Tania Sánchez, L. Lamela, R. Valdés, O. López
Evaluation of the productive indicators of Holstein cows in pedestals Pastos y Forrajes,
vol. 29, núm. 1, enero-marzo, 2006
Estación Experimental de Pastos y Forrajes "Indio Hatuey"
Cuba

Available in: http://www.redalyc.org/articulo.oa?id=269121697004
Evaluation of the productive indicators of Holstein cows in pedestals

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Abstract

With the objective of evaluating the productive indicators of Holstein cows grazing in an area of pedestal, an experiment was carried out for two years at the Genetic Firm of Matanzas. A multiplicative model was used to analyze the milk production with effect on the lactation curve; the variables analyzed were: year of production, season and number of lactations, and dry matter availability was measured. The dry matter supply per animal achieved in the pedestal area was higher than 33 and 25 kg/animal/day for the rainy and the dry season, respectively. Milk production per cow was 11.0 and 10.95 kg/cow/day for the first and second year, respectively, with significant differences (P<0.01). The highest milk productions were obtained in the rainy season with significant differences (P<0.01). The highest production was recorded in the third lactation (11.2 kg/cow/day), with significant differences (P<0.05). The inclusion of the pedestal was concluded to achieve dry matter supplies per animal of 33 and 25 kg DM/cow/day during the rainy and dry season, respectively, and a milk production of 11.0 and 10.9 kg/cow/day for the first and second year, respectively, the yield per hectare being 14 116 kg of milk.

Key words: Grasses, legumes, milk production

Introduction

The management and feeding systems have had remarkable influence on the productive results of dairy cattle in Cuba.

During the last years, in the animal production systems the presence of legumes have been given great importance, because of the contribution they make to the nutritive value of the diet and their capacity to fix the atmospheric nitrogen to the soil, which contributes to improve its fertility. For such reason, the systems based on the use of these species need further research, in order to reach accurate conclusions about this issue (Kristensen, Søegaard and Kristensen, 2005).

In the studies carried out by Ramírez-Restrepo and Barry (2005) an improve was found in the performance of the reproductive indicators in sheep, the increase of milk production in cows and the reduction of methane production, due to the inclusion of legumes in the diet.

For these reasons, there is a group of works that recommend the use of different alternatives of legumes for animal production in the tropics, among which stand out the associations in the whole area of grasses and legumes, the protein bank and the pedestals.

Pedestals are a technology based on the use of creeping legumes and improved grasses, which allows to obtain a high availability of green mass (legumes plus grasses) and stand a high stocking rate per area, in which supports are used to increase the yield per surface unit (Anon, 2001). The objective of this work was to evaluate the productive indicators of Holstein cows which grazed in an area of pedestals under commercial conditions.

Materials and Methods

Location of the dairy. The study was performed in a dairy belonging to the Genetic Firm of Matanzas, geographically located at 23° of latitude north and 80° 30’ of longitude west and 70 m above sea level, which is placed near Matanzas municipality, in Matanzas province. The soil on which the experimental work was carried out was classified as Brown with carbonates.
Characteristics of the climate. Mean annual temperature was 23°C, with means of 21 and 27°C in winter and summer, respectively. Mean annual rainfall was 1300 mm, with average of 1 000-1 200 mm in the rainy season and 200-400 mm in the dry season (Academia de Ciencias de Cuba, 1979).

Pastures and animals. A hectare was dedicated to sowing a pedestal of *Neonotonia wightii* plus King grass CT-115, with irrigation every 15 days, where 42 cows grazed during the two years of evaluation in the morning, and the rest of the time in the grassland of *C. nlemfuensis* (42 ha). The cows had a live weight of 450 kg, with average resting time of 31 and 60 days for the rainy season and the dry season, respectively.

Description of the dairy and its general management. A typical dairy was used, with building capacity for 120 cows and a total area of 43 ha. The dairy utilizes the Holstein genotype. The animals in the rainy season had access to the pedestals during four hours in the morning and in the afternoon they were in the area of improved grasses. In the dry season the access to the pedestal was four hours and they were fed king grass and sugarcane forage *ad libitum* the rest of the time. All the animals received a supplementation of 454 g of feed/cow/day as stimulus at the moment of milking.

