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Research Paper

Effect of composition of various Galactomannans on formulating chunks in jelly recipes

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ABSTRACT

Carrageenan is the essential ingredient for formulating the food gels which is expected to impart chew ability to pet cats and hence the various percentages like 67.9, 77.9, 81.9, 86.9, 87.9, 89.0, were investigated. Xanthan, diagum SR, were also changed intermittently to find out the specification of final recipe that have soft texture and without cloudiness. Recipes were evaluated before and after retort so that recipes would sustain the better shelf life with better mouth feeling and chew ability. Chunk in jelly recipes are the formulation where various galactomannans were blended. CGN EC40, XANTHAN, DIAGUM SR, Na carbonate, Dextrose, KCl were part of the compositions. The investigations were performed as such so that the final recipe may be soft jelly when mixed with the chunks and easily chewable by pet cats. P^H of the recipes was also optimized. Sensorial evaluation was studied for their textures, colour, and appearance for their market acceptability.

Keywords: Chunk in jelly; Carrageenan; Xanthan; Cassia gum; dextrose**.**

INTRODUCTION

[1]Hydrocolloids offer food formulators a strong value proposition, based on a unique synergy with other hydrocolloids and proteins. As such, cassia gum, xanthan gum and carrageenan hydrocolloids enable formulation and economic benefits by leveraging existing ingredients used in many processed food systems today. These advantages provide formulators the ability to improve efficiency and performance attributes and offer the potential for innovative food textures.

[2]Cassia gum forms firm, thermoplastic gels with carrageenan. As the level of cassia gum is increased, the gel strength of carrageenan solutions is significantly

[1] This was the commercial investigation of formulating the chunk in jelly recipes for meeting the customer's requirement and specification. Detail sensorial evaluations were also undertaken for the study. Lesser percentage of carrageenan along with xanthan and cassia gum found to have the best formulating recipe.

[2] Formulation expected to be clear and non cloudy that results obviously due high contents of carrageenan but on lowering its percentage and using appropriate percentage of xanthan and cassia gum resulted in specified formulated recipe.

boosted, providing a highly efficient means to increase formulation structure at lower hydrocolloid levels. Cassia gum hydrocolloids gels with carrageenan are stable after high temperature processing, due to the excellent retorting stability of cassia gum. (Cho, 2003; Fernandes, et al., 2003)

Cassia gum and xanthan gum, on their own, do not have the ability to form gels. When combined with xanthan gum, aqueous dispersions of carrageenan hydrocolloids form cohesive, elastic gels. Gel break strength is optimized at a ratio of 40 parts cassia gum to 60 parts xanthan gum. As with carrageenan, cassia is more efficient at forming gels with xanthan gum than other galactomannans, enabling lower total hydrocolloid levels in finished formulations. This is due to the unique branched polysaccharide galactose/mannose structure of cassia gum.

Now days, the pet food industry is using the glucomannan or mixed systems in the production of products of type loaf, chunks in loaf and chunks in jelly. Typically, the jelly is made using semi refined carrageenan. The galactomannan family consists in guar gum, Tara gum, carob gum and cassia gum; the glucomannan consists in konjac mannan gum (Cho, 2003; Fernandes, et al., 2003).

In production, the restructured meat chunks are mixed with a semi refined carrageenan liquid jelly (with other hydrocolloids and dry ingredients) and go together into the can. After retorting the semi refined carrageenan makes the jelly of final product.

Kappa carageenan when used as semi refined the formulated gels are cloudy and shows pyramid at the bottom of the apparatus. This cloudiness is due to the milder extraction procedure from algae which results in a carrageenan containing fragments of algal cell wall cellulose: of about 8-15% cellulosic material in the final composition of a typical semi refined carrageenan. In fact, the cellulose somehow precipitates during the retorting step and subsequently promotes the cloudiness of final gel. In reality, the meat just released from the chunks may also complex with carrageenan cellulose precipitate, increasing even more the presence of precipitate material in the jelly.

