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Hydrocolloids, Modified Hydrocolloids as Food Recipes and Formulating Agents

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Abstract

Modified starches, xanthan, diagum SR, etc were researched as food recipes for **chunk** in gravy for evaluating the possibilities of their sensory and physical evaluations. Various concentrations of major hydrocolloids were formulated as recipes and pH of the recipes was also studied incorporating sodium carbonate. Viscosity of the recipes was determined at 20 and 100rpm. Modified starches from Loryma were evaluated. They were then tested before and after retorting. All the recipes were tested for break strengths. Best results concluded for making the commercial batches for the giants like Master foods USA, Prodotti Giani France etc. The hydrocolloids were of the European foods order involved in the studies for the commercials.

Keywords: Gravy recipes; Modified Tapioca starch; Clear Text starch; Xanthan; Guar; Diagum SR

Introduction

Hydrocolloids were chosen as such that when they are blended as recipe for gravy formulation with the use of chunks must be with the consistent flow. For that reason the following hydrocolloids cleartext, diagum SR, guar gum, dextrose, xanthan and Na_2CO_3 as buffer were investigated with various percent composition. Every hydrocolloid has very special chemistry regard to their synergy with the other hydrocolloids. Retorting of the recipe is utmost important for their shelf life when the chunks are put into the recipe and packed in the containers. On blending each recipe was thoroughly investigated for their consistency with the chunks and shall not become thin when hold for the long period. These recipes were researched for the leading pedigree manufacturing company Master foods USA a giant in the business of pedigree.

Food hydrocolloids have been widely used in the food industry for their gelling, thickening, emulsifying, dispersing, and stabilizing functions. Food hydrocolloids control the texture and at the same time they control flavour and aroma release which has also been studied extensively. Methods of investigation are very diverse ranging from physics to biological chemistry, and it is necessary for workers in this field to learn various methods [1,2].

Collaboration between academia and industry is necessary to further develop understanding and application of food hydrocolloids. The viewpoints of both unity and diversity are necessary for the study of food hydrocolloids. The food hydrocolloids approach proposes that these hydrocolloids can be studied from a unified viewpoint: all these dispersed systems are colloidal systems consisting of water, polysaccharides, proteins, lipids and other ingredients [3].

Hydrocolloids in this context include polysaccharides, modified polysaccharides and proteins acting alone, or in mixture with other food components, as thickening agents, gelling agents or surface acting agents. The scope of the study was to exploit the real and model food colloids, dispersions, emulsions, and forms and the associated physicochemical stability phenomena, creaming, sedimentation, flocculation and coalescence. As fact food hydrocolloids covers the full scope of hydrocolloids behaviour.

Xanthan is a high-molecular-weight polysaccharide which is obtained in a fermentation process employing a microorganism Xanthomonas campestris. The main chain of xanthan has a cellulose structure. It consists of D-glucose units with .beta.-1, 4-bonds. The trisaccharide side-chains consist of two mannose units and one glucuronic acid unit. The terminal .beta.-D-mannose unit is linked by a glycoside bond to the 4-position of the .beta.-D-glucuronic acid, which in turn is linked by a glycoside bond to the 2-position of .alpha.-D-mannose. This side-chain is linked to the 3-position of every second glucose residue of the polymer's main chain.

Clear text SD3 is modified starch responsible for giving smoother and creamy texture to the recipes. It also yields a very clean flavor. Guar gum is an edible thickening agent consisting of galactose and mannose units. Guar Gum, like locust bean gum, is a polysaccharide consisting of a straight chain of D--mannopyranose units joined by B *(1-4) Linkages with a side branching unit of a single D-galactopyranose unit joined to every other mannose unit by a *(1-6) linkages. Locust bean gum has a single galactose side branch every fourth mannose unit. The molecular weight of guar is 220,000 +/-1 0%.

Dextrose is commonly known as glucose and a very good source of energy and used most frequently in food formulations. It is produce commercially via the enzymatic hydrolysis of starch. Na_2CO_3 is used as buffer in these recipes. It helps in maintaining the pH of the blended recipes.