Measurements performed

Dry matter availability. It was estimated by the alternative method proposed by Martínez, Milera, Remy, Yepes and Hernández (1990), which consists in determining the availability through the mean height of the grassland. The samplings were performed every month and 80 observations of that indicator were used per paddock.

Milk production. The monthly weighing of milk was done to 100% of the milking animals during two consecutive years, in order to determine the production per milking cow and the annual production. The effects season and year of production were taken into consideration.

Other indicators of milk production. They were calculated from the records of the dairy and the farm, considering for the calculation the production per hectare, the global stocking rate of the dairy and the duration of lactation.

Processing of the results. The milk production of the cows was processed through a multiplicative model with effect of lactation curve (Menchaca, 1978), which is based on its algebraic representation \( Y_n = a_n b_{-cn} \), according to Wood (1969), and for the analysis of the observations the statistical pack elaborated by the Institute of Animal Science was used.

For the milk production analysis the following model was used:

\[
Y_{ijklm} = a + b \log n + c_n + p_j + d_k + g_l + h_m + e_{ijklm}
\]

where:

- \( Y_{ijkl} = \log Y_{ijkl} \)
- \( a = \log A \), constant common to all the observations
- \( b \) and \( c_n \) = parameters of the lactation curve according to Wood’s algebraic representation (1969)
- \( n \) = n-eth day of lactation corresponding to the observation \( Y_{ijkl-eth} \)
- \( p = \log p_j \), effect of j-eth year
- \( d_k = \log d_k \), effect of k-eth lactation
- \( g_l = \log g_l \), effect of l-eth year
- \( h_m = \log h_m \), effect of m-eth season
- \( e_{ijklm} \) = experimental error

Results and Discussion

Table 1 shows the dry matter availability per animal and its performance per two-month period. The dry matter offer in the area of pedestal was higher than 33 kg/animal/day during the rainy season (MJ, JA, SO); however, in the dry season it was 25 kg DM/cow/day (JF, MA and ND).

(Table 1. Dry matter availability per animal per two-month period (kg/cow/day).)

The total dry matter offer during the experimental period was 45,16 and 59,27 kg/cow/day for the dry season and the rainy season, respectively, due to the inclusion of *C. nlemfuensis* in the diet of the animals (table 2).

(Table 2. Total dry matter offer during the experimental period (kg/cow/day).)

According to Milera (1992), with the increase of pasture offer there was a lineal response in milk production, except in *C. nlemfuensis*, because the minimum availability to obtain acceptable productions with this species is
15 kg DM/cow/day. Nevertheless, for the rest of the species studied the offer levels were within the optimum values to achieve that the milk production did not decrease.

A similar seasonal performance of the pastures was reported in Cuba by Sánchez, Lamela and López (2003) when studying the effect of season on the dry matter availability in a silvopastoral system, which showed the highest yield in the rainy season.

It is valid to point out that Cuba has a tropical climate characterized by rainy summers with high temperatures and dry winters with low temperatures. Rainfall is the main factor in the seasonal differentiation of the year, in which there are the rainy season (May-October) and the dry season (November-April) with 80 and 20 %, respectively, of annual rainfall (1 200-1 300 mm), although there are areas with 600 mm per year.

The average monthly temperature is over 21°C and does not exceed 28°C. The mean temperature of the coldest month (February) is 22.1°C, while in the warmest months (July and August) it is 27.6°C. For such reason, in the rainy season occur the highest number of favorable factors for pasture growth, such as high temperatures and rainfall, independently from the system used. On the other hand, figure 1 shows milk production during the two years of the experimental period; the highest production was achieved in the first year of evaluation, which differed significantly (P<0,01) from the second year.

(Fig. 1. Annual milk production during the experimental period.)

Such performance is due, mainly, to the fact that plants in this period show their greatest vigor, because there is a higher accumulation of reserves because of the plant rest since sowing until the beginning of defoliations, which has a positive influence on the productive yields of the cows in the first year of study; similar effect has been described in the literature (Gerardo and Thompson, 1985).

