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The Substitution of Mustard Oilseed Cake (*Brassica napus*) for Poultry Flour in Snakehead Fish *Channa gachua*

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ABSTRACT: In most of the countries around the world, supplemental feeding is a crucial technique for fish farming. Supplemental feeds like groundnut cake, mustard cake, cotton seed cake, and other oil cakes mixed with rice bran or wheat bran are frequently used. The major components of artificial feed, which are typically provided, are byproducts of various agricultural commodities, including vegetables, oil cake, rice, wheat bran and husk, etc. In order to maximize fish productivity and save costs, nutrient-balanced fish feed must be developed using materials that are readily available regionally. One such widely available fish feed is the oil extracted from the mustard seeds. Following the extraction of oil from mustard seeds, mustard oil cake is produced as a byproduct. These oilcakes are employed as feedstock in the manufacturing of supplemental aquafeed in industrial settings. Depending on the various growth environments and processing techniques, the chemical makeup of mustard cake changes. From June 2018 to May 2019, mustard (*Brassica napus*) oilseed cake was used in place of poultry meal when feeding snakehead fish. In this fish culture, it served as the primary source of protein. The live weight gain, feed conversion rate, protein efficiency ratio, and specific growth rate of fish were assessed in three groups fed diets T_0, T_1, and T_2, respectively. The fish in group T_3 saw a considerable drop in their growth indices, including a poor feed conversion rate (3.64±0.05), a low protein efficiency ratio (0.94±0.03), and a low specific growth rate (2.89±0.05). While fish from groups T_0, T_1, and T_2 all exhibited roughly comparable levels of protein in their bodies, fish from group T_3 ($P<0.05$) shown a substantial drop. Low body fat was evident at the level of total substitution of chicken offal meal with mustard oilseed cake ($P < 0.05$). Although being much greater in fish fed the T_3 diet, The diets T_0, T_1, and T_2 did not substantially differ from one another in terms of moisture content ($P > 0.05$). Fish fed diets T_0, T_1, and T_2 revealed notable variations in body ash content ($P>0.05$), but fish in the T_3 group had a considerably higher level of body ash level. The use of mustard oil cake in place of poultry offal meal had a substantial impact on the histosomatic index, viscerosomatic index, and condition factors ($P<0.05$). The replacement level of T_2 was noted to be unaltered, however considerable modifications were found in the levels above T_2.

Keywords: *Brassica napus, Channa gachua,* Artificial Diet, Histosomatic Index, Viscerosomatic Index.

INTRODUCTION

Just like all the other animals, fish also need a healthy diet to produce high-quality proteins, grow normally, and reproduce (Glencross *et al.,* 2007). Around the world, supplemental feeding is a crucial strategy for fish production. The well-being of each fish species requires a well-balanced nutrition (Ghimire *et al.,* 2017). The common meals for fishes are obtained from fishes, oil cakes, frog wastes, rice, wheat bran, domestic birds, fruits, vegetables, *etcetera* (Sarker *et al.,* 2015). Feed production cost is the most expensive aspect of fish culture (Akiyama *et al.,* 1989). Therefore, lowering the feed cost is essential for the growth of the aquaculture sector. Numerous studies have demonstrated that using poultry meal to partially replace dietary fishmeal can be done without having an adverse effect on the development and feeding effectiveness of most of experimental fish (Devi *et al.,* 1999). Though the high ash content in the poultry meal, with other indigestible substances like feathers, results in low digestibility (Robinson *et al.,* 1996). However, a high-quality protein feed can be produced if an appropriate raw material is selected and handled correctly (Bureau *et al.,* 2000). In order to maximize fish productivity and save costs, a nutrient-balanced fish feed must be developed using materials that are readily available regionally. One such widely available fish feed is the oil extracted from the mustard seeds. Following the extraction of oil from mustard seeds, mustard oil cake is produced as a byproduct. In the

Indian plains, mustard cake is manufactured in great amounts. With different growing environments and processing techniques, mustard cake's chemical make-up differs. It serves as the primary protein source in such fish culture. A significant amount of toxic chemicals, such as glucosinolates, isoflavonoids, cyanoalanine, and cyanogenic glycosides, are present in mustard cake (Sokal *et al.,* 1989). The poisonous components in the mustard oilseed cake may have an impact on the fish's performance in relation to breeding status, growth, palatability (Ghimire *et al.,* 2017).

Channa gachua is a dwarf snakehead freshwater fish species that belongs in the family Channidae. It occupies the top rank among commercially important freshwater fish in India. Due to its excellent potential for survival, the Channidae species, *C. gachua* is one that is frequently used in aquaculture operations. It has a pleasant taste and therapeutic value, making it appropriate for profitable culture. Hence, the current research has been done on *C. gachua*, using mustard (*Brassica napus*) oilseed cake in place of chicken meal.

