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The Effects of Adding Xanthan Gum as a Fat Replacer on the Quality Characteristics of Beef Burgers

تأثير إضافة صمغ الكزانتان كبديل عن الدهن في خصائص جودة برجر اللحم البقري

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Abstract

The chemical, oxidative, microbiological, physical, and sensory properties of low-fat beef burgers containing varying levels of xanthan gum (0.5%, 1%, and 1.5%) as a fat replacer were evaluated. The partial replacement of fat with xanthan gum resulted in a significant stabilizing of the formula during four different periods of being frozen in storage (0, 30, 60, and 90 days). A chemical analysis of low-fat beef burger formulations (25%, 20%, and 15%) revealed that high concentrates of xanthan gum (1.5% and 1%) had significant capacity for the retention of the nutrients in the burger——especially proteins, ash, and moisture. The freezing method had a higher impact in reducing the microbial load of the beef burger; adding more fats to burger formulations could be a potential source of microbial contamination. The significant increase of the Thiobarbituric Acid Reactive Substances' (TBARS') value in the high-fat control formulation (30%) showed a greater oxidative degradation of lipids during the frozen storage periods compared to low-fat formulations (20% and 15%). Physical analysis revealed that low-fat formulations containing xanthan gum had a significantly lower cooking loss and shrinkage rate than that of the high-fat control (C) formulation. The sensory evaluation showed that a high percentage of xanthan gum (1.5 and 1%) had a significant effect of preserving the texture of low-fat burgers compared to the control sample, without significant differences to other sensory attributes. Thus, adding xanthan gum improved the quality characteristics of low-fat beef burgers compared to the high-fat control formulation while frozen and during the cooking process.

الملخص

دُرست كل من الخصائص الكيميائية والميكروبية والفيزيائية والحسية لبرجر اللحم البقري قليل الدهن الذي يحتوي على تراكيز مختلفة من صمغ الكزانتان (0.5، 1، 1.5%) المضاف كبديل للدهون، حيث عمل الاستبدال الجزئي للدهون مع صمغ الكزانتان في الحفاظ على ثباتية صفات خلطات البرجر المجمد خلال فترات التخزين المجمدة المختلفة (30، 60، 90 يومًا). وقد كشفت نتائج التحليل الكيميائي لخلطات برجر اللحم البقري قليل الدسم (25، 20 ، 15% دسم) بأن النسب المرتفعة المضافة من صمغ الكزانتان (1.5 و 1%) ساهمت في الاحتفاظ بالمحتوى الغذائي للبرجر، وخصوصاً محتواه من البروتينات والأملاح والرطوبة. وقد بينت التجارب بأن طريقة الحفظ بالتجميد كان لها أثراً معنوياً في خفض الحمولة الميكروبي لعينات برجر لحم البقر، وإلى جانب ذلك، فإنه يمكن اعتبار إضافة المزيد من الدهون إلى خلطات البرجر كمصدر محتمل للحدوث تلوث ميكروبي. وقد عكس الارتفاع الكبير في قيم TBARS ضمن عينة البرغر الشاهد ذات المحتوى المرتفع من الدسم والبالغ (30%) التدهور التأكسدي للدهون الحاصل أثناء فترات التخزين المجمدة، حيث كان معدل التدهور أكثر بكثير مقارنة مع نتائج خلطات البرجر قليلة الدسم (20، 15%دسم). كما أظهر التحليل الفيزيائي بأن خلطات البرجر قليلة الدسم والتي تحتوي على صمغ الكزانتان قد كانت معدلات صفتي الفقدان بالطبخ والانكماش(التقلص) فيها أقل بكثير من معدلات هاتين الصفتين ضمن خلطة الشاهد(C)، وقد بيّن التقييم الحسي لعينات البرجر بأن النسب المرتفعة من صمغ الكزانتان (1.5 ، 1%) كان لها أثراً مرغوباً في الحفاظ على قوام البرجر قليل الدسم مقارنة مع عينة الشاهد، أما فيما يخص بقية السمات الحسية (اللون، والطعم والقبول بشكل عام) لم يكن هنالك اختلافات معنوية بين خلطات البرجر البقري قليل الدسم. ومن هذه النتائج يمكن أن نستنتج بأن إضافة صمغ الكزانتان قد أدت إلى تحسين خصائص جودة برجر اللحم البقري قليل الدسم مقارنة مع خلطات البرجر البقري التقليدية التي تحتوي على نسب مرتفعة من الدسم وذلك خلال فترات التخزين المجمد وأثناء عملية الطهي.

