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Use of Apple Snails (*Pomacea canaliculata*) as a Source of Fatty Acids in Feed Towards the Performance, Blood Cholesterol and Cholesterol Levels in Alabio Duck (*Anas platyrhinchos borneo*) Meat and Eggs

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Abstract: This research was conducted to evaluate apple snails as a source of fatty acids in Alabio duck feed. There are 180 female Alabio ducks, 22 weeks old, placed in 9 levels of using apple snails in feed R0 (control), R1 (2.5% swampy apple snails + basal feed), R2 (5% swampy apple snails + basal feed), R3 (7.5%, 2.5% swampy apple snails + basal feed), R4 (10% swampy apple snails + basal feed), R5 (2.5% tidal swampy apple snails + basal feed), R6 (5% tidal swampy apple snails + basal feed), R7 (7.5%, 2.5% tidal swampy apple snails + basal feed) and R8 (10% tidal swampy apple snails + basal feed), which are arranged based on a Completely Randomized Design with 4 replications. The variables that are measured were carcass weight, feed conversion, egg production, blood cholesterol profile (triglycerides, LDL, HDL and cholesterol), as well as meat and egg cholesterol. The research results reveal that using apple snails in Alabio duck feed has increase significantly ($p<0.05$) egg production, feed conversion, as well as a reduction in LDL level, meat cholesterol and egg cholesterol. However, no significant difference ($p>0.05$) was observed towards carcass weight, abdominal fat, triglycerides, HDL and blood cholesterol. A subsequent test is done with a Duncan Multiple Range Test to show that using at least 5% of swampy apple snails produce the highest egg production with the lowest meat and egg cholesterol levels.

Key words: Apple snails, Alabio ducks, fatty acids

INTRODUCTION

The contribution of duck meat and eggs for a food supply from waterfowl production is still low in Indonesia compared with chicken meat and egg production. In Indonesia, the duck population is about 46.31 million with a meat production of about 31,000 tons, or only about 1.70% of the total waterfowl meat and egg production of 772.4 thousand tons or 15.81% of the total waterfowl egg production in Indonesia (Livestock Statistics, 2013). The duck population in Indonesia is ranked 6th in the world duck population after India and Vietnam (FAO, 2010). This means that based on the population, duck meat in Indonesia should have excellent potential to fulfill meat needs in Indonesia.

Alabio ducks (*Anas platyrhynchos Borneo*) are a local waterfowl species in South Kalimantan (Purba *et al*., 2005; Hamdan *et al*., 2010) and have a superiority as egg producers (Biyatmoko, 2005; Suparyanto, 2005; Hamdan *et al*., 2010). Compared with other waterfowl species (chickens, quails and turkeys), duck meat contains higher saturated fat at 35.7% (Pisulewski, 2005). Its cholesterol level is 186.26 mg/100 g (Ismoyowati *et al*., 2011). Similarly, duck eggs contain two times as much cholesterol as chicken eggs at 884 mg (Jalaludeen and Churchill, 2006) and 10,036 mg/100 g eggs (Azis *et al*., 2012). Cholesterol has a direct effect on the membrane's instability and has a significant role for brain synapses like in the body's immune system (Ockene *et al*., 2004). The consumption of cholesterol is related with the concentration of LDL cholesterol that progressively leads towards an increase in coronary heart sufferers (USDA, 2005). Consuming 300 mg of cholesterol per day is suspected of increasing the cholesterol serum of 1.5 mg/day (Hopkins, 1992). Adding 100 mg of cholesterol per day causes an increase of cholesterol serum of between 2 until 3 mg/dL (Howell *et al*., 1997). Therefore, it is necessary to find a way to make duck products have lower cholesterol, both for the meat and the eggs. One of the ways to do this is by manipulating duck feed by utilizing local feed ingredients that are rich in unsaturated fatty acid content like apple snails (*Pomacea canaliculata*).

In general, monounsaturated fatty acids (MUFA) have a positive influence on the cholesterol level in the blood. Monounsaturated fatty acids like oleate are effective in reducing the blood cholesterol level, so that it is often used as a processed food formulation ingredient (Krauss, 2001; Roos *et al*., 2001). Similarly, using linolenic acid with 0.6-1.2% of one's total calorie needs can provide protection for coronary heart sufferers (Wang *et al*., 2004). Substituting saturated fatty acids

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with unsaturated fatty acids can reduce the cholesterol level in terms of total cholesterol count and cholesterol low density lipoprotein (K-LDL). In addition, it also increases cholesterol high density lipoprotein (K-HDL), which will retard arteriosclerosis (Muller *et al*., 2003).

