a feed. This is despite reports that rice protein has a high PER value (Hansen *et al.*, 1981). Moreover, broken rice constitutes about 15% of the rice milled in the USA and, in some underdeveloped countries, milling practices are so poor that most of the rice produced is broken (Hansen *et al.*, 1981). The present study was undertaken to evaluate two preparations of rice protein in terms of extractability, recovery, proximate chemical composition and protein functionality, as well as their possible utilization as food ingredients.

MATERIALS AND METHODS

Broken rice was purchased from the retail market in Alexandria, Egypt. Material was ground to pass a 60 mesh screen using a hammer mill.

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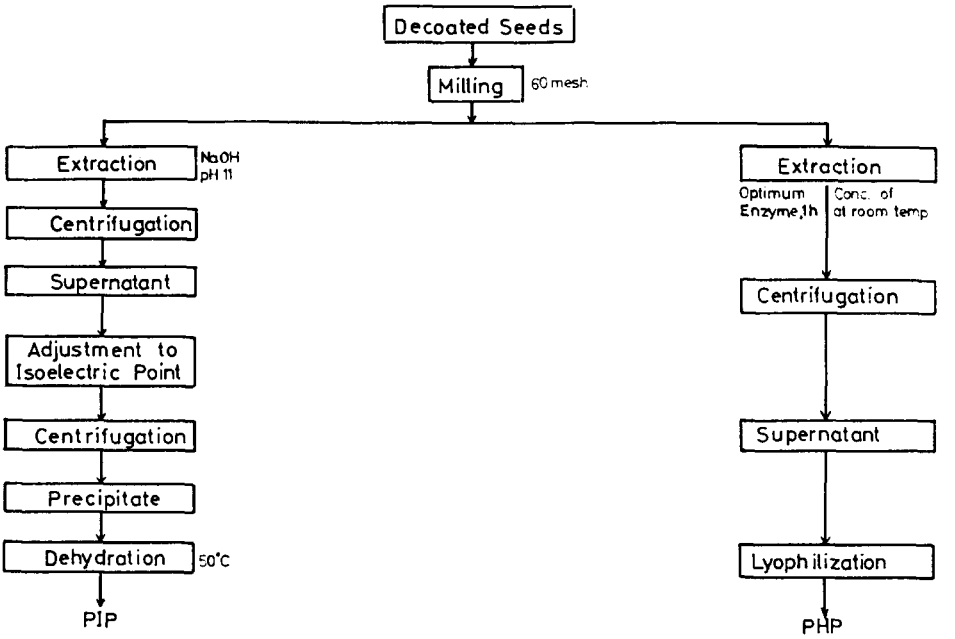

Fig. 1. Flow sheet for preparation of protein isoelectric precipitate (PIP) and partially hydrolyzed protein preparation (PHP).

Official AOAC methods (1980) were used to determine moisture, crude protein, crude fat and ash. Dissolved proteins in the extraction were determined spectrophotometrically (Lowry *et al.*, 1951). The steps in the preparation of PIP and PHP are shown in Fig. 1. Water absorption, fat absorption and nitrogen solubility index (NSI) were determined according to the method of Hulse *et al.* (1977). Oil emulsification was determined according to the technique of Beuchat *et al.* (1975). All experiments were carried out in triplicate.

RF and PIP were each used to extend sausage meat at the 20%, 30% and 40% levels. Taste panel testing was carried out by a ranking method and ranks were transformed into scores to allow for statistical analysis using analysis of variance.

RESULTS AND DISCUSSION

It is clear that the protein content of RF is low as the isolates contain about six times more protein than the original material (Table 1). Table 1

TABLE 1

Proximate Chemical Composition, Protein Recovery and Some Functional Properties of Rice Flour and Its Protein Isolates

Materials	*Dry matter* (%)	*Per cent on dry weight basis*				*Grams of preparation/ 100 g sample*	*Grams of protein/ 100 g sample*	*Per cent protein recovery*[b]	*Water absorption* (%)	*Fat absorption* (%)	*Oil emulsification capacity* (%)	*NSI*	*pH*
		Crude protein	*Crude fat*	*Ash*	*Carbo-hydrates*[a]								
RF	88·00	8·81	0·74	0·54	89·9	—	—	—	146	94·9	10	5·46	6·6
PIP	92·38	53·6	0·95	2·41	43·0	8·11	4·02	51·9	263	165	20	3·37	4·5
PHP	87·19	55·8	0·75	3·82	39·7	7·92	3·85	49·7	154	164	20	16·7	2·4

RF, Rice flour.

