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FATNESS AND MEAT PHYSICAL QUALITY OF BROILER TREATED WITH METHIONINE SUPPLEMENTATION IN A LOW PROTEIN CONTAINING DIET

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Abstract

The study was conducted to investigate fatness and meat physical quality of broiler treated with methionine supplementation in a low protein containing diet. One hundred (100) unsex broiler chickens of avian CP 707 strain at one week old were used in this study. All broiler chickens were randomly divided into 20 pens for 4 ration treatments. The broilers were kept up to 6 weeks old by treatments of 14% protein + 0.14% methionine (M1); 17% protein + 0.10% methionine (M2); 20% protein + 0.06% methionine (M3); and 23% protein without methionine supplementation as a control (M4), respectively. The meat samples were taken from breast for physical quality. Those physical properties were pH, WCH, cooking loss and tenderness. The collected data were analysed by a one-way classification of variance analyses (CRD), followed by testing the significant means by Duncan's test (DMRT). The results indicated that the feeding treatment improved significantly ($P<0.01$) on the weight of abdominal fat, abdominal fat percentage, and meat fat content, respectively. The contrary, not significant different on subcutaneous fat percentage was observed respectively. The average of abdominal fat for M1 (40.20 g), was higher than M2 (25.05 g), M3 (23.85 g) and M4 (23.34 g), respectively. The feeding treatments were significant difference ($P<0.01$) on meat tenderness, cooking loss ($P<0.05$); but not significantly different on pH and WHC. pH and WHC value were similar among dietary treatments and control. Tenderness and cooking loss level of broiler fed with diets containing level of protein 17 and 20% was similar to control, respectively. The tenderest meat was obtained on the diet containing 14% protein. It was concluded that methionine supplemented into rations resulted the higher abdominal fat and meat fat in M1 treatment. The methionine supplemented into rations resulted the similar meat quality to the control.

Key words: Fatness, Meat physical quality, Broiler, Methionine

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Introduction

Generally, a high body weight broiler chicken contains a lot of fat including abdominal fat. The abdominal fat content has a close correlation with the whole body fat (Leenstra, 1984). Methionine is one of the essential amino acid, which is required in the low protein diet (Suzuki, 1988). Decreasing of diet protein content could cause methionine deficiency, and accordingly could reduce performance, carcass quality and could increase fatness. The main principle of amino acid supplementation was supplementing the restricted amino acid as methionine (Syahruddin, 1997). Methionine supplementation could be substituted to complete methionine requirement in the low protein diet. Therefore the study was conducted to investigate the fatness and physical quality of broiler chickens treated with methionine supplementation in the low protein containing diet.

Materials and Methods

The study was conducted at the Poultry Laboratory and at Meat Processing Technology Laboratory, Faculty of animal Science Gadjah Mada University Yogyakarta.

One hundred unsex broiler chickens of Avian CP 707 strain were used in this study. The diets contained 14; 17; and 20% protein, respectively. All diets were calculated to be isocaloric at 3100 kcal ME/kg.

Table 1. Ingredient composition of basal diets

Feed stuffs	Dietary treatment			
	M1 (%)	M2 (%)	M3 (%)	M4 (%)
Yellow corn	60.00	55.00	48.00	40.00
Soybean meal	8.00	15.00	15.00	10.00
PMM	4.84	6.64	12.35	20.91
Rice bran	24.86	21.06	22.35	26.79
Coconut oil	0.47	0.35	0.14	-
Topmix	0.30	0.30	0.30	0.30
L-Lysine HCl	0.47	0.26	0.10	-
Filler	1.06	1.39	1.76	2.00
Total	100.00	100.00	100.00	100.00

Topmix product of PT. Medion Bandung-Indonesia

Each diet was supplemented with DL-methionine to meet a requirement of 0.42%, similar to dietary control, respectively. Accordingly, each diet was added with DL-methionine (0.14; 0.10; and 0.06) and was coded with M1, M2, and M3, respectively. M4 was used as a dietary control, containing 23% crude protein and 3100 kcal ME/kg without DL-methionine supplementation. The diet materials for the basic feed were prepared according to the treatment plan.

