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### Improving Sausage Quality Using Transglutaminase Enzyme to Increase Selling Value

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#### Abstract

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One of the most important aspects that need to be considered in a food product is a product that has good quality. Products that have good quality can be profitable for a company because they can increase consumer interest and have a high selling value, so that the quality of the company will be maintained. Meat is one of the important food sources for humans because of its high protein content. Sausage is one of the derivative products from meat raw materials that is very popular and in demand by most people. Sausage products generally have a chewy and soft texture. The chewy texture of sausages can be influenced by the type of meat used, fillers, and food additives such as STTP (Sodium Tripolyphosphate), carrageenan, mixphos, borax and sodium bicarbonate. However, the use of these additives is not recommended for continuous consumption because the chemicals contained can cause health problems. Efforts can be made to increase the selling value and texture quality by modifying the use of transglutaminase enzyme. This transglutaminase enzyme modification aims to improve the quality of sausage so that it is expected to remain a processed product that is still popular in the community and can compete with other processed meat products, and can be accepted by consumers. The advantage of using transglutaminase enzymes, besides being safe and harmless to foodstuffs, also has economic value so that it is very effective to use. The purpose of this research is to increase the selling value of sausage by improving the quality using transglutaminase enzyme in order to compete with other sausage products. The results of the modification of the use of transglutaminase enzyme showed that there was an increase in the quality of chewiness by 40% compared to without the addition of enzymes, an increase in taste by 8% and the brightness of the product increased by 80%.

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## Introduction

Sausage is a processed product that is in great demand by the public. According to BPS, (2018) sausage production has increased from 2015 by 1,628,307 tons to 2017 by 3,175,853 tons. So that at this time the development of increasingly sophisticated technology has caused changes in people's lifestyles which tend to choose food that is convenient, economical and practical. Sausage is one of the ready-to-eat food products processed from a mixture of minced meat and flour with additional seasonings, food additives, which are placed in a container or sleeve.

Based on SNI (Indonesian National Standard) 01-3820-1995, a good sausage contains a maximum of 67% water, a minimum of 13% protein, a maximum of 25% fat, a maximum of 25% carbohydrates, a maximum of 8% crude fiber, a maximum of 25% and a maximum of 3% ash. According to Ismanto et al. (2020), there are several characteristics that must be met to be considered a quality sausage, including having a chewy texture, low cooking loss, high water binding capacity (DIA) so that it has good juiciness, good slicing power, and has a taste that is acceptable to consumers.

Chewiness is one of several parameters used as a reference to determine whether the quality of sausage products is good or not. There are several ways to maintain the quality of sausages, especially the chewiness texture of sausages, one of which is by using STTP (Sodium Tripoliphosphat) food additives. Sodium tripolyphosphate (STTP) is a chemical to increase the chewiness of processed meat and fish products. However, the continuous use of STTP can cause health problems, especially the use of borax which is very dangerous (Herlina et al., 2015).

The current sources of competitive advantage are innovation and creativity (Safrizal, 2023). Employee performance is a stage of achievement as an employee's work achievement (Safrizal et al. 2020). Human resources are by far the most important asset for an organization (Safrizal et al. 2020). The era of globalization is always marked by rapid changes in overall economic conditions which cause a number of demands to emerge in response to the changes that occur (Safrizal et al. 2020). Focus on technologies that enable MCS to be implemented in smart cities, such as task management, data collection, incentive systems, monitoring, and cost-saving tools (Wildan et al., 2023). High Quality of Service and client-based communication with AI-enabled services is determined by Quality of Experience (QoE), (Padmapriya et al., 2023). Human Activity Recognition has been researched for the past few years (Victoria, et al., 2022). Previous research found that CSR can increase company value (tarjo et al., 2022). International trade is one of the efforts to increase economic growth and development (Priyadi et al., 2022). As a financial institution that has an intermediary function, the role of banks is very important in the economic activities of a country, where banks become institutions that distribute funds and as a place for financial transactions, this makes banks unchanged like the pulse in the human body which is very much needed to support the smooth running of a country's economy (Ryandono et al., 2022).

An alternative that can be used to reduce the use of chemicals is by using transglutaminase enzyme. The benefits of using transglutaminase enzymes can improve the texture of sausages due to the enzyme's ability to make complex protein bonds, so that sausage products become chewy, juicy and reduce cooking loss. According to Zaharudin et al. (2021), transglutaminase enzyme is an enzyme that plays a role in the process of unification or molecular binding of proteins. The action of TGase enzyme can be seen from its ability to catalyze the formation of covalent bonds between amino groups of lysyl residues and carboxyamide groups of glutamine residues in adjacent protein molecules. Therefore, this study aimed to determine the enzyme addition and cooking temperature that are favorable for sausage quality.

