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Effect of *Hydrilla verticillata* in Feed on Production Performance and Carcass Characteristics of Thai Native Chickens

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ABSTRACT

Background: Producing Thai native chickens through feed commercial is costly. To reduce the cost, native chicken could be fed with local plants or agricultural waste. *Hyrrilla verticillate*, a dominate macrophyte in Songkhla Lagoon, contain high crude protein and nitrogen free extract. Therefore, this research studied the use of *Hydrilla verticillate* in Thai native chicken diet on production performance, carcass characteristics and production cost.

Methods: The experiment was executed in a completely randomized design (CRD) with 180 one-day-old commercial Thai native chicks. Four dietary treatments supplemented with 0%, 5%, 10% and 15% *Hydrilla verticillata* were formulated for three different phases of the experimental chickens: starter (1-4 weeks), grower (5-8 weeks) and finisher (9-12 weeks). Two chickens from each replicate were chosen for the carcass characteristics study.

Result: During the starter phase, there was no notable effect shown among the chickens fed with the diet containing *Hydrilla verticillata* in terms of feed intake (FI) and body weight gain (BWG) ($P>0.05$). The control chickens had best feed conversion ratio (FCR) ($P<0.05$), while the grower and the finisher periods, provided with different levels of *Hydrilla verticillata*, revealed no apparent differences ($P>0.05$) concerning FI, BWG and FCR. Considering carcass characteristics, there were significant differences in live weight (LW) ($P<0.05$). But, no significant differences between treatments for hot carcass percentage, pectoralis majors, pectoralis minorstrip, thighs, wings, drumsticks and total edible carcass ($P>0.05$). There were also statistical divergences regarding gizzard weight (GW) ($P<0.05$).

Key words: Carcass characteristics, Feed production costs, *Hydrilla verticillate*, Production performance, Thai native chickens.

INTRODUCTION

Thai native chickens have become a new economic animal, as the estimated value of the poultry market is approximately 23,000 million baht (Department of Livestock Development, 2013) with 5% yearly increase (Office of Agricultural Economics, 2015). The constant market growth attracts both farmers and private sectors to engage in the production of native chickens. The industrial chicken farming is made known by private sectors (Tongumpai, 2017); however, it was challenged by a low production performance (Polsiri, 2001) and high production costs including 70% on commercial feeds and feedstuff (Kunto, 1986; Panja, 1999) To reduce the costs, native chicken production could be localized, *e.g.*, by utilizing local plants or agricultural waste as feed. Songkhla Lagoon is the largest lagoon in Thailand covering an area of 1,046.04 km² (Angsupanich, 2012) and is renowned for the abundance of more than 452 macrophysics (Intasuwan, 1982). *Hydrilla verticillata* dominates most parts of the Songkhla lagoon of 304.35 km², accounting for approximately 114,328.40 tonnes. *Hydrilla verticillata* has been researched for possible fodder due to its high crude protein (20.05%) and nitrogen-free extract contents (45.95%). The digestibility coefficient of dry matter (DM) in native chickens is 64.57% and metabolizable energy (ME) ranges up to 2,065 kcal/kg (Boonkaew *et al.*, 2018). *Hydrilla verticillata* has long been sourced by farmers around Songkhla Lagoon as an animal provender regarding minimized costs.

Evidently, *Hydrilla verticillata* is commercially ideal for native chicken production owing to its abundance, chemical compositions and low costs. However, it is also important to determine the most decent levels of *Hydrilla verticillata* inclusion for the best use.

Objective

The objective of this study was to evaluate the most acceptable levels of *Hydrilla verticillata* inclusion in chicken feed and its effects on native Thai chicken production, carcass characteristics and production costs. Results from this study could potentially be critical for the production of Thai native chickens.

MATERIALS AND METHODS

Location of study

This study was conducted during January to April 2020, at

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Preparation of *Hydrilla verticillate*

The *Hydrilla verticillata* was procured from the middle and upper Songkhla Lagoon and sun-dried for 2-3 days before heating at 65°C for 72 hours. The residue was then ground by a fodder grinder on a sieve with holes of 1 mm.

