Acta Scientiarum

http://periodicos.uem.br/ojs/acta
ISSN on-line: 1807-8672
Doi: 10.4025/actascianimsci.v41i1.47441

Multinutritional blocks as a food strategy to optimize the use of concentrate for lactating goats

João Paulo de Farias Ramos[1*], Wandrick Hauss de Sousa[1], Iara Tamires Rodrigues Cavalcante[2], Juliana Silva Oliveira[2], Edson Mauro Santos[2], Edgard Cavalcante Pimenta Filho[2], Fabianna Fortuna de Freitas[1] and Ricardo Miranda Leite[1]

[1]Empresa Estadual de Pesquisa Agropecuária da Paraíba S.A., Rodovia Ministro Abelardo Juremo, PB 008, Km 7, Jacarapé III, 58047-000, João Pessoa, Paraíba, Brazil. [2]Departamento de Zootecnia, Universidade Federal da Paraíba, Areia, Paraiba, Brazil. *Author for correspondence. E-mail: joaopaulodeframosjp@gmail.com

ABSTRACT. The objective of this study was to evaluate the use of multinutritional blocks (BMs) associated with the concentrate content in the diet of lactating goats and their effects on milk production and economic viability. Eight goats Parda Alpina, multiparas were distributed in two Latin squares (4x4). The experiment consisted of four treatments (0.971, 0.746, 0.521 and 0.296 kg concentrate day^{-1} per goat) and BMs ad libitum. It was evaluated the consumption, milk monitoring and the system was analyzed economically. If there was a significant effect of the concentrate, the control treatment was compared to the others using the Dunnett test and 5% regression analysis. When the concentrate contents were high in the diets, the total dry matter intake decreased linearly. However, there was an inverse behavior for the consumption of BMs. Milk production (PL kg day^{-1}) was linear and positively related to the increase of concentrate levels in the diets. The PL was lower for the decreasing levels of concentrate when compared to the control diet. The economic parameters indicate that the use of low concentrate levels associated with BMs is the best feeding strategy for lactating goats. The multinutritional blocks can be used to feed lactating goats to partially replace the concentrate.

Keywords: Feeding plans; milk composition; profitability.

Received on April 11, 2019.
Accepted on May 6, 2019.

Introduction

The milk is one of the most important foods in human diet and it is an important source of nutritive components, as proteins, fat, carbohydrates, minerals, calcium and vitamins, as amino acids and fatty acids. Similar to cow milk, the goat milk has been considered as high quality food. Many factors have been related as affecting the milk production and its composition, as the race, lactation period, management, the environment where the system is implanted and mainly the feeding (Leira, Botelho, Barreto, Botelho, & Pessoa, 2018). About its production in Brazilian semiarid, the feeding basis of goats is conditioned to the production and conservation of forage cactus, which, by been conditioned to weather variation, suffer an oscillation in the offer of forage cactus along the year, which causes a decrease in productive levels of the goats in function of the lack of food. Beyond the quantity of forage cactus, the quality oscillates during the year, which makes it even more difficult the definition of feeding plans.

The providing of multi-nutrient blocks (MBs) is a good strategy for satisfy all the essential nutrients required by the lactating goats for ideal milk producing. MBs are feeding supplement rich in nitrogen, energy and minerals (Hernández, Carreón, Villarreal, Garcia, & Camacho, 2014). The main advantage of MBs usage with lactating animals is, according Kebede, Guteta, and Dereje (2018) and Grewal et al. (2016), increasing in milk producing in cows, higher levels of fat and milk protein, which is associated to higher usage of cellulolytic fibers of ruminal microbial in presence of urea ammonia provided by MB.

However, there are blankets of information about the usage of MBs in feeding of lactating goats in Brazil, mainly about the effects of substitute the conventional concentrate for MBs and their effects over the productive development. It was aimed to evaluate the using of concentrate levels associated to MBs in diets of lactating goats and their effects about the milking performance and economic viability.

Material and methods

The experiment was made in 2015, from April 20 to June 30, in Experimental Station Pendência of State Agricultural Research Company of Paraíba (EMEPA), located in Meso-region of Paraiban Agreste, Soledade city (7º 8' 18" S and 36º 27' 2" W). They were used eight goats of the genus Parda Alpina, multiparous, with 42 months old, weighing around 43,13±2,03 kg of average living weight with 30 days lactating, distributed in two latin squares (4 x 4), according to milk production. The experiment was approved by Ethical Committee of Animals usage – CEUA-CBiotec of Federal University of Paraíba (UFPB), with protocol: CEUA Nº 01/2016.

The experiment had 60 days length, composed by 4 periods of 15 days, which the 10 first days of each period were used for adaptation of the animals to experimental diets and the 5 left days used to data collecting, quantification of the milk production and milk samples collecting.

The animals were treated against endoparasites and vaccinated against clostridiums, following they stood stored in individual bays of 3 m², with cement floor, provided with feeders, drinking water and trough, for MB providing, forage, concentrated and water *ad libitum*.