Table 2. Nutrient content of basal diets

Nutrient	Dietary treatment			
	M1	M2	M3	M4
Protein (%)	14	17	20	23
ME (kcal/kg)	3100.42	3100.47	3100.33	3116.31
Crude fibre (%)	8.13	7.92	7.88	7.91
Crude Fat (%)	5.48	5.21	5.75	6.83
L-lysine HCl	1.10	1.10	1.10	1.10
Methionine	0.28	0.32	0.36	0.42

Table 3. Dietary composition of control and treatment

Feed component	Dietary treatment			
	M1	M2	M3	M4
Basal diet (%)	98.94	98.61	98.24	98.00
Filler (%)	0.92	1.29	1.70	2.00
DL-methionine (%)	0.14	0.10	0.06	-
Total	100.00	100.00	100.00	100.00
Nutrient content:				
Crude protein (%)	14.00	17.00	20.00	23.00
ME (kcal/kg)	3100.00	3100.00	3100.00	3100.00
Methionine total	0.42	0.42	0.42	0.42

One hundred unsex broiler chickens at one week old were randomly divided into 20 pens; each pen consisted of five broiler chickens. Twenty groups of broiler chickens were kept into 20 pens. Feed and water were available. Each five pens were used as replicates for each treatment. Chicks were kept up to six weeks of age. Water was provided *ad libitum*. Meat samples for physical analyses were taken from breast meat of *Pectoralis superficialis* muscles. The data taken included abdominal fat levels, percentage of abdominal fat, percentage of subcutaneous fat, and physical quality, namely pH, water-holding capacity (WHC), cooking loss, and tenderness. Five broilers of each treatment were slaughtered and the abdominal fats were taken, respectively. The weight and percentage of abdominal fat were measured. The percentage of subcutaneous was measured by using Swatland (1993). The pH and tenderness were measured by using Bouton *et al.* (1971) method, while the water-holding capacity was tested by Hamm (Swatland, 1984) method, and the cooking loss were tested by Bouton *et al.* (1976) method, respectively. The data were analysed by analysis of variance from completely randomised design. The differences between means were tested by Duncan's Multiple Range test.

Results and Discussion

Fatness

The results on the weight of abdominal fat, percentage of abdominal fat, and percentage of subcutaneous fat are presented in Table 4.

Table 4. Fatness of broiler chickens at 6 weeks of age

Parameter	Dietary treatment			
	M1	M2	M3	M4
Abdominal fat weight (g/bird)	40.20^a	25.05^b	23.85^b	23.34^b
Abdominal fat (% carcass weight)	5.24^a	3.08^b	2.25^c	1.86^d
Subcuntaneous (%)	35.77	30.62	27.58	26.84^{ns}
Breast meat fat (%)	1.55^a	1.40^b	1.32^b	1.30^b

^{a,b,c,d} values in the same row with different superscript differ significantly (P<0.01)
ns not significant

The results showed that methionine supplementation in the 14, 17, and 20% protein containing diets significantly increased (P<0.01) the weight of abdominal fat and percentage of abdominal fat, and did not significantly increased the subcutaneous fat between both dietary treatments and dietary control, as presented in Figure1.

Table 5. Methionine and lysine intake of broiler chickens at 6 weeks of age

Parameter	Dietary treatment			
	M1	M2	M3	M4
Methionine (g/bird)	12.16	12.06	12.03	12.00^{ns}
Lysine (g/bird)	31.84	31.60	31.50	31.43^{ns}

ns not significant
(Kartikasari, 2001)

