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## EFFECT OF INTRAMUSCULAR FAT ON FLAVOUR ACCEPTABILITY OF BEEF STRIPLOINS

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### Background :

The influence of intramuscular fat (marbling) on palatability of beef is quite a contentious issue amongst scientists within the meat industry. Views vary on the importance of marbling. Many studies have shown a lack of evidence that marbling improves palatability (Goll *et al*, 1965; Wheeler *et al*, 1994), whilst contrasting studies have shown that meat with high marbling scores has more desirable flavours (Dolezal *et al*, 1982 ; Berry *et al*, 1980).

Currently, with the trend for high levels of marbling in beef destined for the Japanese market, Australian producers are placing increasing selection pressure on animals with superior marbling ability. However, in the last three decades, Australian consumers have been encouraged to reduce the amount of fat in their diet and consume lean beef, to prevent diseases such as atherosclerosis, heart disease, cancer, diabetes and arthritis (Fogerty, 1989). To accommodate this range in consumer and market demands, there are numerous breeds available in the Australian production system, ranging from extremely lean, muscular European breeds, such as the Limousin, to the more marbled British breeds, such as the Angus.

The study reported here utilized such a range of animals to determine their flavour acceptability to Australian consumers. There is a concern that whilst Australian consumers select leaner beef, this may be contributing to the decline in beef consumption due to reduced consumer satisfaction with beef quality. To overcome this dilemma, further evidence of the 'optimum' level of intramuscular fat for flavour acceptability is required.

### Objectives :

The primary objective of this study was therefore to determine the effect of intramuscular fat content on flavour acceptability of beef striploins to the Australian consumer. A secondary objective was to examine several breeds currently used in the Australian production system to determine whether differences in flavour acceptability can be explained genetically, and if so, can these differences be accounted for by differences in intramuscular fat content.

### Methods :

Selection of Animals for study

Beef striploins were collected from 170 animals, representative of breeds produced in Australia. The animals were a subset of those of the Southern Crossbreeding and Davies Gene Mapping Projects (Rutley *et al.*, 1995 and Malau-Aduli *et al.*, 1998, respectively). They were raised in three separate groups and slaughtered after 80 days (heifers) or 180 days (steers) on a grain ration.

1) 70 heifers selected from the Southern Crossbreeding Project (SXB) based at Struan Research Centre, Naracoorte, SA.
2) 70 steers selected from the Southern Crossbreeding Project (SXB) based at Struan Research Centre, Naracoorte, SA.
3) 30 steers selected from the Davies Gene Mapping Project (DGM) based as Mintaro, Martindale, SA.

Steers were slaughtered at 25 months of age (carcass weight ~300kg), whereas heifers were slaughtered at 15 months of age (carcass weight ~200kg). Animals from the Southern Crossbreeding Project consisted of seven sire breeds used over Hereford dams. The sire breeds included Belgian Blue (BH), Limousin (LH), South Devon (SH), Hereford (HH), Angus (AH), Wagyu (WH) and Jersey (JH). Animals from the Davies Gene Mapping Project consisted of purebred Limousins (LL), purebred Jerseys (JJ) and Limousin by Jersey crosses (LJ). Within each of the 17 breed groups, 10 animals were randomly selected.

Muscle Fat Content determination

Muscle samples were trimmed of all visible fat and 100g blended to a homogeneous paste in a food processor (Braun, Model CAS) with the chopper attachment. A subsample (1-1.5 g) was accurately weighed and extracted with chloroform/methanol (2/1) according to the method of Christie (1989). Dried extracts were considered the total fat content. Results were expressed as a percentage of the wet weight.

Taste Panel

Following thawing for 21 hours at 3°C, 1.5cm-thick steaks were grilled to an internal temperature of 70°C on a double-sided hotplate (Silex® 610-80, Hamburg). Steak cubes (2 x 2 x 1.5cm) were rated by a 25-member semi-trained taste panel. Panelists rated samples on a 9-point hedonic scale for flavour acceptability (where 1 =extremely unpleasant). Whilst not reported in this paper, panelists also rated initial and sustained juiciness, in addition to specific flavours such as beef, beef fat, corn, grain, grass and rancid.

