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THE USE OF UREA DILUTION TECHNIQUE FOR ESTIMATING *IN VIVO* BODY COMPOSITION OF TWO BREEDS OF FAT TAILED SHEEP

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SUMMARY
Two breeds (Kordi and Balouchi) male lambs were used to evaluate urea space (US), an estimator of carcass composition, in a separate experiment. Urea space was measured 12 min after the infusion of 20% urea (130 mg urea/kg live weight (LW)). Lambs were slaughtered after urea dilution and carcass weight taken. After chilling overnight, the left side of each carcass was physically dissected into bone, tail fat and total meat. US was related to the percentage of carcass fat through the equations, 52.91-0.52US (P<0.0001) and 57.99 – 0.41US (P< 0.001) for Kordian and Balouchian breeds, respectively. A negative correlation was obtained between US and tail fat, total fat (percentage or kg), live weight and omental fat in both breeds (P<0.05). A positive correlation (P<0.01) was estimated between fat thickness over the 12th rib and total fat in Kordian sheep but not in Balouchian sheep (P>0.05). It is concluded that urea space measurement may be used as a practical estimator of body composition assessed *in vivo* in fat tailed sheep.

Keywords: fat-tail sheep, urea space, fat estimation

INTRODUCTION
Accurate estimation of body composition *in vivo* is of great importance in research concerning factors that affect the composition of live weight gain. Various methods of estimating body composition in the live animal have been developed, which include the use of subjective visual appraisal, live animal measurement, ultrasonic probes, dilution techniques including the use of ^{40}K. Each of these methods has given satisfactory results under specific conditions, yet each suffers from distinct disadvantages such as operating cost and time, accuracy and reliability and the usefulness of applying such a technique under practical conditions.

Several groups (Kock and Preston 1979; Hammond *et al*. 1984; Rule *et al*. 1986; Bartle *et al.* 1987; Moharrery *et al*. 1998) have evaluated the urea dilution technique as an estimator of body composition in cattle. In sheep, Bartle *et al*. (1988) reported that urea dilution was related to body composition in tailed lambs while Alraheem *et al*. (1992) have reported similar results in mature fat-tailed sheep. The objectives of these experiments were to evaluate urea dilution as an estimator of body composition in two different fat-tailed breeds.

MATERIALS AND METHODS
Experiment 1
Forty Kordian male lambs were randomly divided into two groups. The tails of one group were docked 3-4 hrs after birth, using rubber rings and the tails of other left intact. After weaning, 20 lambs from each group were offered an fattening ration *ad libitum* calculated according to the recommendations of the NRC (1985) for 84 days. At the end of the fattening period, 28 lambs were selected randomly for slaughter. The day before slaughter, lambs were fasted, weighed and urea dilution was determined following the procedure described by Preston and Kock (1973). A solution containing 20% urea dissolved in 0.9% saline (130 mg urea /kg live weight) was infused through a jugular vein. Blood samples (5 ml) were obtained immediately before urea infusion and 12 min after infusion time. Blood was centrifuged at 3000 g for 10 min and plasma was collected and stored at -20° C until analyzed for urea N (Bauer, 1982). Urea space and volume were calculated as a percentage of live weight (LW) using the following relationship:

Urea space (%)= A * B / LW / PUN

where A is the volume of urea infused (ml), B is the concentration of urea solution infused (mg urea-N/100 ml), PUN is the difference in plasma urea nitrogen measured in the blood sample prior to and 12 min after infusion (mg urea-N/100 ml). After slaughtering, carcasses were chilled at 4°C for 24 hrs and then half of each carcass was physically deboned and minced. After homogenising of each half side, sub-samples were collected and analyzed for water, protein, fat and ash content (AOAC 1991).

On the other side of each carcass, the area of the longissimus dorsi (eye) muscle at the interface of the 12th and 13th ribs, and fat thickness overlying this muscle was also measured using calipers. The weight of omental fat was also recorded.

Experiment 2
Experiment 1 was repeated using the second genotype, the Balouchian lambs in next year.

Statistical analysis
All data from docked and intact groups were pooled and correlation among variables were determined and tested using a t-test (SAS 1996). Prediction equations relating total carcass fat or fat thickness at the 12th rib interface with US. Regression relationship were established between parameters within each experiment using standard procedures (SAS 1996).

RESULTS AND DISCUSSION
The means and ranges of live weight, carcass weight, omental fat, eye muscle area, carcass composition and urea space are shown in Table 1. The values are similar to the range usually found in growing lambs and those at a commercial of finishing live weight for these breeds (Moharrery and Ziauddin, 1999; Moharrery, 2000).

Table 1. Means and ranges of live weight, urea space, total fat, tail fat, omental fat, fat thickness on 12th rib and eye muscle area in two breeds.

	Kordian sheep				Balouchian sheep			
			Range				Range	
Item	Mean[a]	SD[b]	Low	High	Mean[c]	SD	Low	High
Live weight, kg	48.06	7.192	30.10	58.80	32.63	3.721	25.22	39.54
Urea space (% of LWT[d])	33.09	8.074	20.340	46.505	38.95	5.21	27.16	47.88
Total fat[e], %	35.08	5.167	24.590	44.580	42.12	3.575	33.30	49.80
Total fat, kg	8.864	2.520	3.664	14.668	7.224	1.251	5.210	9.938
Tail fat, kg	4.694	1.994	1.711	9.956	2.046	.860	.938	3.851
Omental fat, kg	1.083	.562	.242	2.823	1.194	.418	.449	2.027
Fat thickness[f], mm	5.64	1.881	3.00	10.500	5.841	2.537	3.600	17.00
EMA[g], cm^2	18.56	2.853	13.480	23.630	15.471	2.706	11.650	23.830

a: n=28, b: SD= Standard deviation, c: n= 27, d: Live weight, e: Determined chemically, f: Fat thickness on 12th rib, g: Eye muscle area.

