

Research Article



Feed Intake, Digestibility, and Growth Performance of Young Male Kacang Goats Fed Diets Containing Different Energy Levels

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Abstract | The study aimed to assess the impact of dietary energy levels on the performance of intensively reared young male Kacang goats. A total of 15 Kacang goats were divided into 3 treatment groups: T1, fed with an energy level (TDN) of 70.038% + crude protein 13.448%; T2, fed with TDN 72.295% + crude protein 13.922%; and T3, fed with TDN 73.264% + crude protein 13.473%. The rations consisted of native grass, *Gliricidia sepium* leaf meal, ground corn, pollard bran, and rice bran. Variables observed included feed intake and digestibility, as well as growth performance metrics such as average daily gain (ADG), conversion rate, and feed efficiency. While there were no significant differences in dry matter (DM) and gross energy (GE) intake among treatments, significant variations ($P < 0.05$) were observed in the intake of organic matter (OM), crude protein (CP), crude fiber (CF), carbohydrates (CHO), and metabolizable energy (ME). OM intake in treatments T2 and T3 was higher than in T1; CP intake in treatment T3 was higher than in T1, but similar to T2. CF intake in T3 was lower ($P < 0.05$) compared to T1 and T2. Moreover, CHO intake was higher ($P < 0.05$) in T2 and T3 compared to T1, while ME intake was higher ($P < 0.05$) in T2 and T3 compared to T1. The digestibility of DM, OM, CP, CHO, and energy (GE and ME) was notably high and relatively consistent across treatments. However, CF digestibility was lower in T3 compared to T1 and T2. Kacang goats receiving 73.264% TDN exhibited better ADG and feed efficiency compared to those receiving 70.038% and 72.295%. Additionally, feed conversion was lower (indicating better performance) in goats receiving TDN levels of 73.264% and 72.295% compared to those receiving 70.038% ($P < 0.05$). In conclusion, the use of an energy level of 73.264% TDN appears to enhance the performance of young Kacang goats compared to levels of 70.038% and 72.295%.

Keywords | Energy level, Kacang goats, Feed intake, Digestibility, Average daily gain, Feed conversion and efficiency.

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INTRODUCTION

The productivity of goats in the tropics is largely determined by the rainy and dry seasons. According to Tahuk and Dethan (2010), livestock performance in the tropics cannot be separated from climate and seasonal changes. Abundant feed availability during the rainy season has a positive impact on livestock growth performance. On the contrary, growth performance decreases in the dry season

due to the lack of nutrients including energy obtained by the animals.

Energy deficiency in livestock, including Kacang goats, is highly undesirable as it negatively affects livestock performance. Kacang goats that experience energy deficiency will experience a depletion of body tissue, both fat tissue and muscle tissue. This depletion occurs due to the dismantling of body fat and protein to meet the energy needs for basic

life. Both fat and muscle tissue depletion will be indicated by a decrease in body weight in Kacang goats (Tahuk and Bira, 2023).

Seeing its very important role, the fulfillment of energy in feed according to the needs of livestock is an important factor in the management of goat maintenance. Therefore, understanding the energy requirements for goats is important for designing a rational livestock production system. Thus, livestock can obtain a balanced ration to fulfill their production needs (Medeiros et al., 2014). With adequate energy, sufficiency can support livestock to be able to carry out all activities, both basic life, production, and reproduction. Livestock that have enough energy will show maximum performance when compared to livestock that lack energy in their feed. The adequacy of energy in these livestock will be indicated by positive livestock growth, maximum carcass production, and good reproductive performance in mothers and males.

Energy sufficiency in livestock is influenced by many factors. But in general, the feed factor is the main determinant of whether livestock are getting enough energy or not. In the tropics, energy sufficiency in goats is largely determined by the season. During the rainy season, the available feed is abundant and easily digestible, ensuring adequate nutrition for the animals, including energy (Tahuk et al., 2016). In contrast, during the dry season, the available feed is scarce, with a high crude fiber content that is difficult for livestock to digest so the energy obtained by livestock is also not optimal to meet livestock needs. As a result, livestock growth in the dry season tends to be lower when compared to livestock growing in the rainy season (Tahuk et al., 2018). In addition, energy requirements are influenced by age, body size, body condition, production stage (growth, rearing, pregnancy, and lactation), and concurrent medical/health conditions (Pugh, 2020).

