PERFORMANCE OF KACANG GOATS SUPPLEMENTED WITH *BAUHINIA PURPUREA* IN COMPLETE FEED

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ABSTRACT

This research aims to determine the effects and limitations of using *B. purpurea* in complete feed on the performance of male Kacang goats. The study involved sixteen male Kacang goats aged 10-12 months with a weight range of 12-14 kg. The research method employed a Completely Randomized Design with four treatments and four replications, consisting of T0: *G. sepium* 30% + Natural grass 38% + Rice bran 7% + Milled corn 24,8% + Mineral mix 0,2% (control); T1: *G. sepium* 30% + Natural grass 38% + Rice bran 6,5% + Milled corn 22,8% + Mineral mix 0,2% + *B. purpurea* 2,5%; T2: *G. sepium* 30% + Natural grass 38% + Rice bran 5% + Milled corn 19,3% + Mineral mix 0,2% + *B. purpurea* 7,5%; T3: *G. sepium* 30% + Natural grass 38% + Rice bran 4,5% + Milled corn 14,8% + Mineral mix 0,2% + *B. purpurea* 12,5%. The results showed that the treatments significantly influenced (P<0,05) blood glucose levels (at 2 and 4 hours after consumption), blood urea levels (at 0 hours before consumption and 6 hours after consumption), crude protein consumption, daily weight gain, weight gain, feed conversion, feed efficiency, and body length. Other variables were not significantly affected. In conclusion, B. purpurea at a concentration of 7.5% yielded the most significant improvements in terms of final body weight, daily weight gain, and feed conversion efficiency.

Key word: additive, blood glucose and blood urea, consumption and digestibility

أداء الماعز من نوع كاكانج معزز بنبات الباوهينيا البربوريا في العلف الكامل

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المستخلص

يهدف البحث إلى تحديد تأثيرات وحدود استخدام B.purpurea في العلف الكامل على أداء ذكور ماعز Kacang شملت الدراسة ستة عشر ذكراً من ماعز الكاكانغ تتراوح أعمارهم بين 10-12 شهراً ويتراوح وزنهم بين 12-14 كجم. استخدمت طريقة البحث التصميم العشوائي الكامل بأربعة معاملات وأربع مكررات، تتكون من T0: G. sepium 30% + العشب الطبيعي 38% + نخالة الأرز 7% + الذرة المطحونة 24,8% + المزيج المعدني 0,2% (السيطرة).); T1: G. sepium 30% + عشب طبيعي 38% + نخالة الأرز 6,5% + ذرة مطحونة 22,8% + مزيج معدني 0,2% + B. بوربوريا 2,5%؛ T2: G. sepium 30% + عشب طبيعي 38% + نخالة الأرز 5% + ذرة مطحونة 19,3% + مزيج معدني 0,2% + B. بوربوريا 7,5%؛ T3: G. sepium 30% + عشب طبيعي 38% + نخالة الأرز 4,5% + ذرة مطحونة 14,8% + خليط معدني 0,2% + B. بوربوريا 12,5%. أظهرت النتائج أن المعاملات أثرت معنويا (P<0,05) في مستويات السكر في الدم (عند 2 و 4 ساعات بعد الاستهلاك)، ومستويات اليوريا في الدم (عند 0 ساعة قبل الاستهلاك و 6 ساعات بعد الاستهلاك)، واستهلاك البروتين الخام، والوزن اليومي. الزيادة، وزيادة الوزن، والتحويل الغذائي، وكفاءة التغذية، وطول الجسم. ولم تتأثر المتغيرات الأخرى بشكل كبير. نستنتج من ذلك أن B.purpurea بتركيز 7.5% حقق أهم التحسينات من حيث وزن الجسم النهائي والزيادة الوزنية اليومية وكفاءة التحويل الغذائي.

