

THE DIFFERENCES OF PHYSICAL, CHEMICAL AND FATTY ACID PROFILE OF MEAT QUALITY OF MALE MUSCOVY (*Cairina moschata*) AND LOCAL DUCK (*Anas platyrhynchos*)

Ismoyowati, N. Iriyanti and S. A. Santosa

Faculty of Animal Science, University of Jenderal Soedirman,
Jl. dr. Soeparno, Karangwangkal, Purwokerto 53123, Central Java - Indonesia
Corresponding E-mail: moy.moyowati@gmail.com

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ABSTRAK

Penelitian ini bertujuan membandingkan perbedaan kualitas fisik, kimia dan profile asam lemak pada daging entog (itik manila) dan itik lokal lainnya (Magelang, Tegal dan Mojokari). Pada penelitian digunakan metode eksperimental, dengan rancangan percobaan Rancangan Acak Lengkap. Faktor bangsa digunakan sebagai perlakuan yaitu Itik Manila, Magelang, Tegal dan Mojokari yang diulang sebanyak 5 kali. Analisis variansi dan uji beda nyata jujur digunakan untuk menganalisis data. Hasil penelitian menunjukkan terdapat perbedaan kualitas fisik daging pada warna, pH dan susut masak, sedangkan daya ikat air dan keempukan tidak berbeda nyata. Kandungan nutrisi secara makro yaitu lemak dan kolesterol dan protein relatif sama, akan tetapi persentase asam lemaknya berbeda. Entog memiliki kandungan asam lemak tak jenuh rantai ganda lebih tinggi dibandingkan dengan itik lokal lainnya. Penelitian dapat disimpulkan bahwa daging entog memiliki kualitas fisik dan kimia relatif sama, akan tetapi profil asam lemaknya lebih baik dibandingkan dengan itik lokal lainnya. Daging itik manila lebih sehat dikonsumsi karena mengandung asam lemak tak jenuh rantai ganda lebih tinggi dibandingkan dengan itik lokal lainnya.

Kata kunci: Itik manila, itik lokal, kualitas daging, asam lemak

ABSTRACT

This research was aimed to differentiate the meat physical, chemical and fatty acid profile quality in muscovy and other local ducks (Magelang, Tegal and Mojokari). Completely Randomized Design was used in this study. Breed used as treatments was muscovy, Magelang, Tegal and Mojokari ducks repeated 5 times. Analysis of variance and honestly significant difference were used to analyze data. Result showed there were differences in physical quality of meat in the term of colour, pH, and cooking loss, while water holding capacity and tenderness were relatively similar. Fat, cholesterol and protein were relatively similar. Muscovy duck has a higher polyunsaturated fatty acids (PUFAs) than the other local duck. In conclusion, the physical and chemical quality of meat of muscovy and other local ducks were similar. Muscovy duck meat is healthier to consume due to a higher polyunsaturated fatty acids than the other local ducks.

Keywords: muscovy, local duck, meat quality, fatty acid

INTRODUCTION

Recent poultry breeding and selection is to increase meat production and quality. The different poultry breed between local species duck (*Anas platyrhynchos*) and muscovy (*Cairina moschata*) results in different meat production and quality. Duck is one of the most desirable poultry products owing to consumer's preference shift from chicken to duck. The meat of muscovy duck, khaki chabbel, Pekin and the

crossbred had a good market potential especially in Asian countries (Huda *et al.*, 2011). Culver duck farm (2012) reported that skinless Pekin duck breast in 100 g meat had lower calories (140 kcal vs 165 kcal), lower fat (2.5g vs 4g), and higher iron (5mg vs 1 mg) than skinless chicken breast. Preserved dried duck has lower water content and higher protein than other meat products (Lorenzo *et al.*, 2011). Dried skinless duck has the highest amino acid of lysine and leucine, then valine, followed by threonine and isoleucine. Dried duck

is also the source of iron, zinc, copper and manganese (Lorenzo *et al.*, 2011).

