Research Article

Supplementing Basal Diet with Sesbania Grandiflora Tablet (SG_{tab}) and its Effect on Semen Quality of Kacang Buck

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Abstract | The study was designed to determine the effect of Sesbania Grandiflora tablet (SG_{tab}) supplementation in a basal diet on the semen quality of the Kacang Buck. This study was conducted on 10 mature bucks with good libido and an average age and body weight of 2.7±0.35 years and 28.4±2.4 kg, respectively. All experimental bucks received a daily diet of native grass equal to 10% of body weight from day 1 to day 20. From days 21 to 35, they received a diet the same as days 1 to 20, in addition to SG_{tab}. Semen was collected using an artificial vagina for 6 consecutive ejaculates at an interval of 120 h from each experimental buck. Fresh semen was evaluated for volume, pH, spermatozoa concentration/ml and concentration/ejaculates, plasma membrane integrity, viability, progressive motility, and morphology, including normal and abnormal spermatozoa. The statistical significance of the results was evaluated by pre- and post-test analyses using T-test with repeated measuring. Data were expressed as Means ± SD and SEM. Results revealed that semen volume, spermatozoa concentration/ejaculate, plasma membrane integrity, viability and progressive motility, and normal spermatozoa were significantly higher in the bucks during SG_{tab} supplementation compared to those before supplementation. It can be concluded that SG_{tab} supplementation in the basal diet has a positive impact on the semen quality of Kacang Bucks. Further studies are recommended to evaluate the effects of different quantities of SG_{tab} on semen quality.

Keywords | Sesbania grandiflora, Tablet, Semen, Spermatozoa

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INTRODUCTION

Inadequate nutritional supplies directly result in low livestock productivity and reproductivity (De Angelis et al., 2021). Recently, several researchers have extensively studied and developed feeding strategies to control and improve ruminants' reproduction characteristics. The reproductive performance of Bali cows, for example, was affected significantly by the addition of calcium soap-soybean oil (Suharti et al., 2017). The spermatozoa quality of Etawah cross-breed bucks could also be improved by Urea Moringa Molasses Multinutrient Block (Syarifuddin et al., 2021). Further, it has been proven that supplementing mango seeds in Damascus goat bucks' diets improved both the quality and quantity of semen production for breeding programs (El-Din et al., 2021). Moringa oleifera in the diet increased the quality of male rabbit semen (El-Kashef, 2022). Oral supplementation of selenium has been reported to improve buck spermatozoa motility and morphology (Lukusa and Kabuba, 2021). The positive impact of melatonin has also been reported to increase mass motility, individual progressive motility, spermatozoa viability, and acrosome integrity (Samir et al., 2020). In addition, Sesban hay had no negative effects on the semen characteristics

(Mahgoub et al., 2022). Oral administration of 250 mg/kg crassocephalum crepidioides leaf extract for 14 consecutive days can significantly increase the spermatozoa quality of West African Dwarf Buck (Ajani et al., 2022).

Some researchers have also documented the relationship between nutrients and reproduction performance of mature male sheep (Murray et al., 1990). The oral supplementation of coenzyme Q10 (CoQ10) increased the semen quality of bucks during summer (El-Sherbiny et al., 2022). Food with higher energy and protein content improved the reproductive performance of Baktiary sheep (Kheradmand et al., 2006). Likewise, Zn supplementation improved the semen quantity and quality of Cashmere buck (Liu et al., 2020). However, none of these studies examined the effect of SG_{tab} on Kacang Buck semen.

Thus, it is clear that the better the quality and quantity of the feed, the higher the reproductive performance of livestock. Notably, a diet with insufficient protein can reduce the quality and quantity of semen (Brown, 1994). The crude protein content of sesbania grandiflora is quite high, 23.65% (Kumar et al., 2017) and 22.61% (Nouman et al., 2013). Dahlanudin et al. (2001) reported that dry matter feed intake (g/head/d), dry matter digestibility (%), supply protein microbes (mg/W $0.^{75}$), and energy metabolism consumption of sesbania grandiflora were 1,070±86.0, 78±5.4, 979.3±222.8, 11.4±0.60, respectively.

The nutrient content of native grass is relatively low; however, the main goat feed for traditional farmers was native grass with no supplement. Wahyono et al. (2019) reported that the average crude protein content and digestibility of nine types of native grass were 3.48–7.60% and 49.39–66.68%, respectively. The feed quality affects the semen quantity and quality. Thus, the bucks fed with native grass as the main feed need to be supplemented to improve the quality of semen.

