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Dairy goat welfare in semi-intensive production systems and drought conditions

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Abstract

*The region of Coquimbo has the highest percentage of goats (*Capra hircus*) in Chile and is severely affected by droughts. This can lead to environmental challenges such as limited water and forage availability when goats are kept in natural grasslands. The objective of this study was to assess the welfare of dairy goats in semi-intensive production systems under drought conditions. The study was carried out in La Serena city, region of Coquimbo, Chile and 22 semi-intensive dairy goat farms were assessed using the Animal Welfare Indicators protocol. In each evaluation, the following indicators and information were gathered: physical and behavioural indicators of animal welfare, farmers' sociodemographic information, farm facilities, husbandry practices and management of the farm, and farmers' perception of animal welfare. Of the goats evaluated (n = 446), the vast majority had a body condition score (BCS) considered normal (n = 349; 78.25%). The main welfare problems were poor hair condition, faecal soiling, overgrown claws and improper disbudding or dehorning. The majority of farmers (96%) considered it 'rather important' or 'very important' to handle their goats in a gentle manner, expressing concern about the welfare of their animals and considering pain as a negative experience for goats. A lower than expected percentage of very thin animals (low BCS) were seen, considering the drought conditions and the forage shortage that affects the region, and no animals were observed with signs of thermal stress. The semi-intensive production systems could be an alternative to pasture-based systems to overcome environmental challenges.*

Keywords: *animal welfare, assessment, dairy goats, drought, indicators, perception*

Introduction

Dairy goat (*Capra hircus*) welfare in production systems can be affected by several factors, such as health and behaviour problems, husbandry practices that cause pain, use of inadequate facilities, predation, exposure to unfavourable weather conditions, water and food availability, among other factors (Dwyer 2009; Larrondo *et al* 2018; Munoz *et al* 2019). In this regard, animal welfare evaluation protocols at farm level must incorporate valid and reliable indicators which, in turn, include both direct (measurable in the animal) as well as indirect (measurable in the environment and the workers' management) indicators (Waiblinger *et al* 2001; Caroprese *et al* 2009; Mattielo *et al* 2015; Spigarelli *et al* 2020). Hence, for the evaluation of animal welfare, multi-dimensional protocols should be used (Can *et al* 2016; Stilwell 2016; Spigarelli *et al* 2020), with the objective of gathering as much information as possible. In 2005, the European Animal Welfare Indicators evaluation protocol was published (AWIN 2015), applicable to intensive and semi-intensive dairy goat systems and which deals with indicators associated with good feeding, good housing, good health, and appropriate behaviour.

Among the environmental factors seen as challenges for goat production systems and their sustainability, there is an emphasis on the problems associated with water and forage availability (Meneses 2017; Joy *et al* 2020). In the last few years, Chile has experienced a sustained drought, which has been characterised by a marked reduction in rainfall, along with other factors, such as the progressive soil desertification and anthropogenic influence (Boisier *et al* 2016, 2018; Meneses 2017). This situation has had a negative impact on ruminant production systems; taking the Coquimbo region as an example, as a consequence of the drought, 2019 saw the death of an estimated 120,000 sheep, cattle and goats, 80,000 of which were goats (MINAGRI 2019).

The majority of goat production systems in Chile belong to small-scale farmers, from which the Coquimbo region predominates, concentrating the highest percentage of goats nationwide (69.5%; n = 310,916 animals) (INE 2017). Currently, the Coquimbo region is considered an agricul-

Table 1 Physical and behavioural indicators evaluated from outside the pen in dairy goats. Adapted from the Animal Welfare Indicators protocol for dairy goats (AWIN 2015).

