

# Antibacterials and behaviors adopted by milk producers in Goiás, Brazil

## Antibacterianos e condutas adotadas por produtores de leite em Goiás, Brasil

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### Abstract

Milk and its derivatives are rich in nutrients and widely consumed by the population. However, the presence of chemical residues is frequent in these products. This study aimed to carry out a diagnosis of the use of antibacterials and evaluate the knowledge about these drugs and behaviors adopted by dairy producers in Goiás, Brazil. A total of 286 dairy farms in 36 municipalities in the State were visited and interviews were conducted with the owner or auxiliary workforce. The questions addressed the production parameters of the property and the use of antibacterials. The answers were presented in percentages and graphs. Statistical analysis was performed using Pearson's chi-square test at a 5% significance level. Only 26.2% of the producers used antibacterials indicated by veterinarians and all producers (100%) disposed of milk with residues inappropriately. Tetracycline and penicillin were the most used among the 21 cited active principles. Enteritis (22.1%), cattle tick fever (21.1%), and mastitis (19.4%) were the main diseases treated with antibacterials. A total of 37.4% of respondents were unable to distinguish antibacterials from other drugs. Moreover, the more specialized the farm, the greater the veterinary assistance and the greater the care for antibacterial treatments. Most respondents (51.7%) had incomplete elementary education. These results provide important information about how rural producers in the State of Goiás use antibacterials and serve as a basis for future interventions. The need for greater access by producers to veterinary services in Goiás is evident to reduce the unnecessary and inappropriate use of antibacterials.

**Keywords:** antibiotic; waste milk; sanitary management; waste; bacterial resistance.

### Resumo

O leite e seus derivados são ricos em nutrientes e largamente consumidos pela população. Contudo, a presença de resíduos de substâncias químicas é frequente nesses produtos. Esse estudo objetivou realizar um diagnóstico sobre o uso de antibacterianos, avaliar o conhecimento sobre esses fármacos e condutas adotadas por produtores de leite em Goiás, Brasil. Foram visitadas 286 propriedades leiteiras em 36 municípios do estado, onde foram realizadas entrevistas com o proprietário ou mão de obra auxiliar. As perguntas abordavam parâmetros produtivos da propriedade e uso de antibacterianos. As respostas foram apresentadas em porcentagem e gráficos. A análise estatística foi realizada pelo teste de qui-quadrado de Pearson ao nível de significância de 5%. Apenas 26,2% dos produtores utilizavam antibacterianos indicados por veterinários e todos (100%) descartavam o leite com resíduos de forma inadequada. Dentre os 21 princípios ativos citados, os mais utilizados foram as tetraciclina e penicilinas. As principais doenças tratadas com antibacterianos foram enterite (22,1%), tristeza parasitária bovina (21,1%) e mastite (19,4%). Observou-se que 37,4% dos entrevistados não souberam distinguir antibacterianos de outros medicamentos. Verificou-se que quanto mais especializada é a fazenda, maior é a assistência veterinária e maiores os cuidados para tratamentos com antibacterianos. A maioria dos entrevistados (51,7%) apresentava ensino fundamental incompleto. Esses resultados fornecem informações importantes sobre como os produtores rurais do estado de Goiás utilizam antibacterianos e servem como base para intervenções futuras. É evidente a necessidade de maior acesso dos produtores a serviços veterinários em Goiás, a fim de reduzir o uso desnecessário e inadequado de antibacterianos.

**Palavras-Chave:** antibiótico; leite de descarte; manejo sanitário; resíduos; resistência bacteriana.

## 1. Introduction

Brazil is the third-largest milk producer<sup>(1)</sup> and has the second-largest dairy herd in the world.<sup>(2)</sup> Milk production is considered one of the most important livestock activities in Brazil<sup>(3)</sup> and the State of Goiás ranks as the fourth largest Brazilian producer.<sup>(4)</sup> Milk is a food with a balanced composition, rich in proteins, vitamins,

minerals, and calcium. It is widely consumed by the population and used to manufacture dairy products. Consumers look for nutrients in milk for a healthy diet, certain that this food is free of contaminating agents and chemical residues.<sup>(5)</sup> However, contamination of milk and dairy products can occur due to the inappropriate use of drugs, such as the application of antibacterial overdoses

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in dairy cows.<sup>(6, 7)</sup> Thus, milk expressed from cows undergoing treatment with antibacterials must be discarded and cannot be consumed before the waiting period indicated by the manufacturer.<sup>(8)</sup> This disposal causes significant economic damage, which may vary according to the cow's production level, the treated disease, and the time of milk disposal. As an example, the treatment of cows with retained placenta and uterine infection resulted in the disposal of 350 liters of milk per animal over 14 days.<sup>(9)</sup> Considering the current price of milk in Goiás (R\$ 2.836/L),<sup>(10)</sup> the loss caused by discarding milk would be R\$ 992.60 per treated animal.

