



Original Article

Effect of dietary supplementation of binahong leaf meal, betel nut meal or their combination on serum albumin and globulin, fecal endoparasites and bacterial counts in milk of Saanen goats suffering from subclinical mastitis

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ABSTRACT

The effect was investigated of dietary supplementation of binahong (*Anredera cordifolia* (Ten.) Steenis) leaf meal, betel nut (*Arecha catechu* L.) meal or their combination on serum albumin and globulin, fecal endoparasites and bacterial counts in the milk of Saanen goats suffering from subclinical mastitis. The goats were randomly allotted to one of four experimental groups: control diet (diet without binahong leaf meal or betel nut meal; CON), diet supplemented with binahong leaf meal (1 g/kg body weight; BNH), diet supplemented with betel nut meal (1 g/kg body weight; BTN) and diet supplemented with a combination of binahong leaf meal and betel nut meal (both 0.5 g/kg body weight; BNH + BTN). After 14 d treatment, the pH was higher ($p < 0.05$) in the milk of the CON group compared to the treated groups. The numbers of udders positive for subclinical mastitis were reduced ($p < 0.05$) following the treatments with BNH, BTN or BNH + BTN. Total viable bacteria were higher ($p < 0.05$) in the milk of the CON group than in the treated groups. The numbers of oocytes and coccidial oocysts were higher ($p < 0.05$) in the feces of the CON group than those in the treated groups. There were no differences ($p > 0.05$) in levels of serum albumin and globulin and milk production across the treatment diets. In conclusion, dietary supplementation of binahong leaf meal, betel nut meal and a combination of both showed potential to reduce the load of endoparasites in the gastrointestinal tract and to reduce subclinical mastitis in lactating Saanen goats.

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Introduction

The number of commercial dairy goat farms in Indonesia is now increasing due to an increased demand of goat milk especially for medicinal purposes; however, the milk production per goat is still low (Astuti and Sudarman, 2012). Several factors may contribute to low goat milk production, one of which is subclinical mastitis (Gelasakis et al., 2016). The intramammary administration of antibiotics has commonly been practiced to control subclinical mastitis in goats (Poutrel et al., 1997). Although it has proved to be effective for treating subclinical mastitis, such treatment may cause antibiotic resistance which has become a global concern both in human and animals (Virdis et al., 2010). With this background, any efforts to find alternatives to antibiotics would be valuable for the treatment of subclinical mastitis in lactating goats.

A variety of plants have been proposed to substitute the use of antibiotics in animal husbandry, including binahong (*Anredera cordifolia* (Ten.) Steenis) normally known as Malabar spinach, which is a leafy vegetable that is widely found in tropical and sub-tropical area including Indonesia (Miladiyah and Prabowo, 2012). This plant, particularly its leaf, has been reported to exhibit antimicrobial activity against *Escherichia coli*, *Aspergillus niger*, *Vibrio cholerae*, *Staphylococcus aureus* and *Salmonella typhi* (Sen et al., 2010). Accordingly, Priya et al. (2015) confirmed that the presence of secondary metabolites such as steroids and triterpenoids in the leaves of binahong may be responsible for the inhibitory activity of binahong against *E. coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis* and *Aspergillus flavus*. This may suggest that binahong could be exploited for new potential antibiotics. Binahong leaf has also been reported to have potent antihelmintic activity (Deshmukh and Gaikwad, 2014). In such cases, the presence of tannins in binahong seems to be responsible for its antihelmintic potential (Rubesh et al., 2011). In addition to antimicrobial and antihelmintic activities, binahong has

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been reported as a potential source of natural antioxidants (Anusuya et al., 2012), and may thus be beneficial in reducing the incidence of mastitis (Yang and Li, 2015). Indeed, some active components present in binahong leaf, such as flavonoids, betacyanins, phenols, vitamin C and tannins, may be responsible for the antioxidant potential of binahong leaf meal (Anusuya et al., 2012; Deshmukh and Gaikwad, 2014).

