# Effect of Mineral Supplementation and Introduction of Setaria sphacelata Grass and Gliricidia sepium Legume on Productivity of Kacang Goat at Serang River Basin Upland Area, Central Java, Indonesia

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# Effect of Mineral Supplementation and Introduction of *Setaria sphacelata* Grass and *Gliricidia sepium* Legume on Productivity of Kacang Goat at Serang River Basin Upland Area, Central Java, Indonesia

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**Abstract:** This experiment was conducted at the upland area of Serang river basin, to study the influence of *Setaria sphacelata* grass and *Gliricidia sepium* legume forages feeding in combination with mineral supplementation on nutritional status and performance of Kacang goat. Twenty four male Kacang goats (14.01 ±0.6 kg) were used as experimental materials. First factor were: F0 (100% conventional forage), F1 (70% conventional forage+ 30% *Setaria),* F2 (40% conventional forage+ 30% *Setaria* + 30% *Gliricidia),* F3 (20% conventional forage + 30% *Setaria* + 50% *Gliricidia).* The second factor, namely: S0 (without supplementation) and S1 (mineral supplementation). The data were analyzed by analysis of variance with 4 x 2 x 3 factorial arrangement in randomized completely block design. The dry matter (DM) consumption in F2 and F3 were higher ($p<0.05$) than that in F0 and F1 treatment groups (301.1 and 328.9 vs 219 and 241.7 g/head/day, respectively). The *in vivo* dry matter digestibility (IVoDMD) in F2 and F3 were higher ($p<0.05$) than that in F1, but non significantly different from F0. The average daily gain (ADG) of goats in F0, F2 and F3 were higher ($p<0.05$) than F1 treatment group (namely: 35.72, 35.95 and 37.42 vs 34.55 g/head/day). Feeding 30% *Setaria sphace/ata* grass and 50% *Gliricidia sepium* legume increased ADG of Kacang goat. Mineral supplementation improved the Ca and P status and Kacang goat ADG.

**Key words:** Mineral, *Setaria sphacelta, Gliricidia sepium,* kacang goat, upland area

## INTRODUCTION

Kacang goat is one of the indigenous livestock in Indonesia, with characteristic: body small and short, ears small, short neck, elevated back, males and females are horned, average height for adult males ranges from 60-65 cm and females 56 cm, adult body weight for males about 25 kg whereas for females 20 kg (Merkel and Subandriyo, 1997). Central Java is province with highest goat population in Indonesia. The main habitat of that animal is in upland area and/or the upstream river basin. Serang River basin is one of production center of goat in Central Java. Almost the entire population of goats were reared by farmers traditionally. Goat husbandry is prospectively developed at the farming level. That based on several factors, among other its price affordable by farmers, precocious, short reproduction cycles and prolific (average of 2 kids per birth). The housing for goat is simple and not so broad, feed for goat also simple compared to big ruminant.

Feed goats reared traditionally only forages with variations in quantity and quality, depend on climate and soil fertility. In addition to deficient in protein, tropical forage often deficient in mineral, especially at upland area, in this case at upstream river basin, because erosion and leaching (McDowell *et al.,* 1983). The mineral closely related to animal growth as well as fertility, because its importance role in protein and energy metabolism and in turn animal products biosynthesis Mineral deficiency could result in decreasing of feed consumption and feed efficiency, decreasing of daily body weight gain and fertility of animal (Suttle, 2010).

Based on above description, the excellent forages need to be introduced to increases the feed quality for that ruminant. *Gliricidia sepium* legume is protein source forage at once can increase the soil fertility, whereas *Setaria sphace/ata* is high quality grass with high dry matter production at once as soil conservation plant, because can avoid the erosion and leaching. Those characteristic are importance to reach the sustainable productive goat farming at upland area. Mineral supplementation also need to be conducted to increase the nutrient utilit and in turn the increasing of goat productivity. The aim of this experiment to study the influence of Setaria sphacelata and Gliricidia forages feeding in combination with mineral supplementation on nutritional status and performance of Kacang goat. This investigation also resulted the information about the importance of mineral supplementation in tropical river basin upland area and the guide to mineral supplement formulation.

