Prediction of the relationship between body weight and body condition score in sheep

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RIASSUNTO – Previsione della relazione esistente tra peso corporeo e nota corporale negli ovini – *La relazione tra peso corporeo e nota corporale (BCS) in pecore adulte è stata studiata utilizzando i risultati riportati in 10 diverse pubblicazioni scientifiche. Sulla base di questi dati è stata sviluppata un'equazione che consente di stimare il peso corporeo (PC) ad ogni BCS sulla base del BCS corrente e del peso delle pecore quando esse hanno un BCS pari a 2,5 (PC@BCS 2,5): PC (kg) = (0,594 + 0,163 *BCS) * PC@BCS 2,5 (kg).*

KEY WORDS: sheep, body weight, body condition score, prediction

INTRODUCTION – During the whole production cycle it is important to monitor the energy balance and to quantify body reserve changes of the ewes. This can be done, both in experimental settings and in the field, by estimating the body condition score (BCS) of the ewes and its variations. However, if this tool is used to balance the diets it is necessary to know the relationship between BCS and body weight (BW), which varies depending on the mature size of the breed and of the population considered within each breed. The relationship between BW and BCS has been studied only for some sheep breeds and populations. For this reason, this research aimed to develop a prediction model of this relationship in ewes for any breed or population.

MATERIAL AND METHODS – A database was developed based on 10 publications (Russel *et al.*, 1969; Guerra *et al.*, 1972; Teixeira *et al.*, 1989; Sanson *et al.*, 1993; Susmel *et al.*, 1995; Treacher and Filo, 1995; Frutos *et al.*, 1997; Oregui *et al.*, 1997; Zygoyannis *et al.*, 1997; Molina Casanova *et al.*, 1998) that reported the relationship between BW and BCS (0-5 scale, Russel *et al.*, 1969) in mature ewes of 12 different breeds (seven dairy breeds and 5 meat or wool breeds). These publications did not report the individual ewe measurements but only empirical regressions, based on actual measurements, relating BW and BCS. For most breeds BW could be predicted by the BCS with simple linear regressions, where the intercept indicated the BW at BCS 0 and the slope predicted the variations of BW for each unitary BCS variation. Only Teixeira *et al.* (1989) found a curvilinear relationship, which we refitted to a simple linear regression to be used in the development of the prediction model. To develop a prediction model of BW based on BCS, both the intercepts and the slopes of the 12 linear simple equations (one for each breed) were fitted against the mature weight of the ewes at BCS equal to 2.5 (BW@BCS2.5), which we think can be considered as a breed standard. BCS 2.5 was chosen because symmetric between 0 and 5 and because it is a score commonly observed in sheep flocks.

We observed that the intercepts were significantly associated to the BW@BCS2.5:

[1] INTERCEPT = - 5.31 (5.87) + 0.69 (0.11) BW@BCS 2.5;

r^2 = 0.80; P<0.0001; standard deviation of the regression = 3.58. Since the intercept of this equation was not significant, equation [1] became:

[2] INTERCEPT = 0.594 (0.02) BW@BCS 2.5.

Similarly, the slopes of the 12 linear equations were linearly associated to the BW@BCS2.5:

[3] SLOPE: = 2.80 (2.43) + 0.11 (0.05) BW@BCS 2.5;

r^2 = 0.37; P<0.035; standard deviation of the regression = 1.49. Since the intercept of this equation was not significant, equation [3] became:

[4] SLOPE = 0.163 (0.01) BW@BCS 2.5.

Equations [2] and [4] were combined to predict ewes' BW at any BCS as long as the breed or population BW@BCS 2.5 is known:

[5] BW = (0.594 + 0.163 *BCS) * BW@BCS 2.5.

Table 1. Relationship between BW and (BCS, scale 0-5) in mature ewes of different breeds as reported in the original publications and as predicted by equation [5].

