ISEP 2007. Workshop 2e: Novel techniques for novel results in energy expenditure and body composition

- **Sections:**
- Energy expenditure / Calorimetry
- Heart rate
- Other approaches of heat production
- Body composition

Energy expenditure / Calorimetry

- What´s new?
- How to improve measurements accuracy?

- **Movement sensors:**
- **Doppler effect / Weight change approach:**
- Add they accuracy to the detection of a change in physical activity?
- Are they preferable to a single photoelectric sensor?

Energy expenditure / Calorimetry

- What´s new?
- How to improve measurements accuracy?

- **Partition of energy expenditure in pregnancy:**
- ***Kiani et al. (2007):***
- Total EE = EEbm + EEwch + EEcon + EEhom
- where EEbm + EEwch = EEnon-gravid tissues and EEcon + EEhom = EEgestation

- ***Rattray et al. (1974):***
- ME intake = a + cEGain + dGestation
- where a = mater maint; c = cost mater gain; d = cost gest factor (either total pregnancy/ conceptus/fetal energy retention).

Energy expenditure / Calorimetry

- What´s new?
- How to improve measurements accuracy?

- **Factors involved in the accuracy of measurements:**
- Chamber volume: The delay in response depends on chamber size
- Air flow measurement
- Calibration of analysers
- Use of factors to correct for the influence of CO_2 on paramagnetic lecture for O_2
- Calibration of the whole system

Energy expenditure / Calorimetry

- What´s new?
- How to improve measurements accuracy?
- **Calibration of gas analysers with reference gas mixtures of known composition is a key point.**

	Cylinder 1	Cylinder 1	Cylinder 2	Cylinder 2
	O2, %	CO2, %	O2, %	CO2, %
Max difference	0.056	0.040	0.016	0.021
l O2 cons. and CO2 prod. for an outgoing flow of 70 l air/min	56.4	40.3	16.1	21.2
Δ HP, kJ/day	913	202	261	106
Δ HP for a 40 kg BW sheep, kJ/kg0.75 per day	57.4	12.7	16.1	6.7
Δ HP/MEm x 100	15.3	3.4	4.4	1.8

Heart rate

- $VO_2 = (HR \times SV) \times (CAO_2 - CVO_2)$
- SV, CAO_2 and CVO_2 may change widely

- **Montaurier et al. (2007)** find in humans a persistent effect of intensive diurnal activity on HR measured in the following night.

- **Brosh et al.** approach (for animals not doing intensive exercise):
- $VO_2 = HR \times (VO_2 / HR)$
- HR estimated along consecutive days (3 to 4 days)
- VO_2 / HR determined in repeated measurements for short periods (10 to 30 min)

Heart rate

- Is the O2P-HR method of Brosh et al. a reliable and accurate technique to estimate EE in free-leaving animals?

- **Three applications:**
- Estimation of EE and EB in ruminants: Which would be an acceptable bias respect to a gas exchange measurement?
- Determination of production efficiency in cattle
- Estimation of energy cost of grazing activities

Other approaches of heat production

- Is the CO2 entry rate technique using 13C as a tracer a reliable and accurate technique to estimate EE in confined and free-leaving animals?

- **Lachica et al.** : Isotopic fractionation of 13C observed by means of cold exposure and dietary treatment
- **Lachica et al. (2003)**: Feasibility in open-range goats
- **Jungans et al. (2007)**: Validation in young bulls

Body composition

- Comparison of three imaging techniques:
  Magnetic Resonance Imaging (MRI) technique
  Colour image segmentation method
  Histological approach

- **Davenel et al.**: Application to study lipid distribution
- Conclusion: Great potentiality of MRI

Energy expenditure / Calorimetry

- **The reliability of results depends on:**

- The quality of the reference gas mixture used to calibrate analyzers
- A simultaneous calibration of gas analyzers and flowmeter

- **Ring tests:** They can help to remove bias due to erroneous calibrations of gas analyzers.
- Should we organise an inter-laboratory test?

CONCLUDING REMARKS??

- A ring test on analysis of components of a reference gas mixture to check analyzers in calorimetric chambers is (is not) recommended.
- Progress in application of HR and other indirect techniques to predict EE in free-leaving conditions will be brought by improving bio-data recording.
- Feasibility of CERT using 13C to estimate HP in free-leaving animals is envisaged as a real event.
- MRI has a great potentiality as a tool in tissue analysis with advantages over other techniques.