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Original Article

Use of Gellan Gum to Replace Carrageenan in Chicken Sausages

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Abstract

The aim of this study was to check the effects of replacing carrageenan with gellan gum on the physicochemical, technological, and sensory characteristics of chicken sausages. Sausages were made with six levels of gellan gum (0, 0.10, 0.20, 0.30, 0.40, and 0.50%) as a substitute for carrageenan (0.50, 0.40, 0.30, 0.20, 0.10, and 0%, respectively), totaling six treatments. The treatments with 0.20 to 0.40% gellan had a lower percentage of exuded liquid and greater emulsion stability. From 0.30% onwards, there was an increase in weight after cooking. The addition of gellan gum reduced water activity, which was lowest with 0.50% gellan gum. Brightness (L*) and red intensity (a*) were not affected, but yellow values (b*) and hue angle (h°) decreased in the treatments with 0.40 and 0.50% gellan gum. The sausages with 0.10 to 0.30% had higher color saturation (C*). Those with 0.20 and 0.30% had higher shear strength. In terms of texture, there was a difference in hardness only between the 0.10% and 0.20% treatments. The inclusion of gellan did not alter the moisture, lipid, carbohydrate, and calorie contents, but it did reduce the protein content. The highest mineral content was observed with 0.40% gellan. Sensorially, the treatment with 0.20% gellan + 0.30% carrageenan was the most accepted in terms of color, taste, appearance, and overall evaluation, standing out in terms of improving stability, texture, and water activity.

Categories: Food security and sustainability, Food biochemistry, Food engineering

Keywords: emulsions, hydrocolloids, stability, texture, ordering test

Introduction

Sausages are one of the oldest processed foods known to man and hundreds of varieties are produced around the world, with great social and economic relevance [1]. They are appreciated both as a snack ingredient and in complete meals, contributing significantly to the intake of protein, fat and other nutrients in the diet. The expansion of meat sausage consumption in the Brazilian market is due to the growing diversity of products developed in the last decade, as well as the low cost compared to other meat products and preparation time [2].

Chicken mechanically separated meat (MSM) is a widely used raw material in the formulation of sausages, and Brazilian legislation allows the inclusion of up to 60% of the meat portion [3]. Thus, the use of MSM in sausages can lead to an increase in tenderness, granulation, the development of off-flavor and redness [4]. In this sense, hydrocolloids have been used to induce thickening due to their ability to bind to water. These components are added to foods in order to confer the desired textural properties, including increased viscosity (thickening), water retention, firmness and smoothness [5].

Natural hydrocolloids have been increasingly used in the food industry to improve the stability, functional properties, quality and safety, as well as the nutritional and health benefits of different food products [6]. The main reason for the extensive use of hydrocolloids in the food industry is their ability to bind to water and modify the properties of food ingredients [7]. Carrageenan, xanthan gum and glucomannan fiber (konjac mannan) are common hydrocolloids used by the industry in meat products [8]. However, despite their wide application, these hydrocolloids may present limitations related to variability in gel strength, susceptibility to syneresis, and dependence on specific ionic and thermal conditions, which can compromise the stability and texture of emulsified meat products.

Carrageenan is a high-molecular weight linear polysaccharide comprising repeated units of galactose and 3,6-anhydrogalactose, sulfated and non-sulfated, joined by alternating (1,3) and (1,4) glycosidic bonds [8]. It is widely used in the food industry for its gelling, thickening, and water-binding properties [9]. Similarly, gellan gum is a linear, negatively charged extracellular polysaccharide with a repeating tetrasaccharide unit consisting of β-D-glucose, β-D-glucuronic acid and α-L-ramnose in a 2:1:1 ratio [10]. It is a non-toxic, biodegradable and biocompatible polysaccharide and can therefore be used as a film former, binder, thickener, and stabilizer in a wide range of food products [11]. In contrast to conventional hydrocolloids, gellan gum is capable of forming highly ordered and stable gel networks even at low concentrations, exhibiting greater thermal stability and allowing precise modulation of textural properties, which are critical attributes for processed meat systems such as sausages.

In addition to these general properties, gellan gum exhibits distinct structural variations that influence its functionality in food applications. It can be presented in two different molecular forms: the natural form, which has two acyl groups (acetyl and glyceryl), and the deacetylated form, obtained through alkaline hydrolysis. Both forms are capable of forming gels in the presence of cations; this process depends mainly on temperature. The gels produced from native gellan are flexible and soft, while those formed from deacetylated gellan are rigid and brittle [12,13]. This structural versatility represents an important technological advantage over other hydrocolloids, as it enables the adjustment of gel characteristics according to the desired texture and stability of the final product.

The commercial form of gellan gum is deacetylated; however, the term gellan gum is simply used to refer to it, while gum with a high level of acyl is called native gum [13]. Acetylation changes soft, expandable gels into strong, hard, glossy gels with high thermal stability [13]. Low-acyl gellan gum has a gelling temperature between 10°C and 60°C, while high-acyl gum has a gelling temperature between 70°C and 80°C [14]. Thus, high-acylation gum would be more interesting for use in the production of sausages, as they are subjected to heat treatment of up to 85°C. This characteristic suggests that gellan gum may better withstand processing conditions compared to traditionally used hydrocolloids, maintaining structural integrity and water retention during heating.

The use of gellan gum is mainly in dairy products, jellies, jams, pie fillings, confectionery, and bakery products [15]. Few studies have evaluated the inclusion of gellan gum in meat products [16-19], and they are usually focused on the addition of gellan gum with the aim of making low-fat products [19,20] or plant-based products analogous to meat [21]. These studies have reported improvements in texture, gel strength, and water-holding capacity, reinforcing the functional potential of gellan gum in structured food systems. However, its application as a direct substitute for traditional hydrocolloids, such as carrageenan, in conventional emulsified meat products remains limited and not fully explored.

