EFFECT OF *SAUROPUS ANDROGYNUS* LEAVES EXTRACT (*SALE*) ON FAT DEPOSITION IN BROILER FED LOW PROTEIN DIETS

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ABSTRAK

Penelitian ini dirancang untuk mengevaluasi efektivitas ekstrak daun katuk (EDK) untuk menurunkan penimbunan lemak pada broiler yang diberi pakan berprotein rendah. Delapan puluh empat broiler jantan dan betina (1:1) umur 20 hari didistribusikan ke dalam 7 kelompok perlakuan sebagai berikut: 1) Broiler dengan pakan mengandung 19% protein tanpa ekstrak daun katuk (EDK)/kg (P0); 2) Broiler dengan pakan mengandung 19% protein plus 4,5 g EDK/kg (P1); 3) Broiler dengan pakan mengandung 17% protein plus 4,5 g EDK/kg (P2); 4) Broiler dengan pakan mengandung 15% protein plus 4,5 g EDK/kg (P3); 5) Broiler dengan pakan mengandung 19% protein plus 9 g EDK/kg (P4); 6) Broiler dengan pakan mengandung 17% protein plus 9 g EDK/kg (P5); 7) Broiler dengan pakan mengandung 15% protein plus 9 g EDK/kg (P6). Hasil penelitian menunjukkan bahwa suplementasi ekstrak daun katuk dalam pakan berprotein rendah berpengaruh tidak nyata terhadap warna daging, cacat dada, bau karkas, dan fatty liver score (P>0,05) tetapi berpengaruh nyata terhadap cacat paha (P<0,01), warna kaki, rasa dan bau daging (P<0,05). Selain itu, suplementasi ekstrak daun katuk berpengaruh nyata terhadap kadar lemak (P<0,05) dan sangat nyata terhadap kadar kolesterol daging (P<0,01), tetapi berpengaruh tidak nyata (P>0,05) terhadap kadar protein dan komposisi asam lemak daging. Disimpulkan bahwa suplementasi ekstrak daun katuk pada dosis 9 g/kg pakan mampu menormalkan deposisi lemak pada broiler yang diberi pakan berprotein rendah. Ekstrak katuk juga mampu memperbaiki mutu karkas broiler.

Kata kunci: esktrak daun katuk, penimbunan lemak, protein rendah, broiler

ABSTRACT

The present study was designed to evaluate the effect of *Sauropus Androgynus Leaves Extract* (SALE) on broiler chickens fed low protein diets. Eighty four mixed broiler chickens (male:female = 1:1) aged 20 days were distributed to seven treatment groups as follows: 1) Broilers fed 19% protein without SALE (P0); 2) Broilers fed 19% protein plus 4.5 g SALE/kg (P1); 3) Broilers fed 17% protein plus 4,5 g SALE/kg (P2); 4) Broilers fed 15% protein plus 4.5 g SALE/kg (P3); 5) Broilers fed 19% protein plus 9 g SALE/kg (P4); 6) Broilers fed 17% protein plus 9 g SALE/kg (P5); 7) Broilers fed 15% protein plus 9 g SALE/kg (P6). Experimental results showed that supplementation of *Sauropus androgynus* extract to low protein diets had no effect on meat colour, haemorrhages scale in breast meat, and fatty liver score (P>0.05), but it significantly affected haemorrhages scale in thigh meat (P<0,01), shank colour, meat taste and flavour (P<0.05). In addition, supplementation of the extract significantly affected meat fat content (P<0.05) and meat cholesterol content (P<0.01), but it had no effect on meat protein content (P>0.05). It can be concluded that the leaves extract of *Sauropus androgynus* supplementation at level of 9 g/kg diets normalized fat deposition in broiler chickens fed low protein diets. *SALE* improved broiler meat qualities.

Keywords: Sauropus androgynus extract, fat deposition, low protein diet, broiler

INTRODUCTION

Experimental results indicate that nutrients strongly correlated with several metabolic diseases such as *atherosclerosis*, coronary heart disease and other chronic disorders. One of the nutrients that can increase the risk of those diseases is animal fat.

