



Acceptability of goat's milk in high and elementary school networks

Florence Dalila Peres¹, Pedro Augusto Dias Andrade², Jean Kaique Valentim^{3*}, Daniela Paulino Parreira¹, Daniel de Souza Oliveira¹, Karynne Luana Chaves de Paula², Janaína Palermo Mendes³, Rita Therezinha Rolim Pietramale³ and Henrique Momo Ziemniczak³

¹Universidade Federal dos Vales do Jequitinhonha e Mucuri, Diamantina, Minas Gerais, Brasil. ²Instituto Federal de Minas Gerais, Bambuí, Minas Gerais, Brasil. ³Universidade Federal da Grande Dourados, Rua João Rosa Góes, 1761, 79825-070, Dourados, Mato Grosso do Sul. *Author for correspondence. E-mail: kaique.tim@hotmail.com

ABSTRACT. The goat's milk is an excellent choice to replace cow's milk for children and adults, who are allergic to cow's milk. Both the proteins and the fat portion of goat's milk are absorbed by the body faster than cow's milk. Visually it is not possible to differentiate cow's milk from goat's milk, which can be differentiated through odor and taste which generates some concern to consumers. The objective of this study were to evaluate the acceptability of goat's milk, compared to cow's milk by children and young adults between 06 and 21 years old, in public network of schools Bambuí-MG, living in different socioeconomic levels, in order to verify if there is difference, in acceptance, between these two types of milk and study if the age and socioeconomic status could influence the results. Samples were prepared with chocolate powder and subjected to sensory evaluation by a group of 330 students, who are milk consumers. The samples were evaluated for preference through the hedonic scale of 5 points, asking about the score of the consumers and the preference of each type of milk. The test was conducted in two public schools. the data were submitted to ANOVA and Tukey test for comparison of means. Although goat's milk has some compositional characteristics and different physicochemical properties of cow's milk, there was no difference between them, due to acceptability between students of the public high school and elementary school network. The mixture 50% goat milk + 50% cow's milk generated greater rejection of the sampled population, a fact justified by the formation of small clots when mixing the different types of milks. Conventional cow's milk can be replaced by goat's milk in school meals, regardless of the age group and socioeconomic status of students.

Keywords: chocolate milk; consumption; dairy; infant-juvenile.

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Introduction

Interest in goat farming has gradually advanced both in the national and international scenario due to the increase in demand for these products that is growing in the market, which makes goat farming attractive for investments. It is noted in recent years that developing countries are more attentive by dairy goat farming, given the improvement of the activity by the highlight of the production that associates a greater value in relation to bovine milk (Abreu et al., 2019). The participation of this activity has been increasing and expanding market opportunities for this type of milk and thus, consequently its derivatives. Many establishments registered in the Inspection Services already produce products of goat milk of excellence, such as milk powder, UHT milk, fine cheeses, candy, pasteurized milk (Santos, 2019).

The nutritional value of goat's milk is known in the scientific environment for its importance in the feeding of populations, especially for children and elderly. It stands out for the possible replacement of cow's milk which is the most common, or even in place of breast milk (Dias, Varanis, Alves, & Raineri, 2018). Milk, regardless of species is an extremely important food in nutrition (Alves, 2003). In the case of humans and species of commercial mammals, there are alternatives to replace breast milk by another who has similar or even higher abilities to meet the needs of the individual when interruptions in lactation or lactose intolerance problems or even food supplementation (Menezes, Sales, Santos, Correia, & Felix, 2015). Although there is still great resistance to the consumption of goat's milk and its derivatives, mainly due to

the strong odor they may have, the production of this type of milk has been increasing over the years, thanks to improvements in management and processing techniques, which has not been enough to achieve product the product popularization (Souza, Assis, Rodrigues, Guerra, & Egypto, 2019).

According to Instituto Brasileiro de Geografia e Estatística (IBGE, 2018) the Brazilian goat herd grew around 16.5%, reaching the mark of 8.55 million heads. In the states of the Northeast, which concentrates 90% of the herd's effective, this growth was notorious, considering that goat farming is an important socioeconomic activity for the region (IBGE, 2018). The 2018 Agricultural Census of the Brazilian Institute of Geography and Statistics (IBGE) points to Paraíba as the largest producer of goat's milk in the country, with a production of 5,898 million liters of milk per year. According to Alves, Pinto, Mendes, and Diniz (2017), although it is proven to be a milk with better availability of nutrients in relation to that of cattle, in general it suffers a rejection of the consumer market due, above all, to its characteristic taste and odor. Properly handling during milking does not completely eliminate odor, but alters or reduces its unacceptance level to the final consumer.