Furthermore, sesbania grandiflora enriched with mineral mix, rice bran, molasses, lime, and salt in the form of a tablet (SG_{tab}) is easy to create and feed to goats. It also increases the natural mating ability of males, whose semen will be taken and processed into liquid or frozen form. Therefore, this study evaluated the effects of SG_{tab} supplementation in basal diet, a cheap protein and energy resource, in improving the semen quality of the Kacang Buck.

MATERIALS AND METHODS

Animals' Management, Diets, And Schedules

The animals used in this study have recommendations from the Animal Ethics Committee with Registration Number: 12/UN18.F2/EC/2022. Of 25 Kacang Bucks, 10 with the best libido and health, with average age and body weight 2.7±0.35 y and 28.4±2.4 kg, respectively, were selected for use in this study. The animals were allowed to acclimatize for 5 days prior to treatment. The research was conducted from June to July 2022 (dry season in Indonesia). The whole experiment concluded within 40 days – 5-day acclimatization and 30-day sampling periods. Semen was collected on days 10, 15, and 20 in the pre-SG_{tab} period and then on days 25, 30, and 35 during the SG_{tab} period. They received a daily diet of native grass equivalent to 10% of their body weight from day 1 to day 35 (Table 1). They received only native grass from day 1 to day 20. From day 21 to day 35, they received the same diet as days 1 to 20 plus SG_{tab}, as mentioned in Table 1.

Table 1: Experimental schedule. Experimental schedule

Note	Days						
	Pre-SG_{tab}			during SG_{tab}			
Acclimatization							
Native grass minus SG_{tab}	1–5						
Native grass plus SG_{tab}		10	15	20	25	30	35
Semen sampling		1	2	3	4	5	6
Blood sampling			1				2

To meet the nutrient requirements, the SG_{tab} supplement was prepared according to the standard nutrient requirement of goats described by the National Research Council (1985). Each buck received equal amounts of 42 g SG_{tab} three times daily at approximately 07:00 h, 13.00 h, and 18:00 h before being offered basal feed. The amount of SG_{tab} was 128 g/day/head (Table 2). The animals were housed in individual wooden-floored crates. Fresh water was available ad-libitum throughout the experimental time points. All bucks were inspected for general health, especially good libido before use in the study.

Table 2: Composition of SG_{tab}

Supplement ingredient	SG_{tab} composition (%)	Total per head (g)
Sesbania G flour	35	45
Rice bran	23	28
molasses	27	35
Lime stone	7	9
Salt	6	8
Mineral mix	2	3
Total	100	128

Note: The nutrient composition of 128 g SG_{tab} was 10, 50, 3.2, and 1.0% of PK, TDN, Ca, and P, respectively.

Sesbania grandiflora leaves were sun-dried for 3 days until water content was at approximately 5% before being

ground to a powder form. SG_{tab} was made by weighing each ingredient according to the requirement. All materials – sesbania grandiflora leaf flour, rice bran, lime stone, mineral mix, molasses, and salt – were mixed evenly and put into the mold at a rate of 42 g/tablet.

Semen Collection And Evaluation

Semen was collected by a trained technician from 10 bucks using artificial vagina for 6 consecutive ejaculates at approximately 07.00 h, before feeding, at 120-h interval from each Kacang Buck (Table 1). Collected semen was transferred as soon as possible to the laboratory and held in a 35°C water bath before further evaluation. Semen was evaluated for volume, pH, spermatozoa concentration/ml and concentration/ejaculates, plasma membrane integrity, viability, progressive motility, and morphology including normal and abnormal spermatozoa (no head, double head, no tail, and looped tail).