Antibacterial residues in fresh milk can inhibit lactic bacteria during the fermentation process, causing damage to the manufacture of dairy products and compromising their organoleptic quality. Also, the presence of these residues in milk increases the risk of the growth of coliforms and pathogenic bacteria.<sup>(11)</sup> Antibacterial residues may affect the health of consumers when present in industrialized milk, as they can cause allergic or toxic reactions, intestinal microbiota imbalance, teratogenic effect in pregnant women, and bacterial resistance.<sup>(6, 12)</sup> In addition, there is a risk of soil and groundwater contamination when milk with residues is discarded along with wastewater or fed to other domestic animals.<sup>(13)</sup>

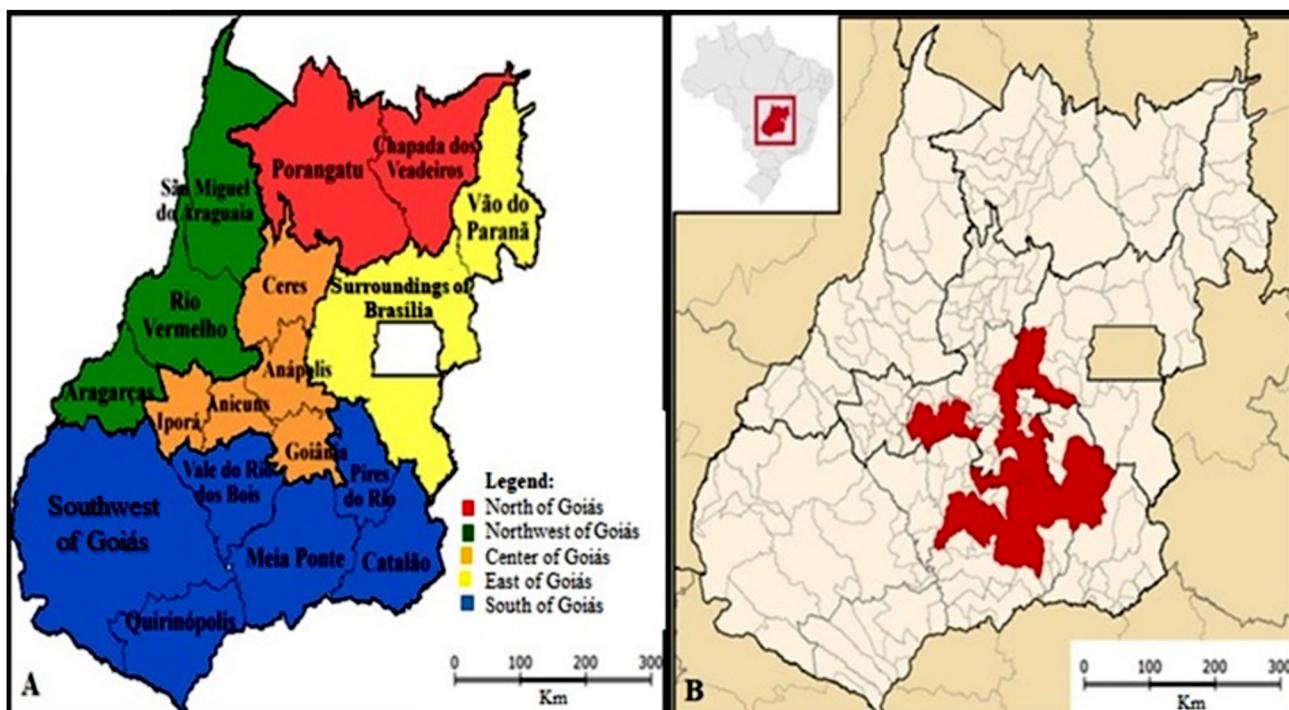
Therefore, studies that investigate the knowledge, practices of use, and resistance of antibacterials used by

livestock farmers are important to guide governmental and private interventions to promote their prudent use and delay the development of bacterial resistance.<sup>(14)</sup> This study aimed to carry out a situational diagnosis of the knowledge and use of antibacterials and evaluate behaviors adopted by milk producers in Goiás, Brazil. In addition, we sought to analyze the influence of veterinary assistance on the use of antibacterials and the way to dispose of milk with residue from these drugs.