Figure 4 is the structures of guar gum, xanthan, and *cassia angustifolia*. Their structures and linkage of maltose and galactose plays an important role in exhibiting the synergies for their physical performances in formulating the foods recipe from the stabilizing, thickening and emulsifying point of view.

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Galactomannans are, like the starches, vegetable reserve polysaccharides which occur in the endosperm cells of numerous seeds of Leguminosae. Upon germination of the seeds, they undergo enzymatic degradation and serve as nutrients for the seedling. The collective term "galactomannan" or "polygalactomannan" comprises all polysaccharides which are built up of galactose and/or mannose residues and in addition can also contain minor amounts of other sugar residues. There is a relatively large number of galactomannans, depending on their origin. The materials principally occur in the endosperm portions and seeds of various Leguminosae (legumes) such as guar, locust bean, Tara, honey bean, flame tree, sesbania and species of Cassia. Galactomannans are built up of a linear mannose chain which itself is built up of mannopyranose rings linked by .beta.-(1, 4-glucoside bonds. To these rings are attached, as branches, isolated galactopyranose residues by .alpha.-(1, 6-glucoside bonds).

Materials and Method

Modified Tapioca (Clear text SD3), starch MR 200 was purchased from Loryma starch Germany. Diagum SR, IMPL, Guar, Shri ram Guar Pvt. Ltd., India, dextrose, Western Chemical Enterprise, xanthan, Rashmi Enterprise and sodium carbonate, Chemplast Enterprise, were purchased from India.

Recipes containing galactomannans discussed were mixed in different percentage. 1-4g of each recipe was then made to disperse in 1 litre of distilled water in a cylindrical glass reactor with high speed agitator and heated at 90±5°C at high rpm for an hour. It was then poured in cubicles in container having cold water at the surface and the cubicles were allowed to rest at ambient temperature. Quality related norms were strictly followed in the QC department well before taking the experimentations in R&D, [4,5]. Na_2CO_3 was used as 2.3g each time to investigate the pH balance in each recipe.

Major hydrocolloids Clear Text SD3 and MR 200 were used in the weight percent ranging from 70-90. Others were blended as such so that entire recipe constitutes of 100 percent.

Required concentrations were prepared as 1, 2, 3 and 4% solution in distilled water. It was heated up to 100°C±5°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°C. The solution was stirred and was poured into jelly boxes. It was kept at room temperature for 5hours without shaking the boxes. The break strength was determined in case the gel formed. Otherwise the solution was stirred at 750rpm to 1-5 minutes and the viscosity was determined. Later sensorial evaluations were made [6,7].

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

Measurement of physical properties of hydrocolloids blend

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 +90 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 [8-11].

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

Results

Table 1 show the data where in clear text SD3 of class E1442 was changed from 70-90 wt% of the compositions. 1-4% concentration of the recipes was prepared with changing other hydrocolloids marginally for studying their sensory evaluation. Their viscosities were evaluated at 20 and 100rpm to test whether chunks stick to them with creamy texture. It was found that with 80 wt% of clear text at 4% concentration the recipe was sticking to the chunks. Diagum SR when was not used in the recipe the solution was not forming the gel and gave good consistency with the creamy texture. These evaluations were before retorting. Whereas after retort the recipes containing 70-90 wt% of clear text at the same concentration were found to stick to the gels. Viscosities of the recipes were less before retort but were increasing after retort (Table 2). 2 and 3% concentration with 70 and 80 wt% of clear text after retort was also observed to sticking to the chunks.

In case of Loryma starch MR 200 of class E1414 with 80 wt% composition and 1 and 2% concentration solution did not find to form any gel. But the viscosity values of 2% solution at 20 and 100rpm were higher as compare to 1% solution. None of the concentration in case of Loryma starch clear text MR 200 found to shown the tendencies for sticking to the chunks before retort (Table 3). Others wt% was maintained at the similar level as that of previous study. But after retorting with the same starch of the same wt% composition found to be sticking to the chunks at 3 and 4% concentration of the recipes (Table 4). In this case the viscosities were found to dropping after retorting. Retorting is the condition for the recipes to meet the required specification to pass commercially.