Briefly, semen volume was measured directly from notation on a collector tube. pH was assessed by a digital pH meter. Spermatozoa concentration/ml (10^9/ml) was counted by Neubauer hemocytometer, as described by Mahmoud et al. (2013). The examination of the plasma membrane integrity of the spermatozoa was carried out as explained by Susilawati (2011), as follows. First, 1 ml of hypo-osmotic solution of 150 m osmol (7.35 g sodium citrate, $2H_2O$, 13.52 g fructose dissolved in 1000 ml aquabides) was dropped into a test tube. Second, 0.1 ml semen was dripped into the test tube containing the hypo-osmotic solution and incubated at 37°C for 40 min. After incubation, one drop of the semen sample was placed on the object glass and examined using a light microscope with a magnification of 400×. The change expected to occur is the presence of swelling or circular tail. Two hundred spermatozoa are counted for the characteristic tail (circular) that identifies plasma integrity (Ahmad et al., 2003; Jeyendran et al., 1984; Susilawati, 2011). To evaluate normal spermatozoa morphology and viability, one drop of the semen sample and two drops of Nigrosin-Eosin were mixed in a warm object glass and left for 30 s. Next, a smear was made and dried on a warm plate. The percentages of normal morphology and viability were examined subjectively using a phase contrast microscope (Olympus CX 43, Optical co., Ltd., Tokyo, Japan) at 400 magnification connected to a monitor (Abdelnour et al., 2020; Marin et al., 2021; Susilawati, 2011). The spermatozoa with no head, double head, no tail, and looped tail were counted and calculated as abnormal spermatozoa. If the spermatozoa absorb color, they are unviable, and if they are transparent or do not absorb color, they are viable (Ibrahim et al., 2021; Jeyendran et al., 1984).

Progressively motile spermatozoa were estimated as a percentage. One drop of fresh semen was diluted in 20 ml NaCl (1:20; v/v) and then homogenized. One drop of the semen sample was placed on a 37°C glass slide with a cover slide and evaluated under a phase-contrast microscope connected to a monitor. The spermatozoa that moved forward were noted as progressively motile (Ibrahim et al., 2021; Marin et al., 1997).

Blood Sampling

Blood sampling was performed at 07.00 h, 15 days after acclimatization and before SG_{tab} supplementation and on day 35, or 10 days after SG_{tab} supplementation. Blood samples were taken in the morning before feeding according to Suharti et al. (2017), El-Din (2021), and Mahgoub et al. (2022) by jugular venipuncture into heparinized tubes to obtain blood serum. Blood samples (5 ml) were collected from four random bucks before and during SG_{tab} supplementation. Blood samples were then centrifuged at 3500 g for 10 min for serum collection for subsequent analyses. Blood serum was measured for blood glucose, total protein, cholesterol, and ureum. The blood samples were analyzed at Hepatica Laboratory, Mataram, Lombok, West Nusa Tenggara Province, Indonesia.

Statistical Analysis

Pre- and post-test analyses were employed using T-test with repeated measuring; independent sample T-test was applied (SAS, 2022). A probability of less than 5% was considered significant. Data are expressed as Means ± SD and Standard Error Means (SEM).

RESULTS AND DISCUSSION

This study found that the semen volume of the Kacang Buck significantly increased when they were offered SG_{tab} (Table 3). Similar results were reported in the bucks offered digitata leaves (Ibrahim et al., 2021). The inclusion of 15% mango seeds in the basal feed of Damascus goat bucks had a positive effect and improved semen production and quality in breeding programs (El-Din et al., 2021). Moringa leaves in urea molasses multi-mineral block did not increase the volume of the semen in Peranakan Etawah (PE) bucks (Syarifuddin et al., 2021). Some studies reported the normal semen volume of the Kacang Buck as 1 ml (Kusumawati et al., 2017) and 0.74±0.13 (Tungujama et al., 2021) and those of the Etawah, Bligon, and Kejebong bucks as 0.87 ml, 0.54 ml, and 0.63 ml, respectively (Rahmawati et al., 2014). The semen volume of bucks significantly increased with an additional intake of 40 mg zinc/kg dry matter (DM) (Liu et al., 2020). Semen volume per ejaculate depends on age, breed, feed quality, body size, and frequency of ejaculation, physical condition, and collector skills (Lemma and Shemsu, 2015).

