EFFECTS OF UREA-MOLASSES-MINERAL-BLOCKS (UMMB) ON THE GROWTH PERFORMANCE OF GOATS (*CAPRA HIRCUS*) MAINTAINED ON NATURAL PASTURES IN PAPUA NEW GUINEA

Lucy Lapauve and Gariba Danbaro

ABSTRACT

Use of urea molasses mineral blocks (UMMB), as feed supplements for goats to improve productivity, especially on farms which depend mostly on fibrous feeds of low nutritional quality in Papua New Guinea (PNG) is limited. This study was therefore conducted to investigate the growth of goats fed on UMMB in terms of their live weight gains (LWG). There were three treatments at each site: Treatment I goats were fed on natural pastures alone without UMMB. Treatment II goats were given an additional supplement of UMMB containing 5% urea and Treatment III goats were given an additional UMMB supplement containing 10% urea. Nine wether goats were randomly assigned to the treatments at each site. The goats grazed the normal pastures during the day and were offered the UMMB as licks only during the night (4pm to 8am next morning). LWG of the goats were measured over 16wks trial period The treatments had significant effect on LWG at both sites ($P<0.05$). LWG of goats on treatments I, II and III were 0.90±0.50kg, 0.47±0.50kg and 4.60±0.50kg respectively at NARI Labu station and -0.2±0.5kg, 2.1±0.5kg and 2.2±0.5kg respectively at Leron farm. LWG of goats in treatments I and II were statistically similar but significantly lower than that of goats in treatment III (LSD, $P<0.05$). However results of the on-farm trial showed that goats on treatments II and III had statistically similar LWG which were significantly higher than LWG of goats in treatment 1. The better performance of goats on UMMB especially on-farm where pastures were nutritionally poorer than those on-station suggest that UMMB technology could be used to increase growth and productivity of goats especially on commercial smallholder and subsistence farms in PNG.

Keywords: *Urea molasses mineral blocks (UMMB), goats, Papua New Guinea, growth performance.*

INTRODUCTION

Animal production is an important part of the agriculture sector of Papua New Guinea (PNG) which contributes to food security and livelihoods of people especially in the rural areas, where about 85% of the populace live. The main ruminant farm animals of PNG are cattle, goats and sheep in order of importance. According to Vincent and Low (2000), goat numbers in PNG were 17,000 (double that of sheep) as far back as 1992 with more than 90% are owned by smallholder farmers. Bourke and Harwood, (2009) further stated that meat goat numbers have increased steadily over the past 30 years despite little or no government encouragement and that there is a potential of milk production from goats.

One important problem of smallholder and subsistence goat production in PNG is poor nutrition of the animals which affects efficiency and productivity of the animals and profitability of the enterprise. Goat production especially on subsistence and smallholder farms in PNG depends mostly on natural pastures with little use of supplements and crop residues. However, natural pastures do not often provide

The Papua New Guinea University of Technology, Dept. of Agriculture, PMB, Lae, Papua New Guinea
llpauve@gmail.com

The Papua New Guinea University of Technology, Dept. of Agriculture, PMB, Lae, Papua New Guinea
dgariba@hotmail.com (corresponding author)

sufficient nutrients to meet the nutritional requirements of these animals. During the rainy season these pastures are lush green with high moisture but low dry matter content and mature rapidly; but in the dry season these pastures tend to have high fibre content and are often deficient in nitrogen, energy and vitamins (Leng, 1983; Bheekhee, 2010). Thus the availability or quantity and balance of nutrients in goat feeds is often poor and this leads to poor growth and long term negative effects on health, fertility and productivity. To improve production in such systems, the efficiency of utilization of the available feed resources can be optimized by using supplements such as urea-molasses-mineral blocks (UMMB), that can provide the deficient nutrients and stimulate activity of rumen microflora.

UMMB are licking blocks, specifically for ruminants, which can be formulated to contain urea, molasses, vitamins, minerals and other nutrients. Feeding of the blocks can be a convenient and affordable method of providing a range of nutrients which may be deficient in the basal diet of forages but required by both the rumen microbes and the animal. The blocks are convenient for packaging, storage, and transport and easy to feed to ruminants (FAO, 2004). The ingredients can be chosen to provide a wide range of nutrients to cover all potential deficiencies in an area or region. For example, in the wet tropical regions where minerals are often deficient in cut and carry grass or crop residue feeding systems (FAO, 2004). UMMB licks can improve the utilization of low quality roughages by satisfying the requirement of the rumen microorganisms for nitrogen (present in the urea as a non-protein nitrogen, NPN) and energy (present in the molasses), creating a better environment for the fermentation of fibrous material and increasing production of microbial protein and volatile fatty acids (Makkar, 2002; Singh and Singh, 2003 Misra, *et al.*, 2006; Bheekhee, 2010; Khanum *et al.*, 2010).

