Y Anglaret, I Ortigues *(INRA-Theix, Laboratoire Croissance et Métabolismes des Herbivores, 63122 Saint-Genès-Champanelle, France)*

The energy cost of standing (ECS) is non-negligible and variable. It can account for up to 25% of whole animal energy expenditure (EE) and should thus be taken into account. This paper reports a simple method of calculating ECS using continuous indirect calorimetry measurements in respiration chambers. EE and posture (standing/lying obtained by an on/off contacter) were measured in 4 preruminant calves at discrete intervals once every 5 min over 2 d. Calculation of EE includes a correction for dead space.

A frequent and non-reproducible lack of concomitance between posture and EE changes is observed in the results as well as a large variability in EE (fig 1a). This makes ECS difficult to measure. Thus, it appeared necessary to confirm or modify the attribution of EE data to the 'quietly lying' or 'standing' postures. Some 'lying' data were eliminated as non-representative of 'quietly lying' if they were superior to the upper limit of the unilateral confidence interval ($p < 0.005$) calculated for each 'lying' period. In addition, the attribution of the first EE data of each 'standing' period and the first 2 following 'lying' EE data were reconsidered. Data superior to the 'lying EE + 1/2 average increment of EE due to standing' (as initially observed) were attributed to the standing posture. All these corrections accounted for the low measurement frequency used and a variable activity in each posture. Corrections improved the synchronization between EE and posture changes, and the discrimination of the 'standing' periods (fig 1). They increased the time spent standing from 326 ± 31 (SE) to 383 ± 34 min/d. This rise remained below measurement errors (5 min on average per standing period). For each standing period ECS was then calculated by difference between average 'standing' EE and the 'quietly lying' EE baseline surrounding this period. Daily intra-animal variability in ECS ranged from 16 to 33% (CV), and ECS was independent of the duration of the standing periods. Daily average ECS was 7.46 ± 0.55 cal/kg LW/min over the 8 daily kinetics, *ie* 23.8% above the lying EE. This value was much lower and less variable than that measured by regression between total daily EE and total daily time spent standing (35.5 ± 14.4 cal/kg LW/min, $n = 8$). On the other hand, it was close to that obtained by Nienaber *et al* [(1987) Energetics of activity using indirect calorimetry. *In: Energy Metabolism of Farm Animal* (PW Moe, HF Tyrell, PJ Reynolds, eds), Rowman and Littlefield, Totowa NJ, USA, 164-167] in newborn calves and sheep using a complex calculation method.

A simple and reliable determination of ECS is thus made possible for each standing period, on a small number of animals, and interpretation of daily changes in EE can thereby be improved.

Estimation of the energy balance in concurrently pregnant and lactating rabbit does during their second pregnancy.

L Fortun, F Lebas *(INRA, Station de Recherches Cunicoles, BP27, 31326 Castanet, France)*

Rabbit does can be mated shortly after parturition and sustain concurrent pregnancy and lactation. This intensive reproduction rhythm is used in husbandry. However, the energy requirements of concurrently pregnant and lactating does are poorly known. The aim of this experiment was to compare the energy balance of pregnant does (P group, $n = 72$) and pregnant and lactating does (PL, $n = 79$), in breeding conditions. All females were mated within 12 h after the first parturition (day 0). The does had similar live weights at mating (3 491 ± 28 g) in both groups, and were fed a commercial diet (17.5% CP, 9.74 MJ DE kg) *ad libitum*. They were slaughtered on day 28 of the second pregnancy to study body characteristics and foetal weight. Energy requirements for maintenance (420 kJ/kg$^{0.75}$ for P does and 468 kJ/kg$^{0.75}$ for PL does), milk production (155 g/d; 8.29 kJ/g; efficiency of utilization = 0.63), and uterus + fœtus growth (2.43 J and 1.76 MJ in P and PL groups; efficiency of utilization = 0.27) were calculated according to Parigi-Bini *et al* [(1991) Utilization and partition of digestible energy in primiparous rabbit does in different physiological states. 12th Symp Energy Metabolism Farm Anim Zurich, 17 Sept].

