Effects of gambir (*Uncaria gambir*) leaf extract as a feed additive on meat quality and cholesterol content in goats

Antonius1,3, A Jayanegara2, K G Wiryawan2, S P Ginting3 and A A Syamsudin4

1Graduate School, IPB University, Gedung Sekolah Pascasarjana Lt. 1 Kampus IPB Dramaga Bogor 16680, Indonesia
2Department of Nutrition and Feed Technology, Faculty of Animal Science, IPB University, Jl. Agatis Kampus IPB Dramaga Bogor 16680, Indonesia
3Indonesian Research Institute for Goat Production, Jl. Sei Putih No 23 Galang Deli Serdang 20585, Indonesia
4Department of Animal Science, Faculty of Agriculture, University of Putra Malaysia, 43400 UPM Serdang Selangor Darul Ehsan, Malaysia

E-mail: antoni.chaniago@gmail.com

Abstract. The demand for high quality and healthy meat has been continuously increasing both in national and international markets. The objective of this study was to investigate the effect of gambir (*Uncaria gambir*) leaf extract as a feed additive on cholesterol content and consumer preference of goat meat. Eighteen Boerka goats aged 10-11 months with an average initial body weight of 20.5±2.79 kg were randomly distributed to three dietary treatments, namely: GE0 (fed basal diet without gambir extract supplementation, GE100 (gambir extract supplementation at levels of 100 mg/kg body weight, and GE200 (gambir extract supplementation at levels of 200 mg/kg body weight. Meat cholesterol content was measured using the Liebermann Buchard method. The meat quality preference was measured using the hedonic scale of the organoleptic method from 16 panelists. Results showed that addition of gambir leaf at 200 mg/kg BW resulted meat cholesterol content of 14.9%, numerically lower than that of control. The meat color, flavour, juiciness and taste were similar among the dietary treatments. The meat was classified as mild juicy meat with a bright red color and well accepted flavour and taste. Based on the hedonic scale, the tenderness level of goat meat fed with 200 mg/kg BW of gambir leaf extract increased from mild tender (in the control treatment) to tender. In conclusion, gambir leaf extract has the potential to reduce cholesterol content and increase meat tenderness without having a negative effect on consumers preference regarding the color, flavour, juiciness and taste of the goat meat.

1. Introduction
The demand for high quality and healthy meat has been continuously increasing both in national and international markets. The consumers usually prefer meat with a bright color, soft, tender, durable, high nutrient and low cholesterol. Researches in recent years have shown that lipid oxidation has a role in reducing meat quality [1]. Lipid oxidation causes loss of nutritional value, unpleasant flavor and texture, discoloration and weight loss [2,3].
The animal bodies have several mechanisms to prevent lipid oxidation, including the activity of the superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GSH-Px) enzyme and non-enzymatic antioxidant glutathione (GSH) [4]. Besides the protection of endogenous enzymes, the oxidative stability of meat is determined by the presence of exogenous antioxidants such as vitamin E and synthetic antioxidants [1]. Several synthetic antioxidants, such as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), tert-butyl hydroquinone (TBHQ), propyl gallate (PG), and nitrite are used in the meat industry [5]. However, these synthetic antioxidants have been reported to have carcinogenic potential risks, therefore, the interest research about natural antioxidants have increased in recent years [6,7].

Catechins are natural polyphenolic compounds belonging to the flavonoid group consisted of two aromatic rings with some hydroxyl groups [8]. Due to phenolic hydroxyl groups (-OH) activity, catechin have several unique chemical properties, including as protein binders, alkaloids, and polysaccharides and as antioxidants that reduce free radicals [9]. Catechins, especially epigallocatechin gallate (EGCG) and epicatechin gallate (ECG) which contain gallate groups, have a very high antioxidant capacity by binding free radicals and increasing the activity of endogenous enzymes [4,10]. Catechins have been shown to enhance the antioxidant capacity of plasma [10] and especially to reduce cholesterol [11,12]. Catechin can reduce cholesterol content in micelles by forming insoluble precipitation with cholesterol, thereby reducing the absorption of cholesterol in the intestine [13].

The catechin supplementation have already been studied in human, rats, beef cattle and chicken, however, few data are available on its antioxidative properties, cholesterol content and meat quality in goats. The objective of this current study was therefore to investigate the effect of gambir (Uncaria gambir) leaf extract as a catechin source on cholesterol content, quality trait and consumer preference of goat meat.