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## MATERIAL AND METHODS

**Experimental materials and procedures:** This investigation was conducted for 3 months at 3 location at Serang river basin upland area. The 24 heads of yearling male Kacang goat were used as experimental unit. Mineral mixture, *Setaria sphacelata* grass, *Gliricidia sepium* legume and conventional forages were used as feed.

There were 2 treatment factors, namely excellent forage introduction (F) as factor I and mineral supplementation (S) as factor II. Factor I consist of 4 treatments, namely F0 (100% conventional forage), F1 (70% conventional forage + 30% Setaria sphacelata grass), F2 (40% conventional forage + 30% *Setaria sphacelata* grass + 30% *Gliricidia sepium* legume), F3 (20% conventional forage + 30% *Setaria sphcelata* grass + 50% *Gliricidia sepium* legume). Factor II consist of 2 treatments, were S0 (without mineral supplementation) and S1 (mineral supplementation), respectively. Conventional forage was forage mixture which usually fed for goat by local farmer. The 24 heads of experimental goat were divided into 3 block based location, as replication. Nutrient composition of forages listed in Table 1, whereas mineral composition listed in Table 2.

**Variable measurement:** The measured variables included *in vivo* dry matter digestibility (IvoDMD) and *in vivo* organic matter digestibility (IVoOMD); ruminal volatile fatty acid (VFA), ammonia ($NH_3$) and total protein production; calcium (Ca) and phosphor (P) concentration in feed, blood serum and feces; feed dry matter (OM) consumption and average daily gain (ADG). Determination of IVoDMD and IVoOMD were conducted by total collection method (Galyean, 1980). Total VFA production was measured by steam distillation method, ($NH_3$) production was analyzed by Conway microdiffusion, whereas total protein production was determined by Kjeldahl method (AOAC, 1990). Determination of Ca and P concentration in feed, blood serum and feces were conducted by spectrophotometry method (Fick *et al*, 1979). Feed consumption data were obtained through deducted the fed ration by the rest feed. Weighing of the body weight was conducted every week. Nutrient composition of feeds were determined by proximate analysis according to Weende method (Galyean, 1980).

**Statistical analysis:** The collected data were processed statistically by analysis of Variance (ANOVA) with factorial treatment patterns 4 x 2 x 3, in randomized completely block design (Steel and Torrie, 1980). Data processing was done by co-stat program.

## RESULTS AND DISCUSSION

All of statistically processed data were listed in Table 3. Those included the data of OM and nutrient consumed, feed utility, mineral status and goat performance.

**Dry matter consumption:** Feed dry matter consumption by experimental goat in F0, F1, F2 and F3 treatment groups were 219, 241, 301 and 328 g/head/day, respectively. Analysis of variance shovved that there were the influence of forage treatment on dry matter consumption ($p<0.05$). Dry matter consumption by goats in F2 and F3 treatment groups were higher ($p<0.05$) than those in F0 and F1 treatment groups. There were not significantly difference in feed consumption between F0 and F1 treatment groups and between F2 and F3 treatment groups. Dry matter consumption in F2 and F3 treatment groups were higher ($p<0.05$) than those in F0 and F1 treatment groups. It was fathomed that IVoDMD in F2 and F3 treatment groups were higher than that in F1 treatment group and tend higher than that in F0 treatment group. Feed with higher digestibility, have the shorter retention time in the rumen. Retention time of digesta in the rumen is decreased along with increasing of its digestibility. Decreasing of retention time resulted in decrease the rumen distention, so that stimulates the appetite and then increase the feed consumption (Nikkah, 2014).