BCS	Aragonesa [1]		Awassi [2]		Bergamasca [3]		Boutsko [4]	
	O	P-O	O	P-O	O	P-O	O	P-O
	kg	kg	kg	kg	kg	kg	kg	kg
0	20.0	2.4	27.9	6.2	43.6	-5.7	19.5	3.0
1	25.7	2.7	39.7	3.8	51.7	-3.4	26.9	1.8
2	33.1	1.5	51.5	1.3	59.8	-1.1	34.2	0.6
2.5	37.6	0.1	57.4	0.1	63.9	0.1	37.9	0.1
3	42.7	-2.0	63.3	-1.1	67.9	1.2	41.6	-0.5
4	55.0	-8.1	75.1	-3.6	76.0	3.6	48.9	-1.7
5	70.8	-17.8	86.9	-6.0	84.1	5.9	56.3	-2.9
BCS	Churra [5]		Karagouniko [4]		Laxta [6]		Manchega [7]	
	O	P-O	O	P-O	O	P-O	O	P-O
	kg	kg	kg	kg	kg	kg	kg	kg
0	30.1	-4.0	33.6	0.1	30.9	-2.0	39.5	0.1
1	35.7	-2.3	42.9	0.1	38.0	-1.2	50.4	0.1
2	41.3	-0.7	52.1	0.1	45.1	-0.3	61.3	0.1
2.5	44.0	0.1	56.8	0.1	48.7	0.1	66.8	0.1
3	46.8	0.9	61.4	0.1	52.2	0.5	72.2	0.1
4	52.4	2.5	70.7	0.1	59.3	1.3	83.1	0.1
5	58.0	4.1	80.0	0.0	66.4	2.1	94.0	0.1
BCS	Merino [8]		Scottish Blackface [9]		Serres [4]		Western range [10]	
	O	P-O	O	P-O	O	P-O	O	P-O
	kg	kg	kg	kg	kg	kg	kg	kg
0	23.2	1.4	33.3	2.2	26.7	2.0	40.9	-4.6
1	30.5	0.9	43.9	1.3	35.3	1.2	49.0	-2.7
2	37.7	0.3	54.4	0.5	43.9	0.4	57.1	-0.8
2.5	41.4	0.1	59.7	0.1	48.3	0.1	61.1	0.1
3	45.0	-0.2	65.0	-0.3	52.6	-0.3	65.2	1.0
4	52.3	-0.7	75.5	-1.2	61.2	-1.1	73.3	2.9
5	59.6	-1.3	86.1	-2.0	69.8	-1.8	81.4	4.7

O = from the original publication; P = predicted by equation [5]. [1] meat dry ewes, observed values obtained with the original curvilinear equation (Teixeira et al., 1989); [2] dairy dry ewes (Treacher and Filo, 1995); [3] meat lactating ewes (Susmel et al., 1995) [4] dairy dry ewes (Zygoyannis et al., 1997); [5] dairy dry ewes (Frutos et al., 1997); [6] dairy dry ewes (Oregui et al., 1997); [7] dairy dry ewes (Molina Casanova et al., 1998); [8] wool dry ewes (Guerra et al., 1972); [9] meat dry ewes (Russel et al., 1969); [10] wool/meat dry ewes (Sanson et al., 1993).

Rearranging equation [5], it is possible to estimate BW@BCS2.5 when current BCS and BW are known: BW@BCS 2.5 = current BW /(0.594 + 0.163 * BCS).

RESULTS AND CONCLUSIONS – The prediction model (equation [5]) was used to predict the BW of the ewes, based on their BCS and BW@BCS 2.5, of the experiments reported in the publications used to create the database. The results were compared with the original values reported in the publications (Table 1). It appears that equation [5] predicted with good accuracy BW at any BCS for most breeds. The highest outliers were observed in the case of the most extreme BCS (0 and 5), which are never observed as flock average. The prediction was less accurate in the case of Aragonesa (Teixeira *et al.*, 1989), Awassi (Treacher and Filo, 1995) and Bergamasca (Susmel *et al.*, 1995) breeds.

In conclusion, equation [5] can be used to predict with good accuracy the BW of mature ewes at any BCS and of any breed or population, as long as the BW at BCS 2.5 of the breed or of the population is known.

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