الكلمات رئيسية :مضافات، الجلوكوز في الدم واليوريا في الدم، الاستهلاك والهضم

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INTRODUCTION

One of the local goat breeds widely raised in Indonesia is the Kacang goat due to its good adaptive traits in various environmental conditions and high reproductive capabilities. It also plays a crucial role as a meat-producing livestock contributing to the national nutritional needs (8, 31). The community's husbandry of Kacang goats involves letting them roam freely in pasture areas. This practice can adversely affect the growth and production of Kacang goats due to the need for more attention from farmers. The bad management of breeding and insufficient nutrition are cited as the primary reasons for the low production levels of goats in traditional systems (3). Additionally, the dry land conditions and a longer dry season than the rainy season impact feed availability. These results in fluctuating livestock productivity depending on environmental conditions and pose challenges to the productivity of ruminant livestock in semi-arid regions due to nutritional stress (40) the productivity of livestock animals is influenced by genetic and environmental factors, with genetics generally accounting for 40% and the environment for 60% in affecting livestock productivity (1). The environment, particularly factors like feed and climate, often plays a significant role (32). The discontinuous availability of good quality feed among farmers requires them to seek alternative feed sources that can be provided without compromising the health of the livestock (2). One type of feed that can be given to livestock is complete feed. Complete feed is nutritionally balanced for specific animals at certain physiological stages, formulated or mixed as the sole food to meet the animal's nutritional needs (36). Although complete feed can be provided as the sole feed capable of meeting the needs of livestock, its optimal use needs to be accompanied by the use of additives to ensure the digestive and nutrient absorption processes occur maximally, resulting in good or buffer livestock performance. B. purpurea Potential as an additive: exploring compounds with anti-inflammatory and antioxidant activities (5, 17). They contain alkaloids, saponins, steroids, and tannins. They act as antibiotics (22) and antibacterial agents (9, 26), which can suppress harmful bacteria, thus improving the feed digestion and absorption of nutrients in the intestines. The use of plants containing secondary metabolites such as tannins and saponins protected the degradation of feed proteins in the rumen (10), and it is expected that these proteins will be digested and absorbed in the small intestine as a source of rumen degradable protein for animal growth. Bioactive compounds in plants can be harnessed to reduce methane emissions, enhance feed efficiency, and health-promoting effects (43, 45). This can lead to improved livestock productivity. However, the content of secondary metabolites is often referred to as antinutritional factors, requiring various processing methods such as physical, chemical, and biological treatments. Additionally, the composition of the application needs to be carefully regulated. Livestock responses to environmental conditions (climate and feed) generally vary. Typically, the response of livestock to a particular factor can serve as a benchmark for assessing the capabilities of the animals and the success of that factor, such as feed. Parraguez et al. (27) reported that nutritional supplementation and herbal antioxidants could be a livestock management strategy under challenging environmental conditions. Adequate nutrition, optimal nutrient absorption, and the use of local resources as feed additives are expected to be well-received by goats, improving their productivity.

MATERIALS AND METHODS

Time, place, and Research Materials: The research was conducted in the Benpasi Village, Kefamenanu Sub-district, North Central Timor Regency, East Nusa Tenggara, Indonesia. Laboratory analysis was carried out at the University of Nusa Cendana. The livestock comprised sixteen male goats aged 10-12 months with an initial body weight range of 12-14 kg. Individual pens measuring 0,5 m x 1 m, equipped with feeding and drinking facilities, were used. The tools and materials used included a feed milling machine, proximate analysis equipment, feeding and drinking facilities, blood analysis equipment, and weighing scales. Materials consisted of sulfuric acid, proximate analysis tools, blood profile analysis tools, forages, concentrates, and B. purpurea. The feed comprised G. sepium, Natural grass, milled corn, Rice bran, mineral mix, and B. purpurea. The chemical composition of complete diets and feedstuff are presented in Table 1.

