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The Effect of Forage Energy Level on Production and Reproduction Performances of Kosta Female Goat

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Abstract: The research on the effect of forages energy level on production and reproduction performances of Kosta female goat was conducted in two phases. The first phase, was observing the growth of Kosta female goat starting from the weaning age of 4 months to first puberty at 7 months and then to mating at 9 months. The variables found at this stage were: daily weight gain, the rations consumed, and the puberty age of the herd. The second phase was observing Kosta female goat from mating until giving birth. The variables determined were: ration consumed, body weight gain, length of pregnancy, litter size, birth weight and weaning weight. The research was conducted in experimental methods by using 24 four months old Kosta female goats weighing 6-7kg, and 3 ram aged at 3-4 years. The design of the experiment used was completely randomized design. The treatments were 3 levels of ration energy 53% TDN (R_1), 61% TDN (R_2) and 69% TDN (R_3), with relatively equal protein percentage of 12% (isoprotein). Each treatment was replicated 8 times. The rations were forage consisted of field grass, leaves of: waru (*Hibiscus tiliaceum. L)*, lamtoro (*Leucaena glauca)*, gamal (*Gliricida septium*), and jackfruit (*Artocarpus heterophylla*). Generally, result of this experiment indicated that: (1) the higher the dietary energy up to 61% TDN in the ration, the higher the production performances of Kosta female goats in term of efficiency of ration usage, body weight gain, birth weight, and weaning weight; (2) the higher the dietary energy up to 61% TDN in the ration, the higher the reproduction performances of Kosta female goats in term of age of puberty, length of pregnancy, and litter size.

Key words: Forage energy, Kosta female goat, production, reproduction

Introduction

Goat production in tropical areas usually is limited by the availability of feeds quantity and quality, though goats could consume other forages that is not consumed by other livestock.

The forages in tropical areas such as Indonesia, usually have very low quality with high fiber and low energy. However, Kosta goats that are found in Banten-West Java, is known as livestock that could utilize almost all the greenery types even the lowest quality. Therefore, if the management of feeding the forage that is still traditional could be developed, it is estimated it will be able to increase the production and reproduction of the Kosta goat which is up to now, far from target.

Supplying the right amount of nutrient to the ration of the goat, especially energy, has a big impact to the production and reproduction of the livestock, because it has become the most frequent limit to the production of goat livestock. Energy is needed for maintenance, for example body functions such as muscle activity, chemistry work in the circulation of substance in the cell, where the excess is used for production, which is the synthesis-catalyst in the body, such as enzyme and hormone.

Lack of energy in livestock will cause the modification of body protein into source of energy that will slow down the rate of growth, while enough energy in the ration will increase the use of food nitrogen for synthesis and disposition of body protein (Crouse *et al.,* 1978; Owen and Zinn, 1988, Belanger, 2001). Protein synthesis in the body will create growth in the livestock's body, that is manifested by the increase of body weight. On the reverse, too much energy on the ration, will add burden to the livestock to discharge the excess heat with the implication low intake ration, that will lead to malnutrient to the livestock.

High energy in the ration of the pregnant animal increases the amount of protein in the body that will be used for the growth and development of the fetus in the womb. Energy will also increase the activity of the endocrine gland, particularly the pituitary gland, ovary, and placenta, which produce hormones that are important in the pregnancy period.

Supplying enough amount of energy in the ration can increase the growth and development of the fetus and its weight on birth, while the lack of energy in the ration will pull down the reproduction process (Dunn and Moss, 1992; Merchen and Titgemeyer, 1992; Schillo *et al*., 1992). Research done by El Shobokshy *et al.* (1992) showed that energy increase in the goat ration, can increase the fertility and the litter sizes are 10% higher per birth.

High energy in the ration of the goat also affects the growth of kid since new-born until they are weaning. The growth of the kid after birth has a strong relationship with the milk that is produced by the goats which the quantity and quality is determined by the amount of forage that is consumed by the goats (Belanger, 2001). Research by Abdel-Azis *et al.* (1978) showed the poor condition of the goat due to lack of forage will give birth to kids with low weight that is followed by the slow growth that will lower the body weight when weaning.

