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SHORT COMMUNICATION

Suitability of linear scoring in meat sheep: the practical case of Merinizzata Italiana breed

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Abstract

Linear scoring is widely applied in domestic animal species, mainly in cattle and horses. There are only few cases of linear scoring in sheep, probably because the small body size and the narrow range of the classes make difficult to correctly evaluate the measures. In this paper the results of a linear scoring test carried out on Merinizzata Italiana sheep breed in order to verify the feasibility of this method in sheep, are reported. Twenty untrained people, with three different levels of scoring experience in meat sheep morphology, evaluated 52 pluriparous ewes for body length, chest circumference, chest width, rump height, rump width, and withers height; to check for misclassification, their scores were compared with a reference score, previously obtained measuring the same animals by the suitable tools (measuring tape and a Lydtin stick). The percentage of correct scoring ranged from 44.4% for body length to 61.8% for withers height, and was not affected by the experience of the judge. In all characters, the distance of the class from the trait mean had a significant effect in increasing the intensity of misclassifications; the judge's experience showed a positive effect in reducing the intensity of the misclassification for body length, that was the hardest trait to score. These results encourage to further verifying in practice the linear scoring in the Merinizzata Italiana sheep and in other meat breeds.

Introduction

The morphological scoring is a common evaluation method in domestic animals; people

employed in this kind of activity must be able to translate in numbers or words their judgement on some features of the animal body by comparing a subject to the ideal type described in the breed standard (Thompson *et al.*, 1981). A problem with this procedure is the "subjectivity" (González Velasco *et al.*, 1999): as a matter of fact, it is sometimes difficult that different judges, although well trained, give the same assessment to the same animal. Besides an update in the standard, or in selection goals, can probably wipe out a data set of morphological scores whilst linear scores will stand.

Because of this, the morphological scoring has been progressively substituted by the linear scoring system, which is based on the objective measures of the body traits. The data obtained from linear evaluation protocols can be useful for estimating traits heritability, as showed by Serrano *et al.*, 2002.

The concept of linear scoring of type traits was conceived in 1976, firstly implemented and tested in 1979 (Thompson *et al.*, 1981). In few years it spread in many dairy cattle associations (Foster *et al.*, 1988). In Italy, the linear scoring was firstly applied in dairy cattle such as "Italian Friesian" (Tartara, 1984) and "Bruna" (Santus *et al.*, 1985). Years later, also the beef cattle associations set up linear scoring protocols: National Association of Piemontese cattle Breeders in Piemontese (ANABORAPI, 2009) and National Association of Italian Beef-Cattle Breeders (ANABIC) in Chianina, Marchigiana and Romagnola (Panella *et al.*, 1992). Besides cattle, the linear scoring is utilized also for water buffalo (2004) as described in a preliminary study by Amante *et al.* (2001) and for several horse breeds, such as: CAITPR (The Italian Heavy Draught Horse) and Haflinger (1992), Bardigiano (1996) and Maremmano (2000) (Samorè, 2008).

Linear scoring in sheep is mainly used in dairy breeds, but is rather rare in meat breeds.

The main reason of the scarce use of this evaluation method in sheep is the hard right assignment of the measures to their correct linear class; in fact, the short biological interval and, consequently, the little range of each class, makes the correct scoring difficult.

One of the most common uses of the linear scoring method is the evaluation of the mammary morphology, which is one factor that determines aptitude for mechanical milking of sheep (Labussière, 1988, De La Fuente *et al.*, 1996, Marie-Etancelin *et al.*, 2005). In Italy, udder evaluation has been implemented in the Sarda breed (Casu *et al.*, 2006). In meat sheep, there is a multibreed evaluation protocol in Belgium (Janssens and Vandepitte, 2004); in Italy, there is an evaluation protocol in the

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Fabrianese sheep (ASSONAPA, 2009).

The Merinizzata Italiana is the main Italian meat sheep for number of heads and geographical distribution: this breed originated from different Merino-like breeds, and its standard was established few years ago, so that it seemed to be useful to test the convenience of applying a linear scoring system, both to improve animal conformation for meat and increase live weight, as Gizaw *et al.* (2008) did in Menz sheep. As matter of fact, the live weight is strictly correlated (Sarti *et al.*, 2003) to some morphological traits, such as chest circumference, and therefore can be indirectly evaluated by the linear score of that.