A report by Tahuk et al. (2016) showed that in the dry season, ruminant animal (Bali cattle) reared on smallholder farms experience energy deficiency due to the low quality of forage obtained by livestock. Where the high crude fiber content in the forage becomes a limiting factor for feed digestibility in the rumen. As a result, the nutrients obtained by livestock to fulfill their basic needs and production are not optimal. Conversely, the feed protein obtained by livestock is abundant due to the sufficient availability of forage protein sources. The imbalance between protein and energy obtained by livestock has an impact on the performance of livestock. According to Pugh (2020), energy limitation can be caused by inadequate feed intake or poor food quality; in addition, excessive water content of feed ingredients can also be a limiting factor.

In general, the amount of energy acquired by goats deter-

mines the utilization of consumed feed protein. A high intake of feed protein without sufficient energy intake can lead to inefficiencies in animal performance due to suboptimal body tissue synthesis (Tahuk et al., 2016). Therefore, determining the balance between energy and protein in intensive goat farming is crucial. Achieving the correct ratio of energy to protein can significantly enhance goat performance for optimal meat production. This research aims to investigate information concerning optimal energy levels in utilizing forage protein sources and their effects on the performance of intensively reared young Kacang goats.

MATERIALS AND METHODS

LOCATION AND TIME OF RESEARCH

The study or experiment took place at the goat farm of the Animal Husbandry Study Programme, Faculty of Agriculture, Timor University, with ethical approval obtained accordingly. The implementation period spanned from March to October 2023. Analysis of feed nutrition, feces, and urine nitrogen was conducted at the Feed Chemistry Laboratory, Faculty of Animal Science, University of Nusa Cendana in Kupang.

ANIMALS AND FEEDING

The livestock used in the study were 15 young male Kacang goats with an age range of 12 - 18 months (based on estimated incisor turnover). The average initial body weight of the Kacang goats was 10.333 ± 1.245 kg. The study used complete feed composed of forage and concentrate. Ration preparation according to the nutrient requirement of young goats with a body weight of 15 kg and expected average daily weight gain (ADG) of 75 g/head/day (Kearl, 1982). The forage used to compose the ration consisted of natural grasses; while the concentrate consisted of protein source feed ingredients in the form of *Gliricidia sepium* leaf meal, as well as feed sources of easily digestible carbohydrates such as ground corn, bran pollard, and rice bran.

The feed was formulated as a complete ration, comprising natural grass as a fiber source and digestible carbohydrates, along with *Gliricidia sepium* leaf meal as a protein source. Additionally, livestock received a mineral premix (manufactured by Medion Bandung Co.) to prevent mineral deficiencies that may occur due to inadequate provision in the feed ingredients. The mineral premix composition includes 165,000 mg of Calcium, 52,000 mg of Phosphorus, 157,000 mg of Sodium, 2500 mg of Iron, 2500 mg of Copper, 2000 mg of Manganese, 125 mg of Iodine, 50 mg of Cobalt, 5000 mg of Selenium, and 10 mg of Zinc. It was added to the ration at a rate of 2% per 100 kg of concentrate mixture used, as prescribed. Table 1 presents the nutritional content of the feed ingredients comprising the ration, while the proportion of feed utilization in the

research (based on dry matter) and the ration composition is presented in Table 2.

EXPERIMENTAL DESIGN

The research used a field experimental method according to a completely randomized design (CRD) pattern. Fifteen (15) young male Kacang goats were grouped into 3 treatments with 5 animals each. The three treatment groups were:

T1: Kacang goats fed energy level (TDN) 70.038 % + crude protein 13.448 %

T2: Kacang goats fed energy level (TDN) 72.295 % + crude protein 13.922 %

T3: Kacang goats fed energy level (TDN) 73.264 % + crude protein 13.473 %

PREPARATION OF COMPLETE FEED

Complete feed preparation was carried out before the study. Fresh natural grass and *Gliricidia sepium* leaves were collected, and sun-dried until fixed weight; then natural grass and *Gliricidia sepium* leaves were ground with a milling machine at a diameter of 10 mm. In the next stage, the ground natural grass and *Gliricidia sepium* leaves were mixed with concentrate feed according to the formulation of each treatment. The complete feed that has been prepared is then applied to livestock according to the treatment.

LIVESTOCK ADAPTATION AND HEALTH CONTROL

The livestock adaptation phase to feed was carried out for 14 days (2 weeks) before the implementation of the study. The aim was to obtain a stable body condition of the livestock during the study, as well as eliminate the effects of previous feed, including adjusting livestock to the cage environment and maintenance patterns. During the adjustment phase, observations were made of the animals and their response to the feed given. To avoid infection with skin diseases such as scabies and internal parasites such as worms, animals were given Wormectin (produced by medion Bandung Co.) at a dose of 0.5 ml/25 kg/day intramuscularly. In addition, disease prevention efforts were made by maintaining cage cleanliness, and giving B-complex vitamins (produced by Medion Bandung Co.) to increase endurance during observation.