## RESEARCH METHODE TOOLS AND MATERIALS

The tools and materials used include texture analyser, color reader, oven,

desiccator, analytical scales, knife, basin, gas stove, sausage casings, stuffer, blender, bowl, cup, mortar, pH meter, beaker glass, measuring cup, thermogan and digital scales. the materials used in this study are beef, salt, sugar, wheat flour, starch flour, ice cubes, distilled water, flavoring and transglutaminase enzyme.

## PROCEDURE

The sausage making process begins with cutting the meat. The cutting process aims to expand the surface of the meat so as to facilitate grinding. Furthermore, the grinding process in the study was carried out in two stages. In the first milling, the meat was mashed using a blender for 40 seconds by adding ice cubes. The addition of ice cubes in the milling process aims to keep the dough temperature low during milling so that emulsion stability is maintained. In the second grinding stage for 60 seconds, additional ingredients such as wheat flour, salt, sugar, egg white, transglutaminase enzyme 0.5% and 1.0% were added. The purpose of the milling process is to smooth the meat to form an emulsion system, expand the contact area of the meat with other ingredients, and mix all the ingredients into homogeneous.

The dough that has been obtained is put into a stuffer with a casing at the end. The end of the casing is tied and then the stuffer is pressed until the dough enters the casing. After containing the sausage dough, the sausages are tied with a bond distance of  $\pm 10$  cm. The molding in this sleeve aims to produce a uniform sausage size during boiling by putting the sausage dough into the sleeve carefully so that there are no air bubbles (Anggraeni et al., 2014). According to Setiasih et al (2003), the texture and elasticity of the sausage is strongly influenced by the density of the sausage contents in the sleeve.

The casing is filled with dough, then the sausage is immersed in water at 60°C and 70°C for about 15 minutes and occasionally controlled with a thermogan. Then, boiling is done in a pot filled with water and cooking is done using low heat for 30 minutes. After boiling, the sausage is drained for 15 minutes. Cooling is done at room temperature to facilitate stripping the casings.

## TESTING PARAMETERS

### Color Test Analysis

Color analysis is carried out based on SNI 2015, namely the color of the sausage is normal (red or brown). Colour reader is a tool used to measure the color of a flat surface. The values that appear when taking data with a color reader are L\* (brightness-darkness), a\* (red-green) and b\* (yellow-blue). (Prasetyo et al., 2020).

### Texture Test Analysis

Texture is an important aspect for quality assessment of food products. Texture testing uses a texture analyzer. Hardness is a change in the shape of the sample when given force or pressure. Cohesiveness is an indication that shows the relationship between the compactness or strength of interacting materials. While springiness or commonly called suppleness is one of the parameters that shows the rate of change of the sample until a change in shape occurs after the product is under pressure. Stickiness or adhesion is a tendency of materials to stick to other materials (Rochmah et al., 2019).

### Organoleptic Test Analysis

Organoleptic testing or sensory assessment is an assessment method that is often used because it can be applied quickly and directly. The organoleptic test aims to give a certain value or score to quality characteristics, namely the assessment of the appearance, aroma, taste, and texture of a product used in the range from 1 to 10 with 10 testers (Darmawati et al., 2021).

## RESULT AND DISCUSSION

### Color Test

The following is the data of color test results and graphs of the relationship between the addition of transglutaminase enzyme, cooking temperature with color which can be seen in Table 1 and Figure 1.

Table 1.  
Testing Results of Color Test

Sample	brightness
E1T1	32,1
E1T2	35,0
E2T1	35,1
E2T2	38,8
E3T1	36,0
E3T2	37,7

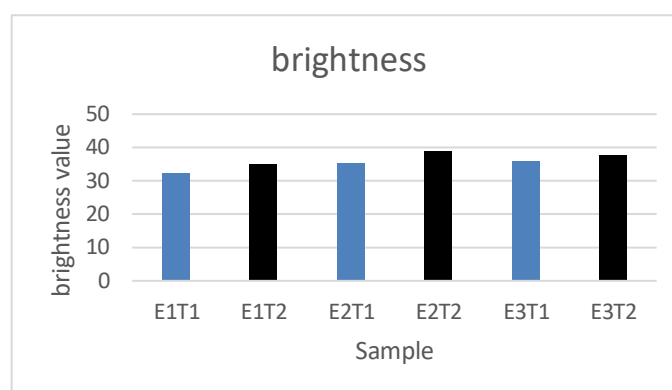


Figure 1  
Relationship Graph of Enzyme Addition, Cooking Temperature and Color

Based on the table and graph above, it shows that the color of the sausage is getting higher (brighter). Cooking with a temperature of 60°C has a color that tends to be darker than the temperature of 70°C. This is possible because the fat content in sausages added with the transglutaminase enzyme is higher than in sausages without the addition of enzymes. The interaction of polysaccharides with proteins will prevent the entry of ingredients that contain into the product, especially heat-sensitive ingredients, including fat (Ismanto et al., 2020). According to Rahasti (2008) in Ulya et al., (2020) stated that color changes can also be influenced by heating and storage, known as the millard reaction.

