

PE4.21 Investigation of the principles of interaction of carragheenan with phosphates in the presence of muscle proteins 67.00

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Abstract. In recent time increase in the level of injection of whole-piece products has led to the production of delicatessen products with the use of structure formers and acidity regulators. Therefore, study of the problems, associated with the nature of interaction of high-molecular components of brine with curing ingredients and muscle proteins is of great importance. The paper describes special features of carragheenan interaction with phosphates in the presence of muscle proteins to substantiate the doses of phosphates in the brine for injecting pork products.

Key words: carragheenan, muscle proteins, phosphates, strength

I. INTRODUCTION

Wide use of polysaccharide nature gel formers in brines for injecting whole muscle meat products has shown that the brines' high molecular components, penetrating into connective tissue interlayers begin to interact both with the components of the brine itself (salt, phosphates) and with muscle tissue elements – soluble muscle proteins. Therefore, the purpose of this work was to study the effect of meat system components formed during injecting and massaging of meat raw materials on gel forming properties of kappa-carragheenan during subsequent thermal treatment.

II. OBJECTS AND METHODS OF INVESTIGATION

The objects of investigations were model systems - kappa-carragheenan gels, prepared with the use of 2% aqueous sodium chloride solution or a salt solution of muscle proteins.

The solution of muscle proteins was prepared as follows:

1 kg of *Longissimus dorsi* isolated from pig side was comminuted, poured with 2.0 l of chilled 3.5% sodium chloride solution and infused with periodic agitation during 1 hour. The obtained mass was filtered, and the solution of muscle protein was poured off. In the obtained solution the content of muscle proteins and sodium chloride was determined by generally accepted procedures to evaluate the fullness of extraction. With this method of extraction, concentration of muscle protein in the solution was $3.0 \pm 0.1\%$, and sodium chloride – $2.0 \pm 0.15\%$.

Purified kappa-carragheenan at 0.5%, 0.75% and 1.0% and also a commercial preparation of edible phosphate, being a mixture of pyro- tri- and polyphosphates (E450, E451, E452) at 0.15%, 0.3%, 0.5% were added to the obtained solution of muscle proteins. The obtained multi-component solution was heated at 75°C during 30 min. and chilled till gel was formed. The gels with different concentrations of carragheenan and edible grade phosphate were subjected to comparative structural-mechanical tests on a universal installation "Instron", determining the limit value of breakdown stress and the work of beginning of breakdown.

III. RESULTS AND DISCUSSION

Results of comparative investigation of structural-mechanical characteristics of 0.5%, 0.75% and 1.0% carragheenan gels, prepared with water and with the solution of muscle proteins, are presented in Fig.1.