KEYWORDS
الكلمات المفتاحية
Beef meat, fat replacer, freezing storage, low-fat burger, quality characteristics
بديل الدهون، برجر منخفض الدهن، الحفظ بالتجميد، خصائص الجودة، اللحم البقر

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1. Introduction

Food gums have many applications in the food industry. They are used as stabilizing, suspending, gelling, and emulsifying agents to give products desired textural properties——especially in meat products that contain fatty components.

Much research has been conducted on the addition of various edible gum-hydrates (hydrocolloids) to meat products as fat replacements, aiming to produce a low-fat meat as an alternative, healthy option to fast food (Demirci *et al.*, 2014). Xanthan gum (E415) is a microbial polysaccharide obtained from *Xanthomonas campestris* bacteria——a pathogenic bacterium found in many plants that grow in Syria (Al-Zoubi *et al.*, 2016). Xanthan gum is soluble in hot and cold water even when used in low concentration; it forms a pseudo-plastic and viscous solution that is unaffected by pH, temperature change, or salt concentration (Rosalam & England, 2006; Sutherland, 2002).

A beef burger is classed as unhealthy fast food due to its high fat content reaching 30%. However, this high percentage is responsible for the desirable sensory characteristics of juiciness and mouth feel. However, it is associated with increased rates of obesity in teenagers and adults. The beef burger is among the top choices for adolescents and young adults worldwide when choosing from a fast-food menu, and Syria is no exception (Ashdown-Franks *et al.*, 2019). This necessitates obtaining alternatives to shift from an unhealthy, traditional diet to a healthy diet composed of low-fat beef burgers that have the same quality characteristics by using xanthan gum as a fat replacer.

The aim of this research is to explore the effects of adding xanthan gum as a fat replacer on the chemical, microbiological, physical, and sensory properties of a beef burger during different periods of freezing for storage.

2. Materials and Methods

A schematic representation of beef burger production is shown in Fig (1), which considers the Syrian standard specification (SNS 2836:2003) for a beef burger.

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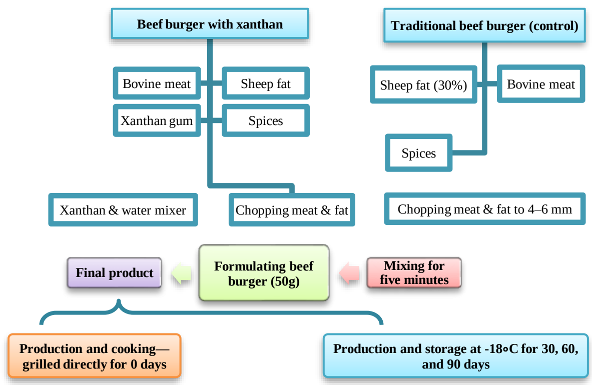
Figure (1): Schematic diagram of beef burger preparation



2.1. Preparation of Raw Materials:

2.1.1. Meat and Fat

Around 7kg of lean beef meat and 2.5kg of sheep fat (mutton fat) were purchased from a local market in Damascus. After removing the fat components and the connective tissues from the beef cuts (sirloin tip side steak), the meat and the fat were initially ground separately using a meat grinder (using a perforated plate with a hole diameter of 5mm) before being divided into ten batches for the various formulations.

2.1.2. Spices and Seasonings

A mixture of ground spices and seasoning (black pepper, coriander, ginger, cinnamon, cumin, nutmeg, and paprika spices) was weighed and added to the beef patties (5% according to the total mass of meat) as well as salt (2% of the total mass of meat).

2.1.3. Xanthan Gum

The locally isolated *Xanthomonas* bacterium was used to produce xanthan gum (in vitro) by the submerged fermentation of sugar beet molasses, which converts its sugars into xanthan gum (this process has been studied in previous research). After purification, the xanthan gum was weighed and dissolved in cold water to make a gel blend that would be added to the beef patties as a fat substitute.

2.1.4. Burger Preparation

The formulation of the beef burgers used in this study comprised beef (70%), sheep fat (mutton fat [30, 25, 20, and 15%]), xanthan gum (0, 0.5, 1, and 1.5%), ice water, spices (5%), and salt (2%). After the burger formulations were prepared, burger discs (50g in weight and 5mm thick) were shaped with a burger maker. The burger formulations are shown in Table (1).

Table (1): Experimental design formulations

Ingredients	Formulations									
	C	1	2	3	4	5	6	7	8	9
Beef %	70									
Fat %	30	25			20			15		
Xanthan %	0	0.5	1	1.5	0.5	1	1.5	0.5	1	1.5
Ice water %	0	4.5	4	3.5	9.5	9	8.5	14.5	14	13.5
Spices %	5 *									
Salt %	2 *									
* Not included in 100%										

2.1.5. Cooking and Storage of the Burgers

Burgers (20 patties per treatment) were divided into four batches (including the control). The first batch was grilled without adding any additional fat, and the other batches were frozen at -18°C and stored for three months after being packed in polyethylene bags.

