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MUSCLE PROTEIN TURNOVER IN YOUNG BULLS IN RELATION TO BREED AND HORMONAL STATUS

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Introduction

It is a well-known fact that large differences in meat production ability are observed between cattle breeds. As meat production is essentially skeletal muscle deposition this process is related to the efficiency of the protein metabolism. Muscle protein deposition is the net result of synthesis and degradation. A complex array of factors control the balance between these two processes. In this study nitrogen metabolism, muscle protein (MP) turnover and hormonal status are described in two breeds with extreme differences in meat producing abilities. These breeds are: the Belgian Blue Breed (BBB), a double muscled highly productive beef breed and the Friesian Holstein (H), a poor beef producer.

Materials and Methods

Six young double muscled BBB and 6 Holstein bulls of similar physiological age (6 months for BBB and 4 months for H) were alotted to two treatment groups. Average initial weights were 264 and 165 kg respectively. The bulls were given a fattening diet composed of 1 kg hay, 1.5 kg soya bean meal, rolled barley in a ratio of 20% of the total diet, dried sugar beet pulp *ad libitum* and 150 g of a mineral and vitamins mixture.

Animals were weighed weekly and feed intake was recorded daily. N-balance was measured over 10 days periods at weeks 4, 14, 22 and 31. 3-methylhistidine excretion, an *in vivo* marker of MP turnover was estimated during the same periods and additionally at weeks 19 and 28.

Venous blood was sampled weekly before the morning meal and twice during a 24 hours period every 20 minutes on weeks 5 and 27 to study nycthemeral hormone profiles.

At slaughter carcass weight was recorded and a one rib cut dissected for estimating carcass composition.

Results and Discussion

Daily growth rates were similar for both breeds although slightly higher for the H-group: 1.36 vs 1.24 kg per day. However, large differences were observed in carcass weight (261 vs 358 kg), dressing percentage (55.4 vs 65.8%) and muscle content in the carcass (56.1 vs 71.3% in the H- and BBB-group respectively). Consequently, compositional growth must have been quite different between both breeds. An indication of this difference is given by N-balances for both groups: mean N-retention was 34.3 g/d for H and 47.1 g/d for BBB. For the H-group it decreased from 39 to about 30 g per day during the last part of the experiment while for the BBB-group N-balance remained high (40-45 g/d). Apparently for the latter, protein accretion continued at a high level, while for the former it was substituted to a large extent by fat deposition. This was also reflected in a higher fat content of the carcass (28 vs 15%). In order to examine whether the higher N-retention and protein accretion observed with the BBB was related to a higher MP synthesis or to a lower degradation rate, or to both, urinary 3-methylhistidine excretion (3-MH) was estimated. Over the whole experimental period average 3-MH excretion was 1421 and 1880 μmoles per day for H and BBB respectively. For both groups 3-MH excretion (E) increased linearly with animal weight (W). The equations were:

$$\text{H} : E = 216.7 + 3.44.W \quad r = 0.989$$
$$\text{BBB} : E = -465.5 + 5.43.W \quad 4 = 0.975$$

Similar linear relationships have been described by Harris and Milne (1981) and Gopinath and Kitts (1984). Since the BBB muscle mass is considerably higher than that of the H-bulls, 3-MH excretion should be expressed on a muscle weight basis. This was approximated by the 3-MH/creatinine ratio. Under the assumption that the muscle mass/live weight ratio was similar during

the experimental period as it was at slaughter, urinary creatinine excretion was considered to be a valid parameter for muscle mass. This approach should have been correct, as for both groups creatinine excretions per kg muscle mass and per day were identical: 100 mg/kg/d. The 3-MH/creatinine ratio was then 133.5 for H and 96.6 μmole/g/d for BBB, indicating a slower breakdown rate per unit muscle mass for the double muscled bulls. Assuming that all retained N was transformed into MP (which obviously is a maximal estimate) net MP accretion could be calculated from N-balance, while accretion + degradation could be regarded as an estimate of MP synthesis. Under the above assumptions of carcass composition the skeletal MP pool was calculated using actual analysis data of *longissimus* and *latissimus dorsi* as typical carcass muscles. This yielded the following fractional rates of synthesis (K_s), degradation (K_d) and net accretion (K_g) (%):

	K_s	K_d	K_g
H	2.88	1.78	1.10
BBB	1.86	1.15	0.71

All these parameters were lower with the BBB-group and decreased with time during the experiment. The ratio K_g/K_s could be considered as a measure of the efficiency for MP synthesis. The average ratios were identical for both groups: e.g. 38.1 and 38.2%, although the evolution with time was different. For the H-group it declined steadly while for the BBB-group it remained sustained, except for the last period.

Attempts were undertaken to relate MP metabolism data with hormonal status. During the first sampling day mean insulin concentrations were 16.8 and 21.0 μIU/ml for H and BBB respectively. For the H animals insulin increased towards the end of the experiment (32.8) while the opposite was found for the BBB-group (11.7). The higher insulin concentration in the H-group has to be associated with the greater fat deposition observed in the carcass of these animals. Testosterone increased with time in both groups and was alway higher for the H-bulls known to reach sexual maturity earlier than the BBB animals. This observation contrasts with the described "anabolic" and meat producing effect of testosterone. The well-known pulsatile pattern of growth hormone (GH) was analysed by a peak detection algorithm described by Veldhuis and Johnson (1986). GH concentrations decreased with age. This decrease was more important for the H-group. At the first period mean peak concentrations were 30.7 and 20.2 ng/ml for H and BBB respectively, while at the second sampling period GH concentrations dropped to 6.7 and 13.2 ng/ml for H and BBB. The resulting higher GH production could be associated with a higher protein accretion and meat production for BBB.

From the present results it appeared that both breeds differed in terms of carcass characteristics, muscle protein turnover and hormonal status. Muscle protein synthesis, degradation and net synthesis fractional rates were lower with the BBB animals which might be an indication of a "slower" protein metabolism with this breed.

(Key Words: Protein Turnover, Hormonal Status, Breed)

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