Research article

Utilization of Corncob as Feedstuff on Growth Performance, Feed Utilization and Carcass Composition of Nile Tilapia (*Oreochromis niloticus* L.)

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Abstract The utilization of corncob as feedstuff was investigated to examine the diet contained corncob in the fingerling Nile tilapia (*Oreochromis niloticus* L.). The initial weight of Nile tilapia fingerlings ranged from 14.66 – 16.66 g/fish. The experiment was divided into four groups by the levels of corncob of 0%, 2%, 8% and 15% and conducted for 120 days. At the end of experiment, the results showed that the growth performance and feed utilization each groups were not significant different ($P > 0.05$). In addition the carcass composition and composition of edible flesh have no difference ($P > 0.05$). On the other hand, the feed cost was decrease by variation with the level of corn cob in diet were 0.14, 0.56 and 1.05%, respectively. Moreover, the water qualities of fish fed with feed contained corncob at different levels were in range of water quality standard. The study indicated that the diets containing corncob at 15% of fiber no negative effect on growth, feed utilization, carcass composition and edible flesh quality. Moreover, it's affected on cost - effectiveness.

Keywords Nile tilapia, corncob, feed, growth performance

INTRODUCTION

Corn production of Thailand is revived up significantly to 4.9 million metric tons in 2014. The average corn yield is estimated to increase to approximately 700 kilogram per rai (4.38 metric tons per hectare), up 2 to 3 percent from the previous year due to favorable weather conditions (Prasertsri and Santella, 2014). High yield of corn followed with the great corncob that is agriculture waste which eradicated by burned in Thailand. In addition, yield of corncob in each country are prodigious. The tremendous corncob is used for many things such as; carbon adsorbent (Tsai et al., 2001), bacterial cellulose (Huang et al., 2015) carbon fuel cell (Jinshuai et al., 2014) and Acetone-Butanol (Kumar et al., 2014). The corncob composition are a lignocellulosic material composed of cellulose, hemicellulose and lignin were detected: cellulose: 38.8%, hemicellulose: 44.4% and lignin: 11.9% (Pointner et al., 2014) protein, fat, moisture and ash were 4.10, 9.96, 5.42 and 4.46%, respectively (Olagunju et al. 2013). Cellulose, hemicellulose and lignin are embedded in a complex matrix which is very resistant to enzymatic degradation (Mosier et al., (2005); Menon and Rao, (2012); Pointner et al., (2014) and affected on fish digestion because it lack of the enzymes to degrade cellulose, and lignin (Halver and Hardy, 2002). Nevertheless, fiber resist digestion property is benefit to control rate of food in digestion tract to slow down that improve the digestion. Moreover, some species of fish have specialized for

herbivorous and many species for instance Cichlidae (Nile tilapia) are able to ingest and digest quantities of plant material. Because the intestine of herbivorous fish are longer relative to organismal size than are those of omnivours and carnivorous fish. The capacity for carbohydrate digestion shows a certain plasticity, particularly in omnivorous fish. Tilapia modify their secretion of digestive enzyme when their diet is valid (Halver and Hardy, 2002; Jobling, 1995; Klahan et al., 2009).

OBJECTIVES

The aim of this study were to apply the corncob as the feedstuff to improve the cost effectiveness of culturing Nile tilapia (*Oreochromis niloticus* L.) and reducing the environment pollution from corncob burning.

METHODOLOGY

Experimental Fish

Nile tilapia (*O. niloticus*, L.) were obtained from commercial farm at Phayao province, Thailand. Fish were acclimated in net cage on earth pond for 1 week by control diet containing 30% crude protein (CP) (no corncob contain) before start the experiment. Fingerling (14 – 16 g) were randomly stocked into 1*1*1.5 m^3 net cages at a density of 50 fish per net cage.

Experimental Diet

The corncobs were collected from the local farm in Phayao province, Thailand. Corncobs (Fig. 1a) were blended to small pieces with grinding machine (Fig. 1b). Take small piece of corncob (Fig. 1c) to mixed with other feedstuff of feed formula. Four isonitrogenous (30% crude protein (CP)) and isocaloric (3000 $KcalKg^{-1}$) diets were formulated and contained corn cob that effected on the fiber level at 0, 2, 8 and 15% (Table 1). The feedstuff of each diet were mixed together for 20 minutes with horizontal mixing and took to extruder for floating pellet feed. The diets were dried at room temperature for 12 hours and stored in plastic bags at room temperature.

