Effect of Chitin and Prawn Shell on the Growth of Albino Rat

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The effect of addition of pure chitin from prawn shell, deproteinised prawn shell, demineralised prawn shell and dry prawn shell in casein based control diet on albino rats was studied. The diets contained 0.5% chitin and 10% protein. The results obtained in the studies show that the weight gain and feed conversion were maximum in the control diet. While addition of pure chitin slightly brought down the weight gain, addition of deproteinsed prawn shell have the minimum weight gain showing that presence of minerals adversely affects both feed consumption and weight gain in the case of albino rats. Although it was reported that addition of pure chitin at 0.5% in the commercial feed of broiler chicken gave increased weight, in the case of albino rats the weight gain was slightly reduced compared to control diet.

In India more than 60, 000tonnes of prawn head and shell waste are available every year for disposal from fish processing industry. Though this material is rich in protein, minerals and the natural carbohydrate polymer, chitin, this has not received proper attention of scientists and technologists until recently. Interest is now being shown by scientists on the study of the properties and uses of chitin and its derivatives. A number of different applications from horticulture to pharmaceuticals have been reported from different parts of the world. Zikakis *et al.* (1982) have reported the effect of chitin on digestion of whey in broiler chicks. Ramachandran Nair *et al.* (1986, 1986a & 1987) have elucidated the growth promoting effect of chitin in broiler chicks. The results of the feeding experiment of chitin, dry prawn shell, deproteinised prawns shell and demineralised prawn shell on rats are reported in this paper. The results are compared with the effect of chitin on the growth of broiler chicks reported by Ramachandran Nair *et al.* (1987).

Materials and Methods

Chitin was extracted from dry prawn shell after removal of protein and minerals. The minerals were removed by treatment with 1.5 N hydrochloric acid at room temperature and protein by boiling with 3% sodium hydroxide. The shell after treatment at both the stages was washed free of acid or alkali and the chitin thus obtained was dried and pulverised in an ultracentrifugal mill to a particle size of 0.5 mm to 1 mm. The deproteinised prawn shell powder and demineralised prawn shell powder were also prepared by treating the dry prawn shell with 3% sodium hydroxide and 1.5 N hydrochloric acid respectively under similar conditions as for chitin. Moisture, ash, protein and fat of dry prawn shell waste, deproteinised prawn shell and demineralised prawn shell were determined by the method of AOAC (1975). Chitin was estimated according to the method described by Hackman (1982).

Four experimental diets were formulated incorporating chitin (Diet A), dry prawn shell (Diet B), deproteinised prawn shell (Diet C) and deminieralised prawn shell (Diet D) in standard casein control diet (Diet E) keeping the concentration of chitin at 0.5% and protein at 10% of the formulated feed. The composition of the diets are given in Table 1. Adequate quantities of mineral mixture (Hubell *et al.*, 1937) and vitamins (Chapman *et al.*, 1959) were also added to the diets.

Six male weaning rats (Wister strain) weighing 45–50 g were assigned to each test

Table 1. *Composition (%) of experimental diets*

	Diet A	Diet B	Diet C	Diet D	Diet E
Casein	12.6	12.0	12.6	12.0	12.6
Refined oil (ground nut)	5.0	5.0	5.0	5.0	5.0
Shark liver oil	2.0	2.0	2.0	2.0	2.0
Mineral mixture	2.0	2.0	2.0	2.0	2.0
Vitamin mixture	1.0	1.0	1.0	1.0	1.0
Glucose	24.5	23.1	23.5	24.28	25.0
Corn starch	52.4	52.4	52.4	52.4	52.4
Chitin	0.5	0	0	0	0
Prawn shell	0	2.5	0	0	0
Deproteinised prawn shell	0	0	1.5	0	0
Demineralised prawn shell	0	0	0	1.32	0

diet. The animals were divided at random into groups adjusted to give similar mean weights and were housed individually in cages. They were fed on weighed amounts of the test diets and water was supplied *ad libitum* for 8 weeks and the average weekly body weight was noted. From the average feed consumption the feed conversion ratios were calculated.