2.2. Chemical Analysis:

The chemical content of each beef burger (protein, fat, moisture, and ash) was estimated according to the following methods: Moisture was determined by drying the burger in an oven at 105° C to the constant weight according to the ISO (1442: 1997). Protein was determined by the Kjeldahl procedure using a conversion factor of 6.25 according to the SNS (85: 2013). Total fat was extracted with petroleum by using the Soxtec System according to AOAC (920.39: 2006), and ash was determined gravimetrically using a muffle furnace by heating the burgers at 550°C for 4 hours according to the ISO (936: 1998).

Determination of Rancidity (Lipid Oxidation) in Meat: Lipid oxidation was monitored by measuring the TBARS value using thiobarbituric acid according to the SNS (3892: 2018) and was measured in milligrams of malondialdehyde (MDA) in kilograms per sample (MDA mg/kg sample).

2.3. Microbiological Evaluation:

Total aerobic bacterial count was quantified for all samples before and after being frozen in storage by using plate count agar (PCA) media in accordance with the ISO method (4833: 2003). The detection of *Staphylococcus aureus* was conducted according to the SNS (2822: 2003) by using Baird Parker agar. In addition, the presence of *Salmonella* bacteria was detected using Salmonella-Shigella Agar (S-S) and Bismuth Sulfite Agar (BS) according to the SNS (2477: 2001). Finally, the insolation and identification of *E.coli* 0157:H7 bacteria was done through a tryptic soy broth with novobiocin (TSB + N) and a Cefixime Tellurite Sorbitol MacConkey Agar (CT-SMAC) in accordance with an SNS method (3311: 2007), and coliform bacteria according to another SNS method (2382: 2001) by using a Violet Red Bile Agar (VRBA) medium.

2.4. Physical Characteristics:

- Cooking loss: The loss percentage was calculated using the following equation proposed by Niamnuy *et al.* (2008):
- Cooking loss **%** = [weight of raw sample (g) - weight of cooked sample (g)] × 100 / weight of raw sample (g)
- Shrinkage after cooking**:** The burger shrinkage percentage due to cooking was determined according to the following equation proposed by Ibrahim *et al.* (2011):
- Shrinkage % = [(diameter of raw sample - diameter of cooked sample) - (thickness of raw sample - thickness of cooked sample)] × 100 / [thickness of raw sample + diameter of raw sample]

2.5. Sensory Evaluation:

Sensory analyses were performed by trained panelists from the Food Science Department (Agriculture Faculty, Damascus) using the nine-point hedonic scale. Burgers were grilled at 150°C in a flat fryer to achieve a core temperature of 72°C (measured by a cooking thermometer) and kept warm until the sensory evaluation. Each panelist randomly evaluated all the formulations and was asked to give a numerical value between 1–9 for the following attributes: Color, texture, taste, and overall acceptability by giving it a value of 1 (I extremely dislike it) to 9 (I extremely like it) for each attribute (Lawless & Heymann, 2010).

2.6. Statistical Analysis:

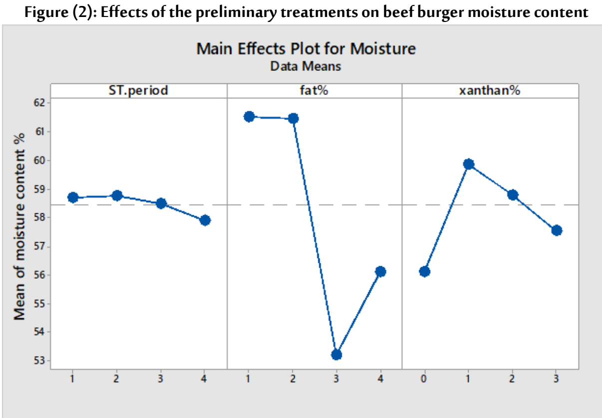
Mean values, standard deviation, and an analysis of variance (ANOVA) were calculated using the Minitab program—version 19.0. The experimental data was compared using the Fisher LSD method at a 5% significance level.