Apple snails (*Pomacea canaliculata Lamarck*) are a source of potential feed protein, because the protein content is equal to fish meal. The composition of apple snail meal nutrients is dried ingredients 87.34%, liquid content 12.66%, dust content 20.13%, crude protein 54.17%, crude fat 4.83%, crude fiber 2.37%, ETN 5.84% and total energy 3,971.88 kcal/kg (Sundari, 2004). Besides that, apple snails also contain high levels of unsaturated fatty acids in the form of stearic acid (C 18:0), oleate acid (C 18:1), linoleate acid (C 18:2) and linolenate acid (C 18:3) (Subhan *et al*., 2010). This is seen from the relatively high level of unsaturated fatty acids and nutrient content that is expected to be beneficial in reducing duck meat and egg cholesterol levels that nowadays are a concern for consumers of duck meat and eggs in Indonesia. Therefore, the purpose of this research is to take advantage of apple snails that come from different habitats (freshwater and saltwater) as a source of unsaturated fatty acids to improve the quality (cholesterol) of Alabio duck meat and eggs.

MATERIALS AND METHODS

Research location: This research is conducted in experiment cages managed by the South Kalimantan Province Hulu Sungai Utara Regency Livestock Agency, Gadjah Mada University Livestock Faculty Biochemistry Laboratory, Veterinary Faculty Pathology Laboratory.

Experiment livestock: The materials used in this research are 180 female Alabio ducks, 22 weeks old, which are purchased from animal breeders in Mamar Village, Hulu Sungai Utara Regency, South Kalimantan. The cages are shaped like mailboxes with 36 units. They are made from wood, bamboo and mesh wiring with a size of 1 x 1.5 x 1 m, as well as feed containers and drinking containers.

Experiment feed: The feed material used for the ration distributions consists of yellow corn, rice bran, soybean meal, MBM (meat bone meal), DL-methionine, L-lysine, NaCl, $CaCO_3$, DCP and top mix medion formulated based on National Research Council (NRC, 1994) standards, treated feed formulated to replace MBM with apple snail meal that is derived from swampy apple snails and tidal swampy apple snails with individual percentages of 2.5, 5, 7.5 and 10%. The ingredients and composition of the feed are listed in Table 1.

Research procedures: This research is conducted for 12 weeks, including a 2-week period to adapt to the experiment feed by using a Complete Randomized Design (RAL). There are 180 female Alabio ducks distributed randomly in nine treatments and four repeat trials. Each of the repeat trials consists of 5 female ducks. The following are the treatments tested:

R0: (control),
R1: (basal feed + 2.5% swampy apple snails)
R2: (basal feed + 5% swampy apple snails)
R3: (basal feed + 7.5% swampy apple snails)
R4: (basal feed + 10% swampy apple snails)
R5: (basal feed + 2.5% tidal swampy apple snails)
R6: (basal feed + 5% tidal swampy apple snails)
R7: (basal feed + 7.5% tidal swampy apple snails)
R8: (basal feed + 10% tidal swampy apple snails)

The basal feed that is mixed with apple snails homogenously is given 2 times a day with 120 g/duck/day for 12 weeks of observation; water is given *ad libitum*. The cages are cleaned and sterilized by using disinfectants every week. In the first week, the ducks are given vitamins for 3 days in a row and the process is repeated if there are weather changes. After 3 months of observation, the ducks are all cut and the breast and thigh parts are taken for analysis of meat cholesterol. Before the ducks are cut up, blood samples are taken from the blood vessels under the wings (*vena axillaris*). The blood samples are then put inside 3 mL canisters that already have blood anticoagulants (EDTA). Next, the samples are put inside Esky (coolers) to be taken to a laboratory to have the blood cholesterol profile examined (triglycerides, HDL, LDL and cholesterol) by using an enzyme method (CHOD-PAP). Meanwhile, the Liebermen-Burchard method is used to analyze the meat and egg cholesterol.

Variables observed: The variables observed include egg production, rejected duck carcass weight, feed conversion, meat cholesterol, egg cholesterol and blood cholesterol profile (triglycerides, LDL, HDL, cholesterol).

