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Effects of Phytogenic Feed Additive with Reduced Dietary Metabolizable Energy and Digestible Essential Amino Acids on Carcass Yields and Meat Quality of Pekin Ducks

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ABSTRACT

An experiment was conducted to study the effect of phytogenic feed additive with reduced dietary metabolizable energy and digestible essential amino acids on carcass yields and meat quality of pekin ducks. Ducking were mixed sex and fed broken-rice-soy-based diets formulated to contain 0 (control), 100, 200 and 300 ppm of supplemental phytogenic feed additive (PFA; blend of essential oils from capsaicin, thymal, cinnamaldehyde and carvacol; Biomin® P.E.P) and 3 levels of reduced dietary metabolizable energy (ME) and digestible essential amino acids (DEAA) at 0 (control), 1.5 and 3.0% levels from the recommendation of NRC (1994) and INRA (2004). Starter diets were fed for the first four weeks of age and 5 to 8 weeks of age and 9 to 12 weeks of age were fed for grower and finisher diets. The experimental design was 4x3 factorial arrangement in CRD (completely randomized design) with 12 experimental dietary treatments and comprised with 4 replicates of 10 birds per each and all of nutrients excepted ME and DEAA were followed by the suggestion of NRC (1994) and INRA (2004). Birds were reared in open-side houses during June until September, 2012 in Thailand and temperature ranged between 28 to 33°C. At the end of experiment periods (12 weeks of age) 4 birds (2 male and 2 females) per replication were randomly selected for measurement of carcass yields and meat quality. The results found that there has no interaction between PFA levels and dietary ME and DEAA and found that reduced dietary ME has no adverse affected on eviscerated carcass percentage, liver, heart and gizzard percentage but had higher (P<0.05) breast meat yield than birds fed the control diet. Feeding the reduced dietary DEAA significantly decreased (P<0.05) breast, thigh and drumstick percentage when compared with control group. However, when supplemented with PFA had significantly improved (P<0.05) breast meat yield, thigh and drumstick percentage and significantly improved (P<0.05) breast meat drip loss percentage when compared with control group and feeding group with reduced dietary ME and DEAA. In conclusion, reduced dietary ME and DEAA levels significantly affected on breast meat yield, thigh and drumstick percentage. However, supplementation of the diets with PFA significantly improved breast meat yield, thigh and drumstick percentage as well as significantly improved meat quality of pekin ducks in term of breast meat drip loss percentage.

Key words: Phytogenic feed additive; metabolizable energy; digestible essential amino acids; carcass yield; pekin ducks

INTRODUCTION

Dietary energy and crude protein, especially essential amino acids represent up to 70% of the feed cost for meat type poultry which eat to satisfy their requirements [9]. It has also been recognized that animal require a specific quantity of energy and balance of the dietary essential amino acids and sufficient nitrogen for synthesis of the non-essential amino acids [8]. Currently, there is an increasing interest the strategy to overcome this problem as well as there has the concerns about possible antibiotic residues and disease resistance have aroused great caution in the usage of antibiotics in the animal industry [5]. William and Losa [12] has reported that one of the alternative feed additives, phytogenic feed additive (PFA; blend of essential oil form capsaicin, cinnamaldehyde, thymal and carvacol) are already used as feed supplements to improve growth performance under intensive management systems. Lee *et al*. [7] also reported that PFA generally recognized as safe admitted by the Food and Drug Administration (FDA), PFA inhibit microbial growth in the gut and enhance nutrient digestibility. Although PFA have been studied and used in swine, chickens and other animals, little is known about their effects on meat-type ducks. Considering that meat-type ducks, particulary pekin ducks is a traditional Asian delicacy and is becoming increasingly popular [11]. Thus, the present study was conducted to study the effect of a commercial PFA with reduced dietary metabolizable energy (ME) and digestible essential amino acids (DEAA) on carcass yields and meat quality of Pekin ducks.