Seven tasting sessions were conducted with the 25 panelists receiving five or six samples each session. Samples were given a random 3 digit number code to eliminate any chance of panelist bias. The six samples were tasted by panelists in a random order which was pre-allocated, to eliminate any effect of tasting order. Each steak (n=170) was tasted by five different panelists.

Statistical Analysis

Analysis of variance was carried out using the GLM procedure (SAS, 1990) using Type III sums of squares, on sensory data. The effect of breed group on both the intramuscular fat content and flavour acceptability was tested. The effect of session (n=7) was included in the model for flavour acceptability. Following this, the effect of breed group (n=17) on flavour acceptability was tested after adjusting all groups to the same intramuscular fat content. Least squares means and standard errors were calculated for intramuscular fat content, flavour acceptability and adjusted flavour acceptability for all 17 breed groups.

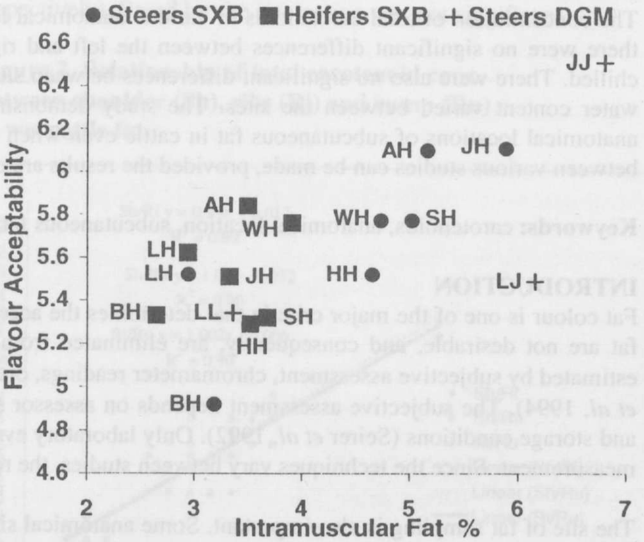
## Results and Discussion :

Breed groups varied significantly ($P<0.05$) for both intramuscular fat content (IMF %) and flavour acceptability (Flavour) (Table 1). When the data was adjusted to the same intramuscular fat content (Adj. Flav), breed group was still significant indicating that other factors besides fatness were accounting for differences in flavour acceptability.

**TABLE 1 – Least Squares Means for IMF%, Flavour and Adj.Flav**

| BREED | IMF % | Flavour | Adj.Flav |
|---|---|---|---|
| **Heifers** | | | |
| BH | 2.7$^{a}$ | 5.8$^{c}$ | 5.4$^{abc}$ |
| LH | 2.9$^{ac}$ | 5.6$^{bd}$ | 5.7$^{bcd}$ |
| HH | 3.5$^{bc}$ | 5.3$^{ab}$ | 5.3$^{ab}$ |
| SH | 3.7$^{bd}$ | 5.3$^{ab}$ | 5.4$^{ab}$ |
| WH | 3.9$^{b}$ | 5.8$^{bd}$ | 5.8$^{bcde}$ |
| AH | 3.5$^{bc}$ | 5.8$^{bcd}$ | 5.9$^{bcde}$ |
| JH | 3.3$^{bc}$ | 5.5$^{b}$ | 5.6$^{bcd}$ |
| **Steers** | | | |
| BH | 3.2$^{acd}$ | 4.9$^{ac}$ | 5.0$^{a}$ |
| LH | 3.0$^{ac}$ | 5.5$^{b}$ | 5.6$^{bcd}$ |
| HH | 4.7$^{e}$ | 5.5$^{b}$ | 5.5$^{abcd}$ |
| SH | 5.0$^{e}$ | 5.8$^{bd}$ | 5.7$^{bcd}$ |
| WH | 4.7$^{e}$ | 5.8$^{bd}$ | 5.8$^{bcd}$ |
| AH | 5.2$^{e}$ | 6.1$^{de}$ | 6.1$^{de}$ |
| JH | 5.9$^{f}$ | 6.1$^{de}$ | 6.0$^{cde}$ |
| LL | 3.4$^{bc}$ | 5.3$^{ab}$ | 5.4$^{ab}$ |
| LJ | 6.2$^{f}$ | 5.5$^{ab}$ | 5.4$^{ab}$ |
| JJ | 6.8$^{g}$ | 6.5$^{e}$ | 6.4$^{e}$ |
| SE | 0.24 | 0.21 | 0.21 |