Data analysis: The research result data is analyzed with ANOVA variance using a Complete Randomized Design. The average differences between treatments are then tested with a Duncan Multiple Range Test (DMRT) (Gomes and Gomez, 2007).

RESULTS AND DISCUSSION

Alabio duck performance

Egg production: The feed treatment variant analytical results show a significant influence ($p<0.05$) towards egg production. The average egg production is the highest in the R2 treatment (adding 5% swampy apple snail meal in basal feed) at 76.00±6.44%, while the lowest average egg production is in the R8 treatment (adding 10% tidal swampy apple snail meal) at

Table 1: Ingredients and composition of feed treatment

	Treatment								
Feed ingredients (%)	R_0	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8
Percentage (%)									
Yellow corn	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Rice bran	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20
Soybean meal	17.50	17.50	17.50	17.50	17.50	17.50	17.50	17.50	17.50
MBM	10.00	7.50	5.00	2.50	0.00	7.50	5.00	2.50	0.00
Swampy snails	0	2.5	10	7.5	10	0	0	0	0
Tidal swampy snails	0	0	0	0	0	2.5	5	7.5	10
DL-Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
L-lysine-HCl	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
NaCl	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
$CaCO_3$	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
DCP	0.1	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Premix	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
Energy (Kcal/kg)	2864.1	2854.1	2844.1	2834.1	2824.1	2854.1	2844.1	2834.1	2824.1
Protein (%)	20.00	20.03	20.07	20.10	20.14	20.03	20.07	20.10	20.14
Crude fiber (%)	4.15	4.11	4.15	4.27	4.35	4.11	4.15	4.27	4.35
Crude fat (%)	5.31	5.40	5.49	5.58	5.67	5.40	5.49	5.58	5.67
Ca (%)	2.80	2.74	2.68	2.62	2.56	2.74	2.68	2.62	2.56
P (%)	0.89	0.76	0.66	0.55	0.45	0.76	0.66	0.55	0.45
Methionine (%)	0.33	0.31	0.29	0.27	0.27	0.31	0.29	0.27	0.27
Lysine (%)	0.41	0.42	0.43	0.44	0.45	0.42	0.43	0.44	0.45
Oleic (%)	1.09	1.13	1.17	1.20	1.24	1.13	1.17	1.20	1.24
Linoleate (%)	1,52	1.99	2.40	2.82	3.23	1.99	2.40	2.82	3.23
Linolenate (%)	2.48	3.09	3.58	4.10	4.60	3.09	3.58	4.10	4.60

Table 2: Production of eggs, carcass weight, feed conversion and percent of abdominal fat in rejected female alabio ducks with using snail treatment in feed

Treatment	Egg production (%)	Feed conversion	Carcass weight (g)^{ns}	Abdominal fat of (%)
R_0	61.33±3.61^{ab}	5.89±1.587^{cd}	643.67±113.11	2.75±1.40
R_1	75.67±2.96^{c}	3.03±0.70^{ab}	765.73±92.83	2.29±1.49
R_2	76.00±6.44^{c}	2.71±0.11^{a}	686.71±107.45	1.12±1.44
R_3	70.00±8.39^{bc}	3.47±0.96^{bc}	695.86±107.05	0.61±0.80
R_4	59.33±6.21^{ab}	7.08±3.79^{cd}	599.80±71.29	0.32±0.64
R_5	64.00±8.07^{ab}	5.20±1.88^{cd}	707.51±78.04	1.27±1.56
R_6	61.00±8.53^{ab}	4.40±0.79^{cd}	645.23±39.24	1.08±1.24
R_7	59.67±3.33^{ab}	4.29±0.62^{cd}	654.38±44.56	0.68±0.80
R_8	54.33±6.38^{a}	5.63±1.93^{cd}	644.75±59.13	0.59±1.19

Different superscripts in the same column reveal significant differences ($p<0.05$)

54.33±6.38. These research results are higher than those reported by Biyatmoko *et al.* (2010), who used fermented tree snail meal at 22.7% with 72.99±5.58. Next, according to Purba (2004), Rohaeni and Setioko (2002), as well as Setioko and Rohaeni (2002), Alabio duck egg production with feed protein is 19.1% and energy with 2,700 kg/kcal is 56.78, 64.63 and 66.86%. The higher egg production from this research is suspected to be due to the complete feed nutrient content, especially the apple snail protein content that is equal to the protein found in fish meal. The Alabio duck egg average production is listed in order in Table 2. These research results reveal a tendency that the higher the apple snail meal added to the duck feed, the lower the egg production due to the apple snail meal being composed of a mixture of shells and meat, so that it is suspected there is an uneven distribution of meat and shells homogenously.

