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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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Meat Traits of Muscovy Ducks Fed on Phytonutrition Meal

Muhamad Ali[1], Sukirno[2], Muhamad Hasil Tamzil[3] and Muhamad Ichsan[3]
[1]Laboratory of Microbiology and Biotechnology,
[2]Laboratory of Animal Product Processing Technology,
[3]Laboratory of Poultry, Faculty of Animal Sciences,
University of Mataram, Jl Majapahit No. 62, Mataram-83125, Indonesia

Abstract: Animal products with high fat content are generally correlated with several human diseases including coronary heart disease, hypertension and arteriosclerosis. However, some unsaturated fatty acids are considered to have pivotal role in human health. As a consequence, many studies were conducted to reduce fat and increase some unsaturated fatty acid content in animal products. This study investigated the use of phytonutrition (duckweed) as feed ingredient on fat and fatty acids composition of Muscovy duck (*Cairina moschata domestica* L.) meat. Results showed that the use of 1% duckweed significantly increased the linoleic acid content of carcass while reducing the fat level. This result might suggest that duckweed can be used as an alternative feed ingredient to produce a healthy poultry meat.

Key words: Muscovy duck (*Cairina moschata domestica* L.), phytonutrition, duckweed, fats, unsaturated fatty acids, linoleic acids

INTRODUCTION

Fats can potentially modulate a broad range of negative effects on human health especially for elder when it is consumed in large portion. Several deathly human diseases such as a global epidemic of caloric imbalance, obesity, coronary heart disease, hypertension and arteriosclerosis have been confirmed due to a high-fat consumption. Framingham Heart Study data showed that people with high saturated fat concentrations has significantly higher risk on coronary artery disease (Castelli, 1992). Therefore, the American Heart Association recommended for high blood cholesterol person to reduce total fat in their foods to below 29% of calories.

On the other hand, several unsaturated fatty acids play many essential roles at all level of human cellular life, for instance cells membrane synthesis, proteins and carbohydrates modification, various structural elements construction in cells and tissue, signaling compounds production and for oxidative fuel (Aydin *et al*., 2001). Moreover, long chain polyunsaturated fatty acids (LC-PUFAs) provide myriad function for normal growth and also may play an important role in the prevention and management of coronary heart disease (Zyriax and Windler, 2000), hypertension and others disease (Simopoulos, 2000; Aydin *et al*., 2001; Aletor *et al*., 2003; Grashorn, 2005). Shang *et al*. (2004) reported that consumption of conjugated linoleic acid by human showed health benefit effects for modulating immune function, reducing body weight and providing protection against cancer and arteriosclerosis.

Several attempts have been made in order to decrease the fat level and increase the unsaturated fatty acid content in animal products such as eggs and meat. Several studies have also succeeded to manipulate fat and fatty acid composition of eggs and poultry meat through diet modifications. Schiavone *et al*. (2004) and Pisulewski (2005) reported that the fatty acid profile of Muscovy duck meat could be considerably modified by manipulating the ratio of soya bean oil and fish oil in diets. Recently, Zanini *et al*. (2008) also confirmed that manipulation of the fatty acids composition in poultry meat and giblets through dietary inclusion of two oil sources and conjugated linoleic acid.

Duckweed (*Lemna minor*), which is monocotyledonous plant family and geographically distributed around the world, grows faster than almost any other higher plant (doubling times in 48 h) and can yield 80 tones/ha/year of dry matter (Journey *et al*., 1991; Yan *et al*., 2013). The aquatic weed has a high content of nutrients, (especially protein, carotene and fatty acid) and have a better array of essential amino acids than most vegetable proteins and closely resembles animal protein (Hillman and Culley, 1978; Yan *et al*., 2013). Recent research has focused on the ability of duckweed to produce starch and protein. These traits have made duckweed a potential high-protein feed resource for domestic animals and fish (Leng *et al*., 1994; Men *et al*., 2001).

The objective of this research is to evaluate the possibility of modifying the fatty acid composition in meat of Muscovy duck (*Cairina moschata domestica* L.) through the addition of duckweed to the diet.