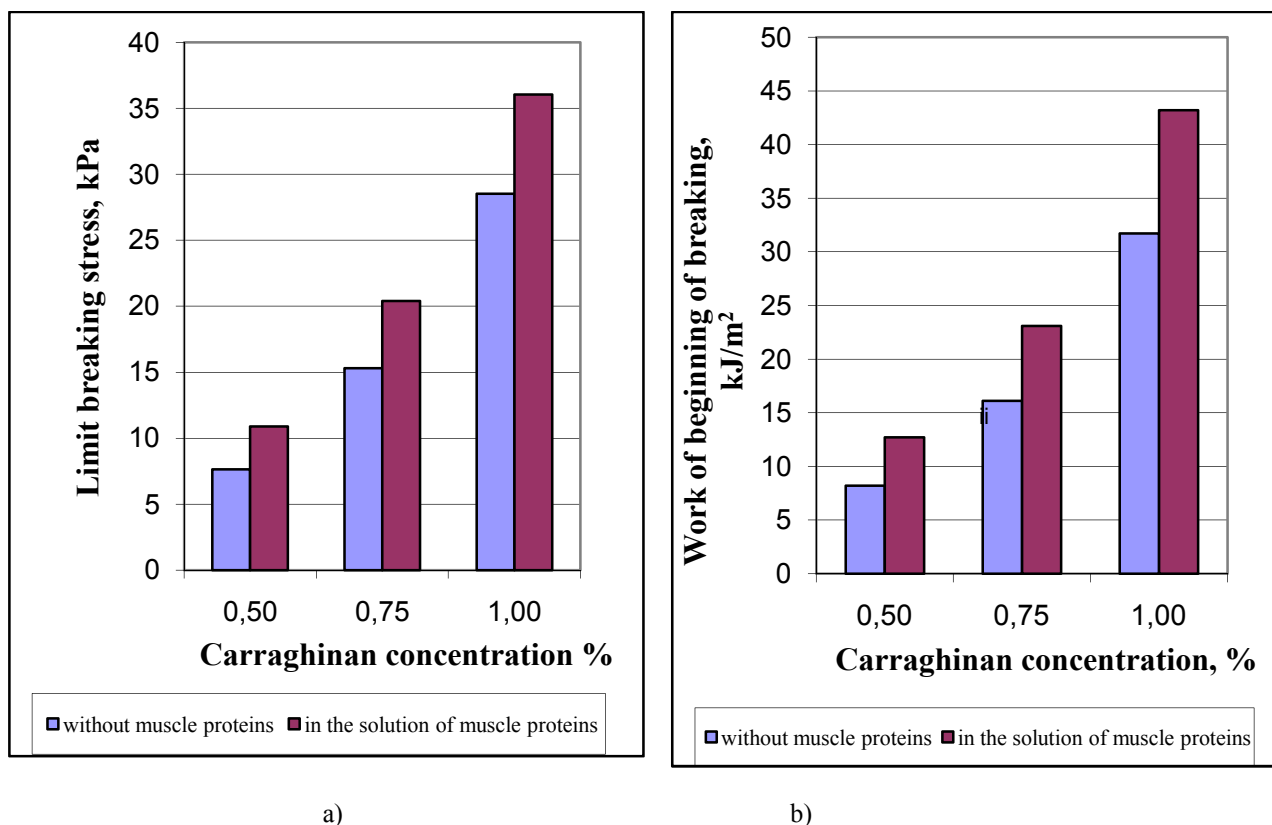


Fig.1 Change in strength (a) and plasticity (b) of carragheenan gel in the presence of proteins

When introducing carragheenan into 3.0% solution of salt-soluble muscle proteins, with salt content 2.0%, gels strength increased as compared to the carragheenan gel in a salt solution without muscle proteins. It should be noted that with the increase in the concentration of structure former, the increment in the limit value of breaking stress and the work of beginning of carragheenan gel and muscle proteins breaking compared to the gel prepared in the absence of proteins, decreased. Thus, with the addition of carragheenan up to 0.5%, the increment in the limit stress value of gel breaking, prepared in the solution of muscle proteins as compared to the gel, prepared from the salt solution of carragheenan with concentration 0.5% in the absence of proteins, constituted 42.7% and of the work of breaking beginning – 54.8%. Further increase in the dose of carragheenan was less efficient, and with the addition of 1.0% of carragheenan the increment in strength properties of gel in the solution of muscle proteins is 26.45, and of properties of plasticity – 36.3%.

The obtained results have shown that interaction of carragheenan with muscle proteins was of synergistic nature, but with the increase of carragheenan concentration to 1.0%, the effect of synergism decreased.

