



# Production Performance of Broiler Chickens Fed with Silkworm Pupa (*Bombyx mori*)

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**Abstract:** The production performance of broilers fed with silkworm pupa (*Bombyx mori*) was studied by focusing on growth, feed utilization, carcass composition and meat quality. There were two difference sources of silkworm pupa: (1) silkworm pupa from spun silk industry (SSP) and (2) silkworm pupa from silk yarn reeling industry (RSP) were mixed into five isonitrogenous (20% CP) and isocaloric (ME = 3,150 kcal/kg feed) diet. The 195 chickens at three weeks old were equally distributed to 15 pens in the closed housing. The experiment was divided into five dietary treatments (three replications each): treatment 1 (10% fishmeal, FM and 0% silkworm pupae) (control)), treatment 2 (0% FM and 10% SSP), treatment 3 (0% FM and 20% SSP), treatment 4 (0% FM and 5% SSP + 5% RSP), and treatment 5 (0% FM and 10% SSP + 10% RSP). Daily weight gain was 0.069, 0.060, 0.051, 0.065 and 0.061 kg/chick in treatments 1, 2, 3, 4 and 5, respectively. It is indicated that replacing fishmeal with silkworm pupa (5%SSP + 5%RSP) performed the same daily weight gain as control but exhibited the higher feed conversion ratio (1.87) than control (1.68). Carcass muscle of control treatment 1 (58.26%) was the highest ( $P < 0.05$ ) and closed to treatment 4 and 5 (57.62% and 57.83%, respectively). Sensory evaluation was not significantly differences ( $P > 0.05$ ). Therefore, treatment 4 (5%SSP + 5%RSP) could be substituted FM with little adverse effect on broiler growth but without any adverse effect on percentage of muscle and sensory test. However, further supplemental silkworm pupa performed reduction in dietary utilization and carcass muscle.

**Key words:** Broiler, silkworm pupa, production performance, carcass, meat quality.

## 1. Introduction

Feed is the key input for animal production. Fishmeal is the main ingredient and as a source of valuable animal protein in the diets. Fishmeal is quite expensive and is in short supply. Alternative resources, such as meat and bone meal, hydrolyzed feather meal, blood meal and some local material such as snail meal and silkworm pupa etc., have been tried to put in diets replacing fishmeal either partially or fully [1]. It has been postulated that insects could be an important source of proteins which contained a large quantity of good quality and highly digestible

protein [2]. Sericulture has been made a well-established in rural agribusiness. The farmer can produce high quality silk cocoon for silk thread reeling industry and low quality silk cocoon for spun silk industry. Silkworm pupa is the by-product after silk thread has been wound off from the cocoon and silkworm pupa serve as food. A small quantity of this silkworm pupa was consumed by rural people. Generally, silkworm pupa contains a lot of nutrients such as 49.4%-60.9% crude protein and up to 72.8% in extracted silkworm pupa and 14.2%-30.3% crude fat [3, 4]. The crude fiber of silk worm pupa is mostly chitin which is hardly utilized by animals. The information on mineral and vitamin content of silkworm pupa are limited [5-7].

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**Table 1** Chemical composition of fishmeal (FM), silkworm pupae form spun silk industry (SSP) and silkworm pupa form silk yarn reeling industry (RSP).

Treatment	Crude protein (%)	Crude fat (%)	Moisture (%)	Ash (%)	Crude fiber (%)	Calcium (%)	Total phosphorus (%)	Metabolizable energy <sup>1</sup> (Kcal/Kg)
Fishmeal	50.03	8.05	10.11	26.72	1.00	7.70	3.90	2,948
Spun silkworm pupa (SSP)	45.87	7.94	6.27	13.73	5.01	0.85	0.31	2,950
Reeling silkworm pupa (RSP)	50.31	25.76	2.48	3.67	4.54	0.073	0.81	3,762

<sup>1</sup> Means metabolizable energy by calculation.

Cost of fishmeal is 26.50 baht, Spun silkworm pupa is 23.37 baht, Reeling silkworm pupa is 11.69 baht.

**Table 2** Broiler feed formulation and proximate composition.

Ingredients (%)	1	2	3	4	5
Corn	61.76	55.45	57.20	57.20	61.70
Palm oil	4.00	5.50	4.50	4.50	1.80
Soy bean meal (44%)	23.20	26.00	15.30	25.20	13.50
Fish meal (50%)	10.00	0.00	0.00	0.00	0.00
Spun silkworm pupa (SSP)	0.00	10.00	20.00	5.00	10.00
Reeling silkworm pupa (RSP)	0.00	0.00	0.00	5.00	10.00
Methionine	0.04	0.00	0.00	0.00	0.00
Dicalcium phosphate (18%P)	0.10	2.15	2.10	2.00	1.70
Calcium carbonate	0.00	0.00	0.00	0.20	0.40
Salt	0.40	0.40	0.40	0.40	0.40
Premix	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Proximate composition by AOAC (1995)					
Crude protein (%)	20.62	21.05	21.08	21.07	21.1
Crude fat (%)	7.38	8.2	8	8.31	8
Moisture (%)	9.54	7.89	8.59	9.79	9.88
Ash (%)	5.25	6.3	6.74	5.75	5.8
Calcium (%)	0.87	0.87	0.86	0.86	0.84
Total Phosphorus (%)	0.61	0.51	0.48	0.5	0.48

## 2.4 Statistical Treatment of Data

A completely randomized design was used. Data were subjected to analysis of variance (ANOVA) using the statistical package and Duncan's multiple range tests were applied to test the level of significance ( $P < 0.05$ ).

