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Management and Value-Added of Goat Production, Thailand: The Leucaena (*Leucaena leucocephala*) as Roughage Source on Performance and Meat Quality in Rainy Season

Research Article

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ABSTRACT

This research is part of knowledge management and value-added transmission of goat production for sustainable career promotion and community food security. The objective of this study was to investigate how fresh leucaena and the effect of different sources of leucaena on growth performance and meat quality in indigenous Anglo-Nubian hybrid goats ale after weaning, with an average weight starting at approximately 15 kg, were divided into 5 groups of 4 with 4 repetitions each. The research was allotted in five into five groups of four repeats each. Treatment 1 received pangola grass as a crude feed source, treatment 2 received leucaena as a 25% feed substitute, treatment 3 received leucaena as a crude feed substitute at level 50%, treatment 4 received leucaena as a feed substitute at level 75, and treatment 5 received leucaena as a 100% coarse feed substitute. Leucaena was able to raise goats at a rate of 75-100%. The average daily gain, feed cost per gain of 1 kg, and blood-urea-nitrogen (BUN) values after 4 hours of feeding were the best and higher than the BUN values of the other groups. The difference in values was statistically significant. ($P<0.05$), and use in percentages 50-100 did not affect the final weight, total weight gain, dry matter content, protein intake, total feed conversion ratio (FCR), dry matter intake (DMI) to percentage body weight (BW), feed cost per gain, economic loss index, production performance index, salable head return, carcass characteristics, quality and chemical composition of meat, or meat acceptance according to research results. The difference was not statistically significant ($P>0.05$).

KEY WORDS *Leucaena leucocephala*, meat, performance, rainy season, roughage.

INTRODUCTION

Thailand is in the tropics, which means it is hot and humid right now. Among farmers, goat meat is very popular. In Thailand, approximately 323,631 goats and domestic animals are incredibly productive. Ruminant feeding with good quality pasture has been advocated to achieve low cost animal production. Accordingly, meat goat production can use good quality pasture to obtain an optimum daily gain (Srivastava and Sharma, 1998; Wanida *et al*. 2017).

Goats are bred for the meat, skin, and hair they produce. Consumption of goat meat is also on the rise in the United States and around the world. We have a variety of rearing approaches because we generally buy goat meat from local farmers in Thailand. Most smallholder groups choose to raise goat meat as a natural means of self-sufficiency (Wanida *et al*. 2017). As a result, goats are fed in insufficient numbers and with food of poor quality, resulting in poor growth rates (Srivastava and Sharma, 1998), especially during the rainy season, which lasts from May to

October each year. Storms and secondary monsoons batter Thailand. The rainy season directs the supply and amount of roughage accessible to goats and results in significant floods and waterlogging for an extended period, as seen in Figure 1. Leucaena (*Leucaena leucocephala*) is well known for its use as fodder due to its nutritious, pleasant, and easily digestible properties. Both cut and fresh leucaena can be fed to animals, and grazing animals are allowed to graze freely (Leketa *et al.* 2019; Semae, 2021).

Leucaena is also a tropical forage plant that may be utilized as a protein feed source and has a nutritional profile similar to the nutritional profile of winter fodder beans. Animals have easy access to local materials. Leucaena can be used as a rough feed source because it has 17-24.4% protein (Leketa *et al.* 2019; Cecilia *et al.* 2021). Department of Livestock Development (2008) reported that 2 forms of Leucaena were found in Thailand: fresh and dry. The protein level of fresh leucaena was 14-16%. Dried leucaena has protein levels of approximately 15.17-25.91%, and many essential nutrients for animals are found in leucaena, as shown in Table 1. According to Islam *et al.* (1995) and Juan *et al.* (2009), mimosine, a primary active poisonous component found in leucaena leaves, can be used to substitute mimosine in the metabolic process. The metabolic process is interrupted when a considerable amounts of the leaves enter the body of the animal, and animals can become poisoned.

