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APPARENT DIGESTIBILTY COEFFICIENT OF PELLETED FISH FEED INCORPORATED WITH WATER HYACINTH (*Echhornia crassipes)*

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ABSTRACT: The objective of this study to determine the apparent digestibility coefficients (ADCs) of dry matter, protein, gross energy and fiber of five pelleted fish feed incorporated with different levels of water hyacinth (*Echhornia crassipes*, 0%, 10%, 15%, 20% and 25%) on performance of red Tilapia fingerlings, using chromium dioxide as an inert bio- marker. Feeds were prepared to be iso-nitrogenous (35.00%±0.20) and iso-caloric (kcal/kg 4700.00±0.52). Proximate compositions of test feeds, fecal matter and chromium contents also were determined. Results revealed the maximum value of ADCs for dry matter (DM) was found in reference feed (68.09%), while the minimum value was found in (test diet 4) 4 (50.36%). Similarly, the maximum ADCs values for crude protein content, gross energy, ether extract and crude fiber were found in control feed, while the minimum values were found in the feed 4. The survival rate was found to be significantly low among studied fish fed with feed 4. The study has shown that red tilapia efficient maximum digestion to nutrients is only up to 20% inclusion of water hyacinth in the feed.

ORIGINAL ARTICLE

Key words: Apparent digestibility, pelleted, water hyacinth

INTRODUCTION

Intensification of tilapia production global wide has made it essential to develop nutritionally efficient and cost effective complete and supplemental feeds to be used for different tilapia culture systems (intensive, extensive, race way, pond and cage culture systems). In Malaysia; red Tilapia culture is the common tilapia practice (Hambal et al., 2000). Malaysian farmers, in 2000, produced 16,383 mt of the red hybrid Tilapia in cages, tanks, pens and ponds. Feed production is the major problem face aquaculture practice in Malaysia Malaysian Industrial Development Authority report in 2009 showed that, animal feed is one of the major food imported item in Malaysia. At present, it is highly needed to search for low cost and better nutrient component ingredients to replace partially or completely the costly ingredients, such as fish meal, as protein or energy source.

Much critical analysis has been conducted in recent years on the requirement of fish for dietary protein (Cho et al., 1982; Abdel-Fattah and Mamdouh, 2008 Falaye and Jauncey, 1999; Maina et al., 2002; Perla et al., 2004; and Iluyemi et al., 2010) including tilapia. The nutritive value of mixed rations depends on the nutrient composition of the individual feed components and the ability of the animal to digest and absorb the nutrients (Smith, 1979; Kirchgessner et al., 1986). Relatively cheap energy yielding nutrients, such as fats or carbohydrates, have been found to reduce dietary requirement of protein. However, replacing fish meal which is being used globally as dietary protein in formulated fish feeds, by alternative, plant sources in aqua-feeds is rather challenging task. The major problems in using fish meal in formulation of fish feed are its rising cost, uncertain availability and variation in quality. Plant feedstuffs present high fiber content; their amino acids and fatty acids profiles do not match fish dietary requirements (Steffens, 1989; Wilson, 1989) and presence of anti-nutritional factors. Much work was done regarding the performance of fish carnivore, in the evolutionary scale, have rather simple and little developed digestive system, and as consequence, reduced ability to utilize carbohydrates as energy sources when compared with herbivore and omnivore fish such tilapia. However, few studies were done on evaluating water hyacinth utilization. Digestibility is one of the most important methods in evaluating the efficiency of feedstuffs no much

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studies so far done on it. Such information is of paramount importance in the assessment of the economical use of this macrophyte plant in aquaculture.

This study was aimed to determine the apparent digestibility of dry matter, crude protein, ether extract, gross energy and crude fiber of pelleted feed incorporated with different percentage of water hyacinth *(Echhornia crassipes*) level on performance of red Tilapia fingerlings.

MATERIALS AND METHODS

Five iso-nitrogenous (35% CP) and iso-caloric feeds incorporated with different levels of water hyacinth (*Echhornia crassippes*) were formulated in (Table 1) as described by Elsyaed (1990). Fish meal, chicken by-product were used as animal protein source while, soya meal was used as plant protein. Wheat bran was replaced gradually by water hyacinth. Chromic oxide was used.