Welfare indicator	Description
Improper disbudding or dehorning	Presence of residual cornual tissue on the head of adult goats that were disbudded when kids, or badly dehorned animals: animals with horns cut near the base, cut asymmetrically
Poor hair coat condition	Fur in poor condition was considered: shaggy hair, matted layers of hair, alopecic areas, accumulation of detritus of the epidermis, longer hair layer in the hindquarters and in the midline of the spine
Queuing at drinking	Animals that stood with their heads facing the trough without being able to drink water, around 50 cm behind the individuals that were drinking. Evaluation time: 15 min
Queuing at feeding	Animals that stood with their heads facing the trough without being able to feed, around 50 cm behind the individuals that were eating. Evaluation time: 15 min
Kneeling at the feeding rack	Animals that were fed at the trough with their forelimbs flexed and hindquarters raised
Oblivion	Animals that were separated from the rest of the herd during synchronised activities such as feeding and resting, goats that were standing and immobile, animals leaning against a wall or structure of the pen, no interaction with their conspecifics during the observation period
Thermal stress	Animals with signs of heat stress: accelerated breathing with their mouths open, panting, excessive salivation

tural emergency zone (GORECOQUIMBO 2019), a scenario significantly affecting goat production systems, which are managed largely extensively, based on grazing in natural grasslands and therefore dependent on rainfall for their growth (Díaz 2006; Meneses 2017). In extensive production systems, animals are more exposed to environmental challenges than those animals in semi-intensive conditions (Gallo & Huertas 2016; Meneses 2017; Spigarelli *et al* 2020), which is why it is of interest to evaluate the latter, with the objective of ascertaining the welfare of animals in this type of system, as well as their infrastructure, so that their feasibility can be estimated as a possible productive alternative to the complex scenario that dairy goat systems face in the country.

Currently, studies carried out in Chile have evaluated the welfare of cattle (*Bos taurus*) (Strappini *et al* 2009; Gallo 2010) and sheep (*Ovis aries*) (Tarumán & Gallo 2008; Tadich *et al* 2009; Gallo *et al* 2018) along the production chain. However, in goat production systems there is a paucity of scientific literature pertaining directly to Chile and therefore the overall welfare of this species is unknown. The main objective of this study was to evaluate the welfare of semi-intensive dairy goats from productive systems in La Serena city, Coquimbo, in drought conditions, utilising the Animal Welfare Indicators protocol for dairy goats (AWIN 2015). This protocol would consider direct and indirect animal welfare indicators, in addition to farmers' perception of animal welfare on their farms.

Materials and methods

This study was approved by the Committee of Research of the Universidad Pedro de Valdivia and carried out between June and August 2019 (winter), in semi-intensive dairy goat farms in La Serena city, Coquimbo, Chile. Goat farmers were invited to participate voluntarily through contact with the Instituto de Desarrollo Agropecuario (INDAP), which is part of the Ministry of Agriculture of Chile. The farms were selected based on being semi-intensive, dairy-producing systems, and located in this specific region of the country. From a total of 115 farms with INDAP advice in La Serena city, 22 were evaluated, corresponding to the 19% of goat farmers with technical advice from the government.

Prior to the onset of the study, the assessor was theoretically trained in the use of each AWIN protocol indicator for five 60-min sessions (AWIN 2015) via a review of photographs, specific definitions of indicators under evaluation at each stage of the assessment and data registration, including implementing the mobile application for AWIN smartphones. Additionally, practical protocol training took place in a semi-intensive farm similar to those included in the study but one that was not included. During this visit, each section of the evaluation guideline to be used was tested and the assessor was trained in its use, from the beginning where it was explained to the farmer what the evaluation would entail. On each subsequent visit, data were recorded using the free mobile phone application based on AWIN assessment protocol. This application enabled the characteristics of each facility to be recorded. In addition, the protocol incorporated a short survey, which each farmer completed at the start of each evaluation to gather information on the perception of the level of welfare at the farm level. Qualitative Behaviour Assessment was not carried out, due to a lack of both staff and time.

During the study, evaluations were always performed by the same assessor and held in pens of adult lactating goats. In order to increase the sensitivity of the evaluation, the protocol indicated selection of pen or pens (according to the number of animals) that present the greatest potential risk for animal welfare (AWIN 2015). This selection considered the following aspects: high animal density per pen; lower proportion of feeding space and drinkers; presence of both horned and hornless goats in the same pen. The evaluation in pens was separated into three stages: the first was carried out from outside the pen (Table 1), while the second and third took place inside (Table 2).

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Table 2 Animal welfare indicators evaluated on dairy goats inside the pen. Adapted from the Animal Welfare Indicators protocol for dairy goats (AWIN 2015).