Table 1. Chemical composition of complete diet and feedstuff

Feed ingredients	Nutrients							
	DM (%)	OM (%)	CP (%DM)	EE (%DM)	CF (%DM)	CHO (%DM)	NFE (%DM)	ME Kkal/Kg DM
T0	89,49	91,17	15,23	4,70	20,65	71,23	50,58	3.147,65
T1	89,55	91,09	17,22	4,52	17,93	69,33	51,39	3.242,64
T2	89,34	91,47	18,84	4,80	16,99	67,81	50,83	3.304,48
T3	89,54	91,50	19,58	4,45	15,17	66,48	51,31	3.407,69
B. purpurea	90,00	90,60	18,28	8,70	20,75	63,62	42,88	3.283,11
G. sepium	85,36	75,12	22,54	12,07	3,67	52,19	41,25	2.849,11
Natural grass	89,56	78,17	5,73	28,48	0,84	70,97	43,07	2.120,10
Rice bran	88,16	78,35	10,78	14,11	8,19	58,70	44,30	2.960,87
Milled corn	84,14	81,65	3,76	0,60	6,16	80,43	79,99	3.776,80

DM=Dry matter, OM=Organic matter, CP=Crude protein, EE=Ether extract, CF=Crude fiber, CHO=Carbohydrate, NFE=Nitrogen free extract, ME= Metabolizable energy

Research Design

The study employed a Completely Randomized Design (CRD) consisting of four treatments and four replications, namely:

T0: *G. sepium* + Natural grass + Rice bran + Milled corn + Mineral mix (kontrol)

T1: *G. sepium* + Natural grass + Rice bran + Milled corn + Mineral mix + *B. purpurea* 2,5%

T2: *G. sepium* + Natural grass + Rice bran + Milled corn + Mineral mix + *B. purpurea* 7,5%

T3: *G. sepium* + Natural grass + Rice bran + Milled corn + Mineral mix + *B. purpurea* 12,5%

Complete feed preparation

Feed ingredients such as G. sepium, Natural grass, and additives are cut and dried using sunlight until the moisture content is around 15-20%, then ground to a particle size of 10 mm. The ground materials are mixed with concentrate (milled corn and Rice bran), mineral mix, and additives according to the treatment percentages (Table 2).

Procedures for providing feed and drinking water: The feed is provided twice daily (morning and evening) and increased from the initial requirement to 5% of the body weight based on dry matter (DM). Natural grass is given separately during feeding, while other feed ingredients and additives are mixed until homogenous. Drinking water is provided ad libitum.

Table 2. Composition of the treatment feeds

Feed ingredients	Treatment feed composition (%)			
	T0	T1	T2	T3
G. sepium	30	30	30	30
Natural grass	38	38	38	38
Rice bran	7	6,5	5	4,5
Milled corn	24,8	22,8	19,3	14,8
Mineral mix	0,2	0,2	0,2	0,2
B. purpurea	-	2,5	7,5	12,5
Total	100	100	100	100

Adaptation and Health Control

Livestock adaptation is carried out for one week. Health monitoring of the livestock involves cleaning the pens and other equipment. Additionally, vitamin supplementation and scabies prevention are implemented by administering intramuscular wormectin.

Data collection procedures

Blood is drawn from the jugular vein and collected in anticoagulant EDTA tubes. The samples are stored in a cool box and transported to the laboratory. Blood collection is performed at the end of the study at 0 hours before feeding, 2 hours, 4 hours, and 6 hours after feeding (4). Data collection, including feed consumption and digestibility, is conducted during the last ten days of the study. Feed consumption is measured by the difference between the amount of feed given and the amount remaining. Digestibility data is collected by the total collection method using faecal samples. The total amount of faeces produced in 24 hours is collected, weighed, homogenized, and a 10% subsample is taken to determine the dry weight. The faecal samples are then finely ground and composited for nutrient analysis (36) using the AOAC (7) method. Body weight gain and linear body measurements are recorded every two weeks (after fasting) throughout the study, using digital scales and measuring tools.

Variable measurement

Blood Glucose and Blood urea: Blood samples are centrifuged at 3,000 rpm for 10 minutes. Blood glucose is measured using a spectrophotometer. Tubes with 5 ml of glucose or urea reagent receive 0.02 ml of plasma, left for 20 minutes. Absorbance is read at 546 nm for both the standard and the sample. Glucose and urea levels are calculated using the absorbance ratio (sample/standard) multiplied by 100 mg/dl (37).

