RELATIONSHIPS BETWEEN SOME OBJECTIVE PROPERTIES OF BEEF AND CONSUMER PERCEPTIONS OF MEAT QUALITY

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SUMMARY

Although cooks' assessments of the fatness of loin steaks, of animals differing widely in age, weight, and fatness were closely and linearly related to carcass fat depth measurements, their assessments of meat colour and consumers' assessments of tenderness were not closely, or linearly related, to objective colour, or tenderness, measurements. Part of the large variation occurred because steaks were assessed the way commercial steaks are assessed, i.e. against notional scales, and a week apart, and part due to variations in the treatment of steaks in the home. Colour was assessed after no, or a variety of, thawing treatments under unstandardised lighting conditions and tenderness after a variety of thawing, ageing, and "degree of cooking" treatments.

INTRODUCTION

Until relatively recently consumer reactions to meat were largely ignored, at least in Australia. Although this was, in part, because problems of production, processing and preservation were more urgent there were also other reasons. These included the lack of suitable procedures to reliably and validly assess consumer response, cost, and, perhaps even more important than cost, the opinion, still held by many, that this is not a rigorous activity and, therefore, cannot be regarded as a proper activity for scientists.

If meats are to retain, or improve, their position in the food market it is important that farmers know what consumer preferences are. There is evidence that in the past the traditional flow of information from consumer, via the butcher, meat buyer, and cattle buyer, to the farmer is slow and can result in distortions and misinformation (Halls 1975). The current national carcass description system in Australia (AUSMEAT) provides farmers with information (age, carcass weight and fat depth) relevant to the potential value of carcasses from a yield (of lean meat), but not a meat quality, viewpoint. To assess the preferences of Australian consumers CSIRO, with the Livestock and Meat Authority of Queensland, and the Department of Agriculture and Rural Affairs of Victoria, surveyed consumer preferences for loin (*M.longissimus dorsi* - LD) and topside (*M.semimembranosus* - SM) steaks in 3 Australian cities, Kingston et al. (1987). Subsamples of the muscles distributed to consumers were assessed objectively for meat colour and tenderness. Potentially, data were available to relate consumer preferences to the objective characteristics of the meat, carcasses, and animals.

In this paper some of the relationships between objective measurements on meat samples and consumer preferences are described and discussed.

METHODS

288 animals, half of British beef breeds and half of Brahman breeds, of five age (= dentition) groups (0, 0-2, 4, 6, and 8 permanent incisors) were used. Half were steers and half females. Carcass weights varied widely (150-450 kg). One half of the total number were effectively electrically stimulated (extra-low voltage). Within each age/dentition group, three, of the four (0-2, 3-7, 8-12, 13-23 mm of fat over the last rib), carcass fat depths were represented. Carcasses were boned 48 hours post-slaughter and steaks for consumer and portions for objective assessment sliced from the cuts the same day. The steaks were packed onto a polystyrene tray, vacuum packaged and frozen before being distributed. Households received six trays of steak, one per week, over a six-week period.

The ultimate pH of objective samples were measured at room temperature (22°C) after the frozen samples were thawed. Surface colour (L, a, and b values) was measured (Minolta Chroma Meter CR-200) on freshly cut surfaces, after they had bloomed for one hour. 200 g samples were cooked at 80°C for one hour, and Warner-Bratzler initial yield (WBIY) and peak force (WBPF) and Instron compression (IC) values determined (Bouton and Harris 1972; Bouton et al. 1975) after the samples had cooled overnight. The selection of 192 representative households in each of the three cities was described by Kingston et al. (1987). Mean consumer scores for each attribute of each cut (LD or SM) were calculated for each animal. The nature of the relationship between mean attribute scores and objective measurements were determined.