Colour of the blended solutions was found to be varying when wt% compositions of other hydrocolloids were changed [11-13].

Discussion

Percent compositions of diagum SR, xanthan, guar, and dextrose were found to make great impact on the sensorial evaluations. Viscosities also found to be changing with change in wt% of other hydrocolloids. We wanted to investigate the recipes composition as such that the chunks when added to the solution should have stick and remain as consistent as possible without forming any creamy layer but retain the creamy texture and mouth feeling for the pets. In both cases of starch employed for the study and investigation were shown to have decrease in their viscosities after retorting but the Loryma starch clear text MR 200 did not perform well before retort and gave better results after retort. This was the case exactly expected out of the investigations. Hydrocolloids chosen as such that they synergise well with other hydrocolloids. Na_2CO_3 was used as a buffer in the recipes.

Figure 1 and 2 brings an insight into the study as how the concentrations and retorting plays an important role for targeting to formulate gravies for chunks. Figure 3 shows the worldwide consumption of hydrocolloids. [11-13]

Conclusions

It was concluded from the study that lower concentrations of blend containing Modified Tapioca starch SD3 and Clear Text MR 200 found to synergise well along with the diagum SR, Guar, Xanthan, Dextrose

Sr. No	Material	%	1% concentration			2% Concentration			3% Concentration			4% Concentration		
.			Break strength (gm)	Viscosity Before Retorting (mPas)	SI	Break strength (gm)	Viscosity Before Retorting (mPas)	SI	Break strength (gm)	Viscosity Before Retorting (mPas)	SI	Break strength (gm)	Viscosity Before Retorting (mPas)	SI.
1	clear text Diagum SR Guar Dextrose Xanthan Na_2CO_3	80 15.7 15.0 5.5 1.5 2.3	No gel form	20rpm-78 100rpm-59	Non Transparent Light colour Thin liquid	No gel Form	20rpm-2280 100rpm-1008	Less thick	33	20rpm 7240 100rpm 3240	Thick Creamy	45	nil	May stick Chunks Off white cream
2	clear text Diagum SR Guar Dextrose Xanthan Na_2CO_3	70 10.0 10.7 5.5 1.5 2.3	No gel form	20rpm-138 100rpm-52	Non Transparent Light yellow Colour Thin liquid	No gel Form	20rpm-478 100rpm-224	Thick liquid	29	nil	Non Transpa Rent Thick liquid	34	nil	Non transparent Soft gel light Yellow colour
3	clear text Diagum SR Guar Dextrose Xanthan Na_2CO_3	80 5.0 5.7 5.5 1.5 2.3	No gel form	20rpm-86 100rpm-77	Milky colour Thin liquid Did not stick To chunks	No gel Form	20rpm-388 100rpm-198	Did not Stick to chunks	No gel forms	20rpm 2080 100rpm 812	May stick chunks	35	20rpm-800 100rpm-308	Yellow colour Semi gel may Stick to chunks
4	clear text Diagum SR Guar Dextrose Xanthan Na_2CO_3	90 0.0 5.7 0.5 1.5 2.3	No gel form	20rpm-88 100rpm-40	Milky colour Thin liquid Did not stick To chunks	No gel Form	20rpm-320 100rpm-120	Did not Stick to chunks	No gel forms	20rpm 1270 100rpm 373	Did not Stick To chunks	No gel form	20rpm-1830 100rpm-840	Greenish tinch Liquid medium May stick chunks

Results were before retorting. SI sensorial investigations

Table 1: Chunk in Gravy Recipes Results and Sensory Evaluations using Loryma Starch Cleartext SD 3 (E1442).