PIP, Protein isoelectric precipitate.

PHP, Partially hydrolyzed protein preparation.

NSI, Nitrogen solubility index.

[a] By difference.

[b] Grams of protein of preparation per gram of protein flour × 100.

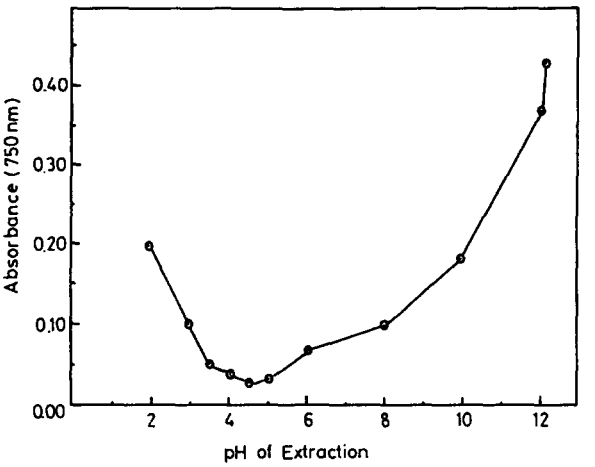

Fig. 2. Solubility profile of rice flour proteins at different pHs.

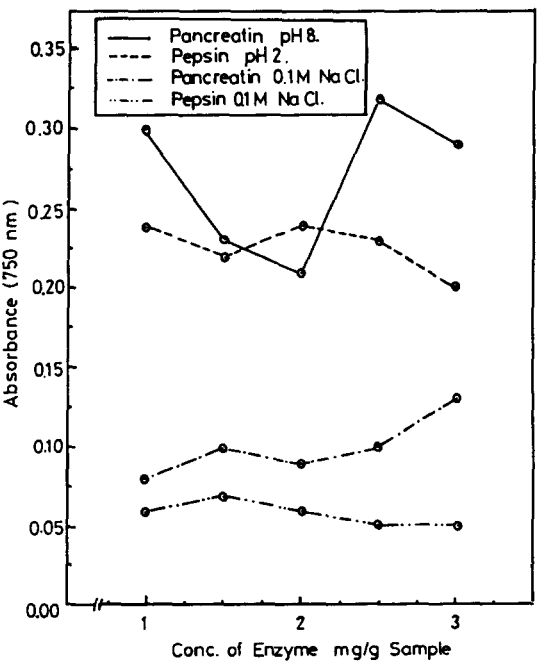

Fig. 3. Relationship between pepsin and pancreatin concentrations used in rice–PHP preparation and absorbance at 750 nm.

indicates that protein isolates had higher water absorption, fat absorption and oil emulsification than their parent flours. The solubility profile of rice flour (Fig. 2) shows minimum solubility at pH 4·5 and maximum solubility at pH 12. Figure 3 indicates that pepsin and pancreatin increase the protein solubility by about 15%. In this respect the optimum concentrations of pepsin and pancreatin were 2 and 2·5 mg per gram of sample, respectively. Statistical analysis revealed that there were highly significant sensory differences in sausage substituted with either RF or PIP. The PIP was found to be preferable to flour at all levels of substitution.

REFERENCES

Association of Official Analytical Chemists (AOAC) (1980). *Official methods of analysis*, Vol. 4. Association of Official Analytical Chemists, Washington, DC, USA.

Beuchat, L. R., Cherry, J. P. & Quinn, M. R. (1975). Physico-chemical properties of peanut flour as affected by proteolysis. *J. Agric. Food Chem.*, **23**, 616–20.

Hansen, L. P., Hosek, R., Callan, M. & Jonses, F. T. (1981). The development of high-protein rice flour for early childhood feeding. *Food Technol.*, **35**, 38–42.

Hulse, J. H., Rachie, K. O. & Billingsley, L. W. (1977). *Nutritional standards and methods of evaluation for food legume breeders*. International Development Research Centre (IDRC-TS 7e), Ottawa, Canada, 86–7.

Lowry, O. H., Rosebrough, N. J., Farr, A. L. & Randall, R. J. (1951). Protein measurement with the Folin phenol reagent. *J. Biochem.*, **193**, 265–75.

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