RESEARCH VARIABLES AND DATA COLLECTION

During the study, observations and data collection were conducted, including feed intake and digestibility, growth, conversion, and feed efficiency. The determination of feed dry matter (DM) intake was achieved by multiplying the fresh feed intake by the feed's DM content. Additionally, the determination of organic matter (OM), crude protein (CP), crude fiber (CF), carbohydrates (CHO), and energy intake was conducted by multiplying the feed DM intake

by the nutrient content (%) of the feed ingredients. Feed nutrient digestibility was determined by subtracting the fecal nutrient content (DM, OM, CP, CF, CHO, and energy) excreted from the feed nutrient intake (DM, OM, CP, CF, CHO, and energy). DM digestibility was determined using the formula:

$$DM \text{ intake (g)} - \text{fecal DM (g)}.$$

The value of DM digestibility (%) was determined using the formula: $DM \text{ digested (g)} / DM \text{ intake (g)} \times 100\%$.

Average daily body weight gain (ADG) of Kacang goats was determined from the difference between final body weight (kg) and initial body weight (kg) divided by the length of observation time (days). Feed conversion was calculated from the ratio of dry matter intake (g) to ADG of Kacang goats (g). The feed utilization efficiency value was known from the ratio ADG of Kacang goats (g) to dry matter intake (g) multiplied by 100%.

DATA ANALYSIS

Data were processed and analyzed by the Analysis of Variance (ANOVA) procedure with the help of Statistical Product and Service Solution (SPSS) Version 26. If the treatment had a significant effect, it was followed by Duncan's multiple tests (Steel and Torrie, 1991) to compare the differences between treatments.

RESULTS AND DISCUSSION

FEED INTAKE

The results showed that the dry matter (DM) intake of male Kacang goats that received different energy levels was not significantly different ($P > 0.05$) between treatments. In contrast, the intake of organic matter (OM) showed a significant difference ($P < 0.05$) between treatments (Table 3). The results of this study illustrate the use of energy (TDN) of 70% - 73% is optimal to increase feed intake. The DM intake is more influenced by the type, form, and nutrient content of the feed provided. When the feed given to livestock has the same quality, the response of livestock in consuming it will be the same. Physical and chemical quality can affect the feed intake of goats (Marhamah et al., 2019). The use of energy level affected organic matter (OM) intake ($P < 0.05$). Livestock that received energy (TDN 72 and 73%) had higher OM intake than T1 treatment livestock fed with 70% TDN. The increase in DM and OM intake was not only influenced by feed quality but also by the palatability of the feed given. The results showed that although BK consumption was relatively the same, the better palatability of the T2 and T3 treatments resulted in higher BO consumption compared to the T1 treatment. According to Suwignyo et al. (2016), OM is a component

contained in DM, so that a decrease or increase in OM intake is strongly influenced by DM intake.

The crude protein intake (Table 3) in this study was significantly different among treatments ($P < 0.05$). The CP intake of treatment T3 was higher than treatment T1; while treatment T2 was relatively similar to treatments T1 and T3. Crude protein intake in this study was relatively low ranging from 11-12% when compared to the ration CP which reached 13%. The results of this study illustrates that the use of different energy levels contributes to increased protein consumption by fattened goats. Nonetheless, the CP consumption of the three groups of treated livestock was lower than the CP of the ration. This is influenced by the response of goats to the protein source feed used. This study used *Gliricidia sepium* leaf meal as a protein source, but its palatability was low. As a result, the intake of *Gliricidia sepium* leaves is low which has an impact on the protein obtained by the third treatment livestock is also relatively lower when compared to the protein contained in the composed ration. Feed intake and feed digestibility are reduced if the crude protein of the feed is $< 6\%$, which can exacerbate energy-protein deficiency. Therefore, for the maintenance of mature and healthy livestock, feed should contain at least 7% crude protein. Crude dietary protein requirements are higher for growth, pregnancy, and lactation (Pugh, 2020). Thus, CP intake of Kacang goats in this research is sufficient for both basic living and production. According to the data (Table 4), it can be seen that the CP intake in this study has met the average crude protein requirement of goats for 10 kg body weight with ADG 50 g/day, which is 39 g (Kearl, 1982). Feed intake is affected by the quality of protein contained in the feed (Riaz et al. (2014); in addition, protein intake is closely related to the body weight gain (BWG) of livestock (Suparjo et al., 2011). Another factor that affects CP intake is the content of CP available in the feed. If the CP content in the feed is high, the CP consumed will also be high (Tahuk et al., 2021).

