EFFECTS OF NON-MEAT PROTEIN / POLYSACCHARIDE BLENDS ON THE GELATION OF EXUDATES FROM REFORMED CURED MEATS

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Keywords: Ingredients, WPC, polysaccharide, reformed meat, exudate, ham, gelation, bind, G', rheology.

Background:

Good adhesion between meat pieces (bind) is a key quality determining property of the final meat product. It is therefore important to understand it fully in order to be able to create and manipulate adhesion successfully (Jolley and Blanshard, 1988). It is the potential applications of protein-polysaccharide mixtures in meat technology that are of most interest at the present time (Tolstoguzov, 1991). The chemistry of these protein-polysaccharide interactions is complex and not specific to any one class of interactions (Ledward, 1994). Multicomponent gels are produced from mixtures of two or more gelling agents, or a single gellant and non-gelling components (Zeigler and Fogeding, 1990). A model food system can act as an intermediary step between model systems and real foods (Kilara, 1994). This approach may be used to measure differences in whey Protein Concentrate (WPC) functionality in combination with polysaccharides in meat model systems. Storage modulus (G'), an elastic component of protein gels, which can be measured with small-strain dynamic testing, is a useful rheological parameter for defining gel network properties (Xiong *et al.*, 1994).

Objective:

The main objective in this study was to determine the the effects of temperature on intermolecular interaction occurring between meat proteins and blends of WPCs and carbohydrates using meat exudates obtained by massaging. A non destructive rheological method (control stress rheology) was applied to determine these interactions.

Methods:

Commercially available WPC powders namely, 35 and 75.0 % high gel and 75.5 % regular powders were blended at a 2% residual powder level with the following carbohydrates, kappa carrageenan, iota carrageenan, pectin (LM), waxy maize starch at 1% residual powder level and sodium alginate at a 0.5% residual powder level. Powders were hydrated in half of the brine water and mixed with the other half, containing the NaCl and curing salts prior to injection. Pork *M. semimembranosus* muscles were obtained 24h *post mortem*, within a pH range of 5.6 - 6.0 and injected to a target level of 25.0 % brine inclusion. Injected meat was then cut into 8 cm cubes and massaged using a model system for 17 h at 10 revs. / min. (20 mins. on and 10 mins. off) for a total of 6800 revs. In all trials, test powder blends were compared to controls without added non - meat proteins. After massaging, meat exudates were collected and composite analysis determined. Heat induced gelation was performed using a control stress rheometer (Bohlin Instruments CS model). This method gives the viscoelastic properties of a protein gel as a function of temperature at a fixed frequency of 1.0 Hz. A 40 mm parallel plate was used with a gap setting of 1 mm. Measurements were made by applying a small amplitude oscillation to the material (0.005 strain units). Meat exudates were heated from 20.0 °C to 80.0 °C at a rate of 1.0 °C / min., held at 80.0 °C for 30 min. and cooled down to 20.0 °C at a rate of 1.0 °C / min. All results presented are recorded in terms of the storage or elastic component (G').

Results and Discussion:

WPC / polysaccharide blends tested increased the storage modulus (G') values at residual powder levels used, in both the heating and cooling cycles, when compared with the control exudate. Increases in G' (Pa) values on heating test meat exudates containing protein / polysaccharide blends were not as large compared to WPCs alone. However G' (Pa) values significantly increased for these test blends compared to WPCs on cooling (Kerry *et al.*, 1995). Compositional analysis of raw test meat exudates (Table 1) showed a 1.0 to 2.0 % increase in protein concentration over controls. Comparing compositional data with G' values, exudates containing test blends were found to be good gelling / binding agents at the levels used. Scanning Electron Microscopy of heated meat exudates show major differences in morphology due to the addition of WPCs and WPC/polysaccharide blends.

Conclusion:

Incorporation of WPC/polysaccharide blends into reformed meat systems increase the storage modulus (G') of meat exudates when compared to control samples on heating and especially on cooling. Compositional analysis of exudates shows a 1.0 to 2.0 % increase in protein concentration due to addition of non meat proteins. A five to six fold increase in G' (Pa) values was observed on the addition of test blends. The 35% and 75% high gel WPC powders in combination with kappa carrageenan, starch and pectin gave the best results in terms of G' (Pa) when compared to controls. Sodium alginate was detrimental to gelation where incorporated.

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Table 1. Composition of raw meat exudates and G' (Pa) rheological data for test and control gelled meat exudates after heating to 80°C x 30 mins and final cooling to 20°C using blends of various polysaccharides with 2% of the following WPCs, **A.** (75% high gel WPC), **B.** (35% high gel WPC) and **C.** (75% regular WPC).