Fat in duck meat is higher than in chicken and turkey (Bae'za *et al.*, 2000; 2002), it is contradiction with reported by Culver duck farm (2012). Chicken and turkey breast is 1-2% on average (Rabot, 1998), while in other order namely *Anas platyrhynchos*, *Cairinamoschata* and the crossbred is relatively high, 2.26-7.57% (Chartrin *et al.*, 2003). In Indonesia there are several female local ducks kept as layer namely Tegal, Magelang and Mojosari ducks. While the male duck for meat production is muscovy duck.

Different meat quality is influenced by the breed or the genetic of the duck. Meat quality is defined by the content of meat fat (intramuscular fat) that influences physical and sensory quality and nutrition content of meat (Ruiz *et al.*, 2001). Intramuscular fat in various fowl species as reported by Chartrin *et al.* (2000) in pekin and muscovy is found different pectoralis in muscle (2.3% vs 4.6%). The different fat content in water fowl is due to different lipoprotein lipase activity (LPL) (Davail *et al.*, 2003). Different balance of lipogenesis muscle and oxidation of long chain fatty acid is the significant factor of different intramuscular fat in any species (Halloway *et al.*, 2009) and within species (Gondret *et al.*, 2004). This research studied the difference of physical, chemical and fatty acid profile quality of male muscovy (*Cairinamochata*) and local ducks (*Anas platyrhynchos*).

MATERIALS AND METHODS

Experimental method with Completely Randomized Design was applied. Ducks used as treatment comprised four types of duck with five times repetition. Materials used were muscovy and local ducks consisted of male Magelang, Tegal and Mojosari day old ducks, 25 birds each. Ducks were fed on feed with composition as shown in Table 1. Chemicals for meat chemical analysis and fatty acid profile, and the equipment used was a set of physical, chemical and meat fatty acid profile analysis.

Day old ducks were reared in brooder up to three weeks old. Feed was given *ad libitum* controlled with starter period feed use a chicken broiler starter (BR I). At four weeks old, ducks were put into treatment cage unit, each consisted of five birds and was repeated five times to make up 20 treatment units. Ducks were fed with grower period based on need, thus 100 g from 4

weeks old and increased to 150 g at 8 weeks old. Water was given *ad libitum*.

The parameters observed in this study were physical quality of the meat duck consisted of skin and meat colour, pH, cooking loss (CL), tenderness and water holding capacity (WHC). The chemical properties were included meat fat, cholesterol, protein and fatty acid profiles (C8=0, C12=0, C14=0, C16=0, C16=1, C18=0, C18=1, C18=2, C18=3, C20=0 and C22=0).

At 10 weeks old, one duck from each unit was slaughtered by Khoser method, followed by processing to obtain carcass that were scalding, defeathering, evisceration, non-carcass chopping and carcass scaling (Rose, 1997). Skin and meat colour was qualitatively observed. Meat sampling for physical, chemical quality and fatty acid profile test was taken from skinless leg and breast.

Physical and chemical meat quality was analyzed by taking sample on leg and breast. pH of the duck meat was measured using pH meter. Cooking loss (%) was measured by placing the weighed duck meat sample, sealed in a plastic bag, in water bath (pre heated to 80°C) for 1 hour (Honikel, 1998). The tenderness was measured using penetrometer, water holding capacity (WHC) was measured with filter paper press method (Honikel and Hamm, 1994). The analysis of meat protein and fat used AOAC method (1990); cholesterol level was measured with Lieberman and Burchard method; and fatty acid composition was measured with HPLC.

The data were subjected to Completely Randomized Design analysis of variance followed by Honestly Significant Difference (HSD).

RESULT AND DISCUSSION

Physical Quality of Duck Meat

Skin and meat color is one of physical quality indicator of fowl carcass. Fowl skin varies from cream to yellow. Result showed that skin and meat of muscovy duck is relatively brighter than the other ducks (Table 2). Darker color on local duck meat indicated higher hemoglobin and myoglobin than muscovy. Raw meat ranges from soft red to red due to hemoglobin and myoglobin content in muscle. The higher the myoglobine in muscle, the darker the meat color. When it was cooked, meat turns darker. Leg meat is darker than other parts especially breast (Guerrero-Legarreta, 2010). Chartrin *et al.* (2006) reported that highly fatty duck breast had paler and more yellowish color.

