EFFECT OF DRIED MEALWORM LARVAE PROBIOTICS ON QUALITY AND OXIDATIVE STABILITY OF MEAT IN BROILERS

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Abstract - The study was conducted to evaluate the dry mealworm larvae probiotics (DMLP) on meat quality and oxidative stability in broilers. A total of 320 day-old Ross 308 male broiler chicks were randomly assigned into four dietary treatments: control (basal diet); 0.2% DMLP (basal diet + 0.2% DMLP); 0.4% DMLP (basal diet + 0.4% DMLP); and 0.8% DMLP (basal diet + 0.8% DMLP) on DM basis in a completely randomized design. Results showed that crude protein content decreased (quadratic, $P<0.004$) and crude ash content increased (linear, $P<0.05$) in breast meat. A linear decrease in myristic acid ($P=0.01$) and dihomo-γ-linolenic acid (DGLA) ($P<0.002$) and increased nervonic ($P<0.004$) and eicosapentanoic acid (EPA) ($P=0.07$) in breast meat, while fatty acid content in thigh meat remain unchanged except reduced myristic acid ($P=0.003$). The cholesterol content and oxidative rancidity were reduced linearly ($P<0.05$) both in breast and thigh meat. Therefore, DMLP can be supplemented as an alternative feed additive to improve meat quality in broiler.

Key Words: Broilers, Dry mealworm larvae, Meat quality.

I. INTRODUCTION

It is an important goal to produce animal protein from animal sources by reducing the environmental impact to feed the overgrown population in the world. The yellow mealworm beetle (*Tenebrio molitor*) is a member of the Tenebrionidae family of the insect order Coleoptera. Ramos-Elorduy *et al.* [1] investigated and reported the great potential of T. molitor to be used as a protein source for broilers (up to 10 % inclusion in the diet) and the production cost at the industrial level would be significantly lower. Considering the meat quality, Ojewola *et al.* [2] found that fishmeal exhibited no superiority over any of the other diets (with grasshopper meal) in terms of the carcass quality of broiler chickens. Thus the objective of this study was to evaluate the dried mealworm (*T. molitor*) larvae fermented with probiotics (DMLP) as functional feed additives on composition, fatty acid profile and oxidative stability of meat in broilers.

II. MATERIALS AND METHODS

The study was conducted at the experimental broiler house of Sunchon National University (Suncheon, Republic of Korea). A total of 320 day-old male broiler chicks Ross 308 were randomly allocated into four treatment groups consisting of ten replications with eight birds in each in a completely randomized design. The dietary treatments were: 1) control (basal diet); 2) 0.2% DMLP (basal diet + 0.2% DMLP, DM basis); 3) 0.4% DMLP (basal diet + 0.4% DMLP, DM basis), and 4) 0.8% DMLP (basal diet + 0.8% DMLP, DM basis). Commercially available broiler diets formulated according to the NRC [3] were used as basal diet, and the

DMLP was mixed with basal diet by replacing an equal amount of basal diet. The birds were reared in a wire-floor caged broiler house with close ventilation system. The cages were furnished with a linear feeder in the front and a nipple drinker in the back to provide feed ad libitum and free access to water.

At the end of the experiment, broilers were slaughtered and breast and thigh muscles were separated from bone and fatty tissue and then ground and stored at –20°C until required for analysis. Proximate compositions were analyzed using 3g of minced meat samples according to the methods described by the Association of Official Analytical Chemists [3]. The cholesterol content of breast meat was determined by gas chromatography (DS 6200, Donam, South Korea), according to the method described by Yang *et al.* [5]. Breast and thigh meat fatty acid profile were determined using 1 g of minced meat samples by the method of fatty acid methyl ester (FAME) using a slight modification of the method described by O'Fallon *et al.* [6] using a gas chromatograph (Agilent, 7890A series, USA). Meat samples were preserved in the refrigerator at 4°C, and thiobarbituric acid reactive substances (TBARS) were assayed for fresh meat and on day 7, 14 and 21 according to Sarker and Yang [7]. TBARS values were expressed as micromoles of malondialdehyde (MDA) per 100 g of meat sample.

Data were analyzed in accordance with the GLM procedure of the SAS (version 9.1; SAS Ins. Inc., Cary, NC, USA). A group of five birds served as the experimental units for meat composition, fatty acid profile and oxidative stability of meat. An orthogonal polynomial contrast test was performed to determine linear and quadratic effects. Treatment means were computed with the LSMEANS and a probability level of $P \leq 0.05$ was considered statistically significant.