Feed consumption: Dry Matter (DM) consumption is calculated by subtracting the remaining feed from the amount given and multiplying it by the DM content. Organic Matter (OM) and Crude Protein (CP) are calculated by multiplying DM consumption by their respective nutrient percentages.

Feed digestibility: The calculation of DM, OM, and CP excretion is done by subtracting the nutrient consumption of feed (DM, OM, CP) from the nutrient content in the faeces (DM, OM, CP).

Daily weight gain (DWG) is obtained by comparing the final and initial weights over the observation period. The ratio between feed consumption and weight gain measures feed conversion.

Feed efficiency is measured by comparing feed consumption with body weight gain and multiplying by 100%.

Linear body measurements include body length, shoulder height, hip height, and chest circumference as per Tagoi et al. (35). Body length is measured from the scapula to the ischium, chest circumference around the chest near the scapula, shoulder height from the shoulder's highest point to the ground, and hip height from the highest hip point to the ground.

Data Analysis: The obtained data were analyzed using **analysis** of variance (ANOVA), followed by Duncan's multiple range test according to the instructions of Steel and Torrie (34). The analysis was conducted using the SPSS software version 26.

RESULTS AND DISCUSSION

Blood glucose and blood urea

Blood glucose levels provide an overview of the energy source in the animal's body. If the blood glucose level is average, energy availability will also be expected, and the metabolic processes in the body will proceed normally as well. Conversely, the animal's condition will be weakened if the energy production is insufficient, which can be reflected in the blood glucose level (23). The results of this study indicate that blood glucose levels increase 2 hours after eating, decrease 4 hours after eating, and then decrease again 6 hours after eating. This is related to the release of insulin hormones during food consumption. Insulin itself is a natural hormone produced in the pancreas, and when animals consume food, insulin hormone converts glucose into energy, and this energy functions to maintain body stability. The results of this study align with the opinion of Mann et al. (20) that the increase in blood glucose levels before and after meals is due to the stimulation of insulin hormone release. Complete feed with additives provides sufficient energy, allowing metabolism to proceed normally. Blood glucose in ruminant animals occurs through the gluconeogenesis process in the liver, with its primary precursor being propionic acid, referred to as glucose precursor. Propionic acid comes from the digestion process that occurs in the stomach of ruminant animals and is absorbed through the rumen wall. The amount of propionic acid produced depends on the feed given to the animals. If the feed given is concentrated, the propionate produced will be higher than low-quality feed. There is a tendency for the use of 2.5% and 7.5% B. purpurea complete feed to have an impact on increasing blood glucose but decreases again with the use of 12.5%. Tannins and saponins present in B. purpurea can inhibit the mechanism of action of the enzyme α-glucosidase, which converts disaccharides into glucose. Additionally, tannins have astringent properties that can precipitate mucous membrane proteins in the intestines and form another layer in the intestines, thus inhibiting the absorption process of glucose. Fiana and Oktaria (14) reported that the content of saponins and tannins plays a role in reducing blood glucose levels in mice. Therefore, the higher the use of B. purpurea in complete feed, the lower the blood glucose levels will be due to saponins and tannins, even though the nutrient content in complete feed is high. Blood urea is the end product of protein metabolism in the body, which is then excreted through urine (18), while urea is a simple organic compound produced by the liver of ruminant animals as the final product of protein catabolism (19). Generally, there is an increase in blood urea levels from 0 hours to 6 hours. The results of this study indicate that goats fed a complete diet with the addition of B. purpurea have a non-significant effect on blood urea levels at 2 and 4 hours after feeding. However, the blood samples taken at 0 and 6 hours show a significant effect. Nevertheless, all treatments result in normal blood urea levels. This is supported by Perdana (29), stating that the normal range of blood urea levels in goats is between 13 and 44 mg/dl, reflecting that rumen microbes are maximally utilizing ammonia as a source of nitrogen and energy for their development. The ammonia production in the rumen is influenced by the type of feed and the time it takes to obtain that feed. Typically, the maximum ammonia production is achieved 2-4 hours after feeding (21), but this also depends on the protein source used and how easily that protein is degraded. Higher concentrations of ammonia N imply an increase in protein degradability in the rumen and a decrease in the digestion of protein in the abomasum and small intestine. This is detrimental to the utilization of high-quality protein by the host animal (41). In this study, the time required to utilize the protein in the feed is relatively long (> 6 hours) due to the presence of tannins and saponins in B. purpurea. Moreover, an increased proportion of B. purpurea in the feed tends to decrease the blood urea levels in goats.

