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Effect of Fermented *Katuk* Leaf (*Sauropus androgynus* L. Merr.) in Diets On Cholesterol Content of Broiler Chicken Carcass

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Abstract: Chicken meat is very nutritious. It is sometimes blamed to cause stroke attack and coronary heart disease in human, because of high fat and cholesterol contents in the chicken meat. Therefore, the aim of this experiment is to evaluate the effect of fermented *katuk* leaf levels in diets on the cholesterol content of broiler chicken carcass. The experiment was based on completely randomized design with eight experimental diets containing 0, 2, 4, 6, 8, 10,12 and 14% of fermented *katuk* leaf. All diets were formulated to contain 21% crude protein and 3200 kcal/kg. Each treatment had three replicates with ten chickens per replicate. Two hundred and forty day old unsexed *Lohmann* broiler chicks were fed *ad lib* for eight weeks and then slaughtered. Feed consumption, body weight gain, feed conversion ratio and cholesterol content of carcass were taken as variable responses. Data were analyzed based on analysis of variance and orthogonal comparisons. Results showed that feed consumption, daily weight gain, FCR and carcass content were not affected by the levels of fermented *katuk* leaf in the diet. However, cholesterol content of broiler carcass was significantly ($p<0.05$) affected by the dietary treatments. Cholesterol content of the carcass was reduced processed 19.32% 72.48 to 58.48 mg/100 g chicken meat. The lowest cholesterol level was obtained by feeding the chickens with diets containing 14% fermented *katuk* leaf.

Key words: *Sauropus androgynus* L. Merr, β-caroten, cholesterol, broiler chickens

INTRODUCTION

Meat chickens are livestock products that have more advantages. However, because of the meat high in fat and cholesterol, it is suspected as a cause of stroke and coronary heart disease. The problem is how to utilize chicken meat nutrition without adverse effects of fat and cholesterol? To answer that question; specific feedstuffs that can produce low-fat carcass and cholesterol needs to be sought. One alternative feedstuff that can be used to reduce levels of fat and cholesterol is *katuk* leaves (*Sauropus androgynus* L. Merr).

Katuk plants have high adaptability, can be grown at 0 to 1500 m above sea level. *Katuk* (*Sauropus androgynus* L.Merr) can be used as garden plant sand medicinal plants. This plant is harvested for the first time at the age 2.5 to 3 months, or about 75-90 days with outcome about 3-4 tones/ha. About 6-7 times harvesting can be do in the first year with outcome reaches 21-30 tones/ha/year. Outcome in the second year and subsequent years can reach 35 tones/ha (Yuliani and Marwati, 1997). The use of *Katuk* leaves depends on productivity and potential health benefits of *katuk* as well as food consumption and for medicinal purposes, however, the potency for utilization *katuk* as poultry feed ingredients are also need to be studied. Based on this data, *katuk* leaves have large potential used for animal feed, *katuk* leaves also contains a moderately high protein: 25.70% CP (Piliang *et al*., 2003) and β-carotene 173 ppm/254 ppm before fermentation and after fermentation (Syahruddin and Rita, 2012). *Katuk* leaf can lower cholesterol levels because of the content of β-carotene (Wardiny, 2006). Beta-carotene can be increased in fermentation with fungus *Trichoderma harzianum*, because these fungi are carotenogenic (producing β-carotene) (MA *et al*., 2000; Hirschberg, 2001; Hsieh and Yang, 2003). The ability of β-carotene decreasing cholesterol associated with hydroxy methyl glutaril enzyme-CoA (HMG) (Wang and Keasling, 2002). This enzyme plays a role in the formation of mevalonic in the biosynthesis of cholesterol. Cholesterol synthesis and synthesis of β-carotene are together through mevalonic and derived from acetyl CoA. If increasing consumption β-carotene greater than saturated fatty acid, it makes biosynthesis process by enzyme HMG-CoA directed at β-carotene, so that saturated fatty acids are not converted into cholesterol (McGilvery and Goldstein, 1996; Nuraini, 2006).

Based on the information above, a research need to be conducted to investigate how to produce broilers with low cholesterol content by feeding *katuk* leaves that contain high fermentation β-carotene.