2. Method

The gambir leaves were boiled for 1.5 hours and then pressed using traditional tools to produce gambir extract solution. The solution was put into a deposition container, macerated for 12 hours and filtered. The gambir extract pasta was pressed to reduce water content, dried in the sun and ground into fine powder.

Eighteen Boerka male goats (a cross breed, Boer and local goat) with average age of 10 months, average initial body weight of 21 ± 2 kg were randomly divided into three equal groups (6 animals in each group) and assigned to three experiment diets for 90 days of feeding trial. The control group (GE0) was fed basal diet without gambir extract supplementation. The other two groups were fed basal diet with dietary gambir extract supplementation at levels of 100 (GE100), and 200 (GE200) mg/kg body weight (on DM basis). The basal diet consist of Pennisetum purpureum grass and concentrate. All goats were allowed a recovery period of two weeks. During feeding period, each goat was fed twice daily (08:00 and 16:00 h) with 735 g feed each day (on DM basis) and free access to fresh water. After 90 days of feeding period, all goats were manually slaughtered and samples collected. About 200 g each of gluteus medius (GM) muscles were sampled for cholesterol content analysis and meat quality preference.

Meat cholesterol contents were measured according to the Liebermann buchard method [14]. A total of 0.1 g of sample was put into a centrifuge tube, add 8 ml of a solution consist of alcohol, hexane and ether. The solution was stirred until homogeneous and centrifuged for 10 minutes (3000 rpm). The supernatant was entered into a beaker glass (100 ml) and evaporated for 1 hour. The residue was evaporated with chloroform and entered into a tube up to a volume of 5 ml. A total of 2 ml of acetic anhydride was added to the tube and dropped with 0.2 ml of H2SO4 (p.a). The solution was vortexed and macerated for 25 minutes in a dark room. The absorbance was read at a wavelength (λ) of 420 nm with a standard of 0.4 mg/ml.

The meat quality preference was measured using the organoleptic method [15] with the assessment criteria using a hedonic scale according to Soekarto [16]. Organoleptic testing was carried out by asking
16 trained panelists for five sensoric evaluation, namely; tenderness, color, aroma, taste and juiciness (table 1).

**Table 1. Organoleptic test assessment criteria**

| Sensoric Evaluation | Hedonic Scale | Criteria          |
|---------------------|---------------|-------------------|
| Tenderness          | 1             | Very Tender       |
|                     | 2             | Tender            |
|                     | 3             | Mild              |
|                     | 4             | Tough             |
|                     | 5             | Very Tough        |
| Color               | 1             | Pink              |
|                     | 2             | Bright red        |
|                     | 3             | Red               |
|                     | 4             | Red Disk Dark Brown |
|                     | 5             | Dark Brown        |
| Aroma               | 1             | Very Well Accepted|
|                     | 2             | Well Accepted     |
|                     | 3             | Accepted          |
|                     | 4             | Not Accepted      |
|                     | 5             | Very Not Accepted |
| Taste               | 1             | Very Well Accepted|
|                     | 2             | Well Accepted     |
|                     | 3             | Accepted          |
|                     | 4             | Not Accepted      |
|                     | 5             | Very Not Accepted |
| Juiciness           | 1             | Juicy             |
|                     | 2             | Very Juicy        |
|                     | 3             | Mild Juicy        |
|                     | 4             | Almost Juicy      |
|                     | 5             | Dray              |

The organoleptic data were analyzed using the equation:

$$x = (n_1 + n_2 + \ldots + n_i) / N$$

where $x$ is average score of all panelists, $n$ is score of each panelists, and $N$ is number of panelists. Cholesterol and organoleptic data were subjected to analysis of variance (ANOVA) using the generalized linear model procedure of SAS [17]. The main effect tested was gambir extract supplementation level for all variables.

