Reduction of Fat Accumulation in Broiler Chickens by *Sauropus Androgynus* (Katuk) Leaf Meal Supplementation

U. Santoso* and Sartini[1]
Department of Animal Science, Faculty of Agriculture, Bengkulu University
Jl. Raya Kandang Limun Bengkulu, Indonesia

ABSTRACT : The present study was designed to evaluate the usefulness of *Sauropus. androgynus* leaf (SAL) meal on reducing fat accumulation in broiler chickens. Eighty unsexed broiler chickens were allocated to four treatment groups with five replicates of four chickens each. SAL meal supplementation had no effect on body, leg, back, breast, wing, liver and heart weights, carcass protein, moisture and ash contents ($p>0.05$). Broilers fed diets supplemented with 30 g of SAL meal had lower feed intake with better feed conversion ratio ($p<0.05$) than did the control chickens. SAL supplementation at all levels significantly reduced fat accumulation in abdomen region, and liver ($p<0.01$), and in carcass ($p<0.05$). Higher SAL supplementation resulted in lower fat accumulation in the carcass (r^2=0.94; $p<0.01$), abdomen (r^2=0.99; $p<0.01$) and liver (r^2=0.98; $p<0.01$). The current study showed that a 30 g supplementation of SAL meal to the broiler diet was effective to improve feed conversion ratio without reducing body weight. SAL meal supplementation to the diet reduce fat accumulation in broiler chickens. (*Asian-Aust. J. Anim. Sci. 2001. Vol. 14, No. 3 : 346-350*)

Key Words : *Sauropus androgynus* Leaf Meal, Carcass Fat, Abdominal Fat, Broiler

INTRODUCTION

Broiler chickens may have abnormalities of lipid metabolism such as fatty liver and excessive fat accumulation. Excessive fat accumulation not only reduces the value of broilers as food and lowers growth efficiency, but also appears to reduce consumer demand. A reduction in consumption of high-fat animal products can reduce the risk of some disorders such as hyperlipidemia, hyperchole- sterolemia, obesity, atherosclerosis and coronary heart disease (Murray et al., 1988). Therefore, producing lean poultry meat becomes a major objective of the broiler industry to meet consumer demand. This goal has often been proven difficult to achieve, as genetic selection for increased body weight has also resulted in a concurrent increase in body and abdominal fat.

Several methods have been tried to lower fat accumulation such as microorganism inclusion (Chah et al., 1975; Danielson et al., 1989; Imaizumi et al., 1992; and Santoso et al., 1995a) and early feed restriction (Plavnik and Hurwitz, 1985, 1988, 1989, 1990; Santoso et al., 1995b, c). Medical herbs have also been proven to be effective to achieve this goal (Satie, 1995). Satie (1995) stated that medical herbs supplementation to the diet could improve growth characteristics of broilers, because they contain antibacterial compounds which have an ability to kill destructive microorganisms in the gastrointestinal tract, and therefore improve nutrient absorption, feed efficiency and growth.

Sauropus androgynus is one of the medical herbs originated from South-East Asia including Indonesia (Sastrapraja et al., 1980). It was reported that *S. androgynus* leaf (SAL) contains per 100 g fresh vitamin A 10.000 IU, vitamin B_1 0.23 mg, vitamin B_2 0.15 mg, vitamin C 136 mg, calcium 234 mg, phosphorus 64 mg, firon 3.1 mg, water 79.8 g, protein 7.6 g, fat 1.8 g, carbohydrate 6.9 g, fibre 1.9 g, ash 2.0 g, and gross energy 310 kJ (Bergh, 1994). Yuliani and Marwati (1997) reported that SAL contains 165.05 mg β-carotene per 100 g. In rabbits, SAL extract reduced blood tension, body temperature and heart rate, increased milk production, uterus and intestine contractions, and caused abortion (Djojosoebagio, 1964). Suprayogi (1993) found that SAL extract stimulated milk secretion in goats. In addition, SAL was reported to contain antimicrobial compounds which could inhibit the growth of *Staphylococcus aureus, Salmonella typhosa* and *Escherichia coli* and had a diuretic effect (Anonymous, 1995). There has been little study on the usefulness of SAL meal in reducing fat accumulation and in improving meat quality. Therefore, the present study was conducted to evaluate the usefulness of SAL meal as feed supplement on improving growth characteristics and on lowering fat accumulation in broiler chickens.

MATERIALS AND METHODS

Preparation of SAL meal

S. androgynus old growth leaf was collected from the field, dried under the sun, and ground; the meal was then stored in a sealed plastic bag at room temperature.

