

THE TENDERISING EFFECT OF MARINATION WITH CITRUS JUICES ON BEEF WITH HIGH CONNECTIVE TISSUE CONTENT

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Introduction

Many methods of altering meat tenderness including the use of marinades have been evaluated (Gault, 1985). Acidic marination involves the immersion of meat in an acidic solution of vinegar, wine or fruit juice (Lewis and Purslow, 1991; Stanton and Light, 1990). Marinades with a tenderizing capacity are particularly important in applications involving muscles rich in connective tissue. These muscles often make up the cheaper carcass cuts and the tenderizing effect of marinating offers a commercially important means of upgrading them (Gault, 1991; Lewis and Purslow, 1991). Burke and Monahan found (2002) that when shin beef strips were immersed in the citrus juice marinade (31% orange juice, 31% lemon juice, 38% distilled water), then the pH value decreased from 5.7 to 3.1 and the Warner-Bratzler shear force value decreased from 178 to 44 N cm⁻² following marination. It has been also found out that the sensory analysis scores for tenderness and juiciness increased following marination. The purpose of this study is to investigate the potential marination of citrus juice on tenderizing the beefs with high connective tissue content. Previous researches have been performed for orange and lemon juice marinades. This study also contains the data for the marination of Seville orange juice.

Materials and Methods

Beef cuts (*M. semitendinosus*) used in this study were obtained from a local Turkish abattoir, 12 samples for 6 different marinades and control group were tested during the investigation. 4% salt and 0.5% sugar was added to deionized water in order to make a control group solution.

Table 1: The content of marinades.

Marinades	Juice (%)	Solution (%)
Control		100
1	Seville orange 31	69
2	Seville orange 62	38
3	Lemon 31	69
4	Lemon 62	38
5	Orange 31	69
6	Orange 62	38

The beef samples were immersed in these solutions. Six of the samples from each marinade were analyzed at the end of 24 hours, whereas 6 of the 12 samples were analyzed at the end of 48 hours. Each side of the samples was grilled for 4 min. The pH measurements, surface colour measurements and the texture analysis were done for the 24 hour-marinated and the 48-hour-marinated samples after cooking. Colour measurements were carried out at the surfaces of samples by using a Minolta chromometer (CM 3600 d). Texture analyses were performed by using Ta Plus Texture Analyser (Amatek Lloyd Instruments Ltd., UK). Correlations between the changes in pH, the a/b value; "the index of consumer testing (ICT)" and the hardness values were calculated.

Results and Discussion

The average pH values of raw meat samples were 5.26 and pure Seville orange juice, lemon juice and orange juice were 2.68, 2.80 and 3.43 respectively. The addition of salt and sugar to deionized water increased the pH of the solution. A decrease in the pH value of the samples was observed at the end of 24th and 48th hours according to the marination process. The pH value of the control group was the highest when compared with the marinated samples. Samples marinated with 62% lemon juice had the lowest pH value (a decrease of 1.51), while the samples marinated with 31 % orange juice had a higher pH value.

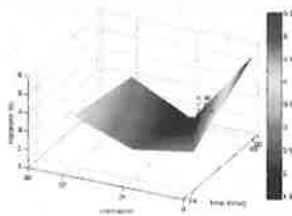


Figure 1:
The effect of Seville orange juice on the hardness of cooked beefs

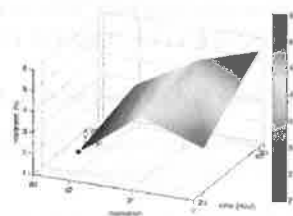


Figure 2:
The effect of lemon juice on the hardness of cooked beefs

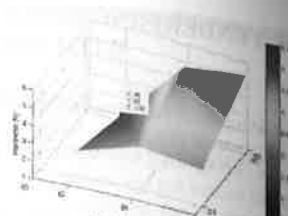


Figure 3:
The effect of orange juice on the hardness of cooked beefs

The hardness of the unmarinated samples increased during storage but marination process reduced this increase. The tenderising effect of marination increased, as the concentration increased except for the Seville orange juice. Although the cooked samples at 48th hour, which were marinated with 62 % content Seville orange juice, had high hardness value (3.08 N); cooked samples marinated with 31 % content Seville orange juice had a lower value (1.41 N) (Figure 1). 62% of lemon juice marination resulted in a rapid tenderising effect (1.97N) at the end of 24 hours compared with Seville orange and orange juices which were effective at the end of 48 hours (Figure 1, 2 and 3). As seen in Figure 3, 62% orange juice marinade gave the most tenderising character to the meat. The hardness values of the 31% Seville orange marinade and 62% orange marinade at the end of 48 hours were similar, which were 1.41 N and 1.32 N respectively. The pH results showed that orange juice have the lowest acidity. It gives the most tendering character at the end of the marination process.

According to the texture analysis, the control group samples had the highest shear force values. Therefore, the marination process can be recommended for these types of cuts.

The samples, which were marinated with 62 % content lemon juice, had the highest and the same ICT values at the end of 24 and 48 hours (0.62). It was calculated that the ICT and the hardness values had a negative correlation ($r = -0.33^*$). It was also found out that there was a negative correlation ($r = -0.34^*$) between pH and the ICT.

Conclusions

These results showed that the marination process provided tenderisation of meat after cooking. Using natural ingredients, the products can be perceived as healthier than those products with synthetic additives. Furthermore, Seville orange and lemons are found easily and are cheaper than other additives so it is much more economical to use the juices of these fruits as marinade ingredients. In this study, it was shown that other than orange and lemon juices; Seville orange juice also has tenderising effect on beef cuts. If it is needed to have a rapid tenderising effect it is recommended to use 62% lemon juice because the effect is observed at the end of 24 hours. However the tenderising effect of orange juice is the highest at the end of 48 hours.

When ICT results are considered, acceptability of the samples marinated with lemon juices are the highest ones.

Acknowledgments

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