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LAMB CLASSIFICATION SYSTEMS TO MEET URUGUAYAN EXPORT MARKET DEMANDS

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Introduction

The use of *in vivo* measurable information to predict carcass quality has been of a big concern on the recent research advances in meat science. Many studies (Kirton et al., 1994; Hassen et al., 1999) were on fitting models to predict a continuous variable. Nevertheless, overseas markets measure and reward quality based on a discrete variable (standards). During the last years, Uruguay has developed an exporting market of lamb carcasses. Meat processors have established requirements for the lambs (current system): liveweight (LW) and body condition (BC) equal to or greater than at least 34 kg and 3.5 grades respectively. This study intent to make a contribution to the development of *in vivo* classification systems of animals to predict carcass standard. It is based on the comparison of the current system, with those classification systems adjusting by discriminant analysis.

Objectives

The objectives are: a) to compare the effectiveness achieved by the current system in estimates the type of carcass that will be produced by a lamb, with systems adjusted by discriminant analysis; b) to evaluate the impact on the effectiveness of a lamb classification system based on LW of including BC and fat depth at the C point (CP) as additional predictors.

Materials and methods

On 408 Corriedale lambs, LW and BC were estimated by the procedures cited by Montossi et al. (1998), while CP was evaluated by the ultrasound technique described by Russel (1994). Lambs were classified into three groups according to the following classification systems: current system (a) or discriminant analysis system, based on LW (b), LW and BC (c) and LW and CP (d). Lambs were slaughtered determining hot carcass weight (HCW) and tissue depth at the GR point (Kirton and Morris, 1989). Carcasses were classified on three groups: group 1 (includes carcasses with LW < 16 kg or GR < 6 mm); group 2 (includes carcasses with LW ≥ 16 and 6 ≤ GR ≤ 12) and group 3 (includes carcasses with LW ≥ 16 and GR > 12 mm). The coefficients of Pearson & Spearman were used to evaluate the relationship between predictors and standards (HCC and GR), while the Wilks´ Lambda coefficient (Norusis, 1993) was used to estimate the discriminant power for each and all functions together.

Results and discussion

Table 1 shows that: a) there is a high association between LW and HCW; b) there are better *in vivo* predictors for HCW than for GR; and c) LW, BC and CP presented similar correlation coefficients with GR. Carcass type explained 61, 63 and 66 % of the discriminant score variation for the systems "b", "c" and "d" respectively (Table 2), indicating that the inclusion of BC and CP in the model increased slightly the discriminant power of the classification systems.

The global effectiveness classification (GEC) was 78.7, 78.4 79.4 and 82.6 for "a", "b", "c" and "d" systems respectively (Table 3 A). Discriminant analysis permits to maintain the GEC without considering BC. The comparison of the GEC between systems "b" and "c", shows that, the inclusion of BC in the model (system "c") makes a little contribution (1 %). When system "b" is compared with "d", the GEC increased by 3.9%, but the use of CP presents some economical and practical constrains under commercial conditions. The small improvement observed in the GEC by including BC or CP in a model based on LW (system "b") is probably related with the use of homogeneous database in terms of lamb biotype, sex and age. The results showed in Table 3 B indicate that the effectiveness of the current system to predict the target group (2) is low (51%). Systems "b" and "c" do not improve the effectiveness achieved with the system "a", but permitted to maintain this effectiveness without using BC. The inclusion of CP in a model based on LW improved the effectiveness to create group 2 (Figure 1), given by the lower discriminant power of BC compared with CP.

If the goal is to predict an homogeneous group of animals to supply a particular market (e.g. carcass type 2), the classification criteria may be changed, "The result of different classification rules for identifying minority cases can be examined by ranking all cases on the value of their discriminant score and determining how many minority cases are in the various deciles" (Norusis, 1993). But, it must be taken into account that to utilize a more strict classification criteria will involve: a) to reduce the number of chosen animals; b) to increase the effectiveness to form the target group and c) to increase the percentage of animals that have been culled producing target carcasses.

