# YIELD, QUALITY AND FEED COST EFFICIENCY OF MILK PRODUCED BY ANGLO-NUBIAN GOATS FED DIFFERENT MIXTURES OF NAPIER (*Pennisetum purpureum)* GRASS AND MALUNGGAY (*Moringa oleifera*)

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## ABSTRACT

**The study evaluated which proportion of Napier grass and Malunggay diet is best in increasing milk quantity and quality of Anglo Nubian dairy goats and assessed the cost of producing goat's milk in these animals. Six purebred and three upgraded Anglo-Nubian goats were distributed into three blocks according to breed and average weight and were subjected to a 60-day feeding period given the following treatment diets: Treatment 1 – 100% Napier grass; Treatment 2 – 70% Napier grass and 30% Malunggay; and Treatment 3 – 60% Napier grass and 40% Malunggay. All treatments received the same amount of concentrate as supplement. After the study, the average milk yield of the animals under Treatment 1 was 246.80 ml while Treatment 2 had 431.33 ml and Treatment 3 had 458.33 ml. The milk density was 26.46, temperature of 34.79ºC and freezing point of -0.381ºC. The milk contained 5.98% fat, 8.31% solids-non-fat, 2.74% lactose, and 4.76% protein. The diet which produced the highest milk yield in goats was the combination of 60% Napier grass and 40% Malunggay. As to the cost, the animals given 100% Napier grass plus concentrate had the lowest cost per liter of milk produced, followed by 40% Malunggay and 30% Malunggay.**

Keywords: Anglo-Nubian, dairy goats, Malunggay, milk yield, Napier grass

## INTRODUCTION

Goats are very adaptable and versatile animals and they can thrive on diverse types of improved grasses such as Napier, Guinea, Para grass and native pasture species (PCARRD 2004a and 2004b). However, dairy or lactating goats need optimum diet to meet their energy, protein, vitamin and mineral requirements to produce milk (Sarian, 2009 and 2010). This can only be achieved through proper nutrition and strict feeding program which consists not only of grass or roughage but of legumes and concentrates and good management practices (Manugbat, 2010 and 2011).

Since dairy goats, like the Anglo-Nubian breed, require more nutrients to supply the requirements for milk production, there is a need to evaluate nutritious,

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locally available yet inexpensive forage legumes. A large number of shrubs and tree legumes have been documented as useful livestock fodder. In particular, ipil-ipil (*Leucaena leucocephala*) and kakawate (*Gliricidia sepium*) have been used as supplements to a wide range of forages and agricultural by-products (Kaitho and Kairuki, 1998). Moreover, Sanchez *et al.* (2005) stated that the crude protein content of Malunggay (*Moringa oleifera*) is of better quality for ruminants than the CP of leaves of *Gliricidia* or *Leucaena* because of its high content of bypass protein, 47% versus 30% and 41% respectively. Malunggay is also rich in carotene, ascorbic acid, iron and in the two amino acids generally deficient in other feeds, *i.e.* methionine and cystine (Nouala *et al.*, 2006; Abonal-Villafuerte and Villafuerte, 2009).

Napier (*Pennisetum purpureum*) grass has been used extensively in goat farming (Mohammad *et al.,* 1988; Arodho, 2006; Taye, 2009). Malunggay is a promising forage legume supplement to augment the needed protein of dairy goats that grasses like Napier grass usually provide. On the other hand, aside from its culinary and medicinal use for humans, Malunggay can also be used as forage especially during lactation because researches revealed that it is a galactagogue, which can increase milk production in ruminants.

This study aimed to evaluate the effect of varied proportions of Napier grass and Malunggay as feeds to Anglo-Nubian goats on milk quantity and quality and feed cost efficiency.

## MATERIALS AND METHODS

Nine upgraded and purebred Anglo-Nubian does with an average live weight of 20-30 kg were distributed into three blocks according to breed and average weight. They were distributed following the Randomized Complete Block Design (RCBD) with three replicate animals for each treatment. The does were on their second month of lactation and the kids have been completely weaned.

The forages used in the treatments were Napier grass and Malunggay with the addition of concentrates. Napier grass and Malunggay were rationed in three different proportions as follows: a) T1 with 100% Napier grass and concentrate; b) T2 with 70% Napier grass, 30% Malunggay and concentrate; and c) T3 with 60% Napier grass, 40% Malunggay and concentrate.