Because at the present in Italy no judges are recognized able to linear score meat sheep, in this paper the results of a test carried out to verify whether untrained people can recognize the differences between linear scoring in sheep are reported.

Materials and methods

In a previous research (Sarti and Panella, 1999), 800 pluriparous Merinizzata Italiana ewes were measured in order to estimate the main statistical parameters of several traits; moreover, on this sample, a multivariate analysis was carried out and it was ascertained that

the most informative characters to evaluate the body conformation were: body length (BL), chest circumference (CC), chest width (CW), rump height (RH), rump width (RW) and withers height (WH). All these traits were positively correlated each other and normally distributed (Sarti and Panella, 1999).

For all the traits five classes were defined as reported in Table 1 (class dimension = 1 standard deviation) and the score frequencies showed.

To evaluate the judges' work on a new sample of 52 randomly chosen pluriparous ewes, the measures of the above cited traits were taken, using suitable tools such as measuring tape and Lydlin stick (Negretti et al., 2008); in this way the correct class was assigned to each animal to be used as reference score.

This sample was then linear scored by 20 judges, i.e. 1040 observations were obtained for each trait. The judges were assigned to three levels according to their previous experience: the 3 judges assigned to level 1 had a good knowledge of meat sheep morphology and experience in morphological scoring of sheep and of linear scoring in other species (cattle); 8 judges were assigned to level 2, because they had a good knowledge of meat sheep morphology, but no experience in scoring; the last 9 judges, who had just a basic knowledge of meat sheep morphology, were assigned to level 3 of experience.

At the scoring time, all the ewes had the wool as recommended by the ASSONAPA. rules (ASSONAPA, 2009).

The fairness of the scoring was evaluated by the difference between the class assigned by the judge and the reference one. To verify if the probability of correct assignment was influenced by the judge experience, the percentage of right classifications was arcsin square root transformed, and then analysed with a linear model, where the judge experience level was the only effect considered.

A two-way Analysis of Variance was also performed on the intensity of misclassification, using a linear model considering the effect of judge experience, the effect of distance of the reference class from the mean class, and their interaction.

Since data were divided in only five classes, also a non parametric analysis was performed. To verify if the intensity of the misclassification, i.e. the absolute value of the difference between the assigned and the reference class, had a linear correlation with experience level of the judge, a Mantel-Haenszel χ^2 test was performed for each trait. Also, the linear correlation between the intensity of trait misclassification and the ewe's difference from the

mean value was tested by Mantel-Haenszel χ^2 .

Statistical analysis was made by means of R package (R Development Core Team, 2007).

Results and discussion

The scored ewes measured under the average for bone traits such as RH and WH, with 70.05% and 72.15% of the animals in the two lowest classes respectively; on the contrary, 57.66% of the ewes were in the two highest classes for CC and also the means for RW was greater than 24.7 cm (Table 1), that was the

mean of the 800 ewes sample (Sarti and Panella, 1999). These facts suggest that the muscularity of the 52 ewes used in the scoring test was better than the breed average.

The judges did not have the same difficulties in scoring different traits (Table 2); the percentage of overall correct scoring was 52.9%, ranging from a minimum of 44.4% for BL to a maximum of 61.8% for WH. Moreover, the analysis of the arcsin square root transformed percentages of correct scoring showed that there was no significant effect of the judge experience on the probability of correct scoring (*data not shown*).

The highest error was 3 classes, but it has to

Table 1. Limits of the classes for each morphological trait (in cm) and the class frequencies in the scored sample (in %).

