

Analysis of Characteristics and Organoleptic of Tomato Sauce with the Addition of Various Concentration Levels of Guar Gum

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ABSTRACT

Guar gum is a thickener with the advantages of increasing viscosity even at low concentrations, a neutral taste and aroma, and easy water solubility compared to other types of gum seeds. The use of guar gum as a thickening agent is reported to produce good volatility. The use of thickening agents is necessary in the production of tomato sauce, as tomatoes have a high water content, which makes them watery. Therefore, adding a thickening agent in the form of guar gum is done to improve the texture of tomato sauce. This study aims to determine the best concentration of guar gum in terms of pH, viscosity, total solubility, and organoleptic levels of tomato paste. The aim is to produce a high-quality tomato sauce that is universally acceptable in terms of flavor, aroma, color, and texture. Additionally, this research supports the use of guar gum as an alternative thickener with desirable viscosity properties. The experimental design used in this study is a laboratory study using a full randomized design (CRD) in which guar gum concentrations were used as treatment groups with 0,4, 0,5, 0,6, 0,7, and 0,8%. The analysis in this study included a number of parameters such as pH, viscosity, total solubility, and anorexic test. Data were analyzed using Analysis of Variance (ANOVA) with Statistical Product and Service Solutions (SPSS) version 23 for parametric data and Kruskal-Wallis for non-parametric data. The findings showed that the incorporation of guar gum had a significant effect on the pH, viscosity, and total solubility of tomato sauce. The optimal treatment was determined to be A5, with a guar gum concentration of 0.8%, yielding the most favorable results.

Keywords: Guar Gum; pH; Tomato Sauce; Total Dissolved Solids; Viscosity.

INTRODUCTION

Tomatoes (*Solanum lycopersicum* Linn.) are plants that are widely grown in Indonesia and have many health benefits, such as being able to lower cholesterol, fighting cancer, anti-free radicals and can control cholesterol (Thalib, 2019). However, tomatoes have high water content, which makes them perishable and easily damaged (Sjarif & Apriani, 2016). The best way to prevent this is to process tomatoes into food products, one of which is tomato sauce.

Tomato sauce is a processed tomato product that is added to many foods and therefore has a high potential for development in the market (Belgis et al., 2022). Data from Food Consumption Statistics 2022 shows that the consumption of tomato sauce increased by 9.09% from 2021 to 2022 (Mas'ud & Wahyuningsih, 2022). This shows that the need for tomato sauce is growing exponentially more valuable to the community.

The raw material for tomato sauce is tomato fruit, which is high in water, and the resulting tomato sauce therefore has a watery texture. The addition of thickening substances in tomato sauce production is necessary because viscosity is an important element (Cai et al., 2020). Therefore, it is necessary to add thickeners, which may enhance the texture of the resulting

tomato sauce.

The most common thickening agents used in tomato sauces are pectin, carboxymethyl cellulose (CMC), and starches such as cornstarch, tapioca flour, and modified flour (Sjarif & Apriani, 2016). Pectin may be dissolved easily in water and may be a stabilizing agent, but in terms of price and method of obtaining it, pectin is rare and expensive (Dipowaseso et al., 2018). CMC is widely used as a thickener in food products, but it has no health benefits (Suprapti, 2000). CMC may be used as a thickener in tomato sauce, but thickeners containing starch have the disadvantage of being easy to reverse this making the characteristics of the sauce less attractive and stable (Herlina et al., 2016). Although cornstarch is effective in providing viscosity, it may make the sauce cloudy and lose clarity, which is in line with the study by Najih (2018), which reported that the addition of flour thickeners may affect the color.

Guar gum is a thickener that is said to have a high viscosity even when added in low concentrations. Guar gum may be used as a thickener and stabilizer in products such as noodles, sauces, jams, and others (Herawati, 2018). Guar gum is white, has a neutral taste, and is tasteless, so it has no significant effect when added to foodstuffs (Tetelepta, 2022). Amalya et al (2023) reported that adding guar gum to Arabica coffee syrup yielded the best results compared with adding thickeners from other types of gum. The thickening mechanism occurs when guar gum is added to the material, causing the polymer chains to bind together and form a three-dimensional network. A membrane may bind water to form a solid structure (Hakim et al., 2018).