Feed dry matter consumption also related to fiber level which reflected the balkiness of that feed. Feed with low fiber level will be consumed on high consumption level. In addition, goat have selective character, tends prefer the nutritious feed (Ondiek *et al*, 2013). Table 3 showed that the crude protein level of feed in F2 and F3 treatment groups were higher than those in F0 and F1 treatment groups (18.77 and 18.35% vs 17.20 and 16.44%). The higher legume proportion in F2 and F3 lead to the higher crude protein level than those in F0 and F1 treatment groups.

Feed consumption by mineral supplemented (S1) goat and unsupplemented (S0) goats were 276 and 269 g/head/day, respectively. Feed consumption by mineral supplemented goat tended higher than unsupplemented goats. Those phenomenon suitable to IVoDMD, which was in S1 treatment group tended higher than IVoDMD in SO treatment group. Nikkah (2014) stated that feed consumption rate also influenced by metabolic rate in animal tissue. The higher metabolic rate increased the energy requirement to supported those metabolic activity, so that the animal were stimulated to consume the more feed. Soetan *et al* (2010) stated that metabolic rate was supported by adequate mineral supply. Feed consumption in S1 treatment group which tended higher than SO treatment group was fathomed also caused by higher metabolic rate in S1 treatment group goats than SO treatment group goats. The higher metabolic rate in mineral supplemented goats were reflected in higher ADG compared to those of unsupplemented goats.

***In vivo* dry matter and organic matter digestibility:** The IVoDMD in F0, F1, F2 and F3 treatment groups were 66.37, 64.76, 66.82 and 67.60%, respectively whereas

Table 1: Nutrient composition of experimental forages

| Feed stuff | CF (%) | CP (%) | EE (%) | NFE (%) | Ash (%) |
|---|---|---|---|---|---|
| *Setaria sphacelata* grass | 29.8 | 4.1 | 1.8 | 54.90 | 10.93 |
| *Gliricida sepium* legume | 20.3 | 21.2 | 2.2 | 43.4 | 12.9 |

CF: Crude fibre, CP: Crude protein, EE: Ether extract, NFE: Nitrogen free extract

Table 2: Mineral supplement composition

| Mineral | Percent | Source |
|---|---|---|
| Phosphorus | 14.0 | Bone meal |
| Cobalt | 0.004 | Cobalt carbonate |
| Copper | 0.4 | Copper carbonate |
| Iodine | 0.032 | Calcium iodate |
| Manganase | 1.0 | Manganase sulfate |
| Zinc | 2.0 | Zinc oxide |
| Iron | 2.0 | Ferrous sulfate |
| Selenium | 0.004 | Sodium selenite |

its IVoOMD were 68.24, 65.89, 69.11 and 70.46%, respectively. Analysis of variance showed that there were influence of forages introduction on IVoDMD and IVoOMD ($p<0.05$). Mean difference test between treatment groups showed that IVoDMD in F2 and F3 treatment groups were higher than those in F1 treatment group ($p<0.05$). The IVoDMD in F0 treatment group was not different from the other treatments group, but tended higher than F1 treatment group. The IVoDMD pattern was similarly to IVoOMD pattern. The IVoOMD in F0, F2 and F3 were higher than those in F1 treatment group ($p<0.05$).

Crude fiber (CF) level of consumed feed in F1 treatment group was higher, whereas its crude protein (CP) level was lower than that in F0 treatment group. Those resulted in the lower IVoOMD and tended lower IVoDMD in F1 than F0 treatment group. The CP and CF levels of consumed feed in F0 treatment group, were 17.20 and 25.79%, respectively, whereas in F1 treatment group were 16.44 and 27.91 %, respectively (calculated based on data in Table 3). Crude fiber was feed organic matter component which slow digestible than other component, so that feed digestibility decreased along with increasing of CF level (Atrian and Shahryar, 2012; Mao *et al.,* 2013; Rahim *et al.,* 2013). Protein is one of essential compound for rumen microbe proliferation. The availability of those in adequate amount will support rumen microbe proliferation, so that increase its fermentation activity (Kamra, 2005; Maeda *et al.,* 2012; van de Vyver and Useni, 2012). The higher Ca and P level in F0 than F1 of consumed feed in F0 than F1 treatment group.