3. Results and Discussion

3.1. Chemical Analysis:

The partial replacement of fat by xanthan gum affected the proximate composition of the beef burger. The moisture content ranged from 51%–64% and differed significantly between samples ($P < 0.05$). The moisture content of the control and the high fat formulations (1, 2, and 3) were significantly lower than that of the low-fat samples ($P < 0.05$) because they were prepared with more fat and less water (Rather *et al.*, 2015). The longer frozen storage periods significantly lowered the moisture of the control burgers ($P <$ 0.05); this is attributed to the dehydration phenomenon "freeze burn," which normally happens when the surface of frozen food is exposed to air (Figure [2]) (Barbut, 2015). The higher moisture retention capacity of xanthan gum retained the moisture content of the samples during freezing storage periods while no significant difference was observed between the various concentrations of xanthan (Rather *et al.*, 2016). The moisture values of treatments 4, 5, 6, 7, and 8 were beyond the limits permitted by the SNS (2836: 2003).

Figure (2): Effects of the preliminary treatments on beef burger moisture content

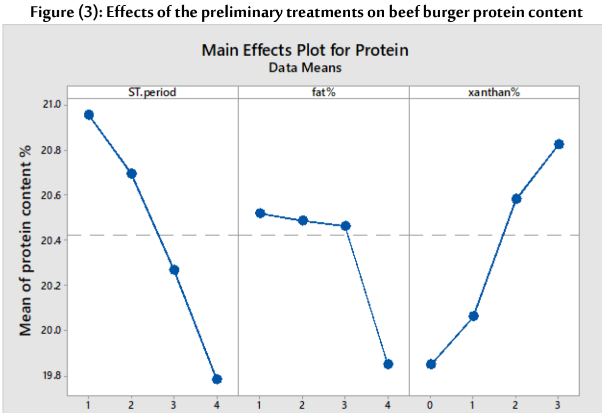


Storage period (1 = fresh, 2 = after 30 days, 3 = after 60 days, and 4 = after 90 days),% fat (1 = 15%, 2 = 20%, 3 = 25%, and 4 = 30%), and xanthan % (0 = 0%, 1 = 0.5%, 2 = 1%, and 3 = 1.5%).

3.1.1. The Protein Content

The protein content ranged from 19%–21%. Being frozen had a higher impact on the control burger than on the other samples ($P <$ 0.05) (Fig [3]), which can be explained by the damaging effects of water crystallization on the cell walls; this causes loss in nutrition content including proteins during the thawing process. Xanthan gum, especially in high concentrations (1.5% and 1% [$P < 0.05$]), preserved the protein content during freezing (Afshari *et al.*, 2017).

Figure (3): Effects of the preliminary treatments on beef burger protein content

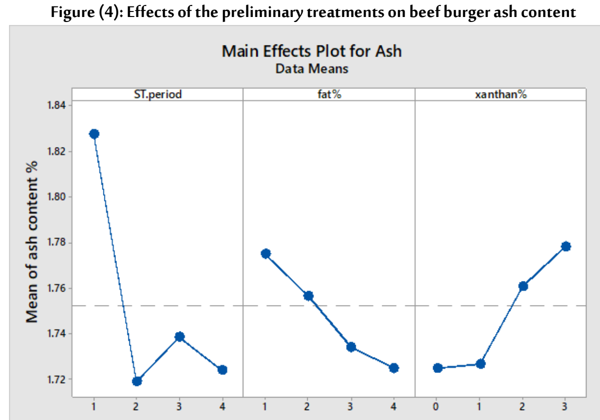


Storage period (1 = fresh, 2 = after 30 days, 3 = after 60 days, and 4 = after 90 days),% fat (1 = 15%, 2 = 20%, 3 = 25%, and 4 = 30%), and xanthan % (0 = 0%, 1 = 0.5%, 2 = 1%, and 3 = 1.5%).

3.1.2. The Ash Percentage

This was affected significantly ($P < 0.05$) by the storage periods of all burger samples (the storage period's impact was 95.6% for the control sample and 59.7% for the other samples). This could be attributed to the formulation of ice crystals, which causes the nutrient contents to bleed from the cells during the thawing process (Barbut, 2015; Sharaf *et al.*, 2009), Moreover, xanthan gum had a significant impact ($P < 0.05$) on reinforcing the nutrient content during the thawing stage by playing the role of an adhesive agent (Rosalam & England, 2006). The ash content of the burger samples ranged from 1.66%–1.87% (Fig [4]).

