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THE EFFECT OF INTRAMUSCULAR FAT PERCENTAGE ON THE SENSORY EVALUATION OF BEEF COOKED ^{B1} DIFFERENT METHODS TO TWO DEGREES OF DONENESS

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There is a perception by the food service industry that marbling acts as an insurance against the detrimental effects of overcooking tenderness. This study examined whether there was an interaction between intramuscular fat percentage (IMF%) and degree of doneness tenderness of meat prepared using both wet cooking (water bath) and grilling methods. Sixteen striploins were selected from electric stimulated (low voltage) grain finished carcasses (fed for 70 or 150 days) to cover a range of marbling (1-3 AUS-MEAT marbling scotter and strange of marbling (1-3 AUS-MEAT marbling scotter and strange of marbling (1-3 AUS-MEAT marbling scotter and strange of marbling scotter and scotter and strange of marbling scotter and scott IMF% was determined and steaks cooked using a water bath (80°C), and a griller (270°C) for set times to achieve rare (60°C) and well of (80°C) internal temperature endpoints. Cold cubes were assessed by an 18 member trained taste panel under green light. Mean IMF^{0} I was 6.1%, with a range of 2.5 to 11.52%. The interaction between IMF% and doneness was not significant (P>0.05) for tenderness juiciness. There was a positive relationship between IMF% and tenderness score (P=0.10). Steaks cooked to a well done end-point w tougher and drier than rare steaks (P<0.05). Cooking method had only a small effect on tenderness (P=0.07). We concluded that electrically time that the steaks (P<0.05). Cooking method had only a small effect on tenderness (P=0.07). We concluded that electrically stimulated carcasses, increased IMF% did not provide insurance against the detrimental effect of overcooking.

Introduction

The influence of intramuscular fat percentage on the palatability of beef is currently one of the most contentious issues in the Australian industry. The debate stems from the fact that Australian consumers actively discriminate against marbling in raw beef (Hearnshaw e 1992), which is in contrast to the opinions of some sectors of the food service industry who argue that marbling is desirable for eating qual Savell and Cross (1986) and charles the sectors of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling is desirable for eating qual to the sector of the food service industry who argue that marbling to the sector of the food service industry who argue that marbling is desirable food service industry who argue that marbling to the sector of the food service industry wh Savell and Cross (1986) concluded that based on compilation of US palatability research, a minimum of 3% intramuscular lipid was needed assure acceptable palatability of loin steaks. One of the perceived benefits of marbling in terms of palatability stems from the belief marbling serves as protection against high temperature or prolonged cooking time (Smith and Carpenter, 1974). However, this was supported by the results of Parrish *et al.* (1973) who found that increasing amounts of marbling did not compensate for the reduction palatability attributes of rib steaks when broiled to higher internal temperatures. This study was conducted to investigate whether interaction between IM% and degree of doneness (rare and well done) affected eating quality of meat from electrically stimulated carcas using different cooking techniques.

Materials and methods

A total of 69 Angus steers were slaughtered over two separate weeks. Steers in the 1st slaughter had been finished on grain for 70 days, we those in the 2nd slaughter had been finished on grain for 150 days. All carcasses were electrically stimulated using a low voltage nasalited using a low v probe system (peak voltage 45 volts, 200 milli-amps, 40 seconds duration). Carcasses were chilled overnight, quartered and 16 stripto selected to cover a range of marbling (1-3 AUS-MEAT marbling scores). Striploin samples were vacuum packed and frozen at -20°C. hours post-slaughter. Frozen striploins was sliced into 22 mm thick steaks for sensory analysis and a 400g block for objective analysis. Sensory Evaluations: Steaks were thawed for 48 hours at 5°C, and trimmed to 125 g (all external fat and epimysial connective the removed). Steaks from each loin were cooled in either and the state of the sensory analysis and a 400g block for objective analysis. removed). Steaks from each loin were cooked in either a water bath (80°C), or vertical griller (270°C) for set times. Cooking times had be previously determined to achieve rare (60°C) and wall down (80°C), or vertical griller (270°C) for set times. previously determined to achieve rare (60°C) and well done (80°C) internal temperature endpoints. Post-cooking colour (L*, a*, b* value was recorded on a cut surface using a Minelte Channel of Chann was recorded on a cut surface using a Minolta Chroma meter. Cold cubes (1cm³) were assessed for tenderness and juiciness on a 100 P scale by an 18 member trained taste panel under fluorescent green light. An incomplete block design was used to evaluate each striplon six different tasters over a total of eight sessions. The assessment scale was anchored at 100 with the words very tender and very juicy, and users to be and very juicy. 0 with very tough and very dry.