RESULTS

Cooks' ratings (1 = much too fat to 7 = much too lean) of the fatness of loin steaks (CFL) were closely and

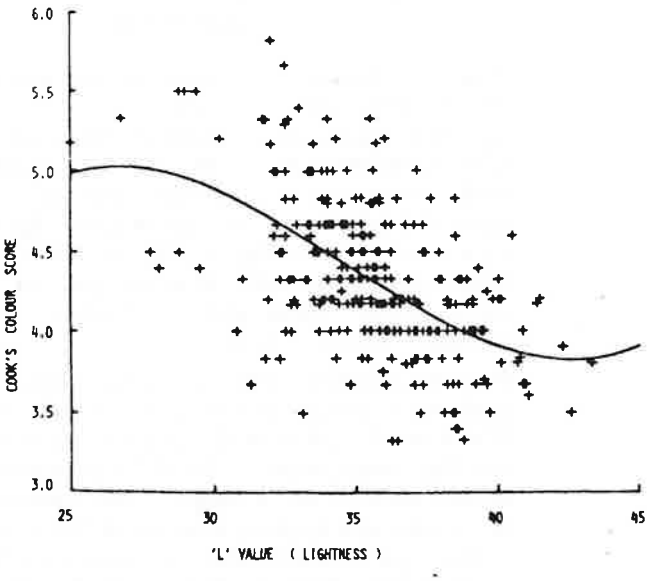

Fig. 1: Relationship between cooks' colour scores and objective 'L' (lightness) values (SM muscle)

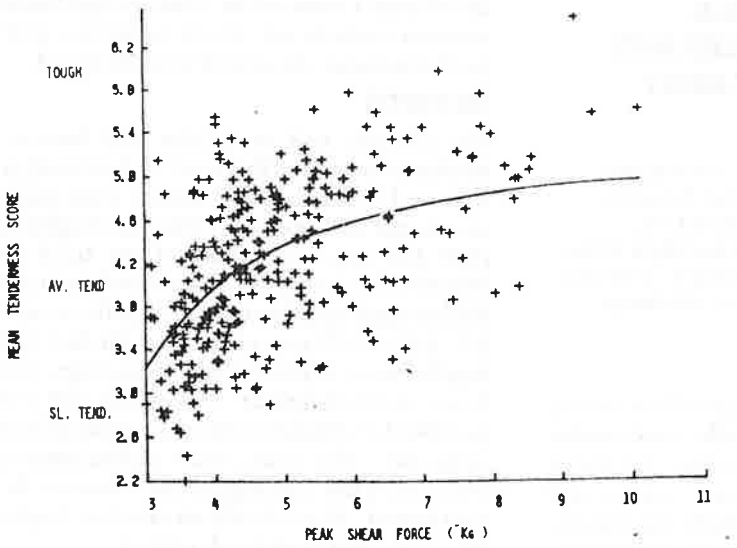

Fig.2: Relationship between consumer tenderness scores and LD peak force values

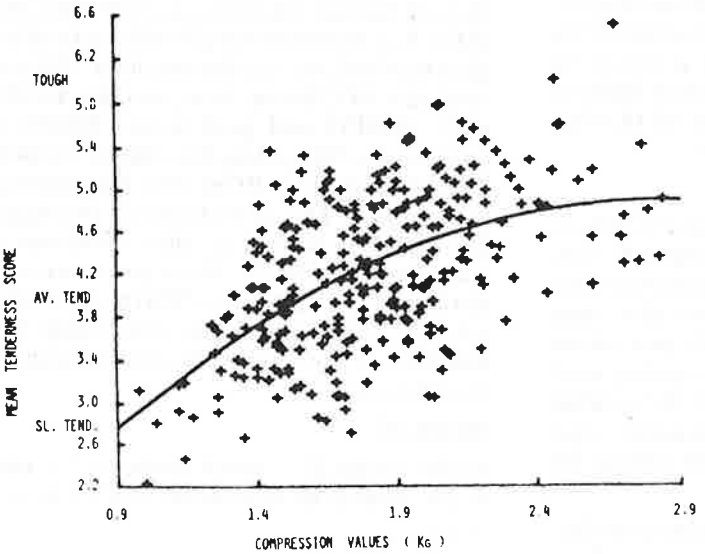

Fig.3: Relationship between consumer tenderness scores and LD compression values

linearly related to rib fat depth (RFD, in mm); CFL = 4.24 - 0.0997 RFD, R = 0.96. The relationship between cooks' colour scores (1 = much too pale to 7 = much too dark) of the SM steaks and the objective lightness ('L') values are shown in Fig. 1. The line of best fit was a third-order polynomial. It is an ogive or "S"-shaped curve; cooks' colour score = 2.046L - 0.0623L + $0.0006L^3$ - 16.6, R = 0.32.