The insertion of goat's milk in school meals aims expansion of the future consumer market, as well as strengthening the milk production chain. Belik and de Souza (2010) report that social policies aimed at school feeding programs generate gains in terms of efficiency in the management of public resources, in education and the health of children and teenager, besides providing the farmer with an incentive to continue working, because these can enhance income and local development. With regard to the research above conducted, it's objective was to evaluate through sensory analysis, the acceptability of goat's milk in relation to cow's milk in Public Schools in the municipality of Bambuí-MG.

Material and Methods

Goat's milk was obtained from eight Saanen animals created in intensive system at the Federal Institute of Minas Gerais - Campus Bambuí (MG, Brazil). The feeding of the animals was based on bulky corn silage and concentrate, both produced on campus. The water was supplied at will in pacifier-type drinking fountains. Milk came from a prophylactic and hygienic milking line, carried out in the morning, before the animals were fed. The breeder is housed in a bay with a distance of 50 meters from the goats, in order to improve the organoleptic quality of milk.

The cow's milk was acquired from Girolando cows from university FIMG, reared in a semi-intensive system, fed mainly with Mombasa pasture, supplemented with corn silage, concentrate and mineral salt in cattle trough. The milking of the animals was performed at seven o'clock in the morning, following the prophylactic and hygienic milking line. Milking was performed manually, and the first jets were discarded, no pre-dipping was executed. After the milking was finished, the post-dipping was used, which is the immersion of the cow tits in a iodo solution. After milking, the milk was stored in brass, passing through a strainer to retain dirt and transported to the institute's own dairy.

In dairy goat's milk went through the process of slow pasteurization by heating in a water bath at 62-65°C for 30 minutes, with the aim of eliminating pathogenic bacteria, part of the saprophyte microorganisms and inactivating some enzymes (phosphatase and peroxidase) that impair the quality of goat's milk.

The equipment used to pasteurize milk was a round 50L tank in stainless oil and with double shirt (heating made with water vapor). The tank had a lid coupled with a thermometer and mechanically agitated water. Soon after pasteurization the milk was sent for refrigeration. Already at a temperature of 4°C degrees, was filled in pet bottles of two liters sanitized and taken to the freezer for freezing. For thawing, the bottles were placed in a water tank at room temperature maintained for 4 hours. Cow's milk was supplied by FIMG dairy, already pasteurized and cold, thus filled in sanitized and sterilized two-liter pet bottles. As the daily volume of cow's milk is higher than goat's milk there was no need for frozen milk storage, so it remained cold in a 24-hour period.

After these procedures the samples were divided into their respective treatments: A- 100% goat's milk, B - 50 % goat's milk + 50% cow's milk, C - 100% cow's milk. It was observed that when mixed 50% goat's milk + 50% cow's milk the mixture presented small particles of clots. All treatments were prepared with chocolate powder traditionally used in institutions, the proportion was 100 grams for every 1 liter of milk without adding sugar. 15 liters of goat's milk and 15 liters of cow's milk were used. The product has been handled within strict forms of hygiene and good manufacturing practices.

The samples were taken to the Public Schools participating in the thermal box research, where they remained at room temperature for milk conservation. The test was performed individually under controlled conditions, the samples were offered in a plastic cup of 30 ml of each milk, and with a plastic cup of 200 ml containing water, so that it was interspersed between the intake of one treatment and another, in this way reducing the risks of confusing the flavors. Three hundred and thirty students between 06 and 21 years old were submitted to 330 sensory evaluations, all milk consumers, without lactose intolerance, without restriction as sex, but from different social classes. The samples were randomly presented with codes. For the acceptance test, a 5-point Hedonic Scale (5=liked it a lot; 4=liked; 3=indifferent; 2=disliked; 1=disliked it very much).

Although the characteristics evaluated by the project are qualitative in order, the data were evaluated quantitatively due to the methodology used to punctuate the preference of the experimental units evaluated (Hedonic Scale). Thus, a randomized block design was adopted for this experiment using the Tukey test at a 5% probability level in variance analysis to evaluate the variables studied, where 330 evaluators (blocks) submitted to three treatments evaluated (A- Goat, B- 50:50 goat's milk: cow, C- Cow).

Results and Discussion

The results of sensory analysis comparing goat's milk, goat's milk + cow and cow's milk (A, B and C, respectively) are presented in Table 1, it is observed that the samples reveal a significant statistical difference ($p < 0.05$) for goat's milk, goat's milk + cow's milk and cow's milk.