To ensure uniformity throughout the study, the goats were housed in an existing structure with individual elevated pens furnished with plastic matting floor for easy waste disposal. Each pen measures 1.5 square meters and was provided with three plastic basin feeders, with one each for the chopped Napier grass, for the concentrate and Malunggay, and for water.

The animals underwent two weeks pre-feeding period according to the ration of the different treatments for the animals to be accustomed to the new ration. After the two weeks pre-feeding period, the animals were fed with the same ration for two months of data gathering. Feed on offer was computed as 20% in excess of the previous day intake. Napier grass was chopped into 2.5-5.0 cm in length for better utilization and was fed to the animals four times a day along with the Malunggay

while 750-g concentrates were given in three separate feeding in a day. Water and Urea-Molasses-Mineral-Block (UMMB) were made available at all times.

Based on the average body weight of the experimental animals which was 27 kg, the amount of Dry Matter (DM) intake was computed as 4% of body weight (Cheeke, 1999).

The does were milked twice a day at 5:00 AM and 3:00 PM. Hand milking procedure was employed. Milk was analyzed using Lactoscan SLP Milk Analyzer (Milkotronic Ltd., 6000 Stara Zagora 167, TsarSimeon Veliki, Bulgaria).

The data gathered were: a) average daily gain, which was taken after subtracting the final weight to that of the initial weight and divided by the 60-day feeding period; b) feed consumption, which was computed by subtracting the feed refused from the feed offered expressed on dry matter basis; c) feed required to produce a liter of milk which was computed by dividing the total feed consumed by the volume of milk produced in liters; d) water consumption represented the water intake of the animal which was obtained by subtracting the volume of water left after 24 hr from the volume of water offered; e) volume of milk production which was measured right after the does were milked in a graduated cylinder; f) and physico-chemical properties of milk such as milk fat (FAT), solids-non-fat (SNF), proteins, lactose, temperature (ºC), freezing point and specific gravity.

Data gathered were analyzed using Analysis of Variance in RCBD. Comparison of treatment means was done on the percentage increase in milk yield between the dairy goats given with Malunggay and the unsupplemented group.

## RESULTS AND DISCUSSION

Table 1 shows that on the 60$^{th}$ day of lactation period, does given with 40% Malunggay had the highest mean yield followed by dairy goats given with 30%

Table 1. Average milk yield (ml, mean±S.D.) over a 60-day lactation period of Anglo-Nubian goats fed Napier grass and Malunggay.

| Treatment* | Period of Lactation$^{ns}$ | | | |
|---|---|---|---|---|
| | 15$^{th}$ | 30$^{th}$ | 45$^{th}$ | 60$^{th}$ |
| 1 100N+C | 202.53±67.45 | 191.93±60.39 | 241.22±51.57 | 246.80±52.05 |
| 2 70N+30M+C | 184.04±34.83 | 275.82±68.96 | 384.10±96.89 | 431.33±99.20 |
| 3 60N+40M+C | 229.11±46.83 | 337.33±54.12 | 438.55±73.24 | 458.33±80.84 |
| Total | 615.68 | 805.0 | 1,063.87 | 1,136.46 |
| Mean | 205.22 | 268.36 | 354.62 | 378.82 |

ns – Treatment means are not different from each other (P>0.05).

*Amount of Napier grass and Malunggay are expressed in terms of percentage of the diet.

Malunggay and animals given with 100% Napier grass. These differences were not shown to be significant. This means that the treatments given with Malunggay had a comparable or similar performance with the animals that were given with 100% Napier grass. However, from the 15th day of lactation up to the 60th, dairy goats given with 30% Malunggay gave a 247.29 ml additional yield from the first lactation period while those given with 40% Malunggay gave 229.22 ml additional yield. The animals given with 100% Napier grass had a small yield of 44.27 ml.

This clearly indicates that the apparent galactagogue effect of Malunggay can be obtained by feeding 30-40% of Malunggay to lactating goats. Dela Cruz (2012) stated that the lactation-enhancing effect of Malunggay leaves was manifested from the increase of maternal serum prolactin levels. Prolactin, according to Belanger and Bredesen (2010) also known as luteotropic hormone (LTH), is secreted by the anterior pituitary gland and, in mammals, this stimulates the initiation of lactation. It also increases the activity of the enzymes that are essential to the works of epithelial cells (in the alveoli), which convert blood constituents to milk. The finding in this study agrees with that of Sanchez *et al.* (2005) which showed 13% increase in milk yield of cattle given Malunggay leaves at a level of 0.3% of body weight.

