Formulation, Processing and Water Stability of Pelleted Feeds with Varying Levels of Protein Used in Carp Nutrition Studies

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Four dry pelleted feeds containing 20%, 30%, 40% and 45% protein were formulated incorporating casein as the main source of protein for use in carp nutrition studies. The caloric content in all the feeds was maintained constant. The method of processing is described. The formulated diets were tested for water stability. This test has revealed that the diet containing 20%, 30% and 40% protein had better stability than that containing 45% protein. This was due to the relatively higher fat content in the former three diets. However, all the feeds were sufficiently stable at the end of one hour in which time carps are known to utilise supplementary diets.

With the emergence of fish farming as an industry, the demand for artificial fish feeds has increased significantly. Due to lack of information on the specific nutrient requirements of carps, earlier the formulation of fish feeds was based on attempts to duplicate the composition of natural foods (Halver, 1972). The objective of artificial feeding is to supply the nutrients for optimal production of fish per unit area. Knowledge on the dietary protein requirement of carps is essential in order to formulate cheap practical fish diets. In view of this, an attempt was made to formulate feeds containing varying levels of protein using casein as the main source of protein. The pelleted feeds thus formulated were used to study the protein requirements of major carps. Since water stability is an important quality of pelleted fish feeds, an experiment was conducted to assess this property of the formulated feeds used in the present study. Details of the method of processing of the experimental diets and results of the water stability test are presented in this communication.

Materials and Methods

Ingredients used for the formulation of the feeds are rice bran, groundnut oil cake, tapioca powder and casein. Cellulose was used as roughage material. The ingredients were sieved through I.S.I. standard mesh No. 1 to get particles of uniform size.

Four kinds of feeds were formulated:

I. PA (Pellet with approx. 20% protein)
II. PB (Pellet with approx. 30% protein)
III. PC (Pellet with approx. 40% protein)
IV. PD (Pellet with approx. 45% protein)

Table 1 gives the proportion of various ingredients incorporated in different feeds. The caloric content was maintained constant in all the feeds. Weighed ingredients were hand kneaded with just sufficient quantity of water to get the required soft consistency to form a dough. The dough was then cooked in an autoclave at 105°C for 30 min. The cooked dough was cooled rapidly and extruded in the form of noodles using a mechanical noodle making machine, having a perforation diameter of 3 mm in the die. The noodles were sun dried to less than 10% moisture and were broken to a size of about 1 cm. The dried pellets were packed in heavy duty plastic bags and stored in a wooden shelf.

Prior to formulation of feeds, all the feed materials were analysed for their proximate composition.

Table 1. *Proportion of various feed ingredients used in the formulation of different pelleted feeds*

	Feed ingredients						
	Casein %	Groundnut oil cake %	Rice bran %	Tapioca %	Minerals %	Cellulose %	Total
Pellet A	6.30	24.00	40.00	28.70	1.00	—	100.00
Pellet B	17.20	24.00	40.00	17.8	1.00	—	100.00
Pellet C	28.10	24.00	40.00	6.70	1.00	0.20	100.00
Pellet D	35.50	24.00	40.00	0.96	1.00	0.54	100.00

Moisture content was estimated by heating the samples in a hot air oven at 65°C for about 24 h to constant weight. Nitrogen was estimated by the Microkjeldahl method (AOAC, 1975) and crude protein by multiplying the nitrogen value by 6.25. Crude fat was extracted using petroleum ether (40–60°C) in Soxhlet apparatus for 6 h and expressed as g/100 g of sample. Total ash was determined by incinerating the sample at 550 ± 10°C for 6 h in a muffle furnace. Crude fibre was analysed by Lees method (1975). Carbohydrate was calculated as nitrogen free extract by the method of Hastings (1976)

The energy values of feed materials and formulated feeds were calculated using values of 8 K.Cal/g for fat and 4 K. Cal/g for carbohydrates (Hastings, 1975) and 5 K. Cal/g for protein (Smith, 1975).

Hasting's method (1964) was employed for studying the stability of pelleted feeds and stability test was carried out for over 7 h.

Results and Discussion

The proportion of ingredients used in the formulation of the feeds was based on the results of proximate analysis of the dry ingredients so as to maintain the required level of protein in different feeds. A 1:1 ratio by the weight of ingredient mixture to water was employed to get a proper consistency to the dough. Venugopal (1980) and Anil (1981) also recommended the same ratio. However, Jayaram & Shetty (1981) have used 2:1.6 ratio of water to ingredients. According to Lovell (1976), cooking at 105°C kills all the pathogens and in the present study also, the ingredients were cooked at this temperature.

The slow feeding habit of carps presents a problem to fish feed manufacturers since the feed should remain stable in water for at least one hour (Jayaram, 1978). Low stability of pellets results in their rapid disintegration leading to fouling of the medium (Balazs *et al.*, 1973). However, highly stable pellets are not desirable as they increase the cost of production and decrease the availability of bound nutrients.

The results of stability test are presented in Table 2. At the end of one hour, all the feeds except pellet D, were found to be quite stable with 90.48, 90.35 and 90.45% of dry matter for pellet A, pellet B and pellet C respectively. and 89.56% in pellet D. At the end of 3 h, the percentage of dry matter remained in the feeds were 85.35, 85.46, 86.13 and 83.18% in pellet A, pellet B, pellet C and pellet D respectively. At the end of 5 h, there was significant fall in the stability of all the pelleted feeds, especially in pellet D and pellet A wherein the percentage of stable dry matter was only 69.30% and 72.58% respectively. At the end of 7 h, interestingly, uniform and similar stability for pellet A, B and C was recorded with corresponding

Table 2. *Results of the stability test: Dry matter weight (%) of prepared fish diets kept in freshwater over varying duration*

Diets	Period (hours) of immersion 1	3	5	7
Pellet A	90.48	85.35	72.58	70.16
Pellet B	90.35	85.46	73.23	70.28
Pellet C	90.45	86.13	76.32	70.00
Pellet D	89.56	83.18	69.30	68.32

values of 70.16, 70.28 and 70.00%. The stability of pellet D at the end of 7 h was the lowest (68.32%).

The results of the water stability test indicated that pellet D is least stable. Pellets A, B and C were quite stable even after 7h in water. Stability of formulated diets is influenced by feed composition, nature of ingredients, type of processing and moisture content (Kainz, 1977). In the present study, the variation in the ingredients appears to be responsible for the difference in the stability between the feeds. Pellet D which was the least stable, had the lowest fat and starch content compared to the other pellets. Presence of more fat not only helps in forming more compact pellets, but also prevents the penetration of water, thereby remaining compact for a longer period (Jayaram & Shetty, 1981). However, all the four kinds of pellets used in the present study appear to have the necessary stability for feeding carps.

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