Evaluation of peanut hay (*Arachis hypogaea*) with grass silage and a protein-energy supplement for fattening bulls with different starting live weights

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The use of peanut hay, sorghum silage and a protein-energy supplement (MUSS-LACTIOBIOL) was evaluated in a starting bull fattening diet. Sixty animals were employed divided in two groups: treatments A and B with average starting live weights of 334 and 361 kg ± 7 kg and stabulated for 113 and 93 d, respectively. Animals were slaughtered at 430 ± 7 kg live weight. Diets consisted of the MUSS-LACTIBIOL supplement supplied at a rate of 1.37 kg.d^{-1} per animal; 10.2 and 8.2 kg of sorghum silage and peanut hay, respectively in humid basis. They were adjusted in proportions (%) for both groups at: 11, 20 and 69 (dry basis) of the MUSS-LACTIBIOL supplement, sorghum silage and peanut hay, respectively. A simple classification design was employed with the previously mentioned treatments. A variance analysis was applied for the means of the productive indicators. Animals of lower initial LW gained more LW daily and at the end of the experiment those of higher initial LW consumed more DM, ME and CP and needed more of those nutrients for succeeding in gaining 1 kg LW. There was a direct negative relationship ($R^2 = 0.89$ $P < 0.001$) between the initial LW and daily gain. Data obtained demonstrated that with a supplement: fibrous feed relationship of 11:89 it is feasible gains close to 1 kg (0.976 and 0.829 kg.anim.d^{-1}) where the peanut hay contributed 69 % of the DM and the CP, and 67 % of the ME, though there is the possibility of generating technologies of meat production with agricultural fibrous waste products.

Key words: *peanut hay, sorghum silage, fattening, stabling, MUSS-LACTIBIOL*

Recently, Agastin *et al*. (2014) realized a meta-analysis in 108 publications with 116 experiments and 399 treatments regarding the effect provoked by the environment on the feeding, grasses and corrals. Results demonstrated that animals fed in corrals showed higher daily live weight gain, hot carcass yields and carcass fat contents that those fed grasses, although with lower muscle and bone percentage.

The majority of the studies carried out demonstrated the use of concentrates in the animals in corrals. This did not happen in this way in grazing animals. In these studies also stand out that animals fed grasses have potential for attaining the same performance as those in corrals when fed similar diets.

Meat production in Nicaragua, the same as in other countries of the Central America area, is developed by long cycles. It is mainly expressed by grass consumption by the animals and lacks of integral technologies allowing the use of local feeds of these tropical regions for meat production from yearlings.

The utilization of the fermentation processes is the most relevant way for the transformation of the by-products in adequate feeds (Elías and Herrera 2008) with the activation of the rumen (Elías 1983 and Ramírez *et al*. 2002). These supplements can be an economical solution for animal feeding, specifically in ruminants.

Peanut production in Nicaragua represents a total of 136.456 t of wastes. It is used as fuel, crude fiber forages, construction boards and production of cellulose or compost (MAGFOR 1997). However, the use of this fibrous resource in diets for stabled bulls could be an adequate source of structural carbohydrates that as legume fiber, will allow its high degradation in the rumen, if the ruminal microorganisms are adequately supplemented, according to Elías (1983) and Valenciaga and Chongo (2004).

Regarding the above mentioned it is necessary to take into account the appeal for attention of Krause *et al* (2013) on the complexity and diversity of the microorganism population in the rumen and the interactions produced between the bacteria species due to the diversity of nutrients in the feeds entering to the ruminal ecosystem and the presence of bacteria high ammonia-N producing. These authors also refer how can be used for improving the efficiency in the use of N in ruminants.

Other factors that also contribute to the success of the functional feeds are the great technological progress, among them the biotechnology (Elías and Herrera 2008) and the scientific research that provide evidence for the benefits of these feeds for health (Jones 2002). The probiotics are nutritional additives based on live microorganisms that improve the productivity and health of the animals. The Lactobacillus and yeasts can fulfill this purpose (Fuller 1996, Elías and Herrera 2008, Huiling Mao *et al*. 2013 and Vyas 2014).