Table 3. Blood Glucose and Urea Levels in Kacang Goats Supplemented with *B.purpurea* in Complete Feed

Variable	Pick up time	Treatment				SEM	P-Value
		T0	T1	T2	T3		
Blood glucose (mg/dl)	0 hours	63,16	65,11	66,03	64,44	0,605	0,429
	2 hours	74,79[ab]	78,98[a]	75,63[ab]	73,89[b]	0,756	0,072
	4 hours	82,60[a]	83,33[a]	80,76[ab]	78,18[b]	0,645	0,006
	6 hours	74,28	76,74	76,87	76,63	0,736	0,593
Blood urea (mg/dl)	0 hours	36,02[a]	33,97[b]	34,13[b]	34,20[b]	0,263	0,003
	2 hours	37,49	36,62	37,34	37,28	0,173	0,313
	4 hours	39,43	39,44	39,87	39,23	0,196	0,744
	6 hours	41,13[a]	40,38[ab]	39,62[b]	37,15[c]	0,436	<0,001

SEM: Standard error of mean

Consumption and digestibility

Consumption is influenced by the nutritional content of the feed, and DM consumption is generally affected by the available DM content in the feed. According to Table (1), the DM content in the feed for all treatments is the same, resulting in the same consumption values. The values for DM consumption also indicate that the palatability of the complete feed is relatively high, leading to average consumption values in goats. B. purpurea, which have a salty taste (referred to as "masi" or "salty" by the community in TTU), are often used for medicinal purposes. The salty taste is a characteristic of B. purpurea, making them appealing to livestock. However, an excessive increase in B. purpurea also intensifies the salty taste, leading to a decrease in consumption, as observed in the values for all nutrient consumption. Consumption of OM is in line with DM consumption. According to Aryanto et al. (6), OM constitutes the most significant part of DM, so the amount of DM feed consumption highly influences the amount of OM consumption. Livestock consumption is generally influenced by various factors such as age, physiological status, nutritional value of the feed, and environmental conditions. This study used goats with similar average age and weight, resulting in similar consumption values. The exact nutritional needs due to their physiological similarities led to the same level of feed consumption. Based on the responses and physiological status exhibited by the treated goats in this study, the observed effects were expected and impacted average feed consumption.

Table 4. Consumption and Nutrient Digestibility of Kacang Goats Supplemented with *B. purpurea* in Complete Feed

Variable	Treatment				SEM	P-Value
	T0	T1	T2	T3		
DM intake (g/head/day)	492,24	492,97	507,84	477,30	13,927	0,915
OM intake (g/head/day)	504,56	501,40	519,75	487,71	14,232	0,909
CP intake (g/head/day)	84,32	94,85	107,13	104,33	3,582	0,082
DM digestibility (%)	81,14	81,39	81,74	80,46	0,538	0,887
OM digestibility (%)	83,06	82,86	83,38	82,25	0,495	0,899
CP digestibility (%)	91,17	90,66	91,99	90,52	0,337	0,437