Betel nut (*Areca catechu* L.) is another plant known as a good source of antimicrobial compounds such as fatty acids, procyanidins and phenol (Panutat and Vatanyoopaisarn, 2005; Jaiswal et al., 2011; Amudhan et al., 2012). It is grown widely in South and Southeast Asia, and has been popular as a traditional herbal medicine (Peng et al., 2015). Rahman et al. (2014) reported that betel nut may act as an antibacterial agent against Gram-positive bacteria (*S. aureus* and *B. Bacillus*). Panutat and Vatanyoopaisarn (2005) showed the inhibitory effect of betel nut to Gram-positive *Bacillus cereus* and *S. aureus* and Gram-negative *Proteus mirabilis*. Betel nut has also been reported to have anti-nematodal and helminthic effects due to its high content of arecoline (Jaiswal et al., 2011; Peng et al., 2015). Apart from the antimicrobial and antihelminthic effects, betel nut has been known to be a strong antioxidant due to its high content of monomeric, dimeric and trimeric procyanidins (Amudhan et al., 2012; Sazwi et al., 2013). Taken together, the antimicrobial, antihelminthic and antioxidant activities of binahong and betel nut may be beneficial for the treatment of subclinical mastitis in lactating goats. Therefore, the aim of the present study was to investigate the effect of dietary supplementation of binahong leaf meal, betel nut meal or their combination on serum albumin and globulin, fecal endoparasites and bacterial counts in the milk of Saanen goat suffering from subclinical mastitis.

Materials and methods

Preparation of binahong leaf meal and betel nut meal

Binahong leaves and betel nut were purchased from the local market. The binahong leaves were sundried for 2 d, ground and sifted. The betel nut was peeled, sliced and then sundried for 3 d. The dried betel nut was then ground and sifted. The binahong leaf meal and betel nut meal were stored in a dry place until use.

In vivo experiment on lactating Saanen goats

Goats were initially selected that were not pregnant and had 3–4 lactation number, an average milk yield (1.6 ± 0.44 L/d; mean $\pm$ SD) and body weight (44.03 ± 3.06 kg; mean $\pm$ SD). Goats that did not meet these criteria were excluded. The selected goats were then tested for subclinical mastitis (based on pH and a mastitis test). In brief, the samples of fresh milk (from the 10 udders of 5 goats for each treatment group) were aseptically collected and analyzed for pH using pH indicator strips (pH 0–14, Macherey-Nagel GmbH & Co.KG.; Düren, Germany). Subclinical mastitis was defined as milk having a pH in the range 6.9–7.2 (Andrews et al., 2004). Mastitis indicator paper (Bovivet indicator paper; Kruuse, Denmark) was also used to define the prevalence of subclinical mastitis in the goats. The mastitis test was performed by adding a couple of drops of milk to the spot indicated on the indicator paper. A possible color change was then observed. A change of color from yellow to green or bluish green on the indicator paper was regarded as positive for subclinical mastitis (Megersa et al., 2010). Upon the selection and determination of subclinical mastitis (using mastitis indicator paper on 40 udders from 20 goats with 5 goats per treatment), 20 Saanen goats were eventually selected for the present *in vivo* experiment. These goats were randomly allotted to one of four experimental groups with five goats in each. These experimental groups were: the

control diet (diet without binahong leaf meal or betel nut meal; CON), diet supplemented with binahong leaf meal (1 g/kg body weight; BNH), diet supplemented with betel nut meal (1 g/kg body weight; BTN) and diet supplemented with a combination of binahong leaf meal and betel nut meal (both 0.5 g/kg body weight; BNH + BTN). The basal diets provided for the entire experiment consisted of elephant grass (*Pennisetum purpureum*), *Gliricidia sepium*, legumes and concentrate (wheat pollard [63%], cornmeal [20%], coconut cake [10%], soybean meal [5%] and mineral mix [2%]).

Samples of blood, feces and milk were collected on the day before treatment to obtain the baseline values of serum albumin and globulin, fecal endoparasites and bacterial counts, respectively, in the milk of Saanen goats. After 14 d of treatment, samples of blood, feces and milk were again collected. The samples of milk were collected from the two udders of each goat. Blood was obtained by puncturing the jugular vein of each goat and was collected in vacutainers containing no anticoagulant. The blood was then allowed to clot for 2 h at room temperature. The serum was obtained after centrifugation at 2000 rpm for 15 min, and stored at -20°C until analysis. Total protein in serum was measured using a photometric test according to the biuret method using a kit (total protein kit, DiaSys Diagnostic System GmbH; Holzheim, Germany). Albumin was determined using a photometric test with bromocresol green (DiaSys Diagnostic System GmbH; Holzheim, Germany). Globulin was obtained by subtracting albumin values from the total serum protein. The albumin-to-globulin ratio (A/G ratio) was then calculated by dividing the albumin values by the globulin values.