Materials and Methods

Research Phase 1 is done to observe the growth of female Kosta goats after weaning at 4 months until its puberty at 7 months and to be mating at 9 months. Assessed variables on this phase are: ration consumption, daily weight gain , and puberty age on the livestock.

Research Phase 2 is done to observe female Kosta goats since the mating to the partus time. Variables assessed in this phase covers: ration consumption, daily body weight gain, length of pregnancy, litter size, kid birth weight, kid weaning weight.

The livestock that is used in this research is 24 female Kosta goats weaning after 4 months, with weight 6-7kg. All goat are from the twin birth from the second birth period from a mother that is born as twin also. As stud, 3 Male Kosta goats aged 3-4 years old, which has been tested of their reproduction ability both in macroscopic and microscopic.

Ration given will be fresh forages such as field grass, leaves of : *waru*, *lamtoro, gamal* and *jackfruit.*

Research methods: The research is done by experimentation, using the Completely Randomized Design. The treatment in this research is by giving forages with three energy levels (53%, 61% and 69% TDN) with relatively equal protein percentage (isoprotein) of 12%. Each treatment was replicated 8 times. The data gathered is analyzed with analysis of variance (ANOVA) and effect test from all treatment using Duncan Multiple Range Test (DMRT) (Steel and Torrie, 1995).

Results

The effect of forage on the production performances of female kosta goats:

Consumption of dry matter ration: Statistic analysis shows that energy level on forage feed up to the level of 61% TDN is very significantly ($P < 0.01$) increases consumption of dry matter ration and reducing conversion of dry matter ration to the Kosta goats on: growth phase aged 4 months to puberty, puberty phase 7 months to mating age 9 months and first pregnancy phase. An exceptional, on the pregnancy phase, the level of energy ration is not affected ($P > 0.05$) to the conversion of dry matter as shown in Table 1.

Tabel 1: Effect of Forage on the Production Performance of Female Kosta Goats

Variable	R1 53% TDN	R2 61% TDN	R3 69% TDN
Consumption of Dry Matter (g/h/day)			
Growth phase (4 months-puberty)	9.05[a]	7.43[b]	6.85[b]
Puberty phase (7 months-9 months)	9.13[a]	7.96[b]	7.51[b]
Pregnancy phase (mating-partus)	14.37[a]	14.65[a]	13.92[a]
Body Weight Gain (g/h/day)			
Growth phase (4 months-puberty)	37.01[a]	57.72[b]	61.82[c]
Puberty phase (7 months-9 months)	41.41[a]	61.87[b]	66.07[c]
Pregnancy phase (mating-partus)	42.49[a]	50.29[b]	55.26[c]
Birth Weight (kg)			
Total	1.58[a]	2.51[b]	2.77[b]
Average	1.27[a]	1.45[b]	1.49[b]
Weaning Weight (kg)			
Total	5.44[a]	9.79[b]	9.15[b]
Average	5.44[a]	6.05[b]	6.12[b]

[abc]Means with common superscript do not differ significantly ($P > 0.05$)

Body weight gain: The more high energy level forage is given, the higher is the average of body weight gain of the female Kosta goats on growth phase (4-7 months.), puberty phase (7-9 months.) and first pregnancy phase as shown on Table 1.

Birth weight: Total birth weight and average birth weight of Kosta kids increase significantly ($P < 0.01$) when the given forage has the level energy up to 61% TDN as reflected on Table 1.

Weaning weight: Statistical analysis shows that the total weaning weight and the average weaning weight increase significantly ($P < 0.01$) when the level of energy of the forage given reached 61% TDN, as shown on Table 1.

The effect of forage on the reproduction performances of female kosta goats:

Puberty age: Statistical analysis shows that the average puberty age of the Kosta kids decrease significantly ($P < 0.01$) when the level of energy of the forage given reached 61% TDN, as shown on Table 2.

Length of first pregnancy: Statistical analysis shows that the length of first pregnancy of the Kosta goat increased significantly ($P < 0.01$) when the level of forage energy given reached 61% TDN as shown in Table 2.

Litter size on first birth: The total average of litter size per birth is very significant ($P < 0.01$) when the level of forage energy given reached 61% TDN as shown in Table 2.

