Genetic and Environmental Factors Influencing the Production of Carora Dairy Cattle in North-West of Venezuela

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Abstract

Readings of rectal temperatures and milk production were taken in 1997 and 1998 on 1,484 cows of Carora breed and cross breed belonging to 9 farms in the North-West of Venezuela. 21,819 ambient temperature measurements were also carried out and used in the THI index. The average of the dairy production in the morning was 5.98±2.72 liters and 5.48±2.64 liters in the evening. The general average was 5.71±2.69 liters. The average rectal temperatures in the morning and in the evening were respectively 38.4±0.45°C and 38.8±2.64 °C with a total average of 38.6±0.49 °C. The production of milk is influenced significantly by the variables "milking", "number of lactations", "days of lactation", "days of gestation" and "type of farm". The hereditability is 0.077, which represents a value largely lower than that quoted in the literature.

Keywords: Bovine, hereditability, milk, rectal temperature, thermal stress

Introduction

High ambient temperature is one many factors which negatively influence the productivity of the domestic animals in tropical countries. It causes a rise in the internal temperature of animal, which disturbs its metabolism (Lefcourt and Schmidtmann, 1989). Temperatures higher than 25°C in cattle cause a reduction in appetite and milk production with deterioration of organoleptic qualities of the latter. (Gauthier *et al.* 1983). In the event of thermal stress, the physiological and reproduction parameters are also disturbed (Johnson, 1985). The goal of this study was to determine the factors, which influence dairy production of the Carora cows or crossed breeds under environmental conditions of North-West Venezuela.

Materials and Methods

Animals

One thousand four hundred and eighty-four (1,484) Carora cows and cross breeds originating from nine farms in the North-West of Venezuela were included in this study. The farm type is intensive or semi-intensive with variable technological level.

Data collection

21,819 measurements of temperature and relative humidity were taken during the 5 days preceding the day of milk sample collection and were incorporated in the climatologically index THI (Temperature Humidity Index) described by Berbigier (1988) and which presents a strong correlation with the rectal temperature. 4,160 measurements of the rectal temperature were carried out at the time of milking with an electronic thermometer Suzuken MC320. The milking took place the morning from 4 to 8 a.m. and, the evening, from 3 to 8 p.m. The study was carried out from January to April, and October at November 1997; and also in March, April, May, August and September of 1998. 1,951 rectal temperature readings were also measured during the morning and 2,209 readings during the evening milking.

Statistical Analysis

The command "xi: nbreg prod jlact i.ferm*nlact i.trait i_grav_trect trectale idjgravid, cluster (idanim) nolog" was used in the Stata software (StataCorp, 2001) to analyze the following model:

$$Yi = \mu + J + (F*L) + T + (G*R) + R + G + e_i$$

with μ general average, **J** effect of lactations days on the milk production, **F*L** interaction between the farms and the number of lactations, **T** effect of milking, **G*R** interaction between number of gestation days and rectal temperature, **R** effect of rectal temperature, **G** effect of the number of gestation days, and **e_i** is a vector of residuals. Taking into account its very strong colinearity with THI confirmed here, only the rectal temperature was used in the model.

For the estimation of the hereditability of the rectal temperature, the data of 1.164 cows whose parents were effectively recorded on the genealogical cards was used. The dairy productions were standardized by taking as reference the production of the cows of the farm n° 4, treats the morning, with the fourth lactation and 80th days of gestation. The following formula was then used: $h^2 = 4\sigma^2 / (\sigma^2_s + \sigma^2_{c/s} + \sigma^2_e)$

Results

Tables 1,2 and 3 show the principal observations of study.

Table 1: Distribution of the cows in function the average milk production, the rectal temperature and the number of lactations per farm

Farm	Number of cows	Variables (average)		
	N	Production (L)	T. Rectal (°C)	Number of lactations
1	214	6.15	38.17	3.31
2	1,410	5.13	38.73	3.01
3	66	8.12	38.25	2.30
4	95	8.35	38.34	2.83
5	127	7.38	39.00	1.65
6	94	7.48	38.20	1.94
7	2,035	5.73	38.61	2.77
8	69	3.88	38.42	2.88
9	50	6.82	38.21	2.44

Table 2: Milk production and rectal temperature for milking in the morning and in the evening

Milking	Variable	Observations	Average	S.D.	Min	Max
Morning	Production (L)	1951	5.98	2.72	0.1	16.5
	T. Rectal (°C)	1951	38.40	0.45	36.5	40.3
Evening	Production (L)	2209	5.48	2.64	0.1	16.0
	T. Rectal (°C)	2209	38.80	0.45	37.2	40.5

Table 3: Average, standard deviation, value minimum and maximum of the variables analyzed

Variables	Obs.	Average	S.D.	Min	Max
T° rectal (°C)	4,160	38.61	0.49	36.5	40.5
Production (L)	4,160	5.71	2.69	0.1	16.5
Number of Lactations	4,160	2.82	2.09	1	13
Days of Lactation (j)	4,160	213.51	147.96	4	700
Days of Gestation (j)	1,162	99.27	61.50	1	290

Discussion

Milk production was not influenced by the rectal temperature ($P > 0.1$). On the other hand, the variables "milking", "number of lactations", "days of lactation" and "days of gestation", showed a significant influence ($P < 0.05$), as well as the variable "farm". This could be explained by the strong heterogeneity of the sample.

The higher quantity of milk in the morning ($P < 0.05$) could be explained by the larger time interval of between the milking in the morning and that of the evening and by the fact that the rectal temperature of the animals decrease during the night. The presence of many animals with a rectal temperature higher than 39°C could be linked to the presence of other explanatory causes of the low performance of the cows like, for example, of the mastitis or of the parasitic and infectious diseases. A very hot environment nevertheless can suddenly favour temporary rises of temperature (E.Thys, personnel communication). The technological level of the farm (manual or mechanical milking, management of the pastures, veterinary care...) could also be a variability factor for productivity, which will have to be studied later on.

The value of the hereditability resulting from the analysis was 0.077, a value remarkably lower than that provided by the literature. The values of hereditability brought back by McKinnon *et al*. (1991), Morris *et al.* (1989) and Turner (1984) are respectively 0.19, 0.20 and 0.33. The

low value of the hereditability of the rectal temperature could indicate that this parameter is strongly related to the level of adaptation of the animals themselves, which is sufficient to be able to be regarded as a breed character (Pizzabiocca, 1999). It should also be stressed that the cows used for the sample belong to a breed absorbing other populations.

Acknowledgements

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