The consumed feed CF level in F2 and F3 treatment groups, were 29.32 and 29.61 %, respectively. Those CF levels were higher than that in F1, but IVoDMD and IVoOMD in F2 and F3 treatment groups were higher than F1. It was caused by more dominant influence from other several aspect, namely higher CP, Ca and P levels than those in F1 (18.40 and 18.80 vs 16.56%; 1.34 and 1.27 vs 1.23%; 0.34 and 0.35 vs 0.30%) (calculated based on data in Table 3). The IvoDMD and IvoOMD of consumed feed in F1 treatment group tended higher than unsupplemented treatment group (F0). The IVoDMD in F0 and F1 treatment groups were 66.15 and 66.63%, whereas its IVoOMD were 67.93 and 68.29%, respectively. Mineral was closely related to feed component fermentation which highly influenced the digestibility, especially cellulose. Those mineral among other Ca and P. The most potential ruminal cellulolytic microbe in cellulose digestion was *Bacteroides succinogenes* because its capacity to cristalline cellulose degradation (Sudake *et al,* 2013). Cristaline cellulose more difficult to be degraded as compared to amorf cellulose. Cellulase enzyme from *Bacteroides succinogenes* was exoenzyme which bound on outer membrane, so that its catalytic activity was effective if adhesion between those microbe and feed particle was occurred. Calcium element increased the positive charge of feed particle, so that facilitating the adhesion between those microbe and feed particle, thus resulting in increased feed digestibility (Jun *et al,* 2007). In addition to Ca, P also had a role in microbial digestion process, because P was essential element which supported the microbe normal function, especially cellulose digester microbes (Soetan *et al,* 2010).

**Production of ammonia, volatile fatty acid and total protein:** There were the influence of feeding *Setaria shacelata* grass and *Gliricidia sepium* legume on ruminal ammonia ($NH_3$) production ($p<0.05$). Mean difference test between treatment groups showed that $NH_3$ production in F2 treatment group was higher ($p<0.05$) than $NH_3$ production in F0, F1 and F3 treatment groups (5.89 vs 5.06; 5.01 and 5.02 mM). There were not significant difference in ruminal $NH_3$ production between F0, F1 and F3 treatment groups. There were two main factors which influenced the ruminal $NH_3$, namely feed CP level and CP degradability in the rumen. Data in Table 3 showed that consumed feed CP level in F2 treatment group was higher than those in F0 and F1, because of feeding *Gliricidia sepium* forage as ration component (30%). In addition, feed IVoOMD which reflected the feed protein degradability in F2 treatment group was higher than F0 and F1 treatment groups. Both resulted in higher ruminal $NH_3$ production in F2 than F0 and F1 treatment groups. Ruminal $NH_3$ production in F3 was lower than F2 treatment group, although its protein level and IVoOMD were higher than F2. Those phenomenon was occurred expected as a result of the use of $NH_3$ for microbe protein synthesis which higher than F2 treatment group. Those were reflected in the lower of VFA production in F3 than F2 treatment group, although the IVoOMD in F3 was higher than F2 treatment group.

