Small Animal Phenotyping Core

(part of NORC Animal Models Core, DRC Animal Physiology Core and Nathan Shock Center Comparative Organismal Energetics Core)

Tim R. Nagy, Ph.D. and Maria S. Johnson, Ph.D.

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Body Composition Analysis

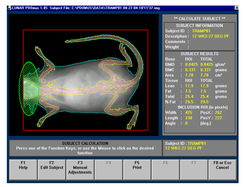
Chemical carcass analysis (CCA)

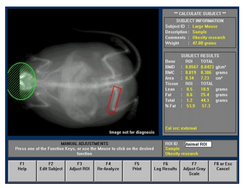
CCA is still the "gold standard" for the determination of body composition. The Core uses CCA as the standard for validating new instruments and techniques. In addition, this method is useful when animals have been killed and frozen prior to analysis. Carcasses undergo drying (to constant weight) to determine water content, followed by the extraction of fat using either petroleum ether (mice) or a chloroform/methanol extraction (rats). Finally the ash content is determined by burning the remaining dry fat-free residue at 600˚ C. Using this method, fat mass, fat-free mass, water content and ash content can be determined.

Soxhlet apparatus

Dual-energy X-ray absorptiometry (DXA)

DXA uses two X-rays of differing intensity to allow for the rapid determination of fat, soft-lean tissue, and bone (bone mineral content and density) *in vivo* in small rodents. This allows for repeated measures of body composition in the same animal. Animals are anesthetized using isoflurane and the scan takes approximately 5 minutes. The Core has three DXA machines that can measure animals from 12g to ~100g and from 250g to 100kg.





Quantitative magnetic resonance (QMR)

With the Echo Medical 3-in-1, and rat systems the core is able to offer the determination of fat and lean tissue and total water *in vivo* in animals from 10mg up to 900g. The organism of interest (from 10 fruit flies up to a 900g rat) is placed into one of the four differently-sized holders (biopsy 0-20mg, tissue 0.2-10.0g, mouse 15-100g, rat (100-900g) and inserted into the instruments, without anesthesia. Measurements take from 80 seconds for mice to 9 minutes for fruit flies.

Bomb calorimetry

The Core is able to determine the energy content of samples by bomb calorimetry. Samples are dried and then burned in pure oxygen. The heat produced is measured and allows for the calculation of the energy content of the sample. Common items measured include different foods and fecal samples.

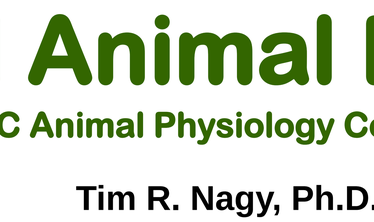
Digestive efficiency can be obtained using bomb calorimetry. Food intake and fecal output are measured over a period of several days by the PI. Energy intake is determined from the energy content of the food together with the amount eaten. The energy content of the feces together with the amount of feces produced gives an estimate of energy not digested. The difference between these values divided by the energy intake, gives an estimate of the digestive efficiency, i.e. how much of the energy consumed is digested/absorbed.

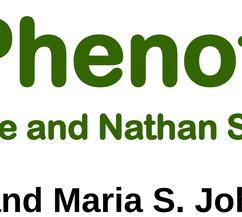
Metabolic Rate and Activity

The Core has a complete mouse metabolic phenotyping setup (TSE Systems) that allows for the determination of oxygen consumption, carbon dioxide production, locomotor activity and food intake in up to 8 mice at a time. This system is housed in an environmental chamber that allows for the manipulation of temperature and photoperiod. Total energy expenditure (TEE), resting energy expenditure (REE) and the respiratory quotient can be calculated from the oxygen and carbon dioxide values.

In addition, there is constant monitoring of food intake from the hopper attached to a weight sensor. This allows for the assessment of timing of meals and the amount of food eaten at each meal. Access to the food hopper can be controlled/restricted and set to specific hours during the day/night, or restricted to a set amount of food eaten.

An infra-red beam grid, mounted outside the cage, monitors locomotor activity in the x and y directions. This activity can be further divided into activity in different areas of the cage. Running wheels can be added to the cages, and the number of revolutions recorded during the measurement of metabolic rate.



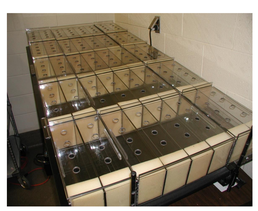


Activity / Exercise

The core has equipment to measure both voluntary activity and forced exercise. In addition to the general activity measured with the TSE system the core has transponders that when implanted into mice or rats will transmit data on ambulatory activity and core body temperature.

Voluntary running activity can be measured with the running wheel cages. The core has 16 mouse and 16 rat cages with wheels that capture data on the number of revolutions run.

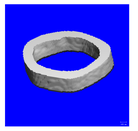
In addition to these measures of voluntary activity, the core has two systems for forced exercise. The modified treadmill with plexiglass lanes allows for up to 20 mice to be run at modifiable speeds and inclines, with additional lanes at the sides for control animals. The forced exercise/walking bed has up to 20 wheels to force mice to walk at varying speeds with intermittent rest stops if necessary. The speed and time can be set by the user.

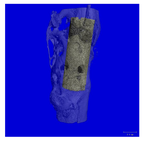


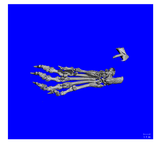
Bone Imaging

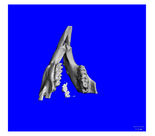
Scanco µCT40

With the Scanco µCT40 instrument, we can three-dimensionally image excised bones up to 36 mm in diameter and 80 mm in length. Six µm resolution is possible in bones of less than 12 mm in diameter (mouse and rat long bones), with a maximum of 18 µm for the samples scanned in the largest (36 mm diameter) holders. Information on trabecular bone (bone volume, density, trabecular number, separation, density and thickness) and cortical bone (bone volume, density, cortical thickness and moments of inertia) are available from the scans. Whole mice may be scanned in this way if they are within the size limits. Additionally, bones that are fixed in formalin or other preservatives can be imaged prior to more destructive analyses like histomorphometry.









Coming soon

Loligo Oxygen Consumption Systems

With the Loligo systems it is possible to measure oxygen consumption in small model systems, ranging from zebrafish, to *Drosophila*, to *C. elegans*. The core is currently testing, validating, and establishing protocols for both our chamber systems (fish, groups of *Drosophila*) and our microplate reader (single *Drosophila* and *C. elegans*).

Current Pricing

Chemical carcass analysis	$25 mice $50 rats
Small DXA	$7.50 per animal
Large DXA	$12.50 per animal
QMR	$5 per animal
Metabolic rate assessment	$15 per animal (2 day acclimation, 1 day measurement)
Voluntary activity	$2 per cage per day
µCT	$75 per hour of scan time
Bomb calorimetry	$18 per sample

Contact

Director:	**Tim R. Nagy, Ph.D.:**	**205-934-4088**	**tnagy@uab.edu**
Lab Contact:	**Maria S. Johnson, Ph.D.**	**205-934-4008**	**mariajoh@uab.edu**