This research focused on the use of guar gum as a thickening agent for tomato sauce. This selection is based on the properties of guar gum, which can easily dissolve in cold water, bind water more easily, produce higher viscosity, improve gel strength, and maintain emulsions (Picauly, 2022). The purpose of this study is to investigate the effect of guar gum concentration on tomato sauce products by testing the pH, viscosity, and total soluble solids by Analysis of Variance (ANOVA) tests. The level of panelist favorability was determined through organoleptic testing. In addition, efficacy testing was conducted to determine the best treatment.

METHODS

Materials

The materials used in the research were tomato fruit (*Solanum lycopersicum* Linn.), guar gum, garlic, salt (kapal), sugar (rose brand), ground pepper (ladaku), water, and vinegar (kura-kura). The materials used for chemical analysis were pH 4 and 7 buffer solutions, and distilled water.

Tools

The equipment used in the research was a blender (Cosmos CB-802), analytical balance (SER 14226114), digital scale (SF-400), pH meter (Eutech pH 150), beaker glass, hand refractometer (VIS-70381-79417), and viscometer (NDJ-8S).

Tomato Puree Preparation

The procedure for making tomato pulp was modified from the literature by Wandestri et al. (2016). In the first step, tomato fruits were sorted to separate damaged, deformed, and rotten

ones. Then the tomatoes were weighed up to 1 kg and washed with running water. Clean tomatoes were steamed at 90°C for 20 minutes and cooled at room temperature, then continued with the pureeing process. The pureeing process was carried out by putting steamed tomatoes, 30 g of garlic, and 500 ml of water into a blender and pureeing at high speed for 3 minutes. The resulting tomato pulp was filtered to separate the granules

Tomato Sauce Preparation

Tomato pulp was cooked with 30 g of salt, 200 g of sugar, 1 g of ground pepper, 12 mL of 25% vinegar, and guar gum according to the predetermined concentration. The cooking process was carried out for 45 minutes using low heat below 90°C, and stirring until the tomato sauce thickened. The tomato sauce was then packaged into sterilized glass bottles. The packaged tomato sauce was re-sterilized by boiling at 70°C for 30 minutes.

Research Design

This research was conducted using a completely randomized design (CRD) and used one variable, which was the concentration of guar gum, including concentrations of A1 = 0.4%, A2 = 0.5%, A3 = 0.6%, A4 = 0.7%, and A5 = 0.8%. This study was repeated three times for a total of 15 experimental units.

Test Parameters

The analyses performed in this study included pH (Sudarmadji et al., 1984), viscosity (Jacobs, 1958), total soluble solids (SNI 01-3546-2004), and an organoleptic test with 25 trained panelists with parameters of color, flavor, aroma, and texture (Suri et al., 2025 & Violalita et al., 2025). The method used in this organoleptic test are the hedonic method with liking-lack of liking of the product to be evaluated, using the following scale 1 = strongly dislike, 2 = dislikes, 3 = slightly likes, 4 = neutral, 5 = slightly like, 6 = like, 7 = strongly like (Setyaningsih, et al., 2010) and effectiveness tests using a variable method where the better average, the more variables desired in the product are needed (Sigit and Budiyanto, 2017).

Data Analysis

The data were analyzed using the analysis of variance (ANOVA), and if there were significant differences between treatments, it was followed by the Least Significant Difference Test (LSDT) at the 5% level. The organoleptic test was analyzed based on panelists' liking to determine whether there was an effect of a treatment carried out using the Kruskal-Wallis test and if there was a difference, it was continued with the Man Whitney U test.

RESULTS AND DISCUSSION

pH Level

Based on the analysis of variance (ANOVA), it shows that the addition of guar gum with different concentration variations has a significant effect on the pH of tomato sauce, as shown in Figure 1.

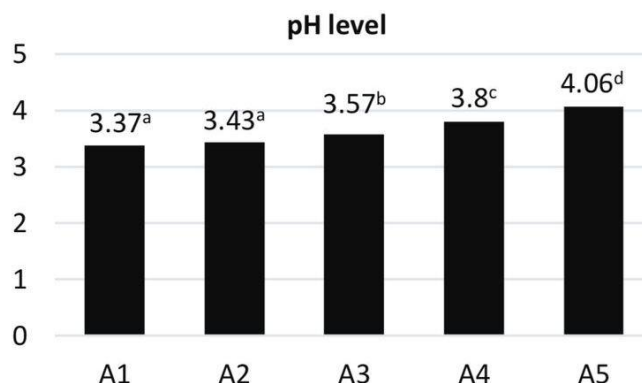


Figure 1: The pH levels of tomato sauce

Notes: Letters behind numbers that have the same notation indicate no difference in the LSD test <5%.

