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# EFFECTS OF FEEDING PROTECTED LIPIDS ON THE CHEMICAL AND PHYSICAL STRUCTURE OF LOTFED BEEF FAT

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In recent years genetic and dietary procedures have been used to modify the fatty acid composition of ruminants meat fat, which contain approximately 35% oleic acid ($C_{18:1}$ *cis*) and 5% vaccenic acid ($C_{18:1}$ *trans*), 20% $C_{18:0}$ (stearic acid) and 25-30% $C_{16:0}$ (palmitic acid). $C_{16:0}$ is considered to be one of the major cholesterol-raising saturated fatty acids in the diet of humans (Grundy and Denke 1990). Ruminants of different genotypes have shown small differences in their fatty composition, with *Bos Indicus* breeds having less $C_{16:0}$ and more $C_{18:1}$ than *Bos Taurus* (Huerta-Leidenz *et al.* 1993). There is also evidence to suggest that Wagyu breeds (Japan) have the highest proportion of palmitoleic ($C_{16:1}$) and $C_{18:1}$ *cis* (May *et al.* 1993). Attempts have been made to increase the proportion of the $C_{18}$ unsaturated fatty acids and reduce the level of $C_{16:0}$ in beef fat by feeding canola seed (St John *et al.* 1987), sunflower seed (Ekeren *et al.* 1992) and cotton seed (Huerta-Leidenz *et al.* 1991) to feedlot cattle, but these attempts have resulted in only small changes in fatty acid profiles. However, there is a dietary strategy that can be used to significantly increase the proportion of $C_{18}$ fatty acid and lower $C_{16:0}$. This involves the feeding of vegetable oils encapsulated in a matrix of aldehyde-treated protein (Rumentek®), which is not degraded in the rumen, but the lipid is released in the abomasum and available for absorption from the small intestine (Scott *et al.* 1970, Ashes *et al.* 1993).

**Table 1. Comparison of subcutaneous fatty acid composition from 200 day lotfed Angus cattle receiving Rumentek® (protected cotton or canola seed supplement) or grain and Wagyu cattle.**

| Genotype | Fatty Acids (%) of total subcutaneous fat | | | |
|---|---|---|---|---|
| | Saturated (Σ14+16+18) | Monounsaturated (Σ16:1+18:1) | Polyunsaturated (Σ18:2+18:3) | Ratio of Unsaturated to Saturated |
| **Angus (grain fed)** | **42** | **49** | **2.5** | **1.22** |
| **Angus(Protected cotton)** | **48** | **39** | **10** | **1.02** |
| **Angus(protected canola)** | **32** | **55** | **7.5** | **1.96** |
| **Wagyu*** | **31** | **59** | **2** | **1.97** |

* May *et al.* 1993

**Manipulation of the fatty acid composition and melting point**

Feeding optimally protected canola oilseed supplement increased the proportion of cis-$C_{18:1}$ (47%), $C_{18:2}$ (5.7%), $C_{18:3}$ (linolenic); (1.7%) and reduced $C_{16:0}$ to 22% in subcutaneous fat when compared to grain fed cattle (Fig 1); there was a small decrease in the proportion of $C_{18:1}$ *trans* isomers from 4.5 to 3%. These changes caused a reduction in the melting point (MP) to 35-36$^0$C, producing a softer fat. This can be compared to a MP of 39-40$^0$C and of 44-45$^0$C for fat from grain fed and protected cotton supplemented cattle respectively. The overall effect of feeding protected canola oilseed (Rumentek®) on fat composition is summarised in Table 1. The (P/S) polyunsaturated to saturated fatty acid ratio in lotfed Angus cattle was similar to that observed in Wagyu breed of cattle (May *et al.* 1993); (Table 1), while the P/S ratio for cattle

fed grain or protected cotton seed was lower. Inclusion of optimally protected cotton seed supplement in the diet of feedlot steers enhanced the $C_{18:2}$ (linoleic acid) level to 10% in subcutaneous fat but the disadvantage was that the proportion of $C_{16:0}$ was unchanged, due to the presence of this acid in the supplement (Fig 1)

**Performance and carcass traits**

Inclusion of Rumentek® supplement, ie. optimally protected fat together with protected protein (Ashes *et al.* 1993) in the rations of feedlot cattle improved the feed to gain efficiency (8-16%), dressing percentage (4%), fat depth (10-15%). In further studies Rumentek® has improved fat colour ("whiter fat") and marbling scores, an example of the latter is presented in Figure 2. The increase in marbling (intra muscular fat deposition) is achieved by increasing the amount of long chain fatty acids available for absorption and incorporation into tissue lipids (Ashes *et al.* 1993, Scott and Ashes 1993) and the use of Rumentek® supplements together with other dietary ingredients ie, roughage and molasses that enhance acetate formation in the rumen.