Results and Discussion

The proximate composition of chitin, dry prawn shell, deproteinised prawn shell and demineralised prawn shell used in the experimental feeds are given in Table 2. An analysis of Tables 3 and 4 shows that the weekly weight gain of group of rats fed on diet E were better than that of those fed on test diets A, B, C and D. In weight gain, feed consumption and feed conversion there was no significant difference between the two groups fed on diets A and D showing that chitin and demineralised prawn shell have similar effect on the growth of rats. But the rats fed on diet C (feed containing deproteinised prawn shell) showed poor weight gain and feed consumption from the second week of feeding compared to those fed on diets B and D as well as to that of the control feed (Diet E) fed group. Though the groups

Table 2. *Proximate composition (%) of chitinous materials used in the formulations*

	Chitin from prawn shell	Dry prawn shell	Deproteinised prawn shell	Demineralised prawn shell
Moisture	3.5	8.2	8.9	8.66
Ash	2.0	31.13	53.0	3.23
Protein	Nil	29.76	Nil	45.45
Chitin	94.5	23.08	33.38	37.80
Fat	Nil	5.05	0.05	2.95

Table 3. *Average weight (g) of albino rats fed on experimental diets*

Age in weeks	Diet A	Diet B	Diet C	Diet D	Diet E
0	48.5	48.60	45.8	48.4	48.00
1	64.3	58.80	54.1	59.0	62.00
2	76.9	71.92	68.1	73.2	75.00
3	96.0	85.64	81.3	87.0	90.70
4	101.8	101.86	97.1	104.8	107.34
5	111.3	110.40	107.8	113.4	118.00
6	124.1	126.72	112.4	128.8	130.02
7	145.5	133.00	120.0	135.0	145.90
8	150.5	143.84	139.2	145.0	156.70

fed on diet B and C showed lower feed conversion ratio than those fed on A, D and E the rats in both the groups were not active and the general health was poor. This can be attributed to the very poor feed intake. Animals fed on chitin (Diet A) and demineralised prawn shell (Diet D) were healthy and active throughout the period of the experiment as in the case of groups fed on casein (Diet E), although there was slight decrease in the weight gain in Diets A & D when compared to diet E. In general the feeds can be graded as casein > chitin > demineralised shell > dry prawn shell > deproteinised shell.

Table 4. *Effect of experimental diets on the growth of albino rats*

Diet	Average feed consumption (g)	Average weight gain (g)	Feed conversion ratio
A	458.2	102.00	4.49
B	420.0	95.24	4.41
C	400.7	93.40	4.29
D	455.0	96.60	4.71
E	462.2	108.70	4.25

The results show that none of the experimental feeds including feed containing pure chitin was equal to the casein diet in the growth of rats. Ramachandran Nair *et al.* (1987) observed in the case of broiler chicks fed on commercial diet containing 0.5% chitin that the birds showed increase in weight gain. According to Spreen *et al.* (1984) and Gyorgy *et al.* (1954) the growth promoting effect of chitin in chicks is due to the presence of *lactobacillus bifidus* in the intestinal tracts of poultry. To explain the reason for the adverse effect of chitin in the growth of rats requires further investigation. The significant difference in the feed consumption, poor activity and health of rats fed on diets B and C may be attributed to the high content of minerals particularly carbonates present in the prawn shell and deproteinised prawn shell.

The results of the study, therefore, show that though addition of 0.5% chitin to broiler chicks significantly improves their growth, it has adverse effect on the growth of rats. It is also seen that the minerals present in the prawn shell further aggrevates the situation.

The authors are thankful to Shri M. R. Nair, Director and Dr. K. Gopakumar, Head of Division and Joint Director of Central Institute of Fisheries Technology, Cochin for the interest shown and encouragement given during this work.

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