TUMBLING VARIABLES IN COOKED MEAT TECHNOLOGY

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SUMMARY

A factorial experiment (3x3) was performed to investigate the effect of rotation and resting time distribution in a tumbling program and what type of alteration there is in myofibrillar proteins composition. The results of the study show that resting time should be proportional to intensity of mechanical work on meat to enhance myofibrillar protein extraction.

Introduction

Tumbling is very important for some meat preserves, as cooked ham or pork rolls, because in this phase ingredients and additives are able to diffuse everywhere and meat proteins are extracted. Generally tumbling is characterised by alternates working time and resting time. Some authors (Gillett et al.. 1982) think that continuous massaging were superior to intermittent massaging, while others (Scheid, 1986), (Muller, 1991) believe the opposite. Bedinghaus et al. (1992) found that intermittent tumbling of prerigor porcine muscle enhances yield and quality in ham. Cassidy et al.(1978) investigated the effect of tumbling method on histological characteristics of porcine muscle tissue: intermittent tumbling resulted in more alteration in cell structure compared to continuous tumbling. We have studied what effects the distribution of massaging have on the product.

Materials and methods

Longissimus dorsi muscles were taken , 24 hours after slaughter, from pork having constant genetic and physicochemical characteristics, and hold at 0° C for 24 hours. Each batch (twenty loins) was pumped to 120% of green weight. Nine different tumbling programs were performed to investigate three working time levels (2, 4 and 6 minutes) and three number of cycles (10, 20 and 30). Tumbling total time was constant (24 hours). Table 1 shows experimental design. Exudate samples were taken to analyse salt, total protein content (Kjeldhal method) and myofibrillar protein composition by SDS-PAGE electrophoreses. After grinding every sample released sarcoplasmic protein by stirring with a buffer of sodium and potassium phosphates at pH 7.4 for 24 hours. Myofibrillar proteins were extracted from the resulting pellet by stirring with 0.725 M KCl for 24 hours. Electrophoreses was carried out on Excelgel 8-18 (Pharmacia). Hunter colour parameters were measured on the products with Chroma Meter II (Minolta). A eight-member sensory panel evaluated some organoleptic characteristic using a score from 1 (negative) to 5 (excellent): cohesiveness, tenderness, juiciness, flavour, colour, and presence of defects. Yield was calculated for each batch. Analysis of variance of each effect was carried out by Cochran and Cox method (Cochran and Cox, 1957).

Results and discussion

From electrophoretic pattern of myofibrillar protein we have seen that during tumbling actin and myosin markedly decrease in meat. Alfa-actinin, myosin, actin and tropomyosin are solubilized, while troponins (T, I and C) remain in tumbled meat. Electrophoreses on exudate protein extracts, collected during tumbling, allows to evaluate the extraction exerted by the brine in this phase. Results agree with those obtained by previous studies (Barbieri, 1992). HC myosin and actin appear first in exudate. Their amount regularly increases and it approaches 8 % of myosin at the end of the tumbling process. Alpha-actinin and tropomyosin are extracted during the first 4 hours of tumbling. There

is no difference in myofibrillar proteins composition of exudate coming from different tumbling program. Analysis of instrumental colour data (table 2) shows that increasing working time a/b values decrease while cycles number has a quadratic influence ($P<0.01$). Double quadratic interaction is the most significant interaction ($P<0.01$). Massaging is negative for colour of product. Yield shows a quadratic relationship with number of cycles as well as working time. Working frequency has a linear positive relationship with protein extraction when working time is small. Adversely an intense work 'into' each cycle reduces this effect because of the fat obstacle obtained (Barbieri et al., 1993). Working time shows a quadratic effect on protein extraction. The highest exudate protein content is achieved by two way: short working time and short resting time or long working time and long resting time (see figure 1). Both cases give the same percentage of myosin in tumbling exudate. Salt diffusion have an important play in order to extract myofibrillar proteins: there is a linear relationship between theirs. Organoleptically, no difference is found in colour among products. Unlike tenderness depends on type of tumbling program (see figure 2). Interaction from quadratic effect of cycles and linear effect of working time is the most significative ($P< 0.01$). Pork rolls obtained by high or low cycle number have a more soft slice (high score) than whose obtained in intermediate conditions. Probably there are two opposite causes leading to the same effect: softening due to myofibrillar proteins solution (salt diffusion) and mechanical softening, growing with cycle number. Cohesiveness has a linear and positive relationship with working time ($P<0.01$). Flavour relies only on cycle number that has a positive effect.. Presence of defects (holes, crack) is reduced increasing massage. Product juiciness is related to cycle number (see figure 3). Best results are obtained with long resting time as well as long working time.

Conclusion

Protein extraction is the central phenomenon of tumbling phase. Especially myofibrillar protein have an important role for technological and organoleptic parameters of product. Their increase produces high yield, but proteins extracted with few cycles and long working time as well as with several cycles and short working time, reduce their water holding capacity during cooking maybe for denaturation process. SDS-page electrophoresis cannot give no information about this. We will be able to know more carrying out a native page electrophoreses. Myofibrillar proteins involved in this process are tropomyosin, alpha-actinin and especially actin and myosin. Their extraction by intense work within cycles followed by long resting time resulted in juicy products having soft slices and best cohesiveness. Yield is very high too. Conversely we have a tougher product when myosin and the other proteins are extracted by tumbling program with several cycles and short rotation time . To increase massage improves flavour but makes worse colour of product. Tumbling program shall take into account all these effects in order to reach an acceptable compromise.

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