

made into dough and autoclaved (Fig. 10) to ensure sterilization which helps to nullify the anti-nutritional factors present in plant based feed ingredients and also increases the binding ability of carbohydrate sources.



Fig. 10 Autoclaving



Fig. 11 Mixing of vitamin and mineral mix after autoclaving

The vitamin and mineral premix should be added (Fig. 11) after autoclaving due to its heat labile nature after which, the pelletizer (Fig. 12) transforms the feed into pellets of different sizes based on the mouth size of the cultivable fishes to be fed. The formulated feed pellets should be dried either by mechanical or manual drying (Fig. 13) to increase the shelf life.



Fig. 12 Pelletizer



Fig. 13 Mechanical drying

V. Formulated Feeds

So far, three different types of fish feeds were formulated at our feed mill by using different island and mainland based ingredients.

(i). Carp grower feed

The carp grower feed (Fig. 14) is a formulation of abundantly available island based ingredients such as fish meal, COC, paddy meal, broken rice, tapioca flour, rice bran in combination with other mainland based ingredients such as GNOC, corn flour and wheat flour. The feed was formulated with 25% protein and 6% lipid content.

(ii). *Macrobrachium lar* feed

The feed (Fig. 15) was prepared with 45% protein and 8% lipid with fish meal, shrimp head mill, squid and cuttle fish meal, GNOC and COC as the protein source, rice bran and broken rice as energy source and tapioca flour as the binding agent.



Fig. 14 Carp grower feed



Fig. 15 *Macrobrachium lar* feed



Fig. 16 Broodstock feed

(iii). Broodstock feed

After the successful breeding of three anemone fishes fed with fish, shrimp and clam meat, a plan has been made for the assessment of artificial feed on the gonadal growth and maturity of the marine ornamental fishes at our Institute. In this connection, a broodstock feed (Fig. 16) was formulated with 55% protein and 10% lipid content using fish meal, squid and cuttlefish meal, shrimp head meal as protein source and corn flour and tapioca flour as energy source.

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LOW COST FISH FEED PREPARATION FOR ISLAND AQUACULTURE



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I. Introduction

The farmers of Andaman and Nicobar Islands (ANI) are practicing aquaculture since the early settlement period. On an average, the Islands produce around 800-1000 kg/ha/yr of freshwater fishes as compared to 8-10 t/ha/yr in mainland India or other Southeast Asian countries and its about 10 times lower than that of mainland India. This immense lag in production is attributed to the improper pond management and feeding practices followed by the farmers. Various problems faced by Island farmers include unavailability of good quality feed, high cost of formulated feed and mainland based feed ingredients, lack of knowledge about alternative indigenous feed ingredients available in ANI. Owing to these reasons, the Island farmers are forced to follow the improper feeding practices which hinder the productivity of the farm. Educating the farmers to utilize the underutilized, indigenous fish feed ingredients enables them to increase the unit production at an affordable price. Feed based aquaculture can create a revolution by increasing the fish production from the same unit area thereby satisfies the consumer demand of better quality protein at a cheaper and affordable price.

II. Island Based Fish Feed Ingredients

Identification of various island based feed ingredients will be helpful for the farmers to utilize it in aquaculture practice. In these islands, groundnut oil cake (GNOC) is being imported from mainland resulting in three times upsurge in the price of the commodity as a result, the farmers find it unaffordable. Thus a better quality feed can be formulated by substituting the GNOC with coconut



Fig. 1 Seeds of *Simaruba glauca*



Fig. 2 Indigenous tree seed kernels

oil cake (COC) which is available plenty in these Islands. Likewise, tree resources such as *Simaruba glauca* (Fig. 1) and tree seed kernels (Fig. 2) can also be used as alternate feed ingredients.

Fish meal serves as the major protein source as well as the costliest ingredient of fish feed all over the world. Whereas in ANI, the abundant fishery resources serve as an advantage for the farmers, as they can easily afford the fishes like sardines and other trash fishes which is having major landings at cheaper price of around Rs. 20-30/kg. Fish meal delivers the essential amino acid requirements which are not satisfied by other ingredients such as coconut oil cake. There are various other ingredients such as leaves, tubers or stems of different plants (Fig. 3) which can also be considered for use as feed ingredient.



Fig. 3 Gunia



Fig. 4 Seaweed

The islands are surrounded with thick mangrove forests and its waters are flourishing with various seaweeds (Fig. 4). These seaweeds are rich in antioxidative and antimicrobial properties, which make their use as feed additive.

III. Fish Feed Mill

A small scale feed mill has been setup by the Fisheries Science Division of ICAR-CIARI at Marine Research Laboratory (MRL), Marine Hill, Port Blair in order to facilitate the supply of fish feed at an affordable price to the farmers. The feed mill consists of basic machineries such as grinder (Fig. 5), mixer (Fig. 6), pelletizer (Fig. 7), autoclave and drier to deliver the production of 10-20 kg feed per hour. The feed mill is working towards the

production of low cost good quality feed by utilizing the island based ingredients.



Fig. 5 Grinder



Fig. 6 Mixer



Fig. 7 Pelletizer

IV. Low Cost Feed Formulation

The utilization of underutilized island based ingredients can be a turnaround for the development of aquaculture sector in the Islands. The following steps are involved in low cost fish feed formulation.

The grinder is used to make fine powder of the ingredients (Fig. 8) which is then thoroughly mixed with another powdered ingredient using the mixer.



Fig. 8 Grinding of ingredients

After proper mixing either by mechanical or manual mixing (Fig. 9a & 9b), the ingredients are



Fig. 9a Mechanical mixing



Fig. 9b Manual mixing