Welfare indicator	Description
Latency to the first contact test	Physical contact between the goat and any part of the assessor's body was timed by a clock. The test was limited to 300 s
Body condition score (BCS)	It was visually categorised into three levels: 'very thin', 'normal' and 'very fat' (–1, 0 and 1, respectively)
Abscesses	Presence of abscesses on the head, neck, shoulders, hindquarters and/or udder area
Faecal soiling	The hindquarters of the goat, the area around the anus and both sides of the tail were observed. All animals that presented the presence of solid pasty and liquid faecal remains were included
Nasal discharge	Discharges around the nostrils or hanging from the nose were evaluated, only white or yellowish secretions (mucosa or purulent) were considered
Ocular discharge	Discharges around the eye(s) or running down the face were evaluated. The presence of ocular discharge was considered to be all types of watery, thick, transparent or whitish discharges. Unilateral and bilateral discharge were considered
Overgrown claws	Only the hind hooves of the animals were considered. Hoof overgrowth was classified as any that exceeded the normal length and width, which led to the loss of the physiological triangular anatomy and its deformation
Severe lameness	Animals with severe lameness were considered to be those with: irregular head movements during walking (elevation or descent), as well as animals that did not maintain the station, individuals that did not get up and those that curved their spine
Udder asymmetry	The hind train of the goat was visually evaluated, standing, observing caudally, having complete vision of the udder region. All those udders that had one of their middles 25% longer than the other were considered asymmetric, excluding the teats

Evaluation from the outside the pen

Visual evaluation from the outside of the pen took place from a strategically advantageous observation point which enabled visualisation of the entire pen, at an approximate distance of 1.5 m. The number of animals (frequency) was quantified, taking into account indicators such as: improper disbudding or dehorning, poor hair coat condition, animals queuing at drinking and at feeding, animals kneeling at the feeding rack, thermal stress (Table 1).

Evaluation from the inside the pen

Here, the assessor entered and took up a position at the end of each pen, and carried out the latency to first contact test (Table 2). The third evaluation stage was carried out, which included 446 lactating goats with a mean (± SD) of 20.2 (± 12.8) lactating goats per farmer. The individual evaluation included the following indicators: body condition score (BCS), presence of abscesses, faecal soiling, nasal discharge, ocular discharge, overgrown claws, severe lameness, and udder asymmetry (Table 2). Finally, each pen's infrastructure was evaluated, including the characteristics and dimensions of feeders and drinkers. The bedding material in each pen was classified as: sufficient —when it was soft and abundant, completely covering the floor; insufficient — when the amount of bedding material was scarce or there were places with an absence of material; or non-existent — when there was no bedding material at all. The cleanliness of the pen was also categorised as 'clean' when bedding was dry and free from faeces or 'dirty' when the bedding showed the presence of urine and scattered faeces.

Farmers' and farm information, farm management and animal welfare perception

Data from each farmer and their farm were gathered through a brief survey, which included: age, gender, animal breeds, numbers of adult lactating goats, number and type of milking parlour. Data on the operations carried out by the producer were collected in the same way as regards: pen grouping strategy, number of feed deliveries per day, frequency of claw trimming, age of goats at first kidding (months), dry period (yes/no), pain management for disbudding and dehorning (yes/no). Also, farmers were consulted as to whether they used a stick when entering the pen (yes/no) and (if so) their reason for doing so (moving the animals/beating the animals/safety tool), as well as the behaviour of the majority of goats when the farmer enters the pen (whether they approach/stay still/move away).

Conversely, each farmer was also asked the degree of importance (not/little/partially/rather/very important) that they assigned to the following questions: touch the goats gently, to talk to the goats during the milking and pain matters to goats.

