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Functional Properties of Pigeon Pea (*Cajanus cajan*) Flour

A. A. Oshodi* & M. M. Ekperigin

School of Pure and Applied Sciences, Federal University of Technology, Akure, Nigeria

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ABSTRACT

*The functional properties of the seed flour of pigeon pea (*Cajanus cajan*) were studied. Results showed that the flour had a good gelation propensity and that the least gelation concentration was 12%. The foaming capacity was found to be 68% while the foam stability was 20%. This foam stability was found to be comparably higher than those of soy flour and sunflower. The emulsion capacity was determined to be 49·4% while the oil and water absorption capacities were 80·7 and 138%, respectively. Protein solubility of the flour was also determined and found to be pH-dependent with minimum solubility at about pH 5.*

INTRODUCTION

The use of soybean as a source of nutritious food and substitute for meat arises from the knowledge of the functional properties of its flour and other products (Kinsella, 1979; Young & Scrimshaw, 1979). The variety of products that can be obtained from soybean (Young & Scrimshaw, 1979) are now good indications of the possible use of foods of plant origin to overcome the problem of shortage of foods of animal origin. Therefore, the use of soybean may be the beginning of a series of formulations which will lead to a substantial drop in dependency on animal sources for nutritous foods.

Pigeon pea is a legume which is more commonly consumed among farmers

* To whom correspondence should be addressed.

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in Nigeria and other developing countries. Earlier studies show that its protein is rich in lysine and it is easy to grow (Oyenuga, 1978). Lysine is the limiting amino acid in maize, which is the source of breakfast for adults and weaning foods for children in most African countries (Akinrele & Edward, 1971).

Earlier workers (Akinrele & Edward, 1971; Edward *et al.*, 1977; Oshodi, 1985) have attempted to fortify protein deficient foods with protein concentrates or improve the limiting essential amino acids by use of protein or protein concentrate of vegetable origin. In order to successfully introduce a new supplementation into any food item, it is necessary to find out whether the supplementations possess appropriate functional properties for food applications and consumer acceptability. These functional properties are the intrinsic physico-chemical characteristics which may affect the behaviour of food systems during processing and storage, e.g. solubility, foamability, gelation and emulsification properties.

The present paper deals with some of the functional properties of pigeon pea flour.

MATERIALS AND METHODS

The pigeon pea seeds used were obtained from the market in Akure town. The seeds were screened and, to one kilogram in a 2 dm^3 beaker, boiling water was added and left until the water cooled to room temperature (25°C). The seeds were then manually dehulled. The process of soaking with boiling water removed rawness (uncooked pea taste) and destroyed the trypsin inhibitor (Duke, 1981). The dehulled peas were dried in the oven at 45°C then dry-milled into flour. The flour was stored in polythene bags and kept at −18°C.

Proximate analyses of the pigeon pea flour for moisture, fat and ash were carried out in at least triplicate using the methods described by AOAC (1975). Nitrogen was determined by the micro-kjeldahl method described by Pearson (1976) and the percentage nitrogen was converted to crude protein by multiplying by 6·25.

The variation of protein solubility with pH for the pigeon pea flour was determined by gently and thoroughly mixing, for 5 min, 2g of the flour with 50 cm^3 of distilled water in a magnetic stirrer at room temperature (25°C). The pH of the resulting solution was adjusted to the selected value using either 0·1 M HCl or 0·1 M NaOH; samples were centrifuged at 5000 × g for 30 min and the protein content of the supernatant determined.

The least gelation concentration, water and oil absorption, and foaming properties of the pigeon pea flour were determined using the methods of

Sathe *et al.* (1982), while the emulsion capacity was determined by the method of Ige *et al.* (1984).

RESULTS AND DISCUSSION

The proximate composition of the pigeon pea flour is presented in Table 1. The flour has a high level of carbohydrate and low fat. The protein is moderate and known to be rich in lysine (438 mg/g N) (Oyenuga, 1978) compared with other peas grown in Nigeria.

