

DIETARY, BREED AND SLAUGHTER WEIGHT FACTORS INFLUENCING THE COMPOSITION AND ACCUMULATION OF SUBCUTANEOUS FAT IN WETHERS

WEBB, EC & CASEY, NH

Department of Animal and Wildlife Sciences, Faculty of Biological and Agricultural Sciences, University of Pretoria, Pretoria, South Africa 0002

Objectives

Three trials were conducted to study the composition and accumulation of long chain fatty acids (FA) in wethers. This research was conducted due to the related effects on the sensory characteristics of the meat resulting from changes in the synthesis and deposition of fatty acids in ruminants, particularly those raised under high energy feedlot conditions. The effect of diet, breed and slaughter weight on the profile and accumulation of FA in the subcutaneous fat (SCF) and some physiological parameters (ruminal pH, volatile fatty acids (VFA) in the rumen and the concentrations of free fatty acids (FFA), VFA, glucose, insulin and glucagon in plasma) were investigated.

Experimental methods

Dorper and SA Mutton Merino wethers were fed two different energy diets (10.2 MJ ME / kg DM and 11.8 MJ ME / kg DM from maize; no fat was added to either of the diets) and slaughtered at either 37 or 43 kg live weight (2 Breeds X 2 Dietary energy levels X 2 Target weights X 7 Replicates; Randomly allocated). A second trial was conducted to study the effects of the same diets presented in either the pelleted or loose form on the accumulation and composition of fatty acids in the SCF of wethers (2 Breeds X 2 Dietary energy levels X 2 Dietary forms X 7 Replicates; Randomly allocated). A third trial was conducted to study some physiological parameters (ruminal pH, volatile fatty acids (VFA) in the rumen and the concentrations of free fatty acids (FFA), VFA, glucose, insulin and glucagon in plasma) associated with the altered fat synthesis (2 Breeds X 2 Dietary energy levels X 7 Replicates; Randomly allocated).

Subcutaneous fat, roasted *M. longissimus dorsi* (L1-L6) and feed samples were obtained (Webb *et al.*, 1994) and stored at -20°C for subsequent lipid extraction with chloroform:methanol (2:1; v/v) (Folch *et al.*, 1957; Ways & Hanahan, 1964). Fatty acids were expressed in both normalised (molar proportion) and gravimetric (g/100g of fresh tissue) formats (Slover & Lanza, 1979; Huerta-Leidenz *et al.*, 1993). The fat pigments were extracted (Kirton *et al.*, 1975) and the absorbancy of each fraction measured (Kruggel *et al.*, 1982). Lutein concentrations were determined by using Beer's Law equation. Blood samples were collected (30 min preprandially and 30, 60, 90, 150 and 210 min postprandially) by means of an indwelling catheter in the *V. jugularis*. The sensory characteristics (aroma, juiciness, flavour and overall acceptability) of the meat (*M. longissimus dorsi*, L1-L6) and quality of the SCF were tested by a trained sensory panel. The contribution of fat pigments (lutein) to the acceptability of the meat was evaluated.

Results and Conclusions

The amount of fat and concentration of FA in adipocytes were found to be directly dependent on the live weight ($P < 0.05$) and maturity ($P < 0.05$) of ruminants, while the profile (molar%) of FA deposited was determined primarily by the diet ($P < 0.05$). The concentrations of FA increased with increasing live weight ($P < 0.05$) and differed between breeds ($P < 0.05$). Greater concentrations of FA ($P < 0.05$) were deposited in wethers fed diets in the loose form as opposed to the pelleted form, mainly due to differences in the accumulation of mono-unsaturated FA ($P < 0.05$) rather than poly-unsaturated FA. Dietary presentation influenced the residence period and subsequent accumulation of triacylglycerols and lutein in the adipocytes which may result in lower scores for fat colour and quality. It appears that at least a minimum level of the xanthophyll pigment lutein is required to produce the typical lamb or mutton aroma. Both dietary factors and breed influenced the sensory characteristics of lamb, through influences on the proportions and concentrations of FA in the SCF.

Carcass fatness and the thickness of the SCF contributed substantially to the sensory characteristics and cooking losses of lamb. Dietary treatment significantly influenced ($P < 0.01$) the balance between saturated and unsaturated FA in the subcutaneous fat. This shift was not related to the proportions of FA in the plasma. Diet influenced the ruminal pH ($P < 0.01$) and was related to a shift in the end-products of ruminal fermentation ($P < 0.05$). Dietary treatments did not significantly affect the concentrations of VFA in the plasma, but variations were observed over time (pre- or postprandially). The results suggest that insulin plays a particularly important role in the *de novo* synthesis and deposition of FA in the SCF of ruminants ($P < 0.05$), and may be related to the shift in the composition of FA in the SCF.

Key words: *Subcutaneous fat; Fatty acids; Lutein; Meat quality; Insulin; Wethers.*

References

- Folch, J, Lees, M & Stanley, HS., 1957. *J. Biol. Chemistry* 226: 497-509.
- Slover, HT & Lanza, E. 1979. *J. Am. Oil Chem. Soc.* 56: 933.
- Kirton, AH, Crane, B, Patterson, DJ & Clare, NT., 1975. *New Zealand J. Agric. Res.* 18: 267.
- Huerta-Leidenz, NO, Cross, HR, Savell, JW, Lunt, DK, Baker, JF, Pelton, LS and Smith, SB., 1993. *J. Anim. Sci.* 71: 625-630.
- Kruggel, WG, Field, RA, Miller, GJ, Horton, KM & Bushboom, JR. 1982. *J. Anim. Sci.* 54(5): 970-975.
- Ways, P & Hanahan, DJ. 1964. *J. Lipid Res.* 5: 318-328.
- Webb, EC, Casey, NH & Van Niekerk, WA. 1994. *Meat Sci.* 38:123-131.