Table 1. Nutrition Composition and Content of Feed for Muscovy and Other Local Ducks as Starter and Grower Period

Feed	Starter Feed	Grower Feed
Corn	BR 1	47.0
Fishmeal		8.0
Rice bran		37.0
Meat bone meal		5.0
Corn cob meal		2.0
Premix		1.0
Total		100
Feed Nutrition Content		
Crude protein (%)	21	15.068
ME (kcal/kg)	3000	2806
Crude fiber (%)	5	7.042
Crude fat (%)	5	4.322
Ca (%)	1	1.805
P (%)	0.9	1.221

Calculation based on NRC (1994)

Result of physical quality measurement of muscovy and various local ducks showed different pH and cooking loss (CL), while water holding capacity (WHC) and tenderness were relatively the same (Table 3). The highest of pH average was on the leg of muscovy duck (6.520 ± 0.247), while the lowest was on the breast of Tegal duck (6.006 ± 0.036). A faster decline on pH in local duck meat indicated the forming of lactic acid due to faster glycogenesis in muscle than that of muscovy duck. The decline depended on the supply of glycogen and glucose on the dying fowl. The rate of pH decline depends on muscle physiology, type of muscle and type of

animal. Meat acidity is affected by lactic acid, in which pH 7 barely had lactic acid on meat, while pH 5.5 had approximately 1% of lactic acid (Soeparno, 2005). pH value in all duck strain was at the acceptable level and the meat was not pale color (PSE). Postmortem influenced pH decline and water holding capacity (Huff-Lonergan and Lonergan, 2005; Adzitey, 2011).

Cooking loss is the loss of water content in boiling process. The different cooking loss was due to intramuscular fat disposition that restrains the loss of meat juice during cooking, although the more fatty meat will lose more fat as well. Result showed that breast meat of muscovy had the highest cooking loss than the other ducks. There was negative correlation between pH and cooking loss. This indicated that as the pH decreased, the cooking loss increased (Table 3). Botha *et al.* (2007) reported that there was a significant correlation ($r = -0.278$) between pH and cooking loss of the ostrich carcasses throughout the 21-days aging period.

Water holding capacity is the ability of meat to bind its water or the additional water during outside treatment such as cutting, heating, grinding, and pressing of meat (Soeparno, 2005). WHC is a term used to describe muscle ability to bind water in certain condition and therefore, it is always related to sensory characteristics of meat like juiciness and taste. Water in muscle is divided into three water compartments, namely, water that is chemically bound by muscle protein as much as 4-5% as the first monomolecular layer; a less strong bound water as the second layer of water molecule toward hydrolytic group as much as 4%, and this second layer will be bound by protein when the vapor pressure increases; the third layer is free water molecules among protein molecules around 10% (Pena *et al.*, 2009). Result of WHC measurement in four types of ducks showed a similar value 75.496-77.698%, in which the higher the WHC, the better

Table 2. Meat and Skin Color of Muscovy and Other Local Ducks

Traits	Muscovy		Magelang		Tegal		Mojosari	
	Breast	Leg	Breast	Leg	Breast	Leg	Breast	Leg
Meat Color	Bright Soft Red	Darker	Dark Red	Dark Red	Dark Red	Dark Red	Dark red	Dark red
Skin Color	Bright Cream	Bright Cream	Cream	Cream	Cream	Cream	Cream	Cream

