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Replacement of Fishmeal with Jack Fruit (*Artocarpus integrifolia*) Waste in the Diets for *Labeo rohita* (Hamilton) Fingerlings

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Abstract

Jack fruit waste *Artocarpus integrifolia* (AIW) was substituted for fish meal at grated levels (10, 20, 30, 40 and 50) in the formulated diets for rohu fingerlings (3.64 ± 0.06 g). A fish meal based diet was served as control and fed to fish for 41 days. The control diet fed fish exhibited a better growth response and nutrient utilization, where as 30% substituted AIW diet fed fingerlings showed higher specific growth rate (SGR), protein efficiency ratio (PER) and protein intake (PI) with low (best) food conversion ratio (FCR). Decreased growth rate, weight gain higher FCR and with low PI and PER of fish were noticeable above 30% inclusion levels of AIW diets. The result revealed that adequate supply of nutrients from feed was available to fish only at upto 30% inclusion level. A significant increase of body protein, lipid and carcass energy of fish fed with 30% inclusion of AIW meal which corresponds to the control diet fed fingerlings supported these results.
Key words : Fishmeal, Jackfruit waste, Diet, *Labeo rohita*.

In aquaculture practice food production has become a major option not only for producing quality protein, but also to enhance higher fish production. Many countries have restored to large scale aquaculture of several varieties of fishes, as the production from capture fishery is stagnating. Aquaculture has the potential of producing large quantities of low cost protein rich food (1). In recent years the demand for dietary protein and energy sources have increased enormously due to rapid expansion of aquaculture practices. To promote higher fish production, commercial fishery industry needs more supplementary feed resources (2). The primary objective of feed formulation is to provide the species under culture with a nutritional diet to yield optimum production at minimum cost (3). Fish meal is used as the major source of animal protein in most of the commercial fish feed. However, due to escalating cost of fish meal, it is essential that alternative sources of protein are to be identified for its partial or complete replacement (4—6). Recently, there has been much interest as the possibility of using various non-conventional plant feed sources, which proved success in partial replacement of fish meal. Use of such plant protein sources could greatly reduce the feed cost and increase the bioavailability of nutrients to the fish. Among the promising protein sources available, biowastes (vegetable wastes, fruit wastes and leaf meals) are most important because they are available in plenty and are left unnoticed. They are rich in protein and energy and the amount in which they are being discarded or unattended are in large amounts. The bio-availability and richness, the available nutrients from the wastes are to be evaluated. If proper attention is made to use these fruit wastes for fishes as dietary components, the problem of deficit provision of costly protein sources in fish feed would be easily solved. Use of waste from mulberry, cabbage, cauliflower, banian fruit were incorporated in fish feed (1). In the series another type ingredient was selected and assessed for its nutrient value (jack fruit waste).

Labeo rohita is one of the important species among Indian major carps and used in ployculture practices. They are efficient converter of food to flesh depending upon the type and composition of the diet (7). As growth of early stage of fish is an important phase in indoor culture practices which saught to promote fry rearing condition as well, the use of low cost feed is of primary importance. So, the present study was focused to assess the nutritional value of

Table 1. Percentage composition of experimental diets.

Feed ingredient	Control	Feed type 1	2	3	4	5	6
1. Fish meal	36	33	26	20	15	10	04
2. Groundnut oil cake	28	24	22	20	17	14	10
3. Rice bran	16	15	14	12	10	08	08
4. Wheat flour	14	12	12	12	12	12	12
5. Tapioca flour	6	6	6	6	6	6	6
6. Jack fruit (*Artocarpus integrifolia*) waste	–	10	20	30	40	50	60

jack fruit waste (*Artocarpus integrifolia*) as the protein source for rohu fingerlings.