However, goats have been demonstrated to be able to ingest considerable amounts of leucaena as feed without causing long-term harm to their bodies. Additionally, soaking such poisons in water for one night or exposing them to the sun for two to three days might turn them nontoxic and can decrease as well as boost the utility of poisons. Leucaena (*Leucaena leucocephala*) grows fast and abundantly during the wet season. Leucaena is a good source of roughage because it is readily available and plentiful. Another option is to offer leucaena to young goats as a roughage source (Shelton, 2001; Anna *et al.* 2021).

Because leucaena can aid in increasing goat nutrition and reducing roughage during the wet season of goat production, this research has examined the management of leucaena as a primary feed source to replace grass feed that has been destroyed or damaged by flooding in the farming area, as well as to finding solutions to the problems of goat farmers during the rainy season (Osakwe and Steingass, 2005).

MATERIALS AND METHODS

This trial was reviewed through funding and animal ethics and conducted by a committee for scientific work experimentation with NSRU-IACUC No 202004 certificate. During Thailand's rainy season, the use of fresh leucaena as a coarse feed source for young goats was managed as follows.

Figure 1 Housing and goat rearing conditions in Thailand
(a) little farmer's goat hut; (b) water logging during the rainy season and (c) finding leucaena trees growing along the path during the rainy season

Table 1 Chemical composition of the experimental diets

Composition	Pangola hay	Concentrate	Fresh leucaena	Dried leucaena
Dry matter (%)	90.50	90.80	91.22	91.00
Crude protein (%)	10.33	22.50	15.00	20.00
NDF (%)	65.81	75.36	50.63	51.52
ADF (%)	38.31	47.78	38.59	36.00
GE (cal/g DM)	3411	3388	3730	3540

NDF: neutral detergent fiber; ADF: acid detergent fiber and GE: gross energy.

Animals

Indigenous Anglo-Nubian hybrid goats ale after weaning, average weight starting at approximately 15 kg, were divided into 5 groups of 4 with 4 repetitions each, cultured for 60 days and pretreated for 7 days under the raised house, open system. The goats had free access to experimental roughage and water.

Feed and management

The experiment used a completed randomized design (CRD) to examine the effects of leucaena as a roughage substitute at 25, 50, 75, and 100 percent ratios on the production efficiency of goats. The cost of producing goats was investigated. Pangola grass as a roughage source was regulated under Treatment 1. Treatment 2: as a roughage alternative, 25% leucaena was used. Treatment 3: leucaena was used as a roughage substitute at a 50% level. Treatment 4: leucaena was used as a roughage substitute in 75 percent of the cases. Group 5: the goats used 100 percent leucaena as a roughage with alternative data storage.

1. Data were collected for manufacturing efficiency analysis. By keeping track of how much feed you eat every week. Weighing every week at the beginning and end of the experiment to calculate daily feed consumption (daily feed intake (DFI)). The average daily growth rate (ADG), the meat exchange rate (feed conversion ratio (FCR), and other indicators were calculated using weekly weight gain (WG). Goats in their infancy have high production expenses.

Economic loss index= BWG × survival rate / FCR × 10^3
Production index= survival rate × BWG / trial day× FCR
Feed cost per gain 1 kg= feed cost (B/kg) × FCR
Salable head return= price × BWG
Slaughter weight= live weight × 100 / living carcass weight

2. Collation of meat quality in a random sampling of characters chemicals composed of mental farms 25 percent, of each group of five groups of four animals, totaling 20 animals, were slaughtered and separated by slaughter according to the method. The animals were weighed and slaughtered before being slaughtered. Then scald with hot water at 58-60 ˚C, remove the entrails, divide the components, and weigh each part.

