

Characterization of quality of raw milk and pasteurized commercialized informally in Colorado do Oeste City, RO, Brazil

Caracterização da qualidade do leite cru e pasteurizado comercializado informalmente na cidade de Colorado do Oeste, RO, Brasil

Edmar Costa Alves*

Aurélio Ferreira Borges

ABSTRACT

Milk quality can be characterized by physicochemical parameters indicating possible changes in the product properties. The poor quality of milk may affect human health and compromise the shelf life of the product. The objective of this study was to characterize the physicochemical quality of milk and to perform reductase testing of twenty four samples of raw milk and of twelve samples of pasteurized milk being informally commercialized in the city of Colorado do Oeste, RO. The density, the cryoscopic index, the fat (using the method of Gerber), the acidity (in Dornic degrees), and the defatted solids (SNG) (according to official methods) were evaluated according to the Normative Instruction 68. The results of cryoscopy and density, showed that 27% (n = 10) and 27% (n = 10) of the samples, respectively, do not comply with the IN-62 criteria. For the content of defatted solids, 19% of the samples were at odds with the legislation. The assessment of physicochemical parameters suggest that the informal trade of milk in the studied retail outlets can compromise the integrity of the product, a problem that might be solved by correcting and intensifying enforcement actions.

KEYWORDS: Point of Sale; Legislation; Physicochemical Analysis; Normative Instruction

RESUMO

A qualidade do leite pode ser caracterizada pelos parâmetros físico-químicos que indicam possíveis alterações nas propriedades do produto. A baixa qualidade do leite pode afetar a saúde humana e comprometer a vida útil do produto. O objetivo desse estudo foi caracterizar a qualidade físico-química em 24 amostras de leite cru e 12 amostras de leite pasteurizado comercializados informalmente na cidade de Colorado do Oeste, RO. Foram avaliados: densidade; índice crioscópico; gordura pelo método de Gerber; acidez em graus Dornic e sólidos desengordurados, de acordo com os métodos oficiais preconizados pela Instrução Normativa nº 68. Os resultados da crioscopia e da densidade, apontam 27% (n = 10) e 27% (n = 10) amostras, respectivamente, não conformes, segundo critérios da Instrução Normativa nº 62. Para o teor de sólidos desengordurados foi detectado 19% (n = 7) amostras em desacordo com os critérios da IN-62. A avaliação dos parâmetros físico-químicos sugere que o comércio informal de leite, nos pontos de venda estudados, compromete a integridade do produto, cujo problema poderia ser melhorado pela correção e intensificação de ações de fiscalização.

PALAVRAS-CHAVE: Ponto de Venda; Legislação; Análises Físico-Químicas; Instrução Normativa

Instituto Federal de Educação,
Ciência e Tecnologia de Rondônia
(IFRO), Colorado do Oeste, RO,
Brasil

* E-mail: edmar.meta@gmail.com

Received: Nov 13, 2015

Approved: Fev 22, 2016



INTRODUCTION

Milk, due to its richness in nutrients, is considered one of the richest and most complete foods, presenting fundamental nutritional values for the human diet, besides occupying a prominent position on the children and elderly feeding. Its physicochemical and microbiological composition is determinant to ensure the food safety and adequacy to the human consumption, according to Tronco¹.

One of the important aspects of food insecurity on the consumption of milk refers to the lack of treatments like pasteurization, making the sale of raw milk a probable vehicle of foodborne diseases and a carrier of pathogens, thus corroborating the researches of Dalzini et al.² that confirm that the transport of microorganisms by milk are related to foodborne diseases.

Silveira and Bertagnoli³ claim that consumers that unknow the basic principles about hygiene and milk quality may compromise their health when consuming raw milk. The obtainment, transport and trade of raw milk without inspection are prohibited in Brazil since 1980⁴. Nevertheless, researches by Montanhini and Hein⁵ and Sovinsk et al.⁶ indicate that this type of product is still informally commercialized. Consequently, there are frequent problems of public health that make necessary the submission of milk to thermal treatment in order to decrease the microbial load and to mainly eliminate pathogens. Bánkuti et al.⁷ claim that the informality may be understood as a process through which the milk and/or milky products are not submitted to the pasteurization process and/or are not inspected by the competent agency (service of sanitary inspection). By doing so, informality also involve evading taxes.