Crude fiber (CF) is a source of structural carbohydrates in ruminants. Crude fiber consumed by livestock will be broken down into cellulose which is then digested by rumen microbes and produces VFA which will then be used as an energy source for ruminants (Nurhajjah et al., 2016). The average intake of CF (g/head/day) (Table 3) of each treatment was T1 treatment of 45.625 ± 2.282 g, T2 44.439 ± 0.580 g, and T3 treatment of 40.754 ± 0.837 g. According to the results of statistical analysis, it can be seen that the intake of CF (g/head/day) was higher than that of T2 treatment. According to the results of statistical analysis, it can be seen that the CF intake of Kacang goats in T3 treatment is lower ($P < 0.05$) when compared to the CF intake of Kacang goats in T1 and T2 treatment; where the two treatments have CF intake that is not much different

($P > 0.05$). The results of this study illustrate that increasing energy sources (73% TDN) can reduce the CF obtained by livestock due to the increase in easily digestible carbohydrates obtained by livestock. When compared to other research reports, the CF intake of T1 - T3 cattle in this study was lower than the report of Yulianti et al. (2019) who obtained CF intake in male PE goats given fermented feed of tofu pulp and palm kernel cake of 83.7-119 g/head/day. The difference in CF intake is related to the different CF content of the research feed used. If the CF content of the feed is high, it will also increase the CF intake of the livestock. Goats need sufficient dietary fiber for normal rumen activity and function, but the need for fiber in goat rations has not been established in the guidelines and standards of nutritional needs (Suparjo et al., 2011).

Carbohydrate (CHO) intake (g/head/day) (Table 3) of each treatment was T1 treatment at 191.557 ± 4.515 ; T2 treatment at 241.870 ± 4.387 , and T3 treatment at 239.564 ± 5.739 . The T2 and T3 treatments, which received 67 and 70% TDN energy respectively, had higher CHO intake ($P < 0.05$) when compared to the T1 treatment which had lower CHO intake. The CHO intake (g) obtained in this study was lower than the report of Tahuk and Bira (2022) who obtained CHO intake in male, female, and castrated male goats ranging from 236.31 ± 39.16 - 244.92 ± 26.52 g/head/day. According to Garcez et al. (2020), in livestock given rations with forage and concentrate fractions, mixed separation can be carried out due to the action of animals that turn the feed in the trough with their snouts to select the feed consumed. This affects the quality and quantity of feed consumed, in addition to the chemical composition of the remaining feed, leading to variations in nutrient intake by the livestock.

Gross energy (GE) intake (Kcal/kg.DM) (Table 3) of each treatment was 1797.937 ± 1203.733 for treatment T1, 1996.373 ± 1118.974 for treatment T2, and 1860.889 ± 1241.866 g/head/day for treatment T3. While the metabolic energy (ME) intake (Kcal/kg.DM) for T1 treatment was 1516.425 ± 1014.874 ; T2 treatment was 1708.554 ± 957.520 ; and T3 treatment was 1622.226 ± 1082.764 . According to the results of the analysis of variance, GE intake was relatively the same among treatments; on the other hand, ME intake of treatments T2 and T3 was higher ($P < 0.05$) than treatment T1. Energy for livestock mainly comes from carbohydrates (sugar, starch, and fiber) and fat in the diet. In addition, leafy forages and grasses, as well as tree leaves contain enough energy to meet the nutritional needs of every goat on the farm. Feed grains that contain high energy include corn and wheat (Luginbuhl, 2015). Therefore, the use of maize and bran pollard in this study contributed positively to the increase in energy obtained by Kacang goats.

FEED DIGESTIBILITY

The digestibility of dry matter and organic matter (%) of male Kacang goats that received different energy levels were very high but relatively similar ($P>0.05$) between treatments. The DM digestibility coefficient of treatment T1 was $69.3410 \pm 9.801\%$, treatment T2 was $74.783 \pm 8.887\%$ and treatment T3 was $79.273 \pm 5.750\%$. Similarly, the OM digestibility coefficient for T1 was $72.886 \pm 8.753\%$, T2 treatment was $77.718 \pm 7.912\%$, and T3 treatment was $81.700 \pm 5.139\%$ (Table 4). The high and relatively equal intake of DM and OM illustrates that the use of energy levels (TDN) ranging from 70 - 73% in the ration is optimal for increasing microbial activity in the rumen. As a result, the digestibility of dry matter and organic matter can be maximized. This high value of DM and OM digestibility contributes positively to livestock performance due to maximum nutrient utilization. The results of this study showed that the digestibility of DM and OM followed a different pattern of energy level (TDN) utilization in each treatment. According to Tahuk et al. (2016), the use of easily digestible carbohydrates as energy in the ration can increase the role of microorganisms in digesting feed ingredients. Increasing feed digestibility has a close relationship with feed intake in livestock. When feed digestibility increases, the rate of gastric emptying will be faster. As a result, livestock will be stimulated to increase their feed intake. Similarly, an increase in dry matter digestibility will also affect the digestibility of other food substances (Aryanto et al., 2013); and is a very important determinant for evaluating nutrients absorbed by ruminants (Al-Arif et al., 2017). The DM digestibility results of this study were higher than the report of Mariam et al. (2023) who obtained DM digestibility ranging from 82.75 ± 4.64 - $87.50 \pm 3.78\%$; and the report of Febrina et al. (2021) which obtained DM digestibility ranging from 69.66 ± 7.05 - $73.35 \pm 1.12\%$; while OM digestibility was not much different from the report of Mariam et al. (2023) with OM digestibility ranging from 84.5 ± 3.69 - $88.75 \pm 3.30\%$; and the report of Febrina et al. (2021) on complete feed, OM digestibility was 79.32 ± 4.71 - $81.89 \pm 0.80\%$.