Feed conversion: The average feed conversion produced from this research shows a significant difference ($p<0.05$). The lowest feed conversion is in the R2 treatment (basal feed + 5% swampy apple snails) at 2.71±0.11, while the highest feed conversion is in the R4 treatment (basal feed + 10% swampy apple snails) at 7.08±0.39. The research analysis results are then continued with the Duncan Multiple Range Test that reveals significant differences between the R2 treatment and control (R0), as well as with the R1, R3, R4, R5, R6, R7 and R8 treatments. Similar with the R1 treatment, differences are also found with the other treatments. Between the control with R3, R4, R5, R6, R7 and R8, there are no significant differences. However, when the R4 and R8 treatments are compared, the R4 feed conversion is higher, even though its egg production is also high. This is due to the R8 treatment has relatively bigger egg production, so that the total weight of the

Table 3: Profile of alabio duck blood cholesterol (Triglycerides, LDL, HDL, Cholesterol) with using snail treatment in feed

Treatment	Triglycerides^{ns}	LDL	HDL^{ns}	Cholesterol^{ns}
R_0	657.14±179.57	140.83±24.16^{c}	54.17±51.20	195.00±74.16
R_1	764.29±100.68	94.17±32.43^{bc}	58.33±37.82	152.50±42.72
R_2	750.00±97.24	90.00±71.09^{abc}	75.00±45.92	165.00±46.55
R_3	685.72±134.20	59.44±25.60^{ab}	72.81±14.95	127.50±10.00
R_4	571.43±143.81	50.28±27.85^{ab}	59.72±11.45	110.00±29.44
R_5	710.71±182.34	83.06±30.37^{abc}	83.13±30.37	127.50±5.00
R_6	610.72±262.74	29.45±20.70^{a}	56.49±20.14	160.00±82.87
R_7	600.00±160.36	67.22±40.88^{ab}	67.22±40.88	107.50±22.17
R_8	817.86±131.64	62.22±38.66^{ab}	64.72±38.41	165.00±76.81

Different superscripts in the same column reveal significant differences ($p<0.05$)

Table 4: Cholesterol content of alabio duck products (Meat and Eggs) with using snail treatment in feed

Treatment	Meat	Eggs
R_0	67.02±2.81^{DE}	1201.43±32.88^{D}
R_1	61.79±3.03^{BC}	946.77±37.42^{A}
R_2	57.55±2.54^{A}	955.89±44.01^{A}
R_3	58.30±2.49^{AB}	981.92±75.84^{AB}
R_4	69.33±2.45^{E}	1173.71±33.79^{D}
R_5	64.02±1.60^{CD}	1138.14±103.42^{CD}
R_6	63.83±1.54^{CD}	952.72±48.42^{A}
R_7	78.40±2.36^{F}	1066.53±62.86^{BC}
R_8	58.36±2.80^{AB}	1136.52±103.84^{CD}

Different superscripts in the same column reveal significant differences ($p<0.01$)

eggs produced are also big, resulting in a lower feed conversion. The egg laying duck feed conversion is calculated based on the total egg production in 'g' divided by the total feed consumption in 'g'. The higher the egg production, the higher the total egg weight, so that the feed conversion is better. In contrast, in treatment with high feed conversion, one of the causative factors is because of low egg production, while the total feed consumed is the same because the feed given is limited to 120 g/day. The ration conversion can be used as a depiction to discover the level of production efficiency. The ration conversion number shows the level of feed efficiency; this means that if the ration conversion number is higher, then using rationing is not very economical and the other way around. Anggorodi (1985) found that ration conversion is a technical indicator that can depict ration usage. The ration conversion number will be better when the relationship between energy and protein in a ration is adjusted appropriately. The factors which influence feed conversion are egg production, energy content in a ration, body weight, nutritional content in feed and air temperature.