Figure (4): Effects of the preliminary treatments on beef burger ash content

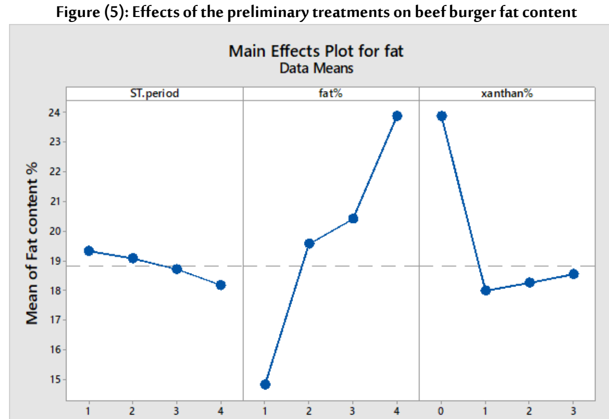


Storage period (1 = fresh, 2 = after 30 days, 3 = after 60 days, and 4 = after 90 days),% fat (1 = 15%, 2 = 20%, 3 = 25%, and 4 = 30%), and xanthan % (0 = 0%, 1 = 0.5%, 2 = 1%, and 3 = 1.5%).

3.1.3. The Fat Content

The fat content ranged from 14–25.3% and was significantly higher in the control sample than in the other burger samples ($P < 0.05$), as illustrated in Figure (5). The most effective method in lowering the calorie level is to reduce the fat content in meat products by adding food gums as a replacement (Demirci *et al.*, 2014). Adding xanthan gum at the levels of 0.5, 1, or 1.5 resulted in a significant reduction of fat content ($P < 0.05$), while the moisture values of all samples were within the limits of the SNS (2836: 2003).

Figure (5): Effects of the preliminary treatments on beef burger fat content

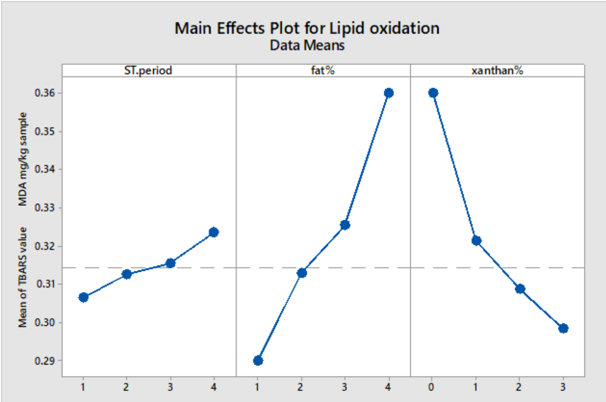


Storage period (1 = fresh, 2 = after 30 days, 3 = after 60 days, and 4 = after 90 days),% fat (1 = 15%, 2 = 20%, 3 = 25%, and 4 = 30%), and xanthan % (0 = 0%, 1 = 0.5%, 2 = 1%, and 3 = 1.5%).

3.1.4. Determination of Rancidity (Lipid Oxidation) Results/ Thiobarbituric Acid Reactive Substances (TBARS) Value

Lipid oxidation was evaluated by the levels of TBARS, as shown in Figure (6). TBARS exhibited significant effects in high values of the high fat content samples (C 1–3) ($P < 0.05$). In contrast, the TBARS values of the low-fat formulations decreased significantly ($P < 0.05$) with the increasing concentration of xanthan gum. Several researchers have reported that xanthan gum suppresses lipid oxidation by iron chelation between two side chains with a pyruvate residue, therefore disarming the peroxyl radicals (secondary lipid oxidation products) (Khouryieh *et al.*, 2015). In addition, xanthan gum reduced the undesirable effects on the burger formulations due to being frozen in storage compared to the control sample ($P < 0.05$), which had the highest value of TBARS (0.4) MDA mg/kg sample at the end of the storage period (90 days) (Sharaf *et al.,* 2009).

Figure (6): Effects of the preliminary treatments on values of beef burgers' TBARS



Storage period (1 = fresh, 2 = after 30 days, 3 = after 60 days, and 4 = after 90 days),% fat (1 = 15%, 2 = 20%, 3 = 25%, and 4 = 30%), xanthan % (0 = 0%, 1 = 0.5%, 2 = 1%, and 3 = 1.5%).