* Corresponding Author: Urip Santoso. Tel: +62-736-21170 extension 219.
[1] Department of Animal Science, Faculty of Agriculture, Universitas Muhamadiyah Bengkulu, Indonesia.
Received September 22, 2000; Accepted December 8, 2000

Animals and diets

Eighty 7-day-old unsexed broilers (Hubbard, males: females=1:1) were raised in floor cages with inconsistent house temperature and continuous lights and fed a diet with no antibiotics included. Feed and water were provided *ad libitum*. Broiler chickens were weighed individually and divided into 4 treatment groups with 5 replicates of 4 chickens each. One group was a control with no additive, and the other three groups were given the diet supplemented with 10, 20 or 30 g SAL meal/kg diet. The composition of the experimental diets after inclusion of the SAL meal is shown in table 1. Broilers were weighed individually on a weekly basis, and feed consumption was recorded daily.

General procedure

At 35 days of age, eight broiler chickens (4 males and 4 females) from each group were killed by decapitation, and abdominal fat, liver and heart were removed and weighed. Carcasses were the body without head, neck, blood, feather, shank, internal organs except kidney and lungs, and their parts (leg, breast, wing and back) were determined. The legs were removed from the body at the femur-ilium junction and the wings at the humerus-scapula junction. The back was separated from the breast by cutting along parallel to the thoracic vertebrae extending from caudal tip of the floating ribs through the junctions of the vertebral (dorsal segment) and sternal (ventral segment) ribs. Fatty liver score was measured based on liver color from normal color (1) to white (5). Santoso (1995) showed that fatty liver score could be used to estimate liver fat in broiler chickens. Carcass and the chemical composition of SAL meal were determined by the methods of AOAC (1980). Each sample was analyzed three times.

Statistical analysis

Treatment effects were assayed for all response variables using one-way ANOVA in which the differences between control and treatment group were represented by single d.f. orthogonal contrasts (Shinjo, 1990). Differences were statistically assessed with significance set at 5% level. Where appropriate, regression analysis was used to assess the statistical significance of the correlation between variables.

RESULTS

Chemical composition of SAL is shown in table 2. SAL meal was relatively high in fat, fiber and ash content but low in protein and nitrogen free extract.

As shown in table 3, statistically significant effects of SAL were not seen in body weight ($p>0.05$). A decreased feed intake was observed in the 30 g SAL meal supplemented groups compared to control chickens ($p<0.01$), and was accompanied by improved feed conversion ratio ($p<0.05$). SAL meal supplementation had no effect on body, leg, wing, breast, back, liver and heart weights ($p>0.05$).

Table 2. Chemical composition of *Sauropus androgynus* leaf

Nutrient	Composition
Moisture, %	10.8
Fat, %	20.1 (22.3)
Protein, %	15.0 (16.8)
Crude fiber, %	31.2 (35.0)
Ash, %	12.7 (14.3)
NFE, %	10.1 (11.6)

NFE = Nitrogen Free Extract
(..) on dry matter basis

Table 1. Chemical composition of experimental diets (g/kg diet)

Dietary treatment	Control	10 g SA	20 g SA	30 g SA
Ingeredient;				
Corn	520	515	510	505
Commercial concentrate (212)	480	475	470	465
SAL meal	0	10	20	30
Total	1000	1000	1000	1000
Chemical composition (%);				
Moisture	12.5	12.4	12.4	12.4
Protein	21.8	21.7	21.7	21.6
Fat	2.6	2.8	2.9	3.1
Crude fiber	5.9	6.2	6.5	6.7
Ash content	8.1	8.0	8.2	8.2
ME (kcal/kg)	2,935	2,930	2,925	2,920

SA=*Sauropus androgynus* leaf.

In comparison to the control, the ratio of abdominal fat weight to body weight was significantly decreased in treatment groups (p<0.01) (table 4). Carcass protein, moisture and ash contents were not significantly different (p>0.05). Carcass fat contents were significantly decreased in chickens fed SAL meal as compared to the control (p<0.05), and with SAL meal also had lower fatty liver score as compared with the control (p<0.01). Higher SAL meal supplementation resulted in lower fat accumulation in the carcass (r^2=0.94; p<0.01; Y=108.9-0.61X), abdomen (r^2=0.99; p<0.01; Y=8.7-0.18X) and liver (r^2=0.98; p<0.01; Y=1.72-0.023X).