The objective of this study was to evaluate in stabled bulls of different initial live weights the utilization of diets based on hay of peanut wastes with a protein-energy product called MUSS-LACTIBIOL, as future technology for its application in Nicaragua.

Materials and Methods

Sixty bulls of different Zebu crossings with

European meat breeds were used with predominance in the proportion of Zebu in the herd. Animals were individually weighed for their grouping in two treatments: A, with average initial live weight (LW) of 334 kg, from animals of 300 to 350 kg; B, with initial LW of 361 kg, from animals of 350 to 400 kg for evaluating what effects produce initial LW on the variables related to the nutrition and productivity of the animals during fattening.

Animals were stabulated in lots and a diet based on MUSS-LACTIBIOL supplement was supplied at a rate of 1.37 kg.d^{-1} per animal in humid basis: 10.2 and 8.2 kg of sorghum silage and peanut hay, respectively. Bulls were maintained stabulated for 113 and 93 d, respectively until attaining average live weights of 430 ± 7 kg for their marketing and slaughter in the abattoir. The diet was adjusted to the following proportion: 11, 20 and 69 % in dry basis of MUSS-LACTIBIOL supplement, sorghum silage and hay from the peanut harvest wastes, respectively.

For coarse feeds 10 % more were offered weekly in fresh way for not limiting their consumption, except for the activator whose supply was controlled. Animals were bathed, weighed and all parasites were removed since the first day of work. There was no adaptation period to the diets supplied and they were weighed at the end of the experiment. Consumption was weekly measured in each group for correcting feed supply. A simple classification design with two treatments was used and the analysis of variance was realized for the consumption means of each feed, live weight gain and ME intake, DM and protein. Correlations between all variables were determined. The conversion efficiency of the diet was estimated which was designed for a concentration of 9.63 ME/kg DM and 126 g CP/kg DM^{-1}.

The equation of Hart (1971, cited by Elías 1983) was used for determining the metabolizable energy (ME) concentration of each coarse feed. CP and DM of all feeds were established according to AOAC (1995). The Infostat program, Version 2001, was used for the statistical processing.

MUSS-LACTIBIOL is a product biologically active of the MEBA line (Elías and Herrera 2008), that contains a high population of yeasts and lactobacilli and their metabolites. It functions as probiotic, capable of producing appreciable amounts of organic acids of short carbonated chain; also it contains the nutritive requirements for the development of the rumen microorganisms and for a better use of the fiber.

Results and Discussion

In table 1 is shown that there was a difference of 27 kg in the initial LW of the animals and of 15 kg at the end of the experiment, in favor of animals of higher initial LW. ADG was higher in 126 g, in the animals of lower initial LW. Although there was higher DM consumption and the rest of the components of the diet in the animals of higher initial LW, the differences obtained regarding those of lower LW was of little importance, since by expressing consumption in relation to kg.LW^{-1} was constant at a rate of 25 g DM; 238 KJ ME and 3.3 g CP, for both treatments, regardless that the animals grew in the time. Clearly that this will be reflected in daily LW gain (figure 1) through the direct negative relationship ($R^2 = 0.89$ $P < 0.001$) obtained on increasing the initial LW: at higher weight, lower ADG. Thus, the need of finding the adequate LW for fattening must be evaluated with diets of poor energy concentration.

On realizing the calculations for obtaining the conversions, the need of 93.63 MJ. kg DM^{-1} of ME, 1228 g CP.kg DM^{-1} and 9.72 kg DM was demonstrated for animals with lower initial LW. While animals of higher initial LW will require 113.69 MJ .kg DM^{-1}, 1492 g CP.kg DM^{-1} and 11.83 kg DM, with differences of 20.06 MJ; 264 g CP and 2.11 kg DM in favor of the animals with higher LW, which means worsening in the utilization efficiency of these nutrients.

According to NRC (1984) the efficiency in the ME utilization is directly related to the decrease in the participation of fibrous feed in the diet: for greater forage-concentrate (F-C) relationship lower efficiency. If the MUSS-LACTIBIOL supplement is considered as a concentrate, the F:C relationship will be of 89:11, with ME concentration of 9.62 MJ. This will correspond, on comparing in the NRC tables of requirements for animals between 350 and 400 kg LW, a gain of 0.9 to 1.1 kg and CP requirements of 0.8 to 0.83 and ME of 86.94 to 93.63 MJ.