On the one hand, feeding low protein diets on broiler is important, because it will reduce production costs and pollution levels caused by excessive nitrogen excretion (El-Hakim *et al*., 2009; Hernandez *et al*., 2012), lower levels of air and water pollution, lower the conversion of nitrogen to ammonia gas and increase nitrogen digestibility efficiency (El-Hakim *et al*., 2009; Nahm, 2007) and lower levels of stress caused by heat stress (Furlan *et al*., 2004). Hernandez *et al.* (2012) found that the reduction of protein levels by 1.5% or 3.0% decrease nitrogen excretion into the environment of 9.5 and 17% in male broilers, and 11.8 and 14.6% in females. On the other hand, feeding low protein diets increased fat deposition in broiler chickens (Farahdiba *et al*., 2011; Jlali *et al*., 2012; Labussiere *et al*., 2008: Pesti, 2009; Wood *et al*., 2004) .

The high fat deposition in broiler chickens would reduce the profit of broiler industries because of lower price of fat and increase the cost of waste treatments. In addition, the high fat content of meats reduce meat taste and increase the risk of metabolic diseases occurrences such as coronary heart disease (Tumova and Teimouri, 2010). In developed countries, consuming of high fat meats was positively correlated with an increase in the risk of incidence of metabolic diseases (Patil *et al.*, 2010). Therefore, feeding low protein diets in broiler chickens needs to be balanced by feed supplement to inhibit rapid deposition of fat. SALE is potential supplement to inhibit fat deposition.

SALE has been proven to reduce cholesterol and triglyceride contents as well as the deposition of fat in the meat of broiler chickens (Santoso *et al.*, 2010a, 2010b; Santoso and Suharyanto, 2011) and laying hens (Santoso *et al.*, 2005) fed a normal protein levels. It is unknown whether SALE effectively reduce the deposition of fat in broilers fed low protein diets. It is well known that inclusion of feed supplement which reduce fat deposition in poultry fed normal protein diets might not reduce that deposition when poultry was fed low protein diets.

Therefore, this study was designed to examine the effect of SALE on fat deposition in broiler chickens fed a low protein diets.

MATERIALS AND METHODS

Animals

This study used a 20-day old mixed sex broiler chickens (finisher period) strain Arbor Acress. Experimental diets contained various levels of crude protein (19%, 17% and 15%) and Metabolizable Energy 3.200 kcal/kg diets (SNI, 2006).

Sauropus androgynus Leave extraction

Feeding Treatment

At twenty days of age, 84 mixed sex broiler chickenss (male:female = 1:1) were distributed into 7 treatment groups as follows: 1) Broilers fed 19% protein without SALE (P0); 2) Broilers fed 19% protein plus 4.5 g SALE/kg (P1); 3) Broilers fed 17% protein plus 4,5 g SALE/kg (P2); 4) Broilers fed 15% protein plus 4.5 g SALE/kg (P3); 5) Broilers fed 19% protein plus 9 g SALE/kg (P4); 6) Broilers fed 17% protein plus 9 g SALE/kg (P5); 7) Broilers fed 15% protein plus 9 g SALE/kg (P6). Each treatment group consisted of three pens (as replications) with four mixed sex broiler chickens each. Nutritional composition of experimental diets is presented in Table 1.

Parameters and Procedures

At the end of the study, four mixed sex broiler chickens (1:1) for each treatment group were slaughtered and internal organs were removed and weighed. Thigh meat for each treatment group were collected for analysis of cholesterol, fat, protein and fatty acid composition of meat.

Ten trained sensory panelists were asked to compare the relative palatability such as taste and odor of meats to test organoleptic characteristics. Organoleptic test was measured at the end of the study. Panelists were asked to score the taste and odor of breast meat with a value of 1 to 5. Meat color assessed by comparing the color of breast with standard color according to Institute for Animal Science and Health, Netherlands reference scale of 1-5. Meat odor was assessed based on the value of 1 (very fishy), value 2 (fishy), grade 3 (somewhat fishy), grade 4 (less fishy) and value of 5 (not fishy). To test meat taste, trained panelists previously tasted the breast broth obtained by boiling the meat at various concentrations. Value of 1 (bad taste) is obtained by making a broth of 1 g of meat boiled in 50 ml of water, the value of 2 (discomfort) at a ratio of 4 g meat/50 ml of water; 3 values (taste pretty good) on the comparison of 7 g meat/50 ml of water, the value of 4 (good taste) in comparison 10 g meat/50 ml of water, and a score of 5 (very good) in the ratio of 13 g meat/50 ml of water.

