

Physical and Chemical Parameters of Raw Milk

Candy Dulcieri García de Ruiz*, E. Guzmán Torres**, Nelson Zaldívar Quintero**

* UPT José Félix Ribas, Territorial division

** Departament of Morphophysiology, University of Granma, Cuba

garciacandy0@gmail.com; nzaldivarq@udg.co.cu

ABSTRACT

The physical and chemical parameters of raw milk were evaluated on dairy farms from the municipality of Pedraza, Barinas State, Venezuela. Twenty dairy farms under similar conditions were distributed in two equal groups (A and B). Samples were drawn from the milk container after milking and were tested separately by ultrasound, using four replicas. The variables measured were acidity, density, fat, protein, and cryoscopy. A descriptive statistical analysis and a simple variance analysis (ANOVA) were performed. The parameter values for both groups matched the Covenin Standards; however, cryoscopy showed lower values in group B. Variance analysis indicated a significant difference ($P < 0.001$). Milk manipulation and delivery from farms to the plant may account for this difference. Moreover, the variation in acidity values owed to seasonal changes.

Key Words: *physical-chemical parameters, raw milk*

INTRODUCTION

One of the main indicators measured in dairy industry is commercial milk quality, directly dependant on the source (it must come from healthy animals, be handled hygienically, and be free of toxic residues). Therefore, raw milk control must be efficient in the farms (Soler, 1997; Street, 2003; Piñeros *et al.*, 2005).

In 2005, a bovine herd of 56 301 heads was studied in the Pedraza municipality by the State Unit from the Venezuelan Ministry of Agriculture and Land (UEMAT). The total production of raw milk and cheese in the area is 38 869 l and 952 919 kg, respectively. Pedraza municipality is the second largest milk producer in the state of Barinas, accounting for 19 % of all the state's output (Lugo *et al.*, 2006). Most of the milk is used by the industry to turn it into powdered and fluid milk; the rest is used for making cheese at the local dairy plant.

The milk from Pedraza that is sent to Pie del Monte dairy processing plant has low quality levels (acidity, density, cryoscopy, fat and protein values below COVENIN Standards). The impact affects the economy and the plant's sustainability, not to mention the end-consumer's health. Consequently, the aim of this research is to evaluate the physical and chemical parameters of raw milk in two groups of farms from Ciudad Bolivia District, municipality of Pedraza, State of Barinas, Venezuela. The study will comprise a direct milk sampling on the farms for later ultrasound analysis at the plant.

MATERIALS AND METHODS

A completely random design was set up in two groups of farms located in the district of Ciudad Bolivia, Municipality of Pedraza, State of Barinas, Venezuela. Milk samples were directly collected from the container for a period of four months.

The population included two milk collecting itineraries set up by the Pie del Monte dairy processing plant in Pedraza. One itinerary collects the milk from the San Antonio Area, district of Ciudad Bolivia; the other from the Parcelas de Tico-poro Area, in the same district. Ten out of the 35 farms (28.5 %) in each itinerary were selected as analysis units. Two groups (A and B) were set, the two with similar terms, as to the breed, feeding procedures, kind of milking, number of milking, age, lactation times and agro-climatic conditions. The total number of samples was 80, since sampling was performed on a monthly basis, between December 2011 and March 2012.

The area is located between 7° and 9° northern latitude, and 61° y 70° western longitude. The area has 27.6 °C and 73 % relative humidity, respectively. Yearly precipitation mean values are 1 726 mm, with maximum evaporation means of 249 mm (Lugo *et al.*, 2006). It corresponds to a tropical rainforest according to Holdridge (1978) and has 141 and 186 above sea level.

The milk samples were collected from every farm straight from the container, in air-tight plastic vessels, previously sterilized at 100 °C for

15 min and then wrapped in aluminum foil to prevent contamination. The samples were cooled for preservation and were analyzed 3 h later.

Ekomilk Total was used to analyze the milk by ultrasound, following the physical and chemical parameters for the Covenin standard 903-93 for raw milk. Each sample was analyzed separately, with four repetitions in each case. Repetition number 4 was used as the standard. The variables measured were density (g/l), fat (%), protein (%) and cryoscopy ($^{\circ}\text{H}$). Acidity (lactic acid percent) was achieved by titration according to the Covenin Standard 658-1997. Density was measured at farm level, using Quevenne's thermolactodensimeter, at 15 $^{\circ}\text{C}$, and Ekomilk.

Statistical Analysis

The variables were analyzed using SPSS statistics software, version 15.0. Statistical-descriptive analysis and simple variance analysis were performed. The evaluation factors for the variance analysis were group A and the months of the year.