Research hypothesis: Provision of β-carotene from leaves *katuk* substrate fermentation can lower cholesterol broiler chicken carcasses.

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MATERIALS AND METHODS

Studies on nutrient content of fermented *katuk* leaf were carried out in the Laboratory of Farm Faculty Andalas University in Padang. Biological assay using broiler chickens held in the Technical Implementation Unit (UPT) Farm Faculty Unand Padang.

Process of making flour *katuk* leaves and fermentation: Before being fermented, *katuk* leaves that have dark green, thinly sliced and dried in room temperature for 1-2 days, then dried in oven at temperature 50°C for 24 hours. Furthermore *katuk* leaves were ground to fine powder form. Powdered *katuk* leaves were then analyzed and prepared for fermentation using fungi *Trichoderma harzianum*, with inoculum dose of 9% incubated for 10 days with the thickness of 2 cm substrate at pH 5.5 and temperature 30°C.

Poultry: The poultry that used in this study is 240 Lohmann broiler strains age 1 day (DOC). At the end of the study (8 weeks), the chicken were slaughtered, two broiler per unit experiment. The meat and bones was separated. The samples were blend until smooth and homogeneous and then kept for analysis of cholesterol.

Cages and equipment: Twenty four cages, measuring 80×60×60 cm for ten chickens each were used. Each cage equipped with food and drinking holder placed outside the cage and heated with 60-watt in can descent bulbs in each plot. Sanitation of the equipment is done everyday by cleaning places for feeding and drinking.

Ration treatment: Ration treatment was arranged by isocalori and isoprotein. Ration treatment consists of eight levels, i.e:

R0 = ration control (without addition of fermented *katuk* leaves)
R1 = ration+2% fermented *katuk* leaves
R2 = ration+4% fermented *katuk* leaves
R3 = ration+6% fermented *katuk* leaves
R4 = ration+8% fermented *katuk* leaves
R5 = ration+10% fermented *katuk* leaves
R6 = ration+12% fermented *katuk* leaves
R7 = ration+14% fermented *katuk* leaves

Rations were mixed every week in the cage. Ration arranged based on calculation of NRC (1994) and the results of the proximate analysis of food (Table 1).

Experimental design: The study was conducted according to the completely randomized design (Steel and Torrie, 2005), with eight treatments and 3 replicates with 10 chickens for each replication.

Variables measured: Feed intake (g/head), body weight gain (g/head) is calculated every week. Feed conversion is the value of the distribution of feed intake with body weight gain and carcass weight percentages determined at the age of 8 weeks. Cholesterol levels were analyzed by the method of Liberman-Burchard (1980).

RESULTS AND DISCUSSION

Effect of treatment for feed consumption, body weight gain and feed conversion ratio: Average feed consumption, body weight gain and feed conversion ration of broilers fed rations containing fermented *katuk* leaf can be seen in Table 2. The feed consumption was ranging from 5097.820 to 5323.740 g/chicken and body weight gain ranged from 2341.330 to 2606.210

Table 1: Composition of ration (%), the content of nutrients (%) and metabolic energy (kcal/kg) of broiler ration

	Treatment (%)							
Ingredients	RO	R1	R2	R3	R4	R5	R6	R7
Yellow Corn	46.25	44.25	42.25	42.25	40.75	38.45	38.15	36.75
Fine Bran	8.00	8.50	9.00	9.00	6.50	5.30	3.60	3.00
Fish Meal	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
Coconut Cake	6.50	6.50	6.50	6.50	7.00	7.00	7.00	7.00
Soybean Meal	19.50	19.00	18.50	16.50	17.50	19.00	19.00	19.00
Fermented *Katuk* Leaf	0.00	2.00	4.00	6.00	8.00	10.00	12.00	14.00
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Palm Oil	1.50	1.50	1.50	1.50	2.00	2.00	2.00	2.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Crude Protein[a]	20.91	21.09	21.08	21.06	21.03	21.04	20.98	20.97
Crude Fat[a]	5.31	5.55	5.72	5.78	5.83	5.85	5.87	5.89
Crude Fiber[a]	5.03	5.24	5.29	5.35	5.42	5.49	5.57	5.66
Ca[a]	1.14	1.14	1.15	1.15	1.16	1.16	1.17	1.17
P[a]	0.83	0.82	0.81	0.80	0.79	0.78	0.77	0.76
ME[a]	3206.4	3203.1	3199.8	3196.5	3202.2	3201.66	3201.0	3202.5
β-carotene (mg/kg)[b]	10.40	25.20	40.00	54.80	69.60	84.40	99.20	114.00

