Original research article

Chemical Composition and Nutrients Digestibility of Thai Native Chicken Feed Containing Various Levels of Pond Snail Meal

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ABSTRACT

The experiment was carried out to determine the chemical composition and digestibility of pond snail meal (PSM) in Thai native chicken (TNC) feed. Twenty-eight Thai native cocks. 25 weeks old (Paduhangdum Chiang Mai strain) were used. Three types of pond snail preparations were used to find the nutritive value of the pond snails. The treatments were 1. snail meat (without shell), 2. cooked dried (whole snail), and 3. raw dried (whole snail). Nutrients digestibility were divided into 7 treatment groups (control, 5, 10 and 15% of cooked and snail meal) with 4 replications of one cock each. It was found that pond snail meat has the higher CP and EE than cooked and raw whole pond snail, but pond snail meat has lower CF, ash and Ca. The nutrients digestibility had no significant difference ($p > 0.05$) in DM and CP, EE and NFE; however, DM and NFE digestibility were the highest in 5% cooked pond snails. Whereas 10% cooked pond snail had the highest digestibility of CP and Ca and 15% raw pond snail had the highest EE digestibility. Pond snail meat has high protein but whole snail has high Ca. Levels at 10% cooked pond snail meal may be suitable for Thai native chicken feed.

Keywords: Thai native chicken; Pond snail; Digestibility

Introduction

Thai native chickens have played an important role in the nutrition and protein supply of the people in the Thai region, and also play an important role as a food reserve for households [1]. The rapid growth of human population, together with the ever increasing standard of living, has placed pressure on the existing source of animal protein, thereby making it expensive. It is therefore necessary to explore non-conventional protein sources such as snail [2]. One study recommended that improving local Thai native chicken production should be based on better exploitation of low-cost feed and feed supplementation using locally grown crops and their by-products [3]. In the aquaculture of fresh water fish in of Thailand, it was reported that Chiang Rai province has 20,000 members of aquaculture

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group (Nile Tilapia) [4]. The total pond area is about 48,000,000 m^2, mostly in Phan District, and can produce an average of 12 metric tons of Nile Tilapia fish per day. The pond has been heavily infested with the unwanted pond snail (*Filopaludina martensi*), especially in the mixed system of fish culture with swine farm in which the fishes from the pond are fed pig manure. After draining the water from the pond and harvesting the fish, large amounts of pond snail have been found on the bottom of the pond. The local people consider them too dirty for human food. Therefore, these pond snails had been abandoned to rot and attract flies; this becomes a pollution problem for the next round of raising fishes. However, the information about the chemical composition and utilization of pond snail in poultry feed has not been established. In this study, the chemical composition and the nutrient digestibility of chicken feed containing pond snail were evaluated for use in the formulation of poultry diets.

Materials and Methods

The protocol of this study was approved by the Animal Care and Use Committee of Maejo University, and the birds were handled according to humane care guidelines provided by Maejo University

Pond snail meal (PSM) Preparation.

Pond snails (*Filopaludina martensi*) were obtained from Tilapia (planile) culture in Phan District, Chiang Rai Province, Thailand. Three types of pond snail were used to find the nutritive value: snail meat meal, cooked dried whole snail, and raw dried snail whole snail. The treatment includes 1. Snail meat (without shell), 2. Cooked dried (whole snail) and 3. Raw dried (whole snail). Snails were washed and the first two types were cooked for 2 and 20 minutes in boiling water, respectively. They were minced using an electric grinder and dried by oven at 60ºC for 48 hours. The whole snail (raw or fresh) was minced and dried by oven at 60ºC for 48 hours. The pond snails were analyzed for chemical composition; gross energy was measured with a bomb calorimeter (IKA C5001 IKA® Werke GmbH & Co. KG Staufen Germany). Dry matter (method 7.003), crude protein (N × 6.25; method 7.015), ether extract (method 7.061), crude fiber (method 7.066), crude ash (method 7.009), and calcium and phosphorus (method 7.099b) were determined according to [5].