The experiment was a control diet formulated according to National Research Council (NRC, 2007), to attend the requirements of lactating goats with production of 3 kg goat day^{-1}, live weight of 45 kg and 3.5% of milk fat and contained concentrated (0.971 kg day^{-1}), forage cactus and Tifton-85 grass. The other diets were composed by three decreasing levels of concentrated (0.746; 0.521 and 0.296 kg goat day^{-1}) and MBs *ad libitum* for all treatments.

The concentrated were provided individually, in two portions, after morning and afternoon milking. The forage cactus *Nopalea cochenillifera* Salm-Dyck and the Tifton grass were provided in enough quantity to allow lefts of 10%. Everyday morning the lefts were taken from the feeder and discarded, being provided new food. The chemical-bromatological of the concentrated, palm forage, Tifton-85 grass and multi-nutrient blocks are described in Table 1 and the proportions and chemical composition used are in Table 2.

The MBs were made in the State Agricultural Research Company of Paraíba (EMEPA), using the following ingredients: 27% of molasses, 7% of livestock urea, 23% of corn bran, 20% of soy bran, 7,8% of common salt, 3% premix, 8.2% of hydrated lime, 3.22% of limestone and 0,78% of ammonia sulfate. The ingredients of blocks, after being weighted in digital balance, they were mixed in a mixer, put in a hydraulic press of 6 tons for 1 to 2 minutes, following they were taken from the press and kept in room temperature for 72 hours before the consumption.

The data for DM consumption were obtained through the difference of the offered food and of the lefts (concentrated, forage and MBs) and the consumption of MBs was quantified the provided and individual left each 5 days of MBs.

The milk control was realized day by day through the individual weighting of the milk, during the last five days of each period, the milking were manual, made twice a day (7h00min and 15h00min). At 11th, 13th and 15th days of experimental period it was realized the milk collecting for physic-chemical analysis. After milk weighting at the morning, it was stored in refrigerated environment being in following mixed with the milk of the afternoon milking, previously weighted, composing a sample of composed goat day^{-1}, respecting the proportion of the milk produced by turn: morning 60% and afternoon 40%, being collected a total of 200 ml (120 ml and 80 ml, respectively). At the end of each day it was taken a sample of the milk and stored in a Becker, mixing them with a glass stick, where were realized twice to avoid mistakes, obtaining more reliability of the results. After, it was analyzed the chemical composition using an electronic milk analyzer machine MASTER MINIR®, where they were measured the parameters of fat percentage, non-fat solids, protein, lactose, water level, temperature, freezing point and solids.

To convert the milk production to 3,5% of fat, it was used the formula suggested by National Research Council (NRC, 2001):

$$\text{LCG } 3{,}5\% = (0{,}425 \text{ x kg of milk}) + [16{,}425 \text{ x } (\%\text{fat}/100) \text{ x kg of milk}].$$

The correction of the milk to total solids was realized according Tyrrell and Reid (1965) using the equation:

$$\text{LCST} = (12.3 \text{ x g of fat}) + (6.56 \text{ x g of non} - \text{fat solids}) - (0.0752 \text{ x kg of milk}).$$

Table 1. Chemical composition of the ingredients of experimental diet and multinutrient blocks in dry-matter based (g).

	Ingredients				
	Tifton grass	Forage cactus	Soy bran	Corn bran	MBs
DM	886.6	110.7	857.2	857.7	657.4
OM	934.2	881.9	939.3	981.7	675.7
MM	65.8	118.1	60.7	18.3	324.3
CP	99.7	45.7	510.0	85.5	364.8
EE	28.4	16.5	22.6	51.8	13.6
FND	737.3	213.3	185.5	109.2	139.3
TC	806.1	819.7	406.7	844.4	297.3
NFC	68.8	606.4	221.2	735.2	158.0

DM= dry matter (% of natural matter); OM= organic matter; PB= crude protein; EE ether extract; MM=mineral matter; FND= fiber in neutral detergent; TC= total carbohydrates; NFC= non-fiber carbohydrates. MBs= multi-nutrient blocks.

Table 2. Feed proportions and chemical composition of base diet (control).

Proportions of ingredients (g kg^{-1})	
Tifton Grass	278.2
Forage cactus	328.3
Corn Bran	228.0
Soy Meal	155.0
Urea	2.70
[2] Mineral Premix	7.80
Chemical composition (g kg^{-1})	
[1]DM	621.9
OM	918.9
CP	149.0
EE	28.6
Ash	70.7
FND	328.8
TC	748.9
NFC	422.9
TND	627.0

[1]DM= dry matter (% of natural matter); OM= organic matter; CP= crude protein; EE ether extract; Ash=mineral matter; FND= fiber in neutral detergent; TC= total carbohydrates; NFC= non-fiber carbohydrates. MBs= multinutrient blocks; TDN= total digestible nutrients. [2] Mineral Premix (nutrient kg^{-1} de supplement): vitamin A 135.000,00 U.I.; vitamin D3 68.000,00 U.I.; vitamin E 450,00 U.I.; calcium 240 g; phosphor 71 g; potassium 28,2 g; sulfur 20 g; magnesium 20 g; copper 400 mg; cobalt 30 mg; chrome 10 mg; iron 2500 mg; iodine 40 mg; manganese 1350 mg; selenium 15 mg; zinc 1700 mg; maximum fluorine 710 mg; solubility of phosphor (P) in citric acid at 2% (min.).