Animals with 334 kg of initial LW had an average weight of 368 kg during the whole experiment. ADG was 0.961 kg; ME consumption, 89.87 MJand that of CP, 1.180 kg. This demonstrates that with the exception of CP consumption, that was too much, the rest of the indicators were in the range reported by the NRC.

The CP excess was also reflected in the g CP consumed per MJ of ME relationship that in this study was 13, while the NRC recommends a 9 relationship.

Something similar to that previously analyzed will occur if data obtained from animals that started with higher LW are compared, but with more inefficiency. In this sense, it is necessary to highlight that the requirements recommended by the NRC are for diets with F:C (45-55: 55-45) relationships lower to those of this study.

In spite of the beneficial effect of the nitrogenous supplementation in cattle fed pastures or forages of poor quality (Elías 1977, Elías 1983, Delgado *et al.* 2002, Díaz and Padilla 2003, Ruiz *et al.* 2003 and Ramos 2005), LW gains obtained by these authors were below those of this experiment. Possibly this is due to the fact that the MUSS-LACTIBIOL supplied enough peptides and amino acids for fulfilling what was referred by Elías *et al*. (2006) who state that when animals in pastures or

Table 1. Comparison of the productive indicators and of consumption in the peanut diets supplemented with MUSS-LACTIBIOL

Indicators	Treatments (initial weight, kg)		SE ± Sign.
	A (334)	B (361)	7
Final weight, kg	423.0	438.0	2.27*
Accumulated live weight, kg	89.3	77.1	1.17*
Mean gain/d, kg	0.961	0.835	0.003*
Silage consumption in dry basis, kg	1.88	1.98	0.006*
Consumption of peanut hay in dry basis, kg	6.48	6.84	0.008*
Supplement consumption in dry basis, kg	1.01	1.07	0.004*
Total consumption in dry basis, kg	9.35	9.88	0.03*
Total CP consumption, g	1180.0	1246.0	4.91*
ME consumption, MJ	89.87	94.87	1.21*

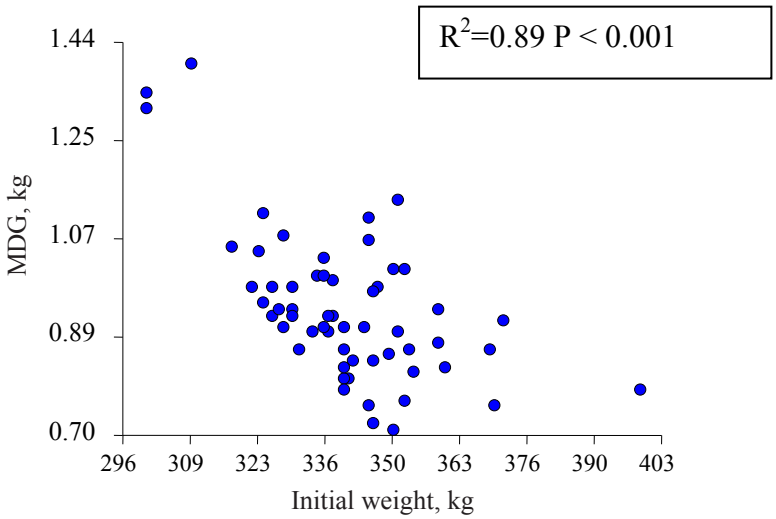

Figure 1. Relationship between initial LW and animal gain

forages, with CP concentration of 8 %, approximately, are not supplemented with sufficient degradable protein in rumen, the concentration of peptides and free amino acids, in this organ is zero and the concentration of volatile fatty acids lowers. Thus, following these authors the conversion of the apparent digestible energy is limited, affecting the energy conversion of these fibrous feeds. In addition, it is possible that together with the above mentioned, the MUSS-LACTIBIOL, also supplied the oligoelements, vitamins and other nutrients that, according to Elías (1983) stimulate ruminal cellulolysis and protein synthesis from NPN and, thus, voluntary intake, as reported by other authors (Ortiz 2000, Ramos 2005 and Krause *et al*. 2013). Furthermore, it is possible that yeasts contained in the MUSS-LACTIBIOL can also stimulate the celullolytic bacteria and fiber digestibility as previously reported by Kamra and Agarwal (2004), Hui-Lin *et al*. (2013 and Vyas *et al*. (2014).