Fecal samples were obtained aseptically from each goat and immediately analyzed. The numbers of oocytes in the feces were enumerated according to a simple flotation method (Dryden et al., 2005), while coccidial oocysts were enumerated based on a sedimentation technique (Ryley et al., 1976). The samples of fresh milk from each goat were aseptically collected and analyzed for pH, prevalence of subclinical mastitis and total viable bacteria in the milk. The pH and mastitis test (on milk) were determined as described above using the pH indicator strips and mastitis indicator paper, respectively. Total viable bacteria in the milk were enumerated in natrium agar according to the total plate count method (Raikwar and Shukla, 2015).

Data analysis

The data before and after the treatments were analyzed separately according to a completely randomized design using the analysis of variance component in the General Linear Models Procedure in SAS (SAS Inst. Inc.; Cary, NC, USA). To evaluate the time effect, the data within each experimental group (before versus after treatment) were compared using the Student's *t*-test. The data on number of udders with subclinical mastitis were analyzed with the GLIMMIX procedure in SAS. The data were tested for normality prior to the analysis. Animal was treated as the experimental unit and the results were presented as means and standard error of the means (SEM). Significant differences among treatment groups were further analyzed using Duncan's multiple-range test at a significance level of $p < 0.05$.

Results

pH and Bovivet score of milk

The pH levels of Saanen goat milk before and after the treatments are presented in Table 1. There was no difference ($p > 0.05$) in the pH of milk within each treatment group (before versus after treatment), nor was the pH of milk different ($p > 0.05$) among the groups before the treatments. However, the treatments, the pH was

Table 1
pH of Saanen goat milk.

	Before treatment	After treatment
CON	7.08 ± 0.10	6.84 ± 0.06 ^{a*}
BNH	6.92 ± 0.04	6.68 ± 0.04 ^b
BTN	6.92 ± 0.02	6.57 ± 0.06 ^b
BNH + BTN	7.22 ± 0.17	6.66 ± 0.04 ^b

CON = control diet (diet without binahong leaf meal or betel nut meal); BHN = diet supplemented with binahong leaf meal (1 g/kg body weight); BTN = diet supplemented with betel nut meal (1 g/kg body weight); BNH + BTN = diet supplemented with a combination of binahong leaf meal and betel nut meal (both 0.5 g/kg body weight).

* Means (±standard error of the mean) in the same column with different lowercase, superscript letters (a, b) are significantly ($p < 0.05$) different. There was no difference ($p > 0.05$) in the pH of milk within each group (before versus after treatment).

higher ($p < 0.05$) in milk of the CON group compared to the treated groups. Based on the Bovivet mastitis test, almost all udders of Saanen goats were considered positive for subclinical mastitis before the treatments. The numbers of udders positive for subclinical mastitis were reduced ($p < 0.05$) following the treatments with BNH, BTN or BNH + BTN (Table 2). There was no difference ($p > 0.05$) in the number of udders positive for subclinical mastitis within the CON group, between the before and after treatment.

Total viable bacteria in milk

The numbers of viable bacteria were higher ($p < 0.05$) in milk of the BNH + BTN and BNH groups than in that of other groups before the treatments. After the treatments, total viable bacteria were higher ($p < 0.05$) in milk of the CON group than in that of the treated groups (Table 3). With regard to the time effect, the number of viable bacteria increased ($p < 0.05$) after the treatment in the CON group. Conversely, the bacteria decreased ($p < 0.05$) in the BNH and BNH + BTN groups and remained unchanged in the BTN group after the treatment.

Serum albumin and globulin

The data of serum albumin, globulin and A/G ratio of Saanen goats are presented in Table 4. There were no differences ($p > 0.05$) in these mentioned parameters across the treatment diets. The parameters also did not change before and after the treatments.

Total fecal endoparasites

Table 5 shows the number of oocytes in the feces of Saanen goats. While there was no significant difference among groups

Table 2
Number of udders of Saanen goats with subclinical mastitis.

	Before treatment (subclinical mastitis udders/total udders)	After treatment (subclinical mastitis udders/total udders)
CON	9/10 ^{x*}	8/10 ^{x,a†}
BNH	9/10 ^x	0/10 ^{y,b}
BTN	9/10 ^x	2/10 ^{y,b}
BNH + BTN	8/10 ^x	1/10 ^{y,b}

CON = control diet (diet without binahong leaf meal or betel nut meal); BHN = diet supplemented with binahong leaf meal (1 g/kg body weight); BTN = diet supplemented with betel nut meal (1 g/kg body weight); BNH + BTN = diet supplemented with a combination of binahong leaf meal and betel nut meal (both 0.5 g/kg body weight).

