MULTIPLE PROTEIN PHASES APPROACH FOR BETTER UNDERSTANDING MEAT PRODUCT QUALITY - UNRAVELLING KEY INTERACTIONS BY USING A MULTIPLE PHASE AGGREGATION MODEL

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Keywords: meat product quality factors, sarcoplasmic protein, myofibrillar protein, collagen, multi phase aggregation

Introduction

There is a general consensus that factors affecting meat quality and the quality of meat-based products are related to proteins. Over the years it has become an accepted notion that myofibrillar proteins are crucial in meat texture. (Acto)myosin in particular, is regarded as a protein that governs important textural characteristics of meat products, like stiffness and elasticity. Clearly, muscle proteins like myosin and actin are important estimators of meat quality. A cooking experiment with two types of deboned chicken meat with similar protein content reveals that stiffness and elasticity parallels myofibrillar protein content. Furthermore, cooking loss increases with decrease of myofibrillar protein. In this case it was clear that the textural quality of the cooked meat must be related to myofibrillar proteins. Systematic studies using meat models that focus on muscle protein provide useable insight, but they are single-protein-phase oriented in nature. Thereby important data on interactions between meat proteins, like salt-soluble myofibrillar (incl. myosins and actins), (water and salt insoluble) collagens and water-soluble sarcoplasmic proteins, are left out in the meat quality specification. In this paper we will discuss the importance of looking at the various protein phases besides myosin.

Materials and Methods

In this study 4 different types of chicken meat and 4 industrial meat composite samples were used.

Table 1: Samples and protein content.

sample	% total protein
A	10.92
B	8.42
C	19.87
D	23.16
E	14.34
F	15.53
G	16.25
H	16.85

Samples A – D, are various chicken derived meat fraction: from skin-rich fraction to chicken filet. Samples E- H are various deboned chicken meat samples.

The total protein and the protein content of the distinguished protein fractions: myosin, collagen and sarcoplasmic were determined. With each type of meat, a heat-induced gel was prepared by emulsifying the protein in a suspension of water with 2% NaCl. Cooking loss was determined. This resulted in a model-type meat sausage. Of these meat sausages the consistency was measured with a texture analyser. The textural properties were compared with various protein factors. For the content of specific fractions the cooking loss was corrected for, resulting in protein effectively present in the cooked meat gel.

Results and Discussion

When specifying meat quality, protein content of the uncooked starting material is often related to end product properties. In Figures 1and 2, it is demonstrated that protein content has no relation to texture.
Next to myosin there are also sarcoplasmic proteins present in meat products, however, this class of proteins also does not reveal an encouraging correlation with final textural properties (Fig 3). The result in figure 4 reveals an interesting correlation. The correlation revealed here indicates that the collagen phase and the myosin phase act together in determining final textural properties. Total protein, or myosin protein correlations do not reveal a good relationship with technological quality. Hence we propose a multiphase approach. This multiphase approach is discussed in the following section.

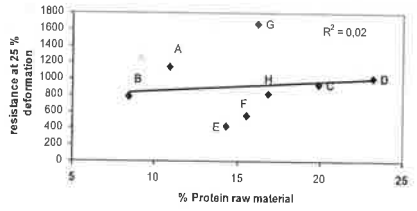


Figure 1.

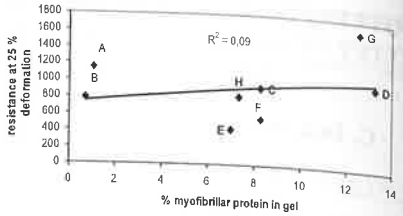


Figure 2.

Another factor often looked at, is the content of muscle proteins: myosin. This was determined for the gelled protein sausages but also here a poor correlation is revealed (Figure 2).

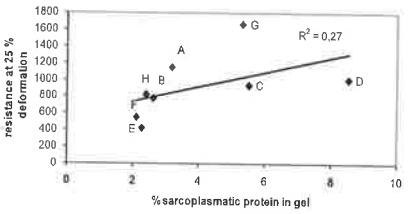


Figure 3.

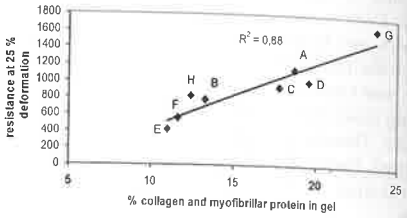


Figure 4.

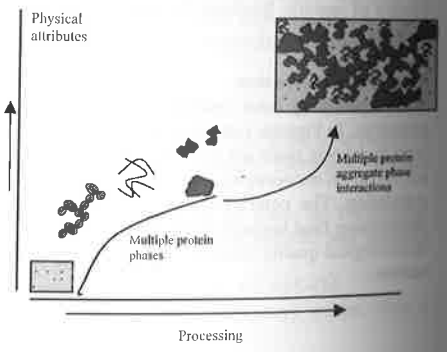
In order to improve meat and meat product quality assessment, a multiple-protein-phases aggregation model is proposed. Viewing the various meat protein constituents as being of separate phase behaviour is for one justified by the fact that isolation of each protein requires specific conditions for solubility, in this case, extraction. These differences in solubility criteria indicate also a different behaviour during cooking. Sarcoplasmic proteins readily dissolve in water, during cooking these proteins denature and coagulate at 40-60°C. Myofibrillar proteins are not readily soluble in water, but when excess salt is added solubility improves. Myofibrillar proteins change structure at 60- 80°C. Collagens require strong base (NaOH) or SDS - urea to dissolve. During heat-up, collagens shrink at 50-60°C, only after prolonged heating collagens may soften and form a more gelatine-like phase. All these changes take place during the preparation of meat products.

By taking these typical differences into account the multiple-protein-phases aggregation model provides a framework to better understand the network formation phenomena in meat products. On the macro-level, heat-induced meat protein network can be viewed as a particle network. For the meso-level 3 types of protein-network phases are hypothesised:

1) a large aggregate network phase 'skeleton structure'
2) colloidal particle network sub-phase
3) polymeric gel sub-phase.

The water caught in the network formed has constituents that are molecularly dissolved; this is defined as liquid phase.

Multiple phase aggregation model



Conclusion

The framework of the multiple protein phase aggregation model helps to improve our understanding of final meat product quality factors. This will support the industry to select more effectively among various meat sources and the vast amount of additives intended to improve final product properties. Our latest results will be addressed during the ICoMST meeting.