Figure 1 shows the variation of the solubility of protein in pigeon pea flour as a function of pH. The figure indicates that the minimum protein solubility of the flour protein is at a pH of about 5·0 and it is highly soluble in both the acidic and basic pH regions. The high solubility of the protein of this flour in

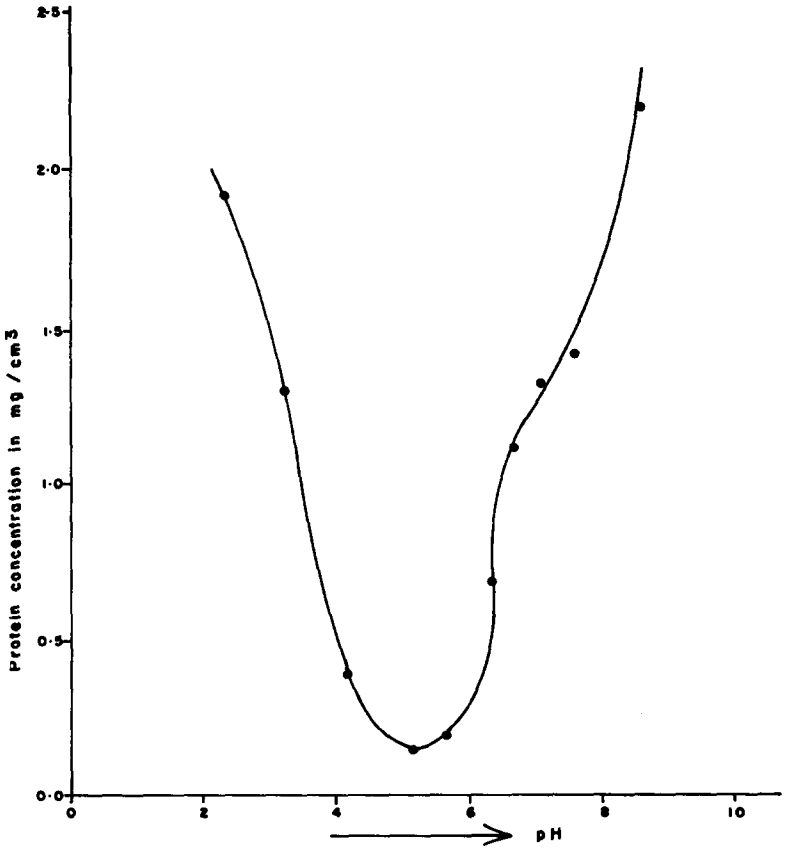

Fig. 1. Variation of protein solubility of the Pigeon Pea Flour with pH.

TABLE 1
Proximate Composition of the Pigeon Pea Flour

Components	*Percentage*
Moisture	5·24 ± 0·11
Protein (N × 6·25)	22·4 ± 0·05
Fat	2·63 ± 0·08
Ash	5·76 ± 0·02
Fibre	3·82 ± 0·06
Carbohydrate (by difference)	59·4 ± 0·14

the acid region of pH indicates that the protein may be useful in the formulation of acid food, e.g. protein-rich carbonated beverages (Kinsella, 1979).

Table 2 shows the results of other various functional properties determined. The water absorption capacity of 138% is comparably higher than the 130% for soy flour reported by (Lin *et al.*, 1974) but lower than the values reported for the three varieties of melon by Ige *et al.* (1984). The oil absorption (89·7%) of the pigeon pea flour is comparably higher than that of wheat flour and soy flour, i.e. 84·2% and 84·4%, respectively, reported by Lin *et al.* (1974).

The lowest gelation concentration for the pigeon pea flour was 12% (w/v). This value is higher than that obtained for the great Northern bean flour (10% w/v) (Sathe & Salunkhe, 1981) but lower than the value of 14% (w/v) recorded for lupin seed flour (Sathe *et al.*, 1982).

The emulsion capacity of 49·4% is much higher than the value of 7–11% for wheat flour and 18% for soy flour reported by Lin *et al.* (1974).

The foaming capacity of 68% is comparable to that of soy flour (66%) but less than that of sunflower (600%) reported by Lin *et al.* (1974). The foam

TABLE 2
Water and Oil Absorption, Emulsion, Gelation and Foaming Capacities of Pigeon Pea Flour

Functional properties	*Percentage*
Water absorbed	138 ± 0·06
Oil absorbed	89·7 ± 0·41
Lowest gelation concentration	12 (w/v)
Emulsion capacity	49·4 ± 0·22
Foaming capacity	68 ± 0·50 (vol. increased)
Foam stability (2 h after)	20 ± 0·24

stability of 20% after 2 h is better than that of soy flour (14·6%) and sunflower (9·0%) as reported by Lin *et al.* (1974) for the same time interval.

The above results show that pigeon pea flour has potential for human food formulations because of its good functional properties which compare well with soy flour and other products.

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