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Material and Methods

Four hundred one-day-old mixed sex Pekin meat ducks were weighed and randomly distributed into 12 groups with 4 replicates per group and 10 meat ducks per replicate. Each replicate was kept in a separate pen (240 x 150 cm). The birds were kept on the floor of open-side house during June until September, 2012 in Thailand and temperature ranged between 28 to 33°C and experimental diets and tap water were available for *ad libitum* consumption. The experimental diets composed of broken-rice-soy-based diets formulated to contain 0 (control), 100, 200 and 300 ppm of supplemental phytogenic feed additive (PFA; blend of essential oils from capsaicin, cinnamaldehyde, thymal and carvocal; Biomin® P.E.P) and 3 levels of reduced dietary metabolizable energy (ME) and digestible essential amino acids (DEAA) at 0 (control), 1.5 and 3.0% levels from the recommendation of NRC [8] and INRA [4]. Starter diets were fed for the first four weeks of age and 5 to 8 weeks of age and 9 to 12 weeks of age were fed for grower and finisher diets. The experimental design was 4 x 3 factorial arrangement in CRD (completely randomized design) with 12 experimental dietary treatments. All of nutrients excepted ME and DEAA were followed by the suggestion of NRC (1994) and INRA (2004). The composition and calculated analysis of the experimental diets were shown in Table1 and Table2, respectively. On d 84, feed was withdrawn and birds fasted overnight prior to processing. From each replication 4 birds (2 males and 2 females) were selected for processing and the eviscerated weight of the test birds was reported at the stage of processing. The main treatment factors were the concentration of PFA and the levels of ME and DEAA in the diets. The data were analyzed by ANOVA in a completely randomized design using the recommendation by Khunthum [6]. Differences among treatment means were compared using the Duncan's new multiple range tests. Statistical significance was established at $P<0.05$.

Table 1: Phytogenic feed additive (PFA)[1/] concentration in dietary experimental diets.

Supplementation levels (ppm.)	Experimental periods (weeks)		
	Starter (0 – 2)	Grower (3 – 5)	Finisher (5 – 6)
Non – supplementation	0	0	0
First supplementation	100	100	100
Second supplementation	200	200	200
Third supplementation	300	300	300

[1/] PFA (phytogenic feed additive; blend of essential oils from capsaicin, cinnamaldehyde, thymal and carvacol; Biomin® P.E.P)

Table 2: Composition and calculated nutrient content of experimental diets which have different reduced ME and DEAA levels (% as dry matter basis).

Item	Diet formulations									
	Starter rations				Grower rations				Finisher rations	
	0%	1.5%	3.0%		0%	1.5%	3.0%		0%	1.5%	3.0%
Ingredient											
Broken rice	42.70	43.50	44.26		47.84	48.62	49.40		48.97	49.83	50.61
Rice bran	20.00	20.00	20.00		20.00	20.00	20.00		25.00	25.00	25.00
Soybean meal (44% CP)	28.18	27.40	26.62		23.42	22.64	21.86		18.08	17.22	16.44
Fish meal (55% CP)	6.00	6.00	6.00		5.50	5.50	5.50		5.00	5.00	5.00
Dicalcium phosphate (21% P)	0.50	0.50	0.50		0.62	0.62	0.62		-	-	-
Limestone	0.95	0.95	0.95		1.01	1.01	1.01		1.45	1.45	1.45
NaCl	0.35	0.35	0.35		0.35	0.35	0.35		0.35	0.35	0.35
L-lysine	0.02	0.02	0.02		-	-	-		-	-	-
DL-methionine	0.80	0.80	0.80		0.76	0.76	0.76		0.65	0.65	0.65
Trace minerals [1/]	0.25	0.25	0.25		0.25	0.25	0.25		0.25	0.25	0.25
Vitamin [2/]	0.25	0.25	0.25		0.25	0.25	0.25		0.25	0.25	0.25
Total	100	100	100		100	100	100		100	100	100
Calculated nutrient composition (% as dry matter basis)											
Crude protein	22.00	21.67	21.34		20.0	19.70	19.40		18.00	17.73	17.46
ME (kcal/kg)	2850	2807	2765		2900	2857	2813		2950	2906	2861
Calcium	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
Available phosphorus	0.50	0.50	0.50		0.50	0.50	0.50		0.35	0.35	0.35
Digestible lysine	1.15	1.133	1.115		1.00	0.985	0.97		0.85	0.84	0.83
Digestible methionine	0.80	0.790	0.780		0.75	0.739	0.728		0.66	0.65	0.64
Digestible tryptophane	0.23	0.227	0.226		0.21	0.207	0.204		0.20	0.19	0.18
Digestible threonine	0.90	0.886	0.873		0.85	0.837	0.824		0.75	0.74	0.73