No significant change was noted in the pH value of semen

Table 3: Effect of SG_{tab} supplementation on semen volume, pH, and spermatozoa concentration of Kacang Buck

Variables	Average percentages (n=10)		SEM
	Before SG_{tab} supplementation	During SG_{tab} supplementation	
Semen Volume	0.82±0.26[a]	1.12±0.37[b]	0.05
pH	6.99±0.28[a]	7.04±0.31[a]	0.04
Spermatozoa concentration (10^6/ml)	2,807±417.40[a]	2,955±384.11[a]	0.05
Spermatozoa concentration/ejaculate (×10^6)	2,319±0.84[a]	3,107±1.212[b]	0.14

Note: Different superscript in the same row differ significantly (P<0.05)

Table 4: Effect of SG_{tab} supplementation on the percentages of plasma membrane integrity, spermatozoa viability and spermatozoa progressive motility, and integrity of plasma membrane (IPM) on Kacang Buck semen (n=10)

Variables	Before SG_{tab} supplementation	During SG_{tab} supplementation	SEM
Plasma membrane integrity	80.57±3.10[a]	83.80±3.33[b]	0.44
Spermatozoa viability	76.03±4.57[a]	80.167±2.97[b]	0.56
Progressively motile spermatozoa	74.53±2.97[a]	77.96±2.71[b]	0.51
IPM	74.11±4.78[a]	79.23±5.45[b]	0.74

Note: Different superscript in the same row differ significantly (P<0.05)

before and during SG_{tab} supplementation. Significantly higher or lower pH causes low spermatozoa viability. The normal pH of semen in this study was in the range of 6.4–6.8 (Sekosi et al., 2016) and 6.5±0.34 (Tungujama et al., 2021).

Spermatozoa concentration/ml tends to be higher during SG_{tab} supplementation compared to before supplementation; however, it was not significantly higher. As a result of higher semen volume and concentration per ml, the concentration of spermatozoa per ejaculate was significantly higher during SG_{tab} supplementation compared to before supplementation (Table 3). This result shows a trend similar to those of previous studies wherein bucks supplemented with 40 mg zinc/kg DM showed increased spermatozoa concentration from 4.09 × 10^9/ml to 4.59 × 10^9/ml (Liu et al., 2020). Kusumawati et al. (2017) reported a concentration of 3.540 × 10^6/ml. However, a contrary result was reported by Thasmi et al. (2022) that showed that continuous additional intake of the extract of etanolik malaka leaf for 21 days tended to decrease spermatozoa in rats.

Host test in this study found that the percentages of spermatozoa with a normal membrane were significantly higher in bucks during SG_{tab} supplementation compared to no supplementation (Table 4). It is well known that plasma membrane integrity is an essential requirement for normal functioning of spermatozoa. Therefore, the more spermatozoa with normal membrane the higher will be the percentage of good-quality spermatozoa (Makarevich et al., 2011).

The percentages of spermatozoa cell livability of Kacang Bucks with SG_{tab} supplementation were significantly higher than those with no supplementation (Table 4). Spermatozoa livability in WAD bucks increased from 96.40±1.60 before supplementation with crassocephalum crepidioides to 98±00 and 98.00±00 after being supplemented, respectively, Ajani et al. (2022). Lower spermatozoa livability (61.58±8.50% and 95.8%, respectively) was reported by Tunggujana et al. (2021) and Kusumawati et al. (2017).

The percentages of progressively motile spermatozoa are one of the vital indicators of good-quality semen in both animals and humans (Abdelnour et al., 2019). This research found that progressively motile spermatozoa significantly increased in the bucks supplemented with SG_{tab} compared to those not supplemented with it (Table 4).

This study proved that the supplementation of SG_{tab} in basal Kacang Buck diets can improve the quality of semen produced compared to those not supplemented with SG_{tab}. Several similar studies have shown relatively similar results. Digitata leaf feeding is reported to have a positive impact on semen quality (Ibrahim et al., 2021). Oral supplementation of Coenzyme Q10 at a dose of 3 mg/kg increased the percentage of progressive motile spermatozoa from 69.00±1.77 at week 0 to 78.00±2.14 at week 5 after supplementation with CoQ10 (El-Sherbiny et al., 2022). Likewise, the percentage of viability, normal morphology, and spermatozoa concentration increased significantly from 82.40 ± 1.1, 83.60±2.66, 2.22±0.02×109/ml in week 1 to 91.60±1.44, 91.40±0.54 and 2.45±0.01×109 in week 6, respectively (El-Sherbiny et al., 2022). Oral administration of crassocephalum crepidioides extract was also shown to increase the percentage of spermatozoa motility in WAD bucks from 87.00±4.06 on day 0 to 95.00±0.00 and 96.50±1.50 on days 7 and 14, respectively (Ajani et al., 2022). The percentage of spermatozoa progressive motility in thawed semen of Saanen bucks that received oral