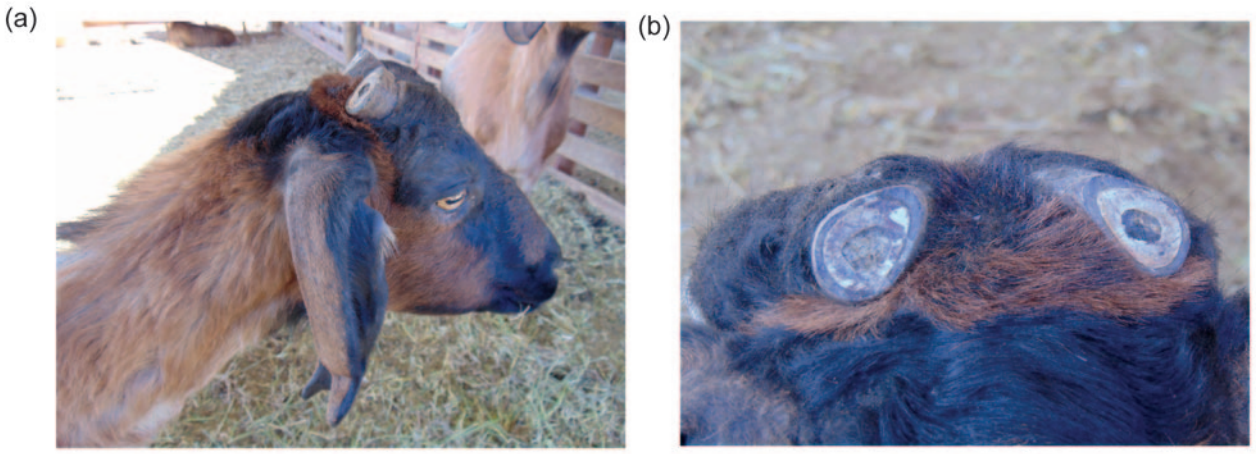
Data analysis

Descriptive analysis of demographic information, management practices carried out on the farms and the survey of perception of animal welfare was carried out. The physical and behavioural indicators evaluated from the outside and inside each pen were coded as frequencies and percentages, calculating the prevalence of each

Table 3 Perception of 22 dairy goat farmers in the Coquimbo region, Chile, regarding the importance of good management of their animals. Number and percentage of responses obtained for each question.

Question	Not important	Little important	Partially important	Rather important	Very important
How important do you think it is to touch the goats gently?	0 (0%)	0 (0%)	1 (4%)	11 (50%)	10 (46%)
How important do you think it is to talk to the goats during milking?	0 (0%)	0 (0%)	4 (18%)	10 (46%)	8 (36%)
How important do you think pain is to goats?	0 (0%)	0 (0%)	1 (4%)	13 (60%)	8 (36%)

Figure 1



Improper dehorning in adult goats showing (a) lateral and (b) craniocaudal views.

indicator in each farm and total (number of goats with problem divided by the total of goats evaluated during the study). The first contact latency test is reported as average time. Data were analysed using the R statistical programme (R Core Team, Vienna, Austria).

Results

Farm information and farmers' perception of animal welfare

Most of the goat farmers visited were male (n = 14; 64%), with less than half female (n = 8; 36%), at an age of 52.8 (± 9.5) years. The total number of goats owned by farmers was 1,786, with an average of 81.1 (± 35.06) animals each. The total number of lactating goats evaluated was 446, with an average of 20.2 (± 12.8) lactating goats per farmer. The main breeds were: Creole (n = 223; 50%), Saanen (n = 100; 22%), Alpina (n = 67; 15%) and hybrid goats (n = 56; 13%). The age at first kidding of the goats was 13.7 (± 2.4) months and no drying therapy took place in any of the study farms. All had one milking parlour and milk was extracted manually. All farms provided daily outdoor grazing for their goats. Three farmers (14%) grouped their animals in the pens according to breed, while the remaining 19 (86%) had no specific grouping strategy. Food was delivered up to three times a day, with six (27%) producers delivering food once a day, eleven (50%) twice, and five (23%) three times a day. In relation to husbandry practices, 15 (68%) farms performed dehorning and disbudding at 17.2 (± 4.47) days of age for disbudding. For both practices, all farms lacked an analgesic and pain management method. On the other hand, claw trimming was carried out subject to need (n = 22; 100%).

One farmer (4%) always carried a stick when entering the pen, while 21 (96%) indicated that they did not use any tool. According to the goats' behaviour with respect to the farmer's entry into the pen, 16 (73%) farmers responded that the animals approached them, while six (27%) noted that the animals stayed where they were carrying out their usual activity. Table 3 shows that all farmers felt there was at least a partial requirement for goats to be touched gently and spoken to during milking, as well as concern amongst them regarding the extent to which pain is a negative experience for goats.