Sr. No	Material	%	1% concentration			2% Concentration			3% Concentration			4% Concentration		
.			Break strength (gm)	Viscosity Before Retorting (mPas)	SI	Break strength (gm)	Viscosity Before Retorting (mPas)	SI	Break strength (gm)	Viscosity Before Retorting (mPas)	SI	Break strength (gm)	Viscosity Before Retorting (mPas)	SI.
1	clear text Diagum SR Guar Dextrose Xanthan Na_2CO_3	80 15.7 15.0 5.5 1.5 2.3	No gel form	20rpm-52 100rpm-51	Thin liquid Did not stick To chunks	No gel Form	20rpm-544 100rpm-256	May Stick to chunks	No gel formed	20rpm 2320 100rpm 1364	Thick Creamy	No gel formed	20rpm-9560 100rpm-3656	May stick to Chunks.
2	clear text Diagum SR Guar Dextrose Xanthan Na_2CO_3	70 10.0 10.7 5.5 1.5 2.3	No gel form	20rpm-52 100rpm-48	Orange Colour, thin Did not stick To chunks.	No gel Form	20rpm-524 100rpm-230	May not Stick to Chunks.	No gel formed	20rpm- 2520 100rpm- 1126	Thick May stick To chunks	No gel formed	20rpm-7740 100rpm-3018	Brown, thick May stick chunks
3	clear text Diagum SR Guar Dextrose Xanthan Na_2CO_3	80 5.0 5.7 5.5 1.5 2.3	No gel form	20rpm-98 100rpm-51	Light orange Liquid, Did not stick To chunks	No gel Form	20rpm-260 100rpm-125	May not Stick to Chunks.	No gel formed	20rpm 1550 100rpm 895	May stick To chunks	No gel formed	20rpm-2750 100rpm-1178	Brown colour Thick liquid May stick to chunks
4	clear text Diagum SR Guar Dextrose Xanthan Na_2CO_3	90 0.0 5.7 0.5 1.5 2.3	No gel form	20rpm-14 100rpm-24	Milky with Yellow tinch Thin liquid Did not stick To chunks	No gel Form	20rpm-508 100rpm-195	May not stick To chunks	No gel formed	20rpm 1360 100rpm 579	Non Transparent Thin pale Yellow colour	No gel formed	20rpm-2105 100rpm-858	, may stick To chunks

Results were after retorting. SI sensorial investigations

Table 2: Chunk in Gravy Recipes Results and Sensory Evaluations using Loryma Starch Cleartext SD 3 (E1442).

Sr. No	Material	%	1% concentration			2% Concentration			3% Concentration			4% Concentration		
.			Break strength (gm)	Viscosity Before Retorting (mPas)	SI	Break strength (gm)	Viscosity Before Retorting (mPas)	SI	Break strength (gm)	Viscosity Before Retorting (mPas)	SI	Break strength (gm)	Viscosity Before Retorting (mPas)	SI
1	Modified Tapioca Diagum SR Guar Dextrose Xanthan Na_2CO_3	80 15.7 15.0 5.5 1.5 2.3	No gel form	20rpm-344 100rpm-102	Very thin Milky colour	No gel Form	20rpm-1626 100rpm-655	medium Milky	22	20rpm 4550 100rpm 1918	Gel Forming Tenancy	30	nil	Gel forming Tendency light Yellow green
2	Modified Tapioca Diagum SR Guar Dextrose Xanthan Na_2CO_3	70 10.0 10.7 5.5 1.5 2.3	No gel form	20rpm-144 100rpm-92	Light yellow Colour, thin Non transparent	No gel Form	20rpm-670 100rpm-392	creamy layer on top observed	18	20rpm-2870 100rpm-1388	Thick liquid	33	nil	Non transparent thin gel
3	Modified Tapioca Diagum SR Guar Dextrose Xanthan Na_2CO_3	80 5.0 5.7 5.5 1.5 2.3	No gel form	20rpm-70 100rpm-42	Did not stick To chunks	No gel Form	20rpm-310 100rpm-177	Did not Stick to chunks	No gel forms	20rpm 1820 100rpm 838	Did not Stick to chunks	No gel formed	20rpm-4140 100rpm-1672	Did not stick to chunks
4	Modified Tapioca Diagum SR Guar Dextrose Xanthan Na_2CO_3	90 0.0 5.7 0.5 1.5 2.3	No gel form	20rpm-18 100rpm-32	Did not stick To chunks	No gel Form	20rpm-238 100rpm-108	Did not Stick to chunks	No gel forms	20rpm 1176 100rpm 408	did not sick to chunks	No gel formed	20rpm-3175 100rpm-1064	Did not stick to Chunks.