3.2. Microbiological Evaluation:

The preliminary results of all the fresh beef burgers showed significant microbial contamination ($p < 0.05$). Total aerobic bacterial count (TPC) ranged between 4.8×10^6 cfu/g (control sample) and 4.2×10^6 to 2.2×10^3 cfu/g (burger formulations), as shown in Figure (7). The total coliform count also ranged between 1.1×10^3 cfu/g (control sample) and 1.3×10^3 to 2.8×10^2 cfu/g (burger formulations). The present study did not detect *E. coli* O157: H7, *Salmonella,* or *S. aureus* from all the examined fresh beef burger samples. The microbial results were within the acceptable limits of the SNS' (2179: 2007) microbiological requirements for food (uncooked hamburgers). The contamination could be attributed to manufacturing practices (slaughter, using a meat grinder, adding spices, and the preparation stage), which could be an additional source of microbiological contamination (Shaltout *et al.*, 2017). During the frozen storage periods, the microbial results of all samples showed a clear decrease in microbial loads and a persistent negative result of *E. coli* O157:H7, *Salmonella,* and *S. aureus*, which supports the efficiency of freezing in eliminating the microbial activity due to thermal shock and ice crystallization (Barbut, 2015). Moreover, reading the microbial content of burger mixtures shows that the reduction of fat ratios had a significant impact ($p < 0.05$) in reducing 31% of the microbial content due to its consideration as a contamination factor. The highest concentration of xanthan gum significantly reduced the microbial load, especially in treatments 5, 6, 8, and 9, which suggests that the xanthan gum lowers the available water activity ($\mathbf{a_w}$) for microbial growth (Barbut, 2015). These results are presented in Figures (7) and (8).

Figure (7): Effects of the preliminary treatments on the total beef burger aerobic bacterial count

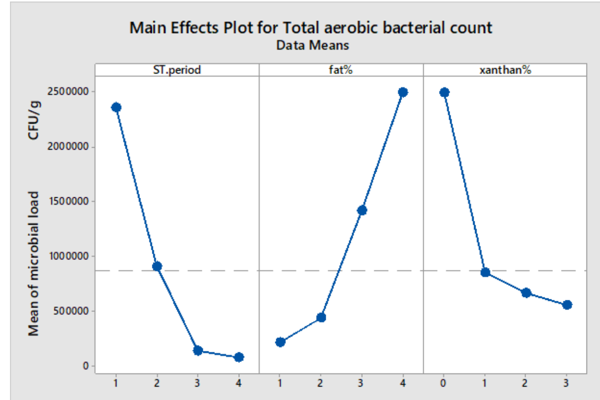
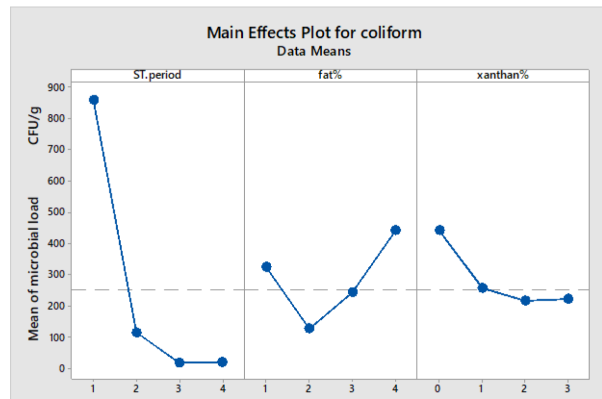


Figure (8): Effects of the preliminary treatments on the beef burger coliform bacterial count



Storage period (1 = fresh, 2 = after 30 days, 3 = after 60 days, and 4 = after 90 days),% fat (1 = 15%, 2 = 20%, 3 = 25%, and 4 = 30%), and xanthan % (0 = 0%, 1 = 0.5%, 2 = 1%, and 3 = 1.5%).

3.3. Physical Characteristics:

Experiments measuring shrinkage rates after cooking (grilling) show that the rates of contraction of the control burger samples ($p < 0.05$) were increased by 86% with a long storage period (90 days), while the experiments on cooking loss rates increased by 57%. This could be explained by the negative effect of the formation of ice crystals within the muscle tissue of meat during the freezing process. These crystals stimulated drips of blood to run away from the product easily during the cooking process, which eventually led to a loss in the product's size (Shanks *et al.*, 2002). By studying the effects of how long beef formulations are frozen in storage, the results illustrate a significant reduction in the rates of shrinkage and loss of cooking. This reduction could be attributed to their content of xanthan gum, which preserved the stability of texture of the burger samples (for about 71%), particularly in those that contained a high percentage of xanthan (formulations 3, 6, and 9) (Demirci *et al.*, 2014; Ibrahim *et al.*, 2011; Rather *et al.*, 2015). In contrast, the highest cooking loss and shrinkage rates were observed in burger samples 1, 4, and 7, which had a low concentration of xanthan gum (0.5%) and a high volume of added water (4.5%, 9.5%, and 14.5%) (Basati & Hosseini, 2018; Demirci *et al.*, 2014). The effects of the preliminary treatments on the physical characteristics of the burger samples are presented in Figures (9) and (10).