Table 1. Nutritional Composition of Experimental Diets

Feed Ingredients	P0	P1	P2	P3	P4	P5	P6
Yellow corn, %	57.00	57.00	60.69	59.44	57.00	60.69	59.44
Bran, %	5.00	5.00	8.82	17.57	5.00	8.82	17.57
Broiler Concentrate, %	34.20	34.20	26.69	19.19	34.20	26.69	19.19
Mineral mixture, %	1.70	1.70	1.70	1.70	1.70	1.70	1.70
Salt, %	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Top mix, %	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Oil, %	1.50	1.50	1.50	1.50	1.50	1.50	1.50
SALE, g	0	4.50	4.50	4.50	9.00	9.00	9.00
Nutritional Composition							
Protein (%)	19.40	19.40	17.13	15.10	19.40	17.10	15.10
ME (kcal/kg)	3155.60	3155.6	3150.2	3102.3	3155.6	3150.2	3102.3
Ca (%)	1.51	1.51	1.31	1.11	1.51	1.31	1.11
P (%)	0.860	0.860	0.811	0.810	0.860	0.811	0.810

P0 = Protein 19% plus 0 g SALE**;** P1 = 19% protein plus 4.5 g SALE/kg diet; P2 = 17% protein plus 4.5 g SALE /kg**;** P3 = 15% protein plus 4.5 g SALE/kg; P4 = 19% protein plus 9 g SALE/kg**;** P5 = 17% protein plus 9 g SALE /kg; P6 = 15% protein plus 9 g SALE/ kg

After the panelists could distinguish the taste of meat as expected, then they were asked to judge the taste of meat range from 1 to 5 value. To test the taste and odor, all meats were boiled at 80^{o}C for 20 minutes, cooled and then tested. Haemorrhages scale in thigh and breast meat were scored according to Institute for Animal Science and Health, Netherlands reference scale of 1-5.

Data Analysis

The experimental results were analyzed variance and if significantly different was tested further by Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Carcass Quality

Table 2 shows the effect of the leaves extract of *Sauropus androgynus* supplementation to low protein diets on carcass quality. The results showed that the leaves extract of *Sauropus androgynus* supplementation to low protein diets had no significantly effect on meat color, haemorrhages in breast meat, the odor of the carcass, and fatty liver score (FLS) (P>0.05), but significant affected on haemorrhages in thigh meat (P<0.01), shank color, taste and odor of meat (P<0.05). It was shown that haemorrhages in thigh meat at P0 and P4 was higher than the P1, P2, P3, P5 and P6, respectively. Meat odor was better on P1, P2, P3, P4, P5 and P6 (P <0.05) than P0. Control (P0) more fishy (P <0.05) than the P1, P2, P3, P4, P5 and P6. Shank color on P0 significantly paler (P<0.05) when compared to P3, P4 and P6, but it was not significantly different from P1, P2 and P5.

Fatty liver score indicates the degree of fat deposition in the liver. No significantly different was found in FLS values when broiler chickens were fed low protein diets supplemented with SALE. It indicated that that supplementation could suppress the increased deposition of fat in the liver caused by feeding low protein diets.

Sauropus androgynus leaves is rich in iron, ie 2.7 mg/100 g of fresh leaves (Wiradimadja *et al.*, 2006), but it did not improve the color of broiler meats. High levels of β-carotene in *Sauropus androgynus* leavesellow color of shank in broiler chickens fed diets supplemented with SALE. Hulshof *et al.* (1997) reported that *Sauropus androgynus* leaves contained as much carotene 12.657 µg per 100 g of fresh leaves (Hulshof *et al.*, 1997).