Figure 1 shows that the higher concentration of guar gum added causes an increase in the pH of the tomato sauce. Krstonosic et al (2021) showed that guar gum has a pH close to neutral conditions, which is around 5-7, so when added, it can increase the pH level of food ingredients. This is in line with the findings of Musbah et al (2018), who reported that the higher the concentration of guar gum added, the higher the pH level.

Referring to the quality requirements for tomato sauce SNI 01-3546-2004, the requirements for the pH of tomato sauce are between 3-4. The treatments that have met the quality requirements for the pH of tomato sauce are treatments A1 to A4.

Viscosity

Based on the analysis of variance (ANOVA), shows that the addition of guar gum with different concentration variations has a significant effect on the viscosity of tomato sauce, as shown in Figure 2.

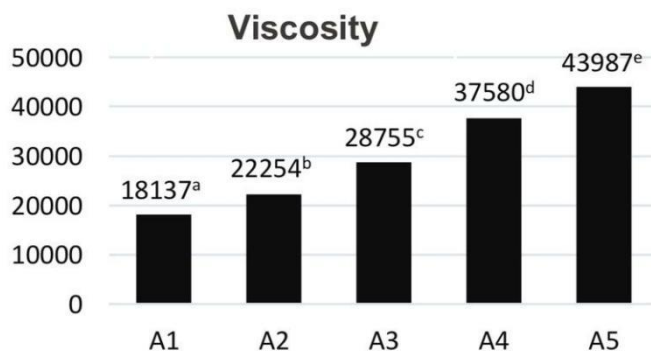


Figure 2: The viscosity of tomato sauce

Notes: Letters behind numbers that have the same notation indicate no difference in the LSD test <5%.

Figure 2 shows that the higher addition of guar gum causes an increase in the viscosity of tomato sauce. Treatment A5 produced the highest viscosity with a value of 43987 mPa · s, while treatment A1 produced the lowest viscosity with a value of 18137 mPa · s. The addition of guar gum at high concentrations causes an increase in the viscosity value. Martha et al stated that the addition of guar gum can reduce water activity, which causes an increase in viscosity. Guar

gum contains crude fiber, which can bind water, causing thickening in food ingredients (Picauly, 2022). The viscosity value is not regulated in the quality requirements of SNI 01-3546-2004 tomato sauce, but it is an important quality parameter. Kumbar et al (2019) stated that viscosity is one of the quality aspects that must be considered in determining the quality and consumer acceptance of tomato products. This is the opinion of Shatta et al (2019), who stated that viscosity is an important quality parameter of tomato sauce products.

Total Soluble Solids

Based on the analysis of variance (ANOVA), shows that the addition of guar gum with different concentration variations has a significant effect on the total soluble solids of tomato sauce, as shown in Figure 3.

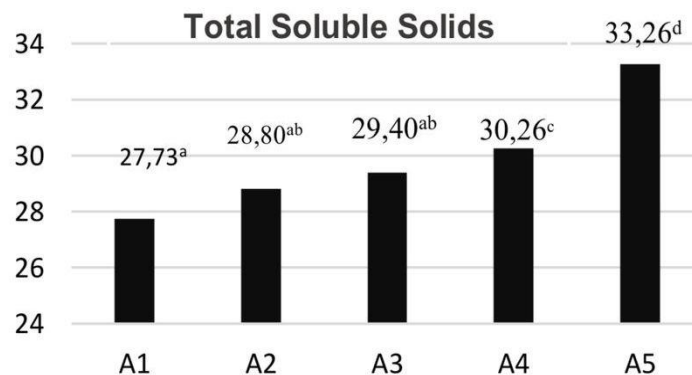


Figure 3: Histogram of total soluble solids of tomato sauce

Notes: Letters behind numbers that have the same notation indicate no difference in the LSD test < 5%.

