Fishery Technology
2000, Vol. 37(1) pp : 51 - 54

Water-Stability of Pelleted Fish Feeds Prepared from Non-Conventional Sources

W. Jayadev and W. Vishwanath
Department of Life Sciences, Manipur University
Canchipur - 795 003, Manipur, India

Fish feed was formulated using easily available low cost material as protein source and the water stability of the formulated feed was tested. It was found that feeds with higher fat content had better stability in water.

Key words: Fish feeds, water stability, non-conventional ingredients, fat content

The development of aquafeed and feeding strategies based on ingredients which are easily available to farmers and which will meet the nutritional requirements of fish would pave the way for further expansion of aquaculture (New, 1989; Tacon, 1992). At present, the cost of commercial aquafeeds is in the range of 30-60% of production cost and most of the supplementary feeds do not meet the protein requirement of different species under culture (Chong, 1993; Pandey *et al.* 1992). The traditional artificial feed used in India in intensive fish culture is a mixture of rice bran and oil cake which is nutritionally imbalanced (Varghese *et al.* 1976). Considerable amount of the feed is also wasted while feeding, since it is a loose mixture. Hence, identification of feed that is stable in water is an important criterion in feed formulation. In India, studies on the formulation and processing of pelleted feeds for carps are still in progress (Varghese *et al.* 1976; Jayaram & Shetty, 1981; Manissery *et al.*, 1988). The present investigation deals with formulation, processing and water-stability of five experimental diets.

Materials and Methods

Rice bran (RB), mustard oil cake (MC), fishmeal (FM), deshelled fresh water snail (*Bellamya crassa*- Benson) (DS), slaughter waste of broiler chicken (except feather) (BC) and silk worm (SW) were used as feed ingredients. All the ingredients were procured from in and around Imphal town, Manipur. BC, SW and FM were dried in an oven till moisture content was less than 10%. It was ground in a grinder and sieved through a fine mesh. DS was boiled for three minutes and the meat removed. Then, similar process of drying, grinding and sieving was followed as before. The different test feeds were formulated using SW, BC, FM and DS as animal protein sources and a mixture of rice bran and mustard oil cake in the ratio 1:1 by weight was used as basal component. The percentage composition of ingredients of the feeds is presented in Table 1. The pelleted feeds were prepared by manually kneading the ingredients with water in the ratio 1:1 by weight. The dough was autoclaved for 30 min. After cooling, the dough was passed through a pelletiser of 3 mm diameter pore size and the noodles were dried in an oven till moisture content was reduced to less than 10%. The noodles were then broken manually to a length of 5 to 10 mm.

Proximate composition of the formulated feeds was analysed. Total nitrogen was estimated by microkjeldahl method (AOAC, 1960) and crude protein was calculated by Kirk's conversion coefficient of 6.25 for animal and 5.7 for plant protein (Singh *et al.*, 1990). Total lipid was extracted using chloroform:methanol mixture, following the method of Folch *et al.* (1957).

Table 1. Ingredients used in the pelleted diets (%)

Ingredients	Pellet I	Pellet II	Pellet III	Pellet IV	Pellet V
RB	25.45	21.20	30.08	29.51	43.20
MC	25.45	21.20	30.08	29.51	56.80
FM	49.10	–	–	–	–
DS	–	57.59	–	–	–
BC	–	–	39.84	–	–
SW	–	–	–	40.98	–

Moisture content was determined by hot air oven method of Hart & Fisher (1971). Total ash was estimated by igniting the moisture free sample at 550°C for 6 h in a muffle furnace (ISI, 1982). The water stability of the pelleted feeds was determined after 1st, 3rd, 5th and 7th h of immersion in water. Each feed was tested in triplicate following the method of Hastings (1964).

The difference in water stability of pelleted feeds was tested for significance using 't' test.

Results and Discussion

The proximate composition of the diets is presented in Table 2. The ingredients were mixed to get a protein level of 35%. Devi (1995) obtained best growth of *Osterobrama belangeri* (Val.) juveniles when percentage of crude protein in feed was between 30% and 40%. Protein level of 30% in feed was economically efficient in carp culture (Renukaradhya & Varghese, 1987).

Jayachandran & Paulraj (1977) reported that pelleted feed comprising silkworm pupae, rice bran and wheat flour in the ratio 6:3:1 with a proximate composition of 5.80% moisture, 33.05% crude protein, 17.00% crude fat and 10.8% ash showed a pellet stability of 83% after an immersion of 10 min. The diets formulated for the present study have a comparable proximate composition. The low level of moisture content of these diets ensures a long shelf life, keeping them free from fungal and insect attack.

Jayaram & Shetty (1981) opined that excess water would render the dough soft, resulting in clumping together of the noodles which would hamper their drying and breaking into uniform size. Low water content would lead to improper gelatinisation of starch, resulting in decreased water-stability of the pellets and requiring more energy for extrusion through the dye. The ingredients were mixed with water in equal weight, as proposed by Hastings (1976). Cooking of feeds in a pressure cooker for 30 min would result in killing most of the pathogenic bacteria and improve the utilisation of nutrients in fish feeds (Lovel, 1976) besides reducing the toxic effect of plant ingredients.

Carps being slow feeders, require feeds which remain stable in water without much

Table 2. Proximate composition of formulated diets

Pellets	Protein %	Moisture %	*Fat %	*Ash %
I	35.50	2.98	13.20	17.00
II	35.50	3.83	18.60	15.00
III	35.51	4.88	20.10	18.00
IV	35.72	2.01	22.20	6.50
V	35.21	4.111	12.00	9.50

* On dry weight basis

Table 3. Water-stability of formulated feeds as percentage of dry matter obtained after immersing the feeds in water over varying duration.

Pellets	Period of immersion (hours)			
	1	3	5	7
I	84.5 ± 0.10[a]	83.7 ± 0.50[a]	82.52 ± 0.67[a]	79.85 ± 0.25[a]
II	89.4 ± 0.40[b]	86.8 ± 00[b]	85.32 ± 0.65[b]	83.7 ± 0.50[b]
III	85.0 ± 0.40[b]	76.5 ± 0.30	73.22 ± 0.07[b]	72.6 ± 0.61
IV	91.5 ± 0.50[b]	87.1 ± 0.10[b]	85.45 ± 0.44[a]	85.7 ± 0.30[b]
V	85.4 ± 0.20[a]	75.6 ± 0.40	70.1 ± 0.07	68.0 ± 0.40

Values with the same superscripts in the same column do not vary significantly $p<0.01$

disintegration for at least one hour (Das *et al.*, 1994). Therefore, water-stability of formulated diets is an important criterion in assessing their efficiency. The results of the water-stability studies on different formulated diets are given in Table 3. Hastings (1971) reported that water-stability of pellets is influenced by different factors like feed composition, nature of ingredients, type of processing and moisture content. In the present study, pellet IV had the best water stability followed by pellet II. The least stable was pellet V. Pellets of higher fat content retained compactness for longer period as fat prevents water penetration (Jayaram & Shetty, 1981). The degree of stability of feeds is also dependent on the extent of gelatinisation during steam conditioning (Stivers, 1970).

The authors are grateful to the Ministry of Environment and Forests, Government of India (Sanction No. 14/36/95-MAB/RE dated 27-8-1997), for financial assistance.

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