DISCUSSION

In comparison with the results of Djojosoebagio (1964), the present study showed that SAL contained higher ash (14.3% vs. 9.4%), crude fiber (35.0% vs. 10.0%), and fat (22.3% vs. 8.1%). The difference might be partly caused by difference in plant maturity. The present study confirmed the result of Yuliani and Marwati (1997) who found that SAL meal contains high fat (26.31%). Because SAL meal is rich in oil, it is possible to produce SAL oil; it was known that vegetable oil is rich in polyunsaturated fatty acid (Beare-Rogers, 1989).

Broiler receiving SAL meal showed a tendency for lower weight gain. SAL contains tannin, saponin, alkaloids and flavonoid (Anonymous, 1990). Generally, tannins interfere with different aspects of the digestive process resulting in reduced growth (Rahayu, 1999). Saponin increases the permeability of the small intestinal mucosa cells, leading to inhibition of active nutrient transport and facilitating the uptake of components to which the gut normally would be impermeable and thus resulting in lower body weight (Ueda et al., 1996; Ueda and Shigemizu, 1998).

Some studies have reported significant reductions in feed intake by chickens fed diets containing tannins (Mitaru et al., 1983: Ibrahim et al., 1988) or saponin (Ueda et al., 1996; Ueda and Shigemizu, 1998). Saponin is bitter and astringent (Cheeke, 1980), and tannins have an astringent taste (Butler, 1989; Trevino et al., 1992). Therefore, saponin and tannins have antipalatability properties. However, because taste

Table 3. Effect of *Sauropus androgynus* (SA) leaf meal on growth performance of 35-d-old broiler chickens

Variables	Control	10 g SA	20 g SA	30 g SA	Pooled SE
Initial BW (g)	89.21	89.6	88.3	87.9	2.1
Final BW (g)	1261.2	1228.1	1195.9	1247.1	35.3
Feed intake (g/bird)	2101.9	2188.3	2010.4	1890.7**	51.9
FCR (feed/gain)	1.8	1.9	1.8	1.6*	0.04
Leg (% BW)[2]	21.9	21.9	22.5	22.4	0.57
Wing (% BW)[2]	8.7	9.1	8.6	8.8	0.41
Breast (% BW)[2]	38.4	38.6	37.9	38.4	0.66
Back (% BW)[2]	31.0	30.4	31.0	30.4	0.68
Liver (% BW)[2]	3.4	3.5	3.7	3.5	0.31
Heart (% BW [2]	1.1	1.0	1.1	1.0	0.01

[1] Values reported represent for 20 chickens.
[2] Values reported represent for 6 chickens.
* p<0.05, ** p<0.01.

Table 4. Effect of *Sauropus androgynus* (SA) leaf meal on carcass composition and fat accumulation in 35-d-old broiler chickens

Dietary treatments	Control	10 g SA	20 g SA	30 g SA	Pooled SE
Carcass composition (%)					
Moisture	70.3[1]	71.9	72.0	72.5	1.5
Protein	15.9	15.8	15.8	15.8	1.0
Fat	11.3	9.7*	9.6*	9.3*	0.2
Ash	2.5	2.6	2.6	2.4	0.2
Liver fat[2]	1.8	1.4**	1.2**	1.1**	0.1
Abdominal fat (% BW)	1.0	0.5**	0.5**	0.4**	0.14

[1] Values reported represent for 6 chickens.
[2] Liver fat is expressed as fatty liver score with color as indicator.
* p<0.05, ** p<0.01.

acuity in the chicken is not well developed (Moran, 1982; Urata et al., 1992), it seems unlikely that taste plays a role in decreasing feed intake. Antipalatability effects of saponin, alkaloid and tannin might be mediated in part by a neurological effect. Alkaloids for example are oxidized in the liver, producing metabolites such as dehydrosparteine, and resulting in neural inhibition.

It was reported that SAL contains antibacterial compounds which have the ability to kill destructive microorganisms such as *Escherichia coli* (Anonymous, 1995), *Staphylococcus aureus* and *Salmonella typhosa* (Darise and Sulaeman, 1997). This will improve the balance of microorganisms in the intestine and therefore improve nutrient absorption (Satie, 1995), and result in improved feed conversion ratio. It is of interest to note that an improvement in cumulative feed conversion ratio was caused by a drastic improvement of feed conversion ratio at the fourth week of experimental period as a result of lower feed intake with higher body weight gain (data not shown).

SAL supplementation resulted in lower fat accumulation in the liver, abdomen and carcass. It was postulated that SAL might contain active compounds which reduce fat accumulation. Tannin (Tebib et al., 1994) and saponin (Ueda et al., 1996; Ueda and Shigemizu, 1998) are known to reduce triglyceride and cholesterol. A reduction of 54.7% abdominal fat weight in chickens fed 30 g SAL would result in an annual saving of 135.6 million dollars in the United States (Nelson, 1980). Mabray (1979) estimated that the problem of excessive abdominal and visceral fats in broilers cost processors 250 million dollars in 1978. In addition, a reduction in abdominal fat would reduce the cost of waste management.

