Comparison of DXA with chemical analysis for body composition measurement

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Dual energy x-ray absorptiometry (DXA) has become increasingly popular as a technique for soft tissue measurement of the human body. Comparison of DXA with hydrodensitometry and other methods of determining body composition showed it to be precise, convenient, non-invasive and safe (1). The suggestion that it become an accepted reference method has led to a study of its accuracy (2). This preliminary study aimed to evaluate the accuracy of DXA determinations by comparing DXA estimates of fat mass and lean tissue with chemical analysis of small animal carcasses.

Whole body DXA scans were performed on two eviscerated sheep carcasses using a Hologic QDR-1000/W (Waltham-MA) densitometer and standard whole body protocol (V5.47). Four anaesthetised Hooded Wistar rats were scanned in vivo using the Hologic QDR-2000/plus Rat Whole Body protocol (V5.67) prior to euthanasia. Previous studies have shown CV <1.0% for BMC, 1.3% for fat and 0.6% for lean mass for adult human subjects with this instrumentation. Animals were weighed before and after dissection and chemically analysed for protein, fat, ash and water.

Results are described for total body analysis. Percentage differences between the means of DXA and chemical analysis were compared using t-tests for paired samples.

% ± sem	Body weight	BMC (ash)	Lean mass	Fat mass
Sheep	-3.0 ± 0.5	-29.8 ± 2.9	0.2 ± 0.8	-10.0 ± 4.2
Rats	0.9 ± 1.7	-44.2** ± 2.4	0.4 ± 0.8	31.8* ± 11.9

Significant difference of DXA from chemical analysis : *p<0.05; **p<0.01

DXA determined body weight in both species was highly correlated with scale weight ($r = 0.971$). Lean mass from DXA correlated significantly with lean mass derived from chemical analysis ($r = 0.973$, $p = 0.027$), being almost identical with both techniques. BMC by DXA correlated highly with ash by chemical analysis (rats $r = 0.854$) with densitometric values lower in both species. This could be explained by the mineral content of soft tissue. However, although DXA fat mass correlated highly with chemically determined fat (rats $r = 0.897$), it overestimated fat by 32% (15-57%) in rats and underestimated it by 10% (13-7.7%) in sheep.

We conclude that the differences between DXA-determined and chemically-determined fat mass identified in this preliminary study warrant further investigation.

1. Pritchard JE, Nowson CA, Strauss BJ, Carlson JS, Kaymakci B, Wark JD. Evaluation of dual energy x-ray absorptiometry as a method of measurement of body fat. Eur J Clin Nutr 1993;47:216-28.
2. Kohrt WM. Body Composition by DXA: tried and true? Med Sci Sports Exerc 1995;27:1349-53.