The value of CP digestibility (%) (Table 4) in male Kacang goats that received different energy levels showed no significant effect between treatments. In general, the digestibility value of CP (%) produced in this study is very high to ensure nutrient adequacy for livestock to improve their growth performance. The percentage of CP digestibility of each treatment was T1 at $82.392 \pm 5.131\%$, T2 treatment at $85.904 \pm 4.701\%$, and T3 treatment at $87.263 \pm 2.635\%$ ($P>0.05$). The relatively similar value of CP digestibility illustrates that the use of energy (TDN) in the ration at the level of 70 - 73% gives maximum contribution to the rumen microbes to digest feed optimally. The relatively similar digestibility of CP is in line with the digestibility of DM and

OM which is also relatively similar between treatments. The CP digestibility value in this study was higher than the report of Tahuk and Bira (2022) who obtained CP digestibility ranging from $81.97 \pm 2.91\%$ - $88.12 \pm 3.55\%$ in male Kacang goats, castrated males, and female Kacang goats that received concentrates. The difference in digestibility values among the research reports illustrates that in the same breed of livestock, the response to feed, age and sex, and physiological status of livestock are different. The high value of CP digestibility indicates that the adequacy of energy in the ration determines the activity of rumen microbes in digesting feed consumed by livestock. According to Rahmawati et al. (2021), the digestibility value of crude fat from forage can vary depending on the type of forage, nutrient content, and feed quality. Although statistically relatively the same, the results of this study show that the use of higher energy (TDN) in the ration can increase the digestibility of CP. The High and low degradation of protein and fat is determined by the ability and activity of microbes in the rumen. Thus it can be said that increasing the energy content in the ration to 70% contributes positively to the performance of rumen microbes in degrading feed. The crude fiber (CF) digestibility (Table 4) of male Kacang goats that obtained different energy levels were relatively the same. Where the CF digestibility value of each treatment is T1 of $34.157 \pm 22.354\%$, T2 of $48.329 \pm 18.831\%$, and T3 treatment of $55.585 \pm 13.706\%$. The coefficient of crude fiber digestibility that was not significantly different was due to the type and quality of forage given to the three treatments in the form of natural grass and *Gliricidia sepium* leaves were the same. As a result, the degradation of fiber in the rumen by microorganisms is almost the same. According to Selim et al. (2022), the characteristics and content of the fiber fraction of feedstuffs, as well as the amount and ability of rumen microbial activity greatly determines the high and low degradation. Although statistically relatively similar, but quantitatively involved that the use of energy (TDN) 70 - 73% in rations with 13% CP has not provided maximum CF digestibility. This is thought to be influenced by the quality of the forage, especially natural grasses whose use has passed the generative phase. As a result, the formation of lignin, cellulose, and hemicellulose increases; thus contributing to the low degradation of fiber in the rumen. (In addition, the protein source used in this study was *Gliricidia sepium* leaves whose proportion of use reached 30. As a result, the tannin content contained in *Gliricidia sepium* leaves can reduce the activity of rumen microbes in digesting feed (Besharati et al., 2022). The low digestibility of crude fiber can occur due to the population of cellulolytic bacteria not developing optimally due to the influence of tannins contained in feed ingredients (Ahmad et al., 2020). According to Stergiadis et al. (2015), nutrient digestibility and DE and ME concentrations are negatively related to grass-neutral detergent fiber (NDF)