* Means in the same row with different lowercase, superscript letters (x, y) are significantly ($p < 0.05$) different.

† Means in the same column with different lowercase, superscript letters (a, b) are significantly ($p < 0.05$) different.

Table 3
Total viable bacteria in Saanen goat milk.

	Before treatment ($\times 10^6$ colony forming units/mL)	After treatment ($\times 10^6$ colony forming units/mL)
CON	51.6 ± 0.15 ^{y*,a†}	116 ± 0.11 ^{x,a}
BNH	254 ± 0.17 ^{x,b}	79.3 ± 0.18 ^{y,b}
BTN	61.2 ± 0.15 ^{x,a}	58.4 ± 0.07 ^{x,b}
BNH + BTN	353 ± 0.22 ^{x,c}	66.4 ± 0.05 ^{y,b}

CON = control diet (diet without binahong leaf meal or betel nut meal); BHN = diet supplemented with binahong leaf meal (1 g/kg body weight); BTN = diet supplemented with betel nut meal (1 g/kg body weight); BNH + BTN = diet supplemented with a combination of binahong leaf meal and betel nut meal (both 0.5 g/kg body weight).

* Means (±standard error of the mean) in the same row with different lowercase, superscript letters (x, y) are significantly ($p < 0.05$) different.

† Means (±standard error of the mean) in the same column with different lowercase, superscript letters (a, b, c) are significantly ($p < 0.05$) different.

before the treatments, the numbers of oocytes in the feces were different after the treatments, when goats in the CON group had higher ($p < 0.05$) numbers of oocytes than those in other groups. Within each treatment group, there was no difference ($p > 0.05$) in the numbers of fecal oocytes before and after treatments.

Table 6 shows the number of fecal coccidial oocysts of Saanen goats. There was no difference ($p > 0.05$) in fecal coccidial oocysts among groups before the treatment. After the treatment, the number of coccidial oocysts in the feces of the CON group was higher ($p < 0.05$) when compared with those in the BTN or BNH + BTN groups (Table 6). With regard to the time effect, the number of fecal coccidial oocysts in the CON group was not different before and after treatment.

Milk production

The data on the milk production of Saanen goats are presented in Table 7. No significant difference in milk production was observed in Saanen goats both before and after the treatments. No effect of time (before versus after treatment) on milk production was observed.

Discussion

Mastitis (clinical and subclinical) is one of the most important diseases in dairy goats as this disease causes substantial milk yield loss (Megersa et al., 2010). Different from clinical mastitis that can be diagnosed by clinical examinations, the visible abnormalities in the udders and milk cannot be observed in dairy goats suffering from subclinical mastitis (Raikwar and Shukla, 2015). To detect subclinical mastitis in Saanen goats, pH indicator strips and mastitis card test were used in the present study. Indeed, these two methods are reliable diagnostic tests for subclinical mastitis in dairy goats (Andrews et al., 2004; Megersa et al., 2010; Raikwar and Shukla, 2015). In addition to these methods, Raikwar and Shukla (2015) suggested that microbial examination (total viable count method) could also be used for the diagnosis of subclinical mastitis in dairy goats. However, the latter method needs more time (for incubation) and is labor intensive. For this reason, the present study did not use microbial examination during the selection of the subclinical mastitic goats for the present trial.

Following the global concern about antibiotic resistance both in human and farm animals, research has been intensified to search for antibiotic substitutes for treating subclinical mastitis in dairy animals. As noted in the review earlier, binahong leaf and betel nut have long been known to have antimicrobial, antihelmintic and antioxidant activities that are beneficial for health. In humans,

Table 4

Serum albumin and globulin of Saanen goats*.