## 2. Material and methods

### 2.1 Study design

The study was carried out in the State of Goiás, Brazil, between 2019 and 2021. A semi-structured interview about the use of antibacterials was carried out during the execution of this research with 286 rural producers or auxiliary workforce on dairy farms in 36 municipalities (Table 1). The analysis included five mesoregions and seven microregions of the State, which had different educational and social levels (Figure 1). The selection of rural establishments took place by simple occasional sampling in properties located within a radius of 200 km from Goiânia, the State capital. The project was approved by the Research Ethics Committee of the Federal University of Goiás under number 5,443,471 before data collection. The questionnaire used in the interview was adapted from Nunes et al.<sup>(15)</sup>



**Figure 1.** A) Meso- and microregions of the State of Goiás, Brazil. B) Location of the municipalities in Goiás with the location of the 286 dairy farms where the interviews were carried out between 2019 and 2021. Source: A: Barroso and Paixão.<sup>(16)</sup> B: Adapted from Abreu.<sup>(17)</sup>

**Table 1.** Mesoregions, microregions, and municipalities of the 286 dairy farms in the State of Goiás, Brazil, where interviews were conducted between 2019 and 2021.

City/Municipality	Quantity	Mesoregion	Microregion	Subtotal		
<b>CENTER OF GOIÁS</b>						
Firminópolis	5					
Turvânia	13					
Anicuns	11				Anicuns	40
Nazário	8					
Santa Bárbara de Goiás	2					
São Luís de Montes Belos	1		Goiânia	42		
Hidrolândia	2					
Bela Vista de Goiás	3					
Nerópolis	2					
Santo Antônio de Goiás	3					
Goiânia	7	Center of Goiás				
Goianápolis	8					
Caldazinha	3					
Senador Canedo	2					
Leopoldo de Bulhões	12					
Ouro Verde de Goiás	9				Anápolis	47
São Francisco de Goiás	4					
Petrolina de Goiás	14					
Damolândia	7					
Nova Veneza	13					
Total	129					
<b>SOUTH OF GOIÁS</b>						
Edealina	13		Vale do Rio dos Bois	51		
Edéia	1					
Varjão	26					
Vianópolis	11		Meia Ponte	40		
Pontalina	5					
Morrinhos	13					
Professor Jamil	7					
Piracanjuba	15				South of Goiás	
Santa Cruz de Goiás	5			Pires do Rio	25	
Palmelo	2					
Cristianópolis	6					
Pires do Rio	1					
Urutaí	3					
Orizona	8					
Total	116					
<b>EAST OF GOIÁS</b>						
Abadiânia	15	East of Goiás	Surroundings of Brasília	41		
Pirenópolis	26					
Total	41					
Grand total	286					

## 2.2 Semi-structured interview

The questionnaire was divided into three stages (Supplementary Material). The first stage contemplated the identification of the property and the owner. The second stage addressed issues related to the property characterization such as type of exploitation, rearing system, number of milkings per day, type of milking, predominant breed of cattle, number of animals on the property and lactating cows, daily milk production, presence of veterinary assistance, type of assistance, areas assisted by the veterinarian, type of facilities in the milking parlor, and aspects related to the cleanliness of the environment. The third stage of the questionnaire addressed questions about the knowledge of rural producers about what antibacterial agents are and their use in dairy herds. In addition, respondents were

asked about who prescribed antibacterials, the situations they were used, the diseases treated, the active ingredients or commercial names of the drugs, and the frequency of application. The package leaflet of the product was checked to identify the active ingredient(s) in cases in which the commercial name of the drugs was cited. Questions were also asked about the disposal of milk from animals undergoing treatment with antibacterials, the criteria for defining the disposal time, and the destination of milk with residues.

In the end, the properties were grouped according to daily milk production into three categories: up to 300 liters, from 301 to 600 liters, and over 600 liters. We considered for comparative purposes that illiterate, semi-illiterate, and people with incomplete or complete primary education had a “low education.” Producers with incomplete or complete

secondary education, incomplete or complete graduation, and incomplete or complete postgraduation were grouped in the “high education” category. The use of antibacterials was classified as “with veterinary assistance” when the prescription was given by the veterinarian at the agricultural store or by the veterinarian who periodically assists the property. Producers who used antibacterials on their own initiative or with assistance from the seller of livestock inputs were included in the category “without veterinary assistance.” The presence of veterinary assistance was considered when a veterinarian attended the property periodically. The occurrence of incorrect disposal of milk from animals undergoing treatment was characterized when it was fed to other animals, sold to dairy factories, used in the manufacture of dairy products, and discarded directly into the soil. Correct disposal was considered when milk with residue was disposed of in a septic tank. The combination of these response categories aimed to facilitate the presentation, comparison, and discussion of results.