Ingredients used and diets preparation

Water hyacinth was collected from water canal inside University Malaysia Terengganu (UMT), roots was removed and washed gently, cut into small pieces and oven dried (45℃/72hrs) powdered (2 microns) using motor grinder (FRITSCH, Puluersette 14, Germany) and store in room temperature for further use. Fish meal, soya meal and wheat bran were purchased from mill factory nearby UMT. Chicken by-product was prepared in powder form inside fresh water hatchery UMT after collection of chicken remains from chicken slaughter shop and supplied diets with an iso-nitrogenous and iso-energic. Control and experimental diets were formulated to satisfy requirement of Tilapia (Thomas et al. 1995). Chromic oxide (Cr_2O_3, 1%) was used as an inert marker and incorporated into the control feed and experimental feed. Proximate composition was carried out for used ingredients prior to formulation of experimental diets (Table 1). Diet formulation was carried out in the diet formulation chamber attached to fresh water hatchery, FASM, UMT Water and palm oil were added to premixed ingredients and thoroughly mixed until homogenous in Bio Mixer, Sakura, China. 2.5mm diameter pellet were made using meat grinder (ORIMAS, model: TBS200, China), subjected to an open air for (15 minute), oven dried (50 ℃/24hrs) and stored frozen (-20℃), as described by Qi-Cun and Rong (2010).

Table 1 - Ingredients and proximate composition of experimental diets (on %dry matter basis)

Feeds / Ingredient	Control	Feed1	Feed2	Feed3	Feed4
Fish meal	10	10	10	10	10
Chicken by-product meal	20	20	20	20	20
Soya meal	40	40	40	40	40
Water hyacinth	0	10	15	20	25
Wheat bran	25	20	15	10	0
Palm oil	2	2	2	2	2
Ascorbic acid	0.6	0.6	0.6	0.6	0.6
Choline chloride	0.5	0.5	0.5	0.5	0.5
Calcium diphosphate	0.6	0.6	0.6	0.6	0.6
Chromium dioxide	1	1	1	1	1
Vitamin pre-mix(commercial)	0.1	0.1	0.1	0.1	0.1
Mineral pre-mix (commercial)	0.1	0.1	0.1	0.1	0.1
Binder	0.1	0.1	0.1	0.1	0.1
Proximate composition (on dry matter basis) %					
Moisture	4.8	4.6	4.2	4.4	4.9
Crude protein	35.3	35	35.4	35	35.2
Ether extract	5.3	5	5.1	5	5.4
Ash	8.2	10	9.7	10.6	11.3
Fiber	7.5	7.7	8.3	8.6	8.7
NFE	38.9	37.7	37.3	36.4	28.8
Growth Energy (kcal/kg	4580	4550	4730	4500	4470

Experiment fish

A number of 400 red Tilapia fingerlings (6.2±0.3 g/fish) were brought from Jabatan Perikanan Malaysia, Penang, Malaysia.

Feeding trials, feces collection and analysis

Prior to the start of the study, fish were acclimatized to the control diet in concrete tank for 3 weeks. Fish were randomly distributed into 25-L plastic transparent aquaria (15 fish per aquarium). Fishes were fed to the

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visual satiety twice daily and the feces were collected by siphoning method two hours after the feeding using a modified method of Qi-Cun and Rong (2010). The collected feces were pooled in a glass vials and store at -20℃ (Nazura et al., 2003) for chromium detection and proximate composition analysis (Food science laboratory). Feces were freeze dried after enough feces were gathered.

Chemical analysis

Crude protein, moisture, gross energy, ether extract and fiber content in experimental diets and feces were determined following standard method of (AOAC, 1995). Chromic oxide content of feeds and feces were measured according to the method of Furukawa and Tsukahara (1966).