The technical regulation of production, identity and quality of milk (RTIQ) recommended by the Normative Instruction 62 (IN-62)⁸, instituted by the Ministry of Agriculture, establishes some physicochemical requirements of milk: fat of until 3.0 g/100 g; titratable acidity between 14.0 and 18.0 g/100mL of lactic acid/100 mL; relative density between 1,028 and 1,034 g/mL; cryoscopic index of -0.530°H in -0.550°H ; and at least 8.4 g/100 g of defatted solids.

Considering the great importance that milk has on the human feeding and the informal market of this product in Brazil, the present work was performed with the aim of investigating the

physicochemical quality of raw and pasteurized milk informally commercialized in the municipality of Colorado do Oeste, RO.

MATERIAL AND METHODS

To carry out this study, three points of sale located in the town of Colorado do Oeste, RO were randomly identified. Three samples on each point of sale were collected in the morning (from 07:30 am to 09:00 am) for four weeks: 24 samples (1.000 mL) of raw milk and 12 samples of pasteurized milk were finally obtained. Samples identified with the letters A, B and C were collected on-site in June 2014 according to the availability of outlets.

The outlet A, a business establishment, conditions milk in buckets, stores in freezers and sells the individual packages (plastic bags) with the amount required by the consumer. The outlet B, residential, sells pasteurized milk on plastic bags with individual capacity of one liter, manually closed, and stores in freezers. And the outlet C makes door-to-door sales, splits the product according to the consumer requirement and conditions on domestic household items.

The samples were collected in aseptic bottles conditioned in styrofoam boxes with ice, and were immediately transported to the laboratory of physicochemical analyses of the dairy industry located in the city of Colorado do Oeste.

Physicochemical analyses were performed according to the recommended official methods by the Normative Instruction n. 68 (IN-68)⁹. The physicochemical characteristics analyzed were: density by the use of lactodensimeter of Quevenne; cryoscopy index through the Digital ITR (model MK540); fat by the Gerber method; acidity by the method of Dornic; and, defatted solids (SNG) through the Ackermann disk. In order to evaluate and interpret results, IN-62⁸ was adopted as a reference.

RESULTS AND DISCUSSION

Table presents mean values and standard deviation of the physicochemical variables of the milk informally commercialized in Colorado do Oeste, RO. The results of the analyses obtained in the three outlets presented values according to IN-62⁸ (Table).

Table. Mean values, standard deviation and coefficient of variation of physicochemical parameters of 36 samples of milk informally commercialized in Colorado do Oeste, RO.

Physicochemical characteristics	Outlets			Standard deviation
	A Raw milk	B Pasteurized milk	C Raw milk	
Acidity ($^{\circ}\text{D}$) (g/100 mL)	16.000	15.000	17.000	1.300
Cryoscopic index ($^{\circ}\text{H}$)	-0.530	-0.534	-0.529	8.500
Density g/mL (15°C)	1.030	1.034	1.031	3.100
Fat (g/100g)	3.400	3.800	3.500	0.400
Defatted solids (g/100 g)	8.900	9.200	8.800	1.500

Source: Research data.



It is verified on Table that the standard deviation of the physico-chemical variables presented normal variability.

Besides the arithmetic means, an analysis using graphs and descriptive measures was made. In order to verify the data behavior, a box diagram was used to provide an idea of position, dispersion and asymmetry.

The results of cryoscopic index (Figure 1) pointed values at odds with the legislation⁸.

The cryoscopic index evaluates the freezing temperature of milk in relation to water. The acceptable range is between -0.530 and -0.545 °H. Mean values found on Table are in accordance with IN-62, but according to the Figure 1 the cryoscopy ranged from -0.510 and -0.543 °H, which corresponds to 27% ($n = 10$) of samples out of the maximum limit recommended by the legislation⁸.

The outlet C presented minimum value of -0.510 and maximum of -0.543 . Contrarily to the outlets B and C, A presented most of the data concentrated (Figure 1). However, all outlets (A, B, C) presented different concentrations for the cryoscopic index.