Hasegawa et al. (1994a, b, c) found that lower abdominal fat weight was mainly due to the lower triglyceride content in adipose tissue. They found that the lower triglyceride content was caused by the combination of reduced lipoprotein lipase activity in the adipose tissue and decreased triglyceride in plasma resulting from both a reduced rate of triglyceride synthesis and an increased rate of fatty acid oxidation in the liver. In relation to those findings, the present study showed that there was a positive relationship between the abdominal fat weight as dependent variable and the liver fat as expressed by fatty liver score ($Y=-0.13+0.51X$; $r^2=0.28$, $p<0.05$).

SAL inclusion in the diet at 3% level resulted in better feed conversion ratio. If the price of SAL meal is comparable to that of other feeds, its inclusion could be justified. Lower carcass fat content would also be beneficial to consumer health.

REFERENCES

Anonymous. 1990. Tanaman Obat-obatan Tradisional. Bogor. Direktorat Jendral Usahatani.

Anonymous. 1995. Khasiat Sauropus androgynus sebagai tanaman obat. Trubus. 307:65.

AOAC. 1980. Official Methods of Analysis. 11st ed. Association of Official Analytical Chemists, Washington, DC.

Beare-Rogers, J. L. 1984. Some aspects of omega-3 fatty acids from different food. In: Dietary 3 and 6 Fatty Acids, Biological Effects and Nutritional Essentiality (Ed. C. Galli and A. P. Simopoulos). New York Plenum Press, New York. pp. 21-31.

Bergh, H. A. V. D. 1994. *Sauropus androgynus* (L.) Merrill. In: Plant Resources of South-East Asia (Vegetables) (Ed. J. S. Siemonsma and K. Piluek). Prosea, Bogor, Indonesia.

Butler, L. G. 1989. Sorghum polyphenols. In: Toxicants of Plant Origin, Vol. 4, Phenolics (Ed. P. R. Cheeke). CRC Press, Boca Raton, Florida. pp. 95-114.

Chah, C. C., C. W. Carlson, G. Semeniuk, I. S. Palmer and C. W. Heseltine. 1975. Growth-promoting effects of fermented soybean for broilers. Poultry Sci. 54:600-609.

Cheeke, P. R. 1980. Biological properties and nutritional significance of legume saponins. In: Leaf Protein Concentrates (Ed. L. Telek and H. D. Graham) Avi Publishing, Connecticut. pp. 396-414.

Darise, M. and Sulaeman. 1997. Ekstraksi komponen kimia daun katuk asal Sulawesi Selatan berbagai metoda serta penelitian daya hambat terhadap bakteri uji. Warta Tumbuhan Obat Indonesia 3(3):37-38.

Danielson, A. D., E. P. Peo, Jr., K. M. Shahani, A. J. Lewis, P. J. Whalen and M. A. Amer. 1989. Anticholesteremic property of *Lactobacillus acidophilus* yogurt fed to mature boars. J. Anim. Sci. 67:966-974.

Djojosoebagio, S. 1964. Pengaruh Sauropus androgynus (Katuk) terhadap fisiologi dan produksi air susu (sebuah laporan pendahuluan). Seminar Nasional Penggalian Sumber Alam Indonesia Untuk Farmasi. Jakarta.

Hasegawa, S., S. Hatano, K. Ueshima and Y. Hikami. 1994a. Effect of fasting on adipose tissue accumulation in chickens, with reference to change in its chemical composition and lipase activity. Anim. Sci. Technol. 65: 89-98.

Hasegawa, S., T. Kawakami, K. Honda and Y. Hikani. 1994b. Effect of fasting on the adipose tissue weight in chickens, with reference to change in triglyceride synthesis and fatty acid oxidation. Anim. Sci. Technol. 65:509-514.

Hasegawa, S., T. Kawakami, K. Honda and Y. Hikani. 1994c. Effect of fasting on the activities of lipogenic enzymes in chickens adipose tissue. Anim. Sci. Technol. 65:656-660.

Ibrahim, S., C. Fisher, H. El Alaily, H. Soliman and A. Anwar. 1988. Improvement of the nutritional quality of Egyptian and Sudanese sorghum grains by the addition of phosphates. Br. Poultry Sci. 29:721-728.

Imaizumi, K. K. Hirata, M. Zommage, M. Sugano and Y. Suzuki. 1992. Effects of cultured milk product by Lactobacillus, Bifidobacterium species on the secretion of bile acids in hepatocytes and in rats. J. Nutr. Sci. Vitaminol. 38:343-357.

