# A study of replacing dietary crude protein of fish meal by catfish (*Pangasius hypophthalmus*) by-products on growth performance and meat quality of Muscovy ducks

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## Abstract

An experiment was carried out in a household in Hoa Loi village, Chau Thanh district of Tra Vinh province to evaluate the effects of replacing dietary fish meal by catfish (*Pangasiushypophthalmus*) by-product on growth performance and carcass composition of crossbred Muscovy ducks. The ducks (n=150) at four weeks of age were arranged in a completely randomized design with 5 treatments and 3 replicates with 10 birds (balanced for sex) per experimental unit. The treatments were diets in which fish meal protein was replaced by catfish by-product protein at levels of 0, 25, 50, 75% and 100%. The rest of the diet was maize grain and rice bran.

Feed intake and live weight gain followed a curvilinear pattern increasing to maximum values with 75% replacement of fish meal by catfish byproduct protein then decreasing. There was a 50% increase in heart weight of the ducks when the catfish by product replaced all the fish meal (40% of the diet DM). It is concluded that catfish byproduct meal can replace up to 75% of the fish meal protein with slight improvement in growth rate and no effect on carcass quality. However, complete replacement of the fish meal by catfish byproduct may not be advisable in view of potential negative effects on health status as evidenced by a major incease in heart weight of the ducks at this level.

***Key words:*** *carcass quality, dietary fat, heart development*

## Introduction

Ducks have been raised for a long time in Vietnam. They are raised throughout the country, but are concentrated in the Mekong Delta. Several breeds are reared such as common ducks, Super Meat ducks and Muscovy ducks, the latter because of their good performance and high resistance to diseases. Ducks have been raised in scavenging systems around gardens, along canals and in the rice fields post-harvest. In these systems ducks forage for themselves and consume locally available feeds, and are normally only supplemented with small amounts of rice or not at all. They are also raised in confinement systems, in which the ducks are fed purchased concentrates based on fish meal, soybean meal and cereals. This is often unprofitable for producers, because of the high price of the ingredients, especially protein feeds.

In the Mekong Delta and especially in Travinh province, catfish production has considerably increased. Factories produce frozen white cobber filet for export, leaving a large amount of catfish by-products. Catfish by-products are rich in protein level (up to 29% CP in DM) and could be used to replace conventional protein sources in diets for ducks to reduce feed cost.

The present study aimed to evaluate the effects on growth performance and carcass traits of crossbred Muscovy ducks of replacing fish meal protein by catfish by-product protein.

## Materials and methods

### Experimental design

The experiment with crossbred Muscovy ducks produced in Travinh province was done from August to November 2017. After selection, ducklings (n=150) were brooded and fed a conventional diet from 1 to 28 days of age. They were vaccinated against Duck Plague and Pasteurellosis. The treatments in a completely randomized design of five diets and three replicates were: levels of replacementof fish meal by catfish byproduct of 0, 25, 50, 75 and 100% (Tables 1 and 2). Fresh water spinach was also supplied at 30g/duck per day. The experimental period was twelve weeks.

**Table 1.** Chemical composition of the feed ingredients in the experimental diets

| Item,% | Maize | Rice bran | Fish meal | Water spinach | Catfish by-product |
|---|---|---|---|---|---|
| DM | 89.6 | 90.7 | 89.0 | 9.55 | 50.8 |
| OM | 97.5 | 90.3 | 79.0 | 87.7 | 90.9 |
| CP | 9.26 | 11.6 | 59.2 | 23.2 | 27.0 |
| EE | 3.80 | 11.5 | 11.3 | 9.89 | 48.1 |
| CF | 2.90 | 10.5 | 0.80 | 14.7 | 1.70 |
| NDF | 24.5 | 28.2 | 14.6 | 38.3 | 4.10 |
| Ash | 2.50 | 9.70 | 21.0 | 12.3 | 9.10 |

| | | | | | |
|---|---|---|---|---|---|
| ME (MJ/kg) | 13.9 | 13.2 | 12.4 | 9.25 | 14.5 |

*style="border-top: 1.0pt solid"Dry matter (DM), Organic matter (OM), crude protein (CP), crude fiber (CF), Neutral detergnent fiber (NDF), ether extract (EE), Metabolizable energy (from Janssen et al 1994)*

**Table 2.** Feed ingredient composition in diets of the experiment (DM, %)

| **Item, %** | **CF0** | **CF25** | **CF50** | **CF75** | **CF100** |
|---|---|---|---|---|---|
| Maize | 57.0 | 54.7 | 47.7 | 43.3 | 34.4 |
| Rice bran | 28.8 | 25.8 | 27.1 | 24.1 | 25.6 |
| Fish meal | 14.2 | 11.2 | 7.90 | 4.30 | - |
| Catfish by-products | - | 8.30 | 17.3 | 28.3 | 40.0 |
| **Total** | **100** | **100** | **100** | **100** | **100** |
| Chemical composition, % in DM except for DM which is on "as fed" basis | | | | | |
| DM | 89.8 | 84.5 | 78.6 | 75.0 | 71.9 |
| CP | **17.0** | **16.9** | **16.9** | **17.0** | **17.0** |
| EE | 7.08 | 10.3 | 14.6 | 17.4 | 20.4 |
| CF | 4.80 | 4.53 | 4.47 | 4.37 | 4.25 |
| NDF | 24.2 | 24.5 | 20.9 | 19.8 | 18.7 |
| Ca | 1.04 | 1.49 | 2.03 | 2.38 | 2.72 |
| P | 1.22 | 1.27 | 1.33 | 1.36 | 1.39 |
| ME(MJ/kg, DM) | 13.5 | 13.6 | 13.7 | 13.8 | 13.9 |