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Methods

Fingerlings of *Labeo rohita* were bought from Fish Farmer's Development Agency, (FFDA), Manimuthar and transported to the Center of Aqua feed and Nutrition (CAFeN) laboratory, St. Xavier's College, Palayamkottai and acclimatized for 10 days in rectangular cement tanks (400 liter capacity). During acclimatization period fish were fed with ground nut oil cake and rice bran (1:1) ratio. At the start of the experiment fish were recruited from the stock and divided into seven groups and each group in turn was divided into two sets. First group was control, other six groups were used as experimental. A fish meal (FM) based diet as prepared and served as control feed. In other series of diets, the chosen particular non-conventional plant protein was used instead of fish meal along with rice bran (RB), groundnut oil cake (GOC) and tapioca flour (TF) in the respective proportions (Table 1) and prepared as dry pellets. Throughout the experimental period of 41 days fish were fed with 5% of initial body weight of feed twice a day (0900 and 1600 hours). The unfed feed and feces were removed from each group daily by manual siphoning, dried and stored. At the end experimental period all the fish were sacrificed and dried in sunlight and dry weight were taken and used for biochemical analyses (8). Growth performance was calculated using the formula mentioned below. The data were analyzed using one way ANOVA and the difference of the means was tested with DMRT (9).

Table 2. Bio-chemical composition of formulated feed given to *Labeo rohita* fingerlings.

Feed type	Protein (%)	Carbo-hydrate (%)	Lipid (%)	Fiber (%)	Ash (%)	Mois-ture (%)	Energy (J/mg)
1. Control	42.50	8.02	7.8	10.24	11.8	8.25	18.53
2. AIW_1	29.50	14.01	6.3	11.05	13.70	8.32	17.10
3. AIW_2	28.02	14.79	6.0	11.78	12.50	8.28	17.24
4. AIW_3	28.25	15.02	5.8	12.39	16.4	8.43	17.86
5. AIW_4	27.33	15.54	5.3	12.92	16.8	8.18	16.35
6. AIW_5	27.10	15.92	5.6	14.17	17.1	8.37	16.72
7. AIW_6	26.52	16.24	5.1	14.24	17.7	8.29	16.10

$$\text{Specific growth rate (SGR)} = \frac{I_nI_2 - I_nI_1}{\text{Experimental duration (day)}} \times 100$$

Table 3. Growth performance and protein budget of *Labeo rohita* fingerlings fed with formulated diet containing jack fruit (*Artocarpus integrifolia*) waste. Mean values in the same column sharing different superscript differ significantly (P<0.05).

Feed type	Initial body weight (g)	Final body weight (g)	Growth (g)	Growth rate (mg/g fish/day)	Feeding rate (mg/g fish/day)	SGR	FCR	PI (%)	PER
1. Control	3.36±0.05	3.60±0.02	0.24±0.02	2.92±0.07	11.59	0.168±0.03	3.95±0.02	8.80±0.09	0.661±0.03
2. AIW_1	3.97±0.05	4.70±0.01	0.73±0.03	7.53±0.03	24.16	0.411 ± 0.07^{ab}	3.20 ± 0.05^{ab}	16.80 ± 0.01^{ab}	1.057 ± 0.07^{a}
3. AIW_2	2.06±0.02	2.90±0.05	0.84±0.07	16.71±0.09	50.15	0.834 ± 0.09^{bc}	3.00 ± 0.09^{a}	17.21 ± 0.07^{ab}	1.18 ± 0.01^{a}
4. AIW_3	2.78±0.03	4.16±0.03	1.38±0.02	20.35±0.02	54.42	0.983 ± 0.04^{c}	2.67 ± 0.02^{a}	25.43 ± 0.09^{c}	1.32 ± 0.07^{b}
5. AIW_4	3.14±0.07	3.82±0.02	0.68±0.01	8.87±0.01	29.37	0.478 ± 0.05^{ab}	3.30 ± 0.04^{ab}	14.90 ± 0.10^{ab}	1.10 ± 0.05^{a}
6. AIW_5	3.73±0.05	4.26±0.07	0.53±0.03	5.82±0.05	21.10	0.324 ± 0.04^{a}	3.62 ± 0.07^{b}	12.63 ± 0.03^{ab}	1.01 ± 0.09^{b}
AIW_6	2.80±0.02	3.10±0.05	0.30±0.08	4.39±0.02	18.01	0.248 ± 0.03^{a}	$4.10^{c}\pm0.02$	7.95 ± 0.07^{a}	0.92 ± 0.08^{a}

Table 4. Carcass composition of *Labeo rohita* fingerlings fed with formulated diets containing jack fruit (*Artocarpus integrifolia*) waste. Mean values in the same column sharing different superscripts differ significantly (P<0.05).