Fig. 1 Corncob (A), grinding machine (B) and small piece of corncob (C)

Experimental Procedure

The experiment design was completely randomized design (CRD) included 4 treatments. Each of the 4 experimental diets was randomly assigned to triplicate groups of fish and all the groups were fed with their respective diet at 3% body weight day twice daily for 120 days. Also, water is changed for every two - three days for 30% throughout the study.

Table 1 Feed formulation of the experimental diets (on dry matter basis)

Feedstuff (g/100)	Dietary corncob contain (%)			
	0	2	8	15
Fishmeal	25	25	25	25
Soybean meal	32	32	32	32
Rice bran	19	17	11	4
Corncob	0	2	8	15
Cassava	15	15	15	15
Vegetable oil	3.5	3.5	3.5	3.5
Fish oil	3.5	3.5	3.5	3.5
Premix[1]	1	1	1	1
α - starch	1	1	1	1
Total	100	100	100	100
Chemical analysis (%)				
Moisture	2.26	2.37	2.69	3.06
Protein	30.48	30.29	29.74	29.10
Fat	9.59	9.56	9.48	9.38
Fiber	3.69	5.20	9.71	14.98
Ash	9.42	9.35	9.16	8.94
GE (Kcal100g-1)[2]	292.25	295.07	303.53	303.40

[1] *premix: each 0.5 kg contain vitamin A 500,00 IU, Vitamin D3 100,000 IU, Vitamin E 10,000 IU, Vitamin K 800 mg ,Vitamin B1 250 mg, Vitamin B2 200 mg, Vitamin B2 750 mg ,Vitamin B12 5 mg ,pantothenic acid 3,000 mg, niacin 2,150 mg , folic acid 300 mg, inositol acid 25,000 mg, biotin 25 mg, selenium 30 mg, iron 20,000 mg, zinc 32,000 mg, copper 2,000 mg and feed preservative 50 mg*

[2] *GE (gross energy): calculated followed NRC =(% protein x 5.64 (+)% lipid x 9.44 (+)% NFE x 4.11)*

Analytical Method

During experiment, the mortality was recorded daily and fish in each tank were counted and weighed individually at a monthly. Growth rate were monitored to determine the final weight, weighed gain, specific growth rate (SGR), average daily gain, survival rate, feed intake, feed conversion ratio (FCR) and protein efficiency ratio (PER) were calculated according to Castell and Tiews (1980). At the start of experiment, 10 fish randomly were dried for the determination of body proximate composition. At the end of the feeding trial, 5 fish from each group (n = 15 fish/group) were collected blood for blood analysis of red blood cell, heamatocrit and hemoglobin with auto blood cell count and analyzed for final whole body proximate composition. Proximate composition of body was analyzed following AOAC (2002) methods.

Statistical Analysis

In the experiment, all data were assessed by one-way analysis of variance (ANOVA) followed by Duncan's multiple range tests. A significance level of $P < 0.05$ was used.

RESULTS AND DISCUSSION

Growth Performance

The result of the growth trial showed that all groups were not significantly different ($P > 0.05$) (Table 2). The mean final weight, weigh gain, ADG and SGR of different experimental diets ranged between 68.86 - 75.00 g/f, 53.19 - 59.00 g/f, 0.59 - 0.65 g/f/d and 1.59 - 1.74% respectively. In addition, survival rate in all groups were not significantly different also ($P > 0.05$). Feed utilization of Nile

tilapia fed with contain corncob diet at different level for 120 days showed that not significantly different (P > 0.05). The feed intake. feed conversion ratio and feed conversion efficiency of different experimental diets ranged between1.05 - 1.10 g/f/day, 1.65 - 1.79 and 57.62 - 60.53%, respectively.

Table 2 Growth performance of Nile tilapia fed with corncob contain diet at 120 days

Growth performance	Dietary corncob contain (%)			
	0	2	8	15
Initial weight (g/f)	16.00 ± 2.00	16.66 ± 1.15	15.33 ± 2.30	16.66 ± 1.15
Final weight (g/f)	75.00 ± 0.87	74.15 ± 0.77	72.99 ± 4.01	69.86 ± 6.10
Weight gain (g/f)	59.00 ± 2.18	57.49 ± 1.50	57.66 ± 1.78	53.19 ± 7.09
Average daily gain (g/f/day)	0.65 ± 0.02	0.64 ± 0.02	0.64 ± 0.02	0.59 ± 0.08
Specific growth rate (%/day)	1.72 ± 0.14	1.66 ± 0.07	1.74 ± 0.10	1.59 ± 0.16
Survival rate (%)	98.66 ± 1.15	98.00 ± 2.00	98.66 ± 1.15	94.00 ± 8.71
Feed utilization				
Feed intake (g/f/day)	1.10±0.02	1.07±0.02	1.06±0.06	1.05±0.09
Feed conversion ratio	1.68±0.08	1.68±0.02	1.65±0.04	1.79±0.10
Feed conversion efficiency (%)	59.57±2.86	59.54±0.97	60.53±1.81	57.62±0.19