Digestibility determination

Apparent digestibility coefficients of dry matter (ADC_{DM}), protein (ADC_P), energy ($ADC_{e)}$, ether extract (ADC_{EE}) and fiber (ADC_{CF}) were performed by indirect method, using the chromic oxide as inert marker method as described by Cho *et al* (1982). The apparent digestibility coefficients (ADC) for the nutrients and energy of the test and reference diets were calculated as follows: ADC=1− (F/D×Di/Fi) (Cho *et al* (1982). Please write reference)

Where, D=% nutrient (or kJ/g gross energy) of diet; F=% nutrient (or kJ/g gross energy) of feces; Di=% digestion indicator acid insoluble Ash (AIA) of diet; Fi=% digestion indicator (AIA) of feces.

Statistical analysis

The obtained data were subjected to statistical analysis including analysis of variance (one way ANOVA) and significance of differences between means was tested according to Duncan (1995), using Genstat5 Software Program.

RESULTS AND DISCUSSION

The acceptance of diet by all groups of fish was observed as fish were actively fed when offered feed at each feeding time. All ADCs values for dry matter and nutrients were significantly different ($P<0.05$) among studied diets with different level of water hyacinth (WH) content (Table 1). The control diet with 0% WH was found to be efficiently utilized by fish and of highest digestibility values, while the experimental diet with 25% WH showed the minimum value of digestibility among experimental groups. The diet 4 (25%) had the least values of digestibility for dry matter and nutrients among all feeds. However, the digestibility for protein was recorded to be the highest, while the fiber digestibility was the lowest among nutrients. The survival rate decreased against the increase of WH level in diets, and it was at its lowest percentage for the test 4th experiment diet (Table 1).

Table 2 - Apparent digestibility coefficients of dry matter and nutrients, for experimental groups with different level of water hyacinth

Contents	Control diet (0%WH)	Test diet 1 (10%WH)	Test diet 2 (15%WH)	Test diet 3 (20%WH)	Test diet 4 (25%WH)
$Digestibility_{dm}$	68.09a	65.16b	62.29c	60.47d	50.36e
$Digestibility_{cp}$	92.07a	89.13b	84.83c	81.17d	60.47e
$Digestibility_{ge}$	79.30a	78.27b	71.97c	67.33d	65.52e
$Digestibility_{ee}$	82.07a	76.20b	70.27c	66.83d	59.23e
$Digestibility_{cf}$	34.34a	32.73b	29.96c	28.27d	18.53e
Survival rate%	96	91	88	81	46
P value	(not calculated)				
SEM	(not calculated)				

Figures in the same row followed by the same letters are not significantly different ($P > 0.05$)$_{dm}$= dry matter, $_{cp}$ = crude protein, $_{ge}$ = gross energy, $_{ee}$ =ether extract and $_{cf}$ = crude fiber

The present study demonstrated that WH is a potential partial substitute for wheat bran meal and could be incorporated up to 20% (on dry weight basis) in feed of red Tilapia without negatively affecting growth performance and digestion process. The feeds acceptability and palatability was observed as all groups of fish consumed the offered feeds and no rejection of any of the feeds was recorded. Digestibility of the feeds and survival rate were significantly high with the increase in WH amount in the studied feed up 20%, but decline when the inclusion rate of WH reached 25% (replacement) in test feed, and that could be referred to the fiber content. The fine grinding of WH and the other ingredients and formulation method may also play role in improving the digestibility of the feeds. However, the inclusion of 25% WH or more might be possible only to be utilized as supplementary feed in fish farming system. The results are in agreement with the finding of many authors despite the fact that different methodologies and tilapia species are used. For example, with respect to the form of WH used, how incorporated in the fish diets and tilapia species was used, Abdel-Fattah (2008) has observed that at 20% of WH inclusion level in fish feed, fish performance was reduced, and there no report regarding the digestibility of the tested feeds at all

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tested levels. However, Iluyemi et al. (2010) reported that, the inclusion of bacterial fermented (*Trichderma longibrchiatum*) palm kernel cake reduced the dietary protein digestibility and growth of red tilapia fingerlings.

CONCLUSION

The study finding indicates that fresh water hyacinth can be used with accepted level of nutrients digestibility is only up to 20% in the diet of red Tilapia at closed recirculating system with minimizing fish meal content in diet to 10%.

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