

THE EFFECT ON RATS OF SUPPLEMENTING A NORTH INDIAN DIET WITH VEGETABLE PROTEINS (SPROUTING PULSES) AND CALCIUM

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WILSON and his associates (1936) in discussing the results of a diet survey in Calcutta remark that the protein element in nutrition in India may ultimately prove to be the most important, and it will certainly be the most difficult to remedy. Aykroyd and Krishnan (1937), on the other hand, showed that inclusion of skimmed milk powder, calcium lactate and yeast greatly enhanced growth and improved the general condition of rats fed on a poor south Indian diet and addition of proteins such as casein or an amino acid such as cystine had but only slight effect in improving the nutrition of the rats on the same basal diet, and they are of opinion that the above idea of Wilson *et al.* may

(Continued from opposite page)

Figure 3.—Showing two more outlets of a latrine. The stick is pointing the place where eye-flies were breeding quite heavily. Photograph taken in Hyderabad in May 1938.



Fig. 4.

Figure 4.—An enlarged photograph of the proboscis of the eye-fly. Note, this grows on the sucking surface.

be erroneous. We (Pal and Singh, 1938) corroborated the latter workers' results, namely, that addition of calcium enhances the nutritive value of Indian diets based on rice, as assessed by the growth of groups of young rats, and this effect is slightly increased if phosphorus is also added at the same time.

Up till now very few practical suggestions have been made for improving the nutritive value of the poor north Indian diet by addition of cheap supplements. The inclusion of animal proteins, fish or meat, is not always possible as in many cases it is avoided on religious grounds and even though there may not be any religious prejudice, the poor cannot afford to take it, just as they cannot afford the luxury of a liberal supply of milk or milk products in their diet. Under these circumstances it is a difficult problem how to improve the poor north Indian diet without much increase in the cost. So with a view to investigating the effects on rats, of the addition of an extra quantity of pulses (in a sprouting condition) as a source of vegetable protein and calcium lactate, both individually and together, to the poor north Indian diet, and to find out whether the protein element (Wilson *et al.*, *loc. cit.*) or the calcium (Aykroyd and Krishnan, *loc. cit.*) acts as a better supplement to the typical poor north Indian diet, this present work was taken up.

Experimental

Four groups of half a dozen young rats of an average weight of 54.5 gm. were given the following diet, corresponding roughly to the daily diet of an adult of the poorer classes in north India, mixed and fed in the proportions indicated below.

Whole wheat flour (<i>Triticum vulgare</i>)	8 oz.
Raw polished rice (<i>Oryza sativa</i>)	.. 8 "
Black gram (<i>Phaseolus mungo</i>)	.. 2 "
Dhal Arhar (<i>Cajanus indicus</i>)	.. 2 "
Amaranth leaves (<i>Amaranthus gan-jeticus</i>)	.. 2 "
Brinjal (<i>Solanum melongena</i>)	.. 2 "
Onions (<i>Allium sepa</i>)	.. 1 "
Chillies (<i>Capsicum annum</i>)	.. 2 gms.
Coriander (<i>Coriandrum sativum</i>)	.. 2 "
Mustard oil	.. 1 oz.

Group I was given the basal diet alone. Group II had the basal diet with the addition of a quarter ounce of sprouted gram. Group III was given the basal diet supplemented by 0.88 gm. calcium lactate, or 0.15 gm. for each rat. Group IV received the basal diet together with both the supplements in similar quantities.

The experiment lasted for eight weeks during which the weight of the animals was recorded once every week. The following table and the chart show the average rate of increase in the four groups of animals under experiment for eight weeks.