(a) Laboratory of Non Ruminant Faculty of Animal Science. Andalas University (2012)
(b) Analysis of the Testing Laboratory of Food Technology and agriculture, Faculty of Agricultural Technology, Gadjah Mada University, (2010)

Table 2: Average ration consumption, body weight gain and the feed conversion ratio of broiler chickens during the study (aged 0-8 weeks)

Rations	Feed consumption (g/head)	Body weight gain (g/head)	Feed conversion ratio
RO	5323,740^{a}	2606,210^{a}	2,040^{d}
RI	5296,330^{ab}	2599,780^{ab}	2,040^{bd}
R2	5241,660^{ab}	2540,800^{ab}	2,060^{bd}
R3	5208,290^{abcd}	2532,920^{abcd}	2,060^{abcd}
R4	5165,410^{abcd}	2521,240^{abcd}	2,050^{abcd}
R5	5142,860^{abcd}	2487,910^{abcd}	2,070^{abcd}
R6	5106,310^{d}	2360,000^{d}	2,160^{a}
R7	5097,820^{d}	2341,530^{d}	2,180^{a}
Average	5197,800	2498,790	2,080

Note: Different superscript in the same rows indicate highly significant effects (p<0.01)

Table 3: Mean Effect of Treatment of Percentage of Carcass and Cholesterol Broiler Chicken Carcasses During the study (aged 0-8 weeks)

Treatment	Carcass (%)	Cholesterol carcass (mg/100 g)
R0	67,070^{d}	72,48^{a}
RI	67,530^{bd}	70,550^{b}
R2	67,620^{bd}	68,380^{c}
R3	67,820^{abcd}	65,260^{d}
R4	68,010^{abcd}	62,390^{e}
R5	68,230^{abcd}	58,480^{f}
R6	68,790^{a}	56,580^{g}
R7	68,920^{a}	52,460^{h}
Average	67,990	63,580

Description: Different letters in rows indicate different effects highly significant (p<0.01)

g/chicken, while the value of the feed conversion ratio ranged from 2.040 to 2.180 which is almost the same as the standard rate of growth by Charoen Pokphand (2010).

Based on analysis of variance showed that each treatment influenced significantly different (p<0.05) for feed consumption of broiler chickens. The use of fermented *katuk* leaf of 0, 2, 4, 6, 8 and 10% (R0 to R5) in the ration was statistically not significant different, but the consumption rate tend to decline when the level of fermented *katuk* leaf increased in the ration. Feed consumption, in fact, has no different from R0 to R5 because *katuk* leaves that have been fermented changes become more palatable, according to the statement of Wahju (1992) palatability determines the quantity of food consumed. Fermented *katuk* leaves with *Trichoderma harzianum* improve its nutritional value. During the process of fermentation, *Trichoderma harzianum* produces enzymes that can break down complex components into simpler substances that are easier to digest. Additionally mold can produce aroma and flavour that preferred by livestock (Winarno and Fardiaz, 1980). In addition, Saono (1979) mentioned that fermentation products more palatabel than original materials, it also produces the preferred flavor for livestock and produce some B vitamins i.e. B1, B2 and B12 and minerals (Murugesan, Sathish kumar and Swarninathan, 2005). Vitamin B1 can stimulate appetite (Wahyu, 1997; Piliang and Djojosoebagio, 2001).Feeding fermented *katuk* leaf up to 10% in the ration has no significant effect due to the ration was assigned to be iso-energy and iso-protein, so the level of consumption was adjusted accordingly (Wahyu, 1997).