RESULTS AND DISCUSSION

Table 1 shows the physical and chemical parameters for raw milk, according to the Covenin standard 903-93. Table 4 shows the average of the descriptive statistics for the four months in terms of physical and chemical parameters in the two groups of farms. The variance analysis is shown in table 5, using the groups and months as evaluation factors.

The monthly deviation values and the means are shown in tables 2 and 3 for each of the physical and chemical parameters studied (acidity, density, fat, protein and cryoscopy) in the two groups of farms (A and B).

The values shown in group A (table 2) are within the established ranges by the Covenin Standard 903-93. Regarding acidity, the values range between 15 and 17; a very significant result, considering it is an indicator of the quality of the milk processed at the plant. Density is within the established parameters, coinciding with Calderon *et al.* (2006), in Colombia. The other variables used in this group (fat, protein and cryoscopy) fall within the standard's requisites. Fat and protein are above the established parameters, an indicator of good milk composition (Ponce, 2000; Guevara *et al.*, 2010).

As to group B, acidity, density, fat and protein are within the Covenin Standard; however, cryos-

copy is way below the normal values (- 0.537; - 0.509), possibly due to the water left in the milk containers after they are washed.

These data are similar to reports by Vargas and Lopez de Alcaide (1986), in the State of Aragua; Paez *et al.*, (2002), in the States of Falcon and Yaracruz; Ponce (2000); FAO (2008); and FEPALE (2010).

Highly significant differences were observed in the variance analysis ($P < 0.001$), regarding density parameters, within the groups of farms evaluated, fat, protein, and cryoscopy. The acidity results were not significant for the groups, indicating that similar animal care and handling techniques in all instances, there are significant differences in milk handling during transportation. The months-of-study factor only showed significant differences ($P < 0.05$) for acidity, proving that the time of the year effects on the value.

CONCLUSIONS

The physical and chemical parameters evaluated on the farms, especially fat and protein, showed good milk composition expression.

Highly significant differences were observed during the variance analysis between the groups, maybe due to post handling and transportation from the farm to the plant. Furthermore, acidity was affected by the time of the year.

REFERENCES

- CALDERÓN, A.; GARCÍA, F.; MARTÍNEZ, GLORIA (2006). Indicadores de calidad de leches crudas en diferentes regiones de Colombia. *Revista MVZ*. Colombia: Universidad de Córdoba.
- COVENIN (1997) *Leche fluida. Determinación de la acidez titulable*. Norma COVENIN 658-1997. Caracas, Venezuela: Comisión Venezolana de Normas Industriales, Ministerio de Fomento.
- COVENIN (1993). *Leche cruda*. Norma COVENIN 903. Caracas, Venezuela: Comisión Venezolana de Normas Industriales, Ministerio de Fomento.
- FAO (2008). *Informe mundial del estado de la agricultura y el desarrollo rural*. Roma, Italia: FAO.
- FEPALE (2010). *Informe estadístico del decenio sobre la situación del comercio de lácteos en la Región*. Federación Panamericana de Lechería.
- GUEVARA, R.; LOYOLA, O.; SOTO, S.; BERTOT, J. A.; GUEVARA, G.; CURBELO, L. (2010). Efectos del período de ocurrencia de los partos, alrededor del inicio de la época lluviosa, sobre los indicadores de

