Fishery Technology
1994, Vol. 31(1) pp: 22-24

Water Stability of Newly Formulated Pelleted Feeds

S.K. Das*, J.K. Manissery and T.J. Varghese
College of Fisheries
Mangalore - 575 002, India

Formulation of suitable cost effective nutritious feed is of paramount importance in boosting fish production through aquaculture. In the present study four formulated pelleted feeds incorporating, *Eichhornia, Colocasia* or *Gliricidia* leaf powders and fishmeal were tested for water stability. All the pellets except the *Gliricidia* leaf powder incorporated feed showed the required stability.

The traditional artificial feed used in intensive fish culture in India is a mixture of rice bran and oilcake which is nutritionally poor and imbalanced (Varghese *et al.*, 1976). A considerable percentage of it is also wasted during feeding as it is a loose mixture. Hence, the formulation of suitable cost effective feed is an urgent necessity to boost fish production through aquaculture. The pelletisation process is the most popular method used in manufacture of aquaculture feeds (Mac Grath, 1976). Studies on formulation and processing of pelleted feeds for carps are still under progress in India (Varghese *et al.*, 1976; Jeyachandran & Paulraj, 1977; Jayaram & Shetty, 1981; Manissery *et al.*, 1988). The present investigation deals with formulation, processing and stability of four experimental diets.

Materials and Methods

The ingredients used for the preparation of pelleted and control diets were rice bran, groundnut oilcake, fishmeal, tapioca flour, vitamin-mineral mixture and leaf powders of the plants *Eichhornia crassipes, Colocasia esculenta* or *Gliricidia maculata.* All ingredients except leaf powders were procured from the local market. All the three kinds of leaf powders were prepared from leaves of the respective plants grown around the campus of College of Fisheries, Mangalore. The vitamin mineral mixture used was supplevite-M, supplied by M/s Sarabhai chemicals, Baroda.

Four different types of pelleted feeds were formulated namely, Pellet FM, Pellet E, Pellet C and Pellet G. Pellet FM, used as a control feed, contained fish meal as the main protein source and was prepared as described by Varghese *et al.*, (1976). Leaf powders of *Eichhornia, Colocasia* and *Gliricidia* were incorporated at 30% level by weight to partially replace the fishmeal in Pellet E, C and G respectively. The composition of the test and control diets are presented in Table 1. Each pelleted feed was prepared separately by mixing the required quantities of ingredients. This mixture was kneaded well by hand with sufficient water (1:0.8) to get a dough which was cooked by steam in a pressure cooker for 30 min. After cooling, vitamin-mineral mixture was added and mixed well. The dough was then passed through a pelletiser having 3 mm dia pore size. The noodles so obtained were dried in an oven and in sun till the moisture content was reduced to less than 10%. The dried noodles were manually broken into small pellets of 5 to 10 mm length. Pellets were packed separately in heavy duty plastic bags and stored at ambient conditions.

All the four formulated feeds were analysed for their proximate composition. The moisture content was determined by

Present address : *College of Fisheries (OUAT), Rangailunda, Berhampur - 760 007, India

heating the sample at 105°C for 30 min and then drying at 65°C till constant weight was obtained. Total nitrogen (TN) content was estimated using the microkjeldahl method (AOAC, 1975) and the crude protein was calculated by multiplying nitrogen content of sample with the factor 6.25. The crude fat content was estimated by extraction with petroleum ether (B.P. 40 - 60°C) for 6 to 8 h in a soxhlet extraction apparatus. Crude fibre was estimated by the modified method of De Silva (1985). Ash content was determined by burning the sample at 550± 20°C for 6 h in a muffle furnace. The nitrogen free extract was found out by the difference method (Hastings, 1976).

The pelleted diets were tested for water stability following the method of Hastings (1964). Stability was determined after 1st, 3rd, 5th and 7th h of immersion in water. Each feed was tested in triplicate for their stability.

