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**ВЛИЯНИЕ КОРМЛЕНИЯ ГРАНУЛАМИ GLIRICIDIA SERIUM
И PANICUM MAXIMUM LEAVES НА ЛАКТАЦИОННУЮ
СПОСОБНОСТЬ ДОЙНЫХ КОРОВ**

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Аннотация: В статье рассматривался вопрос оценки влияния листьев глирицидии (*Gliricidia serium*) как альтернативного источника белка, морской травы (*Panicum maximum*), клетчатки на продуктивность коров. Гранулы корма были приготовлены путем включения в состав рациона высушенных и измельченных листьев *Gliricidia*. В качестве контроля предлагалась фермерская диета. 13 Фризских дойных коров на третьей лактации были распределены по полностью рандомизированной схеме (CRD). Суточный удой, суточное потребление корма, состав молока, прибавка в весе измерялись в течение 28 дней с последующим 7-дневным периодом адаптации. Также был проанализирован приблизительный состав рациона.

Ключевые слова: глицидия, морская трава, удой молока, потребление корма, прибавка в весе, усвояемость.

**THE EFFECT OF FEEDING GLIRICIDIA SEPIUM
AND PANICUM MAXIMUM LEAVES PELLETS ON LACTATION
PERFORMANCE OF DAIRY COWS**

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Abstract: The effects of *Gliricidia* leaves (*Gliricidia sepium*) as an alternative protein source and Guinea grass (*Panicum maximum*) as a fiber source on the cows and heifers performances were evaluated. Feed pellets were prepared by incorporating 75% (A), 50% (B), 25% (C) and 0% (D) of dried and chopped *Gliricidia* leaves with 25%, 50%, 75% and 100% of dried and chopped Guinea grass respectively. Farm diet was offered as the control. Thirty Friesian milking cows in third lactation were allocated in a completely randomized design (CRD). Daily milk yield, daily feed intake and milk composition were measured for the period of 28 days followed by 7 days adaptation period. Twelve Friesian heifers age at twelve months were allocated to four dietary treatment groups of three heifers per treatment. Daily feed intake, faecal output and weekly body weight were measured for the period of 28 days followed by 7 days adaptation period. Proximate compositions of the dietary treatments were also analysed.

Proximate results showed that the protein, fat, calcium and vitamin A contents of diet A was the highest (19.2%, 4.5%, 0.5% and 672 mg/100g respectively) while diet D was the least (7.5%, 1.8%, 0.15% and 236 µg/100g respectively). NDF, ADF, sodium and total ash contents of diet D was the highest (69.52%, 54.21%, 91.5mg/kg and 10.6% respectively). All treatments were negatively affected on the milk production. Average milk production of cows fed with treatment A was significantly ($p < 0.0001$) minimally influenced on the milk yield reduction (10.31%) than B, C and D treatments (11.71%, 16.60%, and 20.03% respectively). Replacement of farm diet by 20%, 40%, 60% and 80% of each treatment was not significantly ($p > 0.05$) effect on the milk yield. Total replacement of the farm diet by each treatment was significantly reduced ($p < 0.05$) the average milk yields of each treatment group. However, milk yield was increased by 0.89% and 1.80% (not significantly) with the replacement of farm diet by 20% and 40% of the treatment A respectively. Milk fat

contents were significantly reduced ($p < 0.0001$) by treatment B, C and D but the treatment A was not affected on the milk fat content. Other milk constituents were not significantly affected by the treatments.

Digestibility of the treatment A (52.45%) was significantly higher ($p < 0.05$) than the treatment D (36.03%), but there were no significant differences with treatments B and C (50.65% and 45.93%). It is not recommended to feed mixed pellets of *Gliricidia* and Guinea grass or Guinea grass pellets as a complete diet for high yielding dairy cows as it leads to reduction of milk yield and milk composition.

Keywords: *Gliricidia*, Guinea grass, milk yield, feed intake, weight gain, digestibility.

INTRODUCTION

Current national herd is 1.4 million which is 1.1 million cattle and 0.34 million Buffalo (Department of Census and Statistics, 2020). Forage become the most limiting factor in cattle and buffalo farming. They have an ability to consume various feedstuffs such as pastures, fodders, agricultural by-products, household wastes and formulated feeds. Qualities of those feedstuffs are highly variable in composition, palatability and digestibility.