The values of milk cryoscopy found in this work corroborate those obtained by Alves et al.¹⁰, whose research on the pasteurized milk processed on the dairy industries of Colorado do Oeste, showed a monthly mean between -0.505 and -0.535 . To evaluate the quality of milk samples collected in Santa Maria, RS, Silveira & Bertagnolli¹³ found cryoscopy values of -0.510 °H and -0.465 °H, suggesting tampering as stated by Caldeira et al.¹¹. In the present study the value of cryoscopy (-0.510) suggests fraud by the addition of water in the milk, mainly in the outlet C, because from the 12 analyzed samples, 5 (41%) presented values at odd with IN-62⁸. The provider A presented 2 values (-0.507 and -0.550) out of the normal distribution of data. However, factors related to changing the composition of milk can also change the values of cryoscopy¹¹.

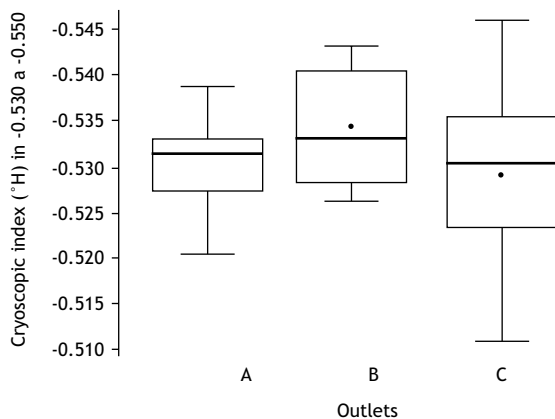
The mean values of milk density on Table ranged from 1,030 to 1,034 g/mL according to the legislation. However, when verifying

the data distribution (Figure 2), values from 1,025 to 1,035 g/mL were noted, which correspond to 27% ($n = 10$) of the samples at odd with the official standards⁸.

The density of milk at 15 °C must present values between 1,028 and 1,034 g/mL according to the established by IN-62⁸. Some factors may cause alterations of this index. The milk density possibly decreases by the addition of water or by a temperature increase, and when the density increases there are evidences of excessive cream and/or low temperature⁵. Non-conforming values of density and freezing point of milk suggest tampering by the addition of water, which leads to a decrease in the density, and accordingly, an increase in cryoscopy^{5,12}. It is important to highlight that, depending on the quality of the water added to the milk, it may affect even more the bacterial quality of this product. It is believed that up to 1,034 values may be due to adulteration by the addition of other substances (sucrose and starch) or skim milk¹³. The milk samples of outlet C presented more variations of relative densities. It was observed a minimum of 1,026 and a maximum of 1,035 (Figure 2). This outlet presented more variations for the cryoscopic index (Figure 1). According to the exploratory analysis of data, the point of sale A presented a consistent behavior of the relative density. Some substances such as urine, sucrose and starch were added to milk to reconstitute its density after the addition of water, for avoiding supervisory bodies to perceive the addition¹.

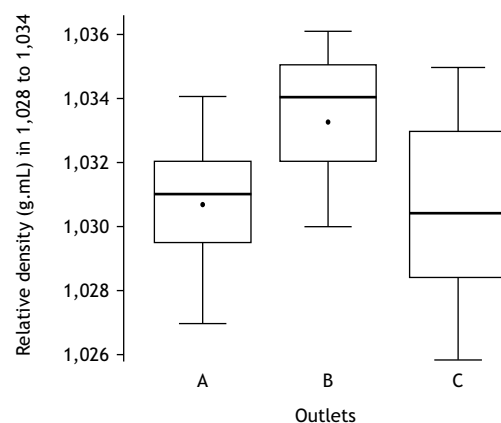
The values of acidity, fat and defatted solids of raw and pasteurized milk of the three point of sale are presented on Figure 3.

It is observed on Figure 3 that only one sample of the fat analyses did not meet the parameters recommended by the legislation. An acidity higher than 18 Dornic comes from the acidification of milk caused by the deployment of lactose induced by bacteria in intense multiplication on the milk. The fat is the most variable component of milk and may vary according to the race, stage of lactation and mainly to the feeding of the animal. Milk has an average concentration of fat around 3.6%;



*Note: The asterisk represents the means

Figure 1. Box diagram of Maximum cryoscopic index (°H) of milk obtained in three outlet (A, B, C).