Results were before retorting. SI sensorial investigations

Table 3: Chunk in Gravy Recipes Results and Sensory Evaluations using Loryma Starch Cleartext MR 200 (E1414).

Sr. No	Material	%	1% concentration			2% Concentration			3% Concentration			4% Concentration		
.			Break strength (gm)	Viscosity Before Retorting (mPas)	SI	Break strength (gm)	Viscosity Before Retorting (mPas)	SI	Break strength (gm)	Viscosity Before Retorting (mPas)	SI	Break strength (gm)	Viscosity Before Retorting (mPas)	SI
1	Modified Tapioca Diagum SR Guar Dextrose Xanthan Na_2CO_3	80 15.7 15.0 5.5 1.5 2.3	No gel form	20rpm-56 100rpm-54	May not stick To chunks.	No gel Form	20rpm-492 100rpm-211	May not Stick to Chunks.	No gel Form	20rpm 1860 100rpm 724	Thick, May stick To Chunks.	No gel Formed	20rpm-5100 100rpm-2136	Thick brown, May stick to Chunks.
2	Modified Tapioca Diagum SR Guar Dextrose Xanthan Na_2CO_3	70 10.0 10.7 5.5 1.5 2.3	No gel form	20rpm-38 100rpm-50	May not stick To chunks.	No gel Form	20rpm-574 100rpm-191	May not Stick to Chunks.	No gel Forms	20rpm- 1680 100rpm- 604	May stick To chunks.	No gel Formed	20rpm-5300 100rpm-2316	may stick To chunks.
3	Modified Tapioca Diagum SR Guar Dextrose Xanthan Na_2CO_3	80 5.0 5.7 5.5 1.5 2.3	No gel form	20rpm-32 100rpm-37	May not stick To chunks.	No gel Form	20rpm-278 100rpm-122	May not Stick to Chunks.	No gel forms	20rpm 1195 100rpm 490	May not Stick to Chunks.	No gel formed	20rpm-2580 100rpm-1004	may stick To chunks.
4	Modified Tapioca Diagum SR Guar Dextrose Xanthan Na_2CO_3	90 0.0 5.7 0.5 1.5 2.3	No gel form	20rpm-12 100rpm-22	may not Stick to Chunks.	No gel Form	20rpm-68 100rpm-71	may Not stick to Chunks.	No gel forms	20rpm- 692 100rpm 296	Non Trans- Parent,	No gel formed	20rpm-1756 100rpm-619	May stick to Chunks

Results were after retorting. SI sensorial investigations

Table 4: Chunk in Gravy Recipes Results and Sensory Evaluations using Loryma Starch Cleartext MR 200 (E1414).

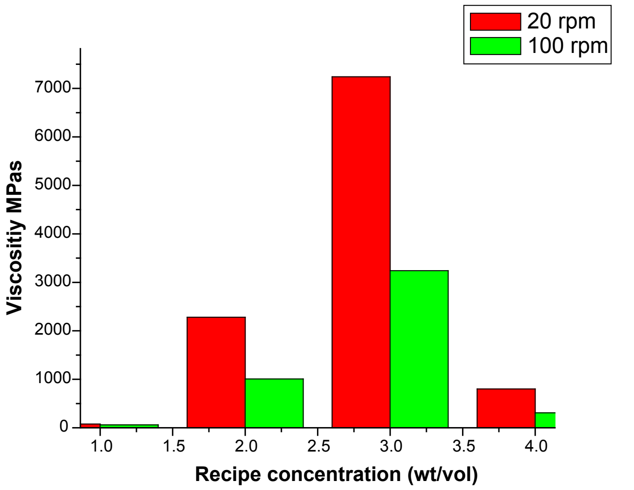

Figure 1: Effect of concentration of hydrocolloids on viscosity before retorting (Clear text SD3).

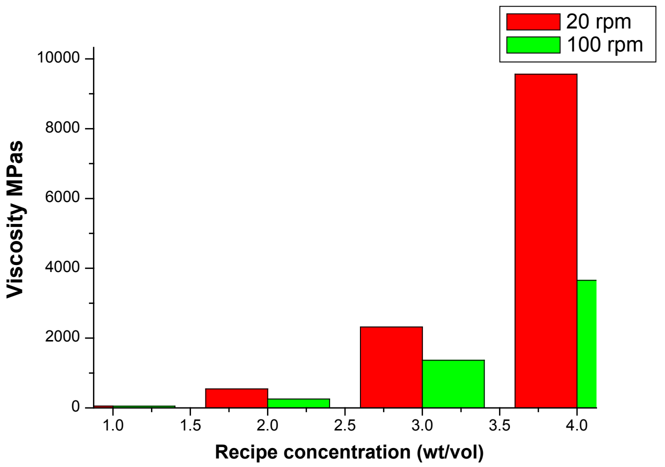

Figure 2: Effect of concentration of hydrocolloid on viscosity after retorting (Clear text SD3).

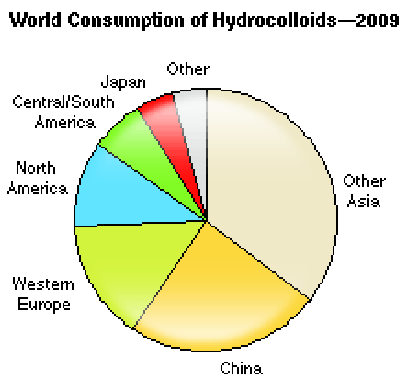

Figure 3: World consumption of hydrocolloids.

and sodium carbonate but failed in meeting the expected results before retort. But as the concentration of the blend was increased then it was found that the blends found to work well for the purpose of sticking to the chunks. The study was confirmed by incorporating vegetables like carrots chunks for the applications purpose. It was found to work for the solutions that did not jellified but rather has the viscosity less than 2000mPas. Consistent flow and creamy texture of the solution was must.

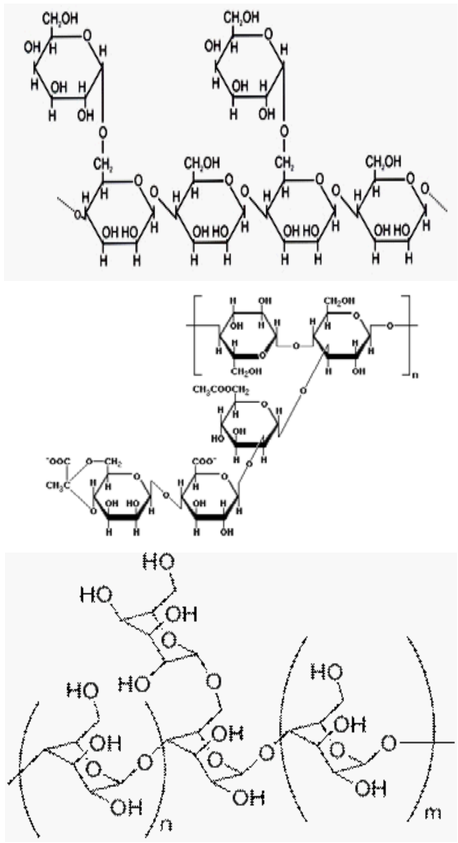

Figure 4: *Galcatomannans of* guar gum, xanthan, and *cassia angustifolia*.

After retort the solutions at higher concentrations of major hydrocolloids shown to have sticking properties to chunks. Hydrocolloids at high weight percent did not show to impart sticking performance rather worked well when the compositions weight percent was low [1]indicating for balanced synergies amongst them self.

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