sured after specific (Lf) or polyclonal stimulation of Peyer's patches cells and splenocytes.

The uptake of Lf induces both a stimulation of total IgA, IL-2 and IL-5 productions and a stimulation of IL-2 and IL-5 secretions by Peyer's patches cells and splenocytes respectively. Increasing level of anti-Lf IgA and to a lesser extent IgG antibodies production was observed in intestinal secretions during the 4 weeks of feeding. In sera, the mice have developed an IgG specific response. These effects on the immune system are corroborated by the dose-dependent proliferation response of the same cells.

In conclusion, the ingestion of bovine Lf with low digestibility in the mice induces a mucosal immune response which probably acts in preventing its systemic absorption.

Energy expenditure during heavy sustained exercise. P Ritz [1], N Fellmann [2], P Rousset [1], J Ribeyre [2], A Chamoux [2], B Beaufrère [1], J Coudert [2] *([1] Laboratoire de nutrition humaine; [2] Laboratoire de biologie et de physiologie du sport; [1,2] CRNH-Auvergne, Clermont-Ferrand, France).*

Adequate energy (EI) and water intakes are key conditions for physical performance. Whereas EI measurements are often biased, the doubly labelled water (DLW) method is the only method for the measurement of total energy expenditure (TEE) and water fluxes that does not interfere with physical exercise. Energy expended during exercise can be estimated from heart rate (HR) recordings, the relationship HR-VO_2 having been calibrated during the assessment of VO_{2max}. The aim of this study was to measure energy and water needs during a 7-day endurance raid.

Nine subjects (42.1 ± 7.8 year, mean ± SD) engaged in a triathlon of 595 km and 13 100 m cumulative gain in altitude. On day 1 they drank a DLW dose (150 mg/kg ^2H and ^{18}O). Saliva/urine samples were collected before, 4, 5, and 6 h after the dose (for total body water estimates, TBW) then daily till day 7 (for measurement of isotope rate constants). TBW was measured again on day 8. HR monitoring was performed during each exercise session with portable HR monitors, and transformed into VO_2 to calculate energy expended during exercise, and relative exercise intensity (% of VO_{2max}).

Time spent on exercise varied between 622 ± 43 min (day 1) and 521 ± 16 min (day 7). Relative intensity of exercise decreased between day 1 (57.6 ± 5.0% of VO_{2max}) and day 7 (47.4 ± 5.1%, $P < 0.001$). TBW increased by 4.1 ± 2.0 L (day 1 to day 7, $P < 0.001$) although body weight was kept constant (68.4 ± 6.5 kg day 1, 68.1 ± 6.8 kg day 7). Water outflow rate (skin, respiratory and urine losses) was 6.44 ± 0.89 L/day. Mean energy expended daily during exercise was 16.9 ± 1.4 MJ/day. TEE was 32.1 ± 4.6 MJ/day, ie, 561 ± 44 kJ/kg lean body mass.

In conclusion, heavy sustained exercise is accompanied by a TEE almost three times as high as sedentary subjects. Water retention observed in the present study suggests a massive energy deficit.

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Comparison of methods for determining energy expenditure of elderly people in free-living conditions. B Morio, P Ritz, E Verdier, C Montaurier, Y Boirie, B Beaufrère, M Vermorel *(Inra, laboratoire de nutrition humaine, centre de recherche en nutrition humaine, 58, rue Montalembert, BP 321, 63009 Clermont Ferrand cedex 1, France).*

The aim of the study was to compare three methods available to determine daily energy

expenditure (DEE) of elderly people in free-living conditions: the doubly labelled water (DLW) technique [Ritz and Coward, (1995), *Diabete & Metab*], the factorial method (MFact) [Visser et al (1995), *Metab*] and the heart rate recording method (MHR) [Ceesay et al (1989), *Br J Nutr*]. For the individual calibration of MFact and MHR, energy costs of the various typical activities and individual relationships between HR and energy expenditure (EE) were determined from continuous measurements of HR and EE during 3 consecutive days in two opencircuit whole-body calorimeters in 12 healthy subjects (six males and six females; 70.1 ± 2.7 years; mean ± SD). In free-living conditions, DEE was determined by DLW during 17 days and by MFact and MHR from recordings of activities and HR during 14 and 4 days, respectively. Mean free-living DEE estimated using DLW, MFact and MHR was 12.8 ± 3.1, 12.7 ± 2.2 and 13.5 ± 2.7 $MJ.day^{-1}$ in men and 9.6 ± 0.8, 8.8 ± 1.2 and 10.2 ± 1.5 $MJ.day^{-1}$ in women, respectively. No significant differences were found between the three methods for both genders, using the *Bland & Altman* test which is based on a paired *t* test (*Lancet*, 1986).

It was concluded that MFact and MHR are satisfactory alternatives to DLW when considering the mean DEE of groups of subjects in free-living conditions, while MFact seems more suitable than MHR to estimate DEE of individuals.

Circadian variation of the energetic and hormonal response to a meal. M Romon [1], JL Edmé [2], C Le Fur [1], B Hecquet [3] (*[1] Service de nutrition, CHU Lille; [2] Cereste, 5, avenue Oscar-Lambret, Lille cedex; [3] Centre Oscar-Lambret, 59000 Lille, France*).

The aim of this work was to study the effect of meal time on the energetic and hormonal response. It was realised among 12 healthy men (BMI: 22.2 ± 1.7 kg/m^2, age 25.2 ± 5.3 years). They were given in a random order a standard meal; either they remained fasting at night (01h00) or during the day (13h00). The meal contained 40% of the estimated daily energy expenditure. During the 6 h following meal time, energy expenditure (EE) was measured by indirect calorimetry and blood samples were drawn at base line and every 20 min for assay of glucose, insulin, C Peptide, cortisol, glucagon and GH. The diet induced thermogenesis (DIT) was calculated as the areas under the curve of the differences between the post meal and the corresponding fasting energy expenditure. Comparisons between the sessions were made by a repeated two-way variance analysis (day/night and hour). During fed sessions, there was an interaction between the two factors ($P = 0.002$), post-meal increase of energy expenditure was blunted during the night, but there was no difference in DIT. All blood parameters were increased post-meal; this increase was significantly higher during the night for glycemia ($P = 0.01$) and insulinemia ($P = 0.04$); for the others parameters there was an interaction between the two factors: post prandial increase is delayed during the night. Post-meal energy expenditure was correlated with C Peptide and 2 h cortisol during the day. During the night, no correlation was found. Multiple regression analysis were performed with energy expenditure as dependent variable and day/night, cortisol, C Peptide and glycemia as independent variables. It resulted in the identification of C Peptide as significant variable ($\beta = 2.68$, $P = 0.01$). This result confirms that the metabolic response to a meal is modulated by meal time.

Precision of energy expenditure (EE) measurement in pre-term infants: contribution of natural isotopic abundance (NIA) variations. JC Picaud [1], S Normand [2], C Pacchiaudi [2], JP Riou [2], BL Salle [1] (*[1] Neonatal Unit Hospital Edouard-Her-*