	Albumin (g/dL)		Globulin (g/dL)		A/G ratio	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
CON	3.99 ± 0.04	4.26 ± 0.18	4.23 ± 0.24	4.54 ± 0.27	0.95 ± 0.05	1.01 ± 0.07
BNH	3.95 ± 0.04	4.18 ± 0.11	3.78 ± 0.12	4.66 ± 0.24	1.05 ± 0.03	0.93 ± 0.07
BTN	3.67 ± 0.08	3.90 ± 0.15	3.42 ± 0.19	4.18 ± 0.11	1.10 ± 0.08	0.91 ± 0.04
BNH + BTN	3.94 ± 0.07	4.10 ± 0.08	4.05 ± 0.19	4.66 ± 0.11	0.98 ± 0.03	0.88 ± 0.02

A/G ratio = albumin to globulin ratio; CON = control diet (diet without binahong leaf meal or betel nut meal); BHN = diet supplemented with binahong leaf meal (1 g/kg body weight); BTN = diet supplemented with betel nut meal (1 g/kg body weight); BNH + BTN = diet supplemented with a combination of binahong leaf meal and betel nut meal (both 0.5 g/kg body weight).

* There was no difference ($p > 0.05$) in serum albumin, globulin and A/G ratio within each group (before versus after treatment) and among groups (within the sampling time).

binahong leaf and betel nut have traditionally been used for pharmaceutical purposes (Deshmukh and Gaikwad, 2014; Peng et al., 2015). However, the use of such herbal products for farm animals (as animal feeds or feed additives or supplements) is scarce. In the present study, binahong leaf meal, betel nut meal and a combination of both were investigated for their efficacy as potential antibiotic substitutes in treating subclinical mastitis in lactating Saanen goats. Due to practical reasons in the present study, binahong and betel nut were administrated as supplements in the diets (provided orally). To evaluate the efficacy of binahong leaf meal and betel nut meal in treating subclinical mastitis in Saanen goats, the samples of milk, blood and feces were collected (before and after treatment) and analyzed for pH, number of udders with subclinical mastitis (based on mastitis indicator paper), total viable bacteria, serum albumin and globulin, fecal numbers of oocytes and coccidial oocysts, as well as milk production. In most parameters, the effect of time was not observed which was indicated by no significant difference, especially in the CON group, before and after treatment. Hence, the interpretation of the results focused on the treatment effects, instead of the time effect.

The present data showed that dietary inclusion with binahong, betel nut and their combination decreased the pH of milk from 6.84 in the CON group to about 6.64 in the treated groups. The pH of normal milk ranges between 6.60 and 6.80, and higher pH values may indicate subclinical mastitis (Andrews et al., 2004). The present data therefore confirmed that treatments with binahong, betel nut or a combination of both showed potential to reduce subclinical mastitis in lactating Saanen goats. Concomitant with the data of pH, the Bovivet mastitis test showed that the treatments could reduce the number of udders with subclinical mastitis. The number of viable bacteria in milk has long been used as an indicator of mastitis in dairy goats, in which udders from the infected goats have the potential to shed more bacteria in milk produced (Raikwar and Shukla, 2015). In the present study, dietary treatments with binahong leaf meal, betel nut meal or both decreased the number of viable bacteria in goat milk. This data further supported binahong

leaf meal and betel nut meal as potential alternative to antibiotics for treating subclinical mastitis in lactating goats. The mechanism through which binahong leaf meal and/or betel nut meal decreased the pH, number of viable bacteria and thus number of udders with subclinical mastitis is largely unknown. However, one possible mechanism could be that the antimicrobial activities of binahong leaf and betel nut might reduce the number of viable bacteria responsible for subclinical mastitis in the udders of goats. Indeed, the decreased number of bacteria in milk has been associated with the decreased number of somatic cell counts (SCC) and pH value of milk (Sharma et al., 2011). Apart from the antimicrobial activities, the antioxidant potentials of binahong leaf meal and betel nut meal may to some extent help the goats recover from mastitis (Yang and Li, 2015). Karyak et al. (2011) reported that antioxidants decreased the number of SCC (and thus the pH value) and the prevalence of subclinical mastitis in cows. In the present study, the antioxidant potentials in binahong leaf meal and betel nut meal may improve the immune competences of Saanen goats (Yang and Li, 2015) and hence, bacterial proliferation and infection causing mastitis could be counteracted.

The albumin-to-globulin ratio has been considered as an indicator of immune response in farm animals, in which a lower A/G ratio may implicate an immune response of animals against infections (Sugiharto et al., 2016). In the case of mastitis, Pandey et al. (2012) and Singh et al. (2014) reported that the A/G ratio decreased in subclinically and clinically infected dairy cows as a result of no significant change in albumin and the increased synthesis of gamma globulin. The increase in globulin could have been due to the presence of infectious bacteria in the udders of animals suffering from mastitis (Singh et al., 2014). In the present study, noticeable differences in the A/G ratio were not observed among the treatment groups, which was therefore different from the above earlier studies. Indeed, the present data were concomitant with Ibrahim et al. (2017), who reported no difference in serum

Table 5

Number of oocytes in feces of Saanen goats.