Table 2. Effect of SALE in Low Protein Diets on Broiler Carcass Quality

Variables	P0	P1	P2	P3	P4	P5	P6	SD
Meat color	2.38	2.25	2.13	2.00	2.50	2.63	2.13^{ns}	0.48
Hamorrhages in breast	2.38	1.88	1.75	1.75	2.75	1.63	1.63^{ns}	0.80
Haemorrhages in thigh	5.00^{a}	2.38^{b}	1.25^{b}	1.00^{b}	3.88^{a}	2.13^{b}	2.13^{b}	1.48
Odor of carcass	2.25	2.25	1.25	1.50	2.25	2.25	2.25^{ns}	0.86
Shank color	2.25^{b}	$2.5\ 0^{ab}$	2.50^{ab}	2.88^{a}	3.25^{a}	2.50^{ab}	3.00^{a}	0.32
Meat taste	3.00^{b}	4.00^{a}	4.00^{a}	4.00^{a}	4.00^{a}	4.50^{a}	4.00^{a*}	0.34
Meat odor	3.00^{c}	4.00^{b}	4.00^{b}	4.00^{b}	4.00^{b}	5.00^{a}	5.00^{a*}	0.28
FLS	2.63	2.00	2.25	2.63	2.75	2.38	2.50^{ns}	0.52

P0 = Protein 19% plus 0 g SALE**;** P1 = 19% protein plus 4.5 g SALE/kg diet; P2 = 17% protein plus 4.5 g SALE /kg**;** P3 = 15% protein plus 4.5 g SALE/kg; P4 = 19% protein plus 9 g SALE/kg**;** P5 = 17% protein plus 9 g SALE /kg; P6 = 15% protein plus 9 g SALE/ kg; FLS = fatty liver score; * P<0.05; ns = non-significant. Different superscript in the same row indicates significantly different at P <0.05.

Sauropus androgynus leaves is rich in flavonoids and antioxidants (Andarwulan *et al*., 2010), and antiinflamantori (Selvi and Bhascar, 2012). These factors were predicted to play a role in the reduction of haemorrhages in thigh meat. The results were consistent with the results of Santoso (2001) that the leaves extract of *Sauropus androgynus* supplementation increased broiler meat odor. Compounds which might play important role in enhancing the taste of broiler meat were glutamic acid, IMP and potassium ions (Fujimura *et al.*, 1995). Agustal *et al.* (1997) found that the *Sauropus androgynus* leaves was rich in methylpyroglutamate. Methylpyroglumate might convert to glutamic acid in gastrointestinal tract of the chickens (Santoso *et al.*, 2005), and therefore increasing the levels of glutamic acid in meat. Compounds that might play an important role in the decline of broiler meat odor was unknown.

The decrease in thigh meat haemorrhages and a decreased in fishy odor and improving taste by increasing supplementation of *SALE*s showed that the leaves extract improved meat quality of broiler chickens.

Levels of Fat, Protein and Cholesterol Meat

Table 3 shows the effect of the leaves extract of *Sauropus androgynus* supplementation in low protein diets on the contents of fat, protein and cholesterol in meat. The results showed that the leaves extract of *Sauropus androgynus* supplementation significantly affected meat fat contents (P<0.05) and meat cholesterol contents (P<0.01), but the effect was not significantly different (P>0.05) on protein content of meat. Further test results showed that the fat content of meat at a P0 (P<0.05) was lower than the P3, but it was not significantly different from (P<0.05) other treatments. The content of cholesterol meat in P1 was significantly lower (P<0.01) than the P2, P3 and P5, but it was not significantly different from P0, P4 and P6.

Singarimbun *et al.* (2013) reported that feeding low protein diets did not reduce contents of protein in the chicken meat from Bangkok Chicken and Arab Chicken crosses. Kamran *et al.* (2004) reported that feeding low protein diets with optimal amino acid profile did not reduce contents of protein in breast meat of broiler chickens. breast. Based on the argument above, the leaves extract of *Sauropus androgynus* supplementation did not increase the protein content of broiler meat.