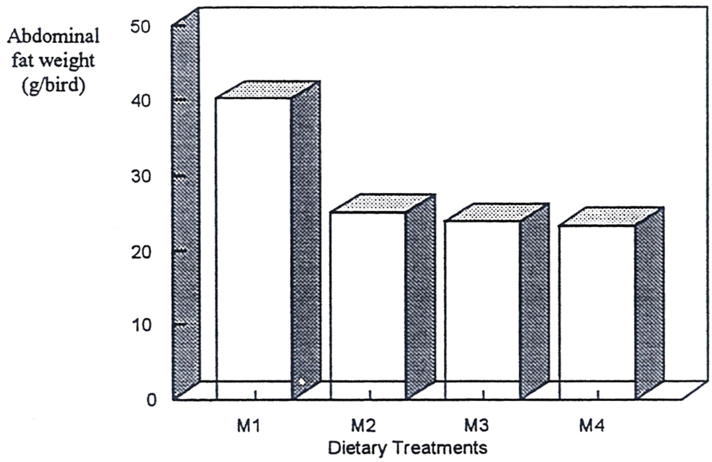

Figure 1. Abdominal fat weight of broiler chickens at 6 weeks of age

The highest abdominal fat was obtained by broiler fed with 14% protein containing diet (M1) namely 40.20 g, whereas the lowest abdominal fat was obtained by broiler fed with dietary control (M4), namely 23.34 g. Dietary treatment M1 resulted highly significant differences on abdominal fat weight ($P<0.01$) compared with dietary treatments of M2, M3, and M4. The differences were likely to be due to the protein difference on M1, so that there was an adequate protein requirement for optimal growth. The broilers on M1 might change the extra energy into fat deposition. The broiler chickens fed with M2, M3, and M4 resulted not significant differences on abdominal fat level. It is possible that the protein contents in M2 and M3 were enough and the methionine containing diets were similar to M4. The difference of abdominal fat level on the broilers fed with M1 against M2, M3, and M4, was because of the extra energy in M2, M3, and M4, which was not deposited as abdominal fat, but was deposited for body activity. The sufficient methionine would furnish carnitine requirement. The carnitine was formed by methyl groups of methionine and carbon skeleton of lysine. The carnitine had a role on oxidation of long chain fatty acid, namely with active carnitine fatty acid (acyl-CoA) assisted by carnitine-palmitil acyl transferase enzyme and could perforate mitochondria and oxidation (Harper *et al.*, 1983).

Percentage of abdominal fat level was highly significant different ($P<0.01$) among dietary treatments (M1, M2, and M3) and dietary control (M4). These results occurred due to differences in carcass weight between dietary treatments and control, respectively. The lowest percentage of abdominal fat was on M4 (1.86%) and it increased significantly on M3, M2, and M1 (2.25; 3.08; and 5.24%), respectively. Dietary treatments (M1, M2, M3, and M4) gave not significant differences on percentage of subcutaneous fat. However there was an indication that the percentage of subcutaneous fat tended to increase with the decrease in protein level. M4 had the lowest percentage of subcutaneous fat (26.84%) and increased (27.58; 30.62; and 35.77%) on dietary treatments M3, M2, and M1, respectively. The not significant differences on percentage of subcutaneous fat might be due to the slaughter age, which was still on the growth period, and the deposition of subcutaneous fat occurred after the deposition of abdominal fat.

Physical quality

The physical quality including pH, WHC, cooking loss and tenderness is presented on table 6. The results indicated that dietary treatment gave not significant differences on meat pH value. These could be caused by the similar activity of the chickens during growth, which resulted the relatively similar lactic acid production. It was supported by the water content that indicated not significant differences between both dietary treatments and control. The average of pH value on dietary treatments and control was 5.92. This value was similar to normal pH of 5.3 to 6.0 (Romans and Ziegler, 1974). The result also indicated that methionine supplementation into dietary protein levels (M1; M2; and M3) gave not significant differences on WHC, due to the not significant differences on pH value between M1, M2, M3, and M4. The pH value has a close relationship with WHC, on the high pH the WHC value was also high (Buckle *et al.* 1978). It was possible that the meat protein level on broilers fed with dietary treatments and control did not significantly different. Meat protein is a responsible substance on meat WHC (Wismer-Pedersen, 1971).