Tabel 3. Physical Quality of Muscovy and Other Local Ducks

Animal	Body Part	pH	CL(%)	WHC(%)	Tenderness (mm/g/sec.)
Muscovy	Breast	6.108±0.106 ^a	41.651±1.955 ^b	75.767±4.106	0.538±0.032
	Leg	6.520±0.247 ^b	38.558±3.646 ^b	76.631±3.100	0.489±0.031
Tegal	Breast	6.006±0.036 ^a	33.870±1.284 ^a	75.615±2.470	0.619±0.205
	Leg	6.226±0.063 ^a	31.516±3.469 ^a	75.496±2.344	0.507±0.055
Magelang	breast	6.240±0.175 ^a	38.774±2.137 ^b	77.698±0.692	0.494±0.068
	Leg	6.320±0.131 ^a	40.899±2.730 ^b	75.794±2.310	0.477±0.047
Mojosari	Breast	6.010±0.032 ^a	34.657±2.020 ^a	77.207±2.016	0.592±0.039
	Leg	6.433±0.133 ^{ab}	32.264±1.759 ^a	76.068±1.451	0.580±0.055
Intra breed		P>0.05	P<0.05	P>0.05	P>0.05
Inter part-intra breed		P>0.01	P<0.05	P>0.05	P>0.05

Different superscript in the same column shows significant difference (P<0.05)

Tabel 4. Fat, Cholesterol and Protein Content in Muscovy and Other Local Ducks

Meat Chemical	Muscovy	Tegal	Magelang	Mojosari	Significance
Fat (%)	2.586±0.401	4.880±1.993	4.181±1.097	3.422±0.145	P>0.05
cholesterol (mg/g)	1.249±0.098	1.078±0.088	1.034±0.143	1.007±0.259	P>0.05
Protein (%)	16.199±0.131	17.683±1.517	17.379±0.518	17.679±1.131	P>0.05

the meat quality.

Meat tenderness in Muscovy and other local ducks shared a similar value in the average of 0.477-0.619 mm/g/sec. Meat tenderness is affected by genetic factor, thus the breed or the species. Muscovy and other local ducks had similar tenderness value, because they had the fat content of meat relatively similar. Meat tenderness was affected by fat content, it was positively correlated with lipid levels (Chartrin *et al.* 2006). Tenderness is also one of the indicators of meat quality and palatability. Consumers prefer tenderer meat because of easier tooth penetration and chewing, while tougher meat is harder to pierce either by teeth or by needle.

Chemical Quality of Duck meat

Nutritional composition of duck depends on

the breed and the strain of duck (Ramadhan *et al.*, 2010). Analysis of variance result showed a relatively similar fat, cholesterol and protein content of meat in various local ducks (Table 4). Biologically, muscovy duck contains lower fat and protein than the other local ducks but the cholesterol is the highest. It indicated that duck breed had no effect on meat composition. Meat sample used in this research was skinless breast and leg so the fat content was lower than that of broiler, turkey, duck and quail according to USDA (2006) (Table 5). Other research reported that fat content in muscovy breast is 2.89g/100g and in Pekin duck is 6.4 g/100 g (Aronal *et al.*, 2012). Indonesian local duck fed 19% protein and 3000kcal/mg ME contains 6.16±1.29% (6.16 g/100g) fat and 186±0.13 mg/g cholesterol (Ismoyowati and Sumarmono, 2011). The

Tabel 5. Chemical Composition of Fowl Meat (g/100g)

Component	Broiler	Turkey	Duck	Quail
Water	74.6	72.5	70.8	74.4
Ash	1.0	0.8	1.2	1.1
Protein	12.1	13.7	12.8	13.1
Fat	11.1	11.9	13.8	11.1
Carbohydrate	1.2	1.1	1.4	1.4

Source: USDA (2006)