Does in the P group gained weight during the first (548 g) and the second (236 g) half of pregnancy, whereas PL does gained weight during the first half of pregnancy (525 g) but lost weight during the second half of gestation (–191 g). At slaughter, the weights of carcass (–17.5%), skin (–20%), and adipose tissus (–71%) were lower in the PL group than in the P group ($P < 0.01$). The weights of pregnant ute-

rus (440 *vs* 553 g) and fœtuses (34.5 *vs* 40.0 g), and the number of fœtuses (8.2 *vs* 9.3) were lower in the PL than in the P group ($P < 0.001$). Feed intake from day 0 to day 28, and thus digestible energy (DE) intake, was 60% higher in the PL than in the P group (8 964 *vs* 5 661 g; 87.3 *vs* 54.7 MJ). DE requirements were estimated at 99.1 and 42.2 MJ in PL and P groups respectively. Therefore, the energy balance over the 2nd pregnancy (DE intake – DE expense) was positive in the P group (+12.5 MJ DE) and negative in the PL group (–11.8 MJ DE). These results show that there is nutritional competition between energy requirements for milk synthesis and fœtal growth in PL does, leading to a reduced fœtal weight.

Heat-induced changes in glucose metabolism in chickens. JCF Padilha [1], PA Geraert [2], N Rideau [2], H Aïn Baziz [3], S Guillaumin [2] ([1] *CNPq-Universidade Federal Santa Catarina, 88049 Florianópolis, Brazil;* [2] *INRA, Station de Recherches Avicoles, 37380 Nouzilly, France,* [3] *Institut Technique des Petits Élevages, Algiers, Algéria*)

Chronically heat-exposed chickens have a low growth, even when compared to pair-fed control-exposed birds [Geraert (1993) *Proc Nutr Soc* 52, 165 A]. In poultry, the main source of dietary energy comes from carbohydrates (starch). The growth reduction observed under hot conditions might then be explained by changes in carbohydrate metabolism. The present experiment was performed to study the effect of chronic heat exposure upon glucose utilisation and glucose–insulin balance.

A total of 216 birds were distributed in 3 groups according to the following design: TA22 (22°C, *ad libitum* feeding), TA32 (32°C, *ad libitum* feeding) and TR22 (22°C, pair-feeding on the TA32). The ambient temperature was kept constant between 4 and 6 weeks of age.

Sensitivity to exogenous insulin was determined by plasma glucose measurement 90 min after intra-muscular injection of saline or porcine insulin solution (20 µg per kg) (table I).

In fasted birds, sensitivity to exogenous insulin was decreased in hot conditions: the plasma glucose drop reaches 42% for TA32 *versus* 57% in control-exposed pair-fed chickens (TR22). Sensitivity is increased in fed heat-exposed birds: the decrease in plasma glucose was 27% in TA32, 20% in TA22 and only 8% in TR22.

A dose–response curve was also constructed with 0, 2, 4, 10, 20, and 40 µg insulin per kg injection. At the same injection dose, similar results as above were obtained. Moreover, glucose tolerance was investigated after administration of a glucose solution (2 ml per kg). Plasma was collected immediately and 10, 15, 30, 45, 60 and 90 min after glucose administration. Maximum of plasma glucose was reached 60 min after glucose administration in heat-exposed chickens compared to only 30 min in control-exposed birds. Plasma insulin concentrations were also measured.

Chronic heat exposure changes the glucose–insulin balance. Such a modification could account for the growth reduction and enhanced fatness of heat-exposed chickens [Aïn Baziz *et al* (1994) *Reprod Nutr Dev* (in press)].

Table I. (JCF Padilha *et al*)

Nutritional state	*TA22*		*TR22*		*TA32*	
injection	*Mean**	*SE*	*Mean**	*SE*	*Mean**	*SE*
Fed						
Saline	2.29[b]	0.04	2.25[b]	0.07	2.45[b]	0.08
Insulin	1.82[a]	0.05	2.06[ab]	0.05	1.77[a]	0.05
Fasted						
Saline	1.87[b]	0.03	1.94[b]	0.04	1.86[b]	0.04
Insulin	0.90[a]	0.04	0.84[a]	0.07	1.08[a]	0.07

* Within a nutritional state, mean values denoted by the same letter were not significantly different ($P < 0.05$).