Welfare Indicators of Milking Sheep and Goats in Commercial Farms in Spain: Evaluation and Differences among Species, Locations and Performances

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Abstract

The objective of this work was to evaluate a system for assessing the welfare of milking sheep and goats in practical farm conditions. The system uses indicators of environmental, management and facilities related welfare. In order to evaluate the animal welfare, 12 indicators ranked in 3 groups were defined: Environment Animal Welfare (EAW, n = 4) (temperature, airflow, ventilation and ammonia load) Management Animal Welfare (MAW, n = 5) (animal load, bedding, comfort, stress and cleanness of animals) and Facilities Animal Welfare (FAW, n = 3) (feeders of concentrate, feeders of forage and watering). All indicators were evaluated from 1 to 10 taking into account objective and subjective criteria. In addition, the average of scores of the three groups (EAW, MAW, and FAW) and the Global Animal Welfare (GAW) score (the average of all the indicators) were also calculated.

One hundred and one assessments (49 in goat and 52 in sheep) were carried out in intensive farms in Spain from 2005 to 2011.

The indicators were then compared by farm size, geographical location and production level of the farms. Results obtained show the relationships between the welfare indicators and the zoo technical characteristics of the farms.

Keywords: Welfare; Farms; Sheep; Goats

Introduction

The importance of animal welfare in the animal production industry is growing increasingly, not only by legal requirements but for its effects on productivity. Only if the animals are in a proper degree of comfort can be achieved optimal production levels [1]. However, the assessment of animal welfare in commercial dairy goats and sheep intensive farms is not well defined yet [2]. Several procedures to assess the animal welfare have been proposed worldwide [3-6]. In addition, according to Dungey [7], qualitative welfare assessment procedures are reliable and have been used in sheep. In all cases, indicators should be valid, reliable, economical and measurable in practical conditions [8]. The aim of this study is to assess the system proposed by Nanta to measure welfare of sheep and goat milking flocks, in practical operating conditions. The variations of the parameters set up, depending on the Spanish region, farm size and level of production have also studied.

Material and Methods

One hundred and one welfare assessments (49 goats and 52 sheep) in 71 intensive dairy farms (34 sheep and 37 goats) were carried out in Spain from 2005 to 2011. Although more than one assessment was made in several farms, the evaluations were carried out in different years. Therefore we consider every assessment as an individual farm.

In order to evaluate the animal welfare, 12 indicators ranked in 3 groups were defined: Environment Animal Welfare (EAW, n = 4) (temperature, airflow, ventilation and ammonia load), Management Animal Welfare (MAW, n = 5) (animal load, bedding, comfort, stress and cleanness of animals) and Facilities Animal Welfare (FAW, n = 3) (feeders of concentrate, feeders of forage and watering). All indicators were evaluated from 1 to 10 taking into account objective and subjective criteria.

In addition, the average of scores of the three groups (EAW, MAW and FAW) and the Global Animal Welfare (GAW) score (the average of all the indicators) were also calculated. The score of several feeding indicators (body condition score and faeces consistency, both of them scored from 1 to 5) were also collected from each farm (scoring only a sample of animals with a one value per farm).

Some productive performance data were taken from each farm: production yield (litters/animal.day), milk composition (fat (%), protein (%), fat plus protein (%), somatic cells (ufc[*]1000/ml) and daily production of fat (g/day), protein (g/

day) and fat plus protein extract (g/day). Average values of productive parameters for sheep and goats, respectively, were: 1.8 ± 0.08, 2.2 ± 0.09 litters/animal.day, 6.7 ± 0.21, 5.0 ± 0.13 fat (%), 5.1 ± 0.14, 3.7 ± 0.10 protein (%) and 910.6 ± 58.39, 1341.6 ± 112.32 somatic cell*1000/ml.

The evaluation criteria of every indicator are shown in Table 1. Scores lower than 3 and bigger than 8 are related to deficient and excellent conditions of welfare respectively (according to the evaluator criteria).

Table 1: Evaluation criteria of every indicator.