Conclusions

In the context of the assumptions taken, discriminant analysis permitted to maintain the GEC achieved with a model based exclusively on LW, without considering BC, based on homogeneous lamb groups (similar sex, age and biotype). The effectiveness to form the group of the desired carcasses (HCW ≥ 16 kg and 6 ≤ GR ≤ 12 mm) was low using the current system (50%). Similar effectiveness was obtained in the systems based on discriminant analysis using only LW or LW and BC as predictors. The use of CP together with LW in a system adjusted by discriminant analysis increased the effectiveness to form the target group by 10% compared with the other systems studied. The effectiveness to form an homogeneous group of Corriedale lambs to supply a certain market which demands carcasses according to specified standard, can be increased by changing the classification criteria used in the discriminant analysis, but implicating to cull some animals that reach the standard. This occur because the potential of the GEC is determined by the correlation achieved between predictors and variables which define the standard.

Finally, the overseas market signals are influencing some changes in the Uruguayan sheep production systems, which will probably increase the variability of the type of lamb produced to meet the requirements of the different markets (eg. lean meat, heavy carcass, heavy high valueable cuts, etc.). In this context, the use of multivariate statistic techniques like discriminant analysis, which consider simultaneously fat and muscle variables could make an important contribution to improve the national lamb classification system.

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Tables and Figures

Table 1. Coefficients of correlation between the variables used as predictors of the variables that define the standard.

	Pearson coefficient of correlation		Sperman coefficient of correlation	
	GR	HCW	GR	HCW
LW	.740**	.970**	.753**	.970**
BC	.719**	.828**	.764**	.836**
CP	.717**	.723**	.692**	.713**

**: p<0.01 (two tails)

Table 2. Discriminant functions by system and Wilks´ Lambda coefficients for function and system.

Discriminant Function	Predicting variables	Constant[1]	b[1]	Wilks´ Lambda: Each function	Wilks´ Lambda: All functions together
System b (based on LW)					
1	LW	-9.905	.314	.389	.389
System c (based on LW and BC)					
1	LW	-9.880	.257	.375	.375
	BC		.489		
2	LW	1.304	-.271	1.000	
	BC		1.982		
System d (based on LW and CP)					
1	LW	-9.377	.247	.356	.336
	CP		.522		
2	LW	3.217	-.231	.939	
	CP		1.341		

[1]: Not standardized.

Table 3. Global (A) and partial (B) effectiveness of classification for each system.

A. Estimated vs. observed carcass group (percentage of the total of animals)

Observed Carcass group	Estimated carcass group: System "a" 1	2	3	System "b" 1	2	3	System "c" 1	2	3	System "d" 1	2	3	Total
1	**61.0**	2.2	0.0	**60.8**	2.0	0.5	**59.6**	3.4	0.2	**60.3**	2.5	0.5	63.2
2	6.9	**11.3**	1.5	5.4	**9.3**	4.9	4.7	**11.3**	3.7	5.1	**10.5**	3.9	19.6
3	2.2	8.6	**6.4**	1.7	7.1	**8.3**	1.2	7.4	**8.6**	1.0	4.4	**11.8**	17.2
Total	70.1	22.1	7.8	67.9	18.4	13.7	65.4	22.1	12.5	66.4	17.4	16.2	100

B. Prior and post probability to obtain carcasses of the group depending on the classification system used.

Carcass group	Prior 1/	Post 2/: System "a"	System "b"	System "c"	System "d"
1	63.2	87.1	87.1	89.5	90.8
2	19.6	51.1	51.1	50.7	60.6
3	17.2	81.3	81.3	60.7	72.7

1/: Frequency of this carcass type in the whole sample. 2/: Frequency of carcasses that effectively belong to the group.

Figure 1. Limits for the classification of Corriedale lambs in function of the expected carcass by system of classification.