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THE ROLE OF SODIUM CASEINATE IN THE STABILITY OF MEAT EMULSIONS

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INTRODUCTION

The production of minced meat products such as sausage, frankfurters and canned meats requires that the meat first be process into an emulsion. This kind of meat emulsion is composed of a solid phase dispersed in a continuous liquid phase (the two phases cannot be mutually desolved) (Saffle, 1968). The continuous phase is an aqueous salt and proteins solution and the fat disperses in it by forming small particles that engage with a complex colloidal system of protein, fat, water, salt and phosphate.

In the meat emulsion, not only can the dispersed fat particles flocculate and precipitate so as to separate the two phases, but also, the aqueous solution may change state, causing water exudation. So the water and fat holding capacities (WHC, FHC) of the protein in the emulsion are important towards the development of stability in the raw meat emulsion, and they are also of great importance to the moisture and oil holding capacities of the final heat treated products.

The function of the FHC and WHC of the meat protein in the stability of the emulsion are therefore of primary interest. As fat is derived from fat cells, when the meat is cut, the fat only becomes ionized while the emulsion is formed. The fat and water can thus form an o/w emulsion. Because the fat-water interface has high interfacial tension, the emulsifying process requires more energy. An unstable thermodynamic state can therefore facilitate a water and oil exudation process. Furthermore, the association of the free fat and the meat protein is an important factor in the stability of the emulsion.

The fat emulsion is wholly finished by the proteins in the meat emulsion. The proteins in meat are composed of myogen, fibrillin and connective tissue protein, and the salt-solluble myogen and fibrillin have the highest activity and emulsifying ability. With the variation in the extent of cutting, the fibrillin in meat is composed of its larger fragments, intermediate sized fragments, the very small myosin molecules, and F-action. The collection of fibrillin fragments behaves as a good emulsifier (Swift *et al.*, 1961; Borchert *et al.*, 1972). It can reduce the interfacial tension and be intensively absorbed on the fat-water interface.

The space-filling modes of the fragments distort by the orientation of their polar and nonpolar groups, causing the molecules to partially extend. Because of the intense affinity between the fibrillin fragments and the fat-water interface, the fat particles are wrapped in a thin film of protein which serves in a protective role. Furthermore, as the fibrillin is on the basic side of the isoelectric point, its hydrophilic substituents are usually negative charged, so the wrapped fat particles are similarly charged and mutually repulsive. Also, the meat emulsion has a high viscocity. All these factors prevent the fat from precipitating (Acton *et al.*, 1972). So the fibrillins have a very high fat holding capacity (FHC).

In the process of forming the meat emulsion, the fibrillin fragments expand by absorbing water to form the three-dimensional structure which facillitates the water holding capability of the emulsion product. Moreover, this structure can prevent water loss and be responsible for the development of a high water holding capacity (WHC).

Some of the fibrillin, fragments emulsify the fat particles by forming a protein film around them. The others form a net structure by expanding intensively to increase the WHC, thereby stabilizing the meat emulsion. When heated, a stable gel is formed to make all the components including free water precipate (Schut and Brouwer, 1971). Thus, a product of good cohesive and elastic properties may be made.

Sodium caseinate also plays an important role in the stability of meat emulsions. When making boiled sausages, inexpensive materials are often used. In such formulations, the free fat and water contents can be very high, but the fibrillar protein content may be insufficient. In such cases the meat emulsion will be unstable. The reasons for this are as follows:

(1) The protein film around the fat particles becomes thinner so its mechanical intensity and elasticity are decreased.

(2) In some parts of the emulsion, one protein collection cannot be absorbed to only one surface of the fat particle, so the flexibility and the resistance to mechanical treatment are reduced.

(3) Fibrillins can be absorbed faster on the fat-water interface, as these molecules are directed by their side chains: The polar substituents associate with the polar phase (water), the nonpolar ones with the nonpolar phase (fat). When the free energy is reduced, the fibrillins on the interface are irreversible denatured and lose their capacity to forming a net structure, and the normal gel cannot be made.

Sodium caseinate, which is made by casein dissolving in a basic solution, is a long chain-like molecule. With a charged and an uncharged part. The charged part is the hydrophilic substituent. It has a very high emulsifying and gelatinizing property at a pH6. When sodium caseinate is added to the unstable emulsion, it can be absorbed to the free fat particles prior to the fibrillins to form a strong film so as to finish the emulsion process (Acton and Saffle, 1972). Therefore, the fibrillins are saved to form a better net structure, and the added sodium caseinate can accelerate the fat fragmentation process during meat cutting. This allows the smaller fat particles to become positioned in the swelled meat fibers, which prevents their constrictions, and decreases the isolation of water during heat. Sodium caseinate does not precipitate at the normal pasteurization or sterilization temperatures, so the protein film does not shrink, and fat is not isolated while being heated. The addition of sodium caseinate therefore stabilizes the fat-protein-water system.

RESULTS AND DISCUSSION

To establish the effects of sodium caseinates, 2% sodium caseinate was experimentally added to a meat emulsion. It was found that the water isolating value was reduced by two to three times, and the fat isolating value was reduced by three times.

Furthermore, the addition of sodium caseinate to the meat emulsion product raised the production rate, elasticity and shearing index.

CONCLUSION

Sodium caseinate, which is a kind of animal protein derivative, has a very high biological effect value (82). It is one of the cheapest raw materials, yet is a valuable protein resource. It can be used as a safe food emulsifier in many countries up to a concentration of 2%.

The sodium caseinate in the meat emulsion can be absorbed onto the fat-water interface prior to the fibrillins to enhance the emulsifying process. More fibrillins are thereby saved in this process to form a better net structure to supply the colloidal system with a high WHC and FHC making it more stable. When heated, a normal gel can be formed to wrap the fat particles and water in this structure to yield high moisture and oil holding capacities. This enhances the elasticity of the resulting product.

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