DM=dry matter, OM=organic matter, CP=crude protein. SEM: Standard error of mean

There is a tendency for a decrease in CP consumption in T3, even though it has the highest CP content among all treatments at 19.58%, with high ME as well (Table 1). The high nutritional content in the feed will also increase the value of nutrient consumption. However, in this study, higher CP and energy levels tended to decrease the value of nutrient consumption. This could be due to the fulfilment of the animals' needs. The standard nutritional requirements for goats weighing 15 kg require a DM consumption of 545 g and a protein intake of 51 g to achieve a DWG of 75 g (25). Feeds with higher nutritional content tend to reduce the amount of feed intake (42). Besides the fulfilled nutritional requirements, another factor contributing to the decrease in consumption of T3 is the tannin content present in B. purpurea, which tends to reduce CP consumption. High tannin in the feed will affect feed consumption because tannin binds with salivary proteins, making the feed less palatable and decreasing feed intake (28). Digestibility values measure feed quality because high digestibility values indicate a more significant opportunity for the livestock to utilize the nutrients in the feed. The level of nutrient digestibility can determine the quality of the feed consumed by the livestock (39), meaning that if the feed given to the livestock is of high quality, the resulting digestibility values will be higher. The results of this study generally show that the digestibility values for all variables are not influenced by the use of B. purpurea in a complete feed. Although, based on statistical tests, the digestibility of food components for all treatments is the same, there is a tendency for a decrease in digestibility with the addition of B. purpurea in complete feed. In general, digestibility values are related to consumption values. If the consumption is the same, the resulting digestibility will also be the same. Pazla et al. (28) stated that the higher the feed consumption in livestock, the higher the digestibility. This is also related to the relatively consistent nutrient content for all treatments except protein and energy. Nutrient digestibility is influenced by the nutrient content available in the feed. If the nutrient content in the feed is high, it will be followed by high digestibility.

Growth performance

Data in Table 5 illustrates that using additives in complete feed can increase body weight, as evident from the final body weight obtained. The use of B. purpurea as an additive in complete feed can enhance daily weight gain compared to the control (T0), but there is a tendency for a decrease in daily weight gain with higher percentages of B. purpurea in the diet. This indicates that 7.5% B. purpurea in complete feed is already effective. Secondary metabolites in B. purpurea can positively influence daily weight gain and its effect on the final body weight obtained. The mentioned secondary metabolite is saponin, which plays a crucial role in food digestion by increasing cell wall permeability, resulting in effective nutrient absorption. Likewise, terpenoids can stimulate the nervous system in the bile, triggering the release of gastric juice containing enzymes such as amylase, trypsin, and pepsin (15). The enzyme amylase aids in the digestion of food substances such as carbohydrates (starch), breaking them down into simpler compounds like glucose. Similarly, pepsin and trypsin assist in the breakdown of proteins into amino acids. The breakdown of complex food substances into simpler ones accelerates the metabolism process, as reflected in the increase in body weight. Sadowska et al. (33) revealed that secondary metabolites in plants can provide protection and act as antioxidants that neutralize free radicals. However, it is essential to regulate the concentration of secondary metabolites optimally to avoid disrupting the digestion and absorption of nutrients in the body (16). An elevated tannin content beyond optimal levels can disrupt protein digestion due to tannins' ability to form complex compounds with insoluble proteins in the digestive tract. This negatively affects rumen fermentation in ruminant livestock nutrition (12). This phenomenon is observed when using B. purpurea as an additive at concentrations exceeding 7.5% in this study, showing a general tendency to decrease for all variables. Although physical treatments like drying, grinding, and mixing feed can balance and reduce tannins and other secondary metabolites, they are tolerable for livestock. The final body weight of the Kacang goats given complete feed with B. purpurea additive is higher in treatments T1 and T2, corresponding to the daily weight gain and feed consumption. Higher consumption provides a significant opportunity for increased daily weight gain and final body weight due to the rapid digestive process driven by high metabolic activity. The absorption of nutrients is then utilized for the growth and development of the body tissues of the goats. Livestock production can be assessed by considering body weight influenced by various factors such as the animal's size, including chest circumference, body length, and height (30). A smaller conversion value indicates that livestock is becoming more efficient in utilizing feed for weight gain. In this study, the addition of B. purpurea additive in complete feed, T1 (0.25%), T2 (0.75%), and T3 (12.5%), resulted in lower or better feed conversion values compared to the control treatment (T0). However, the differences between T0, T2, and T3 are insignificant, and the same applies to T1, T2, and T3. Feed conversion is closely related to the nutritional content available in the feed.