Corresponding Author: Muhamad Ali, Laboratory of Microbiology and Biotechnology, Faculty of Animal Sciences, University of Mataram, Jl Majapahit No. 62, Mataram-83125, Indonesia

MATERIALS AND METHODS

Experimental design: Two groups of animals were exposed to two different diets, one group received Duckweed modified diets and the other group received only normal diets as control, with 5 replicates of each. This study was performed at an experimental farm of CV. Adil Sejahtera Kekalik Gerisak, Mataram, West Nusa Tenggara Province, Indonesia from August to November 2012.

Experimental animals: Hundred one-month-old Muscovy ducks were used as experimental animal divided in two groups. Each group was further divided in five subgroups with each having 10 Muscovy duck. The experimental Muscovy ducks were fed with different diets for 12 weeks.

Housing and management: The ducks were housed in pens from bamboo with thatched roofs and land-sand floors. The average temperature is 26°C in the morning, 30°C at noon and 27°C at night. The yard was grown by banana and mango trees to avoid direct sun transmission in the middle of the day. Feeder used for the experiment were plastic basins 10 cm deep and 30 cm in diameter. Drinkers were 5 deep and 25 cm in diameter. Both feeders and drinkers were filled two time a day and were cleaned daily in the morning before feeding.

Duckweed: Duckweed was grown in 4 x 10 m^2 ponds in waste water of tempe home industry and was harvested twice a day in the morning and afternoon. The duckweed was put in a bamboo bucket for 1 h to drain the excess water, then mixed freshly with other feed ingredients.

Diets and feeding: As a feed control group, a commercial feed manufactured by PT Japfa Comfeed Indonesia with nutrients as shown in Table 1 was used. The two isoenergetics and isonitrogenous diets (metabolizable energy: 2785 kkal/kg feed and crude protein: 20%) differed for commercial ration (crude protein: 21%). Rations were given in wet condition. Freshly duckweed was mixed with other food ingredients (1 kg in 140 g of other food ingredients). Food and water were provided *ad libitum*.

Variable measurements: During the experimental period, some parameters were measured including body weight (gr), daily feed intake (gr), feed conversion ratio (FCR) and some fat and unsaturated fatty acid components. Body weight of all ducks and feed intake were recorded on weekly basis. In addition, at the end of experiment, three representative ducks per pen were slaughtered for carcass traits evaluation (fat and fatty acid). Data were analyzed by analysis of Variance (ANOVA) using SPSS sofwater version 15.

RESULTS AND DISCUSSION

The fresh duckweed offered to Muscovy duck was consumed readily, which indicates the high palatability of the aquatic weed for Muscovy duck. Results also showed that there was no significant difference ($p>0.05$, ANOVA) in food consumption, water consumption and food conversion ratio (FCR) between the two diets, control and duckweed-addition diet. These results indicate that the duckweed can be used as feed ingredient for Muscovy duck.

It is well known that, the fat and fatty acid profile of poultry meat can be considerably modified by the arrangement of ration composition. The use of high fatty acid ration stimulates the endogenous synthesis of fatty acid in poultry, resulting in a slight increasing of these molecules in the poultry meat (Lopez-Ferrer *et al*., 2001). In addition, Chiarini *et al*. (2003) reported that ducks receiving a vegetable diet had effect on the fatty acid composition of hepatic and breast muscle. In this research, the use of duckweed in ration of Muscovy duck gave slight improvement in the meat quality of the poultry.

The fat and fatty acid content of Muscovy duck meat fed with duckweed are listed in Table 2. There was no significant difference in fat content of duck meat fed with 1% duckweed. The saturated fatty acid of ducks meat fed duckweed (phytonutrition ration) tended to be lower than the meat of the duck fed commercial ration, but were not significantly different. Our results of several fatty acid found in this research are close to those reported by other researchers (Schiavone *et al*., 2004).