**Table 3.** Dry matter and nutrient consumption, ruminal fermentability, calcium and phosphorus status and experimental goat performance

| | SO | | | | S1 | | | | Mean of S | | Mean of F | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F0 | F1 | F2 | F3 | F0 | F1 | F2 | F3 | S0 | S1 | F0 | F1 | F2 | F3 |
| **Consumption** | | | | | | | | | | | | | | |
| DM (g) | 198±21 | 253±21 | 305±13 | 319±26 | 241±28 | 229±27 | 297±25 | 338±15 | 269±18 | 276±16 | 219±18$^{a}$ | 241±21$^{a}$ | 301±15$^{b}$ | 328±13$^{b}$ |
| CF (g) | 54.37±5.94 | 71.60±11.64 | 89.52±16.54 | 95.22±8.12 | 56.64±2.03 | 69.12±9.31 | 87.09±7.42 | 99.56±1.23 | 77.68±6.01 | 78.10±5.82 | 55.51±2.85$^{b}$ | 67.86±8.86$^{b}$ | 88.31±4.47$^{a}$ | 97.39±3.78$^{a}$ |
| CP (g) | 34.23±3.84 | 41.96±6.67 | 55.99±4.37 | 59.96±4.34 | 41.41±2.93 | 37.87±4.97 | 34.46±4.28 | 63.40±1.71 | 48.03±3.87 | 49.28±3.57 | 37.82±3.26$^{b}$ | 39.91±3.83$^{b}$ | 55.22±2.75$^{a}$ | 61.68±2.22$^{a}$ |
| TDN (g) | 141.96±11.85 | 176.29±28.19 | 222.31±15.11 | 232.34±21.73 | 172.94±24.30 | 159.80±22.38 | 214.96±20.75 | 244.34±4.48 | 193.22±13.96 | 198.01±13.16 | 157.45±13.92$^{b}$ | 168.04±16.49$^{b}$ | 218.63±11.58$^{a}$ | 238.34±10.26$^{a}$ |
| Ca (g) | 2.82±0.92 | 3.01±0.94 | 4.25±0.32 | 3.87±0.47 | 2.97±0.75 | 2.93±0.88 | 3.82±0.63 | 4.45±0.51 | 3.49±0.36 | 3.54±0.35 | 2.89±0.53 | 2.97±0.58 | 4.43±0.33 | 4.16±0.34 |
| P (g) | 1.01±0.45 | 0.76±0.16 | 0.92±0.12 | 1.32±0.23 | 0.62±0.13 | 0.75±0.12 | 1.11±0.04 | 0.96±0.05 | 1.002±0.04 | 0.85±0.07 | 0.82±0.23 | 0.73±0.09 | 1.01±0.07 | 1.14±0.19 |
| **Ruminal Fermentability** | | | | | | | | | | | | | | |
| IVo DMD (%) | 65.95±1.10 | 64.75±1.78 | 66.40±0.63 | 67.49±0.52 | 66.79±1.81 | 64.77±1.41 | 67.74±0.34 | 67.71±0.55 | 66.15±0.56 | 66.63±0.53 | 219±18a | 64.76±1.04 | 66.82±0.38 | 67.60±0.35 |
| IVo ODM (%) | 67.88±2.05 | 65.85±2.50 | 68.72±0.79 | 69.29±0.94 | 68.62±2.57 | 65.92±1.31 | 69.50±0.35 | 69.12±0.74 | 67.43±0.69 | 68.29±0.76 | 68.24±1.45 | 65.89±0.91 | 69.11±0.42 | 69.21±0.55 |
