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Cost effective floating feeds for Indian Major Carps (IMC) by replacement of soyabean meal with alternative feed ingredients

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ABSTRACT

Three types of iso-nitrogenous floating feeds for Indian Major Carps (IMC) were formulated and prepared in extruder by using different feed ingredients. The first feed (SMF) was formulated with soyabean meal as main protein source whereas 2nd (GNF) and 3rd (TCF) feed were formulated by replacing a part of soyabean meal with alternative feed ingredients i.e. ground nut oil cake and til oil cake respectively. Evaluation of three types of floating feeds showed that, floating percentage, sinking percentage and apparent density were not affected on three different types of floating feed. The water holding capacity was highest in Feed II (GNF) and lowest in Feed I (SMF). The crude fibre and ether extract percentage of the TCF was highest among three floating feeds whereas nitrogen free extract was highest in SMF feed. The proportion of omega 3 fatty acids of three types of feed did not differ significantly. The growth performance of TCF was comparable to GNF floating feed where as it was superior to SMF floating feed. The feed cost was lowest in TCF and highest in SMF feed. This indicated that, the floating feeds (GNF and TCF) developed by replacement of soyabean meal with ground nut oil cake and til oil cake are superior to floating feed (SMF) prepared by inclusion of only soyabean meal and this may be economical for the farmers.

Key words: Extrusion, Feed quality, Fish, Floating feed, Temperature.

INTRODUCTION

Extrusion technology is the primary technique used for fish feed production to maintain high physical and nutritional quality of the feed (Hilton *et al*. 1981). The floating feed prepared by this technology has lot of advantages like less feed wastage, , improved feed efficiency, lower handling costs, easier storage and less bacterial contamination. The farmer can also directly observe and adjust feeding rates when floating feed is used for fish feeding.

One of the major ingredients for production of floating feed is soyabean meal and it is used worldwide as protein feed ingredient. However, the cost of soyabean meal is very high in the local markets and sometimes the supply is very less. However, ground nut oil cakes and til oil cakes are available in local markets throughout the year and cost of these ingredients are less. Hence, an experiment was devised for production of cost effective floating feed through extrusion technology by inclusion of ground nut oil cakes (GNOC) and til oil cakes (TOC) replacing soyabean meal and comparative quality evaluation was done.

MATERIALS AND METHODS

Three iso-nitrogenous fish feeds were formulated for Indian major carps by using locally available feed ingredients. The first feed (SMF) was formulated with soyabean meal as main protein source whereas 2nd (GNF) and 3rd (TCF) feed were formulated by replacing a part of soyabean meal with locally available ingredients i.e. ground nut oil cake(GNOC) and til oil cake(TOC) respectively. The production of three types of floating feed was done in the feed mill located at CIFA campus. The extrusion temperature during feed preparation was remained constant at 130 ^{0}c with constant pressure (10 kg/cm^2) and moisture of 25 percentages. The floating feeds so prepared from three different chemical compositions were then evaluated for physical and chemical characteristics to ascertain the quality of the feed. The physical parameters i.e. floating and sinking percentage were calculated from floating and sinking record of floating feed in glass aquarium (1' x 1' x1') with water. Apparent densities of the floating feeds were calculated by measuring volume and mass by a digital screw gauge and weighing balance respectively. The water holding capacity is the increase in weight of water on 20 minutes water hold. The chemical parameters i.e. dry matter (DM), Crude Protein (CP), Ether Extract (EE), Crude Fibre (CF), Nitrogen Free extract (NFE) and Total ash (TA) were analysed as per AOAC (1990) for quality evaluation. The fatty acid profile of three types of feed was done by gas chromatograph (Shimadzu, 2010).

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Table 1: The Physical characteristics of floating Feeds

Items	SMF	GNF	TCF	SEM	P value
Floating percentage	99	100	98	0.618	0.223
Sinking percentage	2	0	3	0.521	0.087
Apparent Density (gram/ cubic cm)	0.281	0.292	0.292	0.004	0.467
Water holding capacity (%)	175[a]	228[b]	213[b]	9.590	0.034

Means with different superscripts in a row differ significantly (P< 0.05)

A feeding experiment of four weeks duration was carried out in 200L circular plastic tanks at Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar. The water from bore well was filled in twelve nos of tanks to maintain the water column. Ten number fingerlings of *labeo rohita* were stocked in each tank (weight 156 g) and one dietary treatment was allocated randomly to three tanks. Aerators were used in each tank to provide sufficient oxygen and half of water was changed daily. Water quality parameters were also checked and found to be optimum. The biomass in each tank was recorded weekly interval and feed intake was recorded daily. Finally the FCR and cost of three floating feeds was calculated based on the ingredients cost purchased from the local market.

RESULTS AND DISCUSSION

The physical characteristic of floating feed has been presented in Table 1. The physical parameters i.e. floating and sinking percentage were calculated from floating and sinking record of feed pellets in glass aquarium. There was no significant difference in the floating percentage of these three feeds. This showed that, the gelatinization of starch was proper in three types of feed allowing proper swelling. When there is starch in the feed, there is proper swelling and the feed can float for sufficient period of time (Sørensen *et al*., 2005 and Saalah *et al*., 2010). Temperature during extrusion has also an impact on the gelatinization of starch and floating percentage as increasing barrel temperature results in increased expansion (Oliveira, 1990). In this experiment the temperature of 130 ^{0}c was maintained for three types of pellets which is sufficient for gelatinisation of starch and floating percentage was increased. The water holding capacity in this experiment was highest in Feed II (GNF) and lowest in Feed I (SMF), but there was no significant difference between TCF and GNF floating feed. The apparent density (gram/ cubic cm) were not affected on three different types of floating feed. The water holding capacity is the indication of water absorption by the pellets and water absorption is more, if there is hollowness in the pellets. This experiment showed that, porosity of pellets was more in GNF as air passing over the hot pellets was increased and so the water absorption was improved. The porosity of the pellets has an added benefit with respect to the ability of the pellets to absorb oil in the production process.