Expensive protein ingredients, poor quality grass and higher proportion of leftover feed became the most limiting factors in dairy ration formulation and cattle feeding. In dairy farming protein, digestible carbohydrate, vitamin, minerals, and fibre are the important parts of ruminant feed. Among previously mention components, fibre and protein generate crucial importance on milk yield of cow.

Guinea grass is abundance feed stuff for dairy cow. This is palatable to livestock with an average nutritional value. Therefore *P.maximum* can use as a fiber source for cattle feed. But nutrition value of grass could not match the rumen requirement of optimum C: N ratio. Protein and digestible carbohydrates is essential to develop rumen micro-flora. Low protein and digestible carbohydrates feed negatively affect to rumen fermentation and digestibility and ultimately it will affect to the production of cow. Therefore as a proper feed grass with protein supplement is essential to get maximum performance of cow. In commercial level, as a protein source used animal protein such as a fish meal, shrimp meal and blood meal. But those are highly expensive and locally low available.

Gliricidia sepium leaf has high nutritive value. Crude protein content 18-30% and high with digestible carbohydrate, as a protein source *Gliricidia* can be easily use. *Gliricidia* leaves and Guinea grass together, pelleting offers particular advantages.

Feeding animals with pellets provides better feed efficiency, greater starch digestibility, less feed waste and non-selective feeding. In this study the effects of Gliricidia leaves (*Gliricidia sepium*) as an alternative protein source and Guinea grass (*Panicum maximum*) as a fiber source on the cows and heifers performances were evaluated. Reduction the cost of expensive protein source was the alternative aim of this study. In order to achieve the above aim following objectives were sat.

- To measure impact of Gliricidia Leaves pellets on milk yield and milk composition.
- To evaluate digestibility of Gliricidia pellets.

MATERIALS AND METHOD

Feed trial

The experiment was carried out in the dairy unit of Rosita farm, Kotagala, Sr Lanka. The area is located at up country with annual rainfall >2500 mm. The experiment was conducted for 35 days in June and July.

Thirty Friesian milking cows in third lactation were selected according to lactation number, lactation parity and daily milk production. The cows were separated in to five equal sets according to the milk yield and body weight (BW) (Groups A, B, C, D and E). Cows were marked with ear tags and distributed among treatments, six cows per treatment including the control group in a completely randomized design (CRD). BW estimated by use of Rondo weight measuring tape. Initial milk yield also recorded before the experiment. The treatment feeds were sat as follows:

1. Group (A) - 25% Guinea grass + 75% Gliricidia pellets
2. Group (B) - 50% Guinea grass + 50% Gliricidia pellets
3. Group (C) - 75% Guinea grass + 25% Gliricidia pellets
4. Group (D) - 100% Guinea grass pellets

Feed preparation

The Gliricidia branches with leaves, soft twigs and Guinea grass used for production of Gliricidia and Guinea grass leaf pellets for these experiments. Gliricidia and Guinea grass was collected in Kodayana area by cutting manually. The harvested Gliricidia was sun dried for 12 hours before the partially dried leaves were removed by hands and then sun-dried again for approximately 24 hours. The harvested Guinea grass was sun dried for 24 hours. All leaf were chopped for 2cm particles by using Stalk chopping machine (model –JXZ, output [H/T] – 1 to 1.5, Henan Jingxin Machinery Co.,Ltd. China). Then it was mixed in different proportions

to form rations. These were grounded to 2mm particles, boiled at 80 °C to attain the desired binding effects, and pelletized using a machine for this purpose. Palatalized feed store in polythene bags and store in a dry area until experiment is started. Each Treatments moisture percentage was determined by using Draminski Hay & Silage High-Moisture Meter (DRAMINSKI S.A. ul. Owocowa 17 .10 - 860 Olsztyn, POLSKA). Feed sample were analysis according to the AOAC (1984).

Feeding

For the first 7 days each group was provided 20% of experimental diets replacing farm grass diet of their ration. After each week, farm diet was replaced up to 40%, then 60%, 80%, and in the last Seven day completely (100%) replaced by the experimental diet.

Water was provided at all times. The control group was not maintained because of self-control. Data for feed intake and refusals were recorded on a daily basis. Animals were closely observed for the occurrence of any ill health and disorders during the experiment Period. Each of group represented three lactating cows as a replicate.

Milk composition

The cows in feeding experiments were hand-milked twice a day. The milk yield was recorded at each milking. Milk samples of 500 ml were taken in sterile bottles for each of treatment and were immediately frozen at -12°C and then analysed for fat, total solids, CP , ash, solid non-fat and Lactose.

