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MODIFICATION OF CARCASE MEAT BY INJECTION

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Within recent years our knowledge of the relationship of the ionic environment of muscle proteins to the eating quality of lean tissue has been considerably extended. Although we are still far from a complete understanding, considerable success has already been achieved in explaining and improving time honoured practices in handling comminuted meat products. The possibility of a similar approach to carcase meat has become possible through the development of vascular injection techniques initially used by Deatherage (1) for the study of antibiotics.

The present work is an attempt to use injection technique, (1) to determine whether the quality modifications possible with comminuted meat are also possible with carcase meat, (2) to express the modifications in terms of eating quality, and (3) to determine whether such modifications are related to those that can be induced by preslaughter treatment of the animals. Initially the work arose from studies aimed at preventing 'drip' from frozen meat after thawing and was primarily concerned with the effect of injections of various solutions on the extent of drip. The extent of the changes in eating quality directed attention however to the use of injection for improvement of fresh meat.

Injection Technique:

In these experiments chilled hinds without loins were used.

For injection the rump was separated at the last lumbar vertebra, as this coincides with the point where the main arteries and veins of the leg are accessible and can be readily identified.

Pumping was carried out through the aorta if the iliac arteries were still attached to it or through the iliac arteries if

attributes, only in the case of tenderness and saltiness are they statistically significant. It would appear that increases in concentration of brine beyond 5% produce little further increase of tenderness. It is to be noted that though the samples with 10% brine (that is not quite 2% total sodium chloride in the tissue) reached a score on saltiness approaching that described as 'moderate' the samples were not marked down on acceptability - the increased tenderness having offset any objection to the saltiness. It is probable that this level of saltiness would not be objectionable to most consumers. Data on cooking losses did not indicate any difference between the treatments. Presumably any variations in the tendency to lose water during cooking are removed in the freezing and thawing process.

Injection with phosphates:

Phosphates, particularly pyrophosphates and polyphosphates, have been suggested as modifiers of the physico-chemical properties of muscle tissue. Trials were made in which 2.5% anhydrous sodium pyrophosphate was added to sodium chloride brine giving a pH of approximately 9.1. Since the solubility of pyrophosphate is markedly reduced by sodium chloride, the concentration of sodium chloride used was limited to 1.25, 2 and 3%. The effects were examined by comparing injected and uninjected butts from the same animal. Other trials were made with 2.5% sodium pyrophosphate in 2.5% salt at pH 9.1 and with 5% orthophosphate in 2.5% salt at pH 6.5. With these trials the comparisons were made between one butt of an animal injected with the mixed solution and the other butt from the same animal injected with 2.5% salt.

To enable the data to be summarized the figures for the uninjected sides have been corrected by reference to the data of slide 1, to the figure expected for the corresponding salt solution alone and the results are all then given as changes from the value for salt alone. It is known that drip is pH dependent and therefore the results are shown in slide 3 in relation to the corresponding pH shift. Each point is the mean of four muscles. It is seen that the addition of 2.5% pyrophosphate (closed circles) to the brine usually

reduced the drip by about 10%. While this is a considerable reduction it is only just about sufficient, when used with a 2.5% salt brine, to restore the value to that of uninjected samples.

While the effect of pyrophosphate was clearly established it is not clear whether its action was due to the accompanying pH shift, the additional osmotic effect or to a specific effect. Some data are available which permit the effect of pH alone to be estimated. The squares in Fig.3 show the results of experiments on butts from the same animal, one being injected with sodium chloride brine alone and the other with brine of the same concentration adjusted to pH 9.2 by 1.6% carbonate-bicarbonate. These data suggest that an increase of 1 unit per pH decreased drip by 4 to 5% - a figure somewhat less than that obtained by variation of ultimate pH through preslaughter treatment (3). On this basis it would appear that pyrophosphate usually introduced some 6-7% reduction beyond any estimated pH effect and this would be compatible with its action purely as an osmotically active salt. With 5% orthophosphate (indicated by the star), where there was little pH change, the proportionately larger reduction in drip is also compatible with its osmotic effect and there appears to be little reason to postulate specific effects of either ortho- or pyro-phosphate.

Tasting data are available only for comparisons between butts injected with sodium chloride plus pyrophosphate and untreated butts. Only with tenderness and acceptability (slide 4) was there general evidence for an effect of the injection and only with the lowest level of salt was the effect much greater than expected from the salt alone. The increase in acceptability is presumably a direct consequence of the increased tenderness. There is evidence from studies on preslaughter treatment of steers (3) that these attributes of eating quality are dependent on the ultimate pH. Slide 4 shows the changes in tenderness and acceptability (each point being the mean of two joints and seven tasters) in relation to the associated pH changes. The dotted lines indicate the relationships with ultimate pH previously found and it will be seen that,

changes in tenderness and acceptability induced bear no relation to those expected from the pH changes and are in fact usually opposed to them. As indicated above only with the dilutest salt solution was there reasonable evidence that the pyrophosphate has increased the effect of the salt. It appears reasonable, however, to assume that sodium chloride and sodium pyrophosphate are interchangeable in osmotic action and their combined action on tenderness and acceptability reaches saturation at the equivalent of 3 to 4% of salt. This assumption is in line with the data on injection of salt alone already illustrated in slide 1.

The addition of 2.5% pyrophosphate appears to contribute little if anything to the salt flavour.

Injection of Proteolytic Enzymes:

Following the success of tenderizing frozen carcase meat by injection of salt solutions the investigations were extended to study the effect of injecting tenderizing enzymes as a means of improving the quality of fresh meat. It was found desirable to inject the enzymes in a 2.5% salt solution not only because of the tenderizing effect of the salt but also as this prevents the cut surfaces appearing excessively moist. While this work is still largely exploratory success has already been obtained with papain and bromelin. Large effects were produced on tenderness and acceptability but the treatments had little influence on other attributes of eating quality. Slide 5 shows typical effects on tenderness and acceptability with four pairs of butts from aged cows, one uninjected and the other injected with 2% sodium chloride containing .005% papain at which concentration the tenderizing action appears to proceed to a satisfactory stage in 48 hours at approximately 15°C and does not then proceed much further on further storage. At this concentration no foreign flavours were detected.

It is emphasized that all of these experiments are exploratory and that as yet no consideration has been given to the implications in practice or to public health aspects.

REFERENCES

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