**FIGURE 1 – Flavour Acceptability vs Intramuscular Fat%**




As shown in Table 1 and Figure 1, steers had significantly more intramuscular fat content than heifers ($P<0.05$) with the exception of LH, BH and LL. This was to be expected since steers were fed on grain for a longer period (180 vs 80 days) and were more mature (25 vs 15 months). BH and LH steers and heifers had the lowest values for intramuscular fat content, whilst JH and LJ steers had values significantly higher ($P<0.05$) than all other breeds apart from JJ steers. The JJ steers had a least squares mean of 6.8% intramuscular fat content, which was significantly higher ($P<0.05$) than all other breeds in the study. Additionally, JJ steers had the highest flavour acceptability recorded for the study of 6.5, a value significantly higher than other breeds, although not significantly different than AH and JH steers. When adjusted to a constant intramuscular fat content, JJ steers maintained the highest flavour acceptability score, however this was not significantly different from WH and AH heifers or JH and AH steers. BH steers had the lowest flavour acceptability score of 4.9, but this was not significantly different ($P<0.05$) from LH and LJ steers, SH and HH heifers.

Figure 1 shows that in general, as intramuscular fat content increases, flavour acceptability is improved. However, the results also demonstrate that intramuscular fat content was not the only factor determining flavour acceptability, since breed group differences were still seen when the data was adjusted to the same level of intramuscular fat content. Other flavours which reflect fatty acid compositions (not reported in this paper) were recorded by the taste panel and may account for some of the breed differences seen. Additionally, tenderness may have influenced the panelists' judgment of flavour acceptability, since this attribute was not scored. Future objective measurements of tenderness and analysis of individual flavours will clarify this.

## Conclusions :

It appears that whilst flavour acceptability is positively enhanced by increased levels of intramuscular fat, it is not the sole determinant of flavour acceptability. Breed groups were significantly different for flavour acceptability, even after adjusting data to a constant level of intramuscular fat, suggesting that some of the variation in flavour acceptability may be genetic. These findings may explain the opposing findings of previous studies (Goll *et al*, 1965; Wheeler *et al*, 1994). It is interesting to note that the breed with the highest flavour acceptability was the purebred Jersey (JJ), which is normally considered unsuitable for beef production in Australia because of poor visual appearance of the meat, poor conformation and low meat yields. Despite this, the Jersey may be useful in crossbreeding systems to improve the flavour acceptability of leaner well-muscled European breeds.

## References :


Berry, B.W., Maga, J.A., Calkins, C.R., Wells,L.H., Carpenter, Z.L. and Cross, H.R. (1980), *Journal of Food Science*, **45**:1113-1121

Christie (1989), *Gas Chromatography and Lipids*, The Oily Press, Oxford, UK

Dolezal, H.G., Smith, G.C., Savell, J.W. and Carpenter, Z.L. (1982), *Journal of Food Science*, **47**:397-401

Fogerty, A.C. (1989) Dietary Fatty Acids in Blood Lipids, *Food Research Quarterly*, **49** (3&4):36-45

Goll, D.E., Carlin, A.F., Anderson, L.P., Kline, E.A. and Walter, M.J. (1965), *Food Technology*, **19** (5):163–167

Malau-Aduli, A.E.O., Siebert. B.D., Bottema, C.D.K. and Pitchford, W.S. (1998), *Journal of Animal Science*, **76**:766-773

Rutley, D.L., Deland, M.P.B. and Pitchford, W.S. (1995), *Proc. Aust. Assoc. Animal Breeding and Genetics*, **11**:151-154

SAS Institute Inc (1990), *SAS/STAT User's Guide*, Version 6

Wheeler, T.L., Cundiff, L.V. and Koch, R.M. (1994), *Journal of Animal Science*, 72:3145–3151