Indicator	Concept	Score Criteria	
Temperature	At the moment of assessment	3-4	< 1˚C and > 32˚C
		5-6	Between 1˚C and 15˚C and 25˚C-2˚C
		7-8	Between 15˚C and 25˚C
Airflow	Incidence or intensity of airflow	3-4	Air directly at the animals or high intensity
		5-6	Evidence of airflow but animals protected
		7-8	Not airflow
Ventilation	Air volume/Animal. Input and output of air (Surface)	3-4	Volume of air < 4 m^3/animal.
		5-6	Input surface < 0.04 m^2/animal.
		7-8	Output surface < 0.02 m^2 /animal
			One of the two conditions accomplished
			Both conditions accomplished
Ammonia Load	Gas and ammonia load Trought Olfactory perception	3-4	High perception and irritation of eyes
		5-6	Smell perception. Smell remains in clothes
		7-8	Not smell. Smell does not remain on clothes
Animal Load	N° of Animal per square meter	3-4	> 1.0 m^2/animal
		5-6	Between 1.0 and 1.5 m^2 per animal
		7-8	> 1.5 m^2/animal
Bedding	Cleanness, Amount and Dryness of Bed	3-4	Low amount, high Humidity, dirty bed (at least two conditions)
		5-6	Bed clean and dry
		7-8	Bed clean, dry and high amount
Comfort	Humidity	3-4	Not isolation. High Humidity level
	Noise	5-6	Good isolation and normal level of humidity
	Distances	7-8	In addition, there should not be high distances in the pen.
Stress	Behaviour and Stereotypes	3-4	> 60% of animals standing. There are evidence of stereotypes
		5-6	60-80% of animals lying. Stereotypes not observed
		7-8	> 80% of animals lying
Cleanness of Animals	Cleanness in Hair and Legs	3-4	Hair and legs clearly dirty
		5-6	Hair clean and legs dirty below hocks
		7-8	Hair and legs clearly clean
Feeders of Concentrate	Length and Cleanness	3-4	< 0.33 m per animal or dirty feeder
		5-6	> 0.33 m per animal. Cleanness and proper feed
		7-8	> 0.5 m per animal. Cleanness and proper feed
Feeders of Forage	Length, Cleanness and Amount of Forage	3-4	< 0.33 m per animal or dirty feeder
		5-6	> 0.33 m per animal. Cleanness and forage available
		7-8	> 0.5 m per animal. Cleanness and forage available
Watering	Amount, Cleanness and Availability	3-4	< 1 trough/30 animals or < 1m/100 animals, or dirt etc.
		5-6	> 1 trough/30 animals or > 1m/100 animals. Cleanness
		7-8	In addition, not big distances for watering

In order to study the effect of the size of flock on the animal welfare, the farms were classified in three groups: small, medium and large. The distribution of the farms studied according its size and regions are showed in Tables 2 and 3.

The number of animals is expressed in average of animals per assessment.

Table 2: Distribution of the farms in groups of size.

Size range (n° animals/farm assessment)		
Small	**Medium**	**Large**
Sheep		
250-400 (n = 17)	401-1000 (n = 17)	> 1000 (n = 18)
Ewes/farm		
353,1 ± 12,14	686,7 ± 50,11	1861,1 ± 192,19
Goat		
150-300 (n = 23)	301-500 (n = 14)	> 500 (n = 12)
Goats/farm		
263,9 ± 10,33	395,7 ± 10,68	825,0 ± 80,83

The statistical analysis was conducted using SPSS 19 for Windows (SPSS Inc., IBM Corporation, NY, USA). One-way ANOVA analysis was applied to test differences between species and size of flocks (animal amount). The effects of each indicator, EAW, MAW, FAW and GAW on the productive performance were also studied. Linear correlations among total parameters were carried out using deseing program. Significance was declared at $p < 0.05$ and trend was declared at $p < 0.10$.

Table 3: Distribution of farms (number of farms) by species and region.

	Aragón	**Andalucía**	**Castilla y León**	**Centro**	**Valencia**	**Others**
Total	20	16	16	17	11	21
Sheep	18	3	13	9	5	4
Goat	2	13	3	8	6	17

Results and Discussion

Concerning GAW, only 2% of farms were scored under 5. The MAW was the best scored (6.2 ± 0.08), followed by EAW (6.04 ± 0.064) and for FAW (6.0 ± 0.07). The EAW indicators got a slightly different range of variation, mainly stress (score range from 1 to 8) and bedding (score range from 3 to 9) (Table 4).

