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# EFFECT OF COOKING ON THE DIGESTIBILITY AND NUTRITIVE VALUE OF THE PROTEINS OF BLACK GRAM (Phaseolus mungo) AND GREEN GRAM (Phaseolus Radiatus)

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The leguminous seeds (pulses) are an important source of proteins in the Indian dietaries.[1,2] They are rich sources of certain essential amino acids (lysine and threonine) in which cereal and millet proteins are partially deficient.[3] The nutritive value of the proteins of legumes is adversely affected by the presence of tryptic and growth inhibitors present in them.[4] It has been shown by some workers that optimal heat processing destroys the inhibitors and consequently brings about a marked improvement in the nutritive value of their proteins.[2,4] Very little information is, however, available on the effect of different methods of cooking on the nutritive value of common Indian pulses. The results of a comparative study, on the effect of pressure cooking and baking on the digestibility and nutritive value of the proteins of black gram and green gram are reported in this paper.

## Experimental

*Materials:* The black gram dhal (dehusked split legume) and green gram dhal used in this study were purchased from the local market. The dhals were cleaned from impurities and powdered in a stone grinder to pass through 50 mesh sieve.

*Cooking procedures:* Two methods of cooking (i) pressure cooking and (ii) baking were used.

i) *Pressure cooking*: Two hundred grams of the dhal flour were mixed with 100g of water and the mixture was cooked in a pressure cooker at 15 lbs pressure per square inch for 15 minutes. The cooked flour was used for the different experiments.

ii) *Baking:* Two hundred grams of the dhal flour were spread ($\frac{1}{4}$" thick) on stainless steel trays and baked at 400°F for 10 minutes. The baked flour was used for the different experiments.

*Methods*:

*"In vitro" digestion of proteins:* Samples of raw, pressure cooked or baked flour from green gram and black gram containing 1g of protein (N x 6.25) were mixed with 50 ml of M/5 phosphate buffer (pH 8.0) in 250ml conical flasks. 20 mg of pancreatin (B.D.H.) suspended in 10 ml of M/5 phosphate buffer was added to each flask. The mixture was then made up to 150 ml with distilled water. After the addition of 2 ml of toluene, to prevent bacterial contamination, the mixture was incubated at 37°C and was mixed periodically. The rate of proteolysis was followed according to Sorenson's formol titration method[5] at intervals of 5, 10, 24 and 48 hours. The percentage release of amino nitrogen due to hydrolysis at the different intervals is given in Table I.

*Determination of protein efficiency ratio, digestibility coefficient and biological value:* Six groups of male rats, 28 days old, and 4 rats per group were used for the study. The animals were kept in individual cages with raised screen bottoms. They were fed on synthetic diets containing 10% protein

Table I. *Rate of invitro hydrolysis (%) of the proteins of blackgram and greengram by pancreatic enymes*

| Time (Hours) | Blackgram | | | Greengram | | |
|---|---|---|---|---|---|---|
| | Raw | Baked | Cooked | Raw | Baked | Cooked |
| 5 | 10 | 16 | 28 | 12 | 18 | 28 |
| 10 | 18 | 28 | 37 | 21 | 29 | 42 |
| 24 | 26 | 36 | 42 | 30 | 39 | 48 |
| 48 | 29 | 38 | 44 | 32 | 40 | 50 |

(N x 6.25) supplied by either raw, pressure cooked or baked black gram dhal flour or green gram dhal flour. The diets were adequate in other dietary essentials. The composition of the diets was similar to that used by Tasker *et al.*[6] The animals were fed for a period of 28 days on the different diets. Data regarding the weekly increase in body weight and daily food intake were maintained for individual animals. From the results, the protein efficiency ratios of the different foods were calculated. During the fourth week the animals were placed in metabolism cages and the urine and faeces were collected and preserved according to the method of Swaminathan.[7] Records of the food intake of the individual animals during this period were maintained. At the end of the fourth week, the animals were fed a low-protein diet (4% egg albumin diet) for a week, for the determination of the endogenous urinary and faecal nitrogen. The urine and faeces were collected and preserved as before. The nitrogen content of urine, faeces and diet was determined by the micro kjeldahl method. From the data obtained the true digestibility coefficient, biological value and net protein utilization were calculated according to Mitchell.[8]

## Results

*"Invitro" digestion of protein:* The results given in Table I show that the rates of digestion of both the legume proteins are nearly of the same order. Pressure cooking and baking brought about a highly significant increase in the rates of digestion of proteins by pancreatic enzymes.

*Protein efficiency ratio:* The results given in Table II show that pressure cooking brought about a highly significant increase in the PER of the proteins of the two legumes. On the other hand baking did not bring about any significant increase in the PER.

*True digestibility coefficient:* The results (Table II) show that heat processing did not bring about any significant increase in the true digestibility coefficient of the proteins of the two legumes.

*Biological value:* The results in Table II show that heat processing brought about a significant increase in the biological value of the proteins of the two legumes.

*Net protein utilization*: The net protein utilization values of the pressure cooked legumes were significantly higher than those of raw legumes.

## Discussion

A large number of workers have reported that optimal heat processing brings about significant improvement in the nutritive value of the proteins of several legumes.[2-4] The beneficial effect of heat processing has been shown to be due to the destruction of tryptic and growth inhibitors present in them[4]. There is some evidence indicating that black gram and green gram contain tryptic and growth inhibitors.[9,10] The beneficial effect of heat processing observed in this study may be

Table II. *Protein efficiency ratio, digestibility coefficient, biological value and net protein utilization of proteins of blackgram and greengram*

| Sl. No | Method of Cooking | Protein Efficiency Ratio | | Digestibility Coefficient | | Biological value | | Net protein Utilization* | |
|---|---|---|---|---|---|---|---|---|---|
| | | Black gram | Green gram | Black gram | Green gram | Black gram | Green gram | Black gram | Green gram |
| A | Raw | 1.27 | 0.87 | 83.6 | 82.0 | 62.1 | 50.5 | 51.9 | 41.4 |
| B | Pressure cooked | 2.31 | 1.96 | 81.0 | 80.1 | 70.2 | 60.6 | 56.9 | 45.7 |
| C | Baked | 1.59 | 0.89 | 81.7 | 80 1 | 63.2 | 58.9 | 51.6 | 47.2 |
| Significance of the difference between two treatments : | | | | | | | | | |
| A ∞ B | | 1% level | 1% level | 1% level | 1% level | 1% level | 1% level | I% levcl | 1% level |
| A ∞ C | | N.S. | N.S. | ,, | ,, | ,, | ,, | N S. | ,, |
| B ∞ C | | 5% level | 1% level | 5% level | N.S. | 1% level | ,, | 1% level | ,, |

* Calculated as Digestibility Coefficient X Biological Value

due to destruction of growth inhibitors present in the two legumes. Further studies are required to throw light on this aspect of the problem.

**Summary**

1. The effect of pressure cooking and baking on the digestibility and nutritive value of the proteins of black gram and green gram has been studied.

2. Pressure cooking and baking brought about a highly significant increase in the rate of *in vitro* digestibility of the proteins of both black gram and green gram by pancreatic enzyme.

3. The protein efficiency ratio of the two legumes increased significantly on pressure cooking, whereas baking did not bring about any significant increase. Heat treatment did not bring about any significant change in the true digestibility of the proteins of the two legumes. The biological value and net protein utilization of the proteins of the two legumes were increased to a significant extent by pressure cooking.

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