Animal welfare and farm infrastructure problems

In relation to the indicators evaluated from outside the pens, the main problem detected was poor coat condition, followed by disbudding and inappropriate dehorning (Figure 1). No animals were found kneeling at the time of feeding, neither due to inattention nor signs of heat stress (Table 4).

All the evaluated pens were constructed from wood and lacked litter material, finding only soil. Furthermore, nine (41%) were categorised as dirty and 13 (59%) clean. The mean (± SD) area of the pens was 38.3 (± 50.1) m^2 with

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Table 4 Prevalence of welfare and management problems in lactating goats (n = 446) belonging to 22 dairy goat farms in the Coquimbo region, Chile, evaluated from outside each pen using the Animal Welfare Indicators protocol for goats (AWIN 2015).

Welfare indicator	Goats (%)	SD	Minimum	Maximum	Farms (%)
Improper disbudding or dehorning	26 (5.83)	± 1.5	0	7	15 (68.18)
Poor hair coat condition	57 (12.78)	± 1.76	0	6	19 (86.36)
Queuing at drinking	5 (1.12)	± 0.43	0	1	5 (22.73)
Queuing at feeding	4 (0.90)	± 0.39	0	1	4 (18.8)
Kneeling at the feeding rack	0 (0)	0	0	0	0 (0)
Oblivion	0 (0)	0	0	0	0 (0)
Thermal stress	0 (0)	0	0	0	0 (0)

Table 5 Prevalence of welfare indicators in lactating goats (n = 446) belonging to 22 dairy goat farms in the Coquimbo region, Chile, evaluated from inside each pen using the Animal Welfare Indicators protocol for goats (AWIN 2015).

Welfare indicator	Goats (%)	SD	Minimum	Maximum	Farms (%)
Body condition score					
Very thin (–1)	74 (16.59)	± 2.26	0	8	19 (86.36)
Normal (0)	349 (78.25)	± 12.28	4	52	22 (100)
Very fat (1)	23 (5.16)	± 2.54	0	9	5 (22.73)
Abscesses	17 (3.81)	± 1.41	0	6	9 (40.90)
Faecal soiling	52 (11.66)	± 1.84	0	8	19 (86.36)
Nasal discharge	14 (3.14)	± 0.85	0	3	10 (45.45)
Ocular discharge	6 (1.35)	± 0.55	0	2	5 (22.73)
Overgrown claws	49 (10.99)	± 3.24	0	15	21 (95.45)
Severe lameness	1 (0.22)	± 0.21	0	1	1 (4.54)
Udder asymmetry	11 (2.47)	± 0.67	0	2	9 (40.90)

dimensions 6.83 (± 3.26) × 4.56 (± 2.43) m; length × width. Space allowance was 1.7 (± 1.24) m^2 per animal and none of the farms had pens set aside for isolation and treatment of sick animals.

Most of the farms (n = 16; 73%) had only one feeder, while the remaining six (27%) had two. On average, feeders were 2.96 (± 1.63) m in length and allowed 0.17 (± 1.2) m of space per animal. Almost all (n = 21; 95%) had only one drinking fountain, and only one (5%) had two, with an average length of 0.97 (± 0.84) m, and an average space of 0.05 (± 0.03) m per animal.

In the first contact latency test, the average time was 96.54 (± 54.96) s (min–max: 34–240 s). Most of the animals were in a body condition considered 'normal' (AWIN 2015). Physical welfare problems evaluated inside the pens that turned out to be more prevalent were faecal soiling and hoof overgrowth (Table 5).

Discussion

This research represents the first evaluation of animal welfare of goats in the Coquimbo region, Chile; a region of great importance for the goat industry in this country. Most of the study participants were male, in keeping with what was also seen in small ruminant producers in this country (INE 2011; Laytte 2015; Larrondo *et al* 2018). Additionally, the average producers' age of 52.8 (± 9.5) years, is in accordance with the current overall trend in the country, where producer age shows greater predominance in the > 50 years age group (INE 2011, 2017).