The growth performance of fish depend on two systems; digestion and absorption. The digestibility of corncob diets of Nile tilapia from the previous study showed curtailing while the digestibility and absorption of other feedstuff or nutrients were in normal stage by observation from feed utilization data ie. feed intake, feed conversion ratio and feed conversion efficiency. These data were not significant different among groups that effected on growth performance not difference also. Furthermore, the prebiotic attribute of corncob that is the one of reasons make the not difference on growth performance. The property of prebiotic are a nondigestible food ingredient that beneficially affects the host and resistance to gastric acidity and to gastrointestinal absorption (Gibson et al., 2004; Yousefian and Amiri, 2009) The result from this study was the same line with Ren et al. (2015) who found that the growth performance and survival rate of blunt snout bream (2 g/f) fed with diet contained different carbohydrate sources namely wheat flour, maize flour, dextrin, maltose, glucose and cellulose for 3 months were not different. Additionally, this is in agreement with the finding of Dalsgaard et al., (2012) that supplementation of β – glucanase and protease in juvenile rainbow trout diet increased the feed utilization.

Carcass Composition

Table 3 Carcass composition of Nile tilapia fed with corncob contain diet at 120 days

Carcass composition (%)	Dietary corncob contain (%)			
	0	2	8	15
Edible flesh	35.17 ± 0.69	35.05 ± 2.71	35.00 ± 2.07	32.07 ± 0.71
Bone and skin	45.10 ± 0.26	47.74 ± 3.47	45.99 ± 1.25	47.78 ± 1.88
Viscera and fat	7.44 ± 0.48^{c}	8.84± 0.58^{b}	9.07 ±0.69^{a}	9.79 ± 0.31^{a}

^{a,b,c} *Means within a row with common superscript are significantly different (P<0.05). n = 30*

The effect of different corncob contained on carcass composition of fish showed in Table 3. The results showed that there was no significant difference on percentage of bone and skin and edible (P > 0.05) but it effected on percentage of viscera and fat (P < 0.05) that showed the highest on 8 and 15% of corncob in diet and control group. For HSI of control group were highest but lowest in 15% corncob

contained in diet group (P > 0.05). The similar data of carcass composition among groups is meaning that the nutrient intake and nutrient deposit in muscle between groups of fish were close.

Blood Analysis

The result of blood analysis of Nile tilapia fed with contain corncob diet at different level for 120 days showed that not significantly different (P > 0.05). The red blood cell, hematocrit and hemoglobin of different experimental diets ranged between 2.0 - 2.43 cell x10^6/µl, 32.25 - 37.60% and 10.75 - 12.40 g/dl, respectively (Table 4). These data were all in normal range of healthy Nile tilapia.

Table 4 Blood analysis of Nile tilapia fed with corncob contain diet at 120 days

Carcass composition (%)	Dietary corncob contain (%)			
	0	2	8	15
Red blood cell (cell*10^6/µl)	2.19 ± 0.16	2.24 ± 0.34	2.14 ± 0.55	2.00 ± 0.18
Hematocrit (%)	32.95 ± 1.20	34.10 ± 3.95	34.30 ± 5.93	34.150 ± 2.61
Hemoglobin (g/dl)	11.05 ± 0.06	12.30 ± 0.14	11.85 ± 0.21	11.45 ± 0.77

Corncob is the toxic without feed stuff that no effected on fish health. This reason made the blood data showed no difference. These blood data according to Rungkan (2009), the red blood cell, hematocrit and hemoglobin were 2.78 x10^6/µl, 21.11% and 11.82 g/dl, respectively. The comparison of red blood cell, hematocrit and hemoglobin with other fish were in normal range were 0.973 - 2.75 x106/µl, 20 - 51% and 5.46 - 101.33 g/dl, respectively (Duy et al., 2008; Min and Kang, 2008; Pérez et al., 2008). Hence, the wide range depends on the varity of size, type and strain of fish.

CONCLUSION

The corn cob can be as feed stuff for Nile tilapia diet by contained in feed formula 15%. These no negative effected on growth performance, feed utilization and fish health including the flesh quality also. Moreover, the feed cost of 15% corncob group was cheaper than control group about 1.50 Baht/Kg feed (0.04 USD/kg feed).

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