	Before treatment (100 eggs/g)	After treatment (100 eggs/g)
CON	1.73 ± 0.07	1.70 ± 0.07 ^a
BNH	1.51 ± 0.10	1.19 ± 0.14 ^b
BTN	1.46 ± 0.15	1.17 ± 0.20 ^b
BNH + BTN	1.19 ± 0.19	0.80 ± 0.10 ^b

CON = control diet (diet without binahong leaf meal or betel nut meal); BHN = diet supplemented with binahong leaf meal (1 g/kg body weight); BTN = diet supplemented with betel nut meal (1 g/kg body weight); BNH + BTN = diet supplemented with a combination of binahong leaf meal and betel nut meal (both 0.5 g/kg body weight).

* Means (±standard error of the mean) in the same column with different letters (a, b) are significantly ($p < 0.05$) different. There was no difference ($p > 0.05$) in the number of oocytes within each group (before versus after treatment).

Table 6

Number of coccidial oocysts in feces of Saanen goats.

	Before treatment (× 100 oocysts/g)	After treatment (× 100 oocysts/g)
CON	3.93 ± 0.24 ^x	3.22 ± 0.43 ^{x,a1}
BNH	3.53 ± 0.11 ^x	2.31 ± 0.38 ^{x,ab}
BTN	3.82 ± 0.15 ^x	1.55 ± 0.47 ^{y,b}
BNH + BTN	3.92 ± 0.25 ^x	1.32 ± 0.30 ^{y,b}

CON = control diet (diet without binahong leaf meal or betel nut meal); BHN = diet supplemented with binahong leaf meal (1 g/kg body weight); BTN = diet supplemented with betel nut meal (1 g/kg body weight); BNH + BTN = diet supplemented with a combination of binahong leaf meal and betel nut meal (both 0.5 g/kg body weight).

* Means (±standard error of the mean) in the same row with different letters (x, y) are significantly ($p < 0.05$) different.

¹ Means (±standard error of the mean) in the same column with different letters (a, b) are significantly ($p < 0.05$) different.

Table 7
Milk production of Saanen goats*.

	Before treatment (mL/goat/d)	After treatment (mL/goat/d)
CON	1626 ± 219	1404 ± 170
BNH	1487 ± 206	1763 ± 255
BTN	1650 ± 268	1797 ± 188
BNH + BTN	1652 ± 98	1677 ± 103

CON = control diet (diet without binahong leaf meal or betel nut meal); BHN = diet supplemented with binahong leaf meal (1 g/kg body weight); BTN = diet supplemented with betel nut meal (1 g/kg body weight); BNH + BTN = diet supplemented with a combination of binahong leaf meal and betel nut meal (both 0.5 g/kg body weight).

* There was no difference ($p > 0.05$) in milk production within each group (before versus after treatment) and among groups (within the sampling time).

albumin, globulin and the A/G ratio between Holstein mastitic cows and healthy cows as the control. The definite rationale for these divergent results is unclear, but the different severity of infection and species of dairy animals used in the studies may be the reason (Pandey et al., 2012).

Gastrointestinal nematode infection, due to the presence of nematodes or helminths in the gastrointestinal tract, has been known as a major threat for health and production of dairy goats (Hoste et al., 2011). Concurrent with this disease, coccidial infections (caused by different species of *Eimeria*) often occur, which may further aggravate the health and production of goats (Shija et al., 2014). The present results showed that dietary treatments with binahong leaf meal, betel nut meal or both decreased the number of oocytes and coccidial oocysts in the feces of Saanen goat. Thus, it could be assumed that the load of endoparasites of the gastrointestinal tract was diminished due to the treatments. The antimicrobial and anti nematodal/helminthic effects of binahong and betel nut seemed to be responsible in this case. Eventually, the improved health of lactating Saanen goats was related to the increased milk production in the present study, although the difference was not significant.

Dietary supplementation of binahong leaf meal, betel nut meal and a combination of both showed potential to reduce the endoparasitic load in the gastrointestinal tract and to reduce subclinical mastitis in lactating Saanen goats.

Conflict of interest

There is no conflict of interest.

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