Objective Measurements: Blocks were thawed for 48 hours at 5°C and trimmed to 250g as for sensory evaluation. Blocks were cooked at °C for 1 hour in a water bath, cooled in running water, chilled overnight and rectangular strips (150 x 66mm) cut parallel to the fiber Warner Bratzler peak force (WBPF) measurement. Wedge samples (15 mm high) were cut for compression (COMP) determination Intramuscular fat percentage (IMF%) was determined using AOAC (1984) methods, using chloroform rather than petroleum ether. Statistical Analyses: Individual tenderness and juiciness scores were analysed using a mixed model, which contained fixed effects for del of doneness, cooking technique, slaughter group, taster, linear and curvilinear covariates for IMF%, and animal as a random effect w slaughter group. As animals were nested within slaughter group, the effect of slaughter group was tested against animal (within slaughter group) as the error term. The effects of dozen of doze group) as the error term. The effects of degree of doneness, cooking method, IMF%, and all first order interactions were tested against residual error (variation within steaks). Initially all first order interactions were included in the model and non-significant interactions (P>0.05) were sequentially removed. Objective measurements (WBPF and COMP) were analysed using models which included the fill effect for slaughter group and IMF% as the covariate effect for slaughter group and IMF% as the covariate.

Results

Mean IMF% was 6.1%, with a range from 2.5% to 11.5%. Mean tenderness and juiciness scores were 53 and 48, respectively. For objective measurements mean WBPF and COMP measurements were 3.4 and 1.4 kg, respectively.

<u>Sensory analyses</u>. The final model for tenderness score included terms for degree of doneness, (P<0.001) cooking technique (P=0.10) slaughter group (P>0.05), taster, (P<0.001) and IMF% (P=0.10). There was no interaction (P>0.05). slaughter group (P>0.05), taster, (P<0.001) and IMF% (P=0.10). There was no interaction (P>0.05) between IMF% and degree of d_{0}^{per} on sensory evaluations. When assessed on a 100 point scale steaks cooked to the rare endpoint were scored 21 units higher than steaks could to well done (Figure 1). Cooking technique had only a small affect on tend. to well done (Figure 1). Cooking technique had only a small effect on tenderness score with steaks cooked in the vertical griller scoring compared with 51 for steaks cooked in the water bath. The regression coefficient for IMF% indicated that a 1% increase in IMF% resulted a 1.05 unit increase in tenderness score. In the final model for increase in tenderness score. steaks cooked to a rare end-point scored 33 units higher than steak cooked to well done.

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Objective analyses. IMF% did not have a significant effect on WBPF $m_{easurements}$ (P>0.05). There was a curvilinear relationship between M_{Pot} MF% and COMP values, which showed a decrease in COMP values as MF_{0}^{*} increased to about 7.5%, and then a slight increase. The model for WBPF only explained a small amount of the variation ($r^2 = 0.07$), whereas the model for COMP explained a larger proportion ($r^2 = 0.40$).

Discussion

The results from this study and Parrish *et al.* (1973) did not support the contact contention that increased marbling acts as insurance against a decrease in Palatability when steaks were cooked to a well done end point. This contrasts the results of Luchak et al. (1991) who reported Choice steaks higher marbling %) were more tender than Select steaks (lower marbling When cooked to well done, although no variance estimates were Povided for their interaction. Gardner *et al.* (1996) also stated that quality (marbling score) appeared to serve as an "insulator" in that steaks with marbling score) appeared to serve as an instantion of doneness while marbling could be cooked to an increased degree of doneness while maintaining acceptable tenderness, although differences were small.



