THE RELATIONSHIP BETWEEN pH AND R-VALUES IN POSTMORTEM LAMB MUSCLES

M.SERDAROĞLU, S.TÖMEK and S.DEMŸRTAŞ

Ege University, Engineering Faculty Food Engineering Department, Bornova, ŷzmir, TÜRKŸE

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SUMMARY

The high energy compounds available at the moment of death are used up by the continuing muscle metabolism. Metabolic rate (R-value) is a good indicator of rigor onset. The objective of this study was to evaluate the relationship between muscle pH and R-values in three different lamb muscles. For this purpose, the semitendinosus, semimembranosus and M.adductor muscles were removed immediately after slaughtering and stored at 4 °C for 24 hours. Temperatures and muscle pH were measured at various times post mortem, in addition to changes in the absorbtion ratios at R248, R250 and R258. The results show that the concentration of adenine nucleotides (indicated by R248, R250) decreased with decreasing muscle pH. However, high R-values (measured by R258) were found at 24 hours postmortem that indicate a high concentration of inosine compounds. There were no significant differences between the R- values of the threee different muscles at the various times postmortem.
Since R-values are a dynamic measure of the metabolic rate in post mortem muscle, it would be more reliable to determine the changes in R- values than a single measure of pH.

Introduction

Deviations from the normal time course of postmortem could affect the meat quality. High energy compounds available at moment of death are used up the continuing muscle metabolism. The ratio of loss depends several factors such as the concentrations of high energy compounds, genetic factors, stress, and environmental conditions (Honikel and Fischer, 1977). ATP and IMP concentrations exhibit remarkable changes of their concentrations in PSE and DFD muscle types which could affect the meat quality. However the usual methods for the evaluation of ATP and IMP are time consuming but the changes in the UV absorbance during deamination of adenine moiety can be used as an easy objective method for the detection of post mortem changes (Honikel and Fischer, 1977). The maximum absorbance of adenine nucleotides are measured at 258-260 nm., IMP and inosine at 248-259 nm., and hypoxanthine at 250 nm. (Honikel and Fischer, 1977). Several authors have measured the extent of ATP break-down using R250 (Honikel and Hamm, 1978; Fischer and Hamm, 1980). Both R248 and R258 are similar to R250 and any of three R-values could have been utilised to predict ATP and to determine rigor development (Koh et al., 1992).The aim of this research was to evaluate the R-values of different muscles at different periods of post mortem.

Material and Methods

In this research; semitendinosus (ST), semimembranosus (SM) and M.adductor (MA) muscles removed within 20 min. postmortem from 8-10 month-aged Karaman type lambs, of which carcass weights were approx. 14-15 kg., were used. The carcasses were stored at +4 °C and during 24 hrs storage period, temperature, pH values and absorbance ratios (R- values) of the muscles were evaluated. The temperature of the muscles were measured by using Omega digital thermometer and pH values were measured by using digital pH-meter installed with penetrometer type electrode. Samples, for R-values, were removed from SM, ST and MA muscles at 0, 2, 4, 6, and 24 hours postmortem and stored in liquid nitrogen until asseyed. The R value procedure involved homogenization of 10 g. of frozen muscle sample in 50 ml. of 0.9 M. perchloric acid (at room temperature) for 1 minute. The resultant slurry was centrifu- ged for 10 min. at 3000*g. and the supernatant was adjusted to pH 6.0- 6.5 using 2.0 M. KOH. After chilling on ice for 45 min., the solution was filtered through Whatman No1 filter paper. Potassium buffer (pH 6.5, 0.1 M potassium phosphate) was combined with the filtered extract (2.0 ml.+0.1 ml. respectively) and the absorbance of the mixture was

recorded at 248, 250, 258, and 260 nm. R-values was determined by creating a ratio of two absorbance values: R248 was the absorbance at 248 nm. over the absorbance at 260 nm.; R250 was the absorbance at 250 nm. over the absorbance at 260 nm.; R258 was the absorbance at 258 nm. over the absorbance at 250 nm. (Calkins et al., 1983).

Results and Discussion

Means for the temperatures and pH values of ST, SM and MA muscles measured at 0,2,4,6,and 24 hrs of postmortem are presented in Table 1.

The initial temperatures of the muscles were measured within 20 min. postmortem and they were recorded as 36, 37, and 36°C for ST, SM and MA muscles respectively. At the end of 24 hrs of storage period, similar cooling rates were found and all the muscles reached to 4°C, same as the storage temperature.

The initial pH values of ST and SM were measured as 7.33 and the ultimate pH values of these muscles were 5.7, whereas the initial and the ultimate pH values of MA were 7.34 and 5.8 respectively. Similar cooling rates for internal portions of muscles probably resulted similar pH values. Since muscle pH has been considered as a measure of post mortem muscle metabolism, obtained pH values indicate that there were no difference between the metabolic rates of the muscles.

The changes in R-values (R248, R250, R258) of the muscles in different hours of postmortem are given in Table 2.

The adenine nucleotides (ATP, ADP,AMP) exhibit absorbance maxima near 260 nm., while the absorbance of inosine monophosphate (IMP) and inosine peaks near 248 nm. and hypoxanthine absorbance peaks near 250 nm. Absorbance ratios have been used to measure postmortem metabolic rate by several researchers (Koh et al., 1992; Honikel and Fischer, 1977; Honikel et al., 1981). Advancement of rigor mortis is reflected by a decrease in the ratio of adenine nucleotides to inosine compounds (Table 2). Adenine nucleotides were converted to IMP, inosine, and hypoxanthine during postmortem period and it can be seen by decreasing R258 values. Similar results have been reported in previous studies (Calkins et al.,1982,1983; Koh et al., 1992).

Results of regression analyses between pH and R-values (R248, R250, and R258) were given in Table 3.High R2 values are indicative of the strong relationship between the pH and R-values (R248, R250, R258). The relationship between pH and R-values appear to be parabole as seen in figures attached to the text.

Conclusion

In the experiment, the similar cooling rates has been obtained due to the smaller lamb muscles bur in larger carcasses, different cooling rates for the internal and external portions of muscle probably resulted in different pH values. To demonstrate the postmortem metabolism, the measuring of muscle pH alone may not be an effective indicator. So, metabolic rate (R-values) may be a good indicator to control the course of rigor mortis for obtaining meat quality.

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