Use of fermented *katuk* leaves as much as 12 and 14% in the ration was statistically decreased feed consumption than other treatments because increasing fermented *katuk* leaves in ration will decline the rate of feed consumption. Decreasing in feed consumption due to fermented *katuk* leaf in ration is voluminous. Rations that contain voluminous will cause the chicken to feel gorged sooner, because the cache quickly filled that make reduction of feed consumption (Wahyu, 1997).

Mean body weight gain of broilers of each treatment can be seen in Table 2. Based on the analysis of variance showed that treatment influenced significantly different (p<0.05) on body weight gain. The level of fermented *katuk* leaf from 0, 2, 4, 6, 8 and 10% (R0 to R5) in the ration had no significant effect (p>0.05) to weight gain, although tend to decrease as the amount of fermented *katuk* leaf increased in the ration. Not unlike real weight gain with an increase in the use of *katuk* leaf fermentation because during the fermentation process occurs solving complex components become simpler and digested (Winarno and Fardiaz, 1980), Saono, (1979) led to the use of leaf consumption *katuk* fermentation of 0-10% also different unreal. This is in accordance with opinion of Wahyu (1997) who stated that the body weight gain is influenced by the quantity and quality of rations consumed. Winarno and Fardiaz (1980), stated that a food that has under gone fermentation quality will be better than original material before fermentation and to improve the content of vitamins and minerals (Shurtleff and Aoyagi, 1979). In addition increasing nutrient content, fermentation process also increased digestibility of the fermentation products compared with the original material. Fermentation with fungi *Trichoderma harzianum* will produce several enzymes include: amylase enzyme (Heinz *et al*., 2005), cellulase (Deshpande *et al*., 1986), protease (Rhodes *et al*., 1983). Enzymes that produced by fungus *Trichoderma harzianum* would break down proteins, cellulose and hemicellulose into simpler compounds such as amino acids and glucose. Compounds in a simple form and dimetabolik be easily absorbed and distributed through out the body tissues. It is evident that the body weight gain resulting to the use of 10% in ration *katuk* leaf fermentation with weight gain generated by the control ration. Besides that, the speed of growth is determined by the level of nitrogen retention of a substance orations being given as a result of high protein digestibility so that retention of nitrogen will also be high (Wahyu, 1997; Syahruddin *et al*., 2011). Low body weight in R6 and R7 (use 12 and 14%) of *katuk* leaf fermentation compared with other treatments, due to low consumption of rations at R6 and R7. The low consumption in use of 12 and 14% leaf *katuk* fermentation, ration becomes voluminous so chicken's gizzards filled quickly (Wahyu, 1997). The low consumption makes the reduced ration of nutrient in take for growth and resulted in lower body weight gain than other treatments produced.

From Table 2, it can be seen that the conversion ration ratio is an achievement ration usage by a chicken. lower value conversion ration ratio more efficient ration utilization by chicken. Leeson and Summers (1997) stated that the factors that affect conversion ration such as rate of growth, consumption, energy content in the ration, the cattle, the adequacy of nutrients in the ration, temperature and animal health. Value conversion ration in this study ranged from 2.04 to 2.18 showed a statistically significant difference ($p<0.05$). Value ratio results are not much different from the results suggested by Amrullah (2002) at 8 weeks of age chickens 1.98 until 2.30. Scott *et al.* (1982) stated that the value of the conversion rate is determined by the amount rasum ration consumption with resulting weight gain. The use of *katuk* leaf fermentation from 0 to 10% in the ration limit is statistically not significant different to the conversion ration. Unlike in fact no conversion ransum in each treatment caused *katuk* leaf fermentation have better quality than non-fermented (Winarno and Fardiaz, 1980) so that it can be used easily and better by cattle, by giving a better conversion ratios and can conversion ration equaled the control treatment (R0). The high conversion ration the use of 12 and 14% *katuk* leaf fermentation, due to less efficient use of broiler ration to increase weight gain. This may be due to the high intensity of *katuk* leaf fermentation in ration, so that the ration be voluminous, resulting consumption becomes limited and in take of nutrients to be reduced for optimal growth.