Trait	Classes				
	1	2	3	4	5
Body length	<63.7 4.51	63.7÷67.1 46.41	67.2÷70.8 35.58	70.9÷74.4 11.81	>74.5 1.69
Chest circumference	<87.4 1.41	87.4÷94.8 5.91	94.9÷102.3 35.02	102.4÷109.8 39.94	>109.8 17.72
Chest width	<19.6 1.55	19.6÷22.4 24.19	22.5÷25.3 47.12	25.4÷28.2 23.49	>28.2 3.65
Rump height	<62.5 20.82	62.5÷66.8 49.23	66.9÷71.3 24.32	71.4÷75.7 5.49	>75.7 0.14
Rump width	<19.9 1.48	19.9÷23.0 16.88	23.1÷26.3 48.73	26.4÷29.5 27.99	>29.5 4.92
Withers height	<61.3 25.74	61.3÷65.8 46.41	65.9÷70.5 23.35	70.6÷75.1 4.36	>75.1 0.14

Table 2. Correct scoring probabilities, significance (F) of the experience level of the judge and F values from the analysis of variance on the intensity of misclassification.

	Correct score probability	F	Main effects		
			Judge experience	Distance from the mean	Interaction
Body length	44.4	2.68	0.48	7.12 10 ^{33*}	33.32*
Chest circumference	49.6	0.05	0.35	2.07 10 ^{33*}	13.12*
Chest width	51.2	0.16	2.02	2.26 10 ^{33*}	17.84*
Rump height	60.1	0.08	2.52	1.82 10 ^{33*}	8.53*
Rump width	49.9	0.92	0.17	1.43 10 ^{33*}	10.25*
Withers height	61.8	0.35	0.01	6.72 10 ^{33*}	9.31*
Overall	52.9	0.13			

*P<0.001.

Table 3. Mantel-Haenszel χ^2 for linear correlation between intensity of misclassification and judge experience or distance of the ewe's reference class from the mean of the trait.

	Judge experience	Distance from the mean
Body length	5.38*	138.69**
Chest circumference	1.93	21.77**
Chest width	0.01	28.28**
Rump height	0.51	2.57
Rump width	1.84	23.91**
Withers height	0.24	2.68

*P<0.05; **P<0.001.

be pointed out that these heavy mistakes were extremely rare: the highest frequency (1.41%) was registered in RW. Furthermore, the lightest errors seemed to be overestimations, whilst 2 and 3 class errors were mostly underestimation. The two-way analysis of variance performed did not show any significant effect of the judge experience class on the intensity of misclassification (Table 2); on the contrary, the distance of the reference class of the ewe's trait from the mean class was always significant ($P < 0.001$), and the same level of significance was reached by the interaction.

The Mantel-Haenszel χ^2 test showed that for BL, which could be speculated as the hardest trait to score, because of its lowest percentage of assignment to the correct class, there is also a linear correlation between intensity of misclassification and judge experience: in fact, BL was the only trait with a significant value of χ^2 ($P < 0.05$; Table 3). For four traits, the difficulty of correct scoring increased with the distance of the trait value from the mean ($P < 0.001$) (Table 3). This seems to confirm that BL is the most difficult trait to score, whilst for WH and RH, the two traits with the greatest percentages of correct scoring, the amount of the error in scoring does not depend on the real body size of the ewe.

Conclusions

The results of this first test of linear scoring in the Merinizzata Italiana breed can be considered positive: in fact, although the people enrolled as judges were not trained at all in sheep linear scoring, the percentages of evaluation with an error of no more than one class ranged from 92.3% for CW to 86.2% for RW.

The main concern before performing the test was the narrow range of the traits measures in sheep. The results showed that the small dimensions of the sheep do not interfere with linear scoring: in fact, although RH and WH were lower than expected in this breed, these two traits seemed to be the easiest to score. Since the effect of the judge experience on the probability of correct scoring was not significant for all traits, it could be difficult to raise the percentage of correct scoring by mean of a training period; just for BL, that seemed the hardest trait to score, the level of experience has a positive effect in reducing

the intensity of the errors: in this case, the effect of the interaction *judge experience* \times *distance from the mean* reached the highest significance, and this fact shows that the experience in morphology is important to score the extreme classes.

After the result of such a test, the judges can be focused on the errors of their scoring and they become fully operative with a short period of practicing. These results encourage to further verify this method in the Merinizzata Italiana sheep breed, by testing the effect of a training period on scoring results, and also to extend the trials in other meat breeds.

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