The procedures of milking and management of the milk followed recommendations of the Technical Rules of Producing, Identity and Quality of Goat Milk.

The feed efficiency was obtained dividing the milk production corrected to 3,5% of fat (kg day^{-1}) for the consumption of dry matter verified during the period of collecting.

For statistical analysis it was considered the effects of the consumption of nutrient, production of milk and chemical composition of the milk in function of the levels of concentrated associated to MBs for lactating goats.

The economic analysis was based in the determination of the cost for feeding and it was not counted with the implantation spend and cultural treats of Tifton grass and forage cactus. The labor cost was counted from the temporary acquisition of an employee for the 60 days of confinement, based in the value of effective minimum salary (R$ 788.00), being the value of R$ 4.48 $hour^{-1}$, considering an average work journey of 1,5 hour man day^{-1} for milking, rooting and cleaning of the installations. The economic analysis of the treatments was based in the calculate of gross margin (GM), in which the gross revenue (GR) was generated from the selling of produced milk (corrected to 3,5% of fat), while the effective operational cost (EOC) comprehended those referent to feeding, labor and vermifuge. The prices were obtained with consult to buyers and providers of Paraiban Cariri region practiced in March, 2015. It was considered the selling price of milk of R$ 1.80 $liter^{-1}$. The costs of feeding were obtained multiplying the unitary value of each input by the consumed quantity in each treatment, being presented the average values per animal, referent to 20 days (five days of collecting x four periods). To evaluate the economic analysis it was determined the gross margin (GM), the return tax (RT), leveling point (LP) and safe margin (SM), adapted from Hoffmann, Engler, Serrano, Thame, and Neves (1987), considering EOC and GR as total cost and total return, in which:

GM = gross revenue (GR) – effective operational cost (EOC);

Return Tax = GM / EOC;

Leveling Point = EOC / milk price;

Safe Margin = (GR – EOC) / GR x 100.

They were evaluated the effects of the concentrate levels associated to MBs over the quantitative and qualitative variables of lactating goats. When identified a significant effect of concentrated levels, it was compared the control treatment (971 g day^{-1}) with the others, using the Dunnet test and the regression analysis at 5% of probability. It was used the PROC GLM of SAS version 9.3 (Statistical Analysis System [SAS], 2002) and it was adopted the significance level of 5% in all analyses.

Results and discussion

The averages referred to dry matter consumption (DMC), MBs and nutrients consumption can be found in Table 3. The consumption of DM and MBs affected by concentrated levels in diets when compared with the control treatment by Dunnet test ($p < 0.05$).

In the present study, the MBs consumption by the animals was affected, indicating a trying of substitution effect. The linear reduction of the consumption of total DM of the diet with decreasing levels of concentrated and the addition in feeding of MBs result in an increasing in the consumption (36, 40 and 60%) of MBs when compared the levels with control diet, respectively. The MBs consumption provided an increasing in total DM of (4.10; 6.70; 7.60 and 12.80%), as levels of concentrated were decreasing, respectively (Table 3). Kawas, Andrade-Montemayor, and Lu (2010) recommended that the adequate consumption of MBs is important for obtaining the expected results with the supplementation, because if the consumption is less than the expectation, the usage of low quality forage cactus will not be maximized and then the answer to the animal performance will not present the expected levels.

Cordão et al. (2014) evaluating feeding strategies for lambs in Brazilian Semiarid, found average value for DM consumption through MBs of 48.71 g day^{-1}, a value considered under the limit indicated by Kawas et al. (2010), who recommend MBs consumption of 60 to 125g to sheep and goats in general. They can be verified in the present study higher values of consumption (0.090; 0.141; 0.150 and 0.226 g day^{-1} MBs) in function of the partial substitution levels of the concentrated by MBs (Table 3). It is possible due to the kind of essay and to the size of the animal. In this present study, the animals were goats of median size and in confinement.

The milk production (MP kg day^{-1}) increased linearly with increasing levels of concentrated in diets ($Y = 2.5013 + 0.0005x$ r^2= 0.90). The MP was lower 6.66%; 6.96% and 12.40% to the decreasing levels of concentrated, when compared with control diet 39.35 (Table 4).

It was not observed difference ($p > 0.05$) for milk production corrected for 3.5% of fat (MPFC), Total solids (MPTSC) and feeding efficiency (FE) in relation to control diet (Table 4).