Discussion

Table 1. The result of DMRT shows that the energy level 61% TDN of forage increases the consumption of dry matter ration and decreases conversion of dry matter

Table 2: Effect of Forage on the Reproduction Performance of Female Kosta Goat

Variable	R1 53% TDN	R2 61% TDN	R3 69% TDN
Puberty Age (day)	226.25[a]	198.75[b]	201.63[b]
Length of First Pregnancy (day)	148.00[a]	150.75[b]	150.13[b]
Litter Size (head)	1.25[a]	1.75[b]	1.88[b]

[ab]Means with common superscript do not differ significantly (P >0.05)

ration on Kosta goats in: growth phase aged 4 months to puberty, puberty phase 7 months to mating age 9 months, and first pregnancy phase. More than 61% TDN level of ration energy there is no more increase of dry matter consumption nor the decrease of its conversion. The increase consumption of dry matter on a higher energy level on this research is corresponding to Owen and Goetsch (1988) opinion. They stated that ration with a high level of energy will increase its palatability, that will push the goats to consume the ration. The more forage being consumed the more the mobility of the forage in the digestion system, and the digestion system is quickly empty. Therefore, the livestock will continue to consume ration and the amount of dry matter and the nutrient that they consume will increase.

The increase of the consumption of dry matter ration that is caused by the increase of the energy level in ration is very significant (P < 0.01) is followed by body weight increase. As shown on Table 1, on the level of 69% TDN which is the highest energy level the body weight gain is also high each 61.82g/head/day on the Kosta kids at growth phase age 4 months until to the puberty age 7 months., 66.07g/head/day on the puberty phase at 7 month age until to mating at 9 month and 55.26g/head/day on the first pregnancy phase. Similar to the research of Saikia *et al.* (1995), the enhancing of energy in the ration up to 70% TDN with 12% protein content on the ration for the goats that begotten from crossing of Assamese with Beetal, the body weight gain during growth phase was highest by 68.33g/head/day. According to McDonald *et al.* (1975) and Crouse *et al.* (1978) supplying high energy will increase energy intake and protein into the body. The consequently is the chance of rumen microbes to use nitrogen (N) and free fatty acid that is formed as a result of protein alteration, for synthesis and deposition of protein during growth will increase so that the body weight gain is higher. On this research the average body weight gain after puberty and early pregnancy stage declines. This is caused on this phase the nutrient are needed to prepare for the fetus growth and for the mother's growth, where there were competition between the fetus and the mother (Morand-Fehr, 1991).

Total birth weight and average birth weight of Kosta kids on the ration level energy of 69% TDN was higher of 2.77 kg for total birth weight and 1.49 kg for average birth weight, although the difference were not statistically significant (P>0.05) with the ration level energy in 61% TDN (Table 1). This is caused by the high energy ration supplied will increase the intake of : the dry matter, energy, and protein into the body, that will increase the availability of the amino acid to form the protein in the body, that will be used for the growth and production of endocrine gland, that affects of animal reproduction process (Schillo, 1992). If this condition could be maintained through the pregnancy phase, the growth and viability of the fetus will increase and on the birth their total weight and average weight is high. This result is consistent with Aregheore *et al.* (1992) report that the feeding of ration with high energy level to the Gwembe Valley goats in Zambia, resulted to the highest significant birth weight at 1.63 kg/head but there is not difference with the birth weight that is given ration with the medium energy level, that is 1.60kg/head.

The increase of the total birth weight and the average birth weight is followed by the increase of weaning weight on Kosta kids, as shown on Table 1. Total weaning weight and average weaning weight Kosta kids from goats that was fed by ration with energy level more than 61% TDN is higher very significant (P < 0.01) that is 9.79kg for total weaning weight and 6.05kg for average weaning weight. The result is agree to Swenson (1970) that stated that high energy level in mother ration will increase the amount of lactate acid in the rumen, that has the role of producing milk and will affect the kids growth since birth to the weaning. As stated by Devendra and Burns (1983), growth rate of the kid after birth is closely related with the milk that is produced by the mother, in which the quality and quantity is determined by the forage. In relation to the birth weight it turned out that the kid that was born with low birth weight will have a low weaning weight and reversely, as shown on Table 1. where the kid with low birth weight 1.27kg/head was born from goat that was fed with low energy ration (53% TDN), the weaning weight is low also, that is 5.44kg/head. In line with Edey's opinion (1983), birth weight will affect the growth and life of the kid, aside from affecting the weaning weight (Ihsan, 1990).