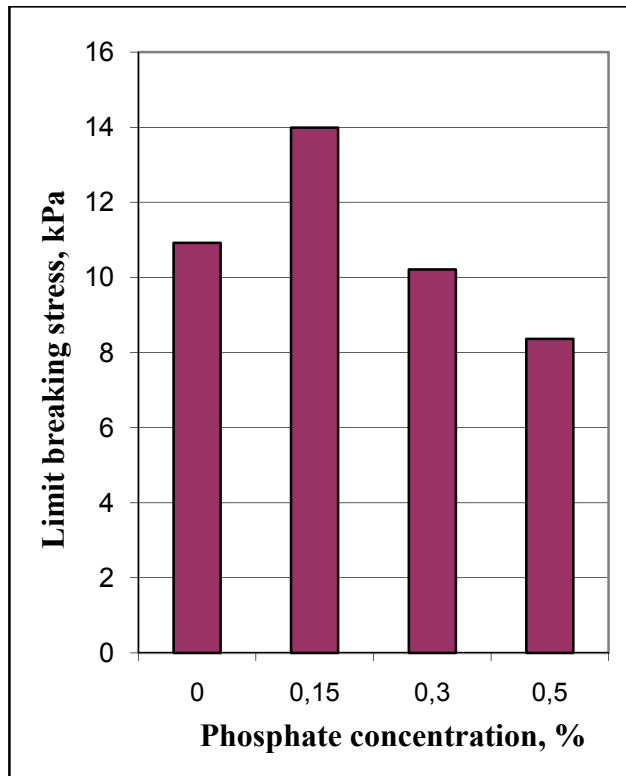
To determine appropriateness of use of commercial preparation of edible-grade phosphate in brines together with carragheenan, and substantiate its optimum dose, comparative structural-mechanical tests of carragheenan gels prepared with muscle protein solution and with the addition of 0.15%, 0.3%, 0.5% of phosphate (in terms of P_2O_5) or without it were carried out (Fig. 2).

The results of structural-mechanical tests have shown that the increase in phosphate concentration to 0.15% led to 28.1% increase in gel strength as compared to the sample without phosphate.

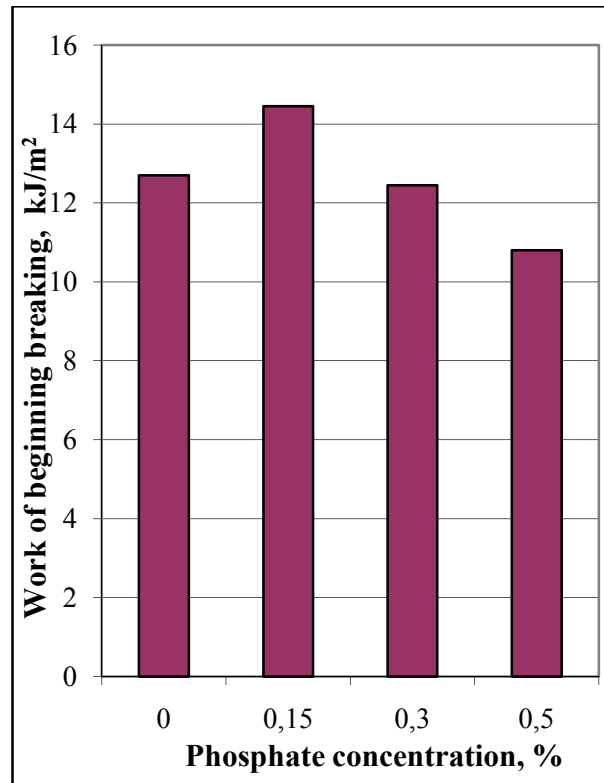
With the increase in phosphate concentration up to 0.3% and 0.5%, the value of breaking stress decreased by 27.0% and 40.2% with regard to the strength of gel, containing 0.15% of phosphate.

The value of the work of beginning of muscle proteins and carragheenan gels breaking increased by 13.8% in case of introduction of 0.15% of phosphates, while further increase of the concentration of phosphates mixtures led to the increase of this index, and already with the doses of phosphates 0.5%,

plasticity of gel reduced by 25.3% with regards to plasticity of gel, containing 0.15% of phosphates.



a)



b)

Fig. 2 Change in strength (a) and plasticity (b) of carragheenan gel and muscle proteins depending on the added doses of phosphates mixtures

The obtained results have shown that the mixture of pyro-, tri- and polyphosphates at not more than 0.15% increased the value of breaking strength of carragheenan and muscle protein gels by 28.1%, and the work of beginning of breaking – by 13.8%, while further increase of phosphate concentration reduced the strength and plasticity characteristics of gels.

IV. CONCLUSION

The results of the investigations have shown that such model systems as carragheenan gels, containing the

components (salt, edible grade phosphate, soluble muscle proteins), characteristic of the meat system, injected with brine, can be used for the evaluation of gel-forming properties of carragheenan, and substantiation of technologically suitable doses of the added phosphate. The technique, presented in the paper, can be used for the minimization of doses of use of food additives with their combined application.