MATERIAL AND METHODS

Preparation of fish meal was done by drying and powdering low-quality fish available from local markets (Ali Akshad *et al.,* 2017). The drying was done by regular exposure to sunlight and a grinder was used to reduce it to a powdered form (El-Sayed 1998). This powdered form is considered as the T_0 (control diet), which has the same level of analyzed crude protein and gross energy. The feeds T_1, T_2 and T_3 have a composition of 30%, 60% and 100% of mustard oilseed cake, respectively, with an addition of poultry meal (Table 1).

Table 1: The different components and proximate composition used for research.

Ingredients (gm 100g^{-1} dry weight)	0% (T0)	30% (T1)	60% (T2)	100 % (T3)
Fish meal	21.7	21.7	21.7	21.7
Soybean meal	26.50	26.50	26.50	26.50
Mustard Oil cake	27.31	18.42	11.52	0
White bran	14.20	14.20	14.20	14.20
Poultry meal	0	10.09	18.18	31.30
Cod liver oil	1	1	1	1
Soybean oil	2	2	2	2
Mix of Mineral	1	1	1	1
Mix of Vitamin	1	1	1	1
Carboxy methyl Cellulose	1	1	1	1
Alpha Cellulose	4.29	3.09	1.90	0.30
Total	100	100	100	100
Analyzed Crude Protein	41.4	40.5	41.4	42.6
Gross energy (kJg^{-1})	15.80	15.80	15.80	15.80

All the ingredients are thoroughly mixed (Hobart electric mixer) with vitamin, mineral, and oil premixes and then steam cooked at 80˚C. Water was gradually added until the mixture had a paste-like consistency (El-Sayed 1998). Polythene bags were used to cover these final prepared diets and refrigerated carefully at a temperature of -4°C.These stored diets are labeled according to their composition and are to be used as feed for the fish throughout the study and for the upcoming procedures. Additional care is taken to preserve the quality of the prepared feeds.

The experimental fish, *Channa gachua* were taken to the laboratory to analyze their growth performance and then treated with $KMNO_4$ (1:3000) solution. For a fortnight, fish were placed in tanks with a volume of 600 liters and with a stock capacity of 210 fishes. For the experimental work, fingerlings (9.09±0.04 gm; 9.18±0.02 cm) were taken and placed it in polyvinyl toughs in triplicate groups (70 liters), which contained 50 liters of water. The arrangement was set up to accommodate seven fingerlings in each trough (Bureau *et al.,* 2000).

For the first five days of the culture phase, fish feed was supplied twice a daily 3 percent of their body weight, then 5% in the following days. There were two windows for feeding a day: 50% in the morning (at 8:30 AM) and the other half in the evening (at 4:30 PM). On the day of the weigh-in, no feed was given to the fish. An electronic balance was utilized for weighing (Precisa 120A; Switzerland). Unconsumed food and excretory feces were taken out of the feeding trough (El-Sayed, 1998). To calculate the amount of prepared feed that the fish ate, the feed that was left in the trough after active feeding, was collected, dried, and weighed. The crude protein, ash, moisture content, and fat content were analyzed by AOAC (1990).

On a Gallenkamp ballistic bomb calorimeter (Loughbrough, England), the gross energy was calculated (Francis *et al.,* 2001). The research on using mustard (*Brassica napus*) oilseed cake in place of poultry meal on snakehead fish, *Channa gachua*were measured by looking at hepatosomatic index, viscera somatic index, condition factor, intake of feed, survival rate, specific growth rate, ratio of protein efficiency, ratio of feed conversion, and live weight gain.

Various calculation methods are as follows:

$Hepatosomatic\ index\ in\ \%$

$$= \frac{\text{Liver weight in grams}}{\text{Body weight in grams}} \text{x } 100$$

Viscerosomatic index in %

$$= \frac{\text{Visceral weight in grams}}{\text{Body weight in grams}} \text{x } 100$$

Condition factor (K)

$$= \frac{\text{Body weight in grams}}{\text{L}^3 \text{ g}} \text{x } 100$$

Live weight gain (%)

$$= \frac{\text{Final body weight} - \text{Initial body weight}}{\text{Initial body weight}} \text{x } 100$$

Specific growth rate (%)

$$= \frac{\text{Final body weight} - \text{Initial body weight}}{\text{Number of days}} \text{x } 100$$

Feed conversion rate

$$= \frac{\text{Dry feed intake in grams}}{\text{Final body weight}}$$

Protein efficiency ratio

$$= \frac{\text{Wet weight gain in grams}}{\text{Protein intake in grams}}$$

Survival rate (%)

$$= \frac{\text{Final fish number}}{\text{Initial fish number}} \text{ x } 100$$

To compare diverse dietary interventions, one-way analysis of variance (ANOVA) was utilized (Soltan, 2005). The Duncan's Multiple Range Test was performed to identify variations in treatment approaches at a (P<0.05) level of significance. Using the SPSS software programme, the calculations were carried out. Throughout the text, data are presented as means and standard errors of three replications (n=3).