According to Costa, Queiroga, and Pereira (2009), the milk production has strong correlation with the consumption of DM, while the level of fat in milk, considered the component most influenced by the nutrition, is correlated with the ruminal correlation of acetate. The same authors relate that the increasing of the concentrated in diet causes more production of propionate, more production of lactic acid, reduction in ruminal PH and low production of acetate in rumen. The decreasing of PH may lead to the decreasing of cellulolytic bacterial activity, affecting the digestibility of the fiber.

Then, the higher level of concentrated incremented only 6,6; 6,9 and 12,4% in total milk production, respectively (Table 4). The data of the present studies show that the higher level of concentrated presented more milk production (3,016 kg day^{-1}) in relation to other levels. These results corroborate to Molina-Alcaide et al. (2010) who evaluated substitution levels of concentrated for MBs for lactating goats. They were tested three diets (A = 400g of concentrated; B = 200g of concentrated + 180g de MBs; C = 200g of concentrated + 180g of MBs), in which they were found results for milk production of A = 1.255; B = 0.973 and C = 1.029 L day^{-1}). The authors concluded that the decreasing of milk productivity with diet C might be tolerated when considered the quality of the milk healthily obtained with this diet in comparison to diets A and B.

Table 3. Average values of DM and MBs, regression equations, variation coefficient and determination coefficient in function of concentrated levels associated to MBs for lactating goats.

	Concentrated (g day goat^{-1})						
Variables	971	746	521	296	CV, %	RE	R^2
DMC (g day^{-1})							
CVC $^{vol.+conc.}$	2.191	2.090	1.954*	1.765*	4.73	$\hat{Y}$ = 1.6019 + 0.0006x	0.95
MBsC	0.090	0.141	0.150	0.226*	30.31	$\hat{Y}$ = 0.2692 – 0.0002x	0.92
DMC ^{total}	2.281	2.232	2.105	1.991*	6.10	$\hat{Y}$ = 1.8718 + 0.0004x	0.95
DMC $^{(\% PC)}$	5.110	5.022	4.666	4.526*	7.96	$\hat{Y}$ = 4.2375 + 0.0009x	0.90
DMC$^{(PV\ 0.75)}$	132.0	129.3	120.8	117.0*	7.30	$\hat{Y}$ = 109.70 + 0.0238x	0.94

*Average significantly differs from witness by Dunnett test ($p < 0.05$) VC = variation coefficient; DMC = dry matter consumption; RE = regression equation; R^2 = determination coefficients; CVC = feed consumption forage plus concentrated; MBsC = multi-nutrient blocks consumption.

Table 4. Regression equations of milk production, variation coefficients and determination coefficient in function of concentrated levels associated to multi-nutrient blocks for lactating goats

	Concentrated (g day goat^{-1})						
Variable	971	746	521	296	VC(%)	RE	R^2
MP(kg day^{-1})	3.016	2.815*	2.806*	2.642*	3.45	$\hat{Y}$ = 2.5013 + 0.0005x	0.90
MPFC$^{3.5\%}$	2.836	2.736	2.721	2.626	7.20	$\hat{Y}$ = 2.730ns	
MPTSC(kg day^{-1})	2.570	2.496	2.479	2.363	7.63	$\hat{Y}$ = 2.477ns	
FE$^{kg\ (MP/DMC)}$	1.243	1.225	1.292	1.318	7.20	$\hat{Y}$ = 1.292ns	

*The averages significant differ from control by Dunnett test ($p < 0.05$); VC = variation coefficient; RE = regression equation; R^2 = determination coefficient and ns = non-significant; MP = milk production; MPFC3.5% = milk production corrected for 3.5% of fat; MPTSC = milk production total solids corrected; FE = Feeding efficiency.

The absence of statistical differences for milk production corrected for 3,5% of fat, total solids production and feeding efficiency in function of the levels of concentrated is possible due to the capacity of consumption of MBs associated to low levels of concentrated in maintenance these characteristics similar. Then, these results emphasize the relevance of MBs which contain protein, energy and minerals, becoming an appropriate way for increase the nutrients contribution, stimulating the microbial activity in rumen for digest fibrous food.

Gabriel, Fajemisin, and Onyekachi (2018) related the positive effects of MBs in production of goats. The authors affirmed that the ruminal organisms need dietetic protein or non-protein nitrogen, the urea may be used as exclusive source, for being converted in ammonia in rumen and posteriorly be used in microbial protein synthesis. For it becomes possible, it is necessary the presence of a source of fast fermentation carbohydrate, as cereal grains, molasses or byproducts from agroindustry, ingredients which compose the MBs. This process, beyond increasing the contribution of nutrients for goats, turns it possible to microorganisms inside rumen have more capacity of fiber digestion, increasing then the consumption of dry matter which will reverberate in a better performance.

Mejía Haro, Delgado Hernández, Mejía Haro, Guajardo Hernández, and Valencia Posadas (2011) affirmed that MBs are a way to complement the feeding of goats, nurturing their ruminal ecosystem, with the objective of gain higher weight, increase the milk production and turn better the productive and reproductive performances of the animals.