### 2.3 Data analysis

The Jamovi Project program (Version 2.3)<sup>(18)</sup> was used to perform descriptive statistics based on absolute and relative frequencies and Pearson’s chi-square ( $\chi^2$ ) test to verify the dependence or independence of the variables.

## 3. Results

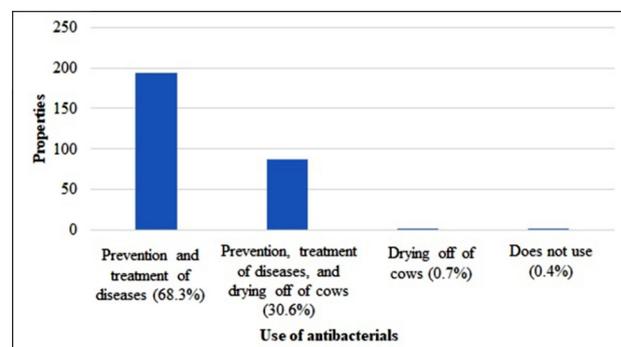
A total of 286 interviews were conducted in dairy farms in the State of Goiás, Brazil. The herd consisted of crossbred animals in 94.1% (269/286) of the properties. European dairy breeds were observed in 5.2% (15/286) and other breeds in 0.7% (2/286) of the farms. Cement floors were found in 60.8% (174/286) of the milking parlors, whereas earthen floors were in 39.2% (112/286). The cleaning of the milking parlor facilities was performed in 82.2% (235/286) of the properties, of which 66.8% (191/286) performed it daily. As for the type of cleaning, 52.8% (124/235) of the farms washed the facilities with running water, 31.5% (90/235) only carried out the picking (removal of feces), and 4.7% (11/235) performed combined cleaning such as sweeping and picking (6), sweeping and

washing (4), or picking and washing (1).

Table 2 shows the production parameters of the dairy farms grouped according to the produced milk volume. The presence of veterinary assistance was reported in 40.5% of the properties (116/286). Veterinary assistance met all the required demands in 77.6% (90/116) of them. The other producers reported that the veterinarian attended specific areas, such as clinical and surgery (4), reproduction (9), nutrition (2), milk quality (1), and health (1), or even a combination of them (10), totaling 23.3% (27/116).

Pearson’s chi-square ( $\chi^2$ ) test showed a statistically significant association between rural producers with low education and the use of antibacterials without veterinary medical assistance ( $p < 0.001$ ). In addition, the absence of veterinary assistance on the property was significantly associated with a lack of technical assistance on the use of antibacterials ( $p < 0.001$ ). However, the prescription of antibacterials by veterinarians did not influence the destination of milk with residues ( $p = 0.908$ ) (Table 3).

No significant association was observed between the destination of milk with antibacterial residues and the variables education of rural producers ( $p = 0.641$ ) and the presence of veterinary technical assistance ( $p = 0.369$ ) (Table 4). Antibacterials were used in 68.3% of the properties for preventing and treating diseases. Respondents stated that they did not use these drugs in 0.4% of the properties (Figure 2).



**Figure 2.** Reasons for using antibacterials in dairy farms located in the State of Goiás visited between 2019 and 2021.

**Table 2.** Production parameters of 286 dairy farms in the State of Goiás, where interviews were conducted between 2019 and 2021.

Variable	Milk production			
	Up to 300 L	301 to 600 L	Over 600 L	TOTAL
	n (%)	n (%)	n (%)	
No. properties	209 (73%)	38 (13.4%)	39 (13.6%)	286
Milk volume/day (L)	22.406 (20.7%)	17.885 (16.6%)	67.720 (62.7%)	108.011
PVA	57 (27.3%)	23 (60%)	36 (92.3%)	116 (40.5%)
Lactating cows	3.226	1.582	3.790	8.598
ALC/property	15	41	91	30
ADP/property (L)	107.2	440.6	1.736.4	2.284.2
ADP/cow $\pm$ SD	7.14 $\pm$ 3.39	10.7 $\pm$ 3.81	19.1 $\pm$ 4.95	76.13 $\pm$ 5.09

No./n: number; L: liters; PVA: presence of veterinary assistance, ADP: average daily production; ALC: average number of lactating cows; SD: standard deviation.

**Table 3.** Association between the use of antibacterials and education, veterinary technical assistance, and destination of milk with residues of antibacterials on 286 dairy farms in the State of Goiás.