Carcass weight: The average carcass weight obtained from this research is highest in the treatment where tidal swampy apple snail meal is added at 2.5% (R5) or 707.51±78.04. Then the lowest is in R4 treatment (basal feed + 10% swampy apple snails) at 599.80±71.29. Although the carcass weight produced is not the same, a statistical analysis does not reveal significant differences ($p>0.05$), either in the control or treatment. This is suspected to be due to the same feed nutrients being given, so that the resulting body weight is not that much different. In addition, at the time the ducks are cut, they are generally still productive so that they consume more feed for egg production. Compared with the research results of Rukmiasih *et al*. (2010) regarding giving beluntas plants (*Pluchea indica*) to rejected ducks, these research results show smaller carcass weights.

Abdominal fat: The abdominal fat measurement results in the research using apple snails in feed shows the highest percentage of abdominal fat is found in the control treatments (without adding apple snails in the feed formulation at 2.75±1.40. The higher the percentage of apple snails added, the abdominal fat content will be relatively reduced. In the treatment by adding 10% of swampy apple snails in basal feed (R4), it will produce the lowest abdominal fat percentage at 0.32±0.64. Although there is a reduction, there is not a significant statistical difference compared with the control or other treatments. This can be compared with the research results of Rukmiasih *et al*. (2010) conducted on rejected female local ducks at 2.43±0.60. Abdominal fat is body fat that is stored in the stomach cavity, including fat that protects the gizzard (Essay and Dawson, 1965). The reduction of ration energy levels or an increase in protein percentage will increase the growth rate; therefore, it will also increase the amount of abdominal fat and size of fat concentration (Amrullah, 2004).

Alabio duck blood cholesterol profile: The research uses apple snails in Alabio duck basal feed toward the blood cholesterol content. The results can be seen in Table 3.

Blood triglyceride levels: The average blood triglyceride levels in using apple snails show a relative reduction in line with the increase of apple snail percentage added in the feed. Adding 10% swampy apple snails (R4) produces the lowest blood triglyceride level at 571.43±143.81. It is also lower compared with the control (R0), even though the variant analytical results do

not reveal significant differences towards the Alabio duck blood triglyceride levels. In detail, the average blood triglyceride levels are displayed in Table 3. These research results are not that much different with the research results of Wijaya *et al.* (2013), who found that local duck blood triglyceride levels are about 293.33-753.34 mg/dL. Meanwhile, according to Fuller (1997), the duck standard triglyceride level ranges between 400-500 mg/dL. The average research results of triglyceride content about the standard are suspected to be due to the ducks being stressed when their blood is taken. Guyton and Hall (2000) reported that the blood triglyceride level is influenced by genetics, age, stress and hormones. Next, according to Ganong (2002), liver disease also influences blood triglyceride levels.

LDL and HDL levels: The average blood LDL levels of Alabio ducks which are given feed with additional apple snail meal show significant differences ($p<0.05$). These research results are followed up with the Duncan Multiple Range Test, which shows that treatments by adding tidal swampy apple snail meal at 5% (R6) produce the lowest average LDL levels at 29.45±20.70. In detail, the average blood LDL levels are displayed in Table 3. Compared with the control (R0), all of the treatments that are given apple snail meal have average blood LDL levels below the average. It is also the case with blood HDL levels that are above the average control HDL levels. The reduction of blood LDL levels and increase of blood HDL levels in all treatments using apple snails in basal feed is suspected to be due to the relatively high presence of omega-9 oleate acid found in apple snail meal. The cholesterol synthetic approach mechanism with the presence of omega-9 oleate acid in apple snail meal is a cis configuration that can reduce the fat absorption, so that the blood cholesterol is reduced. In other words, there is an increase in HDL cholesterol levels (Hartoyo *et al.*, 2005). Next, according to Lough *et al.* (1992) and Murray *et al.* (1997), unsaturated fatty acids have a role in influencing the catabolism rate and increase the number of LDL receptors.