Experimental birds and management

The experiment was conducted in a completely randomized design (CRD) with 180 mixed-sex one-day-old commercial Thai native chicks. Four groups of three replications containing 15 chicks each classified as 1-4, 5-8 and 9-12 weeks were formed. Four dietary treatments supplemented with 0%, 5%, 10% and 15% *Hydrilla verticillata* were given. Feed composition was shown in Table 1, 2 and 3. The experimental chickens were fed ad libitum. Feed intake, body weight were recorded weekly. According to Moreng and Avens (1985), two chickens from each replicate accounting for 24 chickens were randomly selected for slaughter and carcass characteristics study.

Characteristics studied

Key characteristics inspected included feed intake (FI), body weight gain (BWG), feed conversion ratio (FCR), carcass characteristics and production costs of Thai native chickens.

Statistical analysis

Data analysis method using SPSS version 17. Duncan's multiple range test (DMRT) was used for the analysis of variance and comparisons of means.

Code of conduct for laboratory animals

This research was reviewed by the Institutional Animal Care and Committee, Prince of Songkla University No MHESI 6800.11/1550.

RESULTS AND DISCUSSION

Production performance

The effects of feeding diets containing *Hydrilla verticillata* at different levels on production performance of Thai native chicken is shown in Table 4.

Feed intake

The results explained that feed intake (FI) did not differ (P>0.05) among the four groups of the Thai native chickens fed *Hydrilla verticillata*. Nevertheless, there was a tendency for higher FI to be associated with the intensity of *Hydrilla verticillata*. This observation was also identified by Rodjan (2011) that there was a significant effect of feeding combinations of *Hydrilla verticillata* and rubber seed kernel (RSK) for fattening swine weighing 20-60 kg on FI where by FI increased with the increase in the levels of *Hydrilla verticillata* at 0%, 10%, 15% and 20% in the diet accounting for 93.98, 96.56, 101.65 and 104.39 kg, respectively. This *Hydrilla verticillata* contains high fiber which affects adversely in digestive system due to fiber would absorb water in digestive track then make feed intake flow through digestive tract faster. Muzi *et al*., 2017 and Hussein *et al*., 2021 report that fiber addition in diets could cause the reduction of digestibility, consequently resulted insufficient energy in chicken and force chicken eat more feed to receive adequate energy for growing.

Body weight gain

The results obtained revealed that feeding *Hydrilla verticillata* to the chickens aged 1-4, 5-8 and 9-12 weeks old had no significant effect (P>0.05) on body weight gain (BWG). However, it was inclined that inverse variation existed between the increase of *Hydrilla verticillata* and the decrease of WG. The 1-12 weeks old group fed with 15% *Hydrilla verticillata* noticeably had the least WG (P<0.05). In agreement with Rodjan (2011), it was reported that swine weighing 60-90 kg had BWG minimization at 30.00, 29.50, 30.31 and 29.69 kg, respectively, when given 0%, 10%, 15% and 20% *Hydrilla verticillata* mixed with rubber seed kernel (RSK). The finding could have resulted from a typically high

Table 1: Feed composition and nutrient contents for Thai native chickens from 1-4 weeks of age.

Ingredient	Ration			
	1	2	3	4
Corn	57.80	52.80	47.60	42.50
Hydrilla	0.00	5.00	10.00	15.00
Soybean meal	27.00	26.00	25.20	24.30
Fish meal	7.00	7.00	7.00	7.00
Palm oil	3.00	4.00	5.00	6.00
Dicalcium phosphate	2.10	2.10	2.10	2.10
Shell grit	1.30	1.30	1.30	1.30
Salt	0.30	0.30	0.30	0.30
L-Lysine	0.50	0.50	0.50	0.50
DL-Methionine	0.50	0.50	0.50	0.50
Premix	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00
Cost/Kg.	13.36	13.20	13.06	12.91
Analyzed chemical composition (% air-dry basis)				
Metabolizable energy (Me, Kcal/Kg)	3,013.00	3,013.00	3,010.00	3,008.00
Crude protein	21.18	21.09	21.08	21.02
Crude fat	6.17	7.07	7.96	8.86
Crude fiber	3.72	3.94	4.17	4.39
Ash	4.91	6.13	7.36	8.58
Calcium	1.64	1.67	1.71	1.74
Available phosphorous	0.58	0.61	0.63	0.65
Lysine	1.52	1.51	1.51	1.51
Methionine	0.86	0.99	0.99	0.99

[1]Vitamin and Minerals: vit A, D 0.15 g; vit E 50 g; vit K_3 50 0.01 g; vit B_1 0.01 g; vit B_2 0.002 g; vit B_6 0.03 g; vit B_{12} 0.22 g; Biotin 0.00025 g; Folic acid 0.00025 g; Niacin 0.10 g; Pantothenic acid 0.022 g; Selenium 0.60 g; Choline chloride 0.095 g; Fe 1.185 mg; Zn 0.35 mg.

