IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 7, Issue 11 Ver. IV (Nov. 2014), PP 00-00
www.iosrjournals.org

The Effect of Different Level of Gliricidia (Gliricidia Sepium) For Substitute the Concentrate in Diet, On Feed In take And Digestibilty, Production and the Quality of Ettawah Crossbred Goats Milk in Different Location in East Java, Indonesia

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Abstract: *Most farmers that keeping Ettawa Crossbred Goats (ECG) in the lowland (LL) and upland (UL) areas in East Java do not feed their goats with concentrate as it is considered costly. These farmers, however, use the leguminous leaves of gliricidia as part of their goats' ration. This experiment, hence, was designed to study the effect of the gliricidia leaves in substituting the commonly available proteinous concentrate on the ECG performance. A Randomized Block Design was employed including 2 location (upland and lowland) and three feed treatments with 4 replication. Three feed treatments include [1] G_0 that comprised 70% of basal diet plus 30% of concentrate [2] G_{15} comprised 70% basal diet plus 15% gliricida and 15% concentrate [3] G_{30} comprises 70% basal diet plus 30% gliricidia. The basal diet was Napier grass and maize straw silage. A total of 24 ECG of similar body weight age and lactation period were used.The variables under research were feed intake covering dry matter (DM), organic matter (OM), and crude protein (CP). In this research, Nutrient Digestibility included DM, OM, and CP. The milk production was particularly measured in ECM (Hemme, 2010) while the milk quality was analyzed by utilizing Lactoscan. The data analysis applied Nested Designby using Genstat 12.2. The result showed that LL location generated significant impact ($P<0.05$) and was higher than UL compared to intake, DMI (88.9 vs 75.6), OMI (81.1 vs 72.1), CP (10.4 vs 9.2). However, UL gave higher value on digestibility of DM (75.8 vs 64.9), milk production (1.63 vs 1.20) mlECM/h/d, the concentration of fat milk (5.82 vs5.10) %, lactose (4.71 vs 2.31) % and the total solidity of milk (14.9 vs 13.2 %. The forage treatment generated significant impact ($P<0.05$) on ECG performance. On UL, the G_{15}forage gave the highest score on DMI, OMI, CPI, DCP, fat concentrate, lactose concentrate, and the total solid (84.3, 81.4, 11.4, 78.8, 6.18, 4.70, and 15.4 respectively). On LL, the G_O gave the highest score on DMI, OMI, and CPI (93.3, 92.6, and 10.9 respectively). Lastly, the G_{15} forage only gave the highest value of fat concentrate and total solid (5.75 and 14.9). It was concluded that the G15 was the most approriate feed in terms milk quality and cost of feeding.*
Key Words: *Ettawa Crosbred Goat, Legumes tree, Location, Performance, Replacing.*

I. Introduction

Dairy goat is a strategic commodity for farmers in Indonesia like in several developing countries in Asia and Africa (Anothaisinthawee et al 2012).This commodity was chosen as earnings and food security (Devendra 2012; Chenyambuga et al 2012). Goat population in East Java is the second largest commodity after West Java in Indonesia. Now, goat rearing in villages tends to change to dairy goats (BIS 2010, Astuti and Sudarman 2012). On the other hand, there are three main limiting factors for dairy successfull goat rearing, covering local forages availability as basalt feed in dry seasons (Sajimin and Purwantari 2006). The constra in of forages availability occurred due to decrease in land for cultivation (BIS, 2012) and the price of concentrate.

The research was conducted to study gliricidia as protein source (Evitayani et al 2004; Sumitro 2004) for replacing concentrate on basalt feed of Napier grass and Mays strawas the highest local forages for Ettawa crossed bred goat (ECG) feed (Hidayati et al 2012). For increasing feed intake, digestibility, milk production and quality, silage technique was used in this study because it could grade up basal feed quality and saving (Donnem et al 2011). Gliricidia had been dried before used for saving and quality maintenance. Concentrate was made from locally made feedstuff which was available for farmer. The feedstuff was actually the waste from local crops processing industry like fragmented soybean and rice brand. Farmer could find wheat pollard every where at lower price due to subsidy from government.