Feed type	Protein (%)	Lipid (%)	Ash (%)	Moisture (%)
1. Control	41.42 ± 0.03	27.06 ± 0.13	14.25 ± 0.39	78.13 ± 0.30
2. AIW_1	43.51 ± 0.17^a	29.66 ± 0.23^a	12.24 ± 0.61^a	81.25 ± 0.42^c
3. AIW_2	45.27 ± 0.44^a	31.32 ± 0.62^a	11.32 ± 0.27^a	76.47 ± 0.35^b
4. AIW_3	46.48 ± 0.17^{ab}	31.52 ± 0.36^a	10.62 ± 0.61^a	72.55 ± 0.65^a
5. AIW_4	44.75 ± 0.39^a	31.28 ± 0.42^a	11.47 ± 0.70^a	75.21 ± 0.53^b
6. AIW_5	43.05 ± 0.82^a	31.52 ± 0.05^a	11.75 ± 0.63^a	74.90 ± 0.18^a
7. AIW_6	40.68 ± 0.35^a	30.23 ± 0.15^a	10.23 ± 0.33^a	73.25 ± 0.22^a

$$\text{Food conversion ratio (FCR)} = \frac{\text{Dry food consumed (mg)}}{\text{Wet weight gain (mg)}}$$

$$\text{Protein intake (PI) (mg/day)} = \frac{\text{Protein consumed (mg)}}{\text{Duration (day)}} \times 100$$

$$\text{Protein efficiency ratio (PER)} = \frac{\text{Growth (g)}}{\text{Protein consumed (mg)}} \times 100$$

Results and Discussion

Among the six different diets tested for rohu fingerlings a significant increase in the weight gain (1.38 g), SGR (0.98), PER (1.32) and PI (25.41%) with low (best) FCR (2.67) were noticeable in fish fed with AIW_3 diet at 30% incorporation level of jack fruit waste. This result revealed that 30% of jack fruit waste meal might have supplied adequate nutrient to the fish and might have satisfied the requirements of this stage of the fish and induced the growth quite well. Despite the high nutritive value of this fruit waste, very little information is available on the use of this source as a dietary resource, but corollary reports are available, for example, diets containing 25% of *Azolla* fed to mrigala diets showed the best SGR (0.99) and low FCR (2.17) (2); 20% replacement of *Azolla* with soybean meal tested for *Clarias gariepinus* (10) and *Cyprinus carpio* produced higher growth with low FCR (11). Rohu fingerlings fed with 20 to 25% of *Dolicos lablab*, banian fruit, banana flower and cauliflower were also reported (1, 11), which produced better growth performance. The inclusion of jack fruit in fish feed was based on its availability in nature, nutrient bioavailability to the fish and the digestible capacity of the fish.

Regarding the food utilization in terms of absorption and conversion, the fish showed a higher feeding rate upto 30% inclusion level and decreased thereafter. The lower absorption, conversion and growth rates at higher inclusion level might be due to higher fiber and ash contents in the feed (1). Low feeding rate was also due to the presence of some unidentified antinutritional factors (12) which might reduce the growth. The reduction in digestive capacity of the fish owing to higher ash content might have hindered adequate supply of energy transfer from the feed to flesh. The growth depression of fingerlings could also be due to the presence of undigestable complex mucopolysaccharides which might have impaired the metabolic pathway and reduced the energy production (13, 14). Encouraging results were observed in the carcass composition of rohu fed with 30% jack fruit waste. A significant increase in the body protein and moderate increase of lipid at this concentration of AIW diet fed fish corresponding to those fed with control diet, indicated that the bio-availability of the nutrient of the feed was more and adequate for the fish than higher doses of AIW meals. This results was also supported by reduction in the body ash and moisture content of the fish. So from this study, it could be concluded that the jack fruit waste could be a better replacer for fish meal and could be used upto 30% for juvenile rohu diets.

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