III. RESULTS AND DISCUSSIONS

Composition of breast and thigh meat

Crude protein (CP) content decreased (quadratic, P=0.004) and crude ash content increased (linear, P=0.05) in breast meat in DMLP supplementation compared to control. In thigh meat, CP, ether extract and crude ash content remain unchanged (Table 1). The cholesterol content was reduced both in breast and thigh meat compared to control ($P<0.05$) in DMLP supplementation (Table 1), which might be due to the hypocholesterolaemic effects of insect polyunsaturated fatty acid and chitin content. Makkar et al. [8] reported that PUFAs have a hypocholesterolaemic effects. Ramos-Elorduy [9] reported that yellow mealworm are common feedstuffs for pet animals and reptiles and are formidable source of insect protein with 44-70% in their body tissue. Ballitoc and Sun [10] reported the slight increase in protein content of breast meat, while no significant variation was observed in thigh meat. The increased crude ash content of breast meat might be due to combined effect of supplementation insect larvae with probiotics supplementation.

Fatty acid profile and oxidative rancidity

No significant variation was observed in summed and ratios of fatty acid concentration in breast and thigh meat compared to control group (data unpublished). A linear reduction of TBARS value in breast and thigh meat was found in supplementation of DMLP at fresh meat and preserved at 4℃ from first week to third week as compared to control ($P<0.05$) (Figure 1, a and b). Microbial contamination and oxidative reactions are the main factors reducing the shelf life of perishable foods [11]. The oxidative rancidity of meat was expressed as micromoles of malondialdehyde (MDA) which was significantly reduced in supplementation of DMLP of this study in breast and thigh meat during preservation period. It can be explained as reduction of lipid oxidation of breast and thigh meat due to presence of chitin in supplemental feed additives in broiler. Direct fed microbials like *S. cerevisiae* have been reported to possess strong reducing power and radical scavenging ability [12] which might reduce the oxidative stability of meat at preservation.

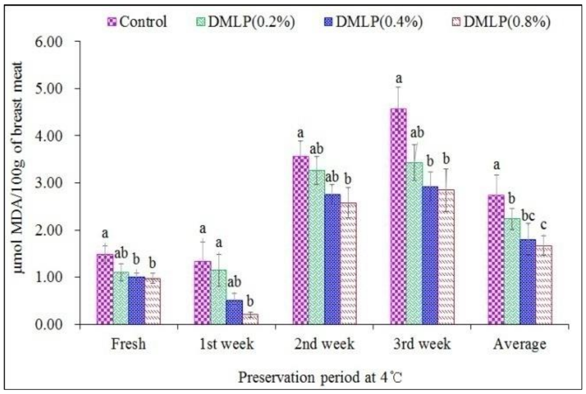
Table 1 Meat composition (%) and cholesterol (mg/100g) contents in broilers

Parameters	DMLP				SEM	P value	
	0%	0.2%	0.4%	0.8%		Linear	Quadratic
Breast meat							
Crude protein	26.07	22.69	24.11	25.21	0.47	0.60	0.004
Ether extract	1.08	0.60	2.05	0.96	0.44	0.72	0.64
Moisture	74.50	74.55	74.67	74.15	0.22	0.39	0.24
Crude ash	1.35	1.54	1.52	1.51	0.04	0.05	0.06
Cholesterol	147.2	137.9	119.5	107.1	6.96	0.001	0.84
Thigh meat							
Crude protein	19.86	19.70	19.95	20.46	0.29	0.14	0.28
Ether extract	4.29	3.33	2.80	3.98	0.51	0.59	0.09
Moisture	73.27	73.76	74.44	73.84	0.31	0.12	0.12
Crude ash	1.14	1.09	1.13	1.18	0.04	0.45	0.36
Cholesterol	225.0	192.2	162.4	141.5	14.96	0.001	0.70

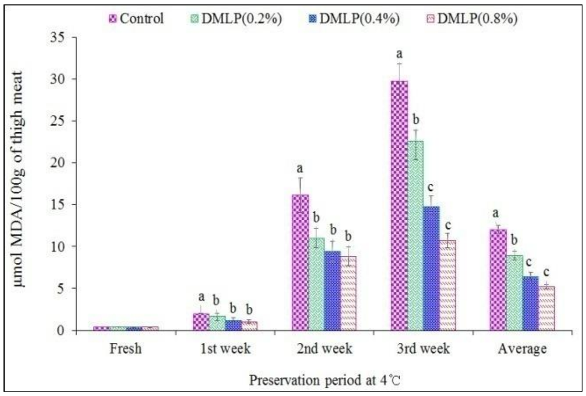
Each value represents the means of ten replications with five birds/replication.

Figure 1. TBARS value of breast (a) and thigh (b) meat. Bars without a common letter in a week differ significantly ($P<0.05$).

a)



b)



IV. CONCLUSION

In the present study, dietary DMLP supplementation showed an increased crude ash content in breast meat, while reduced cholesterol content both in breast and thigh meat. Although summed and ratios of fatty acid content remain unchanged, the oxidative rancidity of breast and thigh meat reduced significantly in supplementation of DMLP. Therefore, DMLP can be supplemented as a functional feed additive to improve meat quality by reducing cholesterol content and oxidative rancidity of meat in broiler.

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