Replacing other commonly used hydrocolloids with gellan gum could improve the texture and stability of the emulsion in meat products such as sausages. Two essential factors for obtaining a desirable emulsified product are the ability to form a strong and coherent matrix and the water retention capacity (WRC) [22]. The combined use of hydrocolloids may positively affect WRC, texture, and color in meat products [9]. Therefore, considering its functional advantages and the existing gap in the literature, the replacement of carrageenan with gellan gum represents a promising strategy to improve the technological quality of chicken sausages. Based on this, the aim of this study was to evaluate the effects of replacing carrageenan with gellan gum on the physicochemical, textural, and sensory characteristics of chicken sausages.

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Materials And Methods

Obtaining raw materials

Mechanically separated chicken meat (69.13 ± 0.35% moisture, 12.11 ± 0.12% protein and 21.74 ± 2.19% lipids) and ground chicken breast fillet meat (77.30 ± 0.24% moisture, 20.37 ± 0.75% protein and 2.39 ± 0.20% lipids), with proximate composition consistent with values reported in the literature [23-26], were purchased from local shops in Dourados/MS, Brazil. The other ingredients used in the formulations and packaging were donated by the company Cavenaghi Eireli (Dourados/MS, Brazil). All ingredients of animal origin were obtained from establishments registered with the Federal Inspection Service (SIF).

Making the sausages

Sausage formulations were prepared (Table *1*), containing different levels of gellan gum (0, 0.10, 0.20, 0.30, 0.40, and 0.50%) as a substitute for carrageenan, totaling six treatments.

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Ingredients	Gellan gum inclusion levels[1] (%)					
	0.00	0.10	0.20	0.30	0.40	0.50
Chicken meat	40.00	40.00	40.00	40.00	40.00	40.00
Chicken CMS	40.00	40.00	40.00	40.00	40.00	40.00
Ice	10.00	10.00	10.00	10.00	10.00	10.00
Soy protein	3.40	3.40	3.40	3.40	3.40	3.40
Cassava starch	2.00	2.00	2.00	2.00	2.00	2.00
Refined salt	2.00	2.00	2.00	2.00	2.00	2.00
Sodium polyphosphate	0.50	0.50	0.50	0.50	0.50	0.50
Dehydrated garlic	0.50	0.50	0.50	0.50	0.50	0.50
Carrageenan	0.50	0.40	0.30	0.20	0.10	0.00
Gellan gum	0.00	0.10	0.20	0.30	0.40	0.50
Sugar	0.30	0.30	0.30	0.30	0.30	0.30
Nutmeg	0.20	0.20	0.20	0.20	0.20	0.20
Black pepper	0.20	0.20	0.20	0.20	0.20	0.20
Coriander	0.20	0.20	0.20	0.20	0.20	0.20
Smoke aroma	0.10	0.10	0.10	0.10	0.10	0.10
Ascorbic acid	0.05	0.05	0.05	0.05	0.05	0.05
Sodium nitrate	0.03	0.03	0.03	0.03	0.03	0.03
Sodium nitrite	0.015	0.015	0.015	0.015	0.015	0.015
Total	100.00	100.00	100.00	100.00	100.00	100.00

TABLE 1: Formulation of chicken sausages with the inclusion of gellan gum and carrageenan.

[1]Gellan gum inclusion levels expressed as percentage (%) of the total formulation, used as a substitute for carrageenan.

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The sausage was processed in accordance with the standards of good handling practices, as well as the conditions of physical structures, as required by law [27]. The MSM and frozen ground chicken breast fillet were cut into cubes to facilitate the comminution phase (fragmentation) and weighed on a digital scale, according to each formulation. The meats were then mixed and taken to the cutter and the other ingredients were added until a homogeneous mass was formed (meat emulsion). The temperature of the dough varied between 12.5°C and 16.2°C.

The emulsions were stuffed by hand into 22 mm gauge synthetic cellulose casing (cellulose hydrate). After stuffing, they were manually twisted to a size of approximately 13 cm and tied with string. The sausages were then cooked in water heated to an initial temperature of 55°C for 30 minutes, 65°C for 15 minutes, 75°C for 15 minutes, and finally 85°C until the internal temperature of the sausage reached 75°C. When the internal temperature of the sausages reached 75°C, they were removed and placed on ice for 5 minutes. For each treatment, the sausages were weighed before and after cooking to determine the cooking yield, which was calculated by calculating the difference in weight of the samples before and after cooking the sausages in water. After the heat shock, the sausages were depilated (removed from the casing), vacuum-packed and stored in a freezer (–18ºC ± 1°C).

Determining emulsion stability

Emulsion stability (ES) was analyzed according to Parks & Carpenter [28]. To do this, samples of the emulsion from each treatment (n = 3) were weighed (between 45 and 50 g) and packed in waterproof plastic containers resistant to high temperatures. The packages were sealed and immersed in water at 70ºC for 1 hour, then cooled to 4ºC. The exudate was discarded and the samples were weighed again. The stability of the emulsion was expressed as a percentage loss of liquid [28].

Water activity analysis

Water activity (n = 3) was determined using the AquaLab CX-2- series 3 equipment (Aqualab, Pullman, USA).

Instrumental color analysis

Instrumental color analysis (n = 5) was carried out on the inside of the sausages using a Konica Minolta Chroma Meter CR 410 portable colorimeter (Konica Minolta Optics Inc., Japan). The parameters L* (brightness), a* (red intensity), b* (yellow intensity), and C* (saturation) were obtained. The hue angle (hº) was calculated according to Equation 1.

Equation 1: $h^\circ = \arctan\left(\frac{b}{a}\right)$

The total color difference, comparing the values obtained for each treatment with those obtained for the sausages without the addition of gellan gum, was determined according to Equation 2 [29].

Equation 2: $\Delta E = \sqrt{\Delta L^2 + \Delta a^2 + \Delta b^2}$

Texture

The shear force of the sausages (10 repetitions) was analyzed using a TA-XT plus texturometer, Stable Micro Systems Ltd. (Surrey, England), equipped with a guillotine/knife shear cell, with pre-test speed: 20 mm/second, post-test: 10 mm/second, test: 20 mm/second, and a distance of 20 mm in samples with 20 × 20 × 10 mm edges, according to González-Fernández et al. [30] with adaptations.