The use of refined gelling agents, and particularly refined kappa carrageenan would improve the clearness of the final gel, but its use is quite limited in pet food industries due to high price, and semi refined material is largely used due to its low price.

Also, the chunk structure is achieved during the cooking and retorting steps mainly through animal or vegetable protein coagulation. Thus, the quality of the obtained chunks is highly dependent on the quality of the protein raw material. This is critical because of the variability of the supplier sources and of the market crisis.

Therefore, our aim was to improve the chunk rigidity and the clearness, of gels and global product quality control in pet food products, without using refined gelling agents and/or functional proteins.

MATERIALS AND METHODS

The carrageenan composition in red seaweeds differs from one species to another. Hondrus crispus is mixture of kappa and lambda, kappaphycus alvarezii contains mainly kappa and Eucheuma denticulatum mainly contains iota.

Xanthan gum is a very long, linear polymer. Its molecular weight has been reported to range from 1-10 million. The molecule consists of a chain composed of D-glucose, D-mannose, and D-glucuronic acid, with short side chains. Pyruvic acid, present in side chains, accounts for 2.5-4.8 of the molecule.

Xanthan gum samples with high pyruvate contents have been reported to yield solutions with higher viscosity than those of low pyruvate samples.

Cassia gum is comprised of at least 75% high molecular weight (approximately 200,000-300,000) polysaccharide consisting primarily of a linear chain of 1, 4-β-D-mannopyranose units with 1, 6 linked α-D-galactopyranose units. The ratio of mannose to galactose is about 5:1. The composition of saccharides is: mannose (77.2-78.9%), galactose (15.7-14.7%) and glucose (7.1-6.3%). Like most polysaccharides, the following formula applies: $(C_6H_{10}O_5)_{n.H2O}$. Cassia gum is related to carob bean gum, Tara gum and guar gum in terms of structure and chemical properties.

Recipes containing galactomannans discussed herein were mixed in different percentage. 1g of each recipe was then made to disperse in 1 liter of distilled water in a cylindrical glass reactor with high speed agitator and heated at 90±5^{o}C at high rpm for an hour. It was then poured into cubicles and allowed to stand in container having cold water at the surface and the cubicles were hold to rest at ambient temperature. Quality related norms were strictly followed in the QC department well before conducting the experimentations in R&D. (Mats, et al., 1998; Tomoko, et al., 2005)

Required concentrations were prepared as 1% solution in distilled water. It was heated up to 100^{o}C±5^{o}C. Post heating evaporated water was compensated. The solutions were then filled in cans and sealed. Sealed cans were then placed in Autoclave and were retorted for an hour at about 130^{o}C. The solution was stirred and was poured into jelly boxes. It was kept at room temperature for 5 hours without shaking the boxes. The break strength was determined.

A successful blend on their evaluation was taken for further consideration of commercializing them.

Measurement of break strength: Within the framework of the present study, the F.I.R.A. Jelly tester was used for the gel measurements and the Brookfield RVT rotary viscometer for the viscosity measurements. The F.I.R.A. Jelly tester essentially consists of a narrow metal sheet which is mounted on a shaft which bears an accurate and easily readable scale calibrated from -10 to +10 degrees of angle. This entire device can be rotated when a torsion force is acting. The torsion force is generated by running water, which runs at a predetermined rate, into a small vessel equipped with a counterweight and connected to the shaft by means of a tension device. The gel strength was measured by dipping the metal blade into the gel and allowing water to run into the small vessel until the metal blade rotates through a certain angle. The higher the amount of water required to reach the predetermined deformation angle, the greater the gel strength (Mats, et al., 1998; Tomoko, et al., 2005).

F.I.R.A. Jelly tester was employed for measuring the break strength (figure 1) of the solution that jellified. Viscosities of the solutions were determined using Brookfield RVT viscometer.