Table 1: Nutrient Content of Feed Ingredients and Research Rations

Feed ingredients	Nutrient content										
	DM (%)	OM (% DM)	Ash	CP	CF	EE	CHO	NFE	TDN (%)	GE MJ/Kg. DM	ME Kcal/ Kg. DM
Field grass*	91.778	90.104	9.90	8.542	30.732	1.701	79.862	49.130	56.644***	16.467	3920.61
<i>Gliricidia sepium</i> leaf meal*	88.481	90.164	9.84	20.161	13.846	7.990	62.013	48.167	69.653***	18.341	4366.79
Ground corn*	88.001	98.322	1.30	10.428	1.894	6.934	80.960	79.066	80.278****	18.899	4499.81
Bran pol-lard*	86.595	99.145	14.16	16.457	8.461	3.344	79.345	70.884	84.029***	18.856	4489.53
Rice bran*	90.256	85.841	0.86	9.957	28.475	4.411	72.472	43.997	62.149****	16.115	3417.49
Ration:											
Ration T1**	89.844	92.087	7.913	13.448	15.913	5.539	73.200	57.287	70.038	17.779	4050.414
Ration T2**	89.677	93.517	6.483	13.922	13.448	5.575	74.020	60.572	72.295	18.072	4168.750
Ration T3**	89.134	94.325	5.675	13.473	11.062	6.109	74.744	63.681	73.264	18.280	4142.903

Information : * Analytical results of the Feed Chemistry Laboratory, Faculty of Animal Husbandry, Fisheries and Marine Sciences, Nusa Cendana University, Kupang (2023); ** The ration was calculated from the feed ingredients used (DM); *** According to the equation of Hartadi *et al.* (1980); **** According to Wardeh Equation (1981); DM: Dry matter; OM: Organic matter; CP: Crude protein; Crude fiber; EE: Extract enter; CHO: Carbohydrate; NFE: Nitrogen free extract; TDN: Total digestible nutrients; GE: Gross energy; EM: Metabolic energy.

Table 2: Feed and ration composition of the study (DM basis)

Description	Nutrient Content of the Ration (%)	
Ration T1	CP (%)	TDN (%)
Field grass	1.282	8.497
<i>Gliricidia sepium</i> leaf meal	6.048	20.896
Ground corn	2.711	20.872
Bran pollard	1.317	6.722
Rice bran	2.091	13.051
Total	13.448	70.038
Ration T2		
Field grass	1.281	8.497
<i>Gliricidia sepium</i> leaf meal	6.048	20.896
Ground corn	3.128	24.083
Bran pollard	2.469	12.604
Rice bran	0.966	5.216
Total	13.922	72.295
Ration T3		
Field grass	1.281	8.497
<i>Gliricidia sepium</i> leaf meal	6.048	20.896
Ground corn	4.693	36.125

Bran pollard	1.152	5.882
Rice bran	0.299	1.864
Total	13.473	73.264

Table 3: Average DM and nutrient intake of young male Kacang goats fed diets with different energy levels

Parameter	Treatment ¹			P
	T1	T2	T3	
DM intake (g/day/head) ^{ns}	300.830±14.356	313.800±7.672	312.048±7.053	0.175
OM intake (g/day/head)	282.771±13.117 ^b	300.216±6.719 ^a	299.872±6.895 ^a	0.032
OM intake (% DM)				
CP intake (g/day/head)	35.322±2.418 ^b	39.422±2.134 ^a	37.236±0.710 ^{ab}	0.030
CP intake (% DM)				
CF intake (g/day/head)	45.625±2.282 ^a	44.439±0.580 ^a	40.754±0.837 ^b	0.001
CF intake (% DM)				
CHO intake (g/day/head)	191.557±4.515 ^b	241.870±4.387 ^a	239.564±5.739 ^a	0.000
CHO intake (% DM)				
GE intake (Kcal/kg.DM)/day/head ^{ns}	1797.937±1203.733	1996.373±1118.974	1860.889±1241.866	0.967
ME intake (Kcal/kg.DM)/day/head	1516.425±1014.874 ^b	1708.554±957.520 ^a	1622.226±1082.764 ^a	0.006

¹Data are presented as mean±SD; T1=Kacang goats given 70.038% energy level; T2=Kacang goats given 72.295% energy level; T3=Kacang goats given 73.264% energy level; DM: Dry matter; OM: Organic matter; CP: Crude protein; CF: Crude fiber; CHO: Carbohydrate; GE: Gross energy; ME: Metabolic energy; ^{ns}: Not significant; ^{a,b}different superscripts in the same row indicate differences (P<0.05).

