STUDY OF RHEOLOGICAL CHARACTERISTICS OF MULTICOMPONENT ADDITIVES FOR USING IN MEAT PRODUCTS

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Introduction

The functional additives take an important part in meat processing now and later on. There is in mind the development and progress in its manufacture, which allow to provide for meat industry with new kinds of additives with strictly specified function in meat farce or saticfy the needs in scarce nutrients. Some of the kinds of biologically active additives to the product are the substances having in the base the components fermented with eubiotics and eubiotics themselves, which are beneficial for absorbtion of nutrients. The group of eubiotic microorganisms, submitted by lactic acid bacteria, in the composition of product is acting as competitive with the obligate microflora of source raw material. So this factor has of the fundamental importance. To indicate the action of such additives as applied to meats can by introducing their into farce during it's production. That can be made on the base of choosing components and design of such additives which protect the lactic acid bacteria.

Aims

The aim of this study is the design of the combined food additive on the base of lactic acid bacteria and biopolymer. This additive is enriched with vegetable components. As biopolymer we use the ether of cellulose or sodium alginate for a water holding agent. It is possible to use starch and its derivatives which are well absorbed and valuable substances and possess a water holding capacity.

Methods

The rheological studies of biopolymer solutions were carried out on "Rheotest-2" in the temperature range 25-50°C. Shearing rate was 1,5-1312 s^{-1}. 2% solutions was prepared by addition of 2g of sample to distilled water and then was filtered from impurities. The microorganisms were suspended in biopolymer solution and then the powder like vegetable components were added. The following main rheological characteristics were taken into consideration: the least (η_0, Pa·s) and the most (η_∞ Pa·s) viscosities, shearing stress, indexes of structurization (N), and value of activation energy. Results and discussion Our studies showed that the solutions investigated were the pseudoplastic liquids, and their behaviour can be described by the equation of Osfwald-deVive $\dot{\gamma}=c\cdot\tau^N$, where c – const, at N=1; c=1/η, γ – shearing rate, η - viscosity, τ – shearing stress.

The index in the formula indicates on the degree of solution structurization and is designated the structurization index. Using this formula for the description of the structure formation in the polycomponent systems studied inveils the potentials in the determination of the next stages in the design of the additive. Such stages are the heat, sublimative, spray drying, extrusion. The rheological characteristics of the bond stability of components and their interactions in solutions allow to orientate on the concrete method. zAuthors emphasized not only the unique of this formula applying to these studies, but the essence of the interpretation of the solution rheological curves obtained.

Table

Coefficiets of viscosities and indexes structurization of biopolimer solutions at the various temperatures

Composition	25°C			30°C			40°			50°C		
	η_0	η_∞	N	η_0	η_∞	N	η_0	η_∞	N	η_0	η_∞	N
2%Na CMC	760	119,47	1,68	342	106,44	1,58	342	86,89	1,51	488	68,64	1,43
2% Na CMC 1% beet	1900	139	1,79	1326,7	121,6	1,66	950	99	1,53	684	74	1,48
2% Na CMC 1% carrot	1500	139	1,78	953,3	121,6	1,66	453,3	96,4	1,57	380	73,9	1,42
2% Na CMC 1% bacteria	760	106,4	1,64	380	93,4	1,60	342	73,9	1,45	760	59,95	1,36
2% Na CMC 2% bacteria	850	130,3	1,70	570	117,3	1,59	570	91,2	1,55	342	73,9	1,47
2% Na CMC 3% bacteria	1140	136,9	1,75	760	121,6	1,64	380	97,8	1,53	380	78,2	1,47
2% Na CMC 4% bacteria	760	119,5	1,71	380	108,6	1,60	760	84,7	1,54	380	69,5	1,47
2% alginate Na	190	47,8	1,35	126	45,2	1,29	105	43,9	1,26	95	40,0	1,27
2% alginate Na 1% beet	1900	73,9	1,45	760	65,2	1,33	456	48,7	1,42	380	40,4	1,25
2% alginate Na 1% carrot	760	58,7	1,35	380	50,0	1,33	285	40,0	1,29	380	32,4	1,27