Regarding goat breeds in the farms evaluated, half were Creole, a breed serving a dual purpose (meat and milk production) and which is crossed with other breeds with the aim of improving their productive indicators (INE 2011, 2017). Over 90% of the goats in Chile correspond to the Creole breed (INE 2017), a rustic animal adapted to the area's arid or semi-arid conditions (INIA 2001). The incorporation of more

specialised genetic protocols in milk production was clearly visible in the study farms, including the use of Saanen and Alpine goat breeds (37% of the animals evaluated).

Over half of the farmers routinely carried out disbudding and dehorning, with no established protocol for either operation. Zober *et al* (2019) disagree on the routine elimination of horns in goat production systems, due to the key role horns play in the social interactions and behavioural repertoire of ruminants (Knierim *et al* 2015; Miranda-de la Lama & Matiello 2010; Miranda-de la Lama 2019). Compared to those without horns, horned animals are involved in fewer agonist interactions (Aschwanden *et al* 2008), although other factors play a role in the increase in these behaviours, such as grouping strategies (Menke *et al* 1999; Aschwanden *et al* 2008; Castro *et al* 2012). The study farms had no grouping strategies for animals, a stance directly contrary to what is recommended in the literature where maintenance of stable groups and the formation of pens with the same animals from when they are young until their adult life, have been found to be tools that improve social interactions between animals (Aschwanden *et al* 2008; Miranda-de la Lama & Matiello 2010).

One of the principle problems noted in our study were poorly implemented disbudding and dehorning procedures, creating increased risks of associated complications, such as osteomyelitis, meningitis and/or sinusitis (Jones *et al* 2017; Hartnack *et al* 2018). It is recommended that disbudding be performed prior to two weeks of age, in order to avoid possible horn growth or the development of abnormal regrowth (scur) in adult life (Andrade 2015; Jones *et al* 2017; Hartnack *et al* 2018). In addition, research has shown disbudding with analgesia to be preferable to dehorning, as the latter is deemed more painful for animals (Stafford & Mellor 2011).

The farmers that were visited made no use of analgesia during painful procedures such as disbudding and/or dehorning, which impinges on the welfare of their animals as both procedures are considered acutely painful. This has been established in various studies, which have also suggested the existence of chronic pain (Stafford & Mellor 2005, 2011; Casoni *et al* 2019). However, almost all (96%) of the farmers considered the absence of pain in goats to be of medium to high importance. Therefore, the perception and importance that producers attribute to the absence of pain in their animals is contrasted with the actions carried out on the farms, results similar to those reported in a previous study carried out on sheep producers in Chile (Larrondo *et al* 2018). Considering the negative impact that disbudding and dehorning have on the welfare of animals (Jones *et al* 2017; Hartnack *et al* 2018; Casoni *et al* 2019), and the alteration in the individual and social behaviour of goats (Knierim *et al* 2015; Miranda-de la Lama & Matiello 2010), it is necessary to question the implementation of such practices or introduce protocols to improve them, for example, the use of pain relief such as non-steroidal anti-inflammatory drugs (NSAIDs). Smith and Sherman (2009) and Jones *et al* (2017) have recommended the use of anaesthetic blocks around the base of the horns, deploying a local injection of 2% lidocaine (0.25 ml over each nerve) prior to carrying out disbudding, added to the use of an NSAID, such as flunixin meglumine (2.2 mg kg^{-1} IV) or meloxicam (0.5 mg kg^{-1} IM).

The prevalence of animals with a poor hair coat condition was lower than the 21.2% reported in ten small commercial farms in Portugal by Can *et al* (2016), but similar to the 7–13% reported in the same country by Andrade (2015). The number of animals in such a condition was similar to those showing a low body condition as well as those displaying faecal soiling, thus suggesting hair coat condition to be a possible indicator of animals' nutritional and health status (Battini *et al* 2015). Moreover, a lack of routine deworming may also be a factor explaining these findings. Some studies carried out in the UK and Portugal found prevalence values ranging from 3 to 5% for animals in very thin body condition and 3 to 17% for those with a high body condition score (Anzuino *et al* 2010; Can *et al* 2016). In contrast to those results, here we found a higher proportion of animals in low body condition score, findings to be expected when we consider the drought and related forage shortage; however, most of the animals assessed in this study were found in a body condition score considered 'normal.' Furthermore, no animals with signs of thermal stress were observed (eg panting), probably due to the fact that our study was carried out during winter, ie at a time the average air temperature did not exceed 20°C (INIA 2019).