The texture profile analysis approach was used to prepare biopsy samples for chemical composition inspection and meat quality inspection. A texture analyzer and a stainless-steel cylindrical No. P/6 probes were used to assess transverse muscle fibers. Prepare a 1 cm biopsy sample and measure each test three times. Assemble the machine in the order listed below. The following are the TA settings for the XT2i: TPA is the mode for meat. Pre-Test Speed: 2.0 mm/s Test Speed: 1.0 mm/s after the test, the speed was 10 mm/s with a 70 percent strain at a distance. Trigger Type: 5 g Auto Force the methods for calculating are as follows: the hardness value is equal to the maximum compression force of the first compression in newtons (N) L2/L1 springiness value equals material recovery rate Curve area= cohesiveness value Chewiness value= Hardness (N) × Cohesiveness × Springiness in Newtons (N). The color of beef tenderloin is determined by Hunter Flex (Hunter Association Lad, Inc. Uthe SA) (Wanida *et al.* 2017). The CIE system is used to report color values. The Kjeldahl Method is used to determine the amount of protein in a sample using the L*, a*, and b* categories; moisture content determination by hot air method; fat content analysis by Soxhlet; and moisture content measurement by hot air method (AOAC, 2000).

3. Sensory evaluation, all types of biopsies were cut across the muscle fibers roughly 2 mm thick and were blanched in boiling water at 80 ˚C for 10 min without any additives applied.

The assessor graded 25 people on a scale of 1 to 5. Tenderness of the meat with a juicy texture and a satisfying flavor (Wanida *et al.* 2017). The assessment was done in the form of a record of assessment outcomes. Compare the results of the consumer satisfaction and acceptance questionnaire as given in Table 2.

Table 2 The sensory evaluation scores and consumer satisfaction criteria

Evaluation criteria	Score
A lot	1
Quite a lot	2
Medium	3
Quite few	4
Little	5

4. Blood collation for BUN analysis, randomized from experimental farms, percent of each group, 5 groups, 4 samples, and a total of 20 blood samples were collected twice before and after the experiment. According to the method of (Srivastava and Sharma, 1998), blood collection for Jugular Vein of goats has collected approximately 5 mL per 1 body. Needle for blood collection size 22 Gx 1.5 inches (0.7×40 mm), syringes, glass blood collection tubes, blood collection tubes, disinfectant, mostly alcohol, cotton swabs, sharp objects to prevent injury from the contents (Chokchai, 1993; Semae, 2021). Sharp plaster for covering wounds when drilling is complete send for blood testing and BUN values at the medical technical Laboratory, Muang District, Nakhon Sawan Province level. Using the Statistical Analysis System SAS® University Edition to analyze animal research (SAS, 2003).

RESULTS AND DISCUSSION

The following were the outcomes of using leucaena as a coarse feed source for young goats in Thailand during the

rainy season: During the rainy season in Thailand, goat production efficiency using fresh leucaena as a feed roughage source for young goats was used at a level of 75-100 percent without influencing final body weight, total live weight increase, total dry matter intake, protein intake, FCR, and total.

The conversion of DMI to percent BW was not statistically significant (P>0.05). However, the use of fresh Leucaena as a raw feed source for baby goats at 75-100 percent yielded higher average daily yields than other levels. The differences were statistically significant (P<0.05), as shown in Table 3.

The use of leucaena as a fuel source has been carefully monitored. According to a study on the cost of producing young goats, fresh leucaena can be used as a coarse feed for goats during the rainy season in Thailand at a rate of 50-100 percent without affecting the feed cost per gain (FCG), economic loss index (ELI), production performance index (PPI), or salable bird return (SBR). Fresh leucaena was used at a rate of 50-100% as coarse feed for goats, resulting in a feed cost per gain of 1 kg cheaper than other levels; there was a statistically significant difference (P<0.05), as shown in Table 4.

The carcass is characterized during Thailand's rainy season, and using fresh leucaena as a source of coarse feed for young goats enhanced meat quality and chemical composition by 100% without affecting carcass characteristics, quality, or chemical composition. There was no statistical significance (P>0.05), as shown in Table 5. Consumer acceptance of meat and BUN levels in blood 4 hours later in goat production stages is good. Fresh leucaena can be fed to goats in Thailand during the rainy season without a statistically significant effect on the meat toughness, the juiciness of the meat, the taste, or overall satisfaction (P>0.05), and using fresh leucaena as a coarse feed source for goats at a rate of 75-100% resulted in higher blood-urea-nitrogen (BUN) values than other levels. The difference was statistically significant (P<0.05), as shown in Table 6.