TABLE I
Average increase in weight in grammes in eight weeks

Group	Initial weight	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week
I	54.5	59.7	66.7	74.5	79.3	87.8	93.8	97.8	102.1
II	54.5	63.5	70.5	83.2	90.0	99.7	107.7	112.7	119.5
III	54.5	62.8	73.3	83.5	86.7	97.0	106.0	112.0	115.3
IV	54.5	61.7	74.0	89.0	94.7	107.7	117.0	120.7	126.1

At the end of the experimental period the length of the animals was measured (from the mouth to the end of the tail), and after the

CHART

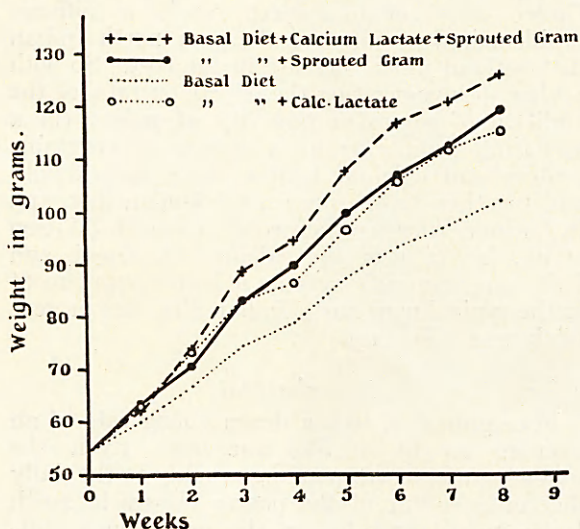


Chart showing the average rate of increase in weight of the four groups of experimental animals for eight weeks.

animals were killed by drowning, one femur of each animal was taken out, thoroughly cleaned and its length was measured with a pair of callipers. Table II shows the average final

TABLE II

Average length of the animals (from mouth to tail) and average length of the femur in the four groups

Group	Average length of the animal	Average length of the femur
I	29.25 cm.	2.46 cm.
II	30.1 "	2.56 "
III	31.1 "	2.65 "
IV	32.0 "	2.76 "

length of the animals and that of the femur for comparison.

Discussion

In another paper, we (Pal and Prasad, 1938) have suggested that increase in weight may not always be a completely satisfactory criterion of better growth and nutrition so we took the length of the skeleton and that of individual bones as well, to study developmental differences in the different groups of animals. In this experiment too, we took into consideration, the increase in weight, and also the difference in the length of the animals as well as their individual bones (*e.g.*, femur) of all the animals, for the comparative study of the growth and nutrition. A perusal of table I shows that the first group of animals on basal diet had on the average an increase of 57.6 gms. in eight weeks, the second group that was given a quarter ounce of sprouted Bengal gram in addition to the basal diet, had a gain of 65 gms., the third group having 0.88 gms. of calcium lactate as supplement to the basal diet, showed an increase of 60.8 gms., and the fourth group having a combination of both as supplements to the diet, had on the average a gain of 72.6 gms. in eight weeks. This shows that 0.15 gm. of calcium lactate was almost equally good, as a supplement to the ordinary north Indian diet, as addition of 1/24 oz. of sprouted Bengal gram daily, for each rat; whereas a combination of both acts slightly better than each individually, as a supplement.

A comparison of table I, showing the final weight of the four groups of experimental animals, with table II, giving the average length of the skeleton and of the femur of the four groups of animals, shows some interesting facts. The first group of animals, on the basal diet alone, weighing 102.1 gms. on the average, had an average length of the skeleton 29.25 cm., with average length of the femur as 2.46 cm., the second group, with sprouted Bengal gram as a supplementary diet, weighing 119.5 gms., were 30.1 cm. long with femur 2.56 cm., the third group whose diet was supplemented by calcium lactate weighing 115.3 gms. were 31.1 cm. long with the femur 2.65 cm. long, on the average, whereas the fourth group, that was given both sprouted Bengal gram and calcium lactate in similar quantities in addition to the basal diet, weighed 126.1 gms., having an average body length of 32.0 cm. with 2.76 cm. as the average length of the femur. All these data make it easy to say that the ordinary diet of the poor people of