**Conclusion**

Feeding optimally protected oilseeds (Rumentek®) to cattle will:- improve the efficiency of feed utilisation; dressing percentage; fat characteristics, such as marbling and meat with varying levels of unsaturated fat and different degrees of hardness. This will have significant economic benefits for consumers and meat producers/processors.

**References**


Ashes, J.R., Thompson, R.H., Gulati, S.K., Brown, G.H., Scott, T.W., Rich, A.C., and Rich, J.C. (1993). Aust. J. Agric. Res. **44**, 1103-1112.

Ekeren, P.A., Smith, D.R., Lunt, D.K., and Smith, S.B. (1992). J. Anim. Sci. **70**, 2574-2580.

Grundy, S.M., and Denke, M.A. (1990). J. Lipid Res. **31**, 1149-1172.

Huerta-Leidenz, N.O., Cross, H.R., Lunt, D.K., Pelton, L.S., Savell, J.W., and Smith, S.B. (1991). J. Anim. Sci. **69**, 3665-3672.

Huerta-Leidenz, N.O., Cross, H.R., Savell, J.W., Lunt, D.K., Baker, J.F., Pelton, L.S., and Smith, S.B. (1993). J. Anim. Sci. **71**, 625-630.

May, S.G., Sturdivant, C.A., Lunt, D.K., Miller, R.K., Smith, S.B. (1993). Meat Sci. **35**, 289-298.

Scott, T.W., Cook, L.J., Ferguson, K.A., McDonald, I.W., Buchanan, R.A., and Loftus Hills, G., (1970). Aust. J. Sci. **32**, 291-293.

Scott, T.W., and Ashes, J. R. (1993). Aust . J. Agric. Res. **44**, 495-508

St John, L.C., Young, C.R., Knabe, D.A., Thompson, L.D., Schelling, G.T., Grundy, S.M., and Smith, S.B. (1987). J. Anim. Sci. **64**, 1441-1447.


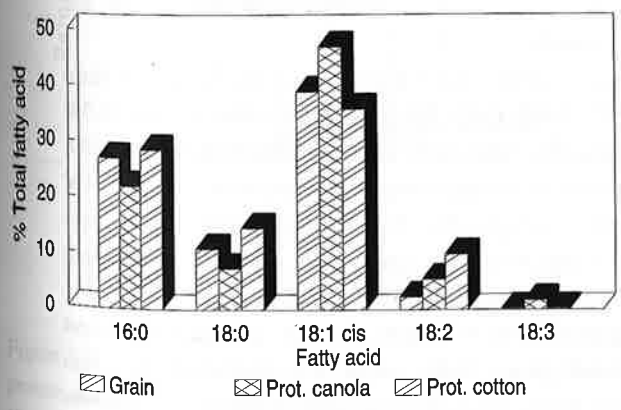


Fig 1. The effect of feeding protected oilseeds or grain on the fatty acid composition of subcutaneous fat from Angus cattle.

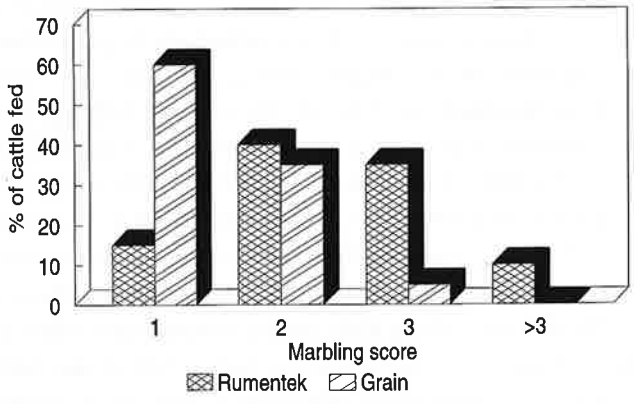


Fig 2. The effect of marbling on lotfed *Bos Indicus* cross cattle