Figure (9): Effects of the preliminary treatments on the cooking loss characteristic of beef burgers

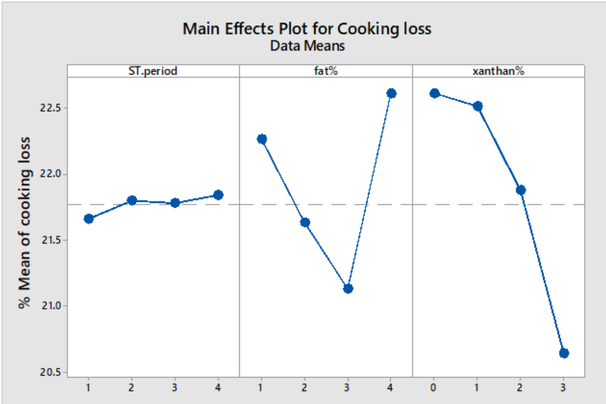
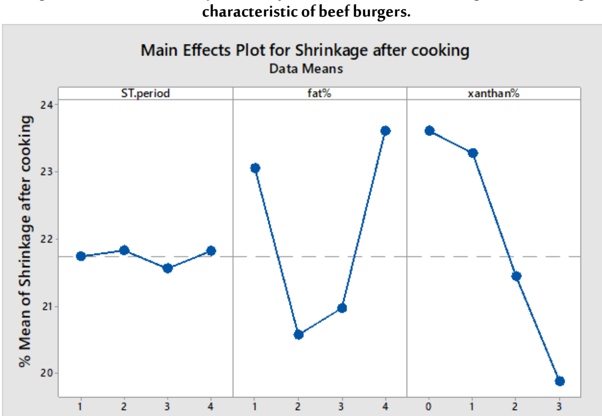


Figure (10): Effects of the preliminary treatments on the shrinkage after cooking characteristic of beef burgers.

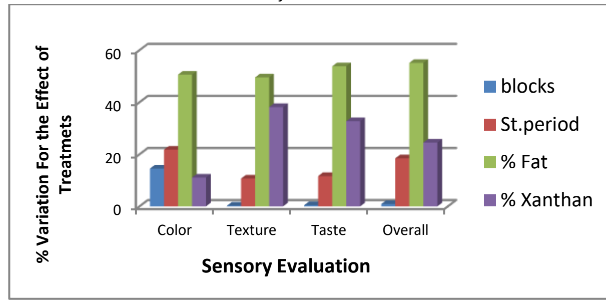


Storage period (1 = fresh, 2 = after 30 days, 3 = after 60 days, and 4 = after 90 days),% fat (1 = 15%, 2 = 20%, 3 = 25%, and 4 = 30%), and xanthan % (0 = 0%, 1 = 0.5%, 2 = 1%, and 3 = 1.5%).

3.4. Sensory Evaluation:

Texture and color are among the most important attributes that influence customer choice. The results of the sensory characteristics of different burger samples are shown in Figure (11). The factor of how long burgers were frozen had a significant effect ($p < 0.05$) on the control sample's texture. The impact of freezing was explained by the large amount of ice crystal formation. The increase in crystals is a product of content drip loss during the thawing phase (Barbut, 2015). Another drawback of the frozen storage factor was the dark color of the control sample; this was a result of air exposure, which caused dryness (freezer burns) during storage and the Oxy-Myoglobin dye (responsible for brighter red color in meat) oxidizing into Met-Myoglobin (Zhang *et al.,* 2016). The comparison between the sensory characteristics of the formulation samples and the control indicates that fat content primarily affects these attributes. This was manifested by increasing the acceptance of color and taste with high content of fat, especially the percentage 15% and 20% (Sharaf *et al.*, 2009). In addition, the tests reveal that adding xanthan to burger samples has a desirable effect ($p < 0.05$) through improving the texture and maintaining the consistency of the burger product during the storage period and cooking level. This confirms the role of the gum of xanthan as a stabilizer and binding agent and indicates its contribution to providing cohesive and succulent effects to the burgers when the fat content is decreased (Barbut, 2015; Rather *et al.*, 2015; Sharaf *et al.*, 2009).

Figure (11): Effects of the preliminary treatments on the beef burger formulations' sensory characteristics



4. Conclusion

The research concludes that xanthan gum can be a suitable fat replacer in low-fat beef burgers as it does not result in any significant decline in the quality or acceptability of this product as perceived by the consumer. Low-fat formulations containing xanthan gum had significantly lower TBARS values, shrinkage, and cooking loss than the traditional beef burger ($P < 0.05$). Furthermore, xanthan gum retained the chemical content of low-fat formulations during the frozen storage periods. Replacing fat with xanthan showed no significant differences in overall acceptability compared to the high-fat content beef burger. Thus, the addition of xanthan gum could be a valuable alternative to improving the quality of low-fat beef burgers.