On Table 2, the result of DMRT shows that the increase of energy level in the ration up to 61% is significant (P < 0.01) to hasten the average age of puberty Kosta goat that is 198.13 days (6.6 months.) compared to the other treatment, although it does not have significant difference with puberty age on the 69% TDN ration energy level, that is 201.38 days (6.7 months). This is due to the close relationship of puberty age to the growth and ration consumed. When the energy in the ration is increased, the amount of dry matter and ration protein will increase, so that the availability of ration nitrogen in the body that is needed for growth increases as well (Fahmy, 1992). Beside for growth animal, nitrogen with amino acids has a big role in the body in the growth and development of follicular, as well as the stimulation of the reproduction hormones release. In this condition,

the ovulation that determines puberty could be hasten, so that the animal puberty could be achieved at an earlier age with a heavier body weight (Hafez, 1995 and Marston *et al.,* 1995).

The length of first pregnancy of Kosta goat is longer significantly ($P < 0.01$) as the increase of ration energy that was given up to 61% TDN which is 150.75 days. This result is in accordance to the report from Devendra and Mc Leroy (1982) that the length of goat pregnancy in the tropical region is around 146 days with the variant of 144-153 days. According to Jainudeen and Hafez (1987) supplying high energy to the pregnant mother will increase the nutrient intake in the body, so that will give the chance to the fetus growth more over. The aviability of nutrient in big amount also will give the chance to the endocrine to boost its activity in controlling the works of the pituitary hormones, ovary, placenta, and uterus, which has a big role during pregnancy. Merchen and Titgemeyer (1992); Dunn and Moss (1992) said that supplying a high energy in the goat ration can increase the fetus growth and lengthens pregnancy period.

The increase of total average of Kosta kid in the first birth that was borned by the goat that received ration with the highest energy level (69% TDN) is 1.88 heads, due to the high energy in the ration makes the activity of rumen microbe in its metabolism to produce free fatty acid such as acetic acid, propionate acid and butyric acid increases. The high level of propionate acid in the body enters the blood circulation will be recycled by rumen microbe as energy source, to create body glucose that is useful in forming insulin in the pancreas gland. The increase of glucose in the body will also increase the secretion of insulin. Together with lipids, insulin that is found in the adipose tissue and amino acid in the muscle tissue, will influence hypothalamus to release Luteinizing hormone that function in increasing the amount of ovum that is released by the ovarian. This condition not only affects the release of progesterone by the uterus that functions to maintain pregnancy will also increase the litter size (Schillo *et al.,* 1992). This result is in line with the report by Devendra and Mc Leroy (1982) that states giving high energy level ration to Barbari and Jamnapari goats produce kids each 2.0 and 1.5/goat/year. Also with the report of Havrevoll *et al.* (1995) in their research on Norwegian goats, mothers given high energy ration will produced 1.33/goat/year. This is higher than the mothers that were given a lower energy ration with the kid born lesser 1.25/goat/year.

Conclusion:

(1) the higher the dietary energy up to 61% TDN in the ration, the higher the production performances of Kosta female goats in term of efficiency of ration usage, body weight gain, birth weight and weaning weight.

(2) the higher the dietary energy up to 61% TDN in the ration, the higher the reproduction performances of Kosta female goats in term of age of puberty, length of pregnancy and litter size.

References

Abdel-Azis, A.S., S.A. Imam, M.T. Ragab and M.A. Sharafeldin, 1978. Phenotypic and Genetic Parameter of Three Body Weight Traits and First and Greazy Fleece in Fleisch Merino Sheep in Egypt. J. Anim. Prod., 18: 29-30.

Aregheore, E.M., C.O.C. Chibanga and J.C.N. Lungu, 1992. Effect of Plane Nutrition on Body weigth and Birth Weight of Pregnant Gwembe Valley Goats in Zambia. Small Ruminant Research. J. Int. Goat Assoc., 9: 202-207.

Belanger, J., 2001. Storey Guide To Raising Dairy Goats. Storey Publishing. North Adam, p: 72-81.

