Physico-chemical properties of chicken nugget by addition gelatin from the skin and bones of goat with pretreatment *L.plantarum* and acetic acid

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Abstract. This study aimed to obtain the best quality of chicken nuggets by adding gelatin from goatskin and bones pretreated with *L.plantarum* and acetic acid. The research method was used a completely randomized design (CRD) with the following treatments: (1)control; (2) goatskin gelatin*L.plantarum*pretreatment(GsgLp); (3) goatskin gelatin acetic acid pretreatment (GsgAa); (4) goat bone gelatin*L.plantarum*pre-treatment (GbgLp); (5) goat bone gelatin acetic acid pre-treatment (GbgAa). The results showed a very significant effect (P<0.01) on pH, nugget shear force, brightness L*, reddish a* and yellowish b*. The chicken nuggets added with GbgLp showed the highest of pH value and brightness L* color, but the nugget shear force showed the lowest value. The chicken nuggets added by GbgAa showed the highest a* reddish color value, as did chicken nuggets with the addition of GsgLp showed the highest yellowish color value. Conclusion, the chicken nuggets added with GbgLp showed better quality.

1. Introduction

The consumption pattern of today's society, both in urban and rural areas, has undergone rapid changes. People, especially in urban areas, prefer to consume food products that are ready to eat and ready to cook. Ready to eat products are food products that when they reach consumers the products can be consumed directly [1]. Meanwhile, ready to cook products are food products that have undergone a process of processing to packaging so that when the product reaches consumers, the product is ready to be fried and then consumed [1], for example, chicken nuggets. Chicken nuggets are chicken meat products made of meat with a mixture of seasoned flour, wrapped in dough, cooked half-cooked and then temporarily frozen to maintain quality [2,3]. The nutritional content of chicken nuggets consists of vitamins, protein, minerals and carbohydrates [4]. In addition to nutritional content, the content of acidity, colour and breaking power of chicken nuggets that affect tenderness must be considered. There have been many studies to improve the physical and chemical quality of chicken nuggets. One way to improve the physical and chemical quality of chicken nuggets is the addition of *L. plantarum*pre-treatment goatskin and bone gelatine and acetic acid [5–7]. Gelatine is a protein derivative compound obtained from collagen extract which has a binding and emulsifying function [8]. Gelatin obtained by pre-treatment of *L. plantarum* and acetic acid showed good quality, healthy and functional food [9]. It is in line with the statement [10] that *L. plantarum* acts as

hydrolysis of the food industry in Indonesia. The research objective was to determine the physical, chemical characteristics of chicken nuggets with the addition of *L. plantarum* and acetic acid pre-treatment goat skin gelatine.

2. Materials and methods

2.1. Materials

The materials used in this study were chicken meat obtained in supermarkets, goatskin and bone gelatin, spices such as cornstarch, salt, garlic, pepper and water.

2.2. Methods

2.2.1. Chicken nugget pH. Gelatin pH A total of 1 g of gelatin was dissolved in 20 ml of distilled water and then homogenized.The pH meter was turned on and stabilized to a neutral pH, then the electrode was immersed in a gelatin solution and the results were determined [11].

2.2.2. Shear force of chicken nugget. Chicken nuggets were measured using the CD-shear force, referring to [12]. The tendernes data obtained from the CD-shear force measurement results show that the chicken nugget break data is expressed in kg/cm^2.Chicken nuggets that have been boiled for 10 minutes are then cut to 1 cm in length with a diameter of ½ inch, the chicken nuggets are inserted into the CD-shear force hole. Chicken nuggets tenderness analysis formula by measuring the breaking power of chicken nuggets the readable CD-shear force scale value is included in the formula to calculate the *Shear force of chicken nugget*s as follows:

$$A = \frac{A''}{\pi r 2}$$

A: *Shear force of chicken nugget* (kg/cm^2)
A": Tension load (kg)
R: The radius on the CD-shear force hole (0.635)
Π: 3.14

2.2.3. Chicken nugget colour

Colour analysis using the L*, a*, b* colour measurement method for each observed parameter by bringing the treated chicken nugget sample closer and then pressing the start button, the L value will appear indicating the brightness level of the sample, the distance value is 0-100 where the value is black = 0 while white = 100.a* negative (-60%) indicates a greenish colour while a* positive (+ 60%) indicates a reddish colour.A negative b* colour (-60%) indicates a bluish colour while a positive b colour (+ 60%) indicates a yellowish colour, following the method of [13].