3. Results and discussion

Effect of treatments on cholesterol content of Boerka goat meat is presented in table 2. Cholesterol content ranged between 0.57–0.67 mg/g DM of meat. Content of cholesterol in this research was higher than experimental result of Bulkaini et al (2016) on Kacang goat (ranged 0.30–0.34 mg/g), but lower than experimental result of Imam et al (2013) on buck of Kacang goat (averaged 0.81 mg/g). Feeding of gambir leaf extract with doses of 100 mg/kg BW and 200 mg/kg BW gave non significant effect on cholesterol of meat [18,19]. This is apparently caused by the similar content of fat between the two treatments. Pratiwi et al (2007) stated that content of meat cholesterol is in line with content of fat and fatty acid in the meat [20].
Table 2. Cholesterol content of young male Boerka goat meat given gambir leaf extract

| Treatment | Cholesterol Content (mg/g DM Mutton) |
|-----------|-------------------------------------|
| GE 0      | 0.67±0.12                           |
| GE 100    | 0.67±0.17                           |
| GE 200    | 0.57±0.10                           |
| Sig.      | 0.51                                |

Feeding of gambir leaf extract with dose of 100 mg/kg BW gave almost same effect with control (GE 0) but tended to decrease with increasing dose of 200 mg/kg BW. Addition of gambir leaf at 200 mg/kg BW resulted meat cholesterol content of 14.9%, numerically lower than that of control. The main element of gambir leaf extract is catechin compound that can reduce cholesterol content in the blood. With the appropriate dosage, catechin can reduced blood cholesterol [21] with increased activity of lipoprotein lipase, so that catabolism of lipoproteins with rich triglyceride was increased [22]. The lack of dosage in this research is probable non significant effect of feeding gambir leaf extract on meat cholesterol.

The result of organoleptic test of treatments is presented in Table 3. Tenderness score of meat ranged 2.69–3.05. Tenderness score in feeding gambir leaf extract dose of 100 mg/kg BW (GE 100) gave effect which almost same score to control (GE 0) with category of mild. Based on the hedonic scale, the tenderness level of goat meat fed with 200 mg/kg BW of gambir leaf extract increased from mild tender (in the control treatment) to tender. The result of statistical test showed that feeding of gambir leaf extract until dose of 200 mg/kg BW gave non significant effect on tenderness of meat. This is showed that catechin in gambir leaf extract did not change content of protein and energy of feed as experimental result of Darmayanti et al (2013) stated that content of protein and energy of feed did not influence tenderness of meat [23].

The result of organoleptic of meat color ranged 2.46–2.69 with category of brighted. The bright red color is the meat color that most consumers prefer, because it indicates the meat is fresh. The result of statistical test showed that feeding gambir leaf extract until dose of 200 mg/kg BW gave non significant effect (P>0.05) on color of meat compared with control (GE 0). This data showed that with this dose, catechins do not have a negative impact on the color and freshness of the meat. Content of catechin in gambir leaf extract did not increase pH of meat. Prido et al (2001) stated that high pH caused darker meat color [24].

Table 3. Meat quality preference of young male Boerka goat given gambir leaf extract

| Treatment | Tenderness | Color | Aroma | Taste | Juiciness |
|-----------|------------|-------|-------|-------|-----------|
| GE 0      | 3.04±0.16  | 2.69±0.38 | 2.59±0.13 | 2.62±0.14 | 3.23±0.15 |
| GE 100    | 3.05±0.60  | 2.46±0.43 | 2.51±0.11 | 2.49±0.43 | 3.00±0.66 |
| GE 200    | 2.69±0.52  | 2.37±0.37 | 2.43±0.17 | 2.43±0.45 | 3.15±0.37 |
| Sig.      | 0.37       | 0.84   | 0.76  | 0.72  | 0.16      |

The score of aroma of meat ranged 2.43-2.59. Based on Hedonic scale, that score in category of well accepted. The result of statistical test showed that feeding gambir leaf extract until dose of 200 mg/kg BW gave non significant effect (P>0.05) on aroma compared with control (GE 0). This is caused feeding gambir leaf extract until dose of 200 mg/kg BW do not influenced content of fat because meat aroma comes from free-carbonyl compounds of fat [25]. Taste and juiciness were also same for each treatment.
Dietary supplementation of gambir leaf extract was able to maintain the taste of goat meat in well accepted and juicy at mild juicy.

4. Conclusion
Gambir leaf extract has the potential to reduce cholesterol content and to increase meat tenderness without having a negative effect on consumers preference regarding the color, flavour, juiciness and taste of the goat meat.

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