The productive results were lower than the ones reported by Verdecia, Falcó and González (2002) in an area of pedestals, where 14 kg of milk were obtained as average during the ten-month evaluation. It is necessary to state that the system had leucaena, glycine and mulberry, in addition to the grass. In turn, they are lower than those reported by Jordán and Elías (2002) when evaluating the effect of three types of concentrate on the milk production of high potential Holstein cows in three commercial dairies (in all the cases it was higher than 20 kg/cow/day).

These units, in order to achieve such productive results, used from 60 to 70 cows as average, improved pastures, irrigation and nitrogen fertilization at a rate of 200-250 kg per hectare a year and supplementation with concentrates from the fourth liter, conditions very different from this system, which was an association of grasses plus glycine, with low supplementation with concentrate to stimulate the animals at the moment of milking and productions of 11,05 and 10,95 kg/milking cow/day during the two years of the experimental period were obtained.

On the other hand, they are similar to the results obtained in Cuba with glycine, when it was evaluated for milk production in protein bank (9-11 kg/cow/day) with half-breed animals, a stocking rate of about 2 animals/ha and supplementation with concentrates (Milera, Iglesias, Remy, Reyes and Martinez, 1989).

Nevertheless, they are higher than in the case when improved grasses and low supplementation with concentrate are used. Hence the importance of the inclusion of legumes in the diet of ruminants. Similar conclusion was drawn by Nyambati, Sollenberger and Kunkle (2003), when studying the effect of supplementation with legumes in a basic diet of *Pennisetum purpureum* Schum cv. Bana, because the inclusion of legumes increased dry matter digestibility and daily milk production when compared to the system of *P. purpureum* without supplementation.

This shows that the productive response of animals depends, to a great extent, on the nutritive quality of the diet fed, on the genotype of the animals used and the specific conditions of the research.

(Fig. 2. Milk production per season.)

The figures achieved in milk production in the dry season (10 kg/cow/day) are higher than those obtained by Carrasco, García-López, Martínez, Enriquez and Fonte(1995)when studying a system with *P. purpureum* (CT-115), with 24 Holstein cows of 454 kg live weight with three parturitions as average and 135 days of lactation during the dry season.
This is because of the effect of the association of \textit{N. wightii} with king grass CT-115. The importance of legumes in ruminant nutrition is acknowledged; this family has high quality in terms of crude protein in comparison to tropical grasses, which contributes to increase the nutritional quality of the ration and to improve the productive results.

When studying the performance of milk production according to the number of lactations (fig. 3), a higher production was found in the third lactation, with significant differences when compared to the second lactation. Similar results were found by Ribas, Gutiérrez, Évora and García (1999) when evaluating the factors that affect such production in Siboney cows from Cuba; these authors observed an increase in the production from the first to the fifth lactation, after which this indicator began to decline.

According to Ribas and Pérez (1995), milk production increased in 12.8\% between the first and second lactation and in 16.7\% from the second, third or the other lactations; in general, the increase in milk production occurs mainly at the beginning of lactation.

The production obtained for the second and third lactation was 11.02 and 11.2 kg/cow/day, respectively, figures lower than those reported by Anon (2001) when exposing the productive results of the pedestal technology, which states an average yield per cow (500 kg live weight) of 14 kg/day per lactation.

When analyzing the production per surface unit, 14 000 kg were achieved in the hectare of pedestal, lower than the figure reported by Anon (2001) in a hectare of pedestal in Havana province (25 000 kg/ha/year). The differences in the results were due to the management used in this study, because the animals stayed part of the time out of the pedestal area; while in the other research they were kept in that area the whole day and were taken out only for the milking.

The average of lactation days was 150 days; it is worth to emphasize that the period of best productive results of the animals was utilized, the period in which they can express to the maximum their genetic potential for milk production if there are no limiting conditions (table 3).

According to the results, the dry matter offers achieved were 33 and 25 kg DM/cow/day during the rainy season and the milk production was 11.05 and 10.95 kg/cow/day for the first and second year, respectively, with a production per hectare of 14 116 kg.