Coefficient of correlation is near 1.From the Table it is follows that the introduction of additives as 1% beet or carrot to 2% aquous solutions of sodium carboxymethylcellulose (Na CMC) and sodium alginate the pronounced increase of vicosity and non disrupted structure take place, especially in the case of beet addition. The viscosity of the disrupted structure changes insignificantly. With increase in temperature of solutions the analogy is retained. It should be noted that the introduction of microbial biomass leads to the minor increase of the non disrupted structure viscosity and fully disrupted structure viscosity.The dependences of the rheological properties of the biopolymer based system studied are presented in Fig. 1-5. Studies of the viscosity of 2% solutions of Na CMC with 3% biomass of lactic acid bacteria (Fig.1) show that with inerease in temperature under the same shearing rate the deformation takes place under the lower values of shearing stress. The indexes of solution structurization are increased insignificantly in the case of 2% and 3% of biomass introduced at the +50°C, however in all cases they are lower the main 2% Na CMC solution (Table). The rheological curves of 2% solutions of Na CMC with beet and carrot are different from the preceding curves (Fig. 2, 3). In connection with the high content of mono-, di – saccharides and pectin in the beet, the deformation of the Na CMC solutions with beet occur under the higher shearing stresses, as campare with solutions with carrot. That is suggested by the indexes of structurization, on the which one can suppose the formation of larger structural units in solutions of Na CMC and beet. The rheological curves of 2% aqeous solutions of sodium alginate with the same additives at 25°C, 50°C have the lower value of shearing stress as compared with Na CMC solutions (Fig. 4, 5). Judging from the indexes of structurization that are lower than in the solutions with Na CMC, the formation of small structures takes place in sodium alginate solutions. The experimental dependences of ln η from 1/T have the linear character and are described by the Airing equation, $\eta = A \cdot e \cdot p\ (E\tau/RT)$. The value of activation energy 23,4 kJ/mole indicates on the formation of the structure in the system due to the hydrogen bond between water molecules and polysacces macromolecules. Analyring aforesaid it should be noted that 2% solutions of Na CMC and sodium alginate are the suitable carriers for the lactic acids microorganisms. The processes of structure formation occuring in the solutions under the introduction of microbial biomass, are characterizing by the indexes of structurization of units of different size. During which the introduction of beet and carrot does not significantly reflect on the formation of these structures. Only in the case with Na CMC they are larger than with the sodium alginate. It was established that the temperature factor is beneficial for the decrease structurization index. The latter is significant for the choosing the method of food additive obtaining. It is neccesary to indicate that the study of bacteria vitality from the temperature, carried out in parallel with rheological studies does not show the significant changes of bacteria amount at 50°C. The experimental drying of the additive in the pilot drying plant (t>100°C) leads to the decrease of cell quantity in 1g of the 2nd older.

Conclusions

The solutions of Na CMC and sodium alginate with microbial biomass and vegetable components are the pseudoplastic liquids. The degree of system structurizations calculated decreases with the increase in temperature.The character of structurization in the systems studied allows to determine the more adequate method of additives obtaining with the aim of the retaining their activity.The compositions of food additives recommended contains bioactive lactic acid bacteria and water holding biopolymers and are well compatible with the meat raw material, that allows for their using in meat technologies as functional, biologically absorbed and protective factor.

Literature: Duda Z. Several problems and development directed in meat technology in the beginning of XXI cenfury., In thesises of Int. Conf. "Products of XXI century. Technolology, quality, safety". Moscow 1998, p. 13-20.

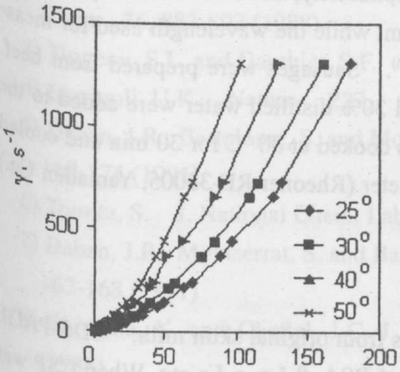

Fig.1.

Rheological curves at different temperatures for 2% aqueous solutions CMC in the present of 3% lactic acid bacteria (fig.1.), 1% powder beet (fig.2.), 1% powder carrot (fig.3.) and for 2% aqueous solutions sodium alginate in the present of 1% powder beet (fig.4.), 1% powder carrot (fig.5.).

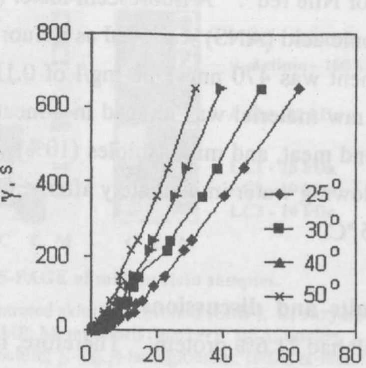

Fig.4.

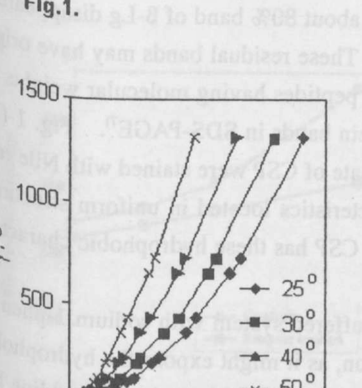

Fig.2.

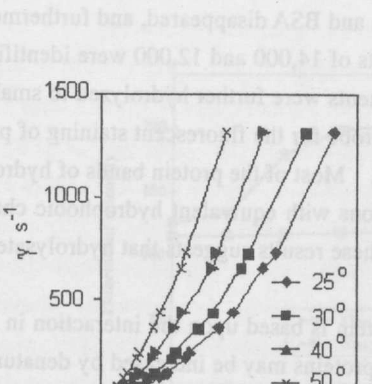

Fig.3.

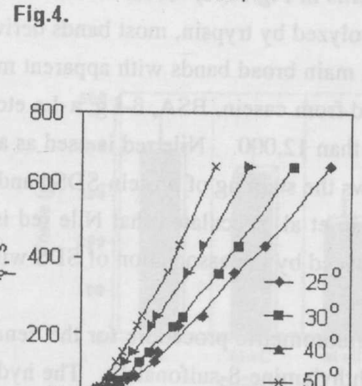

Fig.5.