II. Material And Method

2.1 The Research Area

The research was conducted in two areas at different altitude. They were Deyeng village, Ringinrejo District, Kediri Regency as lowland (LL) area (located at< 200 m asl and has25.6^{0}C average temperature, 76% humidity and 506 mm rainfall), and Jeru Village, Tumpang District of Malang Regency as upland (UL) area (situated at>500 m asl and has 23.5^{0}C of average temperature, 86.23% humidity and 438 mm rainfall).

2.2 Experimental design

2.2.1 Animal and Management before the Treatment

Twenty four of ECG does, in the second lactation period with an average weight of 32.98 + 2.89 kg and age of 2.5-3 years was allotted into four different groups. Grouping was done based on milk production. There were R-1 (400-575), R-2 (576-750), R-3 (751-920) and R-4 925-1100) ml/h/d. since the first month of the pregnancy period, all of the does were adapted gradually on basal diet which was composed of 42% of napier grass silage and 28% mays straw silage, and gliricidia hay as feed treatment.

2.2.2 Diets

Three feed treatments include [1] G_0 that comprised 70% of basal diet plus 30% of concentrate [2] G_{15} comprised 70% basal diet plus 15% gliricida and 15% concentrate [3] G_{30}comprised 70% basal diet plus 30% gliricidia. The ratio of concentrate and basal feed was 30:70. Basal feed consisted mainly of Napier grass silage (60%) and mays straw silage (40%). Concentrate consisted of 15% wheat pollard, 4.5% rice bran and 10.5% fragmented soybean. Feed composition was compiled by CP equivalence for lactation stage based on NRC (2006), as shown in Table 1 and Table 2.

Table 1. Composition of feed (% DM)

	Composition		
	G_0	G_{15}	G_{30}
Forages:	70	70	70
Napier grass silage	42	42	42
Mays straw silage	28	28	28
Concentrate :	30	15	0
Breaked soybean	10.5	5.25	0
Rice bran	4.5	2.25	0
Wheat pollard	15	7.50	0
Gliricidia	0	15	30
Total	100	100	100

The quality of experiment on feedstuff and trial feed is shown in Table 2.

Table 2. Chemical composition of experimental feedstuff (%DM) except DM (Mean and deviation standard)

	DM (g/kg)	Ash	CP	NDF	ADF
Feedstuff					
Napier grass	52.7 (5.69)	6.75 (3.08)	10.2 (0.15)	58.7 (0.21)	34.4 (0.07)
Mays straw	46.2 (0.06)	5.3 (0.84)	10.4 (0.27)	59.4 (0.72)	38.5 (0.07)
Gliricidia	86.6 (0.64)	13.0 (0.56)	20.3 (0.33)	41.8 (0.11)	39.5 (0.59)
Concentrate	83.2 (0.84)	10.2 (0.29)	18.5 (0.25)	40.7 (0.37)	19.6 (0.32)
Trial Feed					
G_0	51.0 (0.28)	9.4 (2.33)	12.8(0.09)	56.6 (0.47)	34.3 (0.36)
G_{15}	48.7 (0.47)	7.9 (0.41)	12.9 (0.04)	46.4 (0.27)	33.1(0.88)
G_{30}	50.9 (0.52)	7.8 (0.18)	13.04(0.01)	56.4 (0.32)	38.2 (0.44)

2.3 Experimental design

Nested Experiment design was used in this research design. Location was the main factor and gliricidia level substitution was the nested factor in location. The design of experiment is show in Table 3:

Table 3 Experimental design

Location	UL				LL			
Group	R1	R2	R3	R4	R1	R2	R3	R4
Level of gliricidia	**G_0**	**G_0**	**G_0**	**G_0**	**G_0**	**G_0**	**G_0**	**G_0**
	G_{15}	**G_{15}**	**G_{15}**	**G_{15}**	**G_{15}**	**G_{15}**	**G_{15}**	**G_{15}**
	G_{30}	**G_{30}**	**G_{30}**	**G_{30}**	**G_{30}**	**G_{30}**	**G_{30}**	**G_{30}**