Table 4: Mean of nutrient digestibility of male Kacang goats fed diets with different energy levels

Parameter	Treatment ¹			P
	T1	T2	T3	
Digestibility of DM (%) ^{ns}	69.3410±9.801	74.783±8.887	79.273±5.750	0.289
Digestibility of OM (%) ^{ns}	72.886±8.753	77.718±7.912	81.700±5.139	0.292
Digestibility of CP (%) ^{ns}	82.392±5.131	85.904±4.701	87.263±2.635	0.301
Digestibility of CF (%) ^{ns}	34.157±22.354	48.329±18.831	55.585±13.706	0.291
Digestibility of CHO (%) ^{ns}	63.850±12.146	75.051±8.924	79.406±5.960	0.096
Digestibility of GE (%) ^{ns}	74.423±8.188	78.588±7.592	82.491±4.869	0.316
Digestibility of ME (%) ^{ns}	81.086±5.988	83.240±5.947	86.273±3.662	0.422

¹Data are presented as mean±SD; T1=Kacang goats given 70.038% energy level; T2=Kacang goats given 72.295% energy level; T3=Kacang goats given 73.264% energy level; DM: Dry matter; OM: Organic matter; CP: Crude protein; CF: Crude fiber; CHO: Carbohydrate; GE: Gross energy; ME: Metabolic energy; ^{ns}: Not significant.

Table 5: Performance of male Kacang goats fed with different energy levels

Parameter	Treatment ¹			P
	T1	T2	T3	
DM Consumption (g) ^{ns}	300.830±14.356	313.800±7.672	312.048±7.053	0.175
Daily Weight Gain (g) ^{ns}	27.143±38.379	46.428±11.294	66.667±22.751	0.186
Feed Conversion	44.925±39.275 ^a	7.152±2.050 ^b	5.007±1.529 ^b	0.057
Feed Efficiency (%) ^{ns}	8.592±12.020	14.749±3.340	21.585±7.948	0.174

¹Data are presented as mean±SD; T1=Kacang goats given 70.038% energy level; T2=Kacang goats given 72.295% energy level; T3=Kacang goats given 73.264% energy level; ^{a,b}different superscripts in the same row indicate differences (P<0.05).

and acid detergent fiber (ADF) contents, but positively related to nitrogen (N), gross energy, and ether extract (EE) contents. According to the results of the proximate analysis of the feed ingredients used in the study, natural

grass and rice bran contributed the most in terms of crude fiber content. Natural grass had CF of 30.732%, while rice bran had CF content of 28.475%. The high CF of these two feed ingredients contributed to the low CF digestibility of the three treatment groups.

The CHO digestibility value of each treatment is quite high and follows the level of energy used in the ration. The higher the energy used in the ration, the higher the CHO digestibility. The CHO digestibility value of T1 treatment was $63.850 \pm 12.146\%$, T2 was $75.051 \pm 8.924\%$, and T3 treatment was $79.406 \pm 5.960\%$. Thus the use of TDN 65, 67, and 70% in the ration has been optimum to increase CHO digestibility. This high CHO digestibility contributes positively to Kacang goats because there are enough carbohydrates available to meet the needs of livestock for basic and for production and reproduction. Feed chemical composition is strongly related to feed digestibility, and crude fiber (CF) has the greatest influence [Selim et al. \(2022\)](#). In addition, the resulting CHO digestibility has the same value because the type and quality of forage used are of the same quality. According to [Li et al. \(2018\)](#), both the quantity and quality of feed affect animal performance. This includes the digestibility of food substances, which is indicated by the feed digestibility coefficient or digestible substances in the feed.

The use of different energy levels (TDN) from the level of 70 - 73% in the ration can increase the digestibility of Gross Energy (GE). However, the increase in GE digestibility is relatively the same between treatments. The GE digestibility of Kacang goats in T1 treatment was $74.423 \pm 8.188\%$, T2 was $78.588 \pm 7.592\%$, and T3 treatment was $82.491 \pm 4.869\%$ ([Table 4](#)). As with GE, the utilization of different energy levels in the ration resulted in relatively similar digestibility of Metabolism Energy (ME) among treatments. The ME digestibility of Kacang goats in T1 treatment was $81.086 \pm 5.988\%$, T2 treatment was $83.240 \pm 5.947\%$, and T3 treatment was $86.273 \pm 3.662\%$. The high digestibility of GE and ME in this study illustrates that high ration energy contributes positively to the feed fermentation process in the rumen because rumen microbes get enough balanced nutrient supply to degrade feed ([Tahuk et al., 2016](#)). The high digestibility and energy values in this study contribute to providing energy to goats to fulfill their basic needs and production needs. Digestibility in ruminants is influenced by the type of feed, chemical composition, intake of feed dry matter by livestock, health status, and rumen bacteria ([Krizsan et al., 2012](#); [Li et al., 2018](#)). In general, the results of this study illustrate that the availability of energy in the ration determines the level of feed degradation in the rumen. Low energy levels display lower feed degradation; conversely, high ration energy can increase the activity of the rumen

microbes in digesting feed.

