

# Stability in Water and Sinking Rate of Pelleted Feeds Formulated from Locally Available Ingredients

A.T. Ramachandra Naik\*, H. Shivananda Murthy, K.M. Rajesh and  
Mridula R. Mendon

*College of Fisheries, Mangalore - 575 002  
Karnataka, India*

Formulations of nutritionally balanced and cost effective feeds for fish and shellfish is of paramount importance in boosting production through aquaculture. Locally available feed ingredients were used for the preparation of pelleted feeds. Water stability and sinking rate of the feed were studied for various durations. The study revealed that stability of the feed reduced while sinking rate increased after 6 months of storage period.

**Key words:** Sinking rate, pelleted feed, carps, freshwater prawn

In aquaculture, feed represents a major input, comprising up to 50% of the total production cost (Naik & Murthy, 1999). Most of the artificial feeds do not meet the protein requirement of different species under culture conditions (Pandey *et al.*, 1992). The advantages of pelleted feed are well known. Though fish culture is an age-old practice in India, the artificial feed used is mostly a mixture of rice bran and groundnut oil cake, which is nutritionally unbalanced (Varghese *et al.*, 1976). Under these circumstances, there is an urgent need for formulation of nutritionally balanced and cost effective diets using locally available ingredients. The pelletisation process is an important criterion to be considered while manufacturing aqua-feed (Mac Grath, 1976). Fish nutritionists have been much preoccupied with physiological aspects of diet evaluation. The present study deals with the wet durability and sinking rate of the pelleted feed prepared for feeding carps and freshwater prawn in grow-out farming.

## Materials and Methods

Various feed ingredients (rice bran, groundnut oil cake, tapioca flour and vitamin mineral premix) used for the preparation of the pelleted feeds were

procured from local market and soya flour was supplied by Soya Good Rich (P) Ltd., Shimoga. The ingredient proportion and their protein contribution is presented in Table 1. Two types of pelleted feeds were formulated namely feed A and B with varying proportions of the ingredients. Groundnut oil cake was finely powdered and all other ingredients were then individually sieved through ISI standard mesh No.1 to get particles of uniform size.

Required quantities of the various ingredients (Table 1) were then kneaded well by hand with just sufficient water to obtain a soft consistency (1:0.8, feed to water by weight). The dough so obtained was cooked under steam in a pressure cooker at 105°C for 30 min following the method of Jayaram & Shetty (1981). The cooked dough was then cooled to room temperature by spreading in an enamel tray and vitamin and mineral premix was added and blended. The dough was thoroughly mixed again and extruded through a pelletizer having 2 mm die. The pellets were dried in a hot air oven at 60°C overnight or till the moisture content was reduced to <10%. Both the feeds were packed separately in high-density polythene bags and stored at ambient temperature.

\* Corresponding author

The experimental diets prepared were evaluated for their keeping quality. The water stability of the two formulated feeds was determined initially and after storage for six months by wet durability test over a period of 7 h as described by Hastings (1964). The sinking rate of pellets was also estimated in an aquarium tank measuring 1.25x0.5x0.5 m, soon after preparation and after 6 months of storage. Uniform sized pellets (1 cm) were gently dropped into the tank and time taken by the pellets to traverse the depth of the water column was noted with a stopwatch. The average time taken by each type of pellet was calculated separately and sinking rate of pellets was expressed as  $\text{cm.s}^{-1}$ .

## Results and Discussion

The feeds prepared had a protein content of 35%. (Table 1). The data on water stability and sinking rate of the two pelleted feeds recorded initially and after six months of storage are presented in Table 2. Feed B

exhibited higher water stability (98.65%) compared to feed A (90.17%). As far as sinking rate was concerned, feed A showed better sinking ability than feed B.