northern India, is deficient in proteins as well as in calcium, which when added to the diet act as good supplements in promoting better growth and nutrition. When sprouted gram is added alone, the development of the muscles is more, while when only calcium is added, the skeletal development is more, but when both are added to the diet there is a more or less harmonious development of both the skeleton and the muscles, promoting better growth and development, as shown by the maximum increase in weight and also in length of the skeleton, amongst the four groups of experimental animals. Freudenberg and György (Stewart and Percival, 1928) think that when both proteins and calcium are present in food in sufficient quantities proteins form a compound with calcium by virtue of its acidic groups, that the resulting compound having a preponderance of basic groups combines with phosphate ions, and that the calcium-protein-phosphate complex so formed breaks down with deposition of calcium phosphate and liberation of original protein which then probably becomes available for other tissues such as muscles. That is probably the reason why a combination of proteins and calcium acts as a better supplement to the ordinary north Indian diet, than each added separately. Such a diet comes very near in composition to the diet no. 11 consisting of atta chapatties smeared with butter, fresh raw cabbage, raw carrots, sprouted Bengal gram and fresh cow's milk, with small quantities of meat twice a week, advocated as the best of all different types of cheap well-balanced diets for Indian people, by Aykroyd and Krishnan (1936).

Summary

Addition of sprouted Bengal gram and calcium, separately or together, enhances the nutritive value of a poor north Indian diet. The increase in weight on a supplement of sprouted Bengal gram is mostly due to development and growth of muscles, whereas calcium as a supplement, promotes better growth and development of the bones and the skeleton, which are mostly responsible for the increase in weight. A combination of both as a supplement, produces an algebraic sum of the effects due to each and as such acts better than either of them individually.

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VOLVULUS AS A CAUSE OF INTESTINAL OBSTRUCTION

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VOLVULUS of the small and large intestine is one of the many causes of intestinal obstruction in India. Reports of this condition in English journals are rare. In the literature on this subject it is said, however, that volvulus as a cause of intestinal obstruction is more common in some parts of Russia, and eastern Europe, as it is in India.

There were eight cases of volvulus admitted and treated from 1932-1936, six of them were in the pelvic colon and two in the small intestine. Three of the six cases of volvulus of the pelvic colon were admitted for acute intestinal obstruction, two were admitted for pyloric obstruction and had remarkably long meso-sigmoids (one of the anatomical types conducive to the formation of volvulus as described by Leichtenstern, Keimboe, Lardennois and Aubourg) and the remaining one was admitted for chronic colic, worse at night with occasional signs of intestinal obstruction for a short period, relieved by subsequent passage of a large amount of flatus. The two cases of volvulus in the small intestine were associated with the congenital abnormality of imperfect fixation of the mesentery. The volvulus in these cases was found along the mesenteric axis formed by the superior mesenteric vessels.

The following are the notes of the cases admitted :—

Acute cases of intestinal obstruction due to volvulus of the pelvic colon

(1) A male aged 40 years was admitted for acute intestinal obstruction with absolute constipation and vomiting lasting eight days. A 'ladder pattern' was seen extending from the left iliac fossa right up to the epigastrium. His general condition and pulse at the time of admission were very poor and he was moribund. Post mortem showed a volvulus of the pelvic colon which had become gangrenous.

(2) A male aged 40 years was admitted with a history of constipation and inability to pass faeces and flatus of three days' duration. Vomiting had started 24 hours before admission. On admission the general condition and pulse rate were found to be good. Under spinal anaesthesia the abdomen was opened by a left paramedian incision. On opening the abdomen a volvulus of the pelvic colon with enormous distension of the loop, which had undergone one complete clockwise turn, was found. Excision of the pelvic colon, with end to end anastomosis, was done after undoing the twist. The patient was discharged cured.

(3) A male aged 50 years was admitted with a history of constipation of three days' duration and distension of abdomen but no vomiting. Ladder pattern was distinctly visible, more on the left side, extending from the left iliac fossa to the epigastrium. General condition and pulse were satisfactory. Under spinal anaesthesia, the abdomen was opened by a left paramedian para-umbilical incision. A volvulus of the enormously distended pelvic colon, twisted one and a