*Premix of vitamins was provided with the same level (0.3%) for all dietary treatment sCF: Catfish, CF0: Control diet, CF25, CF50, CF75, CF100: Diets at levels of 25, 50, 75 and 100 % protein of fish meal in control diet were replaced by catfish by-products.*

The birds were housed in pens divided by plastic netting inside sheds with thatched roof and sandy soil floors covered with rice straw for bedding. Average density was four birds per $m^2$ (Photos 1 and 2). The litter was changed weekly, Fresh water was freely available.

Catfish by-product was bought from a fish processing factory in Travinh province. Other feed ingredients were purchased on one occasion from a local feed store. Fresh feed was offered twice a day, at 8:00h and 4:00h. Water spinach was supplied at 11:00h.

## Chemical analysis

Feeds were analyzed for DM, OM, CP, EE, CF and ash (AOAC 1990) and for NDF (Van Soest et al 1991). ME was calculated according to Janssen et al (1994).

## Measurements

Ten ducks from each experimental unit were weighed individually ar intevals. Daily feed intakes were calculated according to the total feed consumption of the ducks in each pen. At the end of the experiment 30 representative ducks (one male and one female from each pen) were slaughtered to determine carcass traits and internal organ weights. Breast muscles were separated, weighed, and analyzed for DM, OM, CP, EE and ash.

### Statistical analysis

The data were analyzed by the General Linear Model in the ANOVA program of the Minitab software ( Minitab 2010).

## Results and discussion

#### Feed intake, growth rate and feed conversion

Feed intake followed a curvilinear pattern increasing to a maximum value with 75% replacement of fish meal by catfish byproduct meal then decreasing (Table 3; Figure 1). Live weight gain followed the same pattern (Figure 2). The advantage of the catfish byproduct up to 75% replacement of the fish meal protein was probably due to the increasing energy conent of the diet derived from the high oil content in the byproduct meal (48% in DM: Table 1). The depression in growth rate with 100% replacement of fish meal by catfish product protein probably reflected too high an oil level having a negative effect on feed intake as reported by (reference??).

**Table 3.** Mean values for DM intake, weight gain and feed conversion ratio of crossbred Muscovy ducks (g/bird) fed increasing levels of catfish byproduct replacing fish meal

| | CF0 | CF25 | CF50 | CF75 | CF100 | SEM | *p* |
|---|---|---|---|---|---|---|---|
| DM intake, g | 156$^{b}$ | 163$^{ab}$ | 168$^{ab}$ | 176$^{a}$ | 163$^{ab}$ | 3.89 | 0.040 |
| Initial weight | l,057 | l,139 | l,061 | l,076 | l,054 | 27.1 | 0.226 |
| Final weight | 3,429$^{b}$ | 3,587$^{ab}$ | 3,685$^{a}$ | 3,683$^{a}$ | 3,588$^{ab}$ | 51.6 | 0.032 |
| Daily weight gain | 42.3$^{b}$ | 43.7$^{ab}$ | 46.9$^{a}$ | 46.5$^{a}$ | 45.2$^{ab}$ | 0.92 | 0.027 |
| FCR | 3.69 | 3.73 | 3.59 | 3.78 | 3.59 | 0.12 | 0.714 |

*Values in rows with different letters are significantly different (P<0.05)*

**Figure 1.** Curvilinear relationship between feed intake and degree of replacement of fish meal by catfish byproduct in growing Muscovy ducks

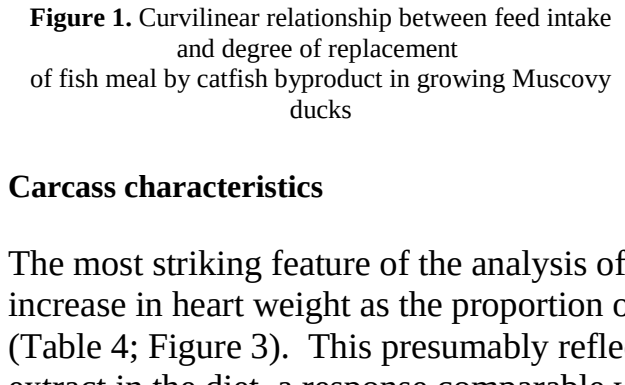
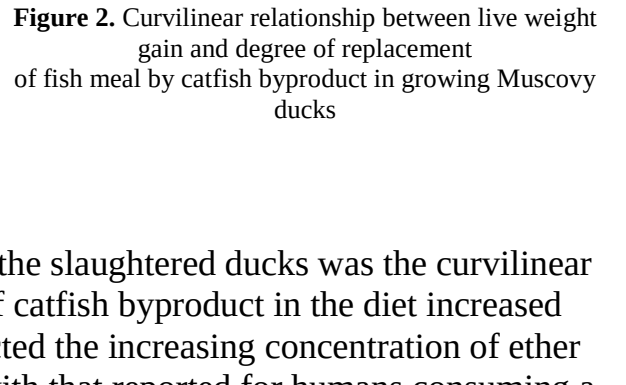