Mabray, C. J. 1979. The influence of energy and amino acid levels of the diet on abdominal fat pad of broiler chickens. M. S. Thesis, Univ. Arkansas, Fayettecille, A. R.

Mitaru, B. N., R. D. Reichert and R. Blair. 1983. Improvement of the nutritive value of high tannin sorghums for broiler chickens by high moisture storage (reconstitution). Poultry Sci. 62:2065-2072.

Moran, E. T., Jr. 1982. Comparative Nutrition of Fowl and swine. The gastrointestinal Systems. Office for Educational Practice, University of Guelph, Ontario.

Murray, R. K., D. K. Granner, P. A. Mayes and V. W. Rodwell. 1988. Harpers Biochemistry, 21st. ed. California. Appleton and Lange.

Nelson, T. S. 1980. Feeding changes in body composition. Proceeding of Florida Nutrition Conference, Orlando, FL. pp. 159-172.

Plavnik, I. and S. Hurwitz. 1985. The performance of broiler chickens during and following a severe feed restriction at an early age. Poultry Sci. 64:348-355.

Plavnik, I. and S. Hurwitz. 1988. Early feed restriction in chickens: effect of age, duration and sex. Poultry Sci. 67:1407-1413.

Plavnik, I. and S. Hurwitz. 1989. Effect of dietary protein, energy and feed pelleting on the response of chickens to early feed restriction. Poultry Sci. 68:1118-1125.

Plavnik, I. and S. Hurwitz. 1990. Performance of broiler chickens and turkey poults subjected to feed restriction, or feeding of low sodium diets at an early age. Poultry Sci. 69:945-952.

Rahayu, I. D. 1999. Sorgum, alternatif pengganti jagung dalam ransum broiler. Poultry Indonesia 229:34-38.

Santoso, U. 1995. Studies on Effects of Early Feed Restriction on Growth and Body Composition. Ph. D disertation. Gifu University, Japan.

Santoso, U., K. Tanaka and S. Ohtani. 1995a. Effect of dried *Bacillus subtilis* culture on growth, body composition and hepatic lipogenic enzyme activity in female chickens. Br. J. Nutr. 74: 523-529.

Santoso, U., K. Tanaka and S. Ohtani. 1995b. Early skip-a-day feeding of female chickens fed high-protein realimentation diets. Performance and body composition. Poultry Sci. 74:494-501.

Santoso, U., K. Tanaka, S. Ohtani and B. S. Youn. 1995c. Effects of early feed restriction on broiler performances and body composition. Asian-Aus. J. Anim. Sci. 6: 401-409.

Sastrapraja, S., S. H. Aminah and H. Soetrisno. 1980. Sayur-sayuran. Jakarta: Balai Pustaka.

Satie, D. L. 1995. Memacu pertumbuhan broiler dengan ramuan tradisional. Poultry Indonesia. 188:23-25.

Shinjo, A. 1990. Fisrt Course in statistics. Laboratory of Animal Breeding, College of Agriculture, University of the Ryukyus, Japan.

Suprayogi, A. 1993. Meningkatkan produksi susu kambing melalui daun katuk (*Sauropus androgynus* (L.) Merr). Agrotek 1(2):61-62.

Tebib, K., P. Besancon and J. M. Rouanet. 1994. Dietary grape seed tannin affect lipoproteins, lipoprotein lipases and tissue lipids in rats fed hypercholesterolemic diets. J. Nutr. 124:2451-2457.

Trevino, J., L. Ortiz and C. Centeno. 1992. Effect of tannins from faba beans (*Vicia faba*) on the digestion of starch by growing chickens. Anim. Feed Sci. Technol. 37: 345-349.

Ueda, H. and G. Shigemizu. 1998. Effects of tea saponin, cholesterol and oils on the growth and feed passage rates in chickens. Anim. Sci. Technol. (Jpn.) 69:14-21.

Ueda, H., Y. Kakutou and M. Ohshima. 1996. Growth depressing effect of alfalfa saponin in chickens. Anim. Sci. Technol. (Jpn.) 69:772-779.

Urata, K., M. Manda and S. Watanabe. 1992. Behavioral study on taste responses of hens and female Japanese quails to salty, sour, sweet, bitter and umami solutions (in Japanese). Anim. Sci. Technol. (Jpn.) 63:325-331.

Yuliani, S and T. Marwati. 1997. Tinjauan katuk sebagai bahan makanan tambahan yang bergizi. Warta Tumbuhan Obat Indonesia 3(3):55-56.