The texture profile analysis (TPA) was carried out (10 repetitions) on the same equipment, equipped with a 50 kg load cell and a 36 mm cylindrical probe (P/36). The TPA was carried out with two 60% compression cycles with a 5-second interval between compressions. The pre-test, test, and post-test speeds were 1, 5, and 5 mm/second, respectively. The hardness, fracturability, elasticity, cohesiveness, chewability, and resilience parameters were calculated using the Exponent software package, version 6.1.9.1 (Stable Micro Systems, Surrey, England).

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Microbiological analysis

For microbiological analyses, 25 g of each sample were aseptically homogenized with 225 mL of sterile buffered peptone water to obtain a 10^{-1} dilution. Serial decimal dilutions were prepared as required. Coagulase-positive *Staphylococcus* was determined using the spread plate method on Baird-Parker agar, followed by confirmation tests, (according to ISO 6888-1:2021 [31]). *Clostridium perfringens* was enumerated using tryptose sulfite cycloserine (TSC) agar under anaerobic conditions (according to ISO 15213-2:2023 [32]). *Escherichia coli* was determined according to ISO methodology [33], and the presence of *Salmonella* spp. was evaluated in 25 g of sample following the standard method [34]. Results were expressed as colony-forming units per gram (CFU/g).

Determining the composition centesimal

Proximate composition was determined in triplicate for each treatment. Moisture content was determined by oven drying at 105°C until constant weight, and ash content was determined by incineration in a muffle furnace at 550°C, according to AOAC methods [35]. Crude protein content was determined by the semi-micro Kjeldahl method [36], involving sulfuric acid digestion of the samples, alkalization, steam distillation of the released ammonia, and titration with standardized acid, using a nitrogen-to-protein conversion factor of 6.25. Lipid content was determined according to the Bligh and Dyer method [37], based on cold solvent extraction with a chloroform-methanol-water system, followed by phase separation, solvent evaporation, and gravimetric quantification. Carbohydrate content was calculated by difference [38], subtracting the sum of moisture, protein, lipid, and ash contents from 100. The caloric value was calculated according to Atwater and Woods [39], using conversion factors of 4 kcal/g for proteins and carbohydrates and 9 kcal/g for lipids. The results were expressed in kcal/100 g.

Sensory analysis

The sensory analysis was carried out with 60 untrained tasters in individual booths under white light. The project was approved by the UFGD Human Research Ethics Committee (CEP/UFGD), under Opinion No. 5751599. The samples were heated for 2 minutes in water at a temperature of 80 to 85°C degrees, cut into 2 cm cubes and kept warm until the moment of analysis.

The sausages were evaluated through a discriminative test, using an ordering test according to preference between six samples. The samples were offered simultaneously to each taster in individual booths under white light. The tasters were asked to rank the six sausage samples according to their order of preference (1 to 6) for the attributes color, odor, taste, texture, appearance, and overall evaluation [40]. The samples were identified with random three-digit numbers, and the tasters interspersed the consumption of the sample with the drinking of water to avoid interference from one sample in relation to another.

Statistical procedures

The data from the physico-chemical analysis of the chicken sausages was evaluated using analysis of variance at a 5% significance level and, in the event of significant differences ($P < 0.05$), the means were compared using the Tukey test. Regression analysis was also carried out at a 5% significance level. When there was a significant effect, the regression equations were presented. The analyses were carried out using JAMOVI software version 2.3.26.0, and the results are expressed as mean ± standard deviation.

For the sensory analysis, the results were given by the sum of the judges' scores for each of the samples. The statistical evaluation was carried out by the Friedman test using the Newell and Macfarlane table at a 5% significance level [41], to verify the existence of a significant difference between the samples. Where the difference between the sums of the orders was greater than or equal to the tabulated value, a significant difference was found at a 5% significance level.

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Results And Discussion

The stable retention of water and lipids in the matrix of meat products after cooking is one of the most important quality parameters in emulsified meat systems [42]. Emulsion stability refers to the amount of liquid (water and/or lipids) exuded after heating; thus, lower liquid loss indicates greater emulsion stability, meaning the fat and water phases remained more effectively integrated during processing. In this study, treatments containing 0.20% to 0.40% gellan gum exhibited lower levels of exuded liquid compared to the formulation with 0.50% gellan gum, which showed the least stability.

Although high acylation gellan gum is known to function as a stabilizer in coarse emulsions likely due to its high viscosity and the formation of gellan microgels or aggregates resulting from molecular entanglement [43]. Its isolated use at a concentration of 0.50% in this formulation did not enhance emulsion stability. Instead, increased liquid exudation was observed, suggesting that high levels of gellan gum may negatively affect emulsion behavior when not used in combination with other hydrocolloids, such as carrageenan. These observations indicate that interactions between hydrocolloids (e.g., carrageenan and gellan gum) may favor emulsion stability under the specific conditions of this study. Previous work has shown that combining gums can lead to improved water retention, texture, and color [9], but further studies are needed to understand the mechanisms underlying such synergistic effects.

An interesting trend was observed in the cooking yield (Table *2*). The cooking yield was significantly affected ($P < 0.001$) by the inclusion of gellan gum, with higher levels (≥0.30%) showing increased values compared to the control. Notably, treatments containing 0.30%, 0.40%, and 0.50% gellan gum presented yields above 100%, indicating water retention during the cooking process rather than loss. Possibly, when there was an inclusion of more than 0.30% gellan gum in the emulsions, it was hydrated or dissolved and formed a gel mixture with the chicken myofibrillar proteins after heating, contributing to reducing water loss by external addition [19]. It is known that gellan gum has a good water retention capacity [44], which may have contributed to the higher water retention observed in treatments with higher gellan gum levels. Gums (xanthan gum, locust bean gum, and gellan gum) are generally more effective at increasing cooking yield when compared to starches (plain wheat flour, tapioca starch, corn starch, and potato starch) [45].