Blood cholesterol level: The Alabio duck blood cholesterol levels by adding apple snail meal in the basal feed show a reduction in line with an increase in the percentage of using apple snail meal in basal feed, the same with a reduction in the blood LDL levels. Compared with the average control (R0) treatments, all of the treatments that are given apple snail meal show a reduction in blood cholesterol levels. The lowest blood cholesterol levels are found in the treatments adding swampy apple snails at 10% (R4) or 110.00±29.44 mg/dL and adding tidal swampy apple snails at 7.5% (R7) or 107.50±22.17 mg/dL. In detail, the average Alabio duck blood cholesterol levels can be observed in Table 3. There is a reduction in blood cholesterol levels in line with an increase in adding the percentage of apple snail meal in basal feed, which is suspected to be due to the unsaturated fatty acid content (linoleate acid) found in apple snail meal. Linoleate acid functions as an antioxidant, so that it is thought that linoleate acid in apple snails is able to increase the secretion of bile acid. The secretion of bile acid needs cholesterol as a raw material, so that it can increase the secretion of bile acid, reducing the total blood cholesterol level (Asmariani and Probosari, 2012). Next, Wahyono (2002) explained that the increasing secretion of bile acid into the intestines will stimulate the liver to synthesize cholesterol and the results will be channeled throughout the digestive system, so that the blood cholesterol will be reduced and used to synthetically mobilize liver fat. Although there is a reduction in blood cholesterol levels resulting from the use of apple snail meal in basal feed, the variant analytical results do not depict a significant difference ($p>0.05$). These research results are not that different from the research results of Wijaya *et al.* (2013) towards the local duck blood cholesterol content in Indonesia of Magelang duck blood cholesterol 136.7±15.3 mg/dL and Tegal duck blood cholesterol 163.3±25.2 mg/dL, but it is lower if compared with the Mojosari duck blood cholesterol level of 203.3±25.2 mg/dL.

Alabio duck meat and egg cholesterol

Meat cholesterol: The average cholesterol content in Alabio duck meat when they are given apple snail treatment in basal feed is detailed in Table 4. The variant analytical results reveal a significant influence ($p<0.01$) towards the meat cholesterol content. The lowest meat cholesterol level is found in the R2 treatment (5% swampy apple snails) at 58.30±2.49. The Duncan Multiple Range Test results show that the R2 treatment is significantly different with R0, R1, R3, R4, R5, R6, R7 and R8, but when compared with R0 (control), all of the treatments have significant differences ($p<0.05$). A reduction in the meat cholesterol level due to apple snail treatment is thought to be because of the presence of the role of unsaturated fatty acids found in apple snails that can stimulate cholesterol excretion through the intestines and stimulate cholesterol oxidation to become bile acids. The duck meat cholesterol levels of this research are lower than that of Ismoyowati and Sumarmono (2011), who found that the average local duck meat cholesterol level with feed treatment is 185.25 mg/100 g meat. The differences in meat cholesterol levels in each of the treatments is suspected to be due to differences in feed consumption that also cause differences in feed consumption that cause variations in fatty acid consumption found in feed. Apple snails contain unsaturated fatty acids that can increase intestinal homeostasis that allows for a destructive mechanism or cholesterol degradation by converting

cholesterol to become bile acids, so that the cholesterol level is reduced (Weiss and Scott, 1979). According to Rahmad and Wiradimadja (2011), the meat cholesterol level will increase in line with an increase in blood cholesterol level, but it will have maximum results when the cholesterol level is above 700 mg/dL.

Egg cholesterol: The egg cholesterol content produced in this research is lower than the control treatment (R0) and the treatment variant analytical results show a significant influence ($p<0.01$) towards the egg cholesterol content. The lowest average cholesterol content is found in the treatment using apple snail meal at 5%, whether it comes from swampy (R2) or tidal swampy (R6) at 955.89±44.01 and 952.72±48.42. The next results are conducted with a Duncan Multiple Range Test. All of the treatments are different from the control except for R4 treatment, which does not show a significant difference. The reduction of egg cholesterol levels is also suspected of being due to the presence of fatty acids that are contained in the apple snails that can stimulate the excretion of cholesterol through the intestines and stimulate cholesterol oxidation to become bile acids. In short, the average treatments in using apple snails towards the cholesterol levels in Alabio duck eggs are depicted in Table 4. Cholesterol in eggs can fluctuate to reach 25%, depending on the feed and fat consumed (Hargis, 1998). Next, according to Han (1993), the influence of fat in feed like vegetable oil, animal oil and sitosterol β liver cholesterol can increase liver cholesterol, serum and egg yolks in egg laying chickens.

Conclusion: Using at least 5% of swampy apple snails produce the highest egg production with the lowest meat and egg cholesterol levels.

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