We was positively associated with tenderness, although the relationship was not strong. To obtain an increase of 10 unit in tenderness were small. ^{was} positively associated with tenderness, although the relationship was not strong. To obtain an increase of the data with tenderness, although the relationship was not strong. To obtain an increase of the data with tenderness evaluations did not differ significantly for the data with tenderness evaluations did not differ significantly for ^{a require} a 10% unit increase in IMF%. Commercially, it is unlikely to be beneficial to produce such a large instance of a large instance of the significantly for ^{a large} improvement in tenderness. Akinwunmi *et al.* (1993) reported trained taste panel tenderness evaluations did not differ significantly for ^{a large} determined taste of the significant of the signif ^{ar imp}provement in tenderness. Akinwunmi *et al.* (1993) reported trained taste panel tenderness evaluations did not the tenderness in the tenderness of the tenderness to increase gradually as the tenderness to increase gradually as The marbling scores (slight and modest). Similarly Australian consumer data (Artifut et al., 1994) showed have a gradually as hyper lipid content and palatability traits of beef steaks. In contrast, other studies have reported tenderness to increase gradually as hyper lipid content and palatability traits of beef steaks. In contrast, other studies have reported tenderness to increase gradually as The lipid content and palatability traits of beef steaks. In contrast, other studies have reported tendentees to increase gravely increased (eg. Smith *et al.*, 1984). The results of the present study compliment Mersmann (1990) and Berry and Leddy (1990) who was a first and a strong association was and that while marbling was positively correlated with palatability, the improvement was often quite minimal and a strong association was ifficult to demonstrate.

^{wult} to demonstrate. ^{thereasing} IMF% has been shown to reduce the length of cooking time required for steaks to reach a set internal temperature (Irtimer *et al.*, 57, 3 Uross, 1977). Therefore in the present experiment, where steaks over a range of maroning were cooked to a set time to the model for with a higher IMF% were cooked to a higher degree of doneness. However when colour (L*,a*,b*) were included in the model for higher the higher to be a higher degree of doneness. However when colour (L*,a*,b*) were included in the model for the best of the base of the higher to be a higher degree of doneness. However, when colour (L*,a*,b*) were included in the model for the base of the base with a higher IMF% were cooked to a higher degree of doneness. However when colour (E, a, b) here included and the regression coefficient IMF% did not change. In particular, when colour was $\frac{1}{\sqrt{2}}$ score, means for doneness, cooking technique and the regression for doneness x IMF% interaction was again not significant (P>0.05).

 V_{ell}^{udded} in the model the doneness x IMF% interaction was again not significant (P>0.05). V_{ell}^{udded} done steaks were evaluated considerably drier and tougher than rare steaks. These results compliment those of Parrish *et al.* (1973), V_{host}^{udded} who reported that, as internal temperature increased, tenderness and ^{supe} steaks were evaluated considerably drier and tougner than rare steaks. These results comparison the steak et al. (1991) and Akinwunmi et al. (1993) who reported that, as internal temperature increased, tenderness and $\frac{1}{\log_{10}}$ ^{the} al. (1976), Luchak et al. (1991) and Akinwunmi et al. (1993) who reported that, as internal temperature increased, tenterness the biogeness decreased. Similarly, Parrish et al. (1973) stated that their study showed that the internal cook temperature of rib steaks was a much

^{winportant} factor in palatability than marbling. ^{Why} did not have a significant effect (P>0.05) on Warner Bratzler scores when samples were all cooked using the waterbath. Berry and ^{Why} did not have a significant effect (P>0.05) on Warner Bratzler scores with decreasing marbling. Berry (1993) also reported shear values $\frac{d}{d}$ (1990) reported a general trend for peak load to gradually increase with decreasing marbling. Berry (1993) also reported shear values ^{by} (1990) reported a general trend for peak load to gradually more slightly lower from cores obtained from Small- rather than Slight- marbled steaks.

Conclusion

The results from this study showed that for striploin steaks from electrically stimulated carcases, there was no evidence to support the meat typically available to ^{soulds} from this study showed that for striploin steaks from electricarily summated carcases, there into the two striploin steaks the detrimental effects of overcooking on sensory scores. If the meat typically available to the striploin that increased IMF% protected against the detrimental effects of overcooking on sensory scores. If the meat typically available to the striploin that increased IMF% protected against the detrimental effects of overcooking on sensory scores. If the meat typically available to the striploin that increased IMF% protected against the detrimental effects of overcooking on sensory scores. If the meat typically available to the striploin that increased IMF% protected against the detrimental effects of overcooking on sensory scores. If the meat typically available to the striploin that increased IMF% protected against the detrimental effects of overcooking on sensory scores. If the meat typically available to the striploin that increased IMF% protected against the detrimental effects of overcooking on sensory scores. that increased IMF% protected against the detrimental effects of overcooking on sensory sector in the sector in the sensory sector in the sensory sector in the sensory sector in the sensory sector in the sector in the sector in the sensory sector in the sector in ^{aquan} consumers (through butchers and supermarkets) has been effectively electrically summared, intramased and the producing summare important in producing the effects on tenderness and juiciness. It was concluded that degree of doneness was considerably more important in producing ender and juicy steaks than was IMF%. References

(h) (the control of cooked beef (the control of cooked bee 1984. Official methods of analysis of the association of official analytical chemists. Ed. S. Williams. 14th Ed. AOAC: Arlington, Virginia.