Variable	Use of antibacterials		p-value
	With veterinary assistance	Without veterinary assistance	
	n (%)	n (%)	
<b>Education</b>			
Low education	37 (19.6%)	152 (80.4%)	<0.001*
High education	36 (39.6%)	55 (60.4%)	
<b>Veterinary assistance</b>			
Yes	69 (60.5%)	45 (39.5%)	<0.001*
No	6 (3.5%)	164 (96.5%)	
<b>Destination of milk with residues</b>			
Animal feed and soil disposal	73 (26.8%)	199 (73.2%)	0.908
Derivatives production	2 (25%)	6 (75%)	

\*P-values ≤ 0.05 are considered significant by Pearson's chi-square ( $\chi^2$ ) test.

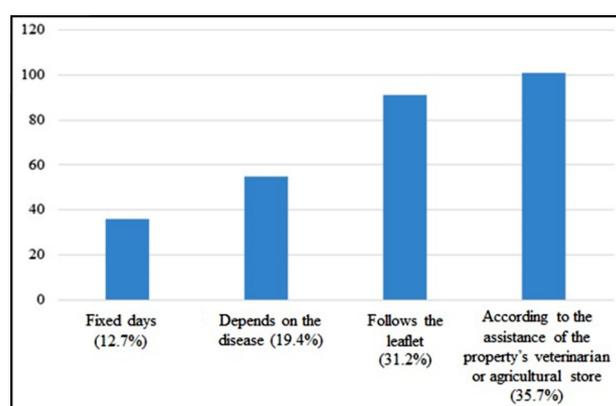
**Table 4.** Association between the destination of milk with residues and education and veterinary assistance in 286 dairy farms in the State of Goiás.

Variable	Destination of milk with residues		p-value
	Animal feed and soil disposal	Derivatives production	
	n (%)	n (%)	
<b>Education</b>			
Low education	180 (96.8%)	6 (3.2%)	0.641
High education	88 (97.8%)	2 (2.2%)	
<b>Veterinary assistance</b>			
Yes	111 (98.2%)	2 (1.8%)	0.369
No	161 (96.4%)	6 (3.6%)	

\*P-values ≤ 0.05 are considered significant by Pearson's chi-square ( $\chi^2$ ) test.

Figure 3 shows the criteria for determining the number of antibacterial applications in the visited properties. Respondents answered that the number of times the antibacterial was applied to the animals varied. Producers followed the advice of the veterinarian on the property or the agricultural store that sold the product in 35.7% of the cases.

After using antibacterials, 94.7% (271/286) of respondents said they discarded milk with residues and only 4.2% (12/286) said they did not. However, the disposal of milk with residues in 4.5% (13/286) of the properties was carried out only from the mammary quarters where the antibacterial was applied. The interviewed rural producers adopted different criteria for defining the milk disposal time so that 62.8% followed the package insert, 33.2% defined the disposal time by their own decision, and 13.4% followed the dairy factory's guidelines for which they provided the milk.



**Figure 3.** Criteria for determining the number of antibacterial applications in dairy farms located in the State of Goiás visited between 2019 and 2021.

Among the antibacterials, there was a wide variety of classes that included tetracyclines (39%),  $\beta$ -lactams

(35.8%), macrolides (9%), sulfonamides (7.1%), fluoroquinolones (4.4 %), aminoglycosides (4.3%), chloramphenicol (0.3%), and quinolones (0.1%). Figure 4 shows the antibacterials cited during the interviews. The respondents mentioned the use of 21 active principles of antibacterials, of which tetracycline (36.7%), penicillin (24.1%), and ceftiofur (8.7%) stood out.

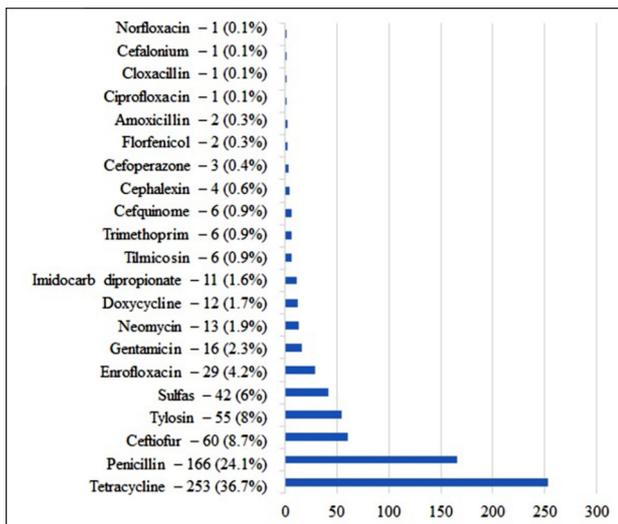


Figure 4. Antibacterials used in 286 dairy farms in the State of Goiás, Brazil, visited between 2019 and 2021.