2.3. Data analysis

Data were analysed of variance using a completely randomized design (CRD) consisting of 5repetition chicken nugget quality testing using the Least Significant Difference Test (LSD).

3. Results and discussion

3.1. Chicken nugget pH

The pH of chicken nuggets was measured to determine how acidic the chicken nuggets were [5]. The pH measurement results indicate that the chicken nuggets are neutral.The pH of the chicken nuggets can be seen in figure 1.

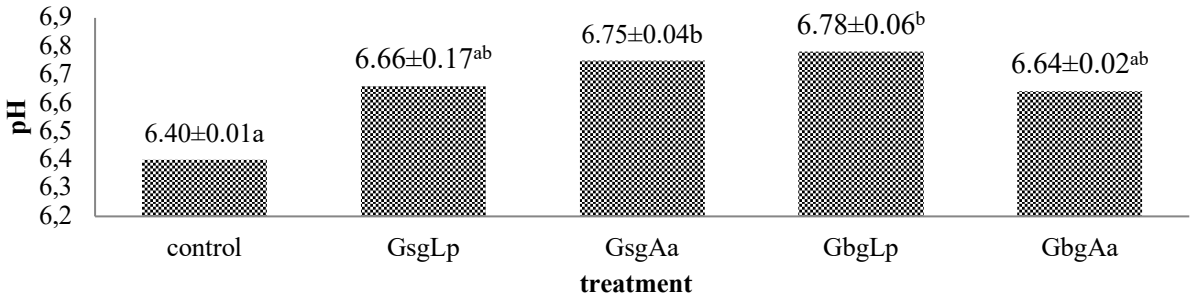

Figure 1. pH of chicken nuggets with the addition of *L.plantarum*and acetic acidpretreatment goatskin and bone gelatin.Different superscripts [ab] showed very significant differences (P <0.01).
Control = chicken nuggets without adding gelatin.
GsgLp = chicken nuggets with the addition of *L.plantarum*pretreatment goat skin gelatin.
GsgAa = chicken nuggets with the addition of acetic acid pretreatment goat skin gelatin.
GbgLp = chicken nuggets with the addition of *L.plantarum*pretreatment goat bone gelatin.
GbgAa = chicken nuggets with the addition of acetic acid pretreatment goat bone gelatin.

Figure 1 Analysis of variance on different treatments showed a very significant effect (P <0.01) on the pH of chicken nuggets.Chicken nuggets with the addition of gelatin had a higher value than the control, making them safe for consumption.The highest pH value in chicken nuggets with the addition of *L. plantarum* (GbgLp) goat bone gelatin was 6.78 ± 0.06, indicating that the pH value of GbgLp was closer to neutral.The neutralization process occurred strongly suspected when mixing the chicken nuggets mixture.According to [14] the neutralizing process is good if the final pH is near neutral.Changes in pH value have an opposite effect on acid levels, if the acid level is high, the pH value is low, while if the acid level is low, the pH value is high [15]. According to [16] the higher the dissolved acid level, the faster it will dissociate to release free protons thereby lowering the pH.Conversely, the lower the acid level, the pH value will increase.

3.2. Shear force of chicken nugget

The shear force of chicken nugget with the addition of different gelatin can be seen in figure2.