Bios

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References

Afshari, R., Hosseini, A., Mousavi Khaneghah, A., & Khaksar, R. (2017). Physico-chemical properties of functional low-fat beef burgers: Fatty acid profile modification. *LWT - Food Science and Technology*, **78**(n/a), 325–31.

Al-Zoubi, H., Jabour, M., Wajhani, Y., & Qarabisa, M. (2016). *National report on the biological diversity of genetic resources for food and agriculture in the Syrian Arab Republic. Country reports*. Syrian: Food and Agriculture Organization of the United Nations (FAO).

Ashdown-Franks, G., Vancampfort, D., Firth, J., Smith, L., Sabiston, C.M., Stubbs, M., & Koyanagi, A. (2019). Association of leisure-time sedentary behavior with fast food and carbonated soft drink consumption among 133,555 adolescents aged 12–15 years in 44 low- and middle-income countries. *International Journal of Behavioral Nutrition and Physical Activity,* **16**(35), 1–11. DOI: 10.1186/s12966-019-0796-3.

Barbut, S. (2015). *The science of poultry and meat processing*. Guelph, Ontario, Canada: University of Guelph.

Basati, A. & Hosseini, S.E. (2018). The effects of adding xanthan and carboxy methyl cellulose on cooking and sensory characteristics of soya burger. *Journal of Food Biosciences and Technology, Islamic Azad University, Science and Research Branch,* **8**(1), 59–64.

Demirci, Z.O., Yılmaz, I., & Demirci, A.S. (2014). Effects of xanthan, guar, carrageenan and locust bean gum addition on physical, chemical and sensory properties of meatballs. *Journal of Food Science and Technology,* **51**(5), 936–42.

Ibrahim, M.A., Salama, M.F., & Hussein, A.A. (2011). Production of functional low-fat chicken burger. *Australian Journal of Basic and Applied Sciences,* **5**(12), 3149–54.

Khouryieh, H., Puli, G., Williams, K., & Aramouni, F. (2015). Effects of xanthan–locust bean gum mixtures on the physicochemical properties and oxidative stability of whey protein stabilised oil in-water emulsions. *Food Chem,* **167**(n/a), 340–348.

Lawless, H. T. & Heymann, H. (2010). *Sensory evaluation of food: Principles and practices*. New York, NY: Springer.

Niamnuy, C., Devahastin, S., & Soponronnarit, S. (2008). Changes in protein compositions and their effects on physical changes of shrimp during boiling in salt solution. *J Food Chem,* **108**(n/a), 165–75.

Rather, S. A., Masoodi, F. A., Akhter, R., Gani, A., Wani, S. M., & Malik, A. H. (2015). Xanthan gum as a fat replacer in goshtaba-a traditional meat product of India: Effects on quality and oxidative stability. *J Food Sci Technol,* **52**(12), 8104–12.

Rather, S.A., Masoodi, F.A., Akhter, R., Rather, J.A., Gani, A., Wani, S.M., & Malik, A. H. (2016). Application of guar–xanthan gum mixture as a partial fat replacer in meat emulsions. *J Food Sci Technol,* **53**(6), 2876–86. DOI: 10.1007/s13197-016-2270-4.

Rosalam, S. & England, R. (2006). Review of xanthan gum production from unmodified starches by Xanthomonas campestris sp. *Enzyme and Microbial Technology,* **39**(2), 197–207.

Shaltout, F.A., Maarouf, A.A.A., & Mohamed, H.H.A. (2017). Bacteriological aspect of frozen beef burger. *EC Nutrition,* **10**(4), 162–72.

Shanks, B.C., Wulf, D.M., & Maddock, R.J. (2002). Technical note: The effect of freezing on Warner-Bratzler shear force values of beef longissimus steaks across several post-mortem aging periods. *J Anim Sci,* **80**(n/a), 2122–5. DOI: 10.2527/2002.

Sharaf, A.M., Ebrahium, M.E., Ammar, M.S., & Abd El-Ghany, M.E. (2009). Influence of using moringa meal flour as meat extender on quality characteristics of beef burger patties during frozen storage. *World Journal of Dairy & Food Sciences,* **4**(1), 32–40.

Sutherland, I. (2002). A sticky business. Microbial polysaccharides: Current products and future trends. *Microbiology Today,* **29**(n/a), 70–1.

Zhang, X., Deyong, L., Meng, Q., He, C., & Ren, L. (2016). Effect of mulberry leaf extracts on color, lipid oxidation, antioxidant enzyme activities and oxidative breakdown products of raw ground beef during refrigerated storage. *Journal of Food Quality,* **39**(n/a), 159–70.