The levels of concentrate in diets did not provided changes in percentages of fat, non-fat solids (NFS), total solids (TS), protein, lactose, minerals and milk pH ($p < 0.05$) when compared to control diet. However, when it was analyzed the production of theses constituents of milk (kg day^{-1}) there was significant difference ($p < 0.05$) for protein, lactose, NFS, TS and minerals to the animals which received decreasing levels of concentrated in diets in relation to those which received the control diet (Table 5).

The values of fat levels, NFS, protein and lactose obtained in this experiment are among the values 2.9; 8.2; 2.8 and 4.3% recommended by current legislation in Brazil for goat milk.

Possibly, the increasing of MBs consumption (0.150 and 0.226 g day^{-1}) for the lower levels of concentrated had been enough to stimulate the microbial activity in rumen, providing an adequate relation in production of fatty acids (acetate:propionate) attending the exigency of energy and proteins of ruminal microorganisms, do not arousing negative effects in milk quality.

Table 5. Average values of physic-chemical composition, production and milk constituents in function of the levels of concentrated associated to multinutrient blocks for lactating goats.

	Concentrated (g day goats^{-1})						
Variables	971	746	521	296	VC(%)	RE	R^2
Fat (%)	3.10	3.32	3.32	3.46	10.10	$\hat{Y}$ = 3.30ns	
NFS (%)	8.25	8.43	8.40	8.30	3.23	$\hat{Y}$ = 8.34ns	
TS (%)	11.35	11.75	11.72	11.76	4.76	$\hat{Y}$ = 11.64ns	
Protein (%)	3.24	3.12	3.07	3.05	8.75	$\hat{Y}$ = 3.12ns	
Lactose (%)	4.52	4.63	4.61	4.55	3.37	$\hat{Y}$ = 4.58ns	
Minerals (%)	0.66	0.67	0.66	0.65	3.74	$\hat{Y}$ = 0.66ns	
pH	6.59	6.60	6.59	6.60	0.66	$\hat{Y}$ = 6.59ns	
Production of milk constituents (g day^{-1})							
Fat	94.5	93.6	92.9	91.4	11.41	$\hat{Y}$ = 90.102 + 0.0046x	0.85
Protein	98.3	87.8*	86.6*	80.6*	8.66	$\hat{Y}$ = 72.788 + 0.0024x	0.91
Lactose	136.8	130.4	129.5	120.1*	4.90	$\hat{Y}$ = 114.93 + 0.0227x	0.91
NFS	249.2	237.1	235.7	219.0*	4.91	$\hat{Y}$ = 209.46 + 0.0408x	0.91
TS	343.7	330.8	328.7	310.5*	6.29	$\hat{Y}$ = 299.87 + 0.0451x	0.92
Minerals	19.8	18.8	18.0*	17.2*	4.47	$\hat{Y}$ = 16.098 + 0.0038x	0.93

*The averages significant differ from the control by Dunnett test ($p < 0.05$); VC = variation coefficient; RE = regression equation; R^2 = determination coefficients and ns = non-significant; TS = total solids; NFS = non-fat solids.

The animals which received diets containing higher levels of concentrated produced linearly more elevated levels of fat, protein, lactose, NFS, TS and minerals in relation to those which received lower levels of the concentrated in diet. It may be explained due the energy destined to milk production have been higher in higher level of the concentrated and in decrease of the increasing in DM consumption (Table 3), what resulted in a bigger milk production and, consequently, a bigger production of milk constituents.

The industrial yield is an indicator of the profits of the processor and determinates the economic viability of the activity. The production of fat and total solids of the present study is desirable in dairy products industry, because provide an increase in products yield. They were not observed significant effects for these two variables, what probably occurred due the higher consumption of MBs by the animals fed with low levels of concentrated (Table 5).

The daily quantities of protein produced in milk increased according to the level of concentrated in ration. The increasing of the daily quantity of protein in milk is related to the increasing of the milk producing and the concentration of protein on milk. These results may be attributed to the increasing in protein ingestion, provided by the rations with higher levels of supplementation, and the higher concentrations of non-fiber carbohydrates, due the higher consumption of DM, which result in bigger ruminal synthesis of microbial bacteria, supplying from 40 to 80% of the demand of protein in mammary glandule (Stelzer, Lana, & Campos, 2009).

The usage of high levels of concentrated in the lactating animal diet reduces the level of milk fat in function of a change in ruminal fermentation (Branco et al., 2011). The ruminal substrate with the biggest proportion of concentrated provides a bigger production of volatile fatty acids which reduce the rumen pH to less than 6.0, causing a smaller degradation of the fibrous portion of the diet. A smaller digestion of fiber reduces the production of propionic acid. As acetic acid is one of the main precursors of the milk fat, its reduction is directly related to the decreasing of the milk fat (Silva & Antunes, 2018). Ngwa et al. (2009) evaluated two levels of concentrated in diets of Alpine goats, 40 or 60%, and they did not verify differences in the production of milk and fat level.