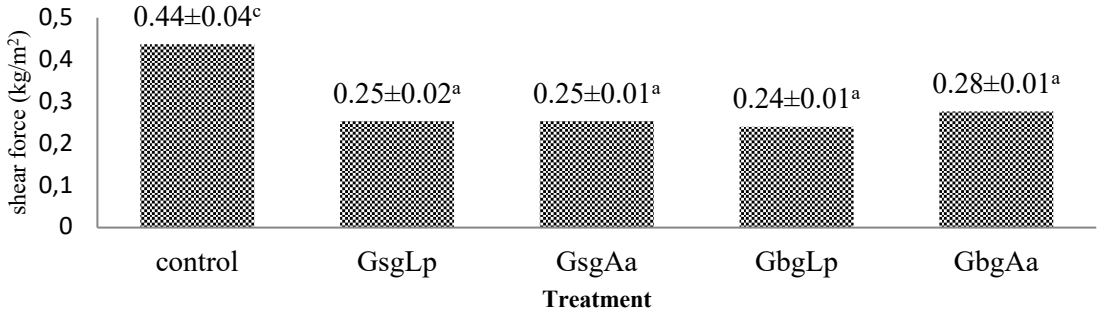

Figure 2. The shear force of chicken nuggets with the addition of *L.plantarum* and acetic acid pretreatment goat skin and bone gelatin. Different superscripts [ac] showed very significant differences (P <0.01).
Control = chicken nuggets without adding gelatin.
GsgLp = chicken nuggets with the addition of *L.plantarum*pretreatment goat skin gelatin.
GsgAa = chicken nuggets with the addition of acetic acid pretreatment goat skin gelatin.
GbgLp = chicken nuggets with the addition of *L.plantarum*pretreatment goat bone gelatin.
GbgAa = chicken nuggets with the addition of acetic acid pretreatment goat bone gelatin.

The shear force of chicken nugget was measured to determine the tenderness of the product [17]. Figure 2 shows the analysis of variance on the treatment given a very significant effect (P <0.01) on the shear force of chicken nuggets. There is a difference between chicken nuggets in the addition of different gelatin with chicken nuggets without the addition of gelatin (control). The shear force value of control chicken nuggets was higher than chicken nuggets with the addition of gelatin. Sudrajat in 2007 stated that the presence of a certain amount of water and gel in the product affected the tenderness [18]. This is because water, fat and the availability of protein extraction results will cause an emulsion. This emulsion causes the chicken nuggets to be chewier and won't break easily. Tenderness is related to the strength of the gel formed by heating [19]. According to [20] collagenization in chicken nuggets consisted of collagenization of starch and collagenization of protein. The collagenization process involves the binding of water by a network formed by the amino acid chain hydroxyproline and starch molecules due to heating. According to [21] the presence of water-binding capacity in meat is due to the direct bonding of the hydrophyl groups of the meat protein groups.The addition of gelatin in chicken nuggets products needs to be considered.According to [22] the smaller the amount of gelatin in the product, the more tender the product will be, conversely, the higher the ratio and level of gelatin administration will produce a compact product but provide high elasticity.This is because gelatin can convert liquid into an elastic solid.Likewise, argued by [23] the reaction of gel formation in gelatin is reversible, that is, when the gel is heated it will form a sol and if it is cooled it will form a gel again.In line with the statement [24] that gelatin protein has functional properties that play a role in the binding process so that the resulting product has an intact texture (not destroyed).

3.3. Chicken nugget color

The color of the chicken nuggets is an important attribute of the level of consumer interest.The results of assessing the color variations of chicken nuggets are shown in figures below:

*3.3.1. Brightness L **

The brightness of L * chicken nuggets with the addition of different gelatin can be seen in figure 3a.