Table 4: Average, maximum and minimum score of indicators.

	Total	**Minimum**	**Maximum**
Environmental Animal Welfare (EAW) (a)	6.04	4.5	7.75
Temperature	6.28	4	8.0
Airflow	6.41	4	8.0
Ventilation	5.81	4	8
Ammonia load	5.66	4	8
Management Animal Welfare (MAW) (b)	6.17	3.6	8.2
Animal load	6.14	3	8
Bedding	6.27	3	9
Comfort	6.06	4	9
Stress	5.81	1	8
Cleanness of animals	6.59	4	8
Facilities Animal Welfare (FAW) (c)	5.96	4.33	8
Feeders of concéntrate	5.95	4	8
Feeders of forage	6.05	4	8

Watering	5.87	3	8
Others indicators			
Feces consistency (1-5)	3.5	2	4
Body condition score (1-5)	3.04	2	4
Global Animal Welfare (GAW) (a+b+c)	6.08	4.75	7.75

Among species (Table 5), goats were better scored (p < 0.001) in cleanness of animals (goat 6.9 ± 0.01 and sheep 6.3 ± 0.13) and (p < 0.1) in MAW (goat 6.3 ± 0.09, sheep 6.0 ± 0.12). However EAW was better scored in sheep (sheep 6.1 ± 0.09, goat 5.9 ± 0.09).

Table 5: Welfare indicators for dairy sheep and goat flocks according the size of the farms.

	Sheep				Goat			
	Small	**Medium**	**Large**	**p**	**Small**	**Medium**	**Large**	**p**
N˚ Animals	353.1[a] ± 12.14	686.7[b] ± 50.11	1861.1[c] ± 192.19	***	263.9[a] ± 10.33	395.7[b] ± 10.68	825.0[c] ± 80.83	***
Airflow	6.13[a] ± 0.155	6.80[b] ± 0.145	6.56[ab] ± 0.217	*	6.26 ± 0.169	6.43 ± 0.202	6.33 ± 0.188	ns
Animal load	5.25[a] ± 0.393	6.27[b] ± 0.228	6.39[b] ± 0.231	*	6.13 ± 0.202	6.43 ± 0.202	6.58 ± 0.229	ns
Feeders of concentrate	5.56a ± 0.182	6.27b ± 0.248	6.44b ± 0.246	*	5.30a ± 0.193	6.21b ± 0.214	6.25b ± 0.279	**
Feeders of forage	5.56 ± 0.203	5.73 ± 0.284	6.28 ± 0.253	ns	5.83a ± 0.149	6.64b ± 0.169	6.50b ± 0.230	**
Watering	5.75 ± 0.171	5.67 ± 0.319	6.06 ± 0.235	ns	5.52a ± 0.226	6.21b ± 0.187	6.25b ±0.305	t
Faeces consistency (1-5)	3.88 ± 0.085	3.53 ± 0.133	3.5 ± 0.146	ns	3.48 ± 0.106	3.29 ± 0.125	3,33 ± 0.188	ns
Body condition score (1-5)	3.08 ± 0.067	3.05 ± 0.078	3.26 ± 0.074	ns	2.89 ± 0.088	3 ± 0.106	3 ± 0.092	ns
MAW	5.66a ± 0.293	6.11ab ± 0.196	6.36b ± 0.145	t	6.19 ± 0.141	6.44 ± 0.178	6.37 ± 0.139	ns
FAW	5.63a ± 0.132	5.89ab ± 0.210	6.26b ± 0.163	*	5.55a ± 0.125	6.36b ± 0.128	6.33b ± 0.169	***
GAW	5.76a ± 0.172	6.12ab ± 0.171	6.29b ± 0.117	*	5.90a ± 0.109	6.32b ± 0.117	6.20ab ± 0.119	*

Regarding the flock size (Table 4), the GAW (p < 0.05) was below (5.8 ± 0.17) in small farms in sheep than large (6.3 ± 0.12).

However, the medium goat flocks were better scored (6.3 ± 0.12) than the smaller ones (5.9 ± 0.11).