Proximate Analysis Proximate parameters determined using the Association of Analytical Chemist (AOAC, 2005) method. Water, ash, crude protein, crude fat and lactose contents were determined by oven drying, furnace, micro Kjeldah, soxlet extraction and titrimetric methods respectively.

Digestibility trial

Twelve Friesian heifers age at twelve months with an initial live weight range of 280 -360 kg (avg. initial weight of 325 kg; 9 month of age) were used for the digestibility study. They were housed in individual place with concrete floors and had free access to water and feed. Feed was provided at 10% in excess of voluntary intake in two meals (8.00 am and 4.00 pm).

The heifers were grouped and treated with the same diets as treated the lactating cows. An adjustment period of seven days was allowed before a 28 day collection period of total faces. Feed offered amounts and leftover amount were recorded each day at 8.00am. Leftover feed's moisture percentage was determined. Faecal samples were collected for 2 times daily. Daily faecal output of each animal

was bulked, weighed, thoroughly mixed and sub-sampled. The sub sample was air dried and completely dried at 105 °C overnight by using the oven. Then weighed the total dry matter in faecal.

A feeding trial is used to obtain data to calculate digestibility values. The following equation is used:

$$\text{Digestibility} = 100 \times (\text{DM}_{\text{food}} - \text{DM}_{\text{faeces}}) / \text{DM}_{\text{food}}$$

Where DM_{food} is the dry matter consumed and $\text{DM}_{\text{faeces}}$ is the dry matter excreted in the faeces.

The data was analysed using analysis of variance (ANOVA) with SAS 19.0 to examine the statistical significance of differences in the mean digestibility of the each treatment.

RESULTS AND DISCUSSIONS

The nutrient composition of all rations of treatments are shown in table 1. The highest crude protein content was observed in treatment A(19.2%). Because treatment A contain 75% of Gliricidia leaves, followed by treatment B (15%), C (10.8%), and D (7.5%) respectively. Normally high yielding cow needs more than 18% digestible protein to produce milk without cow getting stressed. When protein percentage lower than 15%, cow may be get stressed and ultimately reduced the cow production. Also high amount of protein percentage directly influenced to the rumen micro-flora .It was improved micro-flora population in rumen. Ultimately increased the rumen fibre fermentation and digestibility. Which directly effect to the milk production of cows.

Table 1

The nutrient composition of Treatment A, B, C, and D

Nutrients	Quantity % by mass			
	Treatment A	Treatment B	Treatment C	Treatment D
Moisture	5.5	6.4	7.9	7.4
Dry matter	94.5	93.6	92.1	92.6
NDF	48.29	56.48	64.47	69.52
ADF	36.62	42.98	48.24	54.21
Fat	4.5	3.1	2.2	1.8
Protein	19.2	15	10.8	7.5
Total ash	8.9	9.1	9.7	10.6

Phosphorous	0.2	0.2	0.2	0.2
Sodium content, mg/kg	71.2	74	82	91.5
Magnesium	0.3	0.3	0.2	0.2
Calcium	0.5	0.3	0.3	0.15
Potassium	2.3	2.2	2.1	2.4
Vitamin A content, $\mu\text{g}/100\text{g}$	762	520	376	236

According to table 1 treatment D had highest amount of Ash percentage (10.6%) and treatment A had lowest amount of Ash percentage (8.9%). It directly effect to the digestibility of feed. When Ash percentage was high, it reduced the fermentation and digestibility of feed. That resulted the lowest digestibility in treatment D.

When consider about NDF percentages of treatments, treatment A showed lowest NDF percentage (48.29%) compared to other treatments B, C, and D. When NDF percentage is above 35%, it directly influence to the digestibility, DM intake and ultimately affect to the reduction of milk yield. The treatment D showed the highest percentage of NDF (69.52%). This level of NDF could not utilized in rumen micro flora and it ultimately reduced the fibre digestibility.

Treatment A had the lowest percentage of ADF (36.62%) than other treatments B, C, and D (42.98%, 48.24%, and 54.21%) respectively. High amount of ADF also negatively affect to the rumen digestibility and milk production of cow. Also high ADF percentage was reduced the milk fat percentage.

When consider about vitamin A percentages, there was a high significant different among the treatments groups. Treatment A showed highest percentage of vitamin A (762 $\mu\text{g}/100\text{g}$) when compared with other treatment B, C and D (520, 376, and 236 $\mu\text{g}/100\text{g}$) respectively. According to table 10, treatment D showed lowest vitamin A percentage and it had high significant difference than treatment A (Treatment A contain more than five times of vitamin A), because of treatment D only consist with Guinea grass.