RESULTS

Invention of formulation was carried out with increasing the composition of carageenan EC40 as it synergizes well with KCl and the gel formed was evaluated to be with different color and texture. When the high composition of CGN EC40 was used then the break strength measured was 273g and the texture of the gel was stiff while keeping the use of xanthan and diagum SR at null. On decreasing the composition of CGN 40 and increasing the content of other hydrocolloids though the break strength was found to decrease but the stiffness was the same when others were not used. As the percent composition of other hydrocolloids were increased then the cloudiness of the gel was more prominent. Elasticity of the gels was also found to be weak. Sodium carbonate throughout the studies was kept at same composition. In this way the pH of the recipes was found to be below 12 before retort and after retort. When xanthan was included at high percentage then (table 1-2) the pyramids was not observed. (Bayer lien, et al., 1989; Young, et al., 1996; Watelein, et al., 2010)

DISCUSSION

One of the most common of all testing requirements is the determination of break strength. Break strength is generally the tensile or compressive load required to fracture a sample. To determine the break strength you will need to define what a break is (break detector). Generally, there are two common types of breaks: the sharp break is referred to the measurement when a load drops by 5% from its peak measurement. A percentage break is another form of break and is generally determined by the sample material and its relationship to load degradation from a peak load measurement. A plastic material will likely have a load drop of 5%, but not represent a break. In this case, a percentage break would need to be applied. In a tensile test, the breaking load is the break strength. Virtually any product or material will have a break strength characteristic.

Use of 10% of diagum SR in the recipes along with CGN EC40 was found to be unclear but with less cloudiness. Dextrose was either used at 1% or without probably did not exhibit any major changes in the recipes but lowering the percentage composition of CGN 40 to 57.9% and with 20% of xanthan; 10% diagum SR without using dextrose resulted in cloudiness with soft texture. Best composition may be considered where in CGN EC40 and xanthan 67.9 and 20% respectively of the total composition were. The recipe was non-cloudy and highly brittle without any pyramid formation in the solution. Very little change in the solution pH was observed before and after retort (Bayer lien, et al., 1989; Young, et al., 1996; Watelein, et al., 2010).

The high ash content of carrageenan sample shows presence of inorganic material that includes ions such as Na, K. Carrageenan is an anionic sulphated hetero polysaccharide strongly influenced by the types of ions found in solution. The potassium ions yield a gel microstructure with rigid super strands, increasing stability and promoting chain aggregation and the sodium ions give a continuous network of flexible super strands. Also xanthan gum is influenced by the type and concentration of ions found in solution it can be seen that this gum exhibits a substantial amount of sodium ions. Xanthan gum is an extracellular polysaccharide with a semi-rigid chain structure and, in the presence of ions such as sodium or potassium, charge screening causes the side chains to collapse down to the back bone, hence giving the xanthan molecule a rod-like shape and reducing the hydrodynamic volume (Bayer lien, et al., 1989; Young, et al., 1996; Watelein, et al., 2010).

The present invention is an alloy gum composition comprising galactomannan gum extracted from seeds of the genus Cassia co precipitated with a solubilising quantity of consisting of carrageenan, gum composition capable of being rehydrated to form a substantially clear, stable colloidal aqueous solution. The alloy gum composition is prepared by extracting seeds of the genus Cassia with an aqueous medium to form a soluble extract portion of galactomannan gum, an insoluble residue portion, optionally separating the soluble extract portion from the insoluble residue portion, incorporating into the soluble extract portion a solubilising quantity of said gelling and thickening agent and co-precipitating there from an alloy gum composition capable of being rehydrated to form a substantially clear, stable colloidal aqueous solution, optionally containing the insoluble residue portion. With decrease pH the viscosity of the hydrocolloid solutions also decreases at the given conditions so the quantity of the sodium carbonate was chosen as such so that the viscosity of the prepared blend is as per the required specifications. Dextrose and sugars imparts creaminess texture to the recipes and dextrose works well with carrageenan and found to have the satisfactory rheology of the recipes (Bayer lien, et al., 1989; Young, et al., 1996; Watelein, et al., 2010).