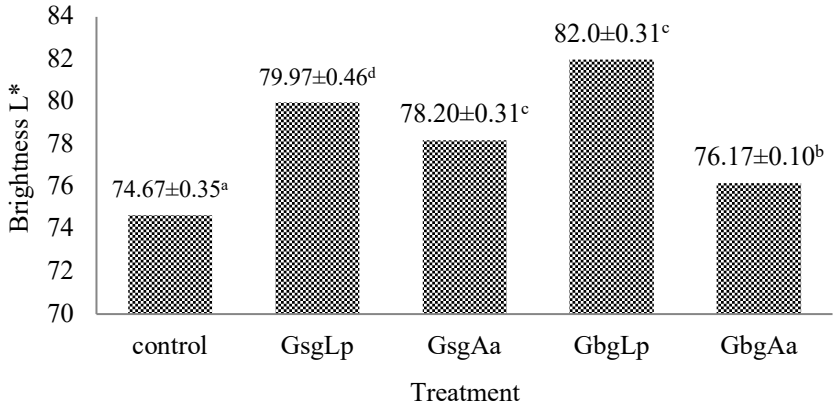

Figure 3. The brightness of L * chicken nuggets with the addition of *L.plantarum* and acetic acidpretreatment goat skin and bone gelatin.
Different superscripts [abcd] showed very significant differences (P <0.01).
Control = chicken nuggets without adding gelatin.
GsgLp = chicken nuggets with the addition of *L.plantarum*pretreatment goat skin gelatin.
GsgAa = chicken nuggets with the addition of acetic acid pretreatment goat skin gelatin.
GbgLp = chicken nuggets withthe addition of *L.plantarum*pretreatmentgoat bone gelatin.
GbgAa = chicken nuggets with the addition of acetic acid pretreatment goat bone gelatin.

Figure 3 showed an analysis of variance on the treatment which had a very significant effect (P <0.01) on the brightness of L * chicken nuggets.The addition of gelatin from pretreatment goat bone *L. plantarum* (GbgLp) showed a higher brightness level. Color change can be determined by the addition of chemicals and the breakdown of enzymes into pigments [8]. Color affects the acceptance of food material because generally, the first thing that is seen is color. An attractive color will increase product acceptance.The color may change during cooking and storage [22]. This can be caused by the loss of some pigment due to the release of cell fluids during cooking and storage, the color intensity has decreased [25].

*3.3.2. Reddish a **

Reddish of a* chicken nuggets with the addition of different gelatin can be seen in figure 4.

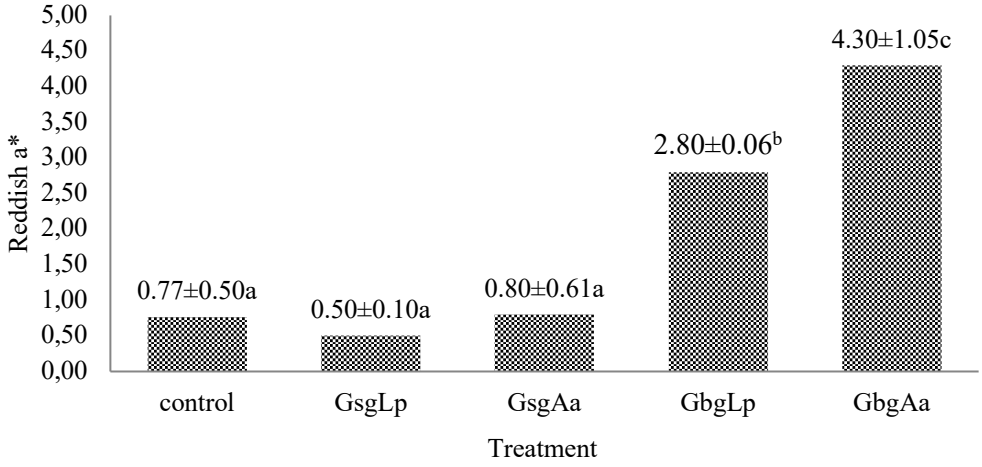

Figure 4. Reddish of a * chicken nuggets with the addition ofv *L.plantarum* and acetic acidpretreatment goat skin and bone gelatin.
Different superscips[abc] showed very significant differences (P <0.01).
Control = chicken nuggets without adding gelatin.
GsgLp = chicken nuggets with the addition of *L.plantarum*pretreatment goat skin gelatin.
GsgAa = chicken nuggets with the addition of acetic acid pretreatment goat skin gelatin.
GbgLp = chicken nuggetswith the addition of *L.plantarum*pretreatmentgoat bonegelatin.
GbgAa = chicken nuggets with addition of acetic acid pretreatment goat bone gelatin.