Crouse, J.D., R.A. Field. J.L. Chant Jr., C.L. Ferrel, G.M. Smith and V.L. Harrison, 1978. The Effect of Dietary Energy Intake on Carcass Composition and Palatability of Different Weight Carcass from Ewe and Ram. J. Anim. Sci., 47: 1207-1218.

Devendra, C. and G.B. Mc. Leroy, 1982. Goat and Sheep Production in The Tropics. Longman Group. London, p; 61-67, 100.

Devendra, C. and M. Burns, 1983. Goat Production in The Tropics Commonwelath Agricultural Bureau. Farnham Royal Bucks England, p: 51-57, 81-85.

Dunn, T.G. and G.E. Moss, 1992. Effect of Nutrient Defficiencies and Excesses on Reproduction Efficiency of Livestock. J. Anim. Sci., 70: 1582-1585.

Edey, T.N., 1983. Tropical Sheep and Goat Production. Dominion Press-Hedge and Bell Melbourne, p: 51-57, 88-100.

El-Shobokshy, A.S., A.M. Aboud-Naga, F.Z. Swedan, N.R. Saad and I.F. Marie, 1992. Increased Productivityof Subtropical Ewes. In: M.K. Yousef (ed) Animal Production In The Tropics, Praeger Publisher. USA, p: 217-219.

Fahmy, M.H., 1992. Maternal Performance of Oxford and Suffolk Breeds of Sheep and Their Crosses. Animal Production, 35: 327-333.

Hafez, E.S.E., 1995. Reproduction Circles. In Hafez (ed) Reproduction Animal 5th ed. Lea and Febriger, p: 112-116, 126.

Havrevoll, Q., S.P. Rajbhandari, L.O. Eik and J.J. Nedkvitne, 1995. Effect of Different Energy On Norwegian Dairy Goats. Small Ruminant Research. J. Int. Goat Assoc, 15: 231-235.

Ihsan, M.N., 1990. Penampilan Produksi dan Reproduksi Kambing Peranakan Etawah dan Persilangan dengan Saanen. Jurnal Universitas Brawijaya, 2: 60-66.

Jainudeen, M.R. and E.S.E. Hafez, 1987. Gestation, Prenatal and Parturition. In: Hafez (ed)-Reproduction in Farm animal. 5th ed. Lea Febiger. Philadelphia, p: 229-259.

Marston, T.T., K.S. Lusby, R.P. Wetterman and H.T. Purvis, 1995. Effect of Performance Of Spring-Calving Cows Grazing Native Range. J. Anim. Sci., 73: 659.

Mc.Donald, P., R.A. Edwards and J.F.D. Greenhalg, 1975. Animal Nutritiom. 2nd ed. Longman Group Ltd, London, p: 72-79.

Merchen, N.R. and E.C. Titgemeyer, 1992. Manipulation of Amino Acid Supply to The Growing Ruminant. J. Anim. Sci., 70: 3238-3247.

Morand-Fehr, P., 1991. Growth. In: Gall (ed)-Goat Production. Academic Press. London. Sydney, p: 256-264.

Owen, F.N. and A.L. Goetsch, 1988. Ruminal Fermentation. In: Church (ed)-The Ruminant Animal. Digestive Physiology and Nutrition. Prentice Hall. New Jersey, p: 145-147.

Owen, F.N. and R. Zinn, 1988. Protein Metabolism of Ruminant Animal. In: Church (ed)-The Ruminant Animal Digestive Physiology and Nutrition. Prentice Hall. New Jersey, p: 227-229.

Saikia, G., K.K. Baruah, S.C. Buragohain, B.N. Saikia, and N.N. Pathak, 1995. Feed Intake. Utilisation of Nutrient and Growth of Assamese X Beetal Goat Fed Three Level of Energy. Small Ruminant Research. J. Int. Goat Assoc., 15: 279-282.

Schillo, K.K., J.B. Hall and S.M. Hileman, 1992. Effect of Nutrition and Season on The Onset of Puberty in The Beef Heifer. J. Anim. Sci., 70: 3997-3999.

Steel, R.G.D. and J.H. Torrie, 1995. Prinsip dan Prosedur Statistika. PT. Gramedia. Jakarta, p: 168-170.

Swenson, M.J., 1970. Duke's Physiology of Domestic Animal. 8th ed. Comstock Publishing Associates. Cornel University Press. Ithaca. London, p: 1267-1268.