Figure 3 shows that the higher addition of guar gum causes an increase in total dissolved solids in tomato sauce. The results showed that the highest total dissolved solids value was obtained in treatment A5 with a value of 33.26°brix, while the lowest total dissolved solids value was obtained in treatment A1 with a value of 27.73°brix. The total dissolved solids value is directly proportional to the viscosity value (Amalya et al., 2023). The addition of guar gum at high concentrations causes an increase in total dissolved solids because guar gum can bind water and increase viscosity, so that total solids increase. This is the opinion of Martha et al. (2022), which shows that increasing the number of bound particles will increase total dissolved solids.

Total dissolved solids are closely related to the reducing sugar content in a treatment. If the sugar content in a sample has a high value, then the total dissolved solids value produced will also be higher (Bait et al., 2022). Guar gum contains monosaccharide molecules composed of galactose, which act as reducing sugars. This is the opinion of Tripathy & Das (2013), who stated that the increase in total dissolved solids occurs because guar gum is composed of a linear chain of β -1,4-D-galactomannan with α -1,6-D-galactose.

Referring to the quality requirements of tomato sauce SNI 01-3546-2004, which requires a minimum total dissolved solids value of tomato sauce of 30°brix, the treatments that meet the quality requirements are Treatment A4 with a total dissolved solids value of 30.26°brix and Treatment A5 with a total dissolved solids value of 33.26°brix.

HEDONIC SCALE

Color

The results of the Kruskal-Wallis test analysis show that there are significant differences between treatments, so the addition of guar gum at different concentrations affects the level of panelist acceptance of tomato sauce color. The results of the organoleptic test analysis of tomato sauce color are also shown in Figure 4.

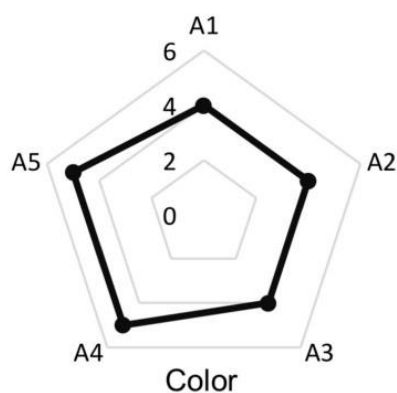


Figure 4. Graph of panelists' liking of tomato sauce color

Figure 4 shows that the results of the organoleptic test on the color of tomato sauce with the addition of guar gum, which is most preferred by the panelists, are in treatments A4 and A5, which are marked by the graph line approaching the corners of A4 and A5.

The higher the concentration of guar gum added, the higher the panelists' liking of the color of the tomato sauce, because it has a brighter color. This is consistent with the research of Amalya et al. (2023), who reported that the addition of hydrocolloids to food ingredients results in a brighter color of the product.

Flavor

The results of the Kruskal-Wallis test analysis show that there are significant differences between treatments, so the addition of guar gum at different concentrations affects the level of panelists' acceptance of the flavor of tomato sauce. The results of the organoleptic test analysis on the flavor of tomato sauce are also shown in Figure 5.

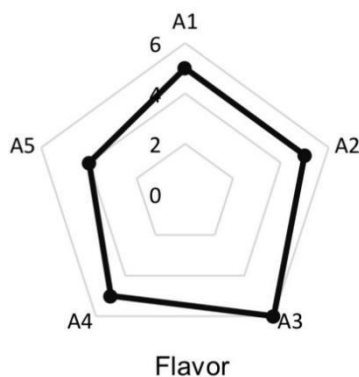


Figure 5. Graph of panelists' liking for tomato sauce flavor

Figure 5 shows that the highest flavor preferences core was obtained by treatment A3, as indicated by the graph line approaching the corner of A3. The addition of guar gum at a high concentration resulted in a lower panelist preference for the flavor of tomato sauce. Guar gum has a bland flavor (Abdel-raouf et al., 2021), so the higher the addition of guar gum, the lower the flavor of tomato sauce.

Aroma

The results of the Kruskal-Wallis test analysis showed that there were no significant differences between the treatments, so the addition of guar gum at different concentrations did not affect the level of panelists' acceptance of the aroma of tomato sauce. The results of the organoleptic test analysis of tomato sauce aroma are also shown in Figure 6.