Table 5. Growth Performance of Kacang Goats Supplemented with *B. purpurea* in Complete Feed

Variable	Treatment				SEM	P-Value
	T0	T1	T2	T3		
Initial body weight (kg/head)	12,41	12,27	12,18	12,52	0,120	0,788
Final body weight (kg/head)	16,37^{b}	17,46^{a}	17,87^{a}	17,27^{ab}	0,196	0,029
Daily weight gain (kg/head)	0,05^{c}	0,06^{ab}	0,07^{a}	0,06^{bc}	0,002	0,015
Weight gain (kg/head)	3,96^{c}	5,19^{ab}	5,69^{a}	4,75^{bc}	0,207	0,006
Feed conversion	10,19^{a}	8,35^{b}	8,86^{ab}	9,09^{ab}	0,280	0,010
Feed efficiency (%)	10,57^{a}	8,02^{b}	7,48^{b}	8,70^{ab}	0,445	0,054
Body length (cm)	53,64^{b}	55,51^{a}	56,15^{a}	55,78^{a}	0,318	0,008
Shoulder height (cm)	50.78	49,40	51,10	50,20	0,325	0,283
Hip height (cm)	51,73	51,30	50,88	50,55	0,351	0,707
Chest circumference (cm)	59,88	60,65	61,23	60,18	0,524	0,846

SEM: Standard error of mean

The higher the nutritional content in the feed, the more the livestock responds with increased weight gain, resulting in a better feed conversion value. Tahuk et al. (39) reported that Kacang goats, given complete silage, produced feed conversion values ranging from 18.45 to 53.38. This is related to the availability of nutrients and the amount of feed provided. In this study, the feed was given at 5% of the body weight based on dry matter, allowing for nutrients for the treated livestock. B. purpurea additive can enhance nutrient absorption by male Kacang goats due to its ability to protect feed protein in the rumen. Protein not broken down by rumen bacteria can then be directly absorbed in the small intestine and deposited as muscle, resulting in weight gain. The more efficient the use of feed by livestock in increasing body weight, the better the feed conversion ratio (38). The results of this study illustrate that the use of B. purpurea does not disrupt livestock production due to the positive effects demonstrated through feed conversion and efficiency. The complete feed's high and complete nutritional content can be utilized by livestock to enhance their productivity. This can be linked to the resulting weight gain. The more efficient use of feed can lead to a high increase in body weight (44). One measure of livestock productivity can be observed through linear body measurements since these measurements serve as a reference for assessing livestock and breed growth (13). The linear body measurements taken in this study include body length, shoulder height, hip height, and chest circumference. Generally, the addition of *B. purpurea* at 2.5% and 7.5% in the complete feed is higher than the control treatment but tends to decrease at 12.5%. This indicates that, besides age, changes in linear body measurements are significantly influenced by feed. Feed containing comprehensive nutrients can enhance linear body measurements. In this study, feed with a combination of forage and concentrate can provide comprehensive nutrition (Table 1), thus meeting the livestock's needs. Body length is closely related to body weight. The greater the body length, the higher the body weight (24). Baysi *et al*. (11) state that vital body measurements (height, body length, and chest circumference) correlate positively with carcass weight, although the strength of this relationship is relatively lower compared to the live weight of male Kacang goats.

CONCLUSION

The research demonstrated that the inclusion of B. purpurea at a concentration of 7.5% yielded the most significant improvements in terms of final body weight, daily weight gain, and feed conversion efficiency. While increasing the concentration to 12.5% did not produce detrimental effects, it did not result in further performance enhancements, suggesting that there is an optimal level of B. purpurea inclusion for maximizing growth parameters.

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CONFLICT OF INTEREST

The authors have declared no conflict of interest.

CONFLICT OF INTEREST

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