According to proximate composition of feed treatments, treatment A had significant amount of nutrients than other treatments, because nutrient values significantly improved with the present of *Gliricidia*.

Average daily milk yield (ADMY) and experimental farm diet replacement

The average milk yield of all treatments during the experimental period is illustrated in figure 1.

There was a significant effect on treatment to milk yield ($p < 0.0001$) and significant effect on replacement proportion on milk yield ($p < 0.0001$). Milk yield was measured in each cow on a daily basis consecutively for 35 days during collection period. The influence of treatments on milk period, according to figure 1, there was a significant difference ($p < 0.0001$) among the treatment groups (Treatment A, B, C, D) during the experimental period of five weeks.

According to the Duncan's Multiple Range test, there was a significant difference in the treatment D from treatments A and B. According to the Duncan grouping all four treatments were significantly differ with initial milk yield. Figure 1 indicates milk decreased percentage with each treatment. There was a high reduction percentage, showed in treatment D (20.033%) than other three treatments A, B and C (10.381%, 11.751%, and 16.601) respectively.

Fig. 1. Influence of different treatments on milk yield (%) of lactating cows
T- A: 25% Guinea grass + 75% Gliricidia pellets; T- B: 50% Guinea grass +
50% Gliricidia pellets; T-C: 75% Guinea grass + 25% Gliricidia pellets; T- D:
100% Guinea grass without Gliricidia

When consider about Treatment A, It has the highest crude protein (19.20% by mass) content within other three treatment's feed. It may be a reason to, treatment A was significantly lower influenced on milk yield. When consider about treatment B,

C and D, their crude protein content respectively low (treatments B-15%, C-10.8% and D-7.50% by mass). Averagely, cow needs more than 18% of cured protein to produce high milk yield, but treatments B, C and D does not match the rumen requirements of protein percentages. It was directly influenced to milk yield depletion of each treatment.

Control group was fed concentrate, Beer pulp and maize powder which contain high amount of nutrients than the treatment groups. Treatment A milk yield reduction, may be due to high Tannins content in *Gliricidia* leaf feed. At higher levels (5–9%) Tannins become highly detrimental [4] as they reduce digestibility of fiber in the rumen [9] by inhibiting the activity of bacteria [6] and anaerobic fungi [3] high levels also lead to reduced intake [8]. Also recent researches showed Tannins may indirectly effect rumen function by reducing rumen ammonia levels through decreased protein degradation in the rumen. It also showed that, if rumen ammonia levels decreased bellow 80mgN/l, then fiber digestibility may be depressed and digestibility is reduced [5].

Fig. 2. Influence of feed replacement percentage and treatment on milk yield
A - 20% replacement; B - 40% replacement; C - 60% replacement;
D - 80% replacement; E - 100% replacement

The milk yield of all treatments reduced when replacing the experimental diets during the experiment (figure 2), except in treatment A. Only in treatment A from 20% to 40% replacement the milk yield improved from 0.893% to 1.804% comparing to initial milk yield. This could be high protein content (19.2%) in treatment 1.

However in higher replacements (60%, 80% and 100%) higher reductions of milk (3.83%, 19.27% and 31.49%) observed as all other treatments ($p < 0.001$).

There was not any significant reduction of milk yield up to 60% replacement of treatment B. In higher replacements (from 60% to 100%) the rate of reduction significantly increased from 7.72% to 27.61%. It was indicate the rapid rate of milk production decrement. That was due to low protein percentage (15% by mass base) and also may be a reason of tannin present in *Gliricidia* leaves.

The same pattern of reduction continued in treatment C. The higher rate of milk yield reduction is observed in 80% and 100% replacements from 26.3% to 37.88% ($p < 0.05$). It was indicate the rapid rate of milk production decrement due to low level of crude protein content in treatment C (10.80% by mass bass) and also high level of ADF (48.24% by mass). High amount of ADF and low protein level was reduced rumen digestion and ultimately decrement milk yield.

There is a significant decline of milk yield observed from 20% to 60% replacements in treatment D ($p < 0.05$). The rate of reduction were 4.99%, 8.77% and 15.06%. The rapid milk yield decrement (Decrement rates – 28.387% and 45.327%) indicated in 80% and 100% feed replacements in treatment D. Treatment D showed the highest rate of milk reduction than other treatments because of it contain only guinea grass .Guinea grass had low protein content (7.50% by mass) than other treatments and also high amount of ADF (54.21% by mass).that was directly influenced to the milk yield decrement because of produce high milk yield, need more than 18% of protein.