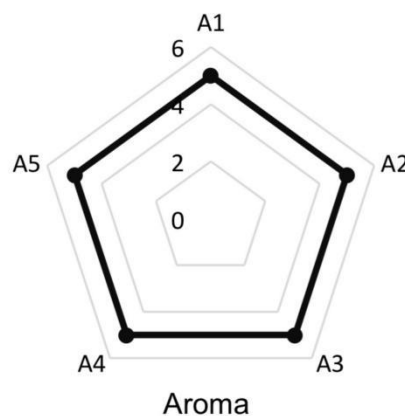


Figure 6. The panelists' liking of tomato sauce aroma

Figure 6 shows that the graph lines form parallel angles, meaning that the addition of guar gum at various concentrations does not affect the panelists' preference for the aroma of tomato sauce. The addition of guar gum does not affect the aroma of tomato sauce because guar gum does not have a specific aroma. Tetelepta (2022) reported that guar gum has odorless characteristics, so when added to food ingredients, it does not have a significant effect.

Texture

The results of the Kruskal-Wallis test analysis show that there are significant differences between treatments, so the addition of guar gum with different concentrations affects the level of panelists' acceptance of tomato sauce texture. The results of the organoleptic test analysis of tomato sauce texture are also shown in Figure 7.

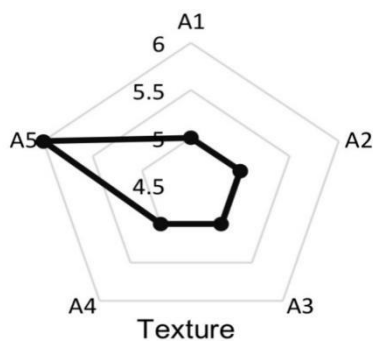


Figure 7. The panelists' liking of tomato sauce texture

Figure 7 shows that tomato sauce treatment A5 produces the highest texture preference value among the other treatments, as shown by the graph line approaching the corner of A5. The addition of guar gum affects the texture of the tomato sauce produced. This is in agreement with their search of Picauly (2022), who reported that the higher addition of guar gum resulted in an increased viscosity value, so the resulting product is thicker. On the other hand, when guar gum is added at a low concentration, the viscosity value decreases, so that the resulting product has a watery texture.

EFFECTIVENESS TEST

The effectiveness test is a test to determine the best treatment of all parameters, which can be seen in their sult value (NH) with the highest value. Determination of the effectiveness value of each variable is done using the formula

$$\text{Index formula} = \frac{NA-NR}{NT-NR}$$

The variance whose average is greater the better, so the low value is the worst value and the high value is the best value. The result value (NH) of each variable is obtained from the multiplication of the normal weight (BN) by the effectiveness value (NE) obtained from all variables and the best combination of treatment is selected, which has the highest result value (NH). The data from the calculation of the effectiveness test are presented in tabular form. The results of the efficacy test are shown in Table 1.

Table1. Total Result Value (NH) Effectiveness Test

Treatment	Total
A1 (Guar gum concentration 0.4%)	0,07
A2 (Guar gum concentration 0.4%)	0,12
A3 (Guar gum concentration 0.6%)	0,28
A4 (Guar gum concentration 0.7%)	0,47
A5 (Guar gum concentration 0.8%)	0,71

Based on the results of the effectiveness test on all the research parameters which include pH levels, viscosity, total soluble solids and organoleptic tests on tomato sauce with the addition of guar gum, it shows that the best treatment is obtained by A5 treatment with the addition of guar gum concentration of 0.8% which has a Result Value (NH) of 0.71 with parameters namely pH levels = 4.06, viscosity = 43987 mPa. S, total soluble solids = 33.26 °brix, and organoleptic test including color = 5 (slightly like), flavor = 4 (neutral), aroma = 5 (slightly like), texture = 6 (like).

CONCLUSION

The addition of guar gum at different concentration variations had a significant effect on the pH, viscosity, and total soluble solids of tomato sauce. The organoleptic test results showed that the A5 treatment was the most preferred treatment by the panelists. Based on the results of the efficacy test, the A5 treatment with the addition of 0.8% guar gum concentration became the best treatment among the other treatments with a Result Value (NH) of 0.71 with parameter criteria, namely pH level = 4.06, viscosity = 43987 mPa.s, total soluble solids = 33.26°brix, color = 5 (slightly like), flavor = 4 (neutral), aroma = 5 (slightly like) and texture = 6 (like).

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