Validation of the iNSiGHT Dual Energy X-ray Absorptiometry (DXA) System

Abstract

The iNSiGHT dual energy x-ray absorptiometry (DXA) scanner manufactured by OsteoSys is a scanner (25 second scan time) that can effectively provide reproducible data for measuring global and local changes in body composition in mice and rats. The system can also assess excised tissue accurately. The purpose of this study was to evaluate the precision and accuracy of the iNSiGHT DXA scanner to the bone mineral content (BMC), total fat mass, total lean mass, and the total weight measured via chemical carcass analysis, ashing, and scale weight. Mean r value for BMC in grams (g), total fat mass in grams (g), lean mass in grams (g) and total weight in grams (g) range between 0.8342 and 0.9996.

Thus, the DXA measurements versus gravimetric/chemical extraction/ashing/scale weight were highly correlated. Currently this is the only available DXA scanner with proper validation against chemical carcass analysis, ashing, and scale weight.

Objective

The objective of this study was to evaluate the precision and accuracy of the iNSiGHT DXA scanner to the actual weight, total fat mass, and BMC measured via chemical carcass analysis, ashing, and scale weight.

Research Methods and Procedures

48 C57BL/6 mice were divided into 4 groups.

Mice either received a standard diet offered by Purima Lab Diet (#5001 Laboratory Rodent Diet) ad libitum or a high fat diet offered by Diet Induced (DIO) Rodent Diet with 45% energy from fat, dyed red (Scott Pharma #58125), provide ad libitum. On day 56 the animals were euthanized by carbon dioxide asphyxiation or inhaled anesthetic isoflurane overdose in accordance with accepted AVMA guidelines. Animals were then placed in the DXA scanner in the prone position center of the measuring plate (16.5 x 25.5 cm scan area). Spine was straightened and paws were laid out from the body. A 25 second dual energy scan was – administered with a 60 kV low energy, 80 kV high energy at 0.8 mA. The X-ray exposure was 5 seconds at each energy level, and there was 15 seconds required for image and data processing. Images include an X-ray image, a bone mineral density (BMD) image, and a colour image (lean mass in green, and fat mass in red) for each animal (Figure 2).

Validated against gold standard techniques: chemical carcass analysis, ashing, and scale weight

These measurements were repeated in triplicates for accuracy. Animals were then weighed on an electronic scale with an accuracy down to 10 mg. Gravimetric and chemical extraction techniques (Soxhlet) were used as criterion methods for the determination of body composition; ash content was determined by burning at 600oC for 8 hours. Then Pearson two-tailed correlation was determined to compare the numbers calculated via gravimetric/chemical extraction/ashing/scale weight versus the DXA measurements.

Treatment Group	# of Animals	Treatment	Treatments per animal	Necropsy Time Point
1	16 (8M, 8F)	Standard Diet	56 days	56 days
2	16 (8M, 8F)	High Fat Diet		
3	8 Ovariec-tomized Females	Standard Diet		
4	8 Ovariec-tomized Females	High Fat Diet		

Table 1. Study Design/Treatment Groups

Results

The iNSiGHT DXA scanner has superior correlation to the actual body composition, highlighting the precision of the dual energy scan and its algorithms. The Pearson two-tailed correlation revealed strong correlation between gravimetric/chemical extraction/ashing/scale weight and DXA measurements for total weight, BMC, fat mass and lean mass (Figure 1). Mean r value for total weight in grams (g) is 0.9996 (P<0.0001). Mean r value for bone mineral content (BMC) in grams (g) is 0.8342 (P<0.0001). Mean r value for total fat mass in grams (g) is 0.9872 (P<0.0001). Mean r value for lean mass in grams (g) is 0.9360 (P<0.0001). Thus, the DXA measurements versus gravimetric/chemical extraction/ashing/scale weight were determined to be highly correlated. This is the only scanner on the market that has this complete set of correlated values with a proper cross reference in ashing, chemical carcass, and weight analysis.

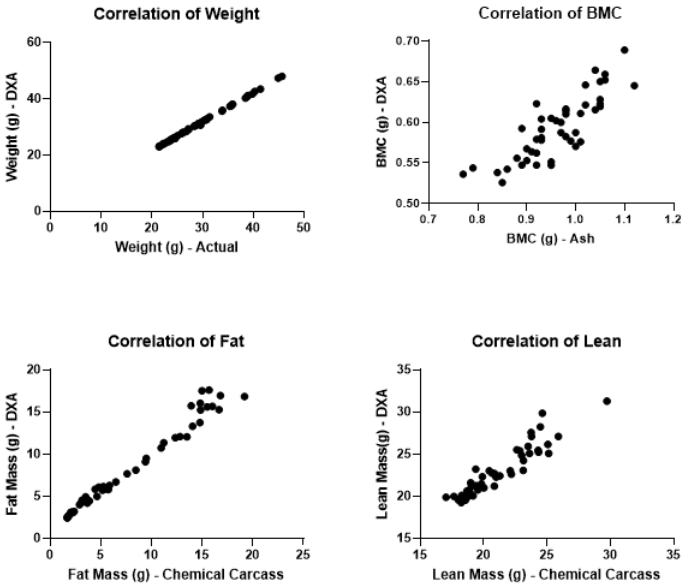

Figure 1. Correlated Values between DXA measurements and Chemical Carcass/Ashing Analysis.

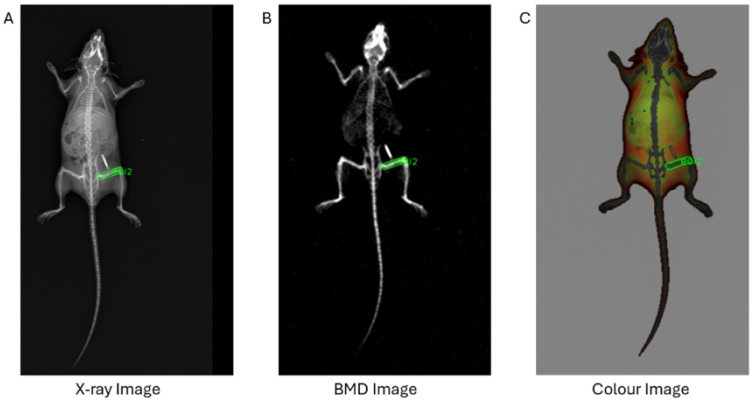

Figure 2. Example mouse images from study. Mouse 38 (Female, C57BL/6, Normal Diet). A) X-ray image. B) BMD Image. C) Colour image (lean mass in green, and fat mass in red).

Conclusion

In this study, gravimetric/chemical extraction/ashing/scale weight and DXA measurements were highly correlated for total weight, BMC, fat mass and lean mass within mice. This represents cross validation of the DXA measurements against the gold standard chemical carcass and ashing analysis. As such, the iNSiGHT DXA scanner manufactured by OsteoSys is the only scanner currently available that can accurately measure changes in body composition in small animal models.

If you have any questions on which method best meets your research needs, feel free to contact us to discuss your model. We have many resources available, from scientist webinars to journal citations, to help point you in the right direction.

To learn more visit our website (www.scintica.com) or feel free to reach out to us via email at info@scintica.com or by phone at 832-548-0895 and we would be glad to assist you.