- eficiencia: II Composición de la leche. *Rev. prod. anim.*, 22 (1).
- HOLDRIDGE, L. (1978). *Ecología basada en zonas de vida*. San José, Costa Rica: Instituto Interamericano de Ciencias Agrícolas (IICA).
- MARDONES, F. R. (1994). *Importancia de la leche y sus productos lácteos en la salud nutricional humana*. Memoria VI Congreso Panamericano de Lechería. Medellín, Colombia.
- LUGO, MARÍA; FLORIO, JAZMÍN; FUENMAYO, R. A.; PÉREZ, N. y SÁNCHEZ, E. C. (2006). *Caracterización forrajera en fincas doble propósito del municipio Pedraza, estado Barinas*. XIII Congreso Venezolano de Producción e Industria Animal, Universidad Rómulo Gallegos, San Juan de los Morros, Venezuela.
- PÁEZ, LUCY; LÓPEZ, NANCY; SALAS, KEYLA; SPALDILIERO, A. y VERDE O. (2002). Características físico-químicas de la leche cruda en las zonas de Aroa y Yaracal, Venezuela. *Científica*, 12.
- PIÑEROS, G.; TÉLLEZ, L. y CUBILLOS, A. (2005). *La calidad como factor de competitividad en la cadena láctea. Caso: Cuenca lechera del Alto Chicamocha (Boyacá)*. Colombia: Universidad Nacional de Colombia, Facultad de Medicina Veterinaria y de Zootecnia.
- PONCE, P. (2000). *Problemas relativos a la calidad de la leche para su consumo*. Artículo presentado en VII Congreso Panamericano de Lechería, 3-9 de marzo, La Habana, Cuba.
- SOLER, D. M. (1997). *Mecanismos endógenos para mantener la calidad de la leche: Sistema Lactoperoxidasa*. Extraído en marzo 2012, desde <http://www.censa.edu.cu/Default.aspx?PageContentID=153&tabid=92>.
- STREET, N. W. (2003). *Manejo adecuado de la leche*. Extraído en marzo 2012, desde http://www.science.oas.org/OEA_GTZ/LIBROS/LA_LECHE/le_html/cap3_leche.htm.
- TAVERNA, M. A. (2001) *Calidad de leche: diagnóstico y adaptación a los requerimientos industriales del mercado*. 24° Congreso Argentino de Producción Animal. Rafaela, Santa Fe, Argentina.
- UNIDAD ESTATAL DEL MINISTERIO DE AGRICULTURA Y TIERRA (2005). *Anuarios Estadísticos*. Barinas: Departamento de Estadística, UEMAT.
- VARGAS, T. y LÓPEZ de ALCAIDE, N. (1986). *Vigencia de los parámetros oficiales establecidos para el punto de congelación de la leche*. V Jornadas Nacionales Veterinarias Carlos Ruiz Martínez, Barquisimeto, Venezuela.

Recibido: 5-9-2012

Aceptado: 9-10-2012

Table 1. Physical and chemical requisites of raw milk

Values	Acidity	Density	Fat	Protein	Cryoscopy
Minimum	15	1.028* 1.026**	3.2	3.0	-0.555
Maximum	19	1.033* 1.031**			-0.540

* (15 °C); ** (20 °C)

Source: COVENIN Standard 903-93

Table 2. Monthly average values of the studied parameters in group A

Month	Acidity	Density	Fat	Protein	Cryoscopy
December	15.40 ± 0.84	1 031.53 ± 1.18	3.60 ± 0.55	3.50 ± 0.08	-0.543 ± 0.02
January	16.50 ± 1.08	1 031.88 ± 1.39	3.42 ± 0.37	3.51 ± 0.12	-0.547 ± 0.02
February	15.90 ± 0.88	1 031.56 ± 1.41	3.28 ± 0.46	3.47 ± 0.10	-0.541 ± 0.02
March	15.50 ± 0.53	1 031.50 ± 0.85	3.56 ± 0.45	3.49 ± 0.05	-0.542 ± 0.01

Table 3. Monthly average values of parameters studied the group B

Month	Acidity	Density	Fat	Protein	Cryscopy
December	15.20 ± 1.55	1 030.61 ± 1.18	4.21 ± 0.52	3.47 ± 0.11	-0.533 ± 0.17
January	15.9 ± 1.29	1 030.32 ± 1.03	3.93 ± 0.53	3.42 ± 0.08	-0.527 ± 0.13
February	15.50 ± 1.43	1 029.22 ± 2.39	3.85 ± 0.47	3.31 ± 0.21	-0.509 ± 0.04
March	15.20 ± 0.79	1 031.13 ± 1.30	3.63 ± 0.62	3.44 ± 0.09	-0.537 ± 0.02

Table 4. Descriptive Statistics of physical and chemical parameters studied in the four-month period

Descriptive Statistics	Acidity	Density	Fat	Protein	Cryoscopy
Means	15.83	1 031.62	3.46	3.49	-0.543
Typical deviation	0.93	1.19	0.46	0.09	0.017
Variance	0.87	1.42	0.21	0.01	0.000
Minimum	14.00	1 029.00	2.67	3.23	-0.576
Maximum	19.00	1 034.00	4.34	3.67	-0.499

Table 5. Variance analysis of the physical and chemical parameters studied in the farm groups

Evaluation factor	Acidity	Density	Fat	Protein	Cryoscopy
Groups (A y B)	0.138 NS	0.000***	0.000***	0.002**	0.001***
Months (December-March)	0.04*	0.28 NS	0.19 NS	0.07 NS	0.13 NS
Minimum values	14.0	29.0	2.67	3.23	-0.576
Maximum values	19.0	34.0	4.34	3.67	-0.499

NS: no significant; * (P < 0.05); ** (P < 0.01); *** (P < 0.001)