Table 1. *Percentage of different ingredients used in the pelleted diets*

Diet ingredients	Pellet FM	Pellet E	Pellet C	Pellet G
Rice bran	40	10	14	15
Groundnut oilcake	24	40	36	35
Fishmeal	25	10	10	10
Tapioca flour	10	9	9	9
Vitamin-mineral mixture	1	1	1	1
Eichhornia leaf powder	-	30	-	-
Colocasia leaf powder	-	-	30	-
Gliricidia leaf powder	-	-	-	30

Table 2. *Proximate composition of formulated diets*

Feed Pellets	Moisture %	Crude protein %	Crude fat %	Crude fibre %	Ash %	Nitrogen free extract %
FM	6.84 ±0.35	30.34 ±0.36	5.94 ±0.42	9.64 ±0.18	18.71 ±0.41	28.53
E	6.87 ±0.40	30.47 ±0.40	6.16 ±0.21	8.28 ±0.31	13.08 ±0.18	35.14
C	5.47 ±0.25	31.05 ±0.21	7.26 ±0.21	7.37 ±0.19	15.57 ±0.32	33.28
G	6.93 ±0.45	30.93 ±0.20	6.40 ±0.14	10.39 ±0.35	11.59 ±0.31	33.76

Differences in water stability of formulated feeds were tested for significance by 't' test.

Results and Discussion

The ingredients used in the preparation of diets were analysed for their proximate composition prior to the formulation of the diets (Table 2). This was done to maintain a protein level of 30% which is suitable for warm water fishes (Dupree, 1976) and also for economic efficiency in carp culture (Renukaradhya & Varghese, 1987).

Table 3. *Water stability of formulated pelleted feeds with percentage of dry matter obtained after immersing the feeds in water over varying durations.*

Feed	Period of immersion, h 1	3	5	7
Pellet FM	89.64 a ±0.67	86.13 a ±.29	81.48 a ±0.44	78.83 a ±0.43
Pellet E	85.54 b ±0.34	82.57 ±0.41	78.36 ±0.58	75.91 ±0.44
Pellet C	90.52 a ±0.33	87.55 a ±0.37	83.61 a ±0.42	80.62 a ±0.34
Pellet G	83.05 b ±0.49	77.22 ±0.37	70.73 ±0.51	62.60 ±0.57

Values with same superscripts do not vary significantly along the columan with P< 0.01

Hastings (1976) opined that a 1:1 ratio by weight of ingredient mixture to water can give a proper consistency to a dough. But, this ratio was kept as 1:0.8 in the present study. According to Jayaram & Shetty (1981), too much water would render the dough soft, resulting in the clumping together of the noodles which in turn would hamper the drying process and breaking of noodles into uniform sized pellets. On the other hand, too little water would lead to improper gelatinisation of starch resulting in decreased water staibility of the pellets and result in a hard dough, requiring more energy for extrusion through the pores. The cooking of feeds in pressure cooker for 30 min helped in killing most of pathogenic bacteria and reportedly improves the utilisation of nutrients in fish feeds (Lovell, 1976) besides reducing the toxic effect of plant in-

gredients.

Carps being slow feeders require feeds which remain stable in water without much disintegration for at least one hour. Therefore, water stability of formulated diets is an important criterion in assessing its efficiency. The results of the stability studies on different formulated diets are given in Table 3. The stability of pellets is influenced by different factors like feed composition, nature of ingredients, type of processing and moisture content (Hastings, 1971). In the present study, highest stability was recorded in pellet C which may be due to its higher fat content. According to Jayaram & Shetty (1981), higher fat content prevents water penetration, thus facilitating to retain its compactness for longer periods. Renukaradhya & Varghese (1987) also found higher water stability for pellets having higher fat contents. The lowest water stability was recorded in pellet G followed by pellet E. The high percentage of crude fibre content in these feeds might have resulted in poor gelatinisation. The degree of stability of feeds is dependent on the extent of gelatinisation during steam conditioning (Stivers, 1970). According to Hastings (1971), the low concentration of gelatinisable matter in pelleted feeds decreases their stability. In the present study, all the pellets except pellet G were found to have the required stability for feeding carps.

The authors are grateful to the Director of Instruction, College of Fisheries, Mangalore for providing necessary facilities and for encouragement.

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