During the rainy season in Thailand, the usage of leucaena as a coarse feed for young goats has an impact on productivity. At a concentration of 75-100%, fresh leucaena was found to be safe to use without affecting final body weight, total live weight, total dry matter intake, protein intake, FCR, or total DMI to percent BW (P>0.05). The 50% leucaena group had a higher weight than the other groups, according to Sareena and Thainthip (2018).

Table 3 Effects of fresh leucaena on growth performance in goats

Item	Leucaena level (%)					SEM	P-value
	T1	T2	T3	T4	T5		
Initial body weight, kg	15.50±7.25	15.21±5.11	15.10±6.23	15.25±4.58	15.42±6.95	0.55	0.07
Final body weight, kg	18.87±5.36	18.82±6.10	18.76±5.54	18.97±6.23	19.15±5.32	0.65	nd
Total live weight gain, kg/h	3.57±1.32	3.59±2.38	3.66±4.33	3.72±2.66	3.73±1.88	0.80	nd
Average daily gain, g/day	59.52±9.12^{c}	59.83±7.11^{c}	61.05±5.33^{b}	62.00±6.23^{a}	62.11±5.21^{a}	2.75	0.02
Total dry matter intake, kg DM/h/day	0.65±1.25	0.66±0.89	0.65±1.52	0.66±1.33	0.66±1.78	8.02	nd
Concentrate, kg DM/h/day	0.27±1.28	0.27±2.88	0.27±1.25	0.27±2.22	0.27±2.45	-	-
Pangola hay, kg DM/h/day	0.38±0.14	-	-	-	-	-	-
Leucaena, kg DM/h/day	-	0.39±0.25	0.38±1.25	0.39±1.02	0.39±2.33	-	-
Protein intake, g DM/h/day	147±2.51	147±3.11	148±2.67	147±2.77	148±3.15	1.52	nd
FCR	10.9±2.54	10.80±2.36	10.65±4.65	10.60±2.25	10.61±2.85	2.15	0.06
Total DMI to % BW, %	1.56±0.21	1.54±0.11	1.56±0.28	1.55±0.13	1.57±0.22	0.85	nd

BW: body weight; DMI: dry matter intake and FCR: feed conversion ratio.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.
nd: no statistical analysis.

Table 4 Cost of goat production

Item	Leucaena level (%)					SEM	P-value
	T1	T2	T3	T4	T5		
Concentrate cost, Bath/kg	194.5	194.5	194.5	194.5	194.5	-	nd
Roughage cost, Bath/kg	45.6	46.8	45.6	46.8	46.8	nd	nd
Total cost, Bath/kg	240.1	241.3	240.1	241.3	241.3	nd	nd
Feed cost per gain, Bath/kg	12.72	12.74	12.79	12.72	12.60	0.27	nd
Feed cost per gain 1 kg, Bath/kg	138.64^{c}	137.59^{b}	136.1^{ab}	134.83^{a}	133.68^{a}	5.10	0.04
Economic loss index, %	33.20	33.00	34.06	35.10	34.61	1.23	nd
Production index, %	56.00	56.50	57.10	57.05	57.20	2.52	nd
Income, Bath/h	2,830.5	2,820	2,814	2,845	2,872.50	nd	nd
Salable head return, Bath/h	535.50	538.5	549	558	559.5	nd	nd

Price at the beginning of 2021 live goat, kg.150 baht, fresh grass price 2 baht per kg, fresh Leucaena 2 baht per kg, fresh goat feed 12 baht/kg.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.
nd: no statistical analysis.