**Percentage increase in milk yield**

Although the treatments did not differ in total milk yield, the Figure clearly indicates a difference in the percentage increase in milk yield from the 15th day of lactation. During the 30th day, except for the control with a decrease of -5.2%, lactating does fed with Malunggay at 30% showed a positive increase of 49.87%

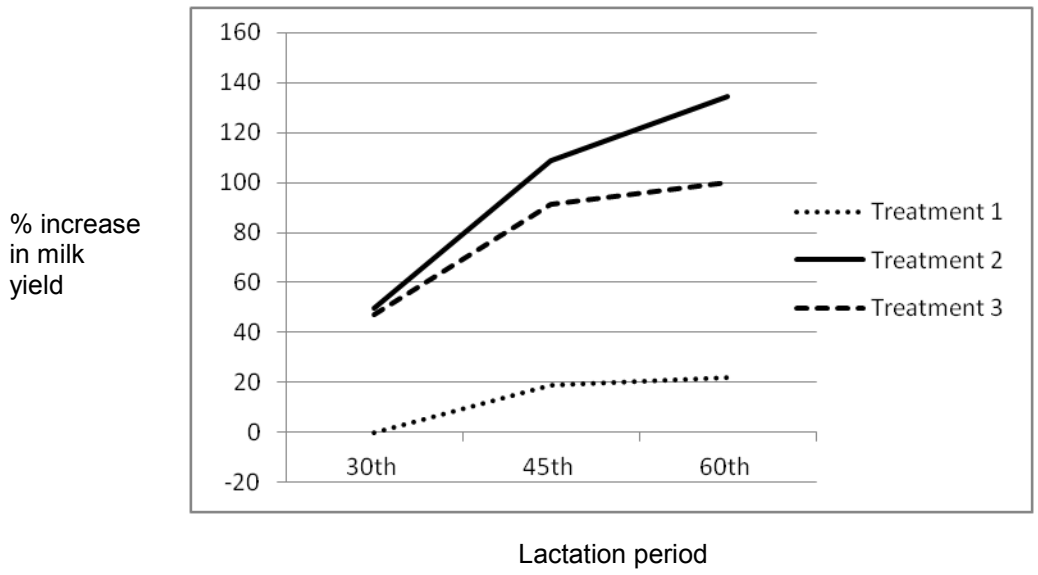


Figure. Milk yield of Anglo-Nubian goats fed Napier grass and Malunggay from the 30th to the 60th day of lactation. Treatment 1: 100% Napier; Treatment 2: 70% Napier and 30% Malunggay; Treatment 3: 60% Napier and 40% Malunggay.

while those animals given a 40% Malunggay diet showed a 47.23% increase in milk yield.

During the 45th day of lactation, lactating goats fed with 40% Malunggay had the highest increase in milk yield of 108.70% compared with dairy goats fed with 30% with a 91.41% increase in milk yield. The animals given 100% Napier grass had a 19.11% increase compared with the treatments given 30% or 40% Malunggay. This trend is consistent up to the 60th day of lactaion , with the highest increase observed in animals fed with 40% Malunggay which had 134.37% increase in milk yield followed by those given 30% Malunggay with 100.05% increase and the lowest with the dairy goats given 100% Napier grass with only 21.86% rise in milk yield.

**Physico-chemical characteristics of goat milk**

The specific gravity among the treatments (Table 2) revealed no significant differences and conforms with the findings of Park *et al.* (2007) and Bhosale *et al.* (2009) having values ranging from 1.025-1.029. There were no significant differences noted in terms of temperature. Likewise, the freezing point in all treatments was lower than the normal temperature range. The physical characteristics were relatively consistent all throughout the study.