The chemical composition i.e. Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), Crude Fibre (CF), Nitrogen Free Extract (NFE) and Total ash (TA) were analyzed as per AOAC (1990) and is presented in Table 2. There was no significant difference in the crude protein content of three types of feed as feeds were iso-nitrogenous. However, the chemical analysis showed that, the Ether Extract (EE) and Crude Fibre (CF) were significantly higher in feed III (TCF) compared to that of feed I (SMF) and Feed II (GNF). This was because of the fact that, TOC contains more Crude Fibre (Kuo, 1967) and Ether Extract (Tacon, 1990) than soyabean meal and ground nut cake resulting higher CF and EE in TCF compared to SMF and GNF. There was no significant difference in the soluble carbohydrate of GNF and TCF but the soluble carbohydrate of SMF was significantly higher than GNF and TCF. The soyabean meal contains more soluble carbohydrates than ground nut cake and til oil cake resulting more soluble carbohydrate in SMF.

The fatty acid profile of floating feed: The fatty acid profile of floating feed has been indicated in Table 3. The mono-unsaturated fatty acids (MUFA) of three types of feed did not differ significantly. However, the poly unsaturated fatty acids (PUFA) content was highest in SMF and lowest in GNF. The omega 3 fatty acids were 2.5, 2.3 and 2.1 percentages of total fatty acids and omega 6 fatty

Table 2: The chemical characteristics of feeds during the experiment (on DM basis)

Items	SMF	GNF	TCF	SEM	P value
DM	92.86	92.94	93.45	0.247	0.635
OM	93.98	93.81	93.56	0.316	0.893
CP	30.58	30.97	30.57	0.137	0.455
CF	5.44[a]	5.81[a]	7.02[b]	0.243	0.001
EE	1.56[a]	1.76[a]	1.97[b]	0.064	0.003
NFE	49.26[b]	47.64[a]	47.41[a]	0.314	0.003
TA	6.02	6.19	6.44	0.317	0.893

Means with different superscripts in a row differ significantly (P< 0.05)

Table 3: The fatty acid profile of floating feeds

Fatty acid %	SMF	GNF	TCF	SEM	P value
SFA	41.2	45.8	46.0	1.558	0.411
MUFA	0.15[a]	0.48[c]	0.23[b]	0.052	0.001
n-3 fatty acids	2.5	2.3	2.1	0.076	0.078
n-6 fatty acids	44.8[a]	40.1[b]	42.5[b]	0.746	0.005
PUFA	47.36[c]	42.35[a]	44.61[b]	0.746	0.002

Means with different superscripts in a row differ significantly (P< 0.05)

acids were 44.8, 40.1 and 42.5 percentage of total fatty acids in SMF, GNF and TCF feeds respectively. The proportion of omega 3 fatty acids of three types of feed did not differ significantly. The omega 6 fatty acid was highest in SMF whereas GNF and TCF had comparable omega 6 fatty acids. However, omega 3 and omega 6 fatty acids in the fish diet has little significance in the growth performance of fish.

The growth performance if IMC: The growth performance of IMC is presented in Table 4. The weight gain of fish in groups TCF and GNF increased significantly compared to fish in SMF whereas weight gain in TCF and GNF did not differ significantly. This increased weight gain in TCF and GNF may be because of balancing in amino acids in TCF and GNF compared to SMF as til oil cake, ground nut oil cake and soyabean meal are good source of methionine, arginine and lysine respectively (Ramachandran *et al.*, 2007). There is more availability lysine + methionine in TCF feed and lysine + arginine in GNF feed compared to SMF feed. Again, the methionine availability of til oil cake is increased to 15 to 22% by heat treatment (Yasothai, R. 2014) and til oil cake is good source of calcium (Ramachandran *et al.*, 2007). The increased intake in TCF and GNF has already been reflected in this feeding experiment.

Similarly the feed cost calculated from the feed ingredients purchased from the local market has been indicated in the Table 4. The cost of the ingredients was calculated based on the market price of the ingredients at the time of the experiment. There was high profit in feed cost of TCF and also there is profit in overall aquaculture production.

Table 4: Effect of three types of feeds on growth performance of IMC

Parameters	SMF	GNF	TCF	SEM	P value
Weight gain, g (4 weeks, 10 no)	22.40 [b]	26.10 [a]	25.83 [a]	0.641	0.001
Intake, g dry (4 weeks, 10 no)	71.02 [a]	78.93 [ab]	83.34 [b]	2.22	0.038
FCR	3.17	3.05	3.23	0.054	0.137
Feed Cost (Ingredients, Rs/kg)	30.50	29.50	26.20	-	-
Cost/kg gain (Rs)	96.68	89.97	84.60	-	-

Means with different superscripts in a row differ significantly (P< 0.05)

CONCLUSION

The present research work showed that overall feed quality and growth performance of TCF and GNF floating feed were comparable but superior to SMF floating feed. This indicated that, the floating feeds (GNF and TCF) developed by replacement of soyabean meal by ground nut cake and til oil cake respectively are superior to floating feed (SMF) prepared by inclusion of only soyabean meal and this may be economical for the farmers.

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