Table 5 Effects of fresh leucaena on carcass parameters and quality of goat meat

Item	Leucaena level (%)					SEM	P-value
	T1	T2	T3	T4	T5		
Carcass composition							
Slaughter weight, kg	18.87±6.23	18.80±5.36	18.76±6.33	18.97±5.63	19.15±5.22	0.65	0.12
Fasted BW, kg	16.15±2.36	16.05±4.23	16.35±2.66	16.35±4.23	16.20±4.65	0.73	0.22
Empty body weight, kg	14.34±5.32	14.32±3.25	14.22±2.55	14.22±1.28	14.25±3.74	0.62	0.79
Hot carcass weight, kg	8.75±2.55	8.69±3.25	8.79±3.22	8.75±3.36	8.76±5.15	0.85	0.08
Cold carcass weight, kg	8.25±3.33	8.20±3.65	8.15±1.25	8.15±3.56	8.12±4.54	0.25	0.90
Dressing percentage, %	45.10±9.25	45.20±9.25	45.30±6.54	45.30±3.00	45.44±7.25	2.15	0.20
Carcass length, cm	49.25±8.66	49.30±8.25	49.50±5.64	49.50±3.58	49.41±7.25	3.05	0.70
Carcass width, cm	23.15±5.22	23.25±5.32	23.30±3.25	23.30±3.56	23.28±6.25	2.45	0.09
The loin eye area, cm^2	13.5±2.12	13.25±2.36	13.33±2.56	13.33±2.04	13.45±2.54	0.75	0.15
Loin depth area, cm^2	25.25±5.69	25.20±5.47	25.38±4.22	25.38±4.23	25.40±4.78	0.21	0.21
Meat, %	58.07±9.54	58.29±8.64	58.35±6.25	58.35±4.69	58.30±8.25	1.25	1.25
Fat, %	4.05±2.87	4.15±1.64	4.70±3.23	4.70±6.25	4.52±1.23	2.71	2.71
Bone, %	18.30±5.30	18.25±6.32	18.49±4.56	18.79±3.26	18.52±5.96	0.90	0.90
pH 45 min	6.27±3.10	6.11±2.36	6.32±3.32	6.37±2.15	6.40±2.36	1.28	0.72
L*(Lightness)	52.00±8.92	52.29±4.59	52.12±8.56	52.15±7.98	52.35±8.54	2.32	0.13
a*(Redness)	5.15±5.56	52.10±8.22	5.42±2.58	5.35±4.65	5.27±4.25	2.27	0.22
b*(Yellowness)	2.05±3.36	5.20±1.36	2.11±1.22	2.18±1.32	2.09±1.23	0.12	0.29
Cooking loss, %	25.70±4.29	2.15±2.35	25.75±5.52	25.65±6.54	25.75±6.11	0.15	0.23
Drip loss, %	54.40±7.65	25.60±6.32	25.75±6.23	54.50±5.05	54.50±8.73	4.25	0.36
Shear force, kg/cm^3	3.15±6.32	3.18±5.22	3.20±1.02	3.19±5.36	3.20±5.22	0.13	0.08
Chemical composition, %							
Moisture, %	75.25±8.98	75.15±8.99	75.50±7.69	75.52±7.64	75.60±9.36	5.15	0.35
Protein, %	22.35±6.36	22.45±5.12	22.19±4.36	22.31±2.23	22.52±2.58	7.25	0.27
Fat, %	1.45±2.33	1.48±1.23	1.50±1.23	1.49±1.02	1.47±1.36	2.00	0.15
Ash, %	1.02±1.25	1.05±1.45	1.12±2.13	1.15±1.25	1.18±2.14	1.15	0.22

SEM: standard error of the means.

Table 6 Shows the impact of employing fresh leucaena as a crude feed source on meat customer approval and blood-urea-nitrogen (BUN) levels in young goat blood

Item	Leucaena level (%)					SEM	P-value
	T1	T2	T3	T4	T5		
Meat taste							
Tenderness	3.31±2.20	3.35±1.33	3.34±1.36	3.43±2.47	3.00±2.39	0.15	1.25
Toughness	3.56±2.30	3.60±2.39	3.58±1.22	3.60±1.75	3.62±1.99	0.11	2.16
Juiciness	2.98±2.25	2.99±1.44	2.89±1.26	2.50±1.00	2.95±1.58	0.75	2.05
Taste	2.33±2.32	3.34±1.58	3.33±2.38	3.35±1.69	3.36±1.36	3.36	1.75
Overall satisfaction	3.29±2.56	3.32±1.66	3.33±2.35	3.35±1.55	3.23±1.02	0.16	0.25
BUN (mg %)							
0 h-post-feeding	25.80±5.66	25.91±1.34	25.35±2.14	25.88±2.52	25.44±2.30	0.25	1.75
4 h-post-feeding	20.22±6.36^{b}	20.11±2.56^{b}	20.35±5.36^{b}	22.20±5.42^{a}	22.30±4.36^{a}	3.15	0.04