Table 1. Sensory evaluation of goat's milk (A), goat's milk + cow (B) and cow's milk(C) of children and teenager from Public Schools of Bambuí-MG.

Acceptance	Milk		
	A	B	C
	4.03 a	3.55 c	3.77 b

CV: 28.86%; Different lowercase letters in line differ from each other ($p < 0.05$).

When compared to the other dairy products evaluated, the goat's milk acceptance test (Milk A) reached the best average, 4.03 versus 3.77 and 3.55 (milk C and B respectively). When compared to the other dairy products evaluated, the goat's milk acceptance test (Milk A) reached the best average, 4.03 versus 3.77 and 3.55 (milk C and B respectively). According to Farnworth, Mainville, Desjardins, Gardner & Fliss (2007) goat's milk has some physical characteristics that distinguish it from cow's milk.

It has a typical taste that, depending on the hygiene conditions where animals are installed and the food they receive, may have a stronger taste, often undesirable. However, if milk is obtained by following the recommended hygiene standards, it is very well accepted, which may justify the acceptability by consumers in the studied range. The results obtained through the interaction between treatments and age group are presented in Table 2.

Table 2. Interaction treatments and age group of children and young adults from Public Schools of Bambuí-MG.

Age	Milk			Mean
	A	B	C	
1 (5 the 11)	4.197 a A	3.93 a A	4.05 a A	4.04 A
2 (12 the 15)	3.89 a A	3.48 b B	3.26 b B	3.69 B
3 (16 the 21)	4.05 a A	3.67 b AB	3.65 b AB	3.65 b AB

CV= 28.41%; Lowercase letters in line differ from each other ($p < 0.05$); Uppercase letters in columns differ from each other ($p < 0.05$).

It was observed that the experimental group 1 (5 to 11 years old) did not present a significant difference between milk types, that is, even though treatment C is the type of milk they commonly consume in school meals and also at home, there was no interference in the taste of these consumers in the approval of goat's milk. The fact can be justified by a study by Osmari, Cecato, Macedo, and Souza (2011) showing that the feeding behavior of the preschool is determined in the first instance by the family, on which it is dependent and, secondarily, by other interactions psychosocial and cultural sectors of the child. The pattern of children's feeding is determined by their food preferences.

It is noted that this experimental unit group is not influenced by the preference of treatments, even though it is an age group with fear of new foods, which may not be possible if they were aware of the origin of treatment A, because it is a food different from what they're used to. In group 2 (12 to 15 years) the

statistical evaluation was significant ($p < 0.05$) between treatment A (goat's milk) and other treatments, and goat's milk was preferred with the highest average. Treatments B (goat's milk + cow's milk) and C (cow's milk) did not differ from each other ($p < 0.05$), even though c treatment was the most consumed milk on a day-to-day by the experimental units. These same results were obtained by group 3 (16 to 21 years).

According to the statements made by Luiz, Drunkler, Henn, and Fett (1999) goat's milk has peculiar sensory characteristics, especially in the color, aroma and flavor attributes. Caproic, caprial and capicic fatty acids confer the typical flavor and aroma and can compromise the acceptability of the products. These acids are also present in cow's milk in a smaller proportion (García, Rovira, Boutoial, & López, 2014), but the peculiar characteristics of goat's milk have not compromised acceptance of treatment in this study.

Analyzing the age groups within the treatments, it is perceived that in treatment A (goat's milk) there was no statistically significant difference ($p < 0.05$) between ages, group 1 (5 to 11 years) with the highest average is justified by the study conducted by Fisberg, Nogueira, Ferreira, and Fisberg (1999) in municipal daycare centers in the city of São Paulo with children aged 05 to 08 years old, stating that one of the possibilities that explain the best acceptance to goat's milk is subclinical intolerance to milk protein, which makes that a high number of children reduce the consumption of cow's milk. Then cow's milk was the most accepted, even though it was the milk of the eating habit of the experimental units.

For treatment B (goat's milk + cow's milk) there was a significant difference ($p < 0.05$) between group 1 (5 to 11 years old) and group 2 (12 to 15 years old). Group 1 was the one that most accepted mixed milk, and group 2 did the least. Group 3 (16 to 21 years old) was indifferent. In Treatment C (cow's milk) there was also a significant difference ($p < 0.05$) between groups 1 (5 to 11 years old) and 2 (12 to 15 years old), group 1 (5 to 11 years old) were indifferent. The Table 3 presented the averages obtained in the acceptance test by each school is displayed for the three treatments under analysis.