Table 6. Physical quality of broiler chickens at 6 weeks of age

Parameter	Dietary treatment			
	M1	M2	M3	M4
pH	5.98	5.89	5.87	5.94^{ns}
WHC (%)	22.40	23.08	25.44	25.96^{ns}
Cooking loss (%)	30.51^{a}	27.50^{b}	27.28^{b}	26.11$_{b}$*
Tenderness (kg/cm^2)	0.29^{a}	0.39^{b}	0.39^{b}	0.43^{b}**

^{a,b} values in the same row with different superscript differ significantly
ns not significant
* ($P<0.05$)
** ($P<0.01$)

Decreasing of the diet protein level tended to decrease WHC value. This might be due to the decrease of meat protein level, according to the decrease of diet protein level. The treatments of dietary protein level (14, 17, and 20%)

supplemented with methionine gave highly significant differences ($P<0.01$) on cooking loss.

M1 had the highest percentage of cooking loss (30.51%). The cooking loss decreased (27.5, 27.28, and 26.11%) on dietary treatments (M2, M3, and M4), respectively. The differences were possible to relate to WHC value on M1 which of was lower than that of M2, M3, and M4, respectively (fig. 2). The low WHC value tended to lose more water during cooking or to retain less water. Dietary treatments M2, M3, and M4 resulted not significant differences on cooking loss, which could be due to the similar protein, WHC, and fat level. High protein level would increase WHC value and after all would decrease cooking loss. Fat content would affect the WHC value and meat cooking loss (table 7). During heating process the fat would lose, and would be distributed into the meat microstructure, so that it could hold the loss of the meat water (Lawrie, 1995).

The tenderness value was highly significant differences ($P<0.01$) among dietary treatments and control. M1 had the highest tenderness value of 0.29 kg/cm^2 and decreased significantly on M2, M3, and M4 (0.39; 0.39; and 0.43 kg/cm^2), respectively. It was possible that the differences related to water content and to fat level. Increasing fatness tended to increase the intramuscular fat and thus to weaken the meat microstructure tissue, so that the meat was more tender. Broilers fed with M2, M3, and M4 resulted not significant differences on tenderness. These could be due to the WHC value, cooking loss, and fat level, which were not significantly different. Tenderness value was affected by WHC value and juiciness (Soeparno, 1992).

Table 7. Meat chemical composition of broiler chicken aged six weeks

Parameter	Dietary treatment			
	M1	M2	M3	M4
Water	74.05	74.01	74.54	74.85^{ns}
Protein	21.30	21.64	21.88	22.25^{ns}
Fat	1.55^a	1.40^b	1.32^b	1.30^b
Ash	1.32	1.37	1.42	1.45^{ns}

a,b values in the same row with different superscript differ significantly ($p < 0.01$)
ns Not significant
(Kartikasari, 2001)

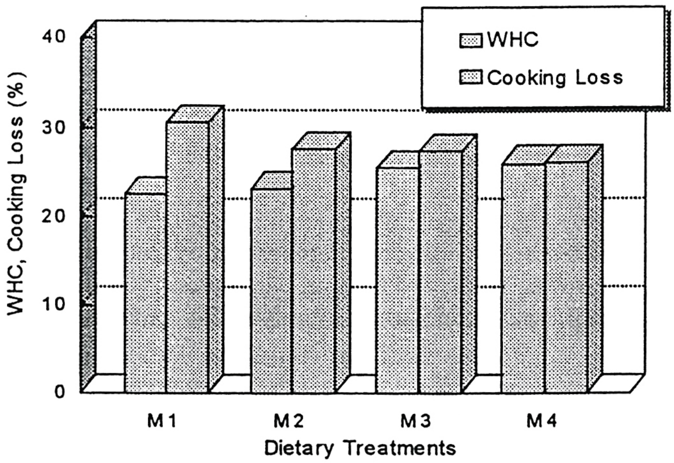

Figure 2. WHC and Cooking Loss Level of broiler chickens at 6 weeks of age

Conclusion

Broilers fed with dietary protein level of 14% (M1) and supplemented with methionine had the highest abdominal fat and meat fat content, as compared with that of 17, 20, and 23% (M2, M3, and M4), respectively. The subcutaneous fat level was similar among dietary treatments and control. pH and water holding-capacity (WHC) value were also similar among dietary treatments and control. Tenderness and cooking loss level of broilers fed with diets containing protein level of 17 and 20% was similar to control, respectively. The tenderest meat was obtained on the diet containing 14% protein.

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