As mentioned previously, most subsistence and smallholder goat farmers in PNG feed their animals on natural pastures and no supplements are usually provided. Even though supplements such as UMMB can be used to improve nutrition, most small scale livestock farmers in PNG are probably not aware of it and do not use this technology on their farms to achieve greater productivity. Furthermore the use of local ingredients to formulate UMMB in the PNG context will help to secure goat production enterprises sustainably in the long term.

The objective of this study was therefore to evaluate the growth performance of goats which were fed UMMB on the station and on-farm in terms of live weight gains in PNG. On station trials usually provide nearly ideal conditions where many extraneous factors which could possibly influence results of trials can be controlled so that the effects of treatments could be better observed. On the other hand, on-farm trials have the advantage that the farmer is closely involved in the design and execution of the experiment therefore, the farmer's views and conditions are accommodated in the trial. This makes it easier for the farmer to better understand the problem being tackled and the solution being proposed thereby facilitating adoption, if the results prove to be positive. However one important disadvantage of on-farm trials is that certain factors which could affect the results are often more difficult to control compared to an on-station trial. It is hoped that this study will contribute to understanding how UMMB technology can be used to the benefit of commercial smallholder and subsistence goat farmers in PNG.

MATERIALS AND METHOD

Site of experiments

Two trials were conducted, one on-station and the other on-farm using two types of UMMB at both sites. The on-station trial was conducted at the livestock research station of the National Agricultural Research Institute (NARI) at Labu, from April to July in 2013. Labu is located about 12 km from Lae city on the Wau-Bulolo road (Lat. 6° 40' 27" S, Long. 146°54' 33" E). The climate at Labu is typically warm and wet with an average temperature of 32°C. The main pasture species on the station were para grass (*Bachiaria mutica*) and koronivia grass (*Brachiaria humidicola*). Goats were usually allowed to graze the pastures from morning till afternoon after which they were returned to an open shed in the night. In addition to the pastures goats were also given cut forages of elephant grass (*Pennisetum purpureum*).

The on-farm trial was carried out at Leron farms from June to September in 2013. Leron farms is in the Markham valley (Lat. 6° 43'0.01", Long. 147°1'1.19"), approximately 70km from Lae city on the Highlands highway and the farm was under smallholder commer-

cial type of management. The climate at Leron is tropical humid with an average rainfall range of 162-426mm and average temperature of 28°C. The main pasture species on the farm were *Imperata cylindrica* and *Leucaena sp*. Goats usually graze the natural pastures and forages whenever the farmer allowed them out for grazing. No cut-and-carry forages were provided to goats.

Goats at both sites were fed on cultivated and natural pastures and there was no routine feeding of supplements.

Treatments and animals

There were two treatments and one control at each site. The first treatment (Treatment I) consisted of goats which were fed only the normal basal diet without UMMB. This basal diet consisted solely of natural pastures and forages which were grazed by goats at the trial site. The second treatment (Treatment II) consisted of goats which were fed a UMMB supplement containing 5% urea, in addition to the basal diet and the third treatment (Treatment III) consisted of goats which were fed UMMB supplement containing 10% urea. Each of the three treatments was replicated three times and each replicate consisted of one goat. Therefore nine goats were used at each site giving a total of 18 goats for both sites. All goats selected for this study were young wether male goats. The goats were nearly of the same age and were randomly allocated to the treatments. At the start of the trial, average age (wks) of goats on treatments I, II and III were 19.5 ± 0.5, 19.7 ± 0.5 and 19.6 ± 0.5 respectively at NARI Labu station and 16.3 ± 0.5, 17.0 ± 0.5 and 16.7 ± 0.5 respectively at Leron farm.