1984. Official methods of analysis of the association of official analytical chemists. Ed. S. Williams. 14" Ed. AOAC: Arington, Virginia. P.A., Hearnshaw, H., Melville, G., Shorthose, W.R. & Sinclair, A.J. 1994. Relationship between marbling score, lipid content and eating quality of beef. *Proc.* Aust. Soc. Anim. Prod. 20:353 B.W. 1993. Tenderness of beef loin steaks as influenced by marbling level, removal of subcutaneous fat and cooking method. J. Anim. Sci. 71:2412 B.W. 1993. Tenderness of beef loin steaks as influenced by marbling level, removal of subcutaneous fat and cooking method. J. Anim. Sci. 71:2412

hy 8.W. 1993. Tenderness of beef loin steaks as influenced by marbling level, removal of subcutaneous fat and cooking incurous of steaks differing in B.W. & Leddy, F. K. 1990. Influence of steak temperature at the beginning of broiling on palatability, shear and cooking properties of beef loin steaks differing in marking the start of the steaks differing in the start of the steaks differing in the start of the steaks differing in the start of the start of the steaks differing in the start of th Marbling, J. of Food Service Systems. 5:287 H.R. 1977. Effects of amount, distribution and texture of marbling on cooking properties of beef Longissimus. J. Food Sci. 42:182.

H.R. 1977. Effects of amount, distribution and texture of marbling on cooking properties of deer Longissinius. 9. 1 oct. 201. 1976. Hereine Standight, Stanfield, M.S. & Koch, E.J. 1976. Beef palatability as affected by cooking rate and final internal temperature. J. Anim. Sci. 43:114 H.R., Stanfield, M.S. & Koch, E.J. 1976. Beef palatability as affected by cooking rate and final internal temperature. J. Anim. Sci. 45:114 M.R., Stanfield, M.S. & Koch, E.J. 1976. Beef palatability as affected by cooking rate and final internal temperature. J. Anim. Sci. 45:114 M.R., Shorthose, W.R., Darnell, R.E., Harrison, D. & Stephenson, P.D. 1992. The effect of subcutaneous fat thickness on consumer preferences for steaks.

Australian Association of Animal Breeding and Genetics. 10:380 T.F., Aldrion, P.J. & Funk, K. 1967. Rate of temperature rise, physical and chemical properties of ground beef cylinders fabricated from selected muscles of the tound tours and the selected muscles of the

GL, Miller, R.K., Hale, D.S. & Cross, H.R. 1991. The determination of cooking characteristics of USDA Choice versus Select retail beef cuts. Final report to the Beneficient of the National Livestock and Meat Board. Texas (A & M).

¹G.L., Miller, R.K., Hale, D.S. & Cross, H.R. 1991. The determination of consequences of the Beef Industry Council of the National Livestock and Meat Board. Texas (A & M). ¹G.L., Miller, R.K., Hale, D.S. & Cross, H.R. 1991. The determination of consequences of the Beef Industry Council of the National Livestock and Meat Board. Texas (A & M). ¹G.L., Miller, R.K., Hale, D.S. & Cross, H.R. 1991. The determination of consequences of the Stephene State of the Stephene Step Science. London. p101 FC, Olson, D.G., Miner, B.E. & Rust, R.E. 1973. Effect of degree of marbling and internal temperature of doneness on beef rib steaks. J. Anim. Sci. 27:430 W. S.C., Olson, D.G., Miner, B.E. & Rust, R.E. 1973. Effect of degree of marbling and internal temperature of doneness on beef rib steaks. J. Anim. Sci. 27:430 W. S.C., Dison, D.G., Miner, B.E. & Rust, R.E. 1973. Effect of beef, pork and lamb. Meat Research Update, Vol. 1. No. 4. p 1-10.

W & Cross, H.R. 1986. The role of fat in the palatability of beef, pork and lamb. Meat Research Update, Vol. 1. No. 4. p 1-10. ¹⁰ & Carpenter, Z.L. 1974. Eating quality of animal products and then the content of the conte