Although it was not evidenced the effect of treatments in milk composition, when considering them separately, it may be supposed that the diets which contain low levels of supplementation associated to MBs resulted in industrial and economic benefits, once the quantity produced of fat, protein, lactose and total solids were satisfactory. The levels of fat and total solids are important not only to the milk which is commercialized in liquid form, for affecting the nutritional value for volume unity, but also for the milk destined to other forms of processing (Table 5).

In Table 6, there are presented the costs of production, revenue and economic indicators of goat milk in function of the levels of the concentrated in diet associated to MBs.

The value of effective operational cost (EOC), which presents how much resources are being deflected to covering expenses, presented higher value to diet (971 g day^{-1} of concentrated), proving the importance of the participation of the feeding cost (78.12%) for this diet, being the diet which presented the highest cost of production of kg of milk per day (R$ 1.07). However, it is verified lower EOC for diets with lower level of concentrated in its composition, with increasing of 7.41; 15.76 and 19.86% of EOC, in that they are increased the levels of concentrated in diets, respectively (Table 6).

According to the values referent to gross income (GI) presented in Table 6, the diet with higher level of concentrated (971 g^{-1}) implanted more value in monetary coin, which represents a difference upper 3.53; 4.06 and 7.39% in relation to diets with levels of decreasing concentrated, respectively, explained by the increasing milk producing. Although the diet with higher level of concentrated had obtained high value to GI, it is important to highlight that the effective operational cost (EOC) was also the higher R$ 121.20 (Table 6), evidencing that the MBs associated to low levels of concentrated may be used as alternative sources of protein, energy and minerals in diet of lactating goats, reducing the expenses with alimentation.

In this way, the participation of MBs associated to low levels of the concentrated in diets has become a better economic option related to diets with high levels of the concentrated, in function of the reducing of the expenses with concentrated in feeding, low cost of nutrients through MBs and consequent increasing in gain margins. The results of the present study with the usage of MBs associated to low levels of concentrated for milk production were satisfactory (positive), evidencing that in the conditions which was realized the research the activity has conditions to survive in short term.

Still in Table 6, the gross margin (GM), variable which allows to know if the establishment survives in short term, that is, if it pays the direct expenses and if it presented positive EOC for all experimental diets? However, the low levels of concentrated (521 and 296 g^{-1}) in diets presented superior values (8.76 and 9.70%) for GM in relation to control diet, respectively. These results of GM also reflected in return tax (RT). According it was reduced the levels of concentrated in diet, it was provided more RT. For each Real (R$ 1.00) applied it got R$ 0.69; R$ 0.71; R$ 0.87 and R$ 0.95 of return, respectively. It demonstrates that these supplementation levels are economically more interesting for an investor, generating revenue of 26 and 37% for month, superior when compared to high levels of concentrated.

Table 6. Economic analysis of lactating goatsfed with levels of concentrated in diet associated to multinutrient blocks.

	Concentrated (g day goat^{-1})			
Item	971	746	521	296
Revenue (R$)				
Milk production (kg day^{-1})	22.692	21.889	21.770	21.014
Experimental Period	5	5	5	5
Total production (kg)	113.5	109.4	108.9	105.1
Price (kg)	1.80	1.80	1.80	1.80
Total Revenue (R$)	204.2	197	195.9	189.1
Costs (R$)				
Consumption DM (Block+Concentrated) kg	87.64	83.64	78.18	70.6
Price (Block + Concentrated) kg	1.08	1.02	0.95	0.87
Cost (Volumous + Concentrated)	94.65	85.31	74.27	61.42
MBs of Consumption in DM (kg)	0.721	1.131	1.207	1.809
Price of MBs (kg in DM)	1.69	1.69	1.69	1.69
Total Cost of MBs	6.094	9.555	10.2	15.29
Cost with Food (R$)	100.7	94.86	84.47	76.71
Cost of Labor (R$)	17.91	17.91	17.91	17.91
Cost of Medicine (R$)	2.5	2.5	2.5	2.5
Effective Operational Cost (R$)	121.2	115.3	104.9	97.12
Activity Cost per kg (R$)	1.07	1.05	0.96	0.92
Costs Participation (%)				
Volumous + Concentrated	78.12	74.01	70.82	63.25
MBs	5.03	8.29	9.72	15.74
Labor	14.78	15.54	17.08	18.44
Medicine	2.06	2.17	2.38	2.57
Economic Indicators				
Gross Revenue (R$ day^{-1})	204.2	197	195.9	189.1
Gross Margin (R$ L^{-1})	83.07	81.73	91.05	92.00
Return Tax (R$)	0.69	0.71	0.87	0.95
Leveling Point (kg day^{-1})	67.31	64.04	58.27	53.95
Safe Margin (%)	40.67	41.48	46.47	48.64
Cost: benefit (R$ day^{-1})	1.69	1.71	1.87	1.95

The leveling point (LP), which demonstrated the minimal productivity per animal for have no loss, it is observed that in proportion that they were reduced the levels of concentrated on diet, the animals might present less productivity of milk (kg day^{-1}) (4.85; 13.43 and 19.84%) for the activity. Then, when they are used high levels of concentrated, the animals have to present a higher productivity for becoming profitable.

