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VET DXA
iNSiGHT

DR Planar Image
Multiple Region of Interest
None Invasive DXA Technology

OsteoSys

Ultimate In Vivo Imaging and Automatic DXA Analysis for Longitudinal Studies

iNSiGHT is a fully shielded DXA cabinet body composition analyzer for lab animals. It offers fast scan, high resolution image, multiple ROIs with cone beam HFG and flat panel detector for ultimate precision an accuracy.

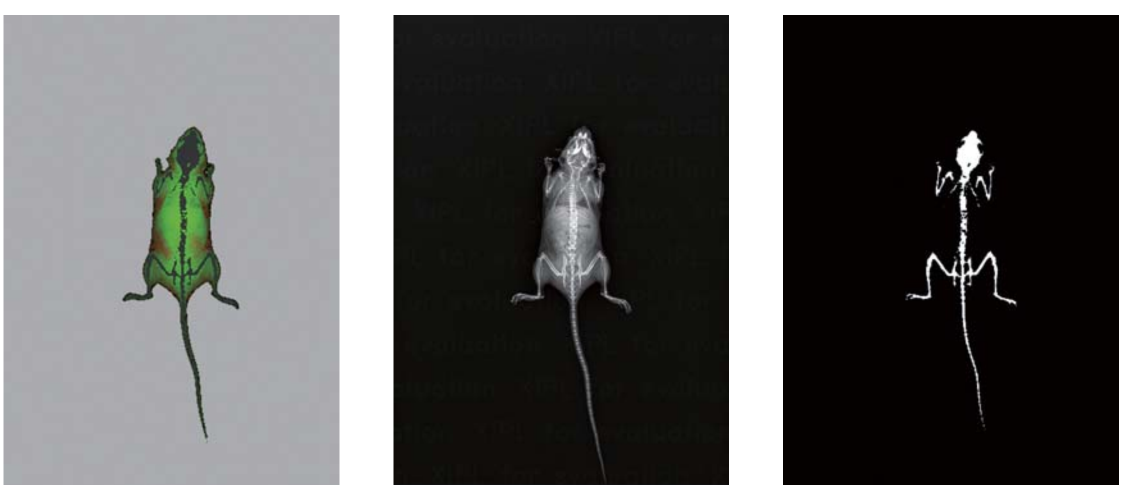
Gold Standard for Body Composition Analysis

DXA(Dual-energy X-ray absorptiometry) is a measurement technology based on the variable absorption of X-ray by the different body components and uses high and low energy X-ray photons. Until the mid-1980s, bone mineral density(BMD) measurements were used mainly for research, and it was only with the introduction of DXA scanners in 1987 that they entered routine clinical practice.

DXA measurements distinguish bone from soft tissue due to the higher atomic number of the calcium and phosphorous atoms in bone compared with the carbon, nitrogen, and oxygen atoms in the soft tissue. Regarding soft tissue, fat is largely composed of repeated methylene units($(CH_2)n$), whereas the x-ray attenuation of lean tissue is similar to water(H_2O). The difference in x-ray attenuation between fat and lean tissue is attributed to the atomic number difference between carbon and oxygen.

Based upon this difference, it is possible for iNSiGHT to accurately separate fat, lean, and bone mass(g) and its ratio(%) in certain ROIs as well as the total body.

DXA Cabinet Body Composition Analyzer for Lab Animals



Measurements and Applications

DXA has a wide range of clinical applications from assessing associations between adipose or lean mass and the risk of disease to understanding and measuring the effects of pathophysiological processes or therapeutic interventions in preclinical settings.

Index	BMD	BMC	Bone Area	Tissue Area	Fat[%]	Fat[g]	Lean[g]	Total Weight
RO11	0.217	9.645	44.453	140.543	21.377	104.072	382.764	496.481
RO12	0.264	0.301	1.142	1.302	16.665	1.331	6.658	8.291
RO13	0.270	0.300	1.115	1.1425	16.788	1.335	6.617	8.253

Bone, Fat & Lean, Body Composition Analysis

Bone

Rodent models are important issue in the preclinical research of bones. They provide insights into bone metabolism of living organisms and potentially uncover positive or negative effects in the use of certain types of medication. Furthermore, they allow us to investigate the physiological process of bone healing. Because of their surgical feasibility and standardization, rat fracture models are of major significance.

Fat & Lean

Different types of adipose tissue at different locations(subcutaneous versus visceral) play different physiological roles. Visceral adipose tissue is a significant risk factor for coronary artery diseases or diabetes and more predictive of obesity-induced pathologies than total or subcutaneous adipose tissues. Equivalent methods in murine models of obesity are still lacking.