All goats were drenched with 5ml of Panacur 25 against internal parasites before the trial started. All goats at each site grazed on the pastures together during the day. However after about 4pm all goats were herded into the shed at the site and goats belonging to different treatments were kept in different pens overnight. Goats on treatments II and III were then provided with UMMB and they had free access to the UMMB lick overnight. The UMMB block was provided in a wooden container which al-

Table 1: Composition of experimental urea molasses mineral blocks (UMMB) for goats

Ingredient	Content (%) in Treatment II	Content (%) in Treatment III
Molasses	40	40
Quicklime	10	10
Salt (sodium chloride)	5	5
Soya bean meal (SBM)	10	10
Bone meal	5	5
Rice bran	25	20
Urea	5	10

Table 2: Proximate composition of UMMB

Nutrients	Ash %	Moisture %	DM %	CP %	CF %	Ca %	Fe mg/kg	Mg %	P %	Na %
Content in Treatment II	21.6	19.2	80.8	21.3	0.62	8.49	714	0.39	0.69	1.8
Content in Treatment III	21.6	20.3	79.7	35	3.23	4.97	472	0.33	0.59	2.39

Legend: DM = Dry Matter, CP = Crude Protein, CF = Crude Fat, Fe = Iron, Ca = Calcium Mg = Magnesium, P = Phosphorus, Na = Sodium

lowed free licking but prevented biting of the blocks by the animals. Water was freely available to all goats at all times during the trial.

UMMB composition and analysis

A standard UMMB lick block was prepared for feeding goats on treatments II and III at both trial sites. The proportions of ingredients which were used to prepare UMMB are shown in Table 1. UMMB used for treatments II and III differed only in their content of rice bran and urea.

Proximate analysis of UMMB was performed at the PNG University of Technology Analytical Services Laboratory (UASL) in Lae, Morobe Province according to the procedures of the Association of Official Analytical Chemists (AOAC, 1990). Results of the analyses are shown in Table 2. Treatment III UMMB had higher content of crude protein, crude fibre and sodium but lower amounts of calcium, iron, magnesium and potassium compared to treatment II UMMB.

Preparation of UMMB

To make the UMMB, all ingredients sufficient to make a 1kg UMMB were weighed using a scale balance. Next, urea was added to molasses in an iron pan and stirred with a wooden stick for several minutes to mix the two ingredients thoroughly. Then, in another container, quicklime was mixed with salt and similarly stirred thoroughly. The contents of the two containers were then mixed with each other and finally the rest of the ingredients (soya bean meal, bone meal and rice bran) were added one after the other to the mixture while stirring with a stick. The uniform semi-solid mixture produced was then poured into a rectangular wooden frame lined with a polythene sheet and pressed by hand for 20-30 seconds. The UMMB was left for 3 days to dry after which the wooden frame was carefully removed to leave a half-dried but intact UMMB on the polythene sheet. The UMMB was kept in a shed at room temperature for another 3 days to air-dry and also harden enough for handling, transporting and feeding to the goats.

Data collection and analysis

The trials at both sites were conducted for sixteen weeks after an adaptation period of 2 weeks. At Leron farm the farmer was given training on feeding of goats with UMMB, data recording and overall management of goats during the first two weeks adaptation period.

Figure 1. Weekly liveweight of experimental goats at NARI Labu

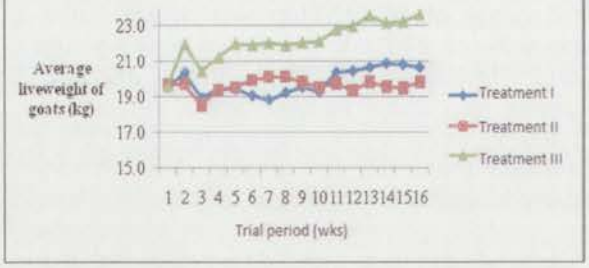

Figure 2. Weekly liveweight of experimental goats at Leron farm

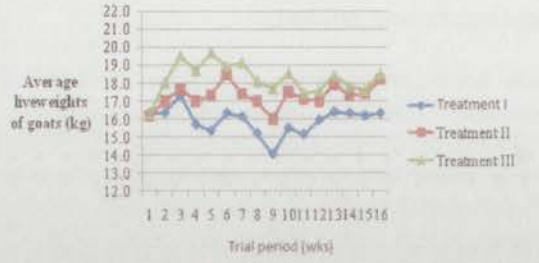

Table 3: Average weight gains (kg) of goats on different treatments.