A prerequisite to reducing the cost gels and thickeners is a sound understanding of their science and technology. This is applicable to all product formats where these ingredients are used. When product design-ingredients, recipe, nutritional specification, palatability, fecal quality, cost were investigated thoroughly then the recipes were further validated for finding more pronounced results.

Hence inventions concluded that CGN EC40 with 77.9 and xanthan 10.0% has yielded the required recipes for the marketability and mouth feeling of the pet with less elasticity and stiffer point of view. The combination of CGN EC 40 and other hydrocolloids has to be compatible from the synergy point of view.

CONCLUSIONS

Carrageenan percentage when increased it was observed that the break strength of the gel was stiffer and cloudiness was also prominent but as the percentage was lowered the stiffness of gels were also lowered. High percentile of carrageenan with lesser percentage of xanthan and diagum SR has yielded the recipes with more cloudiness. Low percentage of carrageenan coherently with low percentage of xanthan and diagum SR has yielded recipes that match the specifications by the customers. Carrageenan is a great material with some fantastic properties. In the context of wet pet food, arguably the synergistic interaction between kappa-carrageenan (which forms a weak, brittle gel in the presence of potassium ions) with a non-gelling hydrocolloid, a synergist-for example, locust bean gum or cassia gum-to form elastic gels is the most important functionality.

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Table- 1: Physical Evaluations of Chunk in jelly recipes.

	CGN EC40=86.9	CGN EC40=81.9	CGN EC40=87.9	CGN EC40=77.9	CGN EC40=67.9
Break strength	273g	278g	218g	181g	114g
Texture	Stiff	Stiff	Stiff	Stiff	Stiff
Appearance	Light yellow	Light yellow	Light yellow	Light yellow	Grayish to light yellow
Inside	Clear non-cloudy	Clear non-cloudy	Non Clear - cloudy	Clear –non cloudy	Unclear –non cloudy
Brightness	Medium	Medium	Medium	Medium	Highly brittle
Remarks	Pyramid at bottom elastic	Pyramid at bottom elastic	Pyramid at bottom elastic	Pyramid at bottom low elastic	No pyramid
Appearance	Shiny	Shiny	Shiny	Shiny	-

- CGN EC40; carrageenan was of as per EU specification

Table-2: Composition of Chunk in Jelly recipes

	CGN EC40=86.9	CGN EC40=81.9	CGN EC40=87.9	CGN EC40=77.9	CGN EC40=67.9
Xanthan	0.0	0.0	0.0	10.0	20.0
Diagum SR	0.0	0.0	0.0	0.0	0.0
Na-carbonate	2.1	2.1	2.1	2.1	2.1
Dextrose	1.0	1.0	0.0	0.0	0.0
KCl	10.0	15.0	10.0	10.0	10.0
pH(BR)	12.1	12.2	12.2	12.0	11.9
pH (AR)	11.1	11.2	11.1	11.3	11.1

- (BR): before retort, (AR): after retort.

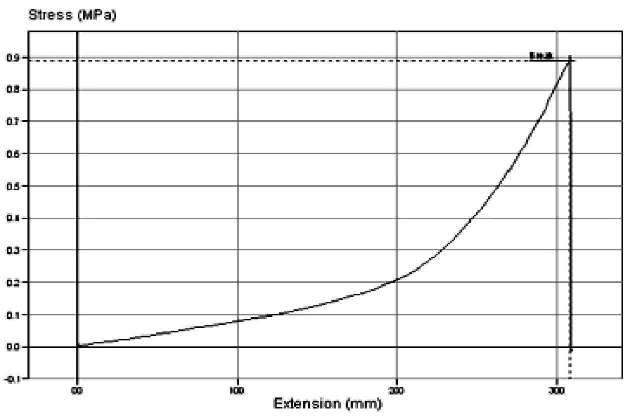

Figure- 1: Measurement of Break Strength with FIRA Jelly Tester.