### Texture Test

The following are data on the results of texture testing and graphs of the relationship between the addition of transglutaminase enzyme, cooking temperature with texture which can be seen in Table 2. and Figure 2.

Table 2.  
Texture Testing Results

Sample	Springiness
E1T1	22,4%

E1T2	7,6%
E2T1	19,6%
E2T2	20,8%
E3T1	23,4%
E3T2	6,0%

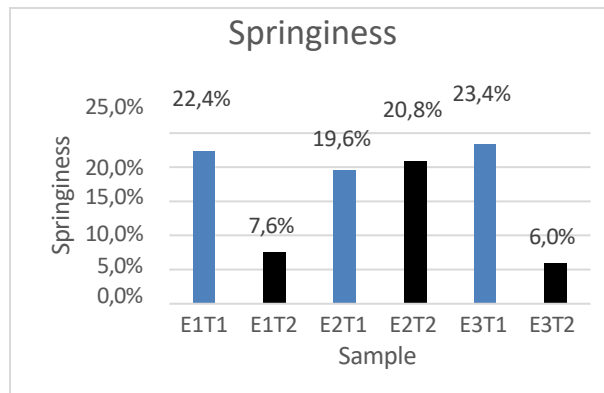


Figure 2  
Relationship Graph of Enzyme Addition, Cooking Temperature and Chewiness

Based on the table and graph above, it shows that the texture test value using a texture analyzer on sausages with the addition of transglutaminase enzyme has increased. The highest level of chewiness was obtained in sample E3T1 (1.0% Transglutaminase Enzyme with a cooking temperature of 60°C). Cooking temperature did not significantly affect the increase and decrease of chewiness level. The increase in chewiness is influenced by the addition of hydrocolloids, the more hydrocolloids added, the chewier the texture (Ramha & Aji, 2017).

#### Organoleptic Test

The following is the data on the results of the organoleptic test and the graph of the relationship between the addition of transglutaminase enzyme, cooking temperature and organoleptic test which can be seen in Table 3. and Figure 3.

Table 3.  
Organoleptic Testing Results

Sample	Taste
E1T1	3,3%
E1T2	3,4%
E2T1	3,5%
E2T2	4%
E3T1	3,6%
E3T2	3,8%

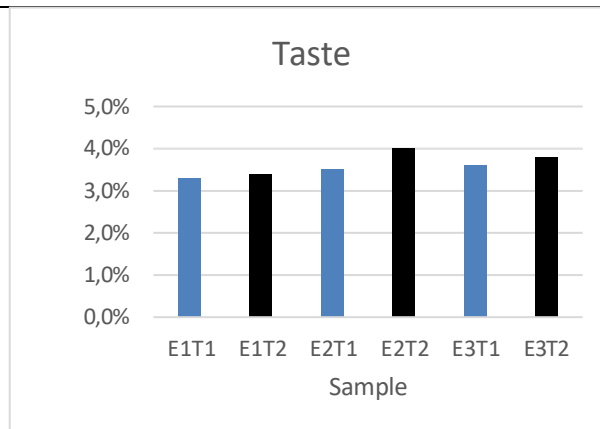


Figure 3  
Relationship Graph of Enzyme Addition, Cooking Temperature  
and Organoleptic

Based on the table and graph above, it shows that the average variable of the best treatment flavor from the panelists' assessment is in the treatment of 0.5% enzyme addition and 70 ° C cooking temperature. The treatment without the addition of enzymes has a low panelist assessment, this is because it has a different taste from sausages in general so that the panelist's assessment is low. The taste of food can be recognized and distinguished by the cecepan bud on the tongue. Taste is influenced by several factors including chemical compounds, temperature, concentration, and interactions with other components. Taste is a factor that determines whether or not a product is accepted by consumers. If the assessment parameters are better but the taste is not liked, then the product will be rejected (Imran et al., 2016).

## CONCLUSION

It was concluded that improving the quality of sausage products can be an effective strategy in increasing the selling value of sausages so that it can be profitable for companies and consumers. so enzymatic improvement of sausage product quality was carried out. The addition of 0.5% and 1.0% transglutaminase enzyme and cooking temperature of 60°C and 70°C had a significant effect on improving sausage quality. In terms of chewiness, the addition of 1.0% transglutaminase enzyme with 60°C cooking temperature was the best sample. The color parameter with a cooking temperature of 70°C, the sausage obtained was brighter in color, while for the taste parameter, the average panelist liked the sample with the addition of transglutaminase enzyme.

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