phy-isotopic-ratio-mass-spectrometry (GC-IRMS). Glucose turnover rate ($R_{a,glc}$) was calculated from d_2-glc enrichment in plasma at steady state. Results are means ± SD, significance of observed differences using paired-*t*-test. Extending the fasting state form 13 h to 37 h: 1) $R_{a,glc}$ decreased from 10.9 ± 1.1 to 8.1 ± 0.6 $\mu mol.kg^{-1}.min^{-1}$, $P < 0.01$, 2) glutamine contribution to neo-formed-glucose carbon skeleton increased from 8 ± 3 to 16 ± 7%, $P = 0.02$, and 3) non specific CO_2 transfer to glucose remained unchanged (4 ± 1 vs 3 ± 2% of total carbon flux to glucose, NS).

Conclusions: a) carbon transfer from glutamine to glucose mainly occurs through the Krebs cycle, and b) glutamine contribution to gluconeogenesis increases with the duration of fasting. This study emphasizes the role of glutamine as a major gluconeogenic precursor in vivo.

Dietary protein quality influences post-prandial protein utilization. Y Boirie [1], M Dangin [1], P Gachon [1], JL Maubois [2], B Beaufrère [1] *([1] Laboratoire de nutrition humaine, CRNH, 63000 Clermont-Ferrand; [2] Laboratoire de technologie laitière, Inra, 35000 Rennes, France).*

During feeding, protein intake modulates post-prandial protein gain, but protein structure may also influence kinetics of protein metabolism. The aim of the study was to evaluate protein catabolism and leucine oxidation after ingestion of two proteins with high biological value, but with different digestion rate. Leucine metabolism was investigated in 12 healthy volunteers in non steady state conditions after a single protein meal consisting in two milk protein fractions, whey protein (WP) or casein (CAS). Using a combination of tracers (13C leucine – either in an intrinsically labelled protein and orally administered, or free and intravenously – and 2H3 leucine – free orally or IV administered – respectively), kinetic modifications over 420 min following meal ingestion were calculated from plasma leucine concentrations and enrichments and from 13CO2 enrichments in breath. Leucine rate of appearance from CAS is slower but more prolonged than from WP (exogenous leucine flux: 0.82 ± 0.03 vs 0.29 ± 0.08 $\mu mol.kg^{-1}$, moy ± SEM, CAS vs WP at 240 min, $P < 0.001$). Endogenous leucine flux (an index of protein catabolism) is progressively inhibited with a constant inhibition between 120 and 360 min with CAS, whereas WP do not change proteolysis (–30.2 vs –7.1% from baseline, CAS vs WP at 240 min, $P < 0.01$). Cumulative ingested leucine oxidation is identical with the two proteins (≈ 1/3 of ingested leucine is oxidized), but total leucine oxidation is lower with CAS. Thus, net leucine balance over 7 h (intake minus total oxidation) is neutral, with WP and positive with CAS (+ 135 ± 38 vs –11 ± 15 $\mu mol.kg^{-1}$, CAS vs WP, $P < 0.01$).

In conclusion, casein administered as a single protein load, compared with whey protein, results in a prolonged rate of amino acids appearance, a net inhibition of proteolysis, a lower total leucine oxidation and is responsible for a better protein gain.

Growth and muscle protein turn-over: effect of genotype and amino acids. S Tesseraud, A Besnard, R Peresson, J Michel, E Le Bihan-Duval, AM Chagneau *(Inra, station de recherches avicoles, 37380 Nouzilly, France).*

Broiler carcass quality can be improved by the usual selection techniques. A quality line was thus selected which yielded birds with low fatness and high breast meat yield [Richard et al (1994), *Inra Prod Anim* 7, 253-261]. We analysed the effects of this selection on amino acid requirements and muscle protein turnover in 3-week-old chicks.

Control (CL) and quality (QL) chicks were fed ad libitum on isoenergetic diets containing 20% crude protein but differing in their lysine content (from 7.5 to 11.3 g/kg). Fractional rates of protein synthesis (Ks) were measured in vivo in the Pectoralis major muscle (breast muscle) with a flooding dose of [^{5}H]-Phe [Garlick et al (1980), *Biochem J* 192, 719-723]. Fractional rates of proteolysis (Kd) were estimated for the same tissue as the difference between protein synthesis and deposition. Data were analysed by two-way Anova.

QL chicks exhibited slightly higher body and breast muscle weights than the CL ($P > 0.05$). They also appeared less sensitive to the lysine deficiency, both in terms of body and muscle weight. Consequently, their dietary requirement was lower.

In chicks fed on an adequate lysine intake, muscle protein turnover rates were similar in the two lines ($P > 0.05$): Ks, 13.0 ± 0.9 and 12.7 ± 1.0%/day in CL and QL chicks, respectively; Kd, 3.9 ± 1.1 and 3.8 ± 1.2%/day, respectively. Similarly, there were no differences between lines ($P > 0.05$) in capacities for protein synthesis Cs, ie, RNA/protein ratio: Cs, 12.1 ± 0.4 and 12.4 ± 0.2 mg/g in CL and QL chicks, respectively. The line-related changes in protein synthesis and proteolysis may be too small and difficult to detect although they may generate a clear modification in skeletal muscle mass over a long period.

In both lines, a severe lysine deficiency (7.5 g lysine per kg) resulted in significantly increased Ks and Cs (+35–45 and +60–85%, in Cl and Ql chicks, respectively), in agreement with previous results [Tesseraud et al (1992), *Reprod Nutr Dev* 32, 163-175; Tesseraud et al (1996), *Br J Nutr* 75, 853-865]. The higher increase of Ks, Cs and particularly Kd in QL compared with Cl chicks suggests that the responsiveness of breast muscle protein turnover to the lysine deficiency depends on the genotype.

In conclusion, these preliminary results show that the effects of lysine deficiency vary in the two lines. Further investigations of protein turnover in various muscles need to be undertaken to improve understanding of the metabolic control by amino acids and genotype.

Effects of ruminal or postruminal fish oil supply on cow milk yield and composition. Y Chilliard, M Doreau *(Laboratoire sous-nutrition des ruminants, Inra, Theix, 63122 Saint-Genès Champanelle, France).*

Fish oil (FO) addition to dairy cow diet decreases the milk fat content. This could facilitate the management of milk fat quotas by farmers, but could also change the milk quality. The aim of this study was to compare the respective effects of a control diet (C), and either a ruminal (R) or a duodenal (D) infusion of FO (menhaden type, 300mL/day for 4 weeks), on milk yield and composition (fat and protein contents, fatty acid profile). A 3 × 3 latin square was designed on 6 mid-lactation Holstein cows fitted with rumen and duodenum cannulas.

FO infusions did not change milk yield (22.7 kg/day) despite decreases in oil-free dry matter intake (C, 19.8; D, 17.7; R, 15.9 kg/day). Milk protein content was significantly lower with R infusion (C, 29.7; D, 28.6; R, 27.8 g/kg), and milk fat content with both infusions (C, 35.4; D, 32.2; R, 25.1 g/kg).

The decrease in milk fat yield (–46 g/day) with D infusion was mainly due to a decrease in C16:0 (–52 g/day) and *cis*-C18:1 (–13 g/day) secretion, that was compensated in part by an increase in C20:5 (+10 g/day) and C22:6 (+3 g/day) secretion. The sharp decrease in milk fat yield (–216 g/day) with R infusion was due to a lower secretion of C4:0 to C14:0 (–67 g/day), C16:0 (–79 g/day), C18:0 (–45 g/day) and *cis*-C18:1 (–98 g/day), that was compensated