2.4 Animal management

Animals were randomly housed in individual cages (Gasperz, 1996). The treatment on feeding was given gradually of dried glirisidia and silage of napier grass and Mays straw. Does were milking every day at 05.00 am and the milk was measured on the basis of its volume in volume glass and BJ with Lactodencymeter. Feeding and water in *ad libitum* for does were given 3 times a day at 06.00; 12.00 am and 17.00 pm.

Figure 1 Experiment cage (out side)

Figure 2 Experiment cages (in side)

Figure 3 Silage of napier grass and mays straw as basal feed

Figure 4 Sun driying of gliricidia

2.5 Measurement and Sample Collection

Individual feed offer and refusal were weighted everyday at 06.00 am after milking to measure the feed intake. The samples of individual feed offered and refused were collected everyday and composited every 7 days (Van der Meer, 1986). In addition, the collection of feces and urine were measured and all samples were collected one the last 7 days of trial to measure the digestibility of nutrient.

Individual milk samples were taken every 7 days for the 30 days trial of lactating stages for measuring the milk quality in Lactoscan. The collection data on digestibilty was conducted 7 days before final feeding treatment. For binding NH_3 in urine, sulphuric acid was added into urineso that it had pH 3. Faces samples were keptin refrigerator at -18^{o}C for N analysis. The climate data was recorded daily for maximum and minimum temperature by using digital thermometer while humidity was recorded with digital hygrometer.

2.6 Chemical analyses

All samples of feed, feed residues, feces were analyzed for determining DM, CP and ash according to the standard method of AOAC (1990). ADF and NDF were analyzed according to Van Soest et al method (1991). Milk production was measured in 1000 ml glass volume, and converted into Energy Corrected Milk (ECM) (Hemme, 2010), as follows,

$$\text{ECM} = \text{Milk Product} \times \frac{(0.383 \text{ x } \%\text{ fat} + 0.242 \text{ x } \%\text{ Protein} + 0.7832\text{x}\%\text{lactose})}{3.1138}$$

Lactoscan was used for milk quality evaluationfor fat, protein and lactose concentration.

2.7 Statistical analyses

Software Genstat version 12.2 was used for data analyses. The variance analyses applied Randomized Block Nested design for analyzing the entire data (Payne 2010). The significant differences of data were determined in Duncan significance difference test in 5% probability (Duncantest).

III. Research Result

3.1 Environment condition

The average maximum and minimum temperature, humidity and rainfall were allmeasured in the UL and LL during the experiment. These are presented in Table 4.

Table 4. Average and sd of maximum, minimum temperature, humidity and rainfall during dry Season

	UL	LL	P value
Maximum (^{0}C)	28.4 ± 1.39	30.1 ± 2.36	1.13
Minimum (^{0}C)	19.9 ± 1.63	21.2 ± 1.04	0.17
Humidity (%)	86.2 ± 3.33^b	78.9 ± 1.22^a	0.001
Rainfall (mm/6 month)*	438 ± 111	506 ± 128	0.87

Note * : Secundair data from BIMG (2012a) and BIMG (2012b)
a,b means within rows in the different superscript are different at P<0.05

Upland (UL) has higher humidity than those in the LL area. Both locations have higher temperature than the ideal temperature for goat. Neutral temperature of comfort zone for goats is 5^0 – 22 ^{0}C (Park and Haenlein 2010).

3.2 Effect of location

The location of dairy goats rearing gave significant impact to feed intake, digestibility, production and quality of milk. These are presented in Table 5. The data showed that lactating does reared in LL was higher than that in DM, OM and CP intake yet lower than that in DM, DCP, milk production and milk lactose in UL.