Since the duckweed contain not only high amount of protein but also soluble fibre and ash, the fibre inhibit fat precursor absorption in digestive tract especially in small intestine, resulting in low amount of fat and saturated fatty acid in meat. Fujii *et al*. (2013) reported that dietary fiber intake was associated with reduced prevalence of abdominal obesity, hypertension, chronic kidney disease and metabolic syndrome as a result of reduction of fat absorption.

Table 1: Composition of feed used in this study

Contents	Commercial feed	Phytonutrition feed
Crude fiber (%)	5	6.60
Ash (%)	7	8.25
Crude protein (%)	21	20.04
Crude fat (%)	3-7	7.34
ME (kkal)	2786	2785

Table 2: Fat and fatty acid composition of the Muscovy duck meat

	---------- Diets ----------	
Composition	C. diets	P. diets
Fat of meat (g/100 g)	1.00±0.02	0.82±0.15
Saturated fatty acid (%)	19.00±1.87	14.00±0.85
Meristic (14:0)	0.20±0.01	0.10±0.02
Palmitic (16:0)	17.85±1.05	13.92±1.13
Palmitoleic (16:1)	0.5±0.19	ND
Stearic (18:0)	1.0±0.27	0.5±0.33
Linoleic (18:2 n-6)	12.5±1.65	13.50±1.88

ND: Not detected C: Commercial P: Phytonutrition

Table 3: Fatty acid composition of the Muscovy duck leg and breast meat

	Leg		Breast	
Fatty acid	Commercial diet	Phytonutrition diets	Commercial diet	Phytonutrition diets
Palmitic	18.3±1.24	13.9±0.94	19.0±0.58	14.0±0.95
Linoleic	12±0.85	13.9±0.89	12.5±12.84	13.5±0.92

C: Commercial P: Phytonutrition

Piliang and Djojosoebagio (1990) reported that the fibre in ration could increase the rate of passage of the ration and subsequently decreased the fat absorption. This result is in agreement with the report of Natawiharja (1992), in which the fibre reduced the abdominal fat in poultry meat fed with high fiber content of ration. Ichsan *et al*. (1998) showed that the use of duckweed reduced the cholesterol content of eggs. This result is consistent with the report of Patras *et al*. (2012) who showed the digestible energy and metabolizable energy fibre reduced the abdominal fat in the meat poultry fed with high fiber content of ration.

The analysis of fatty acids in meat of either legs or breast showed that the same trends were found of increasing palmitic and linoleic content with the use of duckweed in the diets (Table 3). According to Schiavone *et al*. (2004), grasses and leaves are rich in linoleic acid. More recently, Yan *et al*. (2013) reported that the duckweed has significant content of fatty acid and 80% of the fatty acid consists of 16:0 (palmitic), 18:2Δ9,12 (Linoleic acid) and 18:3Δ9,12,15 (α-linolenic acid). Therefore, duckweed supplementation may provide the long chain polyunsaturated fatty acid for the poultry, which then gave contribution to the meat fatty acid. The higher amount of the polyunsaturated fatty acid (linoleic acid) is very important to improve the meat characteristic. The meat with lower fat, saturated fatty acid, but higher linoleic fatty acid was attractive to generate functional and fancy food for consumers. Because the lower of these nutritions, the better effect for consumer especially reduce cancer risk, arteriosclerosis, cholesterol plasma level and increase the body immunity (Aydin *et al*., 2001; Aletor *et al*., 2003; Grashorn, 2005).

The skin of the Muscovy duck fed duckweed has slightly higher carotene (0.047 ug/100 g) than those fed commercial ration (0.023 ug/100 g). It is because the duckweed contains high carotene (Men *et al*., 2001). The carotene was digested from the duckweed and stored in the body without any negative effects for the duck. As a result, the skin of Muscovy duck fed duckweed had yellow color, which was preferable for consumers.

Conclusion: In conclusion, the fatty acid profile of Muscovy duck meat can be considerably modified by management of the diet composition. The use of 1% duckweed reduced carcass fat, saturated and unsaturated fatty acid. The content of linoleic acid of carcass and beta-carotene, however, were increased indicating that duckweed can be used as a good food ingredient for generation of low fat content of Muscovy duck meat.

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