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

The group that received leucaena at a 100% level had significantly lower body weight than the group that received leucaena at a 50% level (P<0.05). Breed, gender, age, and management are all elements that determine disparities. Weaned young goats have an average daily weight gain (ADG) value of up to 100 g per day when fully fed.

Using leucaena as a roughage source for young goats at 75-100 percent gave greater average daily growth than other levels, according to this trial. Young goats fed 50 and 100 percent Leucaena thrived nicely, according to Semae (2021). The ADG of the 100% leucaena group was significantly higher than the ADG of the other groups (P<0.05). A greater proportion than the control group leucaena can be fed to Leketa *et al*. (2019) goats as a crude feed source, with 100% leucaena consumption resulting in increased weight gain. (6.00 kg per head), weight gain (3.70 kg per head, i.e.,) 3.70 kg/head increase in weight, gaining weight in contrast to Dwinta *et al*. (2017), who advocates using leucaena at level 50 since this level produces the best finishing weight. This MDP supported utilizing leucaena at level 50. Sareena and Thainthip (2018) proposed using leucaena at levels of 0, 50, and 100 percent feed consumption as the proportion of body weight. Sareena and Thainthip (2018) recommend adopting leucaena 100 percent because of its strong daily growth rate. Leketa *et al*. (2019) and Semae (2021) discovered that increasing food costs by 50-100 percent had no statistical impact (P>0.05) on Feed Cost per Gain, Economic Loss Index, Production Performance Index, or Salable Bird Return. Feeding coarse feed at a rate of 50-100 percent to young goats resulted in a 1 kg lower feed cost per gain than the other levels. The difference was statistically significant when (P<0.05) was used. Fresh leucaena was used as a source of coarse feed for young goats throughout the rainy season, and the meat quality and chemical composition were unchanged, with no effect on carcass characteristics, quality, or chemical composition. Change in BUN levels in young goat blood and consumer approval of meat were shown to be statistically negligible (P<0.05) (Nur *et al*. 2017; Semae, 2021). During the rainy season in Thailand, fresh leucaena was employed as a source of coarse feed for young goats at a rate of 50-100 percent without compromising meat tenderness, roughness, the juiciness, meat taste, or overall pleasure. The use of 50-100% fresh leucaena as a coarse feed source for young goats resulted in higher BUN values than other levels 4 hours after fresh leucaena feeding, according to statistics (P>0.05).

A statistically significant (P<0.05) discrepancy was consistent with the findings of Sukanya (2001), which suggested that higher levels of urea nitrogen in goat diets could be due to their high protein intake and when urea levels rise, a variety of factors influence blood nitrogen levels, including the amount of protein taken by the animal. According to Chokchai (1993), blood urea nitrogen levels increased after the animal was fed. Blood nitrogen levels changed throughout the day in the area, on the other hand. Urea was discovered at a concentration of 0% in goats treated with leucaena.

According to Sareena and Thainthip (2018), the prefeeding blood urea nitrogen of the goat cohort was significantly higher. The levels of urea in the 0% diet were much lower than the levels of urea in the 0% and 100% leucaena treatments (P<0.05). The nitrogen levels in the experimental group that received 100% leucaena were the highest. The experimental group was given half of the leucaena, whereas the control group was given the least amount.

CONCLUSION

The management of leucaena as a feed source for goat roughage during the rainy season in Thailand showed that fresh leucaena was able to raise goats in Thailand during the rainy season when used at a rate of 75-100%. The average daily gain, feed cost per gain of 1 kg, and blood BUN values after 4 hours of feeding were the best and higher at the rate of 75-100% than those parameters of the other groups.

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