Table 5. Effect of location on intake, digestibility, milk production and quality

	UL	**LL**	**SEM**	**P value**
Intake (g/KgBW^{0,75})				
DM	75.6^a	88.9^b	0.92	0.001
OM	72.1^a	81.1^b	0.92	0.001
CP	9.2^a	10.4^b	1.12	0.002
DM (%BW)	3.6	3.6	0.05	0.64
Digestibility (%):				
DM	75.8^b	64.9^a	1.10	0.001
OM	77.2	74.9	0.82	0.06
CP	76.0	76.9	0.33	0.06
Milk production (l ECM)	1.63^b	1.20^a	89.2	0.003
Milk quality :				
Specific gravity (g/v)	1,03	1,03	0.001	0.67
Fat (%)	5,82^b	5,10^a	0.10	0.001
Protein (%)	3,25	3,24	0.04	0.78
Lactose (%)	4,71^b	2,31^a	0.03	0,001
Total Solid (%)	14,9^b	13,2^a	0.27	0.001

Note : a,b means within rows with different superscript are significantly different at P<0.05

The effect of feed trial in UL and LL is showed in Table 6.

Table 6. Effect of feed between in upland and lowland on mean of intake, digestibility, milk production and quality

	UL			LL				
	G_0	**G_{15}**	**G_{30}**	**G_0**	**G_{15}**	**G_{30}**	SEM	P value
DMI (%BW)	3.76^b	3.47^a	3.42^a	3.85^b	3.47^a	3.43^a	0.09	0.01
DMI (g/kgBW$^{0.75}$)	74.8^b	84.3^c	67.6^a	93.3^d	86.6^c	86.9^c	1.59	0.001
OMI (g/kgBW$^{0.75}$)	72.9^b	81.4^c	61.9^a	92.6^d	75.76^b	75.3^b	1.59	0.001
CPI (g/kgBW$^{0.75}$)	9.05^b	11.4^d	7.09^a	10.9^d	10.0^c	10.2^c	0.20	0.001
DMD (%)	77.8	77.9	71.8	66.3	64.5	61.2	1.43	0.07
DOM (%)	81.1^b	75.5^a	74.9^a	76.3^a	75.0^a	73.4^a	1.42	0.03
DCP (%)	75.0^{ab}	78.8^d	74.3^a	77.3^c	76.1^{bc}	77.4^{cd}	0.57	0.001
Milk Prod (l, ECM)	1.64	1.75	1.51	1.18	1.30	1.13	155	0.76
BJ	1.03	1.03	1.03	1.03	1.03	1.03	0.001	0.51
Fat (%)	5.92^{cd}	6.18^d	5.38^{bc}	4.95^{ab}	5,75^{cd}	4,60^a	0.18	0.001
Protein (%)	3.29	3.24	3.23	3.30	3.32	3.09	0.07	0.16
Lactose (%)	4.83^c	4.70^{bc}	4,58^b	2.25^a	2.34^a	2.34^a	0.05	0.032
TS (%)	15.0^c	15.4^c	14.6^{bc}	13.4^b	14.9^c	11.2^a	0.46	0.001

Note : a-d means within rows with different superscript are different at P<0.05

IV. Discussion

4.1 The Effect of location

The gap between maximum daily temperature and minimum daily temperature in LL during the data collection was 8.6^0 C. The gap between the two in UL was 8.5^0 C. This temperature gap according to Yousef (1990) causes animals to experience the consumption decline due to appetite decline. The appetite decline was caused by the interference on body's heat transfer system which was caused by the high environment temperature. The high environment temperature for animal will incur impact onto their hormonal system, particularly Tyroid hormone. This hormone will get disturbed and affectanimal's appetite. The higher consumption of DM, OM, and CP per metabolic weight in LL was presumed to occur due to cattle's ability to adapt to the existing feed treatment. In LL, the feed which is usually given to ECG prior to treatment is dry forage. This type of forage in fact foster animal ability to adapt to feed treatment, which constituted silage and dry greenery gained from grilicidia. On the other hand, the forage given to animal in UL prior to treatment is fresh greenery.