Birds, Housing and Diets – Twenty-eight Thai native cocks, age 25 weeks old (Paduhangdum Chaing Mai strain) were obtained from the poultry farm of Maejo University. They were selected to be the similar body weight and divided into 7 treatment groups with 4 replications of one cock each. The nutritive values of experimental diets were referred to the recommendation of [6] as shown in Table 2. Each chicken was provided an experimental diet for 7 days as adapted to the environment in the individual cage. The cage was equipped with water nipple and feed troughs. Data were collected for 4 days with a plastic bag attached to the skin with sutures. Total excreta was collected and frozen at -20 ºC every day. Before analysis, the frozen samples were removed from the freezer, dried and ground. Feed and chicken feces were evaluated for proximate analysis following the method described by [5]. The data were analyzed to determine the digestibility of various nutrients of dietary DM of the diets and calculated according to the formulas given in [7].

The data were analyzed as a Completely Randomized Design by ANOVA and using SPSS version 13.0 [8]. Significant differences among treatments were assessed by Duncan's new multiple range test.

Results and Discussion

The study on nutritive value of pond snail found that pond snail meat meal has higher crude protein and EE than cooked and raw whole pond snail, but pond snail meat

has lower crude fiber, ash and Ca because pond snail meal has a shell. However, it was found that dried raw whole snail has higher nutritive value than cooked snail as shown in Table 1 because 20 minutes of boiling in hot water had resulted in loss of modified nutritive value such as CP and CF. This indicated that cooked pond snail used boiling is long over time according to [9] found that the loss of protein in rabbit meat after boiling for 5, 15 and 40 min were 2.51, 7.75 and 17.78%, respectively. Moreover, prolonged boiling caused hydrolysis of connective tissue and other protein in meat [10] and leaking out of sarcoplasmic proteins from the muscle fibers channel [11]. Hydrolysis of proteins and leaking out of sarcoplasmic proteins might be the reason for the higher loss of protein content from the cooked snail than the raw whole pond snail. It was found that CP in pond snail meat (65.58%) was higher than golden snail meat (60.90% [12], snail (*Limicoloria aurora*) meat (51.4%CP cited by [13], Africa giant snail (*Acbatina fulica*) meat (60% reported by [14] and snail (*Pila globosa*) meat (52.40% [15]. Therefore, the meat of pond snail has CP similar to fish meal. Moreover, pond snail meat meal has calcium and phosphorus close to that of golden snail meat meal (2.0%Ca and 0.84%P [12]. Likewise, the whole cooked and raw pond snail has CP (16.38 and 16.94%, respectively), which is higher than whole golden snail (16.10% [12]).

It was found that the digestibility of DM, CP, EE and NFE were not significantly different ($p > 0.05$), while DM and NFE digestibility were the highest in 5% cooked pond snails feed. The 10% cooked pond snail feed had the highest digestibility of CP and Ca, and 15% raw pond snail had the highest digestibility of EE. Digestibility of CF was found the highest in 10% raw pond snail and there was significant difference with 5, 10 and 15% cooked and 15% raw pond snails feed (Table 3.). It was revealed that the ash digestibility was the highest in 15% cooked pond snails feed and there was a significant difference with 5 and 10% cooked pond snails, and 5 and 10% raw pond snails feed. Moreover the result revealed that 10% cooked snails had the highest calcium digestibility and significant difference from other treatments, except 10% raw pond snails. The 5% raw pond snail had the highest phosphorous digestibility and significant difference with control, 15% cooked and 15% raw ($p < 0.05$). Meal prepared from boiled snail (*Achatina fulica*) 15 or 20 min in boiler feed 5 and 10% snail meal had performance better than 10 and 15% raw snail meal [12]. However, boiling can remove slime and sterilize bacteria in body and may be essential to get rid of toxic or unpalatable factors in the snails [16].

Conclusion

The analyses for nutrients composition suggest that snail meat is a source of high levels of protein. Boiling the snail was shown to be necessary to maximize digestibility and levels at 10% cooked pond snail meal in diets which was the high digestibility of CP and Ca in Thai native chickens. These results demonstrate that pond snail can be used as a new feed ingredient for poultry. Use of the whole snail would give a feed high in Ca but relatively low in CP.

Table 1. Nutrients composition of pond snail (g/100 g DM).