Milk composition

The milk composition of all treatments during the experiment was shown in table 2. All milk parameters show non-significant difference among treatments and control except milk fat.

Table 2

Effect of *Gliricidia* leaf and Guinea grass pellet feed on Milk composition of lactating cows

Parameter	Treatment A	Treatment B	Treatment C	Treatment D	Control
Fat %	3 ^a	2.3 ^b	2.1 ^b	2.5 ^b	3.0 ^a
Total Solid%	11.4 ^a	11.3 ^a	11 ^a	11.3 ^a	11.3 ^a
Solid Non Fat %	8.4 ^a	9 ^a	8.9 ^a	8.8 ^a	8.2 ^a

Crude Protein %	3 ^a	3.5 ^a	3.4 ^a	3.4 ^a	3.1 ^a
Ash %	0.7 ^a	0.7 ^a	0.8 ^a	0.8 ^a	0.7 ^a
Lactose	4.5 ^a	4.7 ^a	4.6 ^a	4.4 ^a	4.4 ^a
Water	88.6 ^a	88.7 ^a	89 ^a	88.7 ^a	88.6 ^a

According to table 2, average percentages of milk Fat has decreased. But Treatment A was not indicated change of fat percentage due to, treatment A contain high amount of digestible protein(19.2% b mass) than other treatments and also low level of ADF(36.62%) than other treatments B(42.98%),C(48.24%), and D(54.21%). Digestibility of fibre in rumen is reduced by high percentage of lignified fibre in diet. It may be negatively affected to milk fat and does not utilize it for milk fat as compared with the Frisian cow which consumed control diet. Because control diet content Napier grass (*Pennisetum purpureum*) which content high amounts of digestible non-Lignified fibre.

Although the highest mean crude protein was recorded from treatment B (3.4667) followed by treatment C (3.400), D (3.400), A (3.333) and Control (3.100) respectively, there was no significant difference among treatment groups. The same pattern followed by other milk parameters.

Digestibility trial

The results of digestibility studies conducted with twelve Friesian cows are shown in figure 3.

Fig. 3. The digestibility means of each feed treatments

The feed treatments had significantly affected (0.0282) to the digestibility. The highest mean digestibility of treatment was resulted in treatment A (52.455%) and other three digestibility means were treatment B (50.656%), treatment C (45.939%), treatment D (36.038). Treatment A digestibility mean which had highest mean significantly differ from treatment D. But there was no significantly difference between treatment A, B and C. Treatment C digestibility mean had no significantly difference from treatment D digestibility mean. Treatment D had lowest digestibility than other three treatments. Significantly high digestibility showed in treatment A, because of treatment A content high amount of protein (19.20% by mass) content than other treatment groups. However fallowed by treatment B (15%), A (10.8%), and A (7.50%) respectively.

Treatment D, only contain Guinea grass, which had low crude protein (7.50%) and digestible carbohydrate. Also treatment D contain high amounts of ADF(54.21%), That was a main reason to lowest digestible result showed by treatment high ADF percentage reduce the rate of digestibility.

Gliricidia leaf content deferent types of anti-nutritional factors, such as Tannin (3.51mg/100g), Phytic acid (15.24mg/100g), Phytic-p (4.30 mg/100g), Oxalate (4.82 mg/100g), Saponin (7.51%), and Alkaloid (6.33%) [7, 10]. When tannin percentage is high, it deducted fibre digestibility of rumen also showed rumen, may be depressed and digestibility is reduced [5].That may be a problem of low digestibility result shown in treatments A and B.

Conclusion

Results from this research indicate that the nutritive quality of Gliricidia and Guinea grass pellets no comparable to gain high yield of Frisian lactating cows. All of treatments milk yield were significantly reduced when compared with control group. Treatment A was minimally affected to the reduction of milk yield and Treatment D was highly affected on milk yield. Treatment B, C and D were also negatively affected to the milk fat percentage due to high level of ADF content. Treatments were not significantly affected to the other milk components.

Present of Gliricidia amount was directly influenced to the digestibility. Digestibility was increased with Gliricidia percentage content in feed treatments. 75% Gliricidia pellets was resulted higher digestibility and 100% Guinea grass treatment had the lowest digestibility.

It is not recommended to feed Gliricidia pellets and Guinea grass as a main diet for high yielding Frisian cows as it leads to reduction of yield and milk composition.

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