In accord with the research result by Donnmen et al (2011), the organic ingredient digestibility is highly positively correlated to the value of dry ingredient consumption. The higher the consumption on dry ingredient is, the higher the organic ingredient digestibility will be. The result of the current study is not in line with that by Donnmen. It was, assumedly, due to environmental factor, particularly environment temperature. The environment temperature during the data collection was 30.1^0C in LL and 28.4^0C in UL. The maximum gap between the two locations was 1.73^0C. The gap was considered high for ECG physiological condition. The goat physiological condition at high temperature is similar to that of dairy cow. At the environment temperature of 39^0C, the concentrate of adrenaline and nor adrenaline decline within plasma in a day. The concentration will get normal in 30 days time when the environment temperature reaches 35^0C. The ideal temperature for goat is around $5–22^0$C (Park and Haenlein, 2012) and $10-25^0$C (Yousef, 2000). The temperature in LL is fairly similar to the range of ideal temperature for ECG, especially the maximum temperature. Meanwhile, in LL the maximum temperature is 30.1^0C; this temperature is higher than the ideal one. The maximum environment temperature is reached at 13:00-14:00. At maximum environment temperature, animal will be stimulated to emit energy to keep the energy balance toward environment. The energy emitted to the environment reduces the energy required to digest food in rumen and the energy for absorption, which later might result in digestibility decline. The gradual temperature decline from the maximum temperature (30.1^0C) to the minimum temperature (21.2^0C) takes place at 02:00. The environment temperature decline by 21^0C is rather obstructive for animal in lactation status because it is related to the metabolism for keeping their ideal body temperature and the temperature in de novo process to produce milk. Milk production is strongly affected by the blood circulation pace transferring the basic ingredient to produce milk. The blood circulation control which is related to milk synthesis in mammary gland is affected by catecholamine hormone. This hormonal activity is deliberately under the impact of body heat regulation and will decline during the extreme decline of environment temperature (Yousef, 2000). This later will reduce the synthesis of de novo to produce lactose which is influential to milk volume. The extreme change in environment temperature causes a change in body heat regulation affecting the decline on nutrient absorption and the activity of catecholamine hormone in mammary gland. The value of milk fat in each lactation period is affected by environment temperature, breed, forage, and milk production (Torii et al 2004). The milk lactose is positively correlated to milk production. And this result is similar to that gained by Astuti et al (2003). Comparison between dry matter intake, fat and lactose content of milk from the influence of gliricidia level in feed in the UL and LL shown in Figure 5.

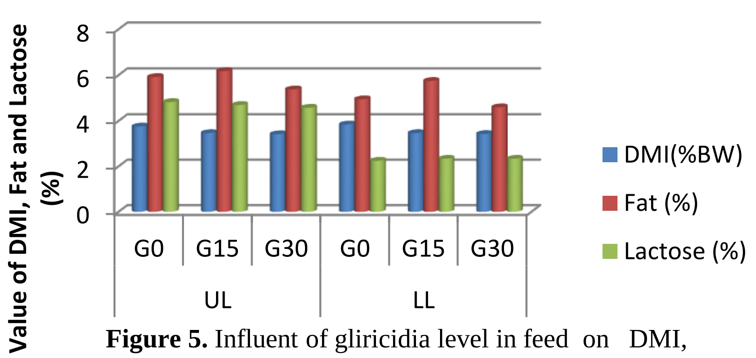

Figure 5. Influent of gliricidia level in feed on DMI, concentration of fat and lactose milk in UL and LL