Table 2: Feed composition and nutrient contents for Thai native chickens from 5-8 weeks of age.

Ingredient	Ration			
	1	2	3	4
Corn	62.98	57.65	51.05	46.05
Hydrilla	0.00	5.00	10.00	15.00
Soybean meal	23.00	22.00	21.80	20.70
Fish meal	6.00	6.00	6.00	6.00
Palm oil	2.50	3.70	5.50	6.60
Dicalcium phosphate	2.50	2.50	2.50	2.50
Shell grit	1.35	1.35	1.35	1.35
Salt	0.30	0.30	0.30	0.30
L-Lysine	0.50	0.50	0.50	0.50
DL-Methionine	0.50	0.50	0.50	0.50
Premix	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00
Cost/Kg.	12.91	12.78	12.84	12.70
Analyzed chemical composition (% air-dry basis)				
Metabolizable energy (Me, Kcal/Kg)	3,030.00	3,033.00	3,022.00	3,019.00
Crude protein	19.12	19.16	19.30	19.16
Crude fat	5.71	6.78	8.42	9.41
Crude fiber	3.51	3.73	3.96	4.17
Ash	4.39	5.60	6.82	8.05
Calcium	1.66	1.70	1.73	1.76
Available phosphorous	0.61	0.63	0.66	0.68
Lysine	1.08	1.37	1.36	1.36
Methionine	0.84	0.85	0.94	0.94

[1]Vitamin and Minerals: vit A,D 0.15 g; vit E 50 g; vit K3 50 0.01 g; vit B1 0.01 g; vit B2 0.002 g; vit B6 0.03 g; vit B12 0.22 g; Biotin 0.00025 g; Folic acid 0.00025 g; Niacin 0.10 g; Pantothenic acid 0.022 g; Selenium 0.60 g; Choline chloride 0.095g; Fe 1.185 mg; Zn 0.35 mg.

fiber and ash content of *Hydrilla verticillate* which consequently, could hinder feed digestibility and efficiency of absorption once passed through GIT and caused nutrient deficiency in feed (Muzter *et al.*, 1977 and Hussein *et al.*, 2021). Owing to the fiber caused feed intake run through digestive track faster meanwhile ash content envelops cell of feed component which later degenerate the feed assimilation efficiency (Muzi *et al.*, 2017; Ohanaka *et al.*, 2018). From this reason, weight gain of the chicken in this treatment was lower than the control group.

Feed conversion ratio

The results disclosed that the diet containing *Hydrilla verticillata* had an influence (P<0.05) on feed conversion ratio on the 1-4 week old chickens. The chickens provided with 0% *Hydrilla verticillata* showed best in FCR (P<0.05). Nonetheless, no apparent FCR was observed in the three treatment groups including 5-8, 9-12 and 1-12 weeks old (P>0.05). Incomplete gastro intestinal tract development affected different FCR occurring in the starter scheme -4 weeks old), causing limited digestibility and efficiency of feed utilization (Kanto, 1986). Moreover, high levels of fiber (8.15%) and ash (28.05%) contents found in *Hydrilla verticillata*, leading to inefficient feed digestibility and absorption resulting in reduced feed utilization. According to Onwedike (1986), when protein-digesting enzyme was deterred by fiber-enriched feed, protein and amino acids utilization would be decreased. There was also an effect of 1 per cent of the fibers in feed on less protein digestibility, accounting for 1.1-1.6% (Siriwathananukul, 1989). Thus, a negative impact on FCR was due to the substances in *Hydrilla verticillata* that featured high fiber and ash contents, yet low nitrogen-free extract contents.