*Note: The asterisk represents the means

Figure 2. Box diagram of the relative density (g/mL) of the obtained in three outlets (A, B, C).

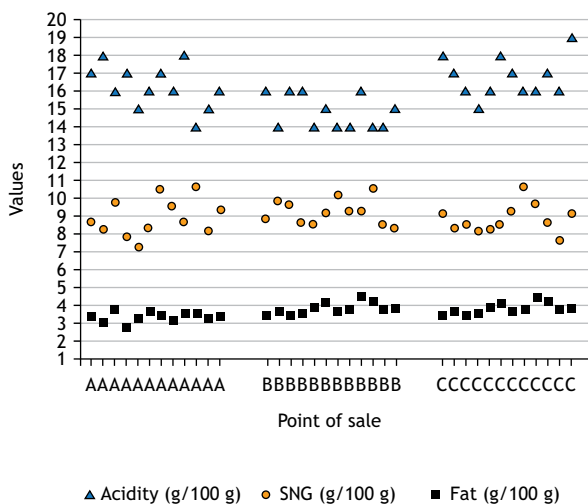


Figure 3. Values of acidity, defatted solids (SNG) and the fat of milk obtained in three point of sale (A, B, C).

variations are due to the handling conditions of the animals, health, food, race and environmental factors such as climate change¹. To keep a high percentage of this component, producers must administer a protein concentrate to the animals and provide more and better fodder¹⁴. The result of fat below the minimum established by law may be due to the addition of water or practice creams⁵; however, a larger number of samples with reduced-fat was expected considering the density values and SNG. Once water is added, the producer adds sucrose and/or starch in an attempt to reverse the density. The presence of the added solids increases the density of the milk watery¹⁵.

Once the fat percentage was established through analyses, the values of SNG were determined. For Tronco¹, mean values of SNG lower than the established by the legislation (8.4) evidences fraud by the addition of water in the milk.

REFERENCES

1. Tronco VM. Manual para inspeção da qualidade do leite. 5a ed. Santa Maria: UFSM; 2013.
2. Dalzini E, Bernini V, Bertasi B, Daminelli P, LosioM_N, Varisco G. Survey of prevalence and seasonal variability of *Listeria monocytogenes* in raw cow milk from Northern Italy. *Food Control*. 2016;60:466-70. doi:10.1016/j.foodcont.2015.08.019
3. Silveira MLR, Bertagnolli SMM. [Quality assessment of raw milk informally commercialized in street markets in the city of Santa Maria-RS]. *Vig Sanit Debate*. 2014;2(2):75-80. Portuguese. doi:10.3395/vd.v2i2.135
4. Ministério da Agricultura (BR). Decreto nº 306.919, de 29 de março de 1952.Regulamento da Inspeção Industrial e Sanitária de Produtos de Origem Animal - RIISPOA. Brasília, DF: Ministério da Saúde; 1952 [cited 2015 Sep 20]. Available from: http://www.agricultura.gov.br/arq_editor/file/Aniamal/MercadoInterno/Requisitos/RegulamentoInspecaoIndustrial.pdf
5. Montanhin MTM, Hein KK. Qualidade do leite cru comercializado informalmente no município de Pirai do Sul, Estado do Paraná, Brasil. *Rev Inst Laticínios "CândidoTostes"*. 2013;68(393):10-4.
6. Sovinski AI, Cano FG, Raymundo NKL, Barcellos VC, Bersot LS. Marketing situation and microbiological and physical-chemical evaluation of raw milk sold informally in Cafelândia, Paraná, Brazil. *Arq Ciênc Vet Zool UNIPAR*. 2014;17(3):161-5.
7. Bánkuti FI, Bánkuti SMS, Souza Filho HM. Entraves para inserção de produtores de leite no mercado formal da região de São Carlos, Estado de São Paulo. *Inf Econ*. 2009;39(7):19-31.
8. Ministério da Agricultura, Pecuária e Abastecimento (BR). Instrução Normativa nº 62, de 29 de dezembro de 2011. Aprova o regulamento técnico de produção, identidade e qualidade do leite tipo A. *Diário Oficial União*. 30 dez 2011.