		% Added Polysaccharide	% Composition of raw exudates Protein	Fat	Moisture	G' (Pa) Heating	G' (Pa) Cooling
	CONTROL	--	**11. 5**	**0. 2**	**83. 1**	**4220**	**9990**
	Carbohydrate						
A	Kappa Carrageenan	1.0	13. 1	0. 3	80. 2	15000	**60000**
	iota Carrageenan	1.0	13. 5	0. 3	78. 9	14000	35000
	Pectin (LM)	1.0	13. 0	0. 3	79. 6	15000	50000
	Starch	1.0	13. 8	0. 3	79. 5	15000	**60000**
	Na. Alginate	0.5	13. 8	0. 2	78. 9	4000	6000
B	Kappa Carrageenan	1.0	12. 6	0. 3	79. 3	12000	**50000**
	iota Carrageenan	1.0	12. 9	0. 2	80. 6	10000	35000
	Pectin (LM)	1.0	12. 6	0. 2	79. 5	14000	30000
	Starch	1.0	12. 6	0. 3	82. 6	12000	**40000**
	Na. Alginate	0.5	13. 0	0. 3	80. 0	4000	10000
C	Kappa Carrageenan	1.0	13. 2	0. 2	81. 2	6000	25000
	iota Carrageenan	1.0	13. 3	0. 2	79. 6	6000	25000
	Pectin (LM)	1.0	13. 3	0. 3	80. 4	14000	25000
	Starch	1.0	13. 5	0. 2	81. 1	16700	**29600**
	Na. Alginate	0.5	13. 4	0. 4	80. 3	4000	6000

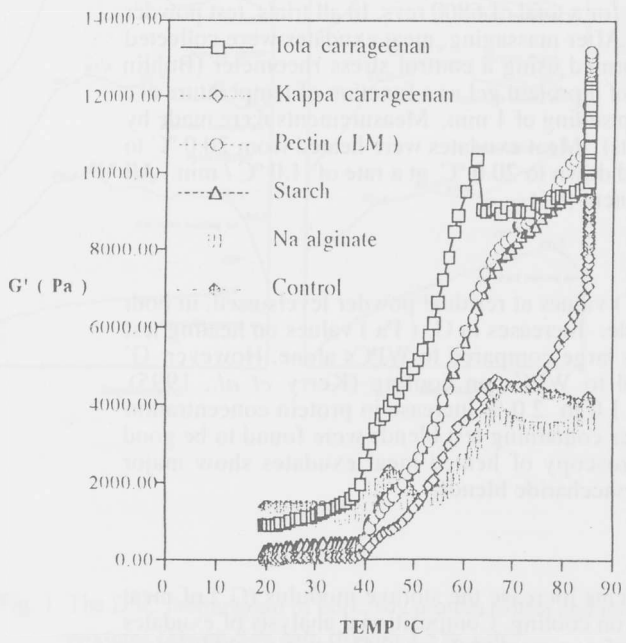

Fig. 1. Plot of G'(Pa) v's increasing temp. (°C) for control meat exudate and test exudates containing blends of 2% of the 35% high gel WPC with selected polysaccharides at 1%.

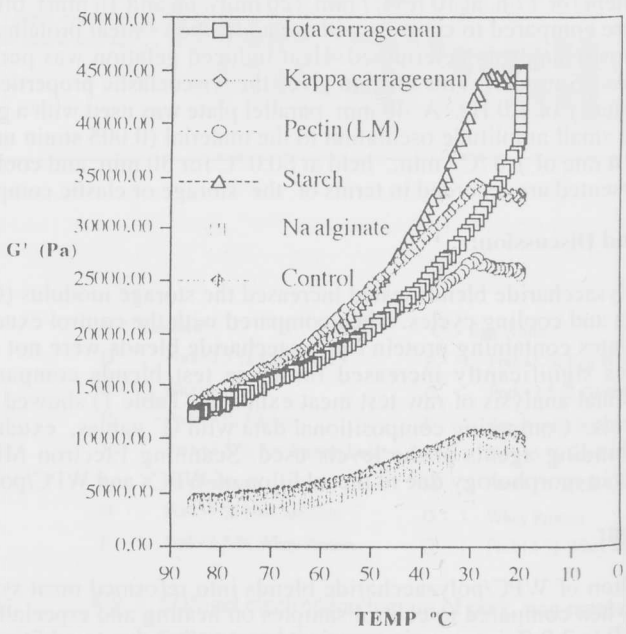

Fig. 2. Plot of G'(Pa) v's decreasing temp. (°C) for control meat exudate and test exudates containing blends of 2% of the 35% high gel WPC with selected polysaccharides at 1%.