Carcass characteristics

Carcass characteristics of Thai native chicken fed diets containing different levels of *Hydrilla verticillata* is shown in Table 5. There were significant differences in carcass characteristics of chickens foddered with 0%, 5%, 10% and 15% *Hydrilla verticillata*. That is, the live weight (LW) was variant when a 24-hour fasting period was applied before slaughter (P>0.05). Since each group treated with *Hydrilla verticillate* had different weights at the final experiment

Table 3: Feed composition and nutrient contents for Thai native chickens from 9-12 weeks of age.

Ingredient	Ration			
	1	2	3	4
Corn	68.50	64.35	58.35	53.35
Hydrilla	0.00	5.00	10.00	15.00
Soybean meal	18.35	16.50	16.00	15.00
Fish meal	6.00	6.00	6.00	6.00
Palm oil	1.50	2.50	4.00	5.00
Dicalcium phosphate	2.50	2.50	2.50	2.50
Shell grit	1.35	1.35	1.35	1.35
Salt	0.30	0.30	0.30	0.30
L-Lysine	0.50	0.50	0.50	0.50
DL-Methionine	0.50	0.50	0.50	0.50
Premix	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00
Cost/Kg.	12.41	12.21	12.18	12.03
Analyzed chemical composition (% air-dry basis)				
Metabolizable energy (Me, Kcal/Kg)	3,024.00	3,013.00	3,021.00	3,012.00
Crude protein	17.67	17.28	17.33	17.24
Crude fat	4.84	5.75	7.11	8.01
Crude fiber	3.37	3.56	3.78	4.01
Ash	4.14	5.34	6.60	7.81
Calcium	1.64	1.66	1.70	1.73
Available phosphorous	0.61	0.63	0.65	0.67
Lysine	1.27	1.26	1.27	1.26
Methionine	0.80	5.75	0.89	0.89

[1]Vitamin and Minerals: vit A,D 0.15 g; vit E 50 g; vit K3 50 0.01 g; vit B1 0.01 g; vit B2 0.002 g., vit B6 0.03 g; vit B12 0.22 g; Biotin 0.00025 g; Folic acid 0.00025 g; Niacin 0.10 g; Pantothenic acid 0.022 g; Selenium 0.60 g; Choline chloride 0.095 g; Fe 1.185 mg; Zn 0.35 mg.

(P<0.05), different weights were shown (P<0.05). No significant differences (P>0.05) were found in the hot carcass percentage, pectoralis majors, pectoralis minors, breasts, thighs, drumsticks, wings and total edible carcass (P>0.05) when dissected for carcass characteristics study. The gizzard weight (GW) was, however, statistically different (P<0.05). The increase in the levels of *Hydrilla verticillata* resulted in greater gizzard weight (GW), as *Hydrilla verticillata* could accelerate the activation of chicken gizzard, causing relatively heavier body weight because of the gizzard's size. Reported by Kubena *et al.* (1974), in comparison with the utilization of the feed with less fiber contents, the consumption supplemented with high fiber contents led to larger sized gizzards. No differences (P>0.05) existed in the sampling chickens in terms of abdominal fat, possibly because L-lysine and methionine were applied in high concentrations. In conformity with the report by Kuprasert (1995), it was determined that higher methionine intake could reduce more body fat accumulation. Restricted feed digestibility and absorption could be predicted as a consequence of a considerable amount of high-fiber feed intake, causing low metabolism (Hussein *et al*., 2021). Therefore, most energy was allocated to sustain living, leaving insufficient energy to be converted into visceral fat.

Cost economics

The results revealed that the finisher period (9-12 weeks) Thai native chickens foddered with 5% *Hydrilla verticillata* was lowest in production costs (38.33 Baht/kg); the other groups fed with 10% and 15% *Hydrilla verticillata* were presented accordingly at 38.61 and 38.61 Baht/kg.