About the safety margin (SM), which represents how much the selling might fall without the enterprise have losses, it is observed that there was linear increase in that the levels of concentrated were decreasing. It means that the market price for the kg of milk may devalue until R$ 0.73; R$ 0.74; R$ 0.83 and R$ 0.87 for diets may continue to reach profits, in function of the levels of concentrated (971; 946, 521 and 296 g day^{-1}), respectively (Table 6).

It is observed that the relation cost-benefit linearly increased according it was been reduced the levels of concentrated in diets. Proportionally, with the decreasing of the levels of concentrated in diets, it resulted in superior cost-benefit relations (1.18; 10.65 and 15.38%) in relation to the control diet.

Experiences from several countries indicate that the supplementation with MBs resulted in substantial increase of productive, reproductive and economic performances of goats, bulls cows, in different systems of animal production (Lawania & Khadda, 2017; Patil, Verma, Singh, Das, & Gaur, 2017; Tekeba, Wurzinger, Baldinger, & Zollitsch, 2013; Tiwari, Shrestha, Mandal, & Panday, 2012). Ben Salem et al. (2010) relates that, according to economic analysis made in different researches, it has been established that the usage of multi-nutrient blocks presents economic revenue as in confinement as in pasture.

It is verified with presented results that all treatments allowed profits, at last in short term, seeking the several other factors related to the production system which are not considered in this research, but in function of the financial indicators. The usage of MBs associated to the level of 521 g day^{-1} of concentrated is the most viable alternative. Thus, the supplementation of goat milk can be substituted (53.65%) by MBs, because among the levels of concentrated in diet, it was the most interesting from the economic point of view and convincing productivity.

Although the parameters of production is favorable to higher level of concentrated, the profit per treatment was lesser to diets which contain high proportions of concentrated and still lesser to the diet with higher level of concentrated, fact that prove economic inefficiency of the application of only concentrated in diet of milking goats with these productions.

Conclusion

The multi-nutrient blocks may be used in feeding of lactating goats to partially substitute the concentrated with no harm over the production and quality of the goat milk.

The economic parameters indicate that the usage of levels 521 and 296 g day^{-1} of concentrated associated to multi-nutrient blocks are the best feeding strategy for lactating goats.

References

Ben Salem, H., Norman, H. C., Nefzaoui, A., Mayberry, D. E., Pearce, K. L., & Revell, D. K. (2010). Potential use of oldman saltbush (*Atriplex nummu*laria Lindl.) in sheep and goat feeding. *Small Ruminant Research, 91*(1), 13-28. doi: 10.1016/j.smallrumres.2009.10.017

Branco, R. H., Rodrigues, M. T., Silva, M. M. C., Rodrigues, C. A., Queiroz, A. C., & Araújo, F. L. (2011). Desempenho de cabras em lactação alimentadas com dietas com diferentes níveis de fibra oriundas de forragem com maturidade avançada. *Revista Brasileira de Zootecnia, 40*(5), 1061-1071. doi: 10.1590/S1516-35982011000500018

Cordão, M. A., Cezar, M. F., Cunha, M. G., Sousa, W. H., Pereira Filho, J. M., Lins, B. S., ... Nóbrega, G. H. (2014). Efeito da suplementação com Blocos Multinutricionais sobre o desempenho e características de carcaça de ovinos e caprinos na Caatinga. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia, 66*(6), 1762-1770. doi: 10.1590/1678-7169

Costa, R. G., Queiroga, R. C. R. E., & Pereira, R. A. G. (2009). Influence of feed on the production on quality of goat milk. *Revista Brasileira de Zootecnia, 38*, 307-321. doi: 10.1590/S1516-35982009001300031

Gabriel, O. S., Fajemisin, A. N., & Onyekachi, D. E. (2018). Nutrients digestibility, nitrogen balance and blood profile of West African Dwarf (Wad) goats fed cassava peels with urea-molasses multi-nutrient block (UMMB) supplements. *Asian Research Journal of Agriculture, 9*(4), 1-11. doi: 10.9734/ARJA/2018/33770

Grewal, R. S., Lamba, J. S., Ahuja, C. S., Chhabra, S., Kaur, S., & Kaur, J. (2016). Effect of free choice salt and mineral licks supplementation on milk production and blood biochemical parameters in crossbred cows. *Journal of Animal Research, 6*(5), 915-919. doi: 10.5958/2277-940X.2016.00119.4

Hernández, J., Carreón, L., Villarreal, O. A., Garcia, F., & Camacho, J. C. (2014). Elaboration and costs multi-nutritional blocs with goatee leaves (Pithecellobium acatlense) consumed by goats in the Mixteca Poblana, Mexico. *Agricultural Sciences, 5*(2), 165-169. doi: 10.4236/as.2014.52020

Hoffmann, R., Engler, J. J. C., Serrano, O., Thame, A. C. M., & Neves, E. M. (1987). *Administração da empresa agrícola*. São Paulo, SP: Editora Pioneira.