Table 2. Means of physico-chemical properties of milk from Anglo-Nubian goats fed with Napier grass and Malunggay.

| Physico- chemical properties | Treatment 1 | Treatment 2 | Treatment 3 | Total Mean |
|---|---|---|---|---|
| | Mean | Mean | Mean | |
| Specific gravity | 1.03±0 .00 | 1.026±0.00 | 1.03±0.00 | 1.026 |
| Temperature (ºC) | 34.75±0.44 | 34.74±0.42 | 34.89±0.34 | 34.79 |
| Freezing point (ºC) | -0.39±0.14 | -0.38±0.00 | -0.37±0.25 | -0.381 |
| % Fat | 6.47±0.30 | 6.47±0.35 | 5.25±0.54 | 5.98 |
| % Solids-non-fat | 8.40±0.27 | 8.30±0.04 | 8.22±0.17 | 8.31 |
| % Lactose | 2.75±0.10 | 2.72±0.01 | 2.74±0.04 | 2.74 |
| % Protein | 4.84±0.13 | 4.78±0.03 | 4.68±0.10 | 4.76 |

Treatment 1: 100% Napier; Treatment 2: 70% Napier and 30% Malunggay; Treatment 3: 60% Napier and 40% Malunggay.

With regards to fat, dairy goats given 40% Malunggay had the lowest value followed by those fed with 30% Malunggay and those not given with Malunggay. All treatments exceeded the normal fat content of goat's milk which is 3.8%. Fat content can be influenced by concentrate supplementation in the diet (Abebe and Tibbo, 2009; Mahmood and Usman, 2010). The solids-non-fat percentages of all treatments were not significantly different from each other and their mean was a little lower than the normal amount of 8.9% The lactose content of all treatments had an average mean of 2.74%, lower than the normal value of 4.1%. Lactose,

according to Frandson *et al.* (2003), does not routinely change with diet. With regards to protein, all treatments were not significantly different from each other and their average mean which is 4.75% is higher than the average of 3.4%. Therefore, Napier grass alone or addition of 30-40% of Malunggay in the diet of dairy goat can increase the protein content of milk.

**Feed consumption and feed cost efficiency**

Table 3 shows that dairy goats which were given pure Napier grass plus concentrate posted the least amount of PhP 119.80 per liter of goat's milk produced. This was followed by those given with 40% Malunggay with PhP 197.97 and the most expensive was the group given 30% Malunggay with PhP 242.05 per liter of milk. The differences in the costs of the three treatments depended on the additional cost of Malunggay which was PhP 30.00/kg in relation to milk production. Compared with the commercial price of goat's milk which is PhP 150.00 per liter, the cost of the treatments given with Malunggay was higher.

Table 3. Total feed consumption and cost of feed to produce one liter of milk of Anglo- Nubian goats fed Napier grass and Malunggay.

| Indicator | Treatment | | |
|---|---|---|---|
| | T1 (100N+C) | T2 (70N+30M+C) | T3 (60N+40M+C) |
| Napier grass consumed (kg) | 332.20 | 245.15 | 197.72 |
| PhP 0.50 /kg Napier grass | 166.60 | 122.57 | 98.86 |
| Malunggay (kg) | - | 99.52 | 98.72 |
| PhP 30/kg Malunggay | - | 2,985.60 | 2,961.60 |
| Concentrate Consumed (kg) | 45.00 | 45.00 | 45.00 |
| PhP 25/kg Concentrate | 1,125.00 | 1,125.00 | 1,125.00 |
| Total Cost (PhP) | 1,291.60 | 4,233.17 | 4,185.46 |
| Total Milk Yield (L) | 2.46 | 19.41 | 22.45 |
| Cost to produce a liter of milk (PhP) | 119.80 | 242.05 | 197.97 |

## CONCLUSION

The results of the study suggest that the best proportion of Napier grass and Malunggay which produced the highest milk yield was 60:40; and the cost of producing a liter of milk was lowest in Napier grass and concentrate diet as compared with those supplemented with Malunggay. To be able to investigate further the benefits of Malunggay, the following are recommended: a) goat's milk fed with Malunggay can be subjected to vitamin and mineral content analysis to determine the influence of Malunggay on its micronutrients content; b) sensory attributes or organoleptic test should be conducted to assess acceptance of goat's milk to different age group like children, adolescents, women, and men; c) a similar

study using other forage legumes like Indigofera, Desmodium, Flemingia or their combinations are recommended since they are cheaper than Malunggay and does not compete with human food; d) use of forage legume alone instead of concentrate to assess its effect on milk quantity and quality; e) use of other breeds of dairy goats like Saanen, Toggenburg, Alpine and La Mancha and their upgrades; f) conduct a longer period of milk collection to cover one lactation period (*i.e.* 250 days for Anglo-Nubian) to determine the optimum effect of feed supplementation; and g) conduct a study on the effect of temperature on milk yield considering the comfort zone of dairy animals.