Nutrients	Snail meat meal	Whole snail meal (cooked dried)	Whole snail meal (raw dried)
Dry matter, %	96.19±0.14	93.54±0.12	93.09±0.15
Gross energy, kcal/kg	3,257±8.30	1,152±5.25	1,216±9.36
Crude protein	65.58±0.10	16.38±0.12	16.94±0.14
Ether extract	6.31±0.14	2.11±0.03	2.44±0.21
Crude fiber	0.50±0.12	1.46±0.27	1.53±0.15
Ash	3.32 ±0.04	46.08±0.02	45.84±0.05
NFE	24.29±1.84	33.97±0.54	33.25±0.85
Calcium	2.24±0.06	30.89±0.45	30.73±0.32
Phosphorus	0.75±0.12	0.27±0.04	0.29±0.07

All parameters of pond snail samples were determined in triplicate.

Table 2. Compositions of the experimental diets.

Items	Control	Cooked snail meal (%)			Raw snail meal (%)		
	0%	5	10	15	5	10	15
Ingredients (%)							
Ground corn	79.12	75.4	70.28	65.13	74.60	70.39	64.63
Rice bran	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Soybean meal	5.65	4.55	2.78	2.48	5.35	2.67	2.46
Vegetable oil	0.50	0.50	1.25	1.50	0.50	1.25	1.50
Fish meal	3.50	3.50	3.50	3.50	3.05	3.50	3.50
Snail meal	0.00	5.00	10.00	15.00	5.00	10.00	15.00
Limestone	0.90	2.00	2.75	3.21	2.00	2.75	3.21
Di-cal. (14% P)	1.25	0.00	0.00	0.00	0.00	0.00	0.00
Normal salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50
L- lysine	0.15	0.12	0.11	0.08	0.12	0.11	0.08
DL-Methionine	0.18	0.18	0.58	0.87	0.18	0.58	0.87
Premix [1/]	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated chemical compositions (%)							
ME, kcal/kg	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Crude protein	14.40	14.40	14.40	14.40	14.40	14.40	14.40

Table 2. Compositions of the experimental diets. (Continued)

Items	Control	Cooked snail meal (%)			Raw snail meal (%)		
	0%	5	10	15	5	10	15
Calculated chemical compositions (%)							
ME, kcal/kg	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Crude protein	14.40	14.40	14.40	14.40	14.40	14.40	14.40
Calcium	0.90	1.67	3.19	4.72	1.65	3.12	4.71
Ava. phosphorus	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Met. + Cys.	0.78	0.78	0.78	0.78	0.78	0.78	0.78
Lysine	0.98	0.98	0.98	0.98	0.98	0.98	0.98

[1/] Provided per kilogram of diet: V.A. 11,925 IU; $V.D_3$. (2,250 IU); V.E. (9 IU); $V.K_3$. (1.8 mg); $V.B_{12}$. (0.02 mg); thiamine (1.1 mg); riboflavin (9 mg); pyridoxine (1.8 mg); biotin (0.1 mg); pantothenic acid (9.9 mg); niacin (38.25 mg); folic acid (0.9 mg); Cl (680 mg); I (1.2 mg); Se (0.18 mg); Fe (70 mg); Cu (10 mg); Zn (60 mg) and Mn (70 mg).

Table 3. The effects of including cooked pond snail meal and raw pond snail meal in diets on nutrient digestibility of Thai native chickens.

Treatment	Nutrient of digestibility (%)							
	DM	CP	EE	CF	Ash	NFE	Ca	P
control	74.95	46.40	88.48	33.84^{a}	8.10^{c}	83.68	30.53^{c}	51.29^{c}
5% cooked	77.16	47.64	89.66	25.20^{b}	16.14^{b}	90.03	36.31^{bc}	62.99^{a}
10% cooked	71.32	52.98	91.49	18.61^{c}	12.95^{bc}	87.31	58.76^{a}	59.55^{ab}
15% cooked	69.25	47.60	89.66	18.19^{c}	32.83^{a}	79.13	39.74^{b}	63.64^{a}
5% raw	76.81	46.13	85.18	32.46^{a}	16.02^{b}	85.32	22.98^{d}	64.52^{a}
10% raw	74.95	45.55	91.98	35.38^{a}	14.85^{b}	80.74	43.40^{a}	60.14^{ab}
15% raw	71.42	44.00	92.43	27.75^{b}	30.88^{a}	84.58	30.53^{c}	58.69^{b}
C.V. (%)	0.82	0.90	3.76	5.66	17.52	2.27	17.59	4.79

[a-c] Values with in column with different superscript are significant difference ($p < 0.05$).

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