Effect of treatment against percentage of carcass and broiler carcass cholesterol level: Based on the analysis of diversity showed that treatment influenced significantly different ($p<0.05$) on the percentage of broiler chicken carcasses. Wahyu (1997) stated the percentage of carcass weight was calculated as comparison between carcasses with live weight multiplied by 100%. This statement is supported by statement of Cherry *et al.* (1998), the percentage of carcass weight is influenced by life weight and Murugesan *et al.* (2005) stated that processing in butchery will affect weight of carcass. From results of this research, the percentage of carcasses ranged from 67.070 to 68.920. These results are consistent with the results recommended by Wahyu (1997) who stated that percentage of broiler chicken carcasses ranged from 65 to 75%. The use of *katuk* leaf fermentation in the ration from 0 to 10% produce same body weight gain or higher but give lower percentage of carcass compared with the ration using 12 and 14% *katuk* leaf fermentation in ration statistically.

From results of this study found that utilization *katuk* leaf fermentation from 0-10% is statistically having the same effect and did not significantly differ affect carcass percentage, but percentage of carcass increased in accordance with utilization *katuk* leaves fermentation in the ration. Different is not real for percentage of carcasses on the use of 0 to 10% due to *katuk* leaf fermentation consumption and resulting weight gain is no different. The use of *katuk* leaf fermentation from 0 to 10% resulted weight gain and a higher consumption more than 12 and 14% *katuk* leaves fermented but produces lower percentage carcass. Low percentage of carcasses from R0 to R5 due to high consumption of ration followed by higher weight of digestive tract are also many shrouded fatty (Proudfood *et al.*, 1982). This statement is also supported by Gunawan and Sihombing (2004) said there had been an increase consumption of ration will be followed by an increase in weight of viscera and contents. Furthermore Zuidhof *et al.* (2004) stated carcasses counted after being expelled stomach contents (vicera) feet, neck, head, feathers and blood. High percentage carcass on use 12 and 14% *katuk* leaves in ration, due to low consumption of ration resulted lower body weight gain. Low body weight gain with increasing use (12 and 14%) *katuk* leaves fermentation in ration caused craw quickly filled because voluminous nature from *katuk* leaves. Low consumption rations will be followed by decreased in take nutrients so that body weight gain become low. Decreased food in take due to limited consumption caused no attachment fatty under the skin and fat that covered digestion tract. It make higher percentage of carcasses in accordance statement Zuidhof *et al.* (2004) stated carcasses counted after being expelled stomach contents (vicera) feet, neck, head, feathers and blood.

In terms of carcass cholesterol, there was decrease of broiler carcasses cholesterol content in treatment of 2, 4, 6, 8, 10, 12 and 14% *katuk* leaf fermentation in ration along with higher levels usage product *katuk* leaves fermentation in ration. In treatment of 14% *katuk* leaves fermentation in ration, can reduce cholesterol content of broiler chicken carcasses in highest value as much as 27.620% from 72.480mg/100g - 52.460mg/100g. Lower cholesterol content of the carcass on the treatment of 14% leaves in ration caused by more usage of *katuk* fermented products in ration so that made β-carotene content in ration increased. In treatment 14% *katuk* leaves fermented, there was β-carotene content as much as 114.00 mg/kg which is mainly derived from the contribution of β-carotene (254 mg/kg) *katuk* leaf fermentation products. Enhancement β-carotene content in ration causes amount β-carotene in consumption also increased. More β-carotene in consumption, lower cholesterol content of carcass because β-carotene can inhibit enzyme HMG-CoA reductase (Hydroksi metyl glutaryl-CoA) that play a role in the formation of mevalonic. Mevalonic required in the process of cholesterol synthesis by inhibition of the enzyme so that it blocked formation of cholesterol (Stocker, 1993; Nurdin, 1994; Kohlmeier and Hasting, 1995).

Conclusion and recommendation: Based on this research, it can be concluded as follows:

a) Increasing percentage of *katuk* leaves fermented from 0% to 10% in ration may decrease cholesterol 19.320% (72.480 mg/100 g-58.480 mg/100 g) without decrease ration consumption, body weight gain, feed conversion ratio and carcass percentage
b) Utilization of *katuk* leaf can produce organic broiler without use chemicals and additives
c) Based on result of this study, it is recommended to carry out further research on other poultry, such as duck, quail etc in order to obtain organic poultry products without using any chemicals and additives

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