| $NH_3$(mM) | 4.93±0.08 | 4.99±0.19 | 5.45±0.03 | 5.15±0.19 | 5.19±0.20 | 5.03±0.12 | 6.33±0.42 | 4.90±0.90 | 5.13±0.08 | 5.36±0.20 | 5.06±0.11$^{a}$ | 5.01±0.10$^{a}$ | 5.89±0.27$^{b}$ | 5.03±0.11$^{a}$ |
| VFA (mM) | 97.33±5.93 | 124.00±11.15 | 127.30±1.33 | 110.70±19.2 | 94.00±6.12 | 112.00±19.44 | 122.00±7.58 | 112.00±11.73 | 114.80±6.08 | 110.00±6.09 | 95.70±3.96$^{a}$ | 118.00±105.58$^{ab}$ | 124.70±3.71$^{b}$ | 111.30±10.27$^{ab}$ |
| Total Protein (mg/g) | 191.00±33.45 | 245.50±63.15 | 210.20±53.75 | 166.50±52.53 | 235.80±61.33 | 171.20±43.16 | 250.00±40.45 | 243.40±47.82 | 203.30±29.45 | 225.10±22.90 | 213.40±33.45 | 208.30±52.84 | 230.10±31.45 | 204.90±36.23 |
| **Ca Status** | | | | | | | | | | | | | | |
| Feed (%) | 1.21±0.24 | 1.22±0.29 | 1.27±0.14 | 1.31±0.13 | 1.41±0.38 | 1.12±0.26 | 1.40±0.08 | 1.20±0.05 | 1.26±0.09 | 1.28±0.21 | 1.31±0.20 | 1.17±0.18 | 1.34±0.11 | 1.26±0.07 |
| Blood Serum (mg/100 ml) | 10.43±0.66 | 9.47±0.84 | 10.77±1.89 | 10.63±1.17 | 13.77±3.07 | 10.63±1.65 | 9.90±1.42 | 10.67±1.90 | 10.33±0.55 | 11.24±1.01 | 12.10±1.59 | 10.05±0.87 | 10.34±1.08 | 10.65±0.99 |
| Feces (%) | 2.40±0.43 | 2.14±0.17 | 2.74±0.17 | 2.26±0.26 | 2.52±0.32 | 2.65±0.44 | 2.61±0.36 | 2.16±0.34 | 2.39±0.14 | 2.49±0.17 | 2.46±0.25 | 2.40±0.24 | 2.68±018 | 2.21±0.20 |
| **P Status** | | | | | | | | | | | | | | |
| Feed (%) | 0.25±0.04 | 0.30±0.03 | 0.38±0.03 | 0.28±0.01 | 0.58±0.32 | 0.30±0.03 | 0.31±0.02 | 0.41±0.06 | 0.30±0.02 | 0.40±0.07 | 0.42±0.16 | 0.30±0.02 | 0.35±0.02 | 0.35±0.04 |
| Blood Serum (mg/100 ml) | 3.67±1.46 | 3.37±0.90 | 3.50±0.74 | 3.93±1.18 | 4.98±0.61 | 4.73±0.84 | 4.86±0.86 | 4.67±0.54 | 3.62±0.48 | 4.80±0.31 | 4.30±0.76 | 4.05±0.63 | 4.18±0.59 | 4.30±0.61 |
| Feces (%) | 0.42±0.04 | 0.46±0.06 | 0.43±0.02 | 0.36±0.05 | 0.40±0.03 | 0.49±0.08 | 0.43±0.03 | 0.35±0.01 | 0.42±0.02 | 0.44±0.02 | 0.41±0.024 | 0.48±0.04 | 0.47±0.02 | 0.37±0.02 |
| **Performance** | | | | | | | | | | | | | | |
| ADG (g / day) | 34.60±0.12 | 33.33±0.37 | 35.39±0.32 | 36.89±0.49 | 36.83±0.77 | 35.77±1.50 | 36.52±0.32 | 37.15±0.81 | 35.06±0.40 | 36.77±0.43 | 35.72±0.62 | 34.55±1.11 | 35.45±0.33 | 37.40±0.49 |

