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THE USE OF BANANA (Musa spp) STEM SAP IN REDUCING TOTAL PLATE COUNT (TPC)OF BROILER CHICKEN FILLET (*Gallus gallusdomesticus*)

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ABSTRACT

From the result of phytochemistry screening, it is found that the sap solution extracted from banana stem consists of saponin, tannin, flavonoid, and phenolic which have antibacterial properties. The objective of this research is to test pH level, water content, and total plate count (TPC) of Broiler chicken fillet before and after being immersed in the sap solution extracted from banana stem (Musa spp). A quasi-experiment design is used in this study with Pre-test-Post-test with Control Group Design. The intervention in this research is associated between the varied concentration of sap solution extracted from banana stem from 0 % (control), 25 %,50%, to 75% and varied immersion period from 30 minutes, 60 minutes, 90 minutes, to 120 minutes. In analysing the effect of sap solution extracted from banana stem, the researcher conducted screening test on pH level, water content, and total plate count (TPC).This research found that there is a significant relationship between the sap solution extracted from banana stem and pH level, water content, and Total Plate Count (TPC) of Broiler chickens fillet by analyzing varied concentration of sap solution extracted from banana stem and immersion period of Broiler chicken fillet in the solution. The result of this study shows that the Broiler chicken fillet being immersed in the 75 % sap solution extracted from banana stem for 30 minutes is better than the fillet being immersed in other various concentrations and for other various immersion periods. It is concluded that the sap solution extracted from banana stem is a useful alternative in enhancing the nutritious quality of Broiler chicken fillet.

Keywords : banana stem sap, pH level, water content, antibacterial activity, total plate count

INTRODUCTION

The meat of Broiler chickens, especially chicken fillet, is a highly nutritious food product. Chicken fillet has a fairly short shelf life because it can be easily contaminated by micro-organisms. The microbial contamination may damage and affect the quality of Broiler chicken fillet. Several studies have been conducted to show that the sap solution extracted from banana stem composed of active ingredients such as saponin, tannin, flavonoid, and phenolic are proven to have antibacterial properties. Therefore, the solution is considered beneficial in maintaining the quality of Broiler chicken fillet. JumriahNur et al (2013) have conducted screening test on the antibacterial activity of

the sap solution extracted from banana stem to inhibit the microbial growth of *Staphylococcus aureus, E. coli,* and *Pseudomonas aeruginosa*. Several syudies have proven that saponin, flavonoid, tanin, quinone, phenol, and lectine are the active ingredients of the sap solution extracted from banana stem which have antibacterial properties. Therefore, it is also proven that the sap solution extracted from banana stem shall maintain the shelf life of Broiler chicken fillet and also prevent the possibility of getting food poisoning.

MATERIAL AND METHODS

The sample of this research is the meat from Boiler chickens (*Gallus gallusdomesticus*) taken from Broiler chickens carcass weigh 100 grams and 5 mm thick. The reseach design used in this study is quasi-experiment with Pretest–Posttest with Control Group Design. The intervention given varies from 0 % (control), 25 %, 50 %, to 75 % concentration of sap solution being used to immerse the Broiler chicken fillet in different immersion periods vary from 30 minutes, 60 minutes, 90 minutes, to 120 minutes. The researcher studies the effect of the sap solution extracted from banana stem in reducing antibacterial activity of Broiler chicken fillet by conducting screening test on the pH level, water content, and total plate count (TPC) of the fillet. The researcher conducts a chi-square analysis to determine the different total place count (TPC) of Broiler chicken fillet before and after being immersed in the sap solution extracted from banana stem. Post Hoc Bonferroni Test is conducted afterward with 5% confidence interval in order to determine the statistical difference between those two treatments.

RESULT AND DISCUSSION

pH level of Broiler chicken fillet

The researcher measures the pH level of Broiler chicken fillet before and after being immersed in the sap solution extracted from banana stem with variedconcentrations and immersion periods. Figure 1 below shows the average pH level of Broiler chicken fillet after being immersed in various concentrations of sap solution extracted from banana stem.