From the total of samples of SNG, 19% (n = 7) were at odds with the IN-62 (Figure 3), this 11% (n = 4) came from the point of sale A. These values corroborate the mean of defatted solids reported by Tronco. It attaches values inferior to the established by the legislation with evidences of fraud by adding water to the milk. This variable presented a standard deviation of 1.5, showing a low variability.

The acidity of milk presented only one sample (19°D) on the outlet C superior to what is allowed by IN-62⁸ (Figure 3). An acidity superior to 18 Dornic came from the acidification of milk caused by the deployment of lactose induced by bacteria (deteriorating and/or pathogenic) found on intense multiplication in the milk. The values (97%) in accordance with the required acidity found in this work corroborated results of Amaral and Santos¹⁶. The acidity presented low standard deviation (1.3) (Table).

CONCLUSION

Physicochemical analyses of milk showed that 27% (n = 10) of samples of both cryoscopy and density were not in accordance to IN-62, with evidences of fraud by addition of water mainly on outlet C.

In relation to the content of defatted solids, 19% (n = 7) of samples were at odd with the legislation, probably because of the possible addition of water. Most of the results of the samples in terms of acidity and fat were in accordance with the legislation. However, the suspected fraud by adding sucrose and starch in the samples induces the completion of water addition followed by reconstitution by SNG. It is necessary to carry out restorative analyses for measuring density and chlorides and for evaluating evidence of possible fraud.

These results indicate a possible food insecurity, a problem that may be minimized by the supervision of competent agencies, monitoring the quality of the raw material obtainment and its trade.



9. Ministério da Agricultura, Pecuária e Abastecimento (BR). Instrução Normativa nº 68, de 12 de dezembro de 2006. Oficializa os métodos analíticos oficiais físico- químicos, para controle de leite e produtos lácteos, em conformidade com o anexo desta Instrução Normativa, determinando que sejam utilizados nos laboratórios nacionais agropecuários. Diário Oficial União. 16 dez 2006.
10. Alves EC, Silva V, Dahmer AM. Características físico-químicas do leite pasteurizado processado em Colorado do Oeste, RO: estudo de caso. Hig Alim. 2011;25(198/199):108-12.
11. Caldeira LA, Rocha Júnior VR, Fonseca CM, Melo LM, Cruz AG, Oliveira LLS. [Characterization of milk commercialized in Janaúba - MG]. Alim Nutr. 2010;21(2):191-5.
12. Mendes CG, Sakamoto SM, Silva JBA, Jácome CGM, Leite AI. Análises físico-químicas e pesquisa de fraude no leite informal comercializado no município de Mossoró, RN. Ciên Anim Bras. 2010;11(2):349-56.
13. Freitas Filho JR, Souza Filho JS, Gonsalves TM, Souza JJS, Silva AHI, Oliveira HB et al. Caracterização físico-química e microbiológica do leite "in natura" comercializado informalmente no município de Garanhuns, PE. Rev Bras Tecnol Agroind. 2009;3(2):38-46. doi:10.3895/S1981-36862009000200005
14. Ribeiro CGC, Lopes FCF, organizadores. Qualidade nutricional da gordura do leite de vacas primíparas alimentadas com dois tipos de óleo de girassol e dois modos de fornecimento de concentrado em dietas a base de capim-elefante picado. In: Anais do XIII Congresso Internacional do Leite; 28-30 jul 2015; Porto Alegre. Porto Alegre: Embrapa; 2015.
15. Campos AAR, Rocha JES, Borgo LA, Mendonça MA. Análise físico-química e pesquisa de fraudes em leite pasteurizado integral tipo "C" produzido na região de Brasília, Distrito Federal. Rev Inst Laticínios "CândidoTostes". 2011;66(379):30-4.
16. Amaral CRS, Santos EP. Leite cru comercializado na cidade de Solânea, PB: caracterização físico-química e microbiológica. Rev Bras Prod Agroind. 2011;13(1):7-13. doi:10.15871/1517-8595/rbpa.v13n1p7-1

Acknowledgments

The authors thank the Federal Institute of Education, Science and Technology of Rondônia - Colorado do Oeste Campus, through Research Department (DEPIPG), financial support.



This publication is licensed under the Creative Commons Attribution 3.0 Unported license. To view a copy of this license, visit <http://creativecommons.org/licenses/by/3.0/deed.pt>.