The correlation coefficients between other important variables and US were estimated and are shown in Tables 2 and 3 for Kordian and Balouchian breeds, respectively. Negative correlation coefficients were obtained between US and each of tail fat, total fat (kg or percentage), body weight, omental fat and fat thickness on 12th rib in both breeds. Eye muscle area was not associated with US ($P>0.05$). In Kordian sheep fat thickness at 12th rib was significantly correlated ($P<0.05$) with total fat (kg or percentage), tail fat and US, but these associations were not apparent in the Balouchian breed ($P>0.05$).

Prediction equations relating US and other carcass variables to carcass chemical composition are shown in Table 4. The high correlation ($P<0.01$) between these parameters demonstrate the predictive power of the measurement of urea space and fat depth at the 12th rib to assess carcass composition irrespective of species.

The relation between live weight and the various parameters used to assess fat status of carcasses, total fat (kg or percentage), omental fat and tail fat, showed highly variable relationships irrespective of in both breeds (Tables 2 and 3). Of these measure the weight of omental fat seems to be the least predictive of carcass fatness and this may be related to the different functional role of this depot within the animal.

Similarly the relationships were highly variable between breeds. This is in agreement with results of Rule *et al*. 1986, who found that the relationship derived from one bovine breed were not applicable in other cattle populations. The potential predictive power of US as an estimator of carcass fatness has been demonstrated also by the high negative correlation between this parameter and percentage carcass fat in fat tailed Awassi sheep (Alraheem *et al*. 1992). Moreover, other workers (Bartle *et al*. 1985; Bartle *et al*. 1988) have found with tailed breeds of lambs, that urea dilution was related to body composition. Similarly in growing male cattle (Holstein) Moharrery *et al*. (1998) reported that urea space was valid for the estimation of body fat in live animals.

Table 2. Correlation coefficients between carcass measurements in Kordian sheep.

	%Fat	Tail fat	O fat	Total fat	EMA	12th FT	LW	US
%Fat	1.0000[a] .000[b]	.8497 .0001	.0057 .9769	.8874 .0001	.0990 .616	.4868 .0086	.5963 .0008	-0.808 .0001
Tail fat		1.0000 .000	-0.0769 .697	.8722 .0001	.1304 .5085	.6117 .0005	.5849 .0011	-0.844 .0001
O fat			1.0000 .000	.2725 .1606	.4081 .0311	.3368 .0797	.5396 .0031	-0.145 .4608
Total fat				1.0000 .000	.2879 .1374	.6746 .0001	.8545 .0001	-0.939 .0001
DMA					1.0000 .000	.3690 .0533	.4261 .0237	-0.183 .3526
12th FT						1.0000 .000	.5887 .0010	-0.544 .0028
LW							1.0000 .000	-0.791 .0001
US								1.0000 .000

%Fat= total body fat as a percentage, Ofat= omental fat, Total fat= total body fat as a kg, EMA= Eye muscle area, 12th FT= fat thickness on 12th rib, LW= live weight, US= urea space. The variable units are the same as shown in the Table 1.
a: Coefficient of correlation
b: Level of probability

Table 3. Correlation coefficients between carcass measurements in Balouchian sheep.

	%Fat	Tail fat	O fat	Total fat	EMA	12th FT	LW	US
%Fat	1.0000 .000	.4362 .0229	.2356 .2369	.5896 .0012	.2466 .2151	.0712 .7241	.1641 .4134	-0.594 .0011
Tail fat		1.0000 .000	-0.090 .6556	.5004 .0079	-0.029 .8843	.1496 .4564	.4097 .0338	-0.708 .0001
O fat			1.0000 .000	.6134 .0007	-0.0002 .9991	-0.229 .2505	.5395 .0037	-0.392 .0432
Total fat				1.0000 .000	.0588 .7706	.0067 .9735	.8381 .0001	-0.853 .0001
EMA					1.0000 .000	-0.203 .3090	-0.295 .1351	-0.118 .5591
12th FT						1.0000 .000	.0174 .9315	-0.115 .5668
LW							1.0000 .000	-0.751 .0001
US								1.0000 .000

%Fat= total body fat as a percentage, Ofat= omental fat, Total fat= total body fat as a kg, EMA= Dorsi muscle area, 12th FT= fat thickness on 12th rib, LW= live weight, US= urea space. The variable units are the same as shown in the Table 1.
a: Coefficient of correlation
b: Level of probability

Table 4. Equations relating carcass composition to urea space and fat thickness over the 12th rib.

Component	Equation	r^2	P<
Kordian breed			
Fat, %	52.911 – 0.517 US	.65	.0001
Fat, kg	18.563 – 0.293 US	.88	.0001
Fat, kg	3.761 + 0.904 FT	.46	.0001
Fat, kg	-3.304 + 0.715 T-fat + 0.183 W	.94	.0001
Balouchian breed			
Fat, %	57.993 – 0.407 US	.35	.0011
Fat, kg	15.202 – 0.025 US	.73	.0001
Fat, kg	-0.604 + 0.476 T-fat + 1.111 Ofat + .169 W	.81	.0001
Fat, %	42.895 + 2.590 T-fat + 4.112 Ofat - .337 W	.33	.025

US= urea space, FT= fat thickness on 12th rib, T-fat= tail fat, W= live weight, Ofat= omental fat

In conclusion, US appears to be a valid estimator of *in vivo* body composition in growing finishing lambs. In addition the measurement of fat thickness over the 12th rib provides a reliable means of estimating total body fat in Kordian sheep, but to a lesser extent in Balouchian sheep.

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