4.2 The Effect of gliricidia level subtitute

The substitution of gliricidia in concentrate gives significantly different impact on consumption, nutrient digestibility, fat value and lactose in milk as well as the total solidity (see Table 6). In UL, G_{15} gives the highest impact on the consumption of DM, OM, and CP compared to G_3 and G_0. However, in LL G_0 gives the highest outcome on the same variable compared to G_{15} and G_{30}. The condition occurred due to the farmers' habit in giving the type of forage. ECG in LL are accustomed to dry forage including greenery while those in UL are used to being given fresh forage so that the cattle in LL can adapt more rapidly to the forage treatment especially dry gliricidia and silage. The habit causes the consumption of DM, OM, CP in LL to be higher than that of DM, OM, and CP in UL. The DM consumption on dairy goat during lactation period is about 31.7-151.3 $g/kgBW^{0,75.}$ (Luo et al 2004). As a result, with regard to the outcome, gliricidia substitution is generally harmless particularly to its production appearance. The amount of gliricidia which is less than 2%-5% of the total forage DM will increase the amount of protein in jejenum and raise the balance of amino acid in animal (Barry and Nabb 1991; Hagerman et al 1992). The supplementation of Calliandra calothyrsus dan Leucaena leucochepala in basalt forage in the form of Brachiaria ruziziensis and napier grass will raise the milk production twice as much compared to the one with control (without legume) (Tendonkeng et al 2012)

The digestibility value of OM by G_0 in UL is higher than any other basalt feed in UL and LL, indicating that the concentrate in basalt feed gives more significant contribution in than others feed. It is also presumed that the amount of Tanin in basalt feed of G_0 in UL is the lowest of the used basalt feed. Accordingly, it gives the highest digestibility impact and that condition resembles the research result by Kamalak et al (2004). Their research indicates that there is negative correlation between the value of Tanin and the OM digestibility of forage. The digestibility value of OM from G_0 is higher in UL than that in LL, which is owing to the environment temperature. The CP digestibility of basalt feed in G_{15} in UL is the highest than any other basalt feed in UL and LL. This condition shows that the concentrate level from the total forage bestows significant contribution to basalt feed in UL. However, it was found out that the number of N in forage given had more significant impact in escalating digestibility value.

In both research areas, G_{15} exerts impact to the value of milk fat and the total solidity. This condition indicates that CP is better than concentrate and gliricidia can give contribution to the value of OM digestibility so that OM can be increasingly digested and it is also presumed that there is increase in fatty acid amount which is obtained from amino acid conversion. Increasing amino acid cause milk fat synthesis and total solidity to get higher, as shown by the research result by Schmidely and Adrarde (2011). The use of fragmented soybean in the concentrate resembles the very use of fragmented soybean in the research conducted by Schmidely and Andrade (2011) regarding soybean flour supplementation and Canola seed on Alpine and Saanen dairy goat. The research outcome indicates higher milk fat value in forage supplemented with the two ingredients than the one supplemented by greenery.

Milk production in ECM does not indicate any significant difference but tend to be higher on G_{15} than G_0 and G_{30}. This condition shows that the level of gliricidia at 15% possesses ideal value of anti-nutrient so that it does not protect forage protein which will be converted into milk. The Tannin value in G_{15} is also not disadvantageous to rumen microbe. As a result, the microbe is able to fermen *rough fiber* to be converted into *acetic acid* and *propionic acid*. This will later cause the microbe to have balance which is almost similar in producing milk like in G_0 (see table 6).

V. Conclusion

1. Upland area has higher value of DM, OM and CP intake, DM digestibility, milk production, fat milk , *lactose* milk and total solid than ECG in lowland area.
2. The level of *gliricidia* substitution impact is significantly different (P<).05) to DM, OM and CP intake, OM and CP digestibility, milk fat, milk lactose and total solidity. Substitution gliricidia at the level of 15% from total DM feed give as the highest fat, lactose and total solidity than any other level. In lowland, gliricidia at 0 and 15% level substitution gives similar impact to DM, OM and CP intake, CP digestibility. Meanwhile at the level of 15%, it has the highest value on milk fat and total solidity.
3. The level of gliricidia substitution at 15% from total DM feed is suggested for dairy goat in upland meanwhile level gliricidia substitution which is less than 15% from total DM feed is suggested for dairy goat in lowland.

Acknowledgements

The authors are very thankful to the Higher Education Directorate, Ministry of Education, and Indonesian Government for providing funds for this research. We would like to thank the farmers in upland and lowland that had allow us to use their goats.

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