Table 4: Performance of Thai native chickens, 1-4, 5-8, 5-12 and 1-12 weeks, fed with diets containing different levels of *Hydrilla verticillata.*

Performance	Rations (%)			
	0	5	10	15
Body weights start (g)	48.00±00	48.00±00	48.00±00	48.00±00
1-4 weeks				
Feed intake (g)	589.33±84.39	613.13±56.89	615.98±41.59	618.24±16.24
Body weight gain (g)	314.22±30.06	296.44±13.87	294.22±16.77	276.44±7.69
Feed/body weight gain	1.87±0.08[a]	2.06±0.13[b]	2.09±0.06[b]	2.23±0.03[b]
5-8 weeks				
Feed intake (g)	1,434.85±166.92	1,429.60±18.86	1,423.86±4.20	1,305.46±123.69
Body weight gain (g)	518.25±40.93	506.66±13.33	502.22±42.86	476.47±68.57
Feed/body weight gain	2.76±0.15	2.82±0.10	2.85±0.26	3.08±0.41
9-12 weeks				
Feed intake (g)	2,178.86±272.93	2,245.66±262.29	2,266.53±248.32	2,291.68±303.36
Body weight gain (g)	701.74±88.95	713.33±58.11	715.55±33.55	711.58±27.99
Feed/body weight gain	3.12±0.42	3.14±0.14	3.17±0.39	3.21±0.36
1-12 weeks				
Feed intake (g)	4,107.44±179.25	4,283.72±292.27	4,273.31±202.80	4,206.01±329.33
Body weight gain (g)	1,498.66±61.10[a]	1,516.44±54.29 [a]	1,500.88±13.87 [a]	1,414.22±20.36[b]
Feed/body weight gain	2.74±0.22	2.82±0.11	2.84±0.11	2.97±0.27

[a, b] Means within rows not sharing superscript are significantly different (P<0.05).

Table 5: Carcass characteristics of Thai native chickens fed varying levels of *Hydrilla verticillata* in the diet.

Carcass composition	Hydrilla (%)				P-value
	0	5	10	15	
Live weight (g)	1,451.66±17.67[a]	1,485.00±66.18[a]	1,462.00±25.51[a]	1,369.33±48.95[b]	0.016
Hot carcass percentage	88.87±0.49	89.37±0.36	89.93±0.82	88.86±0.56	0.440
Pectoralis majors	12.76±0.36	12.59±0.43	12.74±0.05	12.61±0.37	0.903
Pectoralis minors	3.37±0.20	2.93±0.25	2.97±0.04	3.24±0.29	0.108
Breasts	10.04±1.34	9.39±0.44	9.38±0.22	9.63±0.56	0.704
Thighs	10.65±0.53	10.80±0.42	11.98±1.59	11.20±1.23	0.467
Drumsticks	10.07±0.40	10.30±0.26	10.62±0.22	10.14±0.32	0.218
Wings	9.70±0.56	9.41±0.28	9.56±0.14	9.62±0.35	0.809
Gizzard	1.48±0.05	1.73±0.04	2.02±0.07	2.27±0.08	0.000
Abdominal fat	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.000
Total edible carcass	56.61±1.39	55.44±0.71	57.26±1.96	56.46±0.95	0.466

[a b c] Means within rows not sharing superscript are significantly different (P<0.05).

Table 6: Costs of feed containing 0%, 5%, 10% and 15% *Hydrilla verticillata* for Thai native chicken production aged 1-12 weeks.

Period feed-cost calculation	Hydrilla (%)			
	0	5	10	15
Starter period (1-4 week)				
Feed/body weight gain	1.87	2.06	2.09	2.23
Cost of feed (Baht/kg)	13.36	13.20	13.06	12.91
Cost of production (Baht/kg)	24.98	27.19	27.29	28.78
Growth period (5-8 week)				
Feed/body weight gain	2.76	2.82	2.85	3.08
Cost of feed (Baht/kg)	12.91	12.78	12.84	12.70
Cost of production (Baht/kg)	35.63	36.03	36.59	39.11
Finisher period (9-12 week)				
Feed/body weight gain	3.12	3.14	3.17	3.21
Cost of feed (Baht/kg)	12.41	12.21	12.81	12.03
Cost of production (Baht/kg)	38.71	38.33	38.61	38.61
Total period (1-12 week)				
Feed/body weight gain	2.74	2.82	2.84	2.97
Cost of feed (Baht/kg)	12.89	12.73	12.69	12.54
Cost of production (Baht/kg)	35.31	35.89	36.03	37.24

Surprisingly, the control had the highest production costs of 38.71 Baht/kg, because at the finisher period, the price of feed was higher than in other groups as shown in Table 6.

CONCLUSION

The utilization of *Hydrilla verticillata* as feed for Thai native chickens was economically efficient, at a 5% inclusion level in finisher diets.

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