Body Composition Analysis

Based on DXA technology, iNSiGHT analyses body composition of lab animals at the molecular level that is automatically translated into a clinical model made up of fat mass, lean mass, and bone mineral content. iNSiGHT allows total and regional assessment for longitudinal in vivo follow-up of these compartments.

Measurement Window for each ROI

By combining the merit of NMR (High Precision), DXA (In Vivo Body Composition Follow Up) and DR (High Resolution Image), iNSiGHT pioneers the field of animal body composition analysis with delicate customization and spontaneous co-work with researchers.

Longitudinal Measurement In Vivo

01

iNSiGHT is the perfect solution for longitudinal research. It offers FAT, LEAN and, BONE measurement invivo keeping the integrity of the animal. Due to its fast scan time(25 sec total scan, 10 sec X-ray exposure), a simple treatment for anesthesia without any sacrifice of animal is the only prerequisite for measurements.

Genuine In Vivo Longitudinal Investigation

BMD and body composition are commonly reported measures for physiological monitoring. Invasive methods have traditionally been used to determine BMD and body composition, requiring post-mortem studies insmall animals.

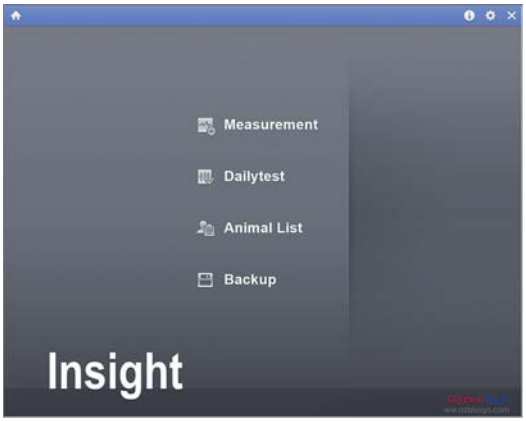
For these purposes, destructive testing, mechanical tests, and ash measurements to reveal chemical composition have been applied. These methods are time consuming, destructive and require sacrificing the animal. Therefore, rapid, quantitative and non-invasive alternatives are desirable.

DXA based imaging device, iNSiGHT, measures BMD and assesses body composition of animal in vivo for a longitudinal investigation to monitor changes in whole body composition with growth and aging in animal. Using non-invasive iNSiGHT, it is able to repeatedly scan cohorts of animal over long-term study.

NMR was used for adipose tissue analysis in rodent but involves prohibitive costs and long acquisition time. Small animal micro-CT involves long-term X-ray exposure precluding longitudinal studies.

iNSiGHT has overcome these limitations by fast planar imaging, minimal radiation exposure and radiation free environment for researchers. It opens a novel method optimized to in vivo investigations of rodent model of obesity allowing automated detection and quantification of fat / lean.

If a research is focused exclusively on a longitudinal monitoring of fat and lean, NMR could be remained as an acceptable solution. However, if bone measurements(BMD, BMC) cover a major portion in the research, DXA is the one and only solution.



Main User Interface

History Analysis for Each ROI

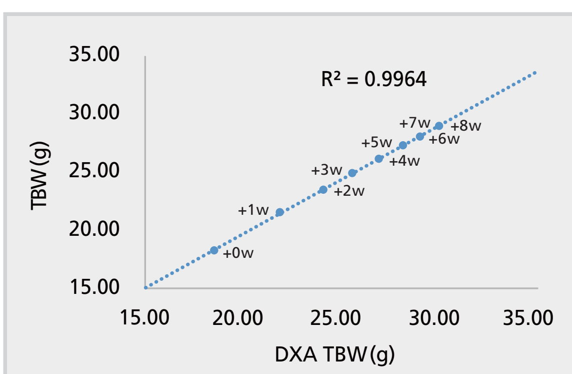
Precision and Accuracy

02

iNSiGHT is proven with its high precision(CV<1%) and accuracy(R^2>0.9) as superb as those of NMR and micro CT. The precision, accuracy and capability of detecting changes for the measurements of total-body weight, fat weight, and lean weight in an 8-week follow-up study of rats was proved by a clinical trial.

On the 8th week, the accuracy was validated by comparing the total body weight measured by iNSiGHT (DXT TBW) with the weight by electronic scale(TBW).
The precision was verified by the coefficients of variation (CV) of repeated analysis for rats' Total Body Weight(TBW), Total Body Fat Weight(TBFW) and Total Body Lean Weight(TBLW) measured by iNSiGHT without repositioning of the animals.