The respondents of 37.4% of the properties mentioned other classes of drugs when asked about the used antibacterial agents, such as antiprotozoal (54.2%), antiparasitic (14%), vermifuge (14%), anti-inflammatory (3.8%), and vitamin K (2.8%) (Figure 5).

The diseases treated with antibacterials according to the respondents are listed in Figure 6.

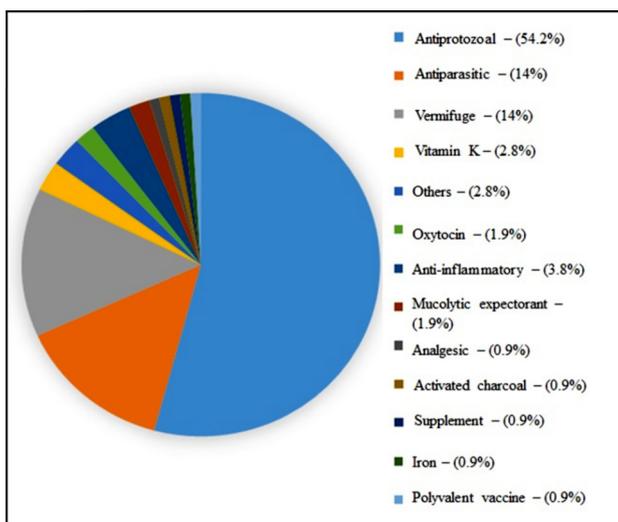


Figure 5. Drugs incorrectly identified as antibacterials by respondents from 286 dairy farms in the State of Goiás, visited between 2019 and 2021.

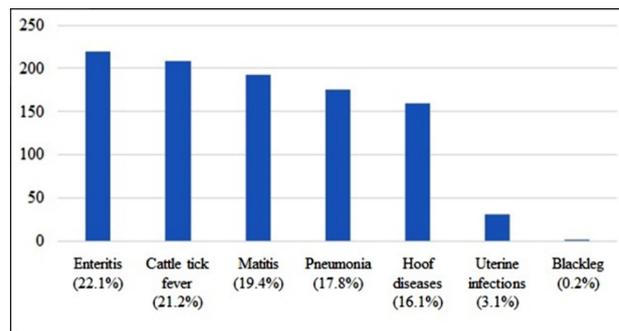


Figure 6. Diseases treated with antibacterials according to respondents from 286 dairy farms in the State of Goiás, visited between 2019 and 2021.

### 3. Discussion

This study presents a survey of data on dairy production, education, veterinary technical assistance, prescription of antibacterials, and disposal of milk with residues of antibacterials in 286 dairy farms in the State of Goiás, Brazil. Thus, we sought to contribute to the situational diagnosis of the influence of veterinary assistance on the use of antibacterials and the disposal of milk with residues. Although the presence of antibacterials has already been identified in samples of pasteurized milk in Goiás,<sup>(19)</sup> no studies with this scope, evaluating the knowledge of rural producers in Goiás about these drugs, have been found. Data surveys are important to support the performance of technical assistance and rural extension services (public and private) to promote milk production with greater food security.<sup>(20)</sup> According to data from this research, most producers value the cleanliness of the milking environment. However, the use of earthen floors (39.2%) and the failure to clean the milking parlor (17.8%) show that hygiene does not meet the minimum standards of identity and quality of the milk required to guarantee food safety in many properties,<sup>(21)</sup> putting public and animal health at risk.<sup>(22)</sup>

Education and veterinary assistance had no significant association with the rural producer's decision to dispose of milk with antibacterial residues, as all producers disposed of the milk incorrectly. We found that 72.7% (152/209) of producers who produced up to 300 liters of milk did not have veterinary assistance. This finding indicates that these producers discard milk without criteria because they do not have adequate technical information. An alternative would be the use of a lined septic tank to avoid drug contact with environmental bacteria.<sup>(23)</sup> However, rural producers do not invest in the correct disposal of contaminated milk, as they always need to cut costs to achieve an economically viable production. Treating milk with antibacterial residues would be a long-term investment for the farm, as it would reduce the selection of resistant bacteria and the

spread of resistance to other environmental microorganisms. This information reinforces the data verified in the 2019 Goiás Milk Chain Diagnosis,<sup>(23)</sup> which found little relationship between education level and milk production ranges. On the other hand, Borsanelli et al.<sup>(20)</sup> demonstrated that producers with a low education level have a higher tendency to milk animals treated with acaricides and not discard the milk of cows being treated for mastitis.