S: mineral supplementation treatment; S0 without mineral supplementation; S1: with mineral supplementation; F: forage introduction; F0: 100% conventional forage; F1: 70% conventionl forage + 30% *Setaria sphacelata grass*; F2: 40% conventional forage + 30% *Setaria sphacelata* grass + 30% *Gliricidia sepium* legume; F3: 20% conventional forage + 30% *Setaria sphacelata* grass + 50% *Gliricidia sepium* legume; DM: dry matter; CF: crude fiber; CP: crude protein; TDN: total digestible nutrient; Ca: calcium; P: phosphorus; IVoDMD: *in vivo* dry matter digestibility; IVoOMD: *in vivo* organic matter digestibility NH3: ruminal ammonia; VFA: ruminal volatile fatty acids; Ca: calcium; P: phosphorus; ADG: average daily gain. The different superscript in the same row showed the significant difference ($P < 0.05$).

Ruminal $NH_3$ production in mineral supplemented goats were not significantly different from those in unsupplemented goats, namely 5.36 and 5.13 mM, respectively. It was presumably because there were not feed protein degradability difference which reflected in not different IVoOMO. In addition, its protein level also not significantly different (17.66 in S0 and 17.72 in S1 treatment group).

There were the influence of feeding Setaria sphacelata grass and Gliiricidia sepium legume on ruminal VFA production ($p<0.05$). Ruminal VFA production in F0, F1, F2 and F3 treatment group, were 95.7; 118.0; 124.0 and 111.3 mM, respectively. Mean difference test between treatments showed that ruminal VFA production in F2 treatment group was higher ($p<0.05$) than F0 treatment group. Between F0, F1 and F3 treatment groups were not significant difference of ruminal VFA production, likewise between F1, F2 and F3 treatment groups.

Ruminal VFA production in F2 tended higher than F0, although IVoOMO in F0 was higher ($p<0.05$) than F1. It could occurred because the more use of intermediate compound (especially from carbohydrate degradation) as carbon skeleton for microbial protein biosynthesis. It was seen from total protein production in F0 which tended higher than those in F1 treatment group. The high IVoOMO in F2 treatment group also resulted in high VFA production. Ruminal VFA production in F3 tended decrease compared to F2, although its IVoOMO tended higher than F2. It presumably because in F3 the use level of intermediate compound (carbon skeleton) for microbial protein biosynthesis was higher than those in F2 treatment group. Microbial protein biosynthesis in F3 also presumably stimulated by availability of branch chain VFA from true protein degradation, which its proportion in F3 was higher than F2 treatment group. It was based on *Gliricidia* proportion in F3 which higher than F2 treatment group (50%). Has been known that legume in addition to higher protein content than non legume, its true protein proportion also higher than non legume. Total protein production between F2 and F3 treatment group were not significantly different because based on IVoOMO presumably the bypassed protein in F2 was higher than F3 treatment group.

Ruminal total protein production in mineral supplemented goats tended higher than those in unsupplemented goats, namely 225.1 mg/g vs 203.03 mg/g. Based on IVoOMO which tended higher and VFA production which lower in S1 compared to those in S0 treatment group, then the tendency of higher total protein production in S1 treatment group presumably caused by the high microbial protein biosynthesis as result of mineral supplementation. Mineral supplementation enable the essential mineral requirement of microbe for normal function was fulfilled and in turn stimulate its proliferation and fermentation activity (Genther and Hansen, 2014).

**Mineral status and body weight gain of experimental goat:** Mineral analysis of experimental goats blood serum showed the Ca and P level of unsupplemented goats blood serum were 10.33 and 3.62 mg/100 ml, respectively. According to Georgievskii *et al.* (1979), that was in the normal range of blood serum Ca level of goat (10-12 mg/100 ml), but P level showed the deficiency. The normal range of blood serum P level in goat, according to Georgeevskii was 4-6 mg/100 ml.