Table 5: Percentages of normal and abnormal spermatozoa as an effect of SG_{tab} supplementation

Variables	Before SG_{tab} supplementation	During SG_{tab} supplementation	SEM
Normal	88.97±2.93[a]	92.47±2.86[b]	0.44
Abnormal	11.03±2.93[a]	7.53±2.86[b]	0.43
No head	2.37±1.19[a]	1.47±1.33[b]	0.17
Double head	2.53±1.68[a]	1.83±1.23[a]	0.19
No tail	3.03±0.96[a]	2.13±1.19[b]	0.15
Looped tail	3.10±1.37[a]	2.10±1.24[b]	0.18

Note: Different superscript in the same row differ significantly (P<0.05)

Table 6: Result of blood sample analysis of bucks before and during supplementation with SG_{tab}

Variables	Before SG_{tab}	during SG_{tab}	SEM
Glucose	47.75±4.65[a]	56.25±6.45[a]	2.44
Total protein	5.7±0.22[a]	6.05±0.37[a]	0.11
Cholesterol	46.5±4.65[a]	43.75±8.22[a]	2.24
Ureum	19.75±2.63[a]	20.75±3.3[a]	0.99

Note: Means in the same row with different superscript differ significantly (P<0.05)

supplementation of selenium was 41.01±0.61, which was significantly higher compared to that of bucks with no selenium supplementation (37.11±1.63) (Lukusa and Kabuba, 2021).

This study found that the percentages of IPM are much higher in the spermatozoa of bucks offered SG_{tab} than those who were not offered supplements (Table 4). Normal plasma membrane integrity of spermatozoa is an important requirement for normal metabolism. Thus, a high percentage of spermatozoa with normal membrane is necessary for frozen semen (Makarevich et al., 2011). The percentage of spermatozoa with an intact membrane of Saanen bucks supplemented with selenium was 42.01±3.02 compared to 35.04±2.12 in bucks that were not supplemented (Lukusa and Kabuba, 2021).

This study also found that the percentage of abnormal spermatozoa significantly decreased from 11.03±2.93 to 7.53±2.86 before and during SG_{tab} supplementation, respectively (Table 5). The percentage of abnormal spermatozoa found in this study was in line with the results reported in other studies as follows. The supplementation of 40 mg zinc/kg DM feed decreased the percentage of abnormal spermatozoa from 15.1 to 14.4 (Liu et al., 2020). A low percentage (2.9%) was reported by Kusumawati et al. (2017) and a higher percentage (14.7±0.00) was reported by Oyeyemi et al. (2021). The percentages of abnormal spermatozoa should not more than 15% (Saili et al., 2016) to 20% (Sekosi et al., 2016). Semen quality is considered substandard if the percentage of abnormal spermatozoa is higher than 20% (Arifiantini and Purwantara, 2010). Thus, semen quality from this study is acceptable because the percentage of abnormal spermatozoa was lower than 15% (Table 5). Standard percentages of buck spermatozoa abnormalities suitable for artificial insemination is not more than 15% (Ax at al., 2008) or 20% (Karatasudjana, 2001). Ax et al. (2008), in addition, stated that fertility decreases when the percentage of abnormal spermatozoa is more than 25% of the total spermatozoa.

Buck blood serum parameters before and during supplementation were presented in Table 6. This research found that the addition of SG_{tab} increased the concentration of blood glucose, total protein, and ureum; however, they were not significant. The concentration of cholesterol, on the other hand, was slightly decreased in the bucks after supplementation with SG_{tab} compared to those before.

The percentage of motile sperm in Tris-citrat extender enriched with cholesterol at 0.5 mg/ml was higher compared to either 0.0 or 1.0 mg/ml, but the difference was not significant. However, the average percentages of motile spermatozoa after thawing was significantly higher in extender enriched with 1 mg/ml (56.0%) compared to 0.0 mg/ml (47.5%) and 0.5 mg/ml (51.5%), respectively (Sitomorang, 2002). In contrast, the low cholesterol content in semen plasma and spermatozoa causes the susceptibility of spermatozoa to cold shock (White, 1993). Cholesterol, in addition, is an important factor to maintain membrane integrity (Voet and Voet, 1990) and the addition of cholesterol to semen extender is expected to increase the viability of spermatozoa, which will eventually increase the percentage rate of pregnancy.