Treatment	N	NARI Labu site	Leron farms site
Treatment I (control group)	3	0.90 ± 0.5^{a}	-0.2 ± 0.5^{a}
Treatment II (5% urea UMMB)	3	0.47 ± 0.5^{a}	2.1 ± 0.5^{b}
Treatment III (10% urea UMMB)	3	4.60 ± 0.5^{b}	2.2 ± 0.5^{b}
Note: Numbers with the same alphabet suffix within a column are not significantly different (P = 0.05			

The farmer's daily routines and activities continued as usual and UMMB was given as an additional supplement to goats on treatments II and III. A technical assistant was similarly trained to manage the experimental goats and collect data at NARI Labu. Furthermore the first author made weekly visits to both sites to monitor the trial, replenish stocks of UMMB, measure body weights and check on the general health and management of the animals. Weekly live weight of goats was measured at both sites. Weight gain of goats was calculated as the difference between live weight in the first and last weeks of the trial. Data on weight gains of the goats were subjected to single factor analysis of variance (ANOVA, Steele and Torrie, 1980). Where the results of ANOVA indicated significant difference among treatment means, then mean separation was carried out using the least significant difference test (LSD, P=0.05).

RESULTS AND DISCUSSION

Live weight changes of goats fed UMMB.

Trends in weekly live weight of the goats at NARI and Leron farm are shown in Figures 1 and 2 respectively and average live weight change of goats at both sites are shown in Table 2.The results shown in Figures 2 and 3 and Table 3 suggest that goats fed on UMMB supplement containing 10% urea gained significantly more weight than goats fed on natural pastures alone throughout the trial period at both sites. Results of the on-station trial at NARI Labu show that goats on treatment II (UMMB containing 5% urea) had statistically similar weight changes as goats on pastures alone (Treatment I). On the contrary, however, goats fed on UMMB supplement containing 5% urea gained significantly more weight than goats fed on natural pastures alone during the on-farm trial at Leron farm where the nutritional challenge to goats was more severe. Pastures on the farm were mostly *Imperata cylindrica* which is, nutritionally, a low quality grass with low digestibility and high lignification (Holmes *et al.*, 1980) compared with pasture species on-station. During the trial period pastures on the farm were mature and partially dry but goats on the farm were not given additional cut and carry forages as was done during the on-station trial at NARI. As mentioned earlier, the usual practice of most small scale goat farmers in PNG is that they do not offer additional forages to their animals apart from the pastures. It is therefore not surprising that goats on pastures alone (Treatment I) on the farm actually lost weight during the trial period (see Table 2) and that UMMB supplement containing 5% urea made a significant impact on weight gain of goats. Poor performance of goats which are fed fibrous feeds without supplementation is often attributed to low efficiency of utilization of the feeds due to low contents of nitrogen, energy, minerals, vitamins and other characteristics that restrict intake and digestibility such as high crude fiber and lignin content (Smith, 2002).

The relatively better weight gains of goats which were fed with UMMB containing 10% urea in this study, is in agreement with the findings of Saddul *et al* (1999), Makkar, (2002); Singh and Singh, (2003); Misra, *et al.*, (2006); and Khanum *et al.*, (2010) all of whom found that UMMB supplementation of ruminants improved weight gain as well as feed intake and body condition. Better performance of ruminants supplemented with UMMB, especially when quality of fodder is poor is often attributed to a more balanced supply of nutrients to the animals. UMMB provides other nutrients that are low in natural pastures and forages such as fermentable nitrogen, energy and minerals that are necessary for optimum microbial growth in the rumen. Under poor pasture conditions UMMB provides the much needed nitrogen in the form of NPN, fermentable carbohydrate in the form of molasses as well as certain minerals and an optimum pH in the rumen which allows cellulolytic bacteria in the rumen to flourish and increase rate of passage of digesta through the rumen. This may lead to goats eating more forages and increasing their live weights accordingly (Costello, 2005; Tiwari *et al*, 2008).

Farmer's perception

The participating farmer at Leron farm reported that goats consumed more forages when supplemented with UMMB and maintained good health. The farmer readily accepted the practice of using UMMB supplementation and is willing to continue in future, if these were available in the local market. The farmer further observed that the benefits of UMMB feeding were not visible immediately. It took at least two to three weeks and regular licking of the UMMB by the goats for the effects of UMMB to be observed visually. For effective utilization of UMMB, it is essential that UMMB must be placed in a location that is accessible to the animals so that they could easily lick the blocks as and when necessary. Under smallholder condition, however, this was not easy to achieve because of many reasons including goat shed design and management practices. In this study, goats were kept in separate pens in the shed in a limited area where they had access to the blocks.

CONCLUSION

The results of this study strongly suggests that UMMB containing 10% urea could make a significant impact on the live weight gains and therefore productivity, of goats on smallholder farms in PNG where pastures and forages are unimproved and usually of poor nutritional value. The UMMB could be fed to goats during dry seasons when good quality forages are mostly unavailable and during critical periods like just before the mating period, during late pregnancy and during the lactation period to increase fertility, milk production and kid survival.