It was known that feeding low protein diets increased fat deposition in broiler chickens (Azarnik *et al.*, 2010). Results of this study showed that the leaves extract of *Sauropus androgynus* at level of 9 g/kg diet could reduce the fat content of meat in broiler chickens fed a

Table 3. Effect of SALE Supplementation in Low Protein Diets on the Contents of Fat, Protein and Cholesterol Broiler Meat

Treatment	Fat (%)	Protein (%)	Cholesterol (mg/100 mg)
P0	4.21^{bc}	16.67	2.02^{ab}
P1	3.38^{c}	18.07	1.29^{b}
P2	4.35^{abc}	17.38	2.36^{a}
P3	5.57^{a}	17.70	2.83^{a}
P4	3.90^{bc}	18.90	2.00^{ab}
P5	4.87^{ab}	17.57	2.49^{a}
P6	4.27^{bc}	17.51	2.22^{ab}
SD	0.82	1.14	0.53
P	P <0.05	ns	P<0.01

P0 = Protein 19% plus 0 g SALE**;** P1 = 19% protein plus 4.5 g SALE/kg diet; P2 = 17% protein plus 4.5 g SALE /kg**;** P3 = 15% protein plus 4.5 g SALE/kg; P4 = 19% protein plus 9 g SALE/kg**;** P5 = 17% protein plus 9 g SALE /kg; P6 = 15% protein plus 9 g SALE/kg; ns = non-significant. Different superscript in the same column indicate significantly different (P<0.05) or highly significant (P<0.01).

15% protein, so that the fat content of meat is equivalent to the control. From the results of this study can be presumed that the extract supplementation of *Sauropus androgynus* leaves up to 9 g/kg diet did not reduce fat deposition under control as a result of increased fat deposition extreme in broilers fed 15% protein. Compounds that play a role in lowering fat contents might be alkaloid and non alkaloid (Santoso *et al.*, 2010b), 3-O-b-D-glucosyl-(1→ 6)-b-D-glucosyl-kaempferol (Yu *et al.*, 2006), flavonoid (Zarrouki *et al.*, 2010), tannin (Aiura and de Carvalho, 2007), polyphenol (Zang *et al.*, 2006).

SALE supplementation up to 9 g/kg diet could lower cholesterol contents of meat to normal contents (control). This means SALE supplementation alone was not enough to lower cholesterol content to below control. Compounds that play a role in lowering cholesterol might be alkaloids and non-alkaloids (Santoso *et al.*, 2010), saponins (Son *et al.*, 2007), polyphenol (Ngamukote *et al.*, 2011; Zang *et al.*, 2006), flavonoid (Shrime *et al.*, 2011). Patil *et al.* (2010) reported that the reduction of cholesterol and triglycerides by alkaloids were in part caused by the reduction of lipogenic enzymes activities and increased bile acid excretion in feces.

Extract supplementation above 9 g/kg was not effective to reduce fat and cholesterol contents due to a high price of the extract, namely IDR 40.000/kg. Therefore, it is needed to look for the chiaper feed supplement which will be combined with *SALE*. One of cheaper feed supplement to reduce fat deposition included turmeric powder (Jain *et al.*, 2007; Samarasinghe *et al.*, 2003; Kermanshahi and Riasi, 2006)).

The fatty acid composition of meat

Table 4 shows the effect of the SALE supplementation in low protein diets on the composition of fatty acids in broiler meat. The results showed that the leaves extract of *Sauropus androgynus* supplementation to low protein diets did not significantly (P>0.05) affect the contents of lauric acid, myristic acid, palmitic acid, stearic acid, oleic acid, linoleic acid, linolenic acid, dokosahexaenoic acid and eicosapentaenoic acid. Although *Sauropus androgynus* leaves was rich ini palmitic acid (Subekti *et al.*, 2006), linoleic acid and linolenic acid (Santoso *et al.*, 2010a), but the leaves extract of *Sauropus androgynus* supplementation did not increase those fatty acids. This is because extract supplementation as much as 9 g/kg feed only provides increased levels of these fatty acids in the feed slightly. Study is in

Table 4. Effect of SALE Supplementation in Low Protein Diets on the Fatty Acid Composition

Fatty acids (g/100 g fat)	P0	P1	P2	P3	P4	P5	P6	SD
Lauric acid	0.13	0.65	0.57	0.61	0.35	0.12	0.19^{ns}	0.30
Myristic acid	1.66	5.05	2.76	2.08	2.90	4.03	4.20^{ns}	1.75
Palmitic acid	19.83	19.86	15.82	17.90	16.95	21.42	23.89^{ns}	4.34
Stearic acid	0.05	0.04	0.32	0.03	0.06	1.18	0.01^{ns}	0.69
Oleic acid	43.75	46.65	46.60	46.37	44.54	44.37	41.62^{ns}	3.26
Linoleic acid	14.09	14.23	10.99	13.37	14.30	12.56	13.68^{ns}	2.62
Linolenic acid	1.03	1.01	1.37	1.30	1.37	0.96	0.90^{ns}	0.39
Dokosa-hexaenoic acid (mg/100 g of fat)	3.38	5.59	7.26	4.57	5.60	3.51	4.77^{ns}	2.74
Eicosapentaenoic acid (mg/100 g of fat)	1.51	2.46	2.82	2.14	2.36	1.16	2.60^{ns}	1.33