RESULTS AND DISCUSSION

According to research on a protein-to-protein basis on the snakehead fish *Channa gachua*, mustard (*Brassica napus*) it was identified that oilseed cake can replace poultry meals up to 60%, as shown by substantial differences (P<0.05). Table 2 displays the feed conversion ratio (1.48-1.54g), live weight increase (240-237g), ratio of protein efficiency (1.82-1.87g), and specific growth rate (4.82-4.66g) for the given fish diets: T_0, T_1, and T_2. The growth parameters had a significant drop in T_3. Fish fed diets containing mustard oil cake had significantly lower feed conversion rate (3.64±0.05), protein efficiency ratio (0.94±0.03), and specific growth rate (2.89±0.05) when their growth performance crossed 60% with significant differences (P>0.05) (Nengas *et al.,* 1999).

Fish growth performance is directly associated with the components and amount of content in the prepared feed (Glencross *et al.,* 2007) The fingerling's body composition is provided in Table 3. Fish bodies in T_0, T_1, and T_2 almost all have equal amounts of protein, but there was a significant drop in T_3 (P<0.05). The size, feeding level, food availability, digestible energy content of the diet, water temperature, and quality of natural foods are only a few of the numerous variables that have a significant impact on fish's protein requirements (Roy, 2002). When poultry meal was completely substituted for mustard oil cake, the quantity of fat was low (P<0.05). The moisture content of the T_3 diet is much higher even though there are no noticeable changes between the diets T_0, T_1, and T_2 (P<0.05). T_3 fish had a high body ash content, whereas fish fed diets T_0, T_1, and T_2 exhibited notable differences. (P>0.05).

Table 2: Conversion efficiency and growth performance of *Channa gachua.*

Growth Parameters	T_0	T_1	T_2	T_3
Initial weight (gm)^1 – Average	9.05±0.02	9.18±0.01	9.18±0.01	9.04±0.02
Final weight (gm)^1 – Average	30.5±0.61	30.8±0.25	30.5±0.07	20±-0.30
Live Weight Gain (%)	240±12	238±11	237±9	138±10
Ratio of feed conversion	1.48±0.04	1.52±0.04	1.54±0.02	3.64±0.05
Ratio of protein efficiency	1.82±0.02	1.84±0.03	1.87±0.02	0.94±0.03
Specific growth rate (%)	4.82±0.04	4.65±0.05	4.66±0.05	2.89±0.05
Intake of feed	30.46±0.13	30.91±0.55	30.83±0.14	33±0.15

Table 3: Body composition of *experimental* fish, *Channa gachua.*

Composition of the Body	Initial	0%	30%	60%	100%
Protein	14.6±0.32	17.5±0.13	17.1±0.4	17.4±0.12	15.6±0.14
Fat	3.3±0.22	4.1±0.03	3.9±0.04	4.5±0.04	3.5±0.10
Moisture	79.6±0.20	78.9±0.04	79.12±0.06	79.62±0.11	80.5±0.04
Ash	2.7±0.13	2.4±0.02	2.8±0.04	2.8±0.15	3.4±0.16

Table 4: Various somatic *indices* of *Channa gachua.*

	HSI - Hepatosomatic index in %	VSU – Viscerosomatic index in %	CF - Condition factor
TO	1.28±0.42	1.98±0.45	1.36±0.52
T1	1.27±0.30	1.94±0.44	1.38±0.42
T2	1.17±0.25	1.85±0.41	1.19±0.21
T3	1.97±0.14	1.97±0.41	1.01±0.13

Histosomatic index, viscerosomatic index and condition factor were also observed (Table 4). These three variables were significantly influenced by the substitution of poultry offal meal instead of mustard oil cake (P<0.05). It was found to be unaffected by the replacement amount of T_2, although considerable modifications were noted beyond T_2 (Priyadarshini *et al.,* 2011).

Studies on the impact of feeding snakehead fish (*Channa gachua*) with mustard (*Brassica napus*) oilseed cake instead of poultry meal, indicated that it was more suitable up to 60%, and that it had a marked effect on the growth performance of *Channa gachua* beyond this limit in feed T_3. The poultry meal can substitute up to 60% of the mustard oilseed cake in the fish meal without effecting the growth and feed utilization efficiency (Soltan 2005). Similarly, it was reported in rainbow trout (Pillay 1990). According to the feed conversion rate data from the current experiment, poultry meal can be replaced by 60% of the mustard oil cake in *Channa gachua* diets. Similar findings were reported by Hudson (1981). The current study's histosomatic index, viscerosomatic index, and condition factor data revealed no significant changes across the treatments up to the substitution of 60% poultry meal with mustard oil cake (Piedecausa *et al.,* 2007). Furthermore, the use of mustard oil cake increased the histosomatic index, viscerosomatic index, and poor condition factor significantly. Similar results were reported by USDA (2013).

CONCLUSIONS

The majority of the experimental fish's growth, performance, and feeding effectiveness were unaffected by the partial substitution of poultry meal for dietary fishmeal. Low digestibility is caused by the poultry meal's high ash content. The mustard cake contains a high level of toxic substances, including glucosinolates, flavinoids, cyanoalanine, cyanogenic glycosides, etc. The toxic components in the mustard oilseed cake may have an impact on the fish's capacity to reproduce, grow, and taste good, among other things.

Conflict of interest. None.

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