Small properties with daily milk production of up to 300 liters predominated in this research, as well as low average daily production per cow. The presence of veterinary assistance was reported in only 20% of the small farms. These data show that properties with low technology, productivity, and profitability still predominate although the State of Goiás is the fourth largest producer of milk.<sup>(23)</sup> Similarly, a survey on the Goiás Milk Chain,<sup>(23)</sup> demonstrated that 52.64% of the properties produce up to 200 liters of milk per day and 79% do not receive continuous technical assistance. In contrast, a smaller portion of the properties in the sampling of the present study was responsible for the higher amount of milk produced. National data reinforce the results shown in this study. In Brazil, 82% of milk production is concentrated in only 17% of the properties.<sup>(24)</sup>

The use of antibacterials without the assistance of a veterinarian predominated among the interviewed producers, being proportionally higher among those with low education. These data demonstrate the lack of knowledge about antibacterials, methods of containing the spread of bacterial resistance, and low specialization of rural properties. This information reinforces the need to train producers and employees involved in the management of dairy farms to make them aware of the health risk of selling milk that does not meet quality standards. In 2019, only 23% of producers and 10% of employees attended a training program on dairy activity in Goiás,<sup>(23)</sup> which demonstrates the urgent need to implement training programs to improve milk quality indices in the State of Goiás.

Veterinary assistance has a direct influence on the use of antibacterials with or without professional guidance. This information reinforces the importance of veterinarians throughout the production chain and, above all, their important role in guiding rural producers regarding the health of herds. This professional is essential to guarantee the food safety of products that reach the final consumer.<sup>(25)</sup> These results demonstrate the importance of technical assistance to increase production rates, which was also demonstrated by Gonçalves et al.<sup>(26)</sup> Despite this, Goiás has a deficiency in the transmission of quality technical information, since neighbors and social networks still represent an important source of consultation.<sup>(23)</sup>

On the other hand, the importance of the commitment of producers who invest in technical assistance and technologies that enable greater intensification of dairy production must also be highlighted. Technicians are responsible for providing producers with modern methodologies and information capable of improving the zootechnical indices of the herd. However, the costs of veterinary assistance can be high for small producers. In Goiás, 37% of dairy farmers are not willing to pay for technical assistance.<sup>(23)</sup> It possibly occurs because it is not directly related to the price paid per liter of milk by dairy factories. An alternative would be the subsidy of large dairy factories for technical assistance to small producers, as this investment would be reversed in increasing milk productivity and quality.

Most producers (99.6%) use antibacterials preventively either to dry off cows or after some specific management, which increases the exposure of the drugs to environmental bacteria. This habit of farmers and even professionals aggravates the context of bacterial resistance. For this reason, the European Union (EU) has issued strict regulations to prohibit the administration of prophylactic antibacterials, particularly regarding their use for metaphylaxis. In addition, EU member countries have carried out strict control over the sale and use of veterinary antibacterials.<sup>(27, 28)</sup> Similar measures should also be implemented in developing countries such as Brazil to contain the accelerated advance of bacterial resistance.

A small portion (31.2%) of the producers has followed the instructions on the leaflet regarding the dose of antibacterials. This result demonstrates that the lack of veterinary assistance in 59.4% of the properties makes a big difference in terms of technical guidance for the use of antibacterials. Thus, the protocols for the use of these drugs must be strictly followed by livestock farmers and veterinarians to prevent the development of bacteria resistant to antibacterials in dairy farms and, therefore, protect animals, humans, and the environment in the context of one health.<sup>(29)</sup>

Despite the veterinary assistance is present in only 40.5% of the farms, 95.8% (271/283) of the properties have discarded the milk after using antibacterials, demonstrating that there is general knowledge of producers about the risks associated with the consumption of milk with residues. Similarly, Redding et al.<sup>(30)</sup> evaluated the use of antibacterials in small dairy farms in Peru. However, the present research showed that the disposal of milk was often carried out for a shorter time than recommended and/or incorrectly. In the latter case, the disposal of milk with residues is a challenge in all properties, as there are no adequate disposal methods that reduce the risk of selection of resistant bacteria. Moreover, most farms provided waste milk for other animals (89.5%). According to Pereira et al.,<sup>(31)</sup> feeding

calves with milk containing low concentrations of antibacterials for six weeks resulted in the selection of multiresistant *Escherichia coli* strains. This reality puts the health of the final consumer at risk, considering that antibacterial residues in milk, when ingested by humans, can result in damage, which is often irreversible.<sup>(6,12)</sup> Stella et al.<sup>(5)</sup> expressed a similar concern. Thus, implementing appropriate practices for the disposal of milk with residues, such as pasteurization, is essential. This technique reduces the risk of exposure of calves and consumers to multiresistant bacteria and reduces their dissemination in the environment.<sup>(32)</sup>