**Figure 2.** Curvilinear relationship between live weight gain and degree of replacement of fish meal by catfish byproduct in growing Muscovy ducks



## Carcass characteristics

The most striking feature of the analysis of the slaughtered ducks was the curvilinear increase in heart weight as the proportion of catfish byproduct in the diet increased (Table 4; Figure 3). This presumably reflected the increasing concentration of ether extract in the diet, a response comparable with that reported for humans consuming a diet high in fats and oils (reference??). As expecyed, the increasing content of oil-rich catfish byproduct in the diet directly increased the fat deposit in the abomasum. However, the diet had no apparent effect on the fat content of the breast meat (Table 5).

**Table 4.** Mean values for slaughter weights, carcass traits and internal organs of crossred Muscovy ducks

| Item | Treatment | | | | | SEM | P |
|---|---|---|---|---|---|---|---|
| | CF0 | CF25 | CF50 | CF75 | CF100 | | |
| Live weight, g | 3,342$^{b}$ | 3,560$^{ab}$ | 3,685$^{a}$ | 3,625$^{ab}$ | 3,582$^{ab}$ | 62.5 | 0.027 |
| Carcass weight, g | 2,252$^{c}$ | 2,392$^{ab}$ | 2,485$^{a}$ | 2,427$^{b}$ | 2,289$^{bc}$ | 37.3 | 0.007 |
| Carcass, % | 67.3 | 67.2 | 67.4 | 66.9 | 63.9 | 1.99 | 0.66 |
| Beast muscle, g | 448$^{b}$ | 453$^{ab}$ | 503$^{a}$ | 500$^{a}$ | 446$^{b}$ | 11.2 | 0.007 |
| %, Breast muscle | 19.8 | 18.9 | 20.2 | 20.6 | 19.5 | 0.01 | 0.340 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Thigh muscle, g | 288[b] | 292[b] | 326[a] | 290[b] | 272[b] | 3.60 | 0.005 |
| Liver, g | 69.8 | 61.4 | 59.8 | 61.7 | 68.8 | 4.88 | 0.496 |
| Gizzard, g | 69.6 | 65.1 | 65.4 | 64.5 | 64.1 | 6.33 | 0.971 |
| Heart, g | 21.6 | 23.4 | 22.8 | 24.9 | 29.8 | 2.58 | 0.262 |
| Abdominal fat, g | 76.4[b] | 84.1[ab] | 86.6[ab] | 90.3[ab] | 98.8[a] | 3.34 | 0.010 |
| Small intestine, cm | 172 | 169 | 183 | 190 | 180 | 4.77 | 0.062 |
| Large intestine, cm | 16.8 | 17.1 | 16.7 | 15.9 | 17.8 | 0.71 | 0.472 |
| Cecum, cm | 13.8 | 14.2 | 14.6 | 14.3 | 13.9 | 0.25 | 0.246 |

*Values in rows with different letters are significantly different (P<0.05)*

**Table 5.** Chemical composition (% fresh basis) of breast muscle of crossbred Muscovy ducks

| | **Treatment** | | | | | **SEM** | **P** |
|---|---|---|---|---|---|---|---|
| | **CF0** | **CF25** | **CF50** | **CF75** | **CF100** | | |
| DM | 26.2 | 25.5 | 26.2 | 26.5 | 26.1 | 0.31 | 0.294 |
| OM | 97.2 | 97.8 | 97.7 | 97.4 | 97.5 | 0.24 | 0.980 |
| CP | 20.4 | 19.4 | 19.8 | 19.7 | 19.7 | 0.30 | 0.238 |
| EE | 2.73 | 3.28 | 3.24 | 3.09 | 3.07 | 0.36 | 0.830 |
| Ash | 2.17 | 2.22 | 2.31 | 2.56 | 2.47 | 0.24 | 0.980 |

*Dry matter (DM), Organic matter (OM), crude protein (CP), ether extract (EE).*

**Figure 3.** Heart weight of the Muscovy ducks increased with a curvilinear trend with increasing replacement of fish meal by catfish byproduct meal

**Figure 4.** Abdominal fat in the Muscovy ducks increased linearly with increasing replacement of fish meal by catfish byproduct meal

## Conclusion

- Catfish by-product, a cheap and abundant local feed resource, could replace fish meal in diets for crossbred Muscovy ducks at levels up to 75% replacement of fish meal protein, with slight improvements in growth rate and without affecting composition of the carcass.

- Complete replacement of fish meal protein may not be advisable in view of potential negative effects on health status as reflected in the dramatic increase in heart weight when the catfish byproduct replaced all the fish meal.

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