Tabel 6. Fatty Acid Profile of Muscovy and Other Local Ducks

Methyl Esther Fatty Acid	Relative Percentage of Fatty Acid Composition			
	Muscovy	Tegal	Magelang	Mojosari
C8=0	0.154±0.060 ^{ab}	0.288±0.027 ^b	0.282±0.087 ^b	0.109±0.010 ^a
C12=0	0.154±0.020 ^{ab}	0.288±0.002 ^b	0.282±0.002 ^{ab}	0.109±0.016 ^a
C14=0	0.492±0.005	0.539±0.112	0.528±0.074	0.369±0.091
C16=0	22.847±0.601 ^b	22.848±3.211 ^b	19.351±3.621 ^{ab}	16.217±1.046 ^a
C16=1	2.439±0.010	2.107±0.207	2.346±0.153	1.890±0.862
C18=0	9.053±0.162 ^b	6.076±0.906 ^a	6.500±0.175 ^a	5.750±0.359 ^a
C18=1	36.223±0.219 ^b	28.250±5.120 ^{ab}	27.685±8.680 ^{ab}	22.443±3.396 ^a
C18=2	14.597±1.267 ^{ab}	13.963±2.022 ^{ab}	19.251±5.269 ^b	10.220±0.744 ^a
C18=3	0.124±0.007	-	-	-
C20=0	0.293±0.033 ^b	-	0.155±0.045 ^a	2.856±0.177 ^b
C22=0	3.185±0.347 ^a	3.495±0.328 ^a	2.715±0.636 ^a	2.493±0.010 ^a

Different superscript in the same column showed significant difference (P<0.05)

differences on fat and cholesterol was due to different feed. Fat and cholesterol synthesis in cell through acetyl coenzyme A was influenced by fat and cholesterol content in the feed.

Protein in human is essential for growth, maintenance and repair of damage tissue, also as the source of energy without carbohydrate. Fat is an important energy source but has negative effect on health. Cholesterol is important for steroid hormone production, normal nerve function, formation of brain cell, cell membrane, vitamin D synthesis and many others. However, over consumed cholesterol causes atherosclerosis that

leads to human death (Griffin, 1999). Endogen cholesterol synthesized in liver is three times higher than cholesterol from the consumed food (Okuyama *et al.*, 2007).

Fatty Acid Profile of Duck Meat

Duck fatty acid profile is presented on Table 6 consisted of saturated fatty acid: C14:0, C16:0, C18:0; monounsaturated fatty acid: C14:1, C16:1, C18:1 and polyunsaturated fatty acid: C18:2, C18:3, C20:4, C20:6. The biggest proportion (%) is oleic acid (C18=1) on 22.443-36.223% in average, palmitic acid (C16=0) on 16.217-

22.848% in average and C18=0 on 10.220-19.251% in average. The observed duck meat was skinless breast and leg. *Cairinamoschata* had the highest oleic acid proportion. This result is different from that of Kokoszyński *et al.* (2002); Wołoszyn *et al.* (2005); Kokoszyński and Bernacki (2010) reported that the higher fatty acid proportion on Pekin duck is palmitic acid which is harmful for human health.

Analysis of variance result showed significant difference on the composition of saturated and unsaturated fatty acid in muscovy and other local ducks (Table 6). Mojosari duck has the lowest unsaturated fatty acid than those of muscovy and other local ducks. Muscovy duck contained the highest monounsaturated fatty acid (MUFA) of other local ducks. Magelang duck contained the highest polyunsaturated fatty acid (C18:2). The C18:3 was detected in Muscovy, but not detected in other local ducks.

The different composition of fatty acid in fowl is due to breed and the feed (Bekerbauer *et al.*, 2001). Duck meat composition is highly defined by the source of fatty feed, grains, plants and water creature in paddy field ecosystem where the ducks are reared, which also significantly affect the fatty acid composition (Cobos *et al.*, 2000). Fatty acid in different meat part has different composition as well, in which fowl white meat (breast meat) contains lower phospholipids and PUFA than fowl red meat (leg meat). Fatty acid composition is related to the type of muscle fiber (Wood *et al.*, 2003)

CONCLUSION

Macro nutritional contents in meat of muscovy and other local ducks namely fat, cholesterol and fatty acid were similar but different in fatty acid percentage. Muscovy duck meat has a higher polyunsaturated fatty acid than the other local duck. Muscovy and other local ducks had different physical and chemical meat quality. Muscovy duck meat is healthier to consume due to a higher polyunsaturated fatty acid than the other local ducks.

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