Conventional forage analysis showed that Ca and P level in that forage had met goat requirement (1.131 and 0.41% respectively). According to Kearl (1982), the adequate feed Ca and P levels for goat were 0.3 and 0.22%, respectively. Those goat mineral status that showed deficiency, presumably caused by the low of mineral bioavailability of feed. According to Church (1988), biovailability of feed Ca and P, were only 50 and 48%, respectively. If there were antinutrition substance, among other oxalate compound, it became to lower. Those blood serum Ca level which found in the normal range, essentially still be doubtful for determined the mineral status of animal. It based on the reality, that there were difficulty to determined the Ca deficiency, because of the homeostatic mechanism. The blood Ca was not responsive to Ca intake, because when Ca level decrease, Ca deposit in bone will be mobilized to prevent the decreasing of blood Ca (Sayed *et al.*, 2012). The Ca homeostasis regulation closely related to calcitonin and parahormone secretion. Hipercalcemia cause release calcitonin and inhibit parahormone secretion, whereas hypocalcemia stimulate the opposite effect. Parahormone stimulates Ca absorption in the intestine, Ca resorption in bone and vitamin O hydroxylation from 25-hydroxy cholecalciferol (25(OH) 03) to 1-25 dihydroxycholecalciferol (1,25 (OH) 203) in kidney. This recent compound also stimulates the Ca absorption in intestine. Calcitonin have opposite action (Galea and Blundell, 2011).

Mineral supplementation resulted in blood serum Ca level tended higher than without supplementation (4.8 vs 3.62 mg/100 ml for P and 11.24 vs 10.33 mg/100 ml for Ca). The increasing of those mineral level statistically not significant, but physiologically very important, especially for P, because it showed the increasing of P level reach the normal range.

There were not significant difference in feed Ca and P levels as well as blood serum Ca and P levels between forage feeding treatment groups. Analysis of variance showed there were the influence of forage feeding treatment on feces Ca and P levels. It seen that little variation in mineral level and not significant statistically, could lead to significant difference in those mineral excretion with feces. It presumably caused by interaction between Ca, P and other several mineral and nutrient as well as antinutrtion substance which influenced its availability. Homeostatic mechanism seen in the

absence of significant variation in blood serum mineral also lead to mineral excretion variation, through its influence on absorption and excretion of endogenous fecal mineral.

There were influence of feeding Setaria sphacelata grass and Gliricidia sepium legume on average daily body weight gain (ADG) of experimental goats. The ADG of F1 experimental goat was lower ($p<0.05$) than ADG of those in F0, F2 and F3 (34.55 vs 35.72; 35.95 and 37.42 g). The highest ADG ($p<0.05$) found in F3 treatment group, whereas between F0 and F2 treatment groups there was no significant difference. The consumed feed in F0 showed higher CP, TON and total protein than F1 treatment group, so that could result in higher ADG than F1 treatment group. Level of CP, TON and total protein production in F0 were equivalent to those in F2 treatment group, that reflected in non significantly different of ADG between those two experimental animal groups. The ADG in F3 treatment group was highest although consumed CP and TON as well as its total protein production equivalent to F2 treatment group. Presumably, quality of total protein in F3 was higher than other treatment groups. It was based on presumably that the microbial protein proportion was higher. The biological value of microbial protein was higher than forage protein. In addition, legume protein bypass also higher than the other treatment groups. Those legume protein especially derived from *gliricidia* and other conventional legume.

In addition to increase the feed utility as nutrient source through rumen microbial function, mineral supplementation also ensure the mineral supply to support the metabolic activity in tissue (Church, 1988). Those increasing of nutrient availability and metabolic activity will increase tissue biosynthesis process in turn increase ADG. It proved to higher ADG of supplemented mineral goats ($p<0.05$) than ADG of unsupplemented goats (36.77 vs 35.06 g/head/day).

**Conclusion:** The CP consumption and Ca status of Kacang goats at upland area of Serang river basin in normal range, whereas TON consumption and P status below normal range. Feeding 30% *Setaria sphace/ata* grass and 50% *Gliricidia sepium* legume in combination with conventional forage increased OM consumption, IVoDMD, IVoOMD and ADG of Kacang goat. Mineral supplementation tend increased feed consumption and capacity of goat to utilized the feed. Mineral supplementation improved mineral status (in this case Ca and P) and increased the Kacang goat ADG at upland area of Serang river basin.

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