## 3. Results and Discussion

### 3.1 Growth Performance

The productive performance of broiler fed diets containing silkworm pupa (*Bombyx mori*) was showed in Table 3. Survival rate of this experiment was 100% in

all treatments. The growth rate in term of weight gain and average daily gain presented that treatment 1; 10% FM (control) and Treatment 4; 5% SSP + 5% RSP had the highest growth rate ( $P < 0.05$ ) than the other treatments. Treatment 2, 3, 4 and 5 had higher feed consume ( $P < 0.05$ ) than control group because silkworm pupa contained a lot of chitin [11] that may cause low digestibility and high feed consumption to fulfill the energy requirement. The control group consumed small amount feed and performed high productive performance in term of growth and feed conversion ratio ( $P < 0.05$ ) because FM is high digestibility material of more than 80% that provided a

**Table 4** Carcass composition of broiler chicken fed diet containing silkworm pupae (mean  $\pm$  SD).

Treatment	Muscle (%)	Bone (%)	Abdominal fat (%)
1	58.26 $\pm$ 0.47 <sup>a</sup>	38.99 $\pm$ 0.46 <sup>b</sup>	2.75 $\pm$ 0.09 <sup>b</sup>
2	57.24 $\pm$ 0.17 <sup>b</sup>	39.58 $\pm$ 0.26 <sup>b</sup>	3.18 $\pm$ 0.10 <sup>a</sup>
3	54.58 $\pm$ 0.67 <sup>c</sup>	42.15 $\pm$ 0.60 <sup>a</sup>	3.27 $\pm$ 0.08 <sup>a</sup>
4	57.62 $\pm$ 0.15 <sup>ab</sup>	39.28 $\pm$ 0.32 <sup>b</sup>	3.10 $\pm$ 0.18 <sup>a</sup>
5	57.83 $\pm$ 0.36 <sup>ab</sup>	39.35 $\pm$ 0.39 <sup>b</sup>	2.82 $\pm$ 0.03 <sup>b</sup>
<i>P</i> -value	0.0001	0.0001	0.0001
Pool-SE	0.4111	0.4225	0.1079

Means within columns followed by the same letters do not differ significantly ( $P > 0.05$ ).

**Table 5** Sensory evaluation on breast muscle of broiler chicken fed diet containing silkworm pupae (mean  $\pm$  SD).

Treatment	Characteristics					
	Appearance	Color	Odor	Taste	Texture	Overall
1	7.14 $\pm$ 0.19	7.05 $\pm$ 0.37	6.53 $\pm$ 0.48	6.54 $\pm$ 0.43	6.56 $\pm$ 0.48	6.66 $\pm$ 0.45
2	7.17 $\pm$ 0.25	7.12 $\pm$ 0.37	6.68 $\pm$ 0.31	6.87 $\pm$ 0.34	6.58 $\pm$ 0.48	6.90 $\pm$ 0.37
3	7.14 $\pm$ 0.37	7.13 $\pm$ 0.43	6.56 $\pm$ 0.46	6.84 $\pm$ 0.27	6.78 $\pm$ 0.48	6.88 $\pm$ 0.46
4	7.25 $\pm$ 0.28	7.09 $\pm$ 0.45	6.63 $\pm$ 0.52	6.99 $\pm$ 0.23	6.73 $\pm$ 0.37	6.90 $\pm$ 0.34
5	7.14 $\pm$ 0.35	7.61 $\pm$ 0.27	6.64 $\pm$ 0.47	6.88 $\pm$ 0.23	6.76 $\pm$ 0.35	6.75 $\pm$ 0.33
<i>P</i> -value	0.9881	0.4025	0.9936	0.4998	0.9491	0.9256
Pool-SE	0.2950	0.3809	0.4514	0.3104	0.4337	0.3937

Score 0 = bad, 9 = good.

#### 4. Conclusion

This study indicated that treatment 4 (5% silkworm pupa from spinning industry (SSP) + 5% silkworm pupa from reeling silk thread industry (RSP)) can substitution for 10% fish meal with little adverse effect on broiler growth and without any adverse effect on percentage of muscle and sensory test. However, further supplemental silkworm pupa performed reduction in dietary utilization and carcass muscle.

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