## ACKNOWLEDGMENTS

The authors wish to convey their gratitude to Dr. Rowena M. Bayrante for the statistical work, Ms. Gretchen C. Mangahas for the editing and the Commission on Higher Education for funding for the study.

## REFERENCES

Abebe T and Tibbo M. 2009. Milk Quality Control. In: Technical Bulletin No. 2. *International Center for Agricultural Research in the Dry Areas*. Pakistan.

Abonal-Vilafuerte L and Villafuerte LR. 2009. *Moringa*. Singapore: Apples Gold Publishing.

Arodho AB. 2006. *The role and importance of Napier grass in the smallholder dairy industry in Kenya*. Accessed 25 October 2011. http://www.fao.org/ag/agp/agpc/doc/newpub/napier/napier_kenya.htm.

Belanger J and Bredesen ST. 2010. *Storey's Guide to Raising Dairy Goats* (4th ed.). North Adams, Massachusetts: Storey Publishing.

Bhosale SS, Kahate PA, Kamble K, Thakare VM and Gubbawar SG. 2009. Effect of lactation on physico-chemical properties of local goat milk. *Vet World* 2:17-19.

Cheeke PR. 1999. *Applied Animal Nutrition: Feeds and Feeding* (2nd ed.) New Jersey: Prentice-Hall.

Dela Cruz RT. 2012. Cattle produces more milk with Malunggay. *Agriculture Monthly Magazine* 16 (5): 34.

Frandson RD, Wilke WL and Fails AD. 2003. *Anatomy and Physiology of Farm Animals* (6th ed.). Baltimore, Maryland: Lippincott Williams and Wilkins.

Kaitho RJ and Kariuki JN. 1998 Effects of *Desmodium sesbania* and Calliandra supplementation on growth of dairy heifers fed napier grass basal diet. *Kenya Agricultural Research Institute* 33.

Mahmood A and Usman S. 2010. A comparative study on the physicochemical parameters of milk samples collected from buffalo, cow, goat and sheep of Gujrat, Pakistan. *Pak J Nutr* 9 (12): 1192-1197.

Mangubat RG. 2011. NDA's Philippine dairy roadmap: Charting new directions for a promising industry. *MARID Agribusiness Digest* 21 (12): 18.

Mangubat RG. 2010. Philippine dairy updates. *MARID Agribusiness Digest* 22

(2):16.

Mohammad N, and Nasir LM and Qamar IA.1988. Effect of nitrogen fertilization and harvesting intervals on the yield and nutritional value of napier grass. *Pak J Agric Res* 9: 1-2.

Nouala FS, Akinbamijo AA, Adewumi HE, Mvetzel S and Becker K. 2006. The influence of *Moringa olefeira* leaves as substitute to conventional concentrate on the *in vitro* gas production and digestibility of groundnut hay. *Livestock Res Rural Dev* 18 (9).

Park YW, Juarez M, Ramos M and Haenlein GFW. 2007. Physico-chemical characteristics of goat and sheep milk. *Small Ruminant Research* 68 (1,2): 88-113.

PCARRD. 2004. *The Philippine Recommends for Forage and Pasture Crops*. Los Baños, Laguna: PCARRD.

PCCARD. 2004. *The Philippine Recommends for Goat Farming*. Los Baños, Laguna: PCARRD.

Sanchez NR, Sporndly E and Ledin I. 2005. Effect of feeding different levels of foliage of *Moringa olefeira* to creole dairy cows on intake, digestibility, milk production, and composition. *Livestock Science*. UK: Saunders Elsevier.

Sarian, ZB. 2009. Goat dairying has great potentials. *Agriculture Monthly Magazine* 13 (5): 5.

Sarian ZB. 2010. New research shows that dairy goat farming is viable. *Agriculture Monthly Magazine* 15 (6): 5.

Taye M. 2009. Growth of Washera ram lambs fed on Napier (*Pennisetum purpureum*) and Sesbania (*Sesbania sesban*) mixture at different levels of combination. *Livestock Res Rural Dev* 21 (12).