[1/]Provided per kilogram of diet : copper (copper sulfate. $5H_2O$), 10 mg; iodine (potassium iodate), 1.4 mg; iron (ferrous sulfate. $7H_2O$), 40 mg; manganese (manganese sulfate. H_2O), 120 mg; and zinc (zinc sulfate. $7H_2O$), 100 mg with calcium carbonate as the carrier.

[2/]Provided per kilogram of diet : vitamin A, 8000 IU; vitamin D3, 3000 IU; vitamin E,25 IU; menadione, 1.5 mg; vitamin B12, 0.02 mg biotin, 0.1 mg folacin, 1 mg; niacin 50 mg; pantothenic acid, 15 mg; pyridoxine 4 mg; riboflavin 10 mg and thiamin, 3 mg.

Results and Discussion

There were no interaction between the two main effects (PFA levels and different reduced ME and DEAA levels). There also found that reduced dietary ME has no adverse affected on carcass percentage, however reduced dietary DEAA significantly decreased (P<0.05) breast and maryland (thigh and drumstick) percentage when compared with control group (Table3). The results are consistent in the literature of Dari *et al*., [1] and Dozier *et al*., [2] who reported that feeding lowers amino acid density without CP minimum than the recommendation of NRC [8] and INRA [4] throughout production period of meat-type birds impaired body weight gain and reduced the accumulative tissue protein. However, when supplemented with PFA had significantly improved (P<0.05) breast meat yield, maryland percentage and significantly improved (P<0.05) breast meat drip loss percentage when compared with control group. The current study was supported by the previous study of Hernandez *et al*., [3] and Stanley *et al*., [10] who reported that essential oil from plant extract had activated the secretion of gastric enzyme and intestinal enzyme which association with the efficiency of nutrient digestibility. So that, it has improved carcass quality, particularly in breast muscle as we as improved proteinaceous tissue of cell membrane as concerned with the improving of water holding capacity of muscle cell membrane.

Table 3: Effect of dietary phytogenic feed additive (PFA) and reduced dietary metabolizable energy (ME) and digestible essential amino acids (DEAA) on carcass yield and meat quality of pekin ducks.

Item	Dressed weight (%)	Eviscerated weight (%)	Breast weight (%)[1/]	Thigh + Drumstick (Maryland) Weight (%)	24h Drip loss (%)[1/]
PFA levels (ppm.)					
0	87.08	85.10	17.13^{b}	9.54	1.60^{a}
100	86.40	84.73	18.44^{ab}	9.57	1.09^{ab}
200	87.95	85.18	19.65^{a}	9.46	0.73^{b}
300	87.24	85.03	19.45^{a}	9.65	0.68^{b}
Reduced ME and DEAA level (%)					
0	87.91	85.04	18.41^{ab}	9.40	1.64
1.5	87.48	85.13	17.11^{b}	9.36	1.58
3.0	87.98	85.63	17.03^{b}	9.40	1.47
Statistic					
SEM[2/]	0.467	0.371	0.060	0.020	0.020
PFA	0.814	0.710	0.044	0.815	0.041
ME and DEAA	0.724	0.745	0.038	0.719	0.182
PFA x (ME and DEAA)	0.790	0.771	0.211	0.776	0.197

[1/] Means with column with different superscripts for each parameter differ significantly (P<0.05)
[2/] SEM : standard error of the mean
* = P<0.05; NS = non significant (P>0.05)

Conclusion and Suggestion:

The present study has shown that it can be used phytogenic feed additive to improve carcass yields and meat quality of Pekin ducks devoid of antibiotics. However, the reduction of dietary metabolizable energy and digestible essential amino acid than the recommendation had adverse effect on carcass yields and meat quality of Pekin ducks. However, the experiment conducted involved a small scale, the additives that showed beneficial effects should be studied further in commercial farms to obtain results that can be incorporated into practice.

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