Two studies reported a significant increase in the total blood protein of chickens when the feed was supplemented with moringa oleifera leaf (Voemesse et al., 2018) and

rabbit (El-Kashef, 2022). However, in contrast with the results of this study, two others studies reported the effect of proteins on reproductive parameters of rams, where protein supply above normal needs had no effect on reproductive parameters, such as testicular size, semen quality, testosterone secretion, or sexual activity (Fernandez et al., 2004; Bielli et al., 1999). Singh et al. (2018) report that optimal feed and nutrition management will have an impact on reproductive health and gonadotropin secretion. This study also found an insignificant increase in blood glucose after SG_{tab} supplementation. Dance et al. (2016) and Geary et al. (2016) report that the level of energy, protein, minerals, and vitamins at every stage of livestock growth and reproduction is very important to maximize the fertility rate of cattle. They also state that the quality of spermatozoa and spermatogenesis is improved if the balance of energy and protein is met through mineral supplementation during the pre-pubertal period.

Protein is required by almost all living things not only for maintenance but also because it carries vitamins and hormones and regulates the metabolism of the entire body (Anderson and Anderson, 2002). When serum proteins change, it may be a potential diagnostic indication of some pathological process. Therefore, serum protein could determine the physiological condition of livestock to differentiate between healthy and unhealthy animals (Tothova et al., 2016).

The values obtained from the proximate analyses of SG_{tab} (percentages), such as water, ash, crude fat, crude fiber, and crude protein, were 19.70, 18.80, 0.34, 7.52, and 6.54, respectively. In this study, some nutritional content of SG_{tab} may have had a significant effect on the semen quantity and quality of the Kacang Buck. Na, K, Cl, Ca, Mg, P, S are essential minerals in the semen with important functions (Marzec-Wróblewska et al., 2012). In addition, such mineral requirements need to be met for spermatogenesis, the promotion of motility, and the quality of spermatozoa, as well as for the development of Sertoli and Leydig cells (Tvrdá et al., 2013).

Two studies report that minerals play a significant role to promote spermatozoa quality, such as progressive, rapid, and velocity in buck spermatozoa (Arangasamy et al., 2018; Liu et al., 2019). Similar results were reported in sheep and cattle (Kumar et al., 2017; Ghorbani et al., 2018). The result of this research is similar to that of a study where Red Sokoto bucks were fed with whole cottonseed (Itodo et al., 2021), in which the plant has high mineral content, such as potassium (Namratha and Sahithi 2015). Potassium is an essential mineral to maintain semen volume (Tvrdá et al., 2013). The same result is reported by Liu et al. (2020); the addition of a small amount of Zn and Cu in feed linearly improved the quantity and quality of semen of Cashmere goats. Increase in parameters such as semen volume, mass motility, viability, membrane integrity, acrosome integrity, and progressively motile spermatozoa was also noted (Mayasula et al., 2021). Therefore, the supplementation of mineral in feed improved semen volume and quality (Arangasamy et al., 2018). However, this research did not analyze SG_{tab} mineral content. Nevertheless, SG_{tab} was composed of lime stone, salt, and mineral mix at 7, 6, and 2% of the total SG_{tab} mixtures, respectively (Table 2).

Since there is no reference pertaining to the effect of native grass as a single feed on buck semen quality, this study has proven that the addition of SG_{tab} enriched with various micro-minerals to native grass-based feed increases nutritional supply and thus increases the production and quality of Kacang Buck spermatozoa. The results of the analyses of blood samples proved that the values of SG_{tab}, glucose, total protein, and ureum were higher than those before supplementation with SG_{tab} (Table 6).

CONCLUSION

The whole parameter of semen quality increased in Kacang buck offered native grass basal diet supplemented with Sesbania grandiflora tabtlet (SG_{tab}). Further researches is recommended to evaluate the effects of different quantity of SG_{tab} on semen quality.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interests

NOVELTY STATEMENT

Sesbania grandiflora tree is a common three in tropical country, rich protein and easy growing. It could also be used as a very high quality feed supplement after enriching with some ingredients such as mineral, molasses, salt and lime stone. This study proven that offering SG_{tab} into basal diet could increase quality and quantity of Kacang Buck semen better than non-supplemented buck.

AUTHORS CONTRIBUTION

All authors were involved in all proses of this study since the draft of proposal to the final report and the final draft of manuscript to be submitted in the journal.

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