The percentage of animals forced to wait and queue for feeding, kneeling at the feeding rack and queuing at drinking was lower than 2%. These results differed from those of Andrade (2015) who used the same evaluation protocol yet reported values ranging from 13 to 40% and around 0 to 6% for queuing at feeding and queuing at drinking, respectively. Our findings might be explained by the small size of farms assessed (20.2 [± 12.8] lactating goats per farmer) and the adequate provision of feeding and drinking space per animal at feeding racks and drinkers (Loretz *et al* 2004), due to goats having synchronous behaviour at feeding and drinking and not needing to wait to perform these activities in farms with adequate facilities (Miranda de la Lama & Mattiello 2010). Moreover, the pens' space allowance lay in the range reported for adult goats varying from 1.5 to 2 m^2 per animal (Toussaint 1997; Sevi *et al* 2009). The confinement, higher animal densities, climatic conditions and inadequate infrastructure in pens can increase the incidence of respiratory diseases (Rahal *et al* 2014). However, the prevalence values of welfare indicators associated with respiratory problems (nasal and ocular discharges) were lower than the expected (< 5%), especially when we consider that the study took place during the winter, a season where susceptibility to respiratory diseases increases due to the environmental challenges (Andrade 2005).

The presence of goats with overgrown claws was one of the most significant problems detected even though our prevalence value was lower than in some studies carried out in intensive dairy goat farms in the UK (79.8%; Anzuino *et al* 2010) and Norway (66.4%; Muri *et al* 2013). This finding might be explained by the semi-intensive farming conditions, where animals have partial access to pastures and greater wear and tear of their claws compared to intensive farming conditions where animals are kept indoors and mostly in pens with straw bedding material (Smith &

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Sherman 2009). Moreover, all the farms visited had pens with no bedding material, which can also contribute to and explain the wear of animals' claws, despite the lack of an established claw-trimming protocol in the farms visited.

The results obtained in the latency of first contact test differed from those reported in intensive farming conditions in Portugal by Andrade (2015), who found average values of 139.7 (± 139) and 156.9 (± 131.4) s for farms categorised according to their flocks' size as small farms (> 50 and < 100 adult dairy goats) and medium farms (> 100 and < 500 adult dairy goats), respectively. One of the possible explanations for the lower values obtained in the present study could be associated with semi-intensive farming conditions, where animals are able to graze and thereby better able to express exploratory behaviours. This may subsequently contribute to them feeling less fear in novel situations (Dwyer 2009). Goats in small dairy farms are also more likely to be in contact with humans. Goats that engage in gentle contact with humans tend to show less fear of them and approach humans faster than animals handled aversively (Jackson & Hackett 2007) and habituation takes less time (Jackson & Hackett 2007; Miranda-de la Lama 2019). Therefore, we might infer a positive human-animal interaction in the evaluated farms, allied to the fact that only one farmer used a stick on entering the pen and the vast majority indicated that animals approached them, or continued their usual activities when the farmer entered the pen. These findings echo the farmers' perception as regards the degree of importance attributed to the good management of their animals, where the vast majority indicated touching goats gently and talking to them during milking as rather important or very important.

Animal welfare implications

The findings of this research showed that semi-intensive production systems could be an alternative to pasture-based systems in which goats are kept permanently outdoors (the most common system in Chile), in order to mitigate the negative effects on welfare of extreme climatic conditions, related to droughts, such as lack of access to shelter/shade, water availability and forage variations.

Conclusion

This is the first study to assess the welfare of dairy goats in semi-intensive production systems in Chile. It was carried out in the region most associated with the caprine production industry. Despite the negative impact of droughts on animal welfare, the vast majority of physical and behavioural problems showed lower prevalence values than similar studies carried out in other countries using the same assessment protocol. Although there is a concern among farmers regarding the welfare of their animals and evidence of positive human animal-interactions, a number of routine husbandry practices require improving, such as timely hoof trimming and disbudding/dehorning pain mitigation.

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