Genuine In Vivo Longitudinal Investigation



Accuracy : $R^2 > 0.9$

Contents	CV(%)*
DXA TBW(g)	0.02 ±0.01 (0.01 - 0.04)
DXA TBFW(g)	0.01 ±0.05 (0.03 - 0.18)
DXA TBLW(g)	0.03 ±0.02 (0.01 - 0.06)

* Mean ± SD (Min - Max)

Precision : CV < 1%

OsteoSys **WCO-IOF-ESCEO Paris 2019** WOOJUNGBIO

Evaluation of iNSiGHT VET DXA (Dual-Energy X-ray Absorptiometry) for Assessing Body Composition in Obese Rats Fed with High Fat Diet: A Follow-up Study of Diet-Induced Obesity Model for 8 Weeks

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ABSTRACT

Objectives

We examined the precision, accuracy, and capability of detecting changes of Dual-Energy X-ray Absorptiometry (DXA) for the measurements of total-body weight (TBW), total-body fat weight (TBFW), and total-body lean weight (TBLW) in an 8-week follow-up study of rats.

Materials and Methods

20 male rats (4-week) were divided into 2 diet groups. For 8 weeks, we measured body composition (TBW, TBFW, TBLW) by DXA and TBW by an electronic scale once a week. In week 8, we measured body composition 5 times by DXA and TBFW by dissecting experiment (EXP) of euthanized rats (12-week). Total-body fat ratio (TBFR) was defined as TBFW / (TBFW+TBLW). The precision of DXA was evaluated by measuring the coefficient of variation (CV) and accuracy was evaluated by comparing DXA-derived data with EXP data. The capability of detecting changes of DXA in follow-up study was verified by analyzing the trend of DXA-derived values over the 8 weeks.

Results

For TBW, TBFW, TBLW of DXA, CVs were 0.02±0.01, 0.10±0.05, 0.03±0.02 and errors were -6.996 ±3.429 (r=0.999), +14.729 ±3.663 (r=0.982), -21.725 ±4.223 (r=0.991). Prediction models were [EXP TBW = -31.767 +1.085(DXA TBW), R2=0.998, root mean square error (RMSE)=1.842] and [EXP TBFR = -0.056 +1.177(DXA TBFR), R2=0.948, RMSE=0.007]. Over 8 weeks, DXA TBW and DXA TBLW steadily increased, DXA TBFW steadily increased followed by saturation or declination, difference of DXA TBFW between 2 diet groups steadily increased.

Conclusions

Our study verified that DXA (iNSiGHT VET DXA, OsteoSys, Korea) is accurate and precise enough to measure body composition of rats. Additionally, we confirmed the possibility that DXA could be used for the long-term follow-up studies.

INSTRUMENT

Objectives	Specification
Measurement Site	Small Animal Total Body
Measurement Range	10 ~ 500g (verified)
Measurement Time	25 s
Exposure Time	**10 s**
Image area	16.5cm x 25.5cm @ 1.2X
Pixel size	100μm @ 1.2X, 31μm @ 4X
Results	BMD, BMC, Bone / Tissue Area, Fat%, Fat(g), Lean(g), Total Weight @ each ROI
Precision	**< 1%** (CV) @ total body weight of mouse, rat
Accuracy	**> 0.9** (R2) @ total body weight of mouse, rat
Dimension	66cm (W) x 61cm (D) x 113cm (H)

- Flat Panel Detector
- Cone-Beam X-ray
- Lead Shielding Body
- DXA Algorithm
- Magnifying Trays

ABSTRACT

Figure 1. Scatter plots between DXA and EXP values (in week 8)

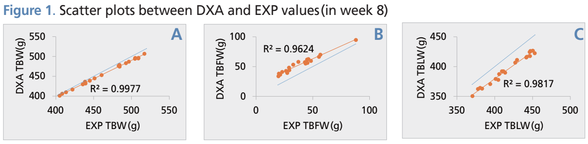


Figure 2. Residual and scatter plot (for 8 weeks)

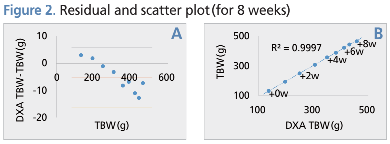


Figure 3. The trend graphs of two diet groups (for 8 weeks)

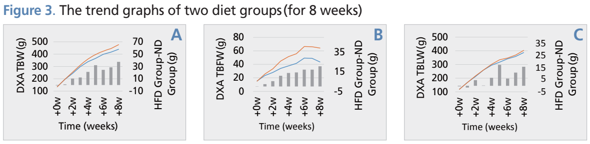


Figure 4. Experimental images (Rat, X-ray, Bone enhanced, Color Composition)