Figure 4showed analysis of variance on the treatment which had a very significant effect (P <0.01) on the redness of a * chicken nuggets.The a * (reddish) color value obtained was still within the acceptable threshold ranging from 0.43 ± 1.05 to 2.80 ± 0.61 on the addition of gelatin from L. plantarum pretreatment goat bone. This is supported by opinion [5] which states that the higher the a * (reddish) color value, the redder it is. The reddish color of a * in chicken nuggets is also influenced by various factors as stated by [18] that environmental influences and the addition of food additives such as collagen and spices affect the redness of the a * products.

*3.3.3. Yellowish b**

The yellowish b * chicken nuggets with the addition of different gelatins can be seen in figure 3c.

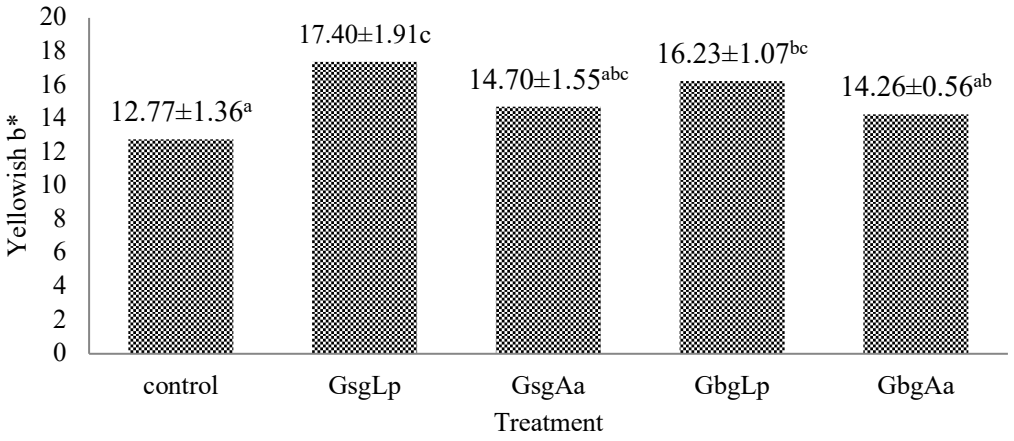

Figure 5. Yellowishof b* chicken nuggets with the addition of *L.plantarum* and acetic acidpretreatment goat skin and bone gelatin.
Different superscipsabc showed very significant differences (P <0.01).
Control = chicken nuggets without adding gelatin.
GsgLp = chicken nuggets with the addition of *L.plantarum*pretreatment goat skin gelatin.
GsgAa = chicken nuggets with the addition of acetic acid pretreatment goat skin gelatin.
GbgLp = chicken nuggets with theaddition of *L.plantarum*pretreatmentgoat bone gelatin.
GbgAa = chicken nuggets with the addition of acetic acid pretreatment goat bone gelatin.

Figure 5 showed that analysis of variance in the treatment given had a very significant effect (P<0.01) on yellow b* chicken nuggets.There were also differences between control and control and the addition of *L. plantarum* pretreatment bone skin gelatin.The yellowish value on commercial chicken nuggets shows the highest b* (yellowish) color.This is supported by the statement [13] which states that the higher the value of Color b * (yellowish), the more yellow it shows. Color b* indicates yellowish (+ 60%) while negative b * value (-60%) indicates bluish color [13]. The yellowish change in the product occurs due to the browning reaction [9].

4. Conclusion

Chicken nuggets with the addition of *L. plantarum* (GbgLp) pretreatment goat bone gelatin showed better physical and chemical characteristics.

Acknowledgement

Thank for LPDP Indonesia endowment fund for education for the research funding facilities that have been provided.

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