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The whole empty body essential amino acid profiles of male Merino and Dohne Merino lambs

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Abstract

The whole empty body essential amino acid composition of finishing Merino and Dohne Merino male lambs was investigated. The amino acid requirements for growth vary considerably between these two breeds. Hence, it appears that whole empty body amino acid profiles need to be established for specific breeds in order to determine essential amino acid requirements.

Keywords: Amino acid, whole empty body, growth, sheep
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Introduction

Each animal has a maximum genetic capacity for protein deposition, depending on age, live weight, physiological state, the ratio of energy and protein supply as well as the amino acid composition of the protein (Tamminga & Verstegen, 1996). Cole & Van Lunen (1994) suggested that the balance of absorbed amino acids is the most important single factor affecting the efficiency of protein utilisation for production of meat and other products. Correspondingly, Lapierre *et al*. (2000) reported increased utilisation of absorbed amino acids for protein synthesis when the profile of the limiting amino acids is improved. Hussein *et al.* (1991) defined the amino acid composition of whole body protein as the ideal amino acid pattern that will allow maximum utilisation of dietary protein. While such a concept has probably been best developed in pigs, it is equally applicable to other species (Cole & Van Lunen, 1994).

Fuller (1996) recognised that the pattern of amino acids required for body protein accretion is closely correlated to the amino acid composition of the whole empty body protein. Therefore, in terms of growth, the essential amino acid composition of the whole empty body could serve as an ideal example of the amino acids required for body protein accretion (Fuller, 1996). Chen & Ørskov (1994) also argued that the amino acid requirements for tissue maintenance are possibly similar to that needed for tissue growth, since protein turnover primarily takes place in tissue. The amino acid profile of the whole empty body protein can thus serve to predict the ideal protein required in the small intestine (Fuller, 1996).

Information on the whole empty body amino acid composition of growing lambs seems to be limited (MacRae *et al*., 1993; Ferreira, *et al.*, 1999; Jurgens, 2002). This study was conducted to establish the whole empty body protein composition of finishing male Merino and Dohne Merino lambs.

Material and Methods

The experimental design, animals, sampling procedure and laboratory analyses were similar to those described by Nolte & Ferreira (2004). The whole empty body amino acid composition was calculated from the proportional amino acid patterns of the carcass, internal and external offal. The GLM procedure of SAS (2000) was used for analysis of variance. The main effect was breed and individual amino acid concentrations were the response variables.

Results and Discussion

The present study contradicts the findings of Smith (1980) who stated that the body amino acid composition of different animal species is remarkably similar, since even breeds seem to differ (Table 1). Except for leucine and phenylalanine, the concentration of every essential amino acid in the whole empty body of Merino and Dohne Merino lambs differed ($P \leq 0.05$; Table 1).

According to Zhang *et al.* (1986) the non-protein nitrogen content in the body varies with increasing body weight. To eliminate the influence of non-protein nitrogen and obtain a clearer picture of the amino acid profile, essential amino acids can be expressed relative to lysine as an ideal protein ratio (Table 2). Lysine is chosen as a reference for ideal protein for several reasons: (1) Lysine and methionine are generally considered limiting in most ruminant diets (Rulquin & Vérité, 1996), (2) Analysis of lysine concentration in

feedstuffs is straightforward (Mack *et al*., 1999), (3) Lysine is only used for body protein accretion (Mack *et al*., 1999), (4) Lysine and methionine have frequently been studied as potential limiting amino acids under a variety of conditions, providing a large body of information (Rulquin & Vérité, 1996).

The whole empty body essential amino acid profiles of Merino and Dohne Merino lambs display substantial differences, since only histidine and isoleucine did not differ ($P \geq 0.37$; Table 2). The higher methionine requirement of the Dohne Merino lambs was unexpected, since it is generally accepted that Merinos produce more wool. Since wool contains high levels of cysteine (MacRae *et al*., 1993), which can be supplied by methionine via transsulphuration (Campbell *et al.*, 1997), higher wool yields are associated with higher methionine requirements. However, Nolte & Ferreira (2004) indicated that Dohne Merino lambs have higher internal offal weights than Merinos, while internal offal contains high methionine concentrations (MacRae *et al*., 1993). This may explain the higher methionine requirement observed for the Dohne Merino lambs.

Table 1 The whole empty body essential amino acid concentration (g EAA[1]/100 g crude protein) of male Merino (35.95 ± 7.25 kg) and Dohne Merino (35.8 ± 6.1 kg) lambs (LS Means ± s.e.m.)

EAA[1]	Merino	Dohne Merino	s.e.m.	P
Arginine	7.12	6.93	0.05	0.03
Histidine	2.56	2.67	0.02	0.0005
Isoleucine	3.24	3.35	0.02	0.003
Leucine	8.16	8.13	0.05	0.67
Lysine	6.74	7.04	0.07	0.003
Methionine	1.52	1.64	0.02	0.0001
Phenylalanine	4.09	4.08	0.02	0.87
Threonine	3.83	4.20	0.05	< 0.0001
Tryptophan	1.11	1.01	0.01	< 0.0001
Valine	5.48	5.29	0.07	0.04

[1]Essential amino acid

Table 2 The whole empty body essential amino acid concentration (%) of male Merino (35.95 ± 7.25 kg) and Dohne Merino (35.8 ± 6.1 kg) lambs relative to lysine (LS Means ± s.e.m.)

EAA	Merino	Dohne Merino	s.e.m.	P
Arg	105.73	98.60	4.55	< 0.0001
His	38.05	38.05	1.07	0.99
Ile	48.07	47.72	1.39	0.37
Leu	121.14	115.59	3.34	< 0.0001
Lys	100	100		
Met	22.57	23.30	0.87	0.007
Phe	60.68	58.05	1.72	< 0.0001
Thr	56.90	59.67	1.77	< 0.0001
Trp	16.40	14.34	1.26	< 0.0001
Val	81.40	75.09	4.42	< 0.0001

Table 3 The whole empty body essential amino acid profiles (%) of various sheep breeds relative to lysine

EAA	Merino	Dohne Merino	SA Mutton Merino[1]	Dorper[2]
Arg	106	99	119	107
His	38	38	69	36
Ile	48	48	48	50
Leu	121	116	131	109
Lys	100	100	100	100
Met	23	23	55	24
Phe	61	58	80	59
Thr	57	60	72	57
Trp	16	14	-[3]	11
Val	81	75	80	73

[1]Data form Ferreira *et al*. (1999); [2]Data from Jurgens (2002); [3]Not determined

From Table 3 it is clear that breeds can vary considerably in their whole empty body essential amino acid profiles. The differences in the weight contribution and amino acid concentrations of various body components between breeds (Nolte & Ferreira, 2004) support the view of Titgemeyer & Merchen (1990) that differences in the genetic capacity of animals to deposit lean tissue would alter estimates of amino acid requirements.

Conclusion

The essential amino acid compositions of the whole empty body of sheep breeds differ. Therefore, if the whole empty body is used as a predictor of amino acid requirements, more breed and species specific research is needed to establish modelling approaches in predicting dietary amino acid adequacy as well as undegradable amino acid requirements for particular livestock categories.

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