Nutritive value of groundnut (*Arachis hypogaea*)

2.* Biological evaluation of different varieties of groundnut grown in the Punjab

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1. The nutritive values of nine varieties of groundnut were determined by the nitrogen balance method in diets containing 10% protein. The results indicated that the varietal differences did not affect the biological values significantly.

2. Three varieties showing small but significant differences of approximately 5% in methionine content were further assayed for protein efficiency ratio at the 10% level of protein for a period of 4 weeks. No significant differences in PER were obtained, but the least significant difference that could have been detected under these conditions was approximately 8%.

The nutritive value of groundnut has been studied by many workers (Mitchell, Burroughs & Beadles, 1936; Jones & Widness, 1946; Block & Mitchell, 1946–7; Rao, Murthy & Swaminathan, 1953). The purpose of most of these studies was to evaluate defatted groundnut meal as a food. As a result of these and other studies it was concluded that groundnut proteins are not of a very high nutritive value because they are severely deficient in methionine and in lysine (Grau, 1946). A knowledge of the quality of groundnut meal of known origin and variety is essential as it may reveal differences due to genetic factors. Only small significant differences in the lysine, methionine and cystine contents were observed by the authors in some important varieties of groundnut of Punjab (Chopra & Sidhu, 1967) and it was considered essential to confirm this similarity by biological experiments.

EXPERIMENTAL

Samples. Composite samples of each of the nine varieties of groundnut grown under identical conditions in the years 1960 and 1961 were taken (Chopra & Sidhu, 1967); the samples were partially defatted by means of a hand-press.

The nutritive value of the meals was evaluated by the balance-sheet method of Mitchell (1923–4) and Mitchell & Carman (1926) and the protein efficiency ratio (PER) by following the procedure of Campbell (1961).

Diets. A basal diet of the following percentage composition on the air-dry basis was used: maize starch 82; groundnut oil 5; vitamin mixture (Hawk, Oser & Summerson, 1954) 4; Salt USP XIV (Campbell, 1961) 4 and sucrose 5. The protein source under test and the reference standard (egg powder) were each incorporated to give 9·7–10·3%

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crude protein (N × 6·25) at the expense of maize starch and of groundnut oil so as to maintain the same total fat content in each diet.

A low-protein diet containing 4% defatted egg powder, 5% sucrose, 4% vitamin mixture, 4% salt mixture, 5% groundnut oil and 78% maize starch was used for determining endogenous excretion of nitrogen. The egg powder was prepared in the laboratory by boiling whole eggs, removing their shells and washing the edible portion with acetone before drying and powdering.

Feeding. Albino rats from our own colony, 1-month old and weighing about 40 g, were randomly distributed into ten groups each consisting of an equal number of males and females and housed in individual metabolism cages. All the groups were first given the low-nitrogen diet containing 4% egg powder for a period of 11 days. The various groups were then assigned the respective experimental diets for 31 days after which the low-nitrogen diet was given again to each group for a further period of 11 days. The diets were offered *ad lib.* containing about 20% water. Unconsumed residues were collected daily, oven-dried at 105° for 8 h and weighed; the amount of diet consumed was calculated for each rat. Distilled water was also provided *ad lib.*

Collection of faeces and urine. During each phase of the experiment the first 3 days were treated as a preliminary period. Urine and faeces were collected for the whole of the remainder of each period, i.e. during the remaining 8 days for the first and last periods and for the remaining 28 days in the central period of the experiment when test and reference diets were given. Urine and faeces were preserved in 5% sulphuric acid and ethanol respectively and analysed for nitrogen content by the method of the Association of Official Agricultural Chemists (1960).

The endogenous excretion of nitrogen was determined separately in urine and faeces samples collected during the first and the third phases of the experiment and the mean values of their nitrogen content were taken for calculation purposes.

Determination of protein efficiency ratio. PER was determined in three varieties of groundnut: 511/28, 5/10 and A20. These varieties contained the lowest, intermediate and the highest contents of methionine and cystine respectively. The measurement was done at a 10% level of protein in the diets and casein was used as reference standard. The composition of the diets was the same as used for the determination of biological value.