P0 = Protein 19% plus 0 g SALE; P1 = 19% protein plus 4.5 g SALE/kg diet; P2 = 17% protein plus 4.5 g SALE /kg; P3 = 15% protein plus 4.5 g SALE/kg; P4 = 19% protein plus 9 g SALE/kg; P5 = 17% protein plus 9 g SALE /kg; P6 = 15% protein plus 9 g SALE/kg, ns = non-significant.

Table 5. Effect of SALE Supplementation in Low Protein Diets on the Weight of Internal Organs in Broiler Chickens

Variables (% BW)	P0	P1	P2	P3	P4	P5	P6	SD
HIS	1.69	1.75	1.74	1.79	1.78	1.84	1.84^{ns}	0.18
Heart	0.38	0.40	0.43	0.41	0.37	0.36	0.49^{ns}	0.07
Intestine	2.37	2.51	2.13	2.44	2.03	2.34	2.28^{ns}	0.29
Gizzard	1.39	1.63	1.58	1.71	1.59	1.62	1.69^{ns}	0.22
Spleen	0.15^{ab}	0.09^{b}	0.11^{b}	0.12^{ab}	0.11^{b}	0.10^{b}	0.21^{a} **	0.05
Pancreas	0.20	0.23	0.23	0.22	0.16	0.19	0.21^{ns}	0.04
Intestine length (mm% BW)	8.25	9.56	9.23	9.25	8.35	7.72	9.52^{ns}	1.02
Shank	4.04	4.15	4.26	4.47	4.00	3.94	4.48^{ns}	0.39
Toxicity	1.85	1.84	1.85	1.91	1.89	1.94	2.05^{ns}	0.20
VSI	6.19	6.61	6.21	6.68	6.03	6.45	6.72^{ns}	0.48

P0 = Protein 19% plus 0 g SALE**;** P1 = 19% protein plus 4.5 g SALE/kg diet; P2 = 17% protein plus 4.5 g SALE /kg**;** P3 = 15% protein plus 4.5 g SALE/kg; P4 = 19% protein plus 9 g SALE/kg**;** P5 = 17% protein plus 9 g SALE /kg; P6 = 15% protein plus 9 g SALE/kg; BW = body weight; ns = non-significant,, ** P<0.01. HIS = hepatosomatic index; VSI = viscerosomatic index. Different superscript in the same row indicate significantly different (P<0.05).

line with the results of the study Santoso *et al*. (2010a) who found that the leaves extract of *Sauropus androgynus* supplementation did not alter the fatty acid composition in broiler meat.

Internal Organ Weight

Table 5 shows the effect of the leaves extract of *Sauropus androgynus* supplementation to low protein diets on internal organ weight in broiler chickens. The experimental results showed that the leaves extract of *Sauropus androgynus* supplementation did not significantly affect (P>0.05) hepatosomatic index (HIS), the weights of heart, intestine, *gizzard*, pancreas, shank, the length of the intestine, and viscerosomatic toxicity index (VSI), but it significantly affected spleen weight (P<0,01). Further test results showed that spleen weight was significantly higher in the P0 (P<0.01) than the P1, P2, P4 and P5. Results of this study contradicted the results of Santoso (2012) who found that the leaves extract of *Sauropus androgynus* supplementation increased spleen weight. Spleen weight range was still within the normal criteria. Normal weights of internal organ and the absence of toxicity showed that the leaves extract of *Sauropus androgynus* supplementation had no negative influence on the performance of broiler chickens as found by Santoso (2012).

CONCLUSION

It can be concluded that the leaves extract of *Sauropus androgynus* supplementation at level of 9 g/kg diets normalized fat deposition in broiler chickens fed low protein diets. *SALE* improved broiler meat qualities.

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