Relationships (lines of best fit) between mean consumer tenderness scores, for LD steaks of each animal, and WBPF and IC values of LD samples were second order (see Fig. 2 and 3, respectively), although that for IC values tended towards an "S"-shape. The equation relating mean consumer tenderness scores of LD steaks and LD compression values (LDIC) was: mean tenderness score = 2.13 LDIC - 0.304 (LDIC) + 1.42 (R = 0.26).

A mean toughness score of 4 (neither tough nor tender) corresponded with a WBPF value of 4.2 kg and an IC value of 1.6 kg.

DISCUSSION

It was not very surprising that loin fat depth was closely and linearly related to mean cooks' scores for fatness of LD steaks. Most individuals can reliably estimate length (Howard 1968) and a similar close relationship between fat depth and panel scores, for the fatness of lamb chops, has been reported previously (Furnival et al. 1977).

The "S"-shaped line of best fit relating objective lightness, L, values to cooks' colour scores is also not unexpected. Relationships between objective measurements and scores of naive scorers tend towards an "S"-shape, because of their reluctance to score at extremes of scales, provided extremes are represented in the set of samples assessed.

The scatter around the line was initially surprising. It can be explained, in part, by variations in the ways cooks treated steaks before assessing meat colour. The vacuum packaged steaks were delivered frozen. For the cooks to assess their colour optimally, lighting conditions would have to have been standard and the steaks thawed and exposed to air for about 30 minutes (i.e. "bloomed"). Two percent of cooks did not thaw steaks, 6% thawed them in a microwave oven, 59% on a bench, and 33% in a refrigerator. The times that steaks were exposed to air before colour assessments in the home were not recorded. 8% (2 + 6%) of cooks assessed colour of frozen, or microwave thawed steaks and an, unknown, proportion of them immediately after removing them from the package.

The variations about the lines of best fit relating subjective tenderness scores to WBPF and IC values are also at first sight disturbingly large. Again some of this variation can be accounted for by the variations in the treatment steaks received in the home. Although method of thawing was recorded, the time that steaks remained thawed (i.e. aged) before cooking was not. An analysis, albeit with very uneven numbers, showed that steaks cooked without thawing were the most tender and those thawed in the refrigerator the least tender. Methods of cooking and, more importantly, degree of cooking also varied. As anticipated, as the degree of cooking ('rare' to 'well done') increased so did the relative toughness of the steaks. These variations in method of thawing and degree of cooking could together account for a large part of the variation.

The steaks were evaluated a week apart. This meant that their attributes were scored relative to notional scales of the assessors and not to another sample viewed, or tasted, at the same time. This reflects the 'real world' situation but results in variations which are large compared to those found for trained taste panel assessments,

particularly when they compare traits of a number of samples at the same time.

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REFERENCES

Bouton, P.E. and Harris, P.V. (1972). *Journal of Food Science* **37:**218.

Bouton, P.E., Harris, P.V. and Shorthose, W.R. (1975). *Journal of Food Science* **40:**1122.

Furnival, E.P., Corbett, J.L. and Shorthose, W.R. (1977). *Journal of Agricultural Science (Cambridge)* **88:**207.

Halls, M. (1975). *The Journal of Agriculture - Victoria* **73:**383.

Howard, A. (1968). "The Measurement of Attributes of Eating Quality". Ph.D. Thesis, University of Queensland.

Kingston, O.L., Congram, I.D., Hopkins, A.F., Harris, P.V., Powell, V.H., Shorthose, W.R. and Swain, A.J. (1987). Livestock and Meat Authority of Queensland (Brisbane), Research Series, Research Report No.22.