Table 3 Sensory analysis of Goat's milk (A), Cow's Milk+Goat (B) and cow's milk (C) on the different school teaching units studied.

School	Milk			Mean
	A	B	C	
1	4.10	3.49	3.88	3.80
2	3.96 a	3.60 b	3.71 a b	3.75 A

Cv=28.86 %; Lowercase letters in line differ from each other ($p < 0.05$); Uppercase letters in columns differ from each other ($p < 0.05$).

When verifying the preference of treatments per school, it is observed that in school 1 there was no significant difference ($p < 0.05$) between treatments A (goat's milk) and C (cow's milk), even though the treatment C was the milk used in these institutions. Treatment A obtained the best score (4.10), the one that best pleased the students. Treatments A and C differed from treatment B and was the least acceptability (3.49). When analyzed, School 1 is perceived that there was a statistically significant difference ($p < 0.05$) between treatments, and goat's milk is the most accepted (3.96) and goat's milk + cow the least accepted (3.60). Treatment A obtained the best score (4.10), the one that best pleased the students. Treatments A and C differed from treatment B and was the least acceptability (3.49). When analyzed, School 1 is perceived that there was a statistically significant difference ($p < 0.05$) between treatments, and goat's milk is the most accepted (3.96) and goat milk + cow the least accepted (3.60). As for milk C was indifferent (3.71). This general preference for goat's milk may have influence of the process of obtaining and pasteurizing the milk obtained for the research, which eliminated the odor and characteristic flavor at an acceptable level of the palate, because the odor and taste are determinant stemming from the quality of the goat's milk.

In addition to the rigorous hygiene process, the distance from the installation of got house, should be considered as a function of billy goat house, which according to Luiz et al. (1999) is also responsible for the production of unpleasant odors and flavors that can be absorbed by milk, compromising the acceptability of products of goat origin. Goat's milk has therapeutic and medicinal uses with indication in allergic problems, digestive disorders, malnutrition and convalescence of children and the elderly, constituting a product of high biological value (Pinto, Pereira, Soares, Camargo, & Fernandes, 2019).

A study by Marinho, Figueirêdo, Queiroz, Santiago, and Gomes (2014) with animals and humans, demonstrated that associating sugar or some preferred flavor with an unknown or less preferred flavor, increases acceptance of the taste less preferred by the association of the flavors. The perception of flavors comprises the feeling of sweet, salty, sour and bitter and some others associated with amino acids. Sensitivity to sweet taste already appears in the prenatal phase, being therefore an innate preference.

Possibly due to this sensitivity to the sweet stimulated by chemicals proves an increase in the acceptance of unknown foods, when they are associated with sugar or naturally sweet foods. This study justifies that the taste of goat's milk that is unknown mixed with the common chocolate becomes imperceptible the characteristic taste of milk, avoiding in this research any rejection, due to the association of flavors.

General rejection of mixed milk can be justified by the formation of small clots by mixing milk types. Lipids and proteins are directly involved with the texture and consistency of the products, so this clot formation is due to this differentiation of protein and lipid compounds of each type of milk, such as casein content, mycelial dispersion, presence of colloidal calcium (Bezerra & Correia, 2012). Lipids are the components that most influence the consistency and texture of dairy products (Božanić, Rogelj, & Tratni, 2002).

The casein content, on the other hand, significantly influences the speed of formation and firmness of the curd. The low casein content, the proportion of α -1-casein and the size of a micelles in goat's milk may be associated with the lack of texture of the product (Park, Juarez, Ramos, & Haenlein, 2007) and cause the clot formed by enzymatic action to present thinner granulation and soft than cow's milk clot (Sanz Sampelayo, Chilliard, Schmidely, & Boza, 2007). Thus the particles are dispersed when mixing, forming small clots.

Regarding the preference of treatments evaluating the means between schools there was no statistically significant difference ($P < 0.05$), which means that the socioeconomic difference of schools did not interfere in the research data, even though school 2 was an institution with more needy students. The influence of income does not appear significant on the food consumption of experimental units.

Conclusion

Although goat's milk has some compositional characteristics and different physicochemical properties of cow's milk, there was no difference between them due to acceptability between students of the public high school and elementary school network. The mixture 50% goat milk + 50% cow's milk generated greater rejection of the sampled population, a fact justified by the formation of small clots when mixing the different types of milks. Conventional cow's milk can be replaced by goat's milk in school meals, regardless of the age group and socioeconomic status of students.

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