According to Hastings (1976), a 1:1 ratio by weight of ingredient mixture to water would give a proper consistency to the dough. But in the present study, this ratio was 1:0.8 for both feeds in order to achieve the desired consistency. Jayaram & Shetty (1981), Das *et al.* (1994) and Jayadevi & Vishwanath (2000) have studied the optimum requirements of water in the formulation of feed. Cooking of ingredients had been found to be advantageous in terms of destruction of pathogenic bacteria and improvement of nutritional quality (Lovell, 1976). One of the most important requirements of feed is that it should remain intact without losing any nutrients for a specified period after it is placed in water. Carps and prawn being slow feeders, require feeds which remain stable in water without much

Table 1. Proportion of ingredients and their protein contribution in the formulated feeds (%)

| Ingredient              | Feed A     |                      | Feed B     |                      |
|-------------------------|------------|----------------------|------------|----------------------|
|                         | Proportion | Protein contribution | Proportion | Protein contribution |
| Fish meal               | 25.0       | 15.1                 | 12.5       | 7.6                  |
| Soya flour              | 25.0       | 10.3                 | 37.5       | 15.5                 |
| Groundnut oil cake      | 20.0       | 7.3                  | 28.8       | 10.5                 |
| Rice bran               | 18.0       | 2.0                  | 11.0       | 1.2                  |
| Tapioca flour           | 10.0       | 0.3                  | 8.2        | 0.2                  |
| Vitamin mineral premix* | 2.0        | —                    | 2.0        | —                    |
| Total                   | 100.0      | 35.0                 | 100.0      | 35.0                 |

\* Supplied by Sarabhai Chemicals, Wadi Wadi, Baroda

Table 2. Moisture content, water stability and sinking rate of the formulated feeds (mean $\pm$ SE)

| Feed                      | Moisture  | Water stability %       |           |           |            | Sinking rate<br>(cm.s <sup>-1</sup> ) |
|---------------------------|-----------|-------------------------|-----------|-----------|------------|---------------------------------------|
|                           |           | Period of immersion (h) |           |           |            |                                       |
|                           |           | 1                       | 2         | 5         | 7          |                                       |
| Fresh                     |           |                         |           |           |            |                                       |
| A                         | 10.4±0.2  | 90.2±0.08               | 89.7±0.23 | 87.2±0.1  | 85.3±0.2   | 6.2±0.12                              |
| B                         | 9.6±0.16  | 98.7±0.29               | 96.4±0.24 | 91.6±0.18 | 87.5±0.1   | 5.4±0.15                              |
| After 6 months of storage |           |                         |           |           |            |                                       |
| A                         | 12.2±0.36 | 89.6±0.2                | 84.4±0.08 | 85.6±0.23 | 84.53±0.27 | 8.4±0.27                              |
| B                         | 11.8±0.17 | 97.1±0.05               | 94.6±0.17 | 88.4±0.16 | 85.5±0.45  | 7.7±0.16                              |

disintegration for at least one hour. The importance of high water stability of pelleted feeds in prawn nutrition was also highlighted by NRC (Anon, 1977). Therefore stability of the pellets in water is an important criterion in assessing their efficiency. The stability of the pellets is influenced by different factors like feed composition, nature of ingredients, type of processing and moisture content (Hastings, 1971). 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. Lim & Dominy (1990) reported that water stability of pellet was inversely related to the level of soybean meal. In the present investigation, there was a slight increase in stability with the increasing level of soya flour in the diet. This could be attributed to the fact that soybean meal is rich in structural high molecular weight carbohydrates, viz., cellulose, hemicellulose and pectins. But it usually contains less than 1% starch (Snyder & Kown, 1987).

The stability of the pelleted feeds decreased when tested after 6 months of storage (Table 2). Ravishankar (1983) and Shyama (1987) have reported that increase in the moisture content of the feed can affect the stability of the feeds in water. It was observed in this study that there was an increase in the moisture content of the pellets during storage and the decrease in the stability of stored samples may be due to the higher moisture level.

In addition to the stability of the feed, sinking rate of the pellets was also determined and is presented in Table 2. The feed employed in the culture system should preferably sink rapidly and be stable for long duration to enable maximum utilization by the culture species. External mastication, exposure to water currents and aeration systems can hasten pellet disintegration and result in loss of nutrients (Anon, 1977).

However, in the present study, the sinking rate of the pellets increased following storage and was inversely proportional to the moisture content of the feed as reported by Ravishankar (1983) and Monteiro (1994).

Of the two feeds, feed B had better stability in water and higher sinking rate compared to feed A. This indicates that substituting the costlier fish meal by the cheaper protein source, soya flour, in the preparation of pelleted feed yields a product with better stability and sinking characteristics.

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