Kawas, J. R., Andrade-Montemayor, H., & Lu, C. D. (2010). Strategic nutrient supplementation of free-ranging goats. *Small Ruminant Research, 89*(2–3), 234-243. doi: 10.1016/j.smallrumres.2009.12.050

Kebede, G., Guteta, A., & Dereje, F. (2018). Characterization of dairy farms, farmers' training and on-farm evaluation of urea-treated straw and urea-molasses-block (UMB) feeding on performances of lactating crossbred cows in Ada District of East Shoa Zone, Ethiopia. *World Journal of Agricultural Sciences, 14*(3), 81-88. doi: 10.5829/idosi.wjas.2018.81.88

Lawania, P., & Khadda, B. S. (2017). Efficacy of urea molasses minerals block on milk production and reproductive performance of Zebu cattle under field condition. *Journal Krishi Vigyan, 6*(1), 83-87. doi: 10.5958/2349-4433.2017.00056.3

Leira, M. H., Botelho, H. A., Barreto, B. B., Botelho, J. H. V., & Pessoa, G. O. (2018). Fatores que alteram a produção e a qualidade do leite: Revisão. *PUBVET, 12*(5), 1-13. doi: 10.22256/pubvet.v12n5a85.1-13

Mejía Haro, J., Delgado Hernández, J. L., Mejía Haro, I., Guajardo Hernández, I., & Valencia Posadas, M. (2011). Efectos de la suplementación con bloques multinutricionales a base de nopal fermentado sobre la ganancia de peso de ovinos en crecimiento. *Acta Universitaria, 21*(1), 11-16. doi: 10.15174/au.2011.46

Molina-Alcaide, E., Morales-García, E. Y., Martín-García, A. I., Ben Salem, H., Nefzaoui, A., & Sanz-Sampelayo, M. R. (2010). Effects of partial replacement of concentrate with feed blocks on nutrient utilization, microbial N flow, and milk yield and composition in goats. *Journal of Dairy Science, 93*(5), 2076-2087. doi: 10.3168/jds.2009-2628

Ngwa, A. T., Dawson, L. J., Puchala, R., Detweiler, G., Merkel, R. C., Wang, Z., ... Goetsch, A. L. (2009). Effects of stage of lactation and dietary forage level on body composition of Alpine dairy goats. *Journal of Dairy Science, 92*(7), 3374-3385. doi: 10.3168/jds.2009-2079

National Research Council [NRC]. (2001). *Nutrient Requirements of Dairy Cattle* (7th rev. ed.). Washington, DC: National Academy Press.

National Research Council [NRC]. (2007). *Nutrient requirements of small ruminants: sheep, goats, cervids, and new world camelids* (7th ed.). Washington, DC: National Academy Press.

Patil, A. K., Verma, A. K., Singh, P., Das, A., & Gaur, G. K. (2017). Effect of molasses based multinutrients and chromium supplementation on the haematological and blood biochemical profile in lactating murrah buffaloes. *Journal of Animal Research, 7*(2), 1-9. doi: 10.5958/2277-940X.2017.00061.4

Statistical Analysis System [SAS]. (2002). *SAS Software, Version 9.3*. Cary, NC: SAS Institute Inc.

Silva, J. C., & Antunes, R. C. (2018). Effect of type of milking and environment on the raw milk quality based on somatic cells count. *Ciência Animal Brasileira, 19*, 1-16. doi: 10.1590/1809-6891v19e-34635

Stelzer, F. S., Lana, R. P., & Campos, J. M. S. (2009). Desempenho de vacas leiteiras recebendo concentrado em diferentes níveis, associado ou não à própolis. *Revista Brasileira de Zootecnia, 38*(7), 1381-1389. doi: 10.1590/S1516-35982009000700030

Tekeba, E., Wurzinger, M., Baldinger, L., & Zollitsch, W. J. (2013). Effects of dietary supplementation with urea molasses multi-nutrient block on performance of mid lactating local Ethiopian and crossbred dairy cows. *Livestock Research for Rural Development, 25*(6), 1-10. doi: 10.17576/jsm-2018-4707-12

Tiwari, M. R., Shrestha, B. K., Mandal, P., & Panday, L. N. (2012). Growth Performance of Khari goats on supplementation of urea molasses mineral block (UMMB) in fodder based diets. *Nepal Journal of Science and Technology, 13*(2), 29-32. doi: 10.3126/njst.v13i2.7710

Tyrrell, H. F., & Reid, J. T. (1965). Prediction of the energy value of cow's milk. *Journal of Dairy Science, 48*(9), 1215-1223. doi: 10.3168/jds.S0022-0302(65)88430-2