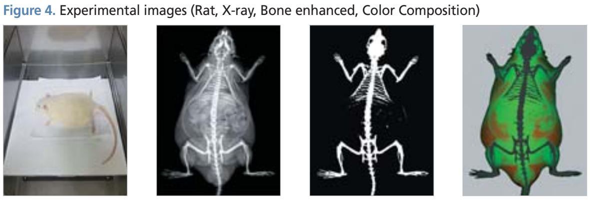


Table 1. The short-term precision (in week 8)

Contents	CV(%)*
DXA TBW(g)	0.02 ±0.01 (0.01 - 0.04)
DXA TBFW(g)	0.01 ±0.05 (0.03 - 0.18)
DXA TBLW(g)	0.03 ±0.02 (0.01 - 0.06)

* Mean ±SD (Min - Max)

Figures and Table Legend

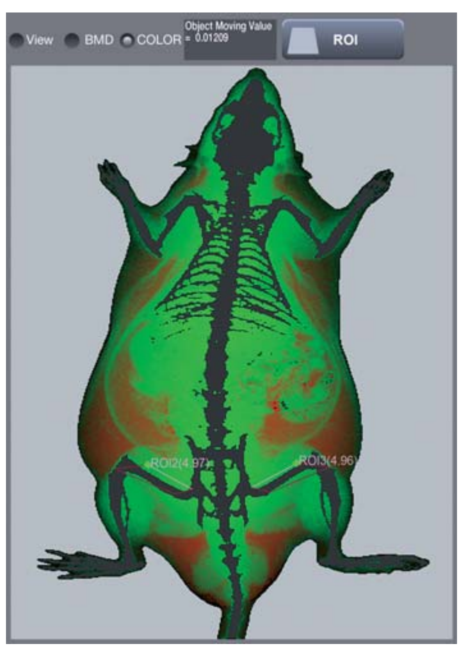
- **Figure 1.** Scatter plots of the relationship of the values between Dual-Energy X-ray Absorptiometry (DXA) and dissecting experiment (EXP) in week 8 for (a) TBW, (b) TBFW, and (c) TBLW.
- **Figure 2.** (a) Residual plot of DXA TBW values for 8 weeks. Each filled circle show the mean error of all rats (n=20). The large dashed lines represent the mean ±2 SD. (b) Scatter plot of the relationship of mean TBW (n=20) between DXA and an electronic scale for 8 weeks with the labels represented each weeks.
- **Figure 3.** The graphs represent the trend of mean DXA values divided into the high fat diet (HFD) group and the normal diet (ND) group for 8 weeks. The solid lines are the trend of HFD group and small dashed lines are the trend of ND Group. Bar graph means the difference between two groups.
- **Figure 4.** A rat placed on the scanning table of DXA, (b) x-ray image, (c) bone enhanced image, (d) color composition image.
- **Table 1.** The short-term precision of Dual-Energy X-ray Absorptiometry (DXA) calculated values in week 8 (n = 20 rats).

In Vivo Imaging

03

iNSiGHT presents an ultimate DXA image with high resolution of 100μmm. DR image and Color Mapping for lean and fat distribution is optimized for visual analysis and assessment. As pivotal tools enabling a genuine longitudinal study, iNSiGHT is equipped with Multiple ROI setting and the History Analysis. Transparent window and wide imaging area of 16.5cmX25.5cm secure measuring environment and process for in vivo imaging and DXA analysis. Magnification shelf supports high-end imaging analysis up to 4X geometric magnification.

In Vivo Imaging by Flat Panel Detector



Color Mapping for Fat/Lean Visualization

Bone-Enhanced Image

X-ray Image by iNSiGHT

Technical Specifications

X-ray System	DXA (Dual Energy X-ray Absorptiometry)
Scan Method	Cone Beam
Scan Object	Small Animal (10 ~ 500g)
Scan Time	25 sec (10 sec for X-ray exposure)
Measurement Parameter	BMD(g/cm^2) , BMC(g), Bone Area(cm^2), Tissue Area(cm^2), Fat(%), Fat(g), Lean(g), Total Weight(g) @ each ROI
Precision	CV < 1%
Accuracy	$R^2 > 0.9$
Image area	16.5cm x 25.5cm @1.2X
Pixel size	100μm @1.2X (DXA Mode) 31μm @4X
Operating System	Windows 10 64bit (recommended)
Dimension (W x D x H)	66cm x 61cm x 113cm
Weight	190kg
Power/ Environment	110/240VAC, 50/60Hz, 200VA
Operating Temp	10 ~ 40°C

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