Twenty-one antibacterial active principles were mentioned by the producers, of which the most used, in descending order, were tetracycline, penicillin, and ceftiofur. The option for these products may be related to the ease of acquisition, accessible prices, and the positive results identified by rural producers and auxiliary workforce. In addition, ceftiofur is called zero waiting period for use in milk due to its rapid metabolism.<sup>(33)</sup> Similar data have been described in countries such as China,<sup>(34)</sup> Timor-Leste,<sup>(14)</sup> Peru,<sup>(35)</sup> and Canada.<sup>(36)</sup> Brown et al.<sup>(37)</sup> found 95 samples of milk (74 pasteurized and 21 unpasteurized) with the occurrence of residues in a survey carried out in Kenya, of which 7.4% were beta-lactams and 3.2% tetracyclines.

Respondents did not know what antibacterial was in 37.4% of the visited properties and pointed out other classes of drugs, including antiprotozoal and antiparasitic agents, as antibacterial. Although surprising, this finding was also observed in surveys in other countries.<sup>(34, 38)</sup> This result is worrying, as the most cited diseases were enteritis, cattle tick fever, mastitis, pneumonia, and hoof diseases, which require therapeutic protocols involving antibacterials. These diseases have affected cattle farms in other countries<sup>(35, 39)</sup> and other species such as pigs,<sup>(34)</sup> and, therefore, the ideal would be to have no doubts about what an antibacterial agent or any other drug is.

Antibacterial resistance, a factor that threatens public health, is a global problem. The use of prophylactic and therapeutic antibacterials in production animals is one of the factors with the highest impact on the spread of bacterial resistance. The knowledge and attitudes of dairy farmers towards the use of antibacterials in animals play an important role in the development of bacterial resistance. Therefore, the conscious and precise use of antibacterials in production animals is essential.

In general, this study identified several negative factors for milk production in properties in the State of Goiás, among which the most important was the lack of training for producers and auxiliary workforce. In addition, there are limitations regarding animal health, including the prevention and treatment of diseases. Therefore, a prospective assessment of this situation shows that it may result in microbial resistance, causing

financial losses to the farms and negative impacts on their one health.

In this context, holding discussions on the subject with dairy producers with the effective participation of institutions representing producers, large dairy factories, research, animal health, and public health institutions, and representatives of society is essential, otherwise resistance to antibacterials will become a more serious problem very shortly. Ting et al.,<sup>(14)</sup> Schwendner et al.,<sup>(40)</sup> Albernaz-Gonçalves et al.,<sup>(41)</sup> Dankar et al.,<sup>(42)</sup> and Olasoju et al.<sup>(7)</sup> drew attention to this situation, demonstrating that those who deal with antibacterials daily do not have adequate knowledge and instructions on their correct use and the consequences that the spread of bacterial resistance has on human and animal health and the environment.

## 5. Conclusions

Veterinary assistance is directly associated with the use of antibacterials by producers with or without veterinary guidance but not with the disposal of milk with residues. Rural producers in the State of Goiás are aware of the need to dispose of milk with antibacterial residues but they do not do it properly. Farms with lower dairy productivity are less careful about the use of antibacterials. The production chain in general has a lack of basic knowledge about drugs. There is an urgent need to expand technical assistance and training of producers regarding food-safe milk production to prevent risks associated with animal and public health in the State of Goiás.

### Conflict of interests

The authors declare no conflict of interest.

### Author contributions

*Project management:* D.B.C. Silva. *Research:* D.B.C. Silva. *Proofreading (proofreading and editing):* D.B.C. Silva and P.J.B. Queiroz. *Conceptualization:* L.A.F. Silva. *Supervision:* L.A.F. Silva. *Formal analysis:* P.J.B. Queiroz. *Visualization:* A.D.F. Noronha Filho. *Data curation:* S.L.R. Freitas and D.R. Santos. *Validation:* N.C. Borges.

### Supplementary material

<https://revistas.ufg.br/vet/article/view/73715/39525>

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