Actually, the FAW score present a lower value in small size (5.6 ± 0.13) of farms to large and medium (6.4 ± 0.13) in goat (p < 0.001) and in sheep in relation to bigger flock size (6.3 ± 0.16, p < 0.05) due to the lower score in feeders of concentrate in sheep (p < 0.05) and feeders of concentrate, feeders of forage (p < 0.01) and watering in goat (p < 0.1).

Besides, MAW in sheep was better scored (p < 0.1) in larger farms (6.4 ± 0.15) than the small farms (5.7 ± 0.39) and animal load got a lower score (p < 0.05) in small farms (5.3 ± 0.39) to medium and large ones (6.3 ± 0.23). There were not significant differences among flock size in both species for faeces consistency and body condition score parameters.

Table 6 shows the welfare indicators with statistically significant differences between regions, highlighting the differences in the FAW both in sheep and goat.

The different breeds and management peculiarities in each region may explain the differences found.

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Some effects of animal welfare on productive performance were also found. In goats, EAW had a positive and significant correlation (0.358, $p < 0.05$) with milk fat content and concerning environmental indicators, only temperature had a significant effect on fat (0.486, $p > 0.01$) and fat and protein content (0.345, $p > 0.05$).

Although no significant effects of MAW on production parameters were found, several indicators were correlated with them: in sheep bedding was correlated positively with milk yield (0.298, $p > 0.05$), stress was correlated negatively with somatic cells count (-0.390, $p < 0.05$) and cleanness of animals was correlated positively with fat and protein (0.347, $p < 0.05$) in sheep and negatively with protein content of milk in goats (-0.347, $p < 0.05$).

Table 6: Animal welfare indicators in sheep and goat by regions.

	Aragón	Andalucía	Castilla y León	Centro	Valencia	Others	p
Sheep							
Feeders of forage	5.33[a] ± 0.198	5.67[ab] ± 0.667	6.08[ab] ± 0.309	6.67[b] ± 0.236	6.00[b] ± 0.548	6.00[ab] ± 0.707	t
Feces consistency	3.83[b] ± 0.090	3.33[ab] ± 0.333	3.54[ab] ± 0.144	3.67[b] ± 0.167	3.00[a] ± 0.316	3.50[ab] ± 0.289	*
FAW	5.57[a] ± 0.117	5.44[a] ± 0.401	6.26[ab] ± 0.161	6.41[b] ± 0.228	6.20[ab] ± 0.271	5.58[ab] ± 0.551	**
Goat							
Feeders of concentrate	4.50[a] ± 0.500	5.77[ab] ± 0.257	6.00[ab] ±1.000	6.63[b] ± 0.324	6.17[ab] ± 0.167	5.41[ab] ± 0.211	*
FAW	5.17[a] ± 0.167	5.90[ab] ± 0.215	6.22[b] ± 0.294	6.50[b] ± 0.252	6.22[b] ± 0.205	5.75[ab] ± 0.133	*

Regarding FAW, a positive correlation was observed with milk yield (0.281, $p < 0.05$), in sheep. On the other hand, in goat flocks, feeding of concentrate correlated in a negative and significant way with protein milk content (-0.357, $p < 0.05$, attributable to a higher concentrate intake, more milk and a dilution effect of higher production in milk solids).

Conclusions

In view of these results, we can conclude that the assessment of animal welfare in dairy goats and sheep flocks through an evaluation system based on indicators is possible. Besides, we can evaluate and compare animal welfare status among, size of flocks and species. Results obtained show the relationships between the welfare indicators and the zoo technical characteristics of the farms.

In general, indicators related to MAW were the best scored. Concerning size of farms, bigger differences were found in FAW in both species (medium size flocks were the best scored in goat, and large size farms in sheep).

The differences among regions (mainly in indicators of FAW) could be explained by peculiarities of management and breeds of each region.

Moreover, some effects of temperature and feeding in concentrate in milk composition were also found. Bedding was also correlated with milk yield.

In addition, this assessment system allows us to get practical and useful information about which of the animal welfare aspects have more influence on productive performance. Scoring and quantifying the indicators offers the chance to improve every aspect and to check the welfare animal evolution in commercial farms.

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