Figure 1 shows that there is an increased pH level between the control group (0 % concentration) and the treatment group (which is being immersed in the sap solution). However, the increasing solution of sap solution used to immerse Broiler chicken fillet is not directly proportional with the increasing pH level of the fillet. The pH level of control group (0% concentration) is 6.7112, while the average pH level of the treatment group with 25%, 50%, and 75% concentration is 6.945. the data above shows that there is an increasing pH level of Broiler chicken fillet after being immersed in the sap solution extracted from banana stem. The result of Univariate Analysis of Variance on the Post Hoc Tests using Bonferroni shows that the pH level of the fillet before and after being immersed on various concentrations of the sap solution is p-*value* = 0,000. It means that there is a significant difference of the pH level before and after being immersed on various concentrations of the sap solution (25%, 50%, and 75%). The statistical analysis shows that the concentration of the sap solution extracted from banana stem is inversely proportional with the pH level of Broiler chicken fillet after being immersed in the sap solution.

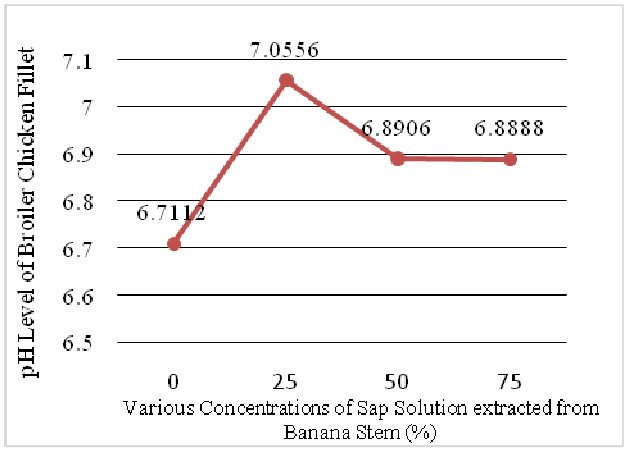

Figure 1. pH Level of Broiler Chicken Fillet being Immersed in Various Concentrations of Sap Solution extracted from Banana Stem

Figure 2 below shows that the average pH level of Broiler chicken fillet is inversely proportional with the immersion period.

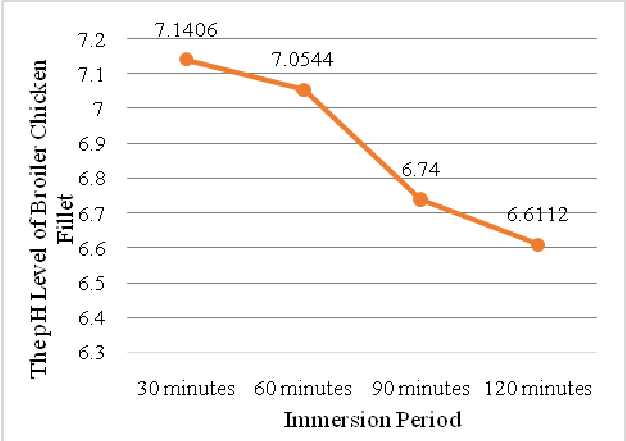

Figure 2: The average pH level of Broiler chicken fillet according to various immersion periods of the fillet in the sap solution

The result of Bonferroni test shows that the pH level of Broiler chicken fillet being immersed on various immersion periods is p <0,05. In other words, it shows that there is a significant difference between the pH level on various immersion periods. This study proves that the longer the Broiler chicken fillet being immersed in the sap solution, the lower the pH score of the fillet.

The Tests of Between – Subjects Effects is conducted to determine relationship between the concentration of the sap solution and the pH level of the Broiler chicken fillet, which is resulted in p = 0,000 (p <0.005). It shows that there is a significant effect of the various concentrations of the sap solution and the various immersion periods on the pH level of Broiler chicken fillet after being immersed, in which the different concentration and immersion period affects 97.1% of the pH level (*R squared* = 0.971), while the rest 2.9% is affected by other unexamined factors.