ACKNOWLEDGEMENTS

The authors wish to express their sincere appreciations to the Department of Agriculture, PNG University of Technology for providing facilities to undertake the research project; to the staff and management of NARI livestock research centre Labu and to the management of Leron farms for dedicating staff, facilities and other resources to this study. The financial assistance from the University of Technology through its Graduate Assistants Program (GAP) is also duly acknowledged.

REFERENCES

Association of Official Analytical Chemists (AOAC), (1990). *Official methods of analysis.* 15th edition, Arlington. 1289p

Bheekhee H, (2010). *Urea molasses multinutrient blocks (UMMB) as a feed supplement for ruminants.* AMAS, Agricultural Research Council, Reduit, Mauritius, pp251-253. Retrieved July 29, 2013 from http://www.gov.mu/portal/sites/ncb/moa/farc/amas99/p2.pdf

Bourke R M and Harwood T, (2009). *Food and Agriculture in Papua New Guinea.* The Australian National University, Canberra, Australia.

Costello R, (2005). *Bloat in young calves and other pre-ruminant livestock.* Merrick's Tech Information. Merrick's. www.merrircks.com retrieved on July 27, 2013.

Food and Agriculture Organization of the United Nations,(FAO), (2004), Papua New Guinea Country Report. *State of the animal genetic resources.* Ministry of Agriculture and Livestock, Port Moresby, Papua New Guinea.

Holmes J H G, Lemerle C and Schottler J H, (1980). *Imperata cylindrica for cattle production in Papua New Guinea. Biotrop workshop on Alang-Alang (Imperata cylindrica),* Indonesia, Bogor, July, 1980. ACIAR Proceedings No. 86: 123-127.

S.A. Khanum, M. Hussain, H. N. Hussain and M. Ishaq (2010) Impact of urea-molasses multi-nutrient block supplementation on livestock production in Pakistan. *In*: FAO. 2011. *Successes and failures with animal nutrition practices and technologies in developing countries.* Proceedings of the FAO Electronic Conference, 1-30 September 2010, Rome, Italy. Edited by Harinder P.S. Makkar. FAO Animal Production and Health Proceedings. No. 11. Rome, Italy p25-28

Leng R A, (1983). T*he potential of solidification molasses-based blocks for the correction of multi-nutritional deficiencies in buffaloes and other ruminants fed low-quality agro-industrial by-products*, Vienna, Austria, p.135-150.

Makkar, H.P.S. (2002). Efficient utilization of crop residues and enhanced animal productivity through feeding of urea molasses multinutrient blocks: Experiences of some Asian, African and Latin American countries. Paper presented at NDDB, Anand, India November 19–20.

Misra, A.K., Reddy, G.S. & Ramakrishna, Y.S. (2006). Participatory on-farm evaluation of urea molasses mineral blocks as a supplement to crossbred cows for dry season feeding in rain-fed agro-eco system of India. *Livestock Res. Rural Develop.*,18(2): *Article #24* (available at http:// www.lrrd.org/lrrd18/2/misr18024.htm).

Saddul D, Seenevassen Pillay M M, Ramnauth R K, Fakim R, Lam Sheung Yuen R, Saraye G, Toolsee P and Boodoo A A, (1999). *Evaluation of the smallholder goat production system in Mauritius.* Annual Meeting of Agricultural Scientists, 1999.

Singh, P.R. & Singh, M. (2003). Effect of UMMB supplementation on milk production in buffaloes and cows: an on farm trial. *Indian J. Anim. Nutr.*, 20 (10): 1–5.

Smith R. (2002). *Improving meat goat nutrition, forages and supplementation, Ruminant Nutrition.* D:\02 rumnut proceedings & pdf\Improving Meat Goat Nutrition with forages and supplementation.PDF. pp 11-20

Steel R G D and J H Torrie, (1980). *Principles and Procedures of Statistics: A Biometrical Approach.* 2nd edn. McGraw-Hill Book Company, New York.

Tiwari S P, Kumari K, Mishra U K, Gendley M K and Gupta R, 2008. *Effect of substituting concentrate mixture by Urea Molasses Mineral Block on protozoal production rates in Murrah buffalo calves.* Livestock Research for Development 20 (11): 20-28.

ncent, D. and Low, S. (2000). *A Review of Papua New Guinea's Red Meat Industry.* ACIAR Monograph No. 66. Australian Centre for International