Four randomized groups of ten weanling male albino rats, about 28 days old and average weight 40 g, were fed *ad lib.* for a period of 4 weeks, during which weekly gains in weight and total food consumption were recorded. The animals were housed in individual cages with screen bottoms. PER was calculated as g weight gain per g protein consumed.

RESULTS AND DISCUSSION

The digestibility and biological value of each of the partially defatted meals of the various varieties of groundnut are given in Table 1 together with the values for defatted egg.

The digestibility coefficient of the varieties ranged from 81·9 (321/2) to 83·2 (145/12-P), the differences being non-significant. These figures are lower than the value of

89 reported by Morrison (1936). Mitchell & Beadles (1937) obtained a value as high as 97·4, and Forbes, Vaughan & Yohe (1958) reported a value of 95 for groundnut. Our digestibility value for the egg reference standard was 93·3 as against 91·5 reported by Bosshardt & Barnes (1946). Henry & Kon (1957) obtained values of 97·8 and 97·2 at 8 and 12% levels of protein intake respectively, and Forbes *et al.* (1958) reported a value of 95 for hexane-extracted whole steam-cooked egg at a protein level ranging from 4·2 to 24·5%.

The mean biological values for different samples ranged from 50·9 (321/2) to 52·8 (A 23). The analysis of variance indicated no significant differences between varieties. The biological values obtained by us are in agreement with the value of 51·4 reported by Balasundaram, Cama, Malik & Venkateshan (1958) but are lower than the value of 57·8 obtained by Mitchell *et al.* (1936). Forbes *et al.* (1958) reported values of 61 and 55 at protein levels of 8·2 and 12·6% respectively. The biological value of acetone-extracted egg reference standard obtained in this study was 93·3. Henry & Kon (1957) reported values of 93·7 and 83·2 at 8% and 12% levels of protein intake respectively as compared to 97 and 92 respectively by Forbes *et al.* (1958).

Table 1. *Digestibility coefficients and biological values of proteins of nine varieties of groundnut*

(Mean values with their standard deviation; six weanling rats/group; 10% protein in diets; 4-week period)

Variety of groundnut	Digestibility coefficient	Biological value
321/2	81·9 ± 5·1	50·9 ± 4·1
511/28	82·5 ± 4·6	51·7 ± 3·3
145/12-P	83·2 ± 3·1	51·6 ± 3·7
142/16	83·1 ± 2·7	51·8 ± 4·1
69/9	82·2 ± 2·4	51·8 ± 1·3
Punjab Groundnut no. 1	83·0 ± 2·9	52·2 ± 2·8
5/10	82·3 ± 4·1	51·1 ± 2·3
A 20	82·1 ± 5·7	51·4 ± 2·1
A 23	82·6 ± 2·3	52·8 ± 3·1
Acetone-extracted whole dried egg powder	93·3 ± 1·5	90·3 ± 1·2

Table 2. *Growth-promoting value of diets containing one of the three groundnut varieties given to ten male rats at 10% level of protein for 4-weeks*

Variety of groundnut	Gain in weight (g)	Protein consumed* (g)	PER†
511/28	17·7 (17·2–20·1)	12·3 (11·8–12·8)	1·56 ± 0·07
5/10	18·2 (16·6–19·8)	11·5 (10·6–12·4)	1·58 ± 0·01
A 20	18·2 (16·7–19·5)	11·6 (11·0–12·2)	1·58 ± 0·05
Casein	27·0 (25·9–27·4)	12·2 (11·6–12·7)	2·26 ± 0·05

* Mean value with range.
† Mean value with standard deviation.

Protein efficiency ratio

The PER values of three groundnut varieties ranged from 1·56 to 1·58 (Table 2). These differences were not significant, and the least difference that would have reached statistical significance would have been approximately 8%. In an experiment of this size a difference proportional to the differences in methionine content, i.e. approximately 5%, could be expected to go undetected. There is therefore no inconsistency between the chemical and the biological results.

Nirmala, Girijabai & Devadass (1966) also obtained a value of 1·60 at the 10% level of protein. Rao *et al.* (1953), on the other hand, reported a PER of 1·45 at the 10% protein level. Values as high as 1·82 and 1·72 have been reported by Jones & Widness (1946) and Block & Mitchell (1946–7) respectively at the 10% level of protein intake during 4 weeks.

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