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Parameters	Gellan gum inclusion levels (%)[1]						*P*-value
	0.00	0.10	0.20	0.30	0.40	0.50	
Cooking yield (%)	95.05 ± 0.00^{c}	96.70 ± 0.00^{bc}	97.25 ± 0.00^{bc}	101.03 ± 0.00^{ab}	101.22 ± 0.00^{ab}	103.29 ± 0.009^{a}	<0.001
ES	4.24 ± 0.13^{ab}	3.98 ± 0.19^{ab}	1.40 ± 0.13^{b}	0.73 ± 0.34^{b}	2.81 ± 0.71 ^{b}	8.51 ± 4.75^{a}	<0.001
WA	0.981 ± 0.001^{a}	0.973 ± 0.001^{b}	0.971 ± 0.001^{b}	0.973 ± 0.001^{b}	0.971 ± 0.002^{b}	0.966 ± 0.001^{c}	<0.001
Color							
L*	61.89 ± 1.52^{a}	61.66 ± 0.88^{a}	61.98 ± 0.97^{a}	61.32 ± 0.51^{a}	62.32 ± 0.53^{a}	61.95 ± 0.61^{a}	0.242
a*	14.07 ± 0.52^{a}	14.49 ± 0.44^{a}	14.02 ± 0.77^{a}	14.39 ± 0.44^{a}	14.40 ± 0.31^{a}	14.48 ± 0.25^{a}	0.123
b*	14.18 ± 0.49^{a}	14.39 ± 0.29^{a}	14.75 ± 0.60^{a}	14.62 ± 0.25^{a}	13.33 ± 0.49^{b}	13.02 ± 0.43^{b}	<0.001
C*	19.98 ± 0.51^{b}	20.42 ± 0.47^{a}	20.36 ± 0.37^{a}	20.52 ± 0.34^{a}	19.62 ± 0.47^{b}	19.47 ± 0.42^{b}	<0.001
h^{o}	45.23 ± 1.45^{a}	44.81 ± 0.65^{a}	46.46 ± 2.54^{a}	45.47 ± 1.03^{a}	42.79 ± 1.02^{b}	41.96 ± 0.77^{b}	<0.001
DE	-	3.78 ± 0.18^{ab}	4.30 ± 0.26^{a}	4.27 ± 0.18^{a}	3.13 ± 0.13 ^{b}	3.17 ± 0.19^{b}	

TABLE 2: Cooking yield (%), emulsion stability (ES), water activity (WA), and instrumental color (L*, a*, b*) of chicken sausages with the inclusion of gellan gum as a substitute for carrageenan.

Luminosity, L*; red intensity, a*; yellow intensity, b*; Saturation, C*; h^{o}, hue angle (calculated as h^{o} = tan^{-1} (b*/a*)); DE, delta E.

[1]Gellan gum inclusion levels expressed as percentage (%) of the total formulation, used as a substitute for carrageenan. Averages on the same line followed by different superscript letters differ according to Tukey's test ($P < 0.05$). Variables without superscript letters indicate no significant differences among treatments ($P \geq 0.05$).

The ability to form a gel also influenced the water activity (Aw) of the sausages (Table 2). Lower (Aw) values were observed when gellan gum was included in the sausages, with the lowest average in the sausage with 0.50% gellan gum ($P < 0.05$). This reduction is likely related to the ability of hydrocolloids to trap free water within a gel matrix, thereby lowering water availability [46-48]. Thus, the greater gel formation in the sausages with the addition of gellan gum possibly caused the Aw of the sausages to decrease, even in the case of the treatments that incorporated water (with an increase in weight after cooking).

Some hydrocolloids, such as guar gum, xanthan gum, pectin, and carrageenan, can be used to control water activity in foods. They can act as water retention agents, helping to maintain moisture in foods and decreasing the availability of water for microorganisms, contributing to food preservation [46-48] with this consequently contributing to the shelf life

of the foods they are used in. In chicken sausages with added inulin, Aw values of between 0.988 and 0.993 were observed. Inulin is one of the most widely used ingredients in meat products and is highlighted as a potential source of soluble dietary fiber, with low caloric value, extracted commercially from chicory root [49].

The behavior of color in meat emulsions significantly influences consumer acceptance and makes it easier to predict changes that occur in the product [50]. In terms of sausage color (Table *2*), the addition of gellan gum did not influence the brightness (L*) and red intensity (a*) of the sausages ($P > 0.05$), which may be explained by the fact that these parameters are more closely related to pigment concentration and processing conditions than to the presence of hydrocolloids. However, the yellow intensity (b*) and the hue angle (h°) were lower in the sausages with 0.40 and 0.50% gellan gum ($P < 0.05$), possibly due to changes in free water distribution and interactions between ingredients, which affect light reflection within the product matrix, as reported by Majzoobi et al. [8]. On the other hand, sausages with 0.10, 0.20, and 0.30% gellan gum had higher saturation averages (C*, $P < 0.05$), suggesting improved color intensity, which may be associated with the formation of a more homogeneous gel structure. Hydrocolloids are known to form transparent gel matrices that influence light scattering and, consequently, color perception [51]. For DE, the sausages with 0.40 and 0.50% gellan gum had lower ($P < 0.05$) averages, indicating more marked differences in coloration compared to the others, which may be related to structural changes at higher hydrocolloid concentrations. Similar trends in color modification have been reported in meat systems with gellan gum, including increased red and yellow intensity in low-fat chicken emulsions and pork products [19]. In general, the brightness of meat products is affected by the fluid exuded on the surface, the moisture content and the ingredients added [45]. As the moisture content of the sausages was not affected ($P > 0.05$) by the inclusion of gellan gum (Table *2*), there were no changes in brightness either. Despite this, the inclusion of 1% of various hydrocolloids in beef burgers increased the brightness and intensity of the yellow color, and these results are also related to the higher moisture content of the formulations [45].

Changes in the color parameters of the samples can be related to the amount of bound water, the interactions between hydrocolloids and sausage components, the stability of the emulsion and the homogeneity of the system, which in turn affect the texture and light reflection of the samples [8]. The differences between hydrocolloids in terms of chemical composition, size and molecular structure, and their effects on water activity can also affect color parameters [8].

The textural properties of meat products are affected by water retention capacity and emulsion stability [45]. In terms of shear force (Table *3*), the highest values were observed in sausages with 0.20 and 0.30% gellan gum included, indicating greater resistance to cutting in these sausages compared to sausages without inclusion ($P < 0.05$). In pork sausages, the addition of gellan gum had a notable effect on reducing the total exudate and improving the texture of the sausage, producing better emulsion stability [17].