BODY WEIGHT GAIN

The results showed that Kacang goats receiving feed with energy (TDN) 70 - 73%, respectively, had relatively similar average daily body weight gain (ADG) ($P > 0.05$). The similar performance of the research animals explain that the use of TDN 70 - 73% has a similar impact. However, the ADG of the Kacang goats in T3 treatment tended to be higher than the Kacang goats of T1 and T2 treatment ([Table 5](#)). The daily weight gain (g/head/day) of T1 treatment was 27.143 ± 38.379 , the T2 treatment was 46.428 ± 11.294 , and T3 treatment was 66.667 ± 22.751 .

This indicates that the use of energy (TDN at 73% level has a significant effect due to increased body tissue synthesis. As a result, the ADG produced can be increased. The effect of ADG produced by the three treatment groups was influenced by the quality and quantity of feed consumed by the Kacang goats. This can be seen from the same intake of dry matter in the three treatment groups ([Table 3](#)). If the intake of DM or other nutrients is the same, the supply of nutrients to the body will also be the same and have an impact on changes in body weight as well. The increase in growth of young male Kacang goats also illustrates that the nutrients that have been obtained are sufficient to meet the basic needs of life; so the excess is used to meet the synthesis of muscle tissue as indicated by the increase in ADG.

FEED CONVERSION AND EFFICIENCY

Feed conversion and efficiency illustrate the use value of feed obtained by livestock to increase their body weight gain. According to the results of the study, feed conversion of livestock that obtained energy (TDN) of 72 and 73% was lower (better) ($P < 0.05$) when compared to livestock that obtained energy (TDN) of 70% ([Table 5](#)).

Feed conversion of each treatment group was T1 of 44.925 ± 39.275 ; T2 of 7.152 ± 2.050 , and T3 treatment of 5.007 ± 1.529 . According to [Nuraini et al. \(2014\)](#), the smaller the feed conversion value, the more efficient the feed utilization. Thus, the results of this study showed that the Kacang goats of T2 and T3 treatment were more efficient in utilizing feed to increase body weight when compared to the Kacang goats in T1 treatment. Feed nutrient content, especially the increase in ration energy content, has a major effect on feed conversion. Feed that contains complete nutrients and suits the needs of livestock will result in low conversion ([Tahuk and Bira, 2022](#)).

The feed utilization efficiency value for each treatment was $8.592 \pm 12.020\%$ for the T1 treatment, 14.749 ± 3.340 for the T2 treatment, and $21.585 \pm 7.948\%$ for the T3 treat-

ment (Table 5). The results of statistical analysis showed that the treatment did not significantly affect the feed efficiency value ($P>0.05$). The relatively similar value of feed efficiency is influenced by ADG and DM intake which is the basis for calculating feed efficiency is also not different between treatments.

Although the results of statistical analysis were relatively the same, quantitatively the feed efficiency value of the T3 treatment exceeded the T2 and T1 treatments. This illustrates that the use value of T3 animal feed with TDN of 73% is higher in increasing ADG of treated Kacang goats. This condition is also related to the more optimal feed conversion value in the T3 treatment. Feed conversion is an illustration of the efficient use of animal feed in increasing animal weight gain (Tahuk and Bira, 2023). This study resulted in better feed utilization efficiency when compared to Islamiyati et al. (2013) gave local goats corn straw inoculated with fungi and enriched with *Gliricidia sepium* with feed use efficiency ranging from 16.90%-23.48%. This is related to the availability of nutrients that are more complete than this study.

The results of this study generally illustrate that the conversion value and feed efficiency in the growing phase of Kacang goats can be maximally improved by increasing the energy in the ration. An increase in ration energy will streamline the utilization of feed protein for maximum body tissue synthesis.

CONCLUSIONS

Based on the study results, it can be concluded that utilizing energy levels at 73% resulted in higher productivity among male Kacang goats compared to those receiving energy levels of 70% and 72%. Factors such as feed intake, digestibility, growth performance, especially average daily gain (ADG), exhibited improvements, along with enhanced feed conversion and efficiency.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest related to this published article. Neither related to this article, nor funding.

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NOVELTY STATEMENT

The lack of adequate energy availability for goats during the dry season in the tropics is a problem that needs to be solved. Therefore, this study has provided the latest information on the utilisation of different energy levels during the dry season in the tropics, and its effect in improving the performance of Kacang goats.

AUTHORS CONTRIBUTION

PKT designed research, statistical analysis and drafted the manuscript. GFB and WVF assisted in the research process and data collection. All authors make significant contributions to research and have read and approved the final manuscript.

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