Table 2 shows the indicators with better correlation between such parameters. Initial live weight had high correlation with the indicators of DM consumption of peanut hay and the MUSS-LACTIBIOL supplement. This indicates that at higher initial live weight there is an opposite correlation.

It is important to highlight that the peanut hay contributed 69 % of the DM and of the CP and 67 % of the ME while the MUSS-LACTIBIOL, 11 % of the DM, 21 % of the CP and 12 % of the ME. The rest of the nutrients were contributed by the sorghum silage.

According to Mac Loughlin (2010) the effects of the quality and protein content of the fattening diets of the animals in fibrous diets, when these do not cover the protein requirements can limit the productive capacity.

According to Ruiz *et al*. (2006) on using oat husks with the addition of urea and enzymatic complexes there are improvements in the rumen capacity to use this fiber. García and Kalscheur (2006) verified that some fermentable fibers as those of soy husks and beet pulp have effective characteristics, very similar to the peanut fiber used in this diet and modify the ruminal fermentation pattern. In this way increases the concentration of acetic acid and rumen contents is not acidified excessively.

Elías (1983) analyzed carefully the factors influencing

Table 2. Correlation between the indicators of the animal performance

	Initial weight	Final weight	ADG, kg	X kg LW	Peanut hay DB, kg	Protein supplement DB, kg	Total DB, kg	Total PB, g
Initial weight	1.0							
Final weight	0.6	1.0						
ADG, kg	-0.65	0.21	1.0					
MDG, kg LW^{-1}	0.92	0.87	-0.3	1.0				
Peanut hay (DB), kg	0.92	0.87	-0.3	1.0	1.0	1.0		
Protein suppl. (DB), kg	0.92	0.87	-0.3	1.0	1.0	1.0		
Total in DM, kg	0.92	0.87	-0.3	1.0	1.0	1.0	1.0	1.0
Total CP, g	0.92	0.87	-0.3	1.0	1.0	1.0	1.0	1.0
ME, MJ	0.92	0.87	-0.3	1.0	1.0	1.0	1.0	1.0
kg DM*kg LW^{-1}	0.77	-0.01	-0.95	0.48	0.48	0.48	0.48	0.48
ME*kg LW^{-1}	0.77	-0.01	-0.95	0.48	0.48	0.48	0.48	0.48
CP*kg LW^{-1}	0.77	-0.01	-0.95	0.48	0.48	0.48	0.48	0.48

on the dietetic fiber digestion and the ruminal celullolytic microorganisms. Sahlin (1999) indicated that the fermentation as a method for feed processing can improve considerably the production of organic acids and the development of the microbiota in the fermentation of grains and cereals. This leads to certain inclusion level for a response to the development of the ruminal microbial activity. Elías (2000 and 2004) indicated the effects of the energy sources in the ruminal microbial population and the final products of the fermentation, depending on the source of energy used which has been confirmed in the results of this study.

The above mentioned could be related to the attainment of a productive response close to one kg gain, obtained in this study from peanut hay supplemented with the MUSS-LACTIBIOL activator.

It can be emphasized that the energy contribution in this diet, based on the utilization of hay from peanut wastes, attains gains close to l kilogram. These results indicate the need, under these conditions, of increasing the energy concentration of the ration (Alende *et al*. 2007), that will allow increasing the gain in the animals of higher weight in its final stage. In addition, a gain rate of 1 kg or higher will be attained with little supplementation.

Results from this paper confirm that through the knowledge of the bovine meat production stages in the tropics, it is possible to structure a strategy for the utilization of local feeds. In this way technologies can be created that will allow high animal production with the use of traditional concentrates in a profitable and sustainable way.

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Received: January 20, 2014