On the other hand, in the analysis of the texture profile (TPA, Table *3*), there was a difference in hardness only in the 0.10% treatment in relation to the treatment with 0.20% added gellan gum, with no significant difference in the other treatments due to the inclusion of gellan gum in the sausages ($P > 0.05$). Sausages with 0.20% gellan gum showed greater hardness ($P < 0.05$), but higher levels led to a decrease in the elasticity of the sausages from 0.20% gellan gum inclusion. On the other hand, the lowest resilience was seen in sausages with 0.30% and 0.40% gellan gum compared to the other treatments. In a previous study, the addition of 0.60% gellan gum in chicken meat emulsions also significantly decreased the values of the TPA parameters [19].

In general, hydrocolloids improve binding and water retention capacities, resulting in slightly lower textural properties [52]. Similar to their effect on cooking yield, gums provide a softer texture to meat products compared to starches and transglutaminase due to their high-water retention capacity [45]. The parameters of fracturability, gumminess and chewiness were not affected by the inclusion of gellan gum in the sausages ($P > 0.05$), indicating that the different inclusion levels did not promote significant changes in the textural profile of the products under the evaluated conditions. Cohesiveness also did not differ among treatments ($P > 0.05$), despite a slight numerical variation observed at the 0.30% inclusion level. This behavior may be attributed to the ability of gellan gum to form stable gel networks

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without markedly altering the structural integrity of meat emulsions at low concentrations. Similar results have been reported in studies with hydrocolloids, where parameters such as gumminess and chewiness remained unchanged due to the stability of the protein-polysaccharide matrix [19, 51].

	Gellan gum inclusion levels (%)[1]						*P*-value
	0.00	0.10	0.20	0.30	0.40	0.50	
SF (kgf/cm)[2]	6.77 ± 0.96^{b}	8.02 ± 0.61^{ab}	8.22 ± 1.08^{a}	8.66 ± 0.52^{a}	7.41 ± 0.73^{ab}	7.50 ± 0.64^{ab}	<0.001
Texture profile (TPA)							
Hardness (N)	0.070 ± 0.004^{ab}	0.065 ± 0.003^{b}	0.083 ± 0.003^{a}	0.071 ± 0.005^{ab}	0.072 ± 0.002^{ab}	0.071 ± 0.004^{ab}	0.038
Fracturability (g)	0.028 ± 0.001^{a}	0.029 ± 0.001^{a}	0.028 ± 0.001^{a}	0.033 ± 0.006^{a}	0.029 ± 0.001^{a}	0.029 ± 0.001^{a}	0.956
Elasticity	0.934 ± 0.002^{a}	0.939 ± 0.003^{a}	0.919 ± 0.005^{b}	0.925 ± 0.004^{b}	0.913 ± 0.002^{b}	0.917 ± 0.003^{b}	<0.001
Cohesiveness	0.802 ± 0.002^{a}	0.806 ± 0.002^{a}	0.777 ± 0.003^{b}	0.789 ± 0.011^{ab}	0.771 ± 0.003 b	0.795 ± 0.002^{a}	<0.001
Gumminess	0.056 ± 0.003^{a}	0.053 ± 0.002^{a}	0.065 ± 0.003^{a}	0.056 ± 0.004^{a}	0.055 ± 0.002^{a}	0.056 ± 0.003^{a}	0.096
Chewiness (Nmm)	0.052 ± 0.003^{a}	0.050 ± 0.002^{a}	0.060 ± 0.003^{a}	0.052 ± 0.003^{a}	0.051 ± 0.002^{a}	0.052 ± 0.003^{a}	0.106
Resilience	0.434 ± 0.003^{ab}	0.449 ± 0.004^{a}	0.408 ± 0.004^{b}	0.420 ± 0.009^{bc}	0.393 ± 0.003^{c}	0.419 ± 0.003^{b}	<0.001

TABLE 3: Shear force (SF) and texture profile analysis (TPA) of chicken sausages with the inclusion of gellan gum instead of carrageenan.

[1]Gellan gum inclusion levels expressed as percentage (%) of the total formulation, used as a substitute for carrageenan. Averages on the same line followed by different superscript letters differ according to Tukey's test ($P < 0.05$). Variables without superscript letters indicate no significant differences among treatments ($P \geq 0.05$).

No significant differences were observed in moisture, lipid, carbohydrate, or caloric content among treatments ($P > 0.05$) (Table *4*). The addition of gellan gum to the sausages, regardless of the amount, reduced the protein content ($P < 0.05$) compared to sausages without gellan gum. Despite this, these values were in line with the standards of identity for sausages, which set a limit of at least 12% protein [3]. In beef sausages, the addition of guar gum, xanthan gum, and chitosan also decreased the protein content compared to control sausages [53]. This decrease in protein content in meat

products due to the addition of gellan gum remains unexplained. Protein-polysaccharide interactions are known to play a significant role in the structure and stability of many processed foods [54]. However, more studies are needed to elucidate these effects.

Parameters (%)	Gellan gum and carrageenan inclusion levels (%)[1]						*P*-value
	0.00	0.10	0.20	0.30	0.40	0.50	
Humidity	72.98 ± 3.83^{a}	69.85 ± 2.68^{a}	69.75 ± 0.13^{a}	70.30 ± 0.15^{a}	71.61 ± 0.28^{a}	71.37 ± 0.28^{a}	0.335
Proteins	17.14 ± 0.58^{a}	16.16 ± 0.54^{b}	15.72 ± 0.40^{b}	15.82 ± 0.43^{b}	15.19 ± 0.02^{b}	15.90 ± 0.43^{b}	0.004
Lipids	5.19 ± 0.96^{a}	5.72 ± 1.40^{a}	4.29 ± 1.04^{a}	3.49 ± 0.98^{a}	3.82 ± 0.93^{a}	3.64 ± 1.02^{a}	0.126
Mineral matter	1.63 ± 0.02^{b}	1.64 ± 0.08^{b}	1.67 ± 0.08^{b}	1.92 ± 0.28^{b}	2.19 ± 0.11^{a}	1.93 ± 0.08^{ab}	0.002
Carbohydrates	3.36 ± 2.91^{a}	6.64 ± 4.48^{a}	8.58 ± 0.88^{a}	8.47 ± 1.07^{a}	7.18 ± 1.21^{a}	7.16 ± 0.63^{a}	0.151
Caloric value (kcal/100 g)	128.70 ± 17.85^{a}	142.67 ± 3.77^{a}	135.80 ± 4.54^{a}	128.55 ± 5.28^{a}	123.90 ± 3.77^{a}	125.05 ± 4.99^{a}	0.123

TABLE 4: Centesimal composition and caloric value of chicken sausages with the inclusion of gellan gum as a substitute for carrageenan.

[1]Gellan gum inclusion levels expressed as percentage (%) of the total formulation, used as a substitute for carrageenan. Averages on the same line followed by different superscript letters differ according to Tukey's test ($P < 0.05$). Variables without superscript letters indicate no significant differences among treatments ($P \geq 0.05$).

The mineral matter content was higher, with a higher average mineral matter content for sausages with 0.40% added, which differed significantly from sausages with 0.00% to 0.30% added, but there was no significant difference in relation to sausages with 0.50% added gellan gum. The slightly higher ash content may be related to impurities in the hydrocolloids [8].

The results of the microbiological analysis are presented in Table *5*. All evaluated parameters were within the limits established by current legislation for cooked poultry meat products [55], confirming the microbiological safety and quality of the sausages.

Parameter	Result (all treatments)	Legal limit*
Coagulase-positive *Staphylococcus*	$<1.0 \times 10^2$ CFU/g	$\leq 10^3$ CFU/g
Clostridium perfringens	$<1.0 \times 10^1$ CFU/g	$\leq 10^3$ CFU/g
Escherichia coli	$<1.0 \times 10^1$ CFU/g	$\leq 10^2$ CFU/g
Salmonella spp. (25 g)	Absence	Absence

TABLE 5: Microbiological analysis of chicken sausages with different levels of gellan gum.

* According to current Brazilian legislation for cooked poultry meat products. CFU, Colony forming unit.

In the sensory evaluation using the ranking test, the evaluators were asked to rank the six different samples according to their preference (Table 5). The lower the sum of these ratings, the greater the acceptance. Thus, it can be seen that the sausages with 0.20% gellan gum inclusion were better accepted ($P < 0.05$) in terms of color, flavor, appearance, and overall evaluation. For odor, sausages with 0.10% gellan gum scored lower and consequently stood out in this attribute. Texture did not differ between treatments ($P > 0.05$).

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	Gellan gum and carrageenan inclusion levels					
Gellan gum (%)	0.00	0.10	0.20	0.30	0.40	0.50
Carrageenan (%)	0.50	0.40	0.30	0.20	0.10	0.00
Color	254^{a}	226^{ab}	156^{c}	185^{bc}	200^{ab}	239^{ab}
Odor	214^{ab}	181^{b}	201^{ab}	255^{a}	200^{ab}	209^{ab}
Texture ^{NS}	204	195	204	202	209	247
Flavor	226^{ab}	178^{b}	187^{b}	210^{ab}	214^{ab}	249^{a}
Appearance	218^{ab}	220^{ab}	166^{b}	182^{b}	206^{b}	267^{a}
Overall assessment	230^{ab}	195^{ab}	172^{b}	215^{ab}	199^{ab}	250^{a}

TABLE 6: Sum of the difference ordination tests of chicken sausages with gellan gum inclusion.

Values represent the sums of ranks assigned by the panelists. Sums within the same row followed by different letters differ significantly according to the Friedman test and the Newell and MacFarlane procedure ($P < 0.05$). Minimum significant difference ≥59. NS, Not significant.

The addition of hydrocolloids seems to have an overall positive effect on the sensory characteristics of meat products [52]. The higher acceptance of sausages with 0.20% gellan gum may be associated with textural characteristics, although this relationship warrants further investigation. It is interesting to note that sausages with only carrageenan or only gellan gum had the highest sums, indicating lower acceptance of these sausages in relation to the attributes of color, texture, flavor, and overall evaluation.

Conclusions

The inclusion of 0.20% gellan gum in combination with 0.30% carrageenan resulted in improved emulsion stability, reduced water activity, and favorable sensory responses in chicken sausages, suggesting this combination as a potentially effective alternative to formulations using carrageenan alone.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

Plant subjects: All authors have confirmed that this study did not involve any herbarium specimen. **Human subjects:** Consent was obtained or waived by all participants in this study. UFGD Human Research Ethics Committee (CEP/UFGD) issued approval 5751599. This research was reviewed and approved by the Human Research Ethics Committee of the Federal University of Grande Dourados (CEP/UFGD), under approval No. 5751599, in accordance with the ethical principles and current regulations for research involving human subjects. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Data Availability Statements

The datasets (and/or code) supporting this study are available from the corresponding author upon reasonable request.

References

1. Carballo J: Sausages: nutrition, safety, processing and quality improvement. Foods. 2021, 10:1-9. 10.3390/foods10040890
2. Oliveira KAM, Ribeiro LS, Oliveira GV, Vidigal MCTR: Goat milk frozen yogurt Caja (Spondias mombin L.) flavor: development and sensory acceptance of an exotic food. Current Nutrition & Food Science. 2016, 12:105-112. 10.2174/1573401312666160130003540
3. Brazil, Ministry of Agriculture, Livestock and Supply: Normative Instruction No. 4, of March 31, 2000. Approving the Technical Regulations for the Identity and Quality of Mechanically Separated Meat, Mortadella, Sausage and Sausage. Federal Official Gazette. Brasília, DF. 2000, 18.
4. Horita CN, Messias VC, Morgano MA, Hayakawa FM, Pollonio MAR: Textural, microstructural and sensory properties of reduced sodium frankfurter sausages containing mechanically deboned poultry meat and blends of chloride salts. Food Research International. 2014, 66:29-35. 10.1016/j.foodres.2014.09.002
5. Hayakawa F, Kazami Y, Ishihara S, et al.: Characterization of eating difficulty by sensory evaluation of hydrocolloid gels. Food Hydrocolloids. 2014, 38:95-103. 10.1016/j.foodhyd.2013.11.007
6. Yemenicioğlu A, Farris S, Turkyilmaz M, Gulec S: A review of current and future food applications of natural hydrocolloids. International Journal of Food Science and Technology. 2019, 55:1389-1406. 10.1111/ijfs.14363
7. Li JM, Nie SP: The functional and nutritional aspects of hydrocolloids in foods. Food Hydrocolloids. 2016, 53:46-61. 10.1016/j.foodhyd.2015.01.035
8. Majzoobi M, Talebanfar S, Eskandari MH, Farahnaky A: Improving the quality of meat-free sausages using κ-carrageenan, konjac mannan and xanthan gum. International Journal of Food Science and Technology. 2017, 52:1269-1275. 10.1111/ijfs.13394
9. Sarteshnizi RA, Hosseini H, Khaneghah AM, Karimi N: A review on application of hydrocolloids in meat and poultry products. International Food Research Journal. 2015, 22:872-887.

10. Nooshkam M, Varidi M: Physicochemical stability and gastrointestinal fate of β-carotene-loaded oil-in-water emulsions stabilized by whey protein isolate-low acyl gellan gum conjugates. Food Chemistry. 2021, 347:129079. 10.1016/j.foodchem.2021.129079

11. Gupta RK, Gupta K, Sharma A, Das M, Ansari IA, Dwivedi PD: Health risks and benefits of chickpea (Cicer arietinum) consumption. Journal of Agricultural and Food Chemistry. 2016, 65:6-22. 10.1021/acs.jafc.6b02629

12. Osmałek T, Froelich A, Tasarek S: Application of gellan gum in pharmacy and medicine. International Journal of Pharmaceutics. 2014, 466:328-340. 10.1016/j.ijpharm.2014.03.038

13. Zia KM, Tabasum S, Khan MF, Akram N, Akhter N, Noreen A, Zuber M: Recent trends on gellan gum blends with natural and synthetic polymers: a review. International Journal of Biological Macromolecules. 2018, 109:1068-1087. 10.1016/j.ijbiomac.2017.11.099

14. Carvalho CYD: Textured mango: impact of processing on the aroma component, Thesis. Instituto Superior de Agronomia, Universidade de Lisboa: Lisbon, Portugal. 2014, 1-96.

15. Gomes D, Batista-Silva JP, Sousa A, Passarinha LA: Progress and opportunities in gellan gum-based materials: a review of preparation, characterization and emerging applications. Carbohydrate Polymers. 2023, 311:120782. 10.1016/j.carbpol.2023.120782

16. Totosaus A, Pérez-Chabela ML: Textural properties and microstructure of low-fat and sodium-reduced meat batters formulated with gellan gum and dicationic salts. LWT-Food Science and Technology. 2009, 42:563-569. 10.1016/j.lwt.2008.07.016

17. Zhou WW, Meng L, Li X, Ma L, Dai R: Effect of the interaction between carrageenan, gellan gum and flaxseed gum on quality attributes of starch-free emulsion-type sausage. Journal of Muscle Foods. 2010, 21:255-267. 10.1111/j.1745-4573.2009.00180.x

18. Petcharat T, Benjakul S: Effect of gellan incorporation on gel properties of bigeye snapper surimi. Food Hydrocolloids. 2018, 77:746-753. 10.1016/j.foodhyd.2017.11.016

19. Li K, Liu JY, Fu L, Li WJ, Zhao YY, Bai YH, Kang ZL: Effect of gellan gum on functional properties of low-fat chicken meat batters. Journal of Texture Studies. 2018, 50:131-138. 10.1111/jtxs.12379

20. Soreshjani BH, Hojjatoleslamy M, Molavi H, Dastgerdi SH, Shariaty MA: Producing low fat chicken nugget through coating by gellan gum. International Journal of Farming and Allied Sciences. 2013, 2:785-789.

21. Dinani ST, Jong S, Vardhanabhuti B, van der Goot AJ: Improving the quality of gluten-free plant-based meat analogs based on soy protein isolate with insoluble soy fibers and low acyl gellan gum. European Food Research and Technology. 2023, 250:389-408. 10.1007/s00217-023-04391-x

22. Savadkoohi S, Hoogenkamp H, Shamsi K, Farahnaky A: Color, sensory and textural attributes of beef frankfurter, beef ham and meat-free sausage containing tomato pomace. Meat Science. 2014, 97:410-418. 10.1016/j.meatsci.2014.03.017

23. Daros FG, Masson ML, Amico SC: The influence of the addition of mechanically deboned poultry meat on the rheological properties of sausage. Journal of Food Engineering. 2005, 68:185-189. 10.1016/j.jfoodeng.2004.05.030

24. Petracci M, Cavani C: Muscle growth and poultry meat quality issues. Nutrients. 2011, 4:1-12. 10.3390/nu4010001

25. Department of Agriculture US, FoodData Central: Chicken, broilers or fryers, breast, meat only, raw. (2023). Accessed: February 12, 2026: https://fdc.nal.usda.gov/food-details/171077/nutrients.

26. Lima DM, Padovani RM, Rodriguez-Amaya DB, et al.: Brazilian food composition table (TACO). Campinas (SP), Brazil; 2011. https://www.cfn.org.br/wp-content/uploads/2017/03/taco_4_edicao_ampliada_e_revisada.pdf.

27. Brazil, Ministry of Agriculture, Livestock and Supply: Normative Instruction No. 51, of December 29, 2006. (2006). Accessed: February 12, 2026: https://www.jusbrasil.com.br/diarios/412082/pg-14-secao-1-diario-oficial-da-uniao-dou-de-04-01-2007.

28. Parks LL, Carpenter JA: Functionality of six nonmeat proteins in meat emulsion systems. Journal of Food Science. 1987, 52:271-274. 10.1111/j.1365-2621.1987.tb06590.x

29. Obón JM, Castellar MR, Alacid M, Fernández-López JA: Production of a red-purple food colorant from Opuntia stricta fruits by spray drying and its application in food model systems. Journal of Food Engineering. 2009, 90:471-479. 10.1016/j.jfoodeng.2008.07.013

30. González-Fernández C, Santos EM, Jaime I, Rovira J: Use of starter cultures in dry-fermented sausage (chorizo) and their influence on the sensory properties. Food Science and Technology International. 1997, 3:31-42. 10.1177/108201329700300104

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31. International Organization for Standardization - ISO: Microbiology of the food chain - Horizontal method for the enumeration of coagulase-positive staphylococci (Staphylococcus aureus and other species) - Part 1: Method using Baird-Parker agar medium. (2021). Accessed: February 12, 2026: https://www.iso.org/standard/76672.html.

32. International Organization for Standardization - ISO: Microbiology of the food chain - Horizontal method for the detection and enumeration of Clostridium spp. - Part 2: Enumeration of Clostridium perfringens by colony-count technique. (2023). Accessed: February 12, 2026: https://www.iso.org/standard/71498.html.

33. Latimer Jr GW: Official Methods of Analysis of AOAC International. AOAC (Association of Official Analytical Chemists), Gaithersburg, MD; 2019.

34. Paez V, Bradley WB, Deng X, et al.: AOAC SMPR® 2016.002. Journal of AOAC International. 2019, 99:1122-1124. 10.5740/jaoacint.smpr2016.002

35. Horwitz W, Latimer GW: Official Methods of Analysis of AOAC International, 18th edition. AOC International, Gaithersburg; 2005.

36. Silva DJ, Queiroz AC: Food analysis (chemical and biological methods). UFV Publishing House, Viçosa; 2002. https://pt.scribd.com/document/366181376/Analise-de-Alimentos-Livro-Silva-e-Queiroz.

37. Bligh EG, Dyer WJ: A rapid method of total lipid extraction and purification. Canadian Journal of Biochemistry and Physiology. 1959, 37:911-917. 10.1139/o59-099

38. Zenebon O, Pascuet NS, Tiglea P: Métodos Físico-químicos Para Análise de Alimentos, 4th edition. Instituto Adolfo Lutz, São Paulo; 2008.

39. Atwater WO, Woods CD: The Chemical Composition of American Food Materials. Government Printing Office, Washington, DC; 1896.

40. Dutcosky SD: Análise Sensorial de Alimentos. Champagnat, Curitiba; 2019.

41. Newell GJ, MacFarlane JD: Expanded tables for multiple comparison procedures in the analysis of ranked data. Journal of Food Science. 1987, 52:1721-1725. 10.1111/j.1365-2621.1987.tb05913.x

42. Shin DJ, Yim DG, Kwon JA, Kim SS, Lee HJ, Jo C: Effect of cutting time and cooking temperature on physicochemical properties of chicken breast meat emulsion sausage with olive oil. Poultry Science. 2022, 101:101554. 10.1016/j.psj.2021.101554

43. Vilela JAP, Cunha RL: High acyl gellan as an emulsion stabilizer. Carbohydrate Polymers. 2016, 139:115-124. 10.1016/j.carbpol.2015.12.045

44. Stevens LR, Gilmore KJ, Wallace GG, In Het Panhuisab M: Tissue engineering with gellan gum. Biomaterials Science. 2016, 4:1276-1290. 10.1039/c6bm00322b

45. Pematilleke N, Kaur M, Wai CTR, Adhikari B, Torley PJ: Effect of the addition of hydrocolloids on beef texture: targeted to the needs of people with dysphagia. Food Hydrocolloids. 2021, 113:106413. 10.1016/j.foodhyd.2020.106413

46. Farbo MG, Fadda C, Marceddu S, Conte P, Del Caro A, Piga A: Improving the quality of dough obtained with old durum wheat using hydrocolloids. Food Hydrocolloids. 2020, 101:105467. 10.1016/j.foodhyd.2019.105467

47. Rios RV, Garzón R, Lannes SCS, Rosell CM: Use of succinyl chitosan as fat replacer on cake formulations. LWT. 2018, 96:260-265. 10.1016/j.lwt.2018.05.041

48. Salehi F: Improvement of gluten-free bread and cake properties using natural hydrocolloids: a review. Food Science & Nutrition. 2019, 7:3391-3402. 10.1002/fsn3.1245

49. Araujo CDLD, Costa GFD, Oliveira FLND, Azerêdo GA: Elaboration of chicken sausages with fat reduction and inulin addition. Brazilian Journal of Food Technology. 2021, 24:1-10. 10.1590/1981-6723.33419

50. Rather SA, Masoodi FA, Akhter R, Rather JA, Shiekh KA: Advances in use of natural antioxidants as food additives for improving the oxidative stability of meat products. Madridge Journal of Food Technology. 2016, 1:10-17. 10.18689/MJFT-1000102

51. García-García E, Totosaus A: Low-fat sodium-reduced sausages: effect of the interaction between locust bean gum, potato starch and κ-carrageenan by a mixture design approach. Meat Science. 2008, 78:406-413. 10.1016/j.meatsci.2007.07.003

52. Kim TK, Yong HI, Jung S, Kim YB, Choi YS: Effects of replacing pork fat with grape seed oil and gelatine/alginate for meat emulsions. Meat Science. 2020, 163:108079. 10.1016/j.meatsci.2020.108079

53. Yilmaz EE, Vural H, Yadigari RJ: Thermal, microscopic, and quality properties of low-fat frankfurters and emulsions produced by addition of different hydrocolloids. International Journal of Food Properties. 2017, 20:1987-2002. 10.1080/10942912.2016.1230743

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54. Andrès S, Zaritzky N, Califano A: The effect of whey protein concentrates and hydrocolloids on the texture and colour characteristics of chicken sausages. International Journal of Food Science and Technology. 2006, 41:954-961. 10.1111/j.1365-2621.2005.01152.x

55. Brazil. Presidency of the Republic. Decree No. 9,013, enacted March 29, 2017. Regulates Law No. 1,283 of December 18, 1950, and Law No. 7,889 of November 23, 1989, regarding the industrial and sanitary inspection of products of animal origin.. (2017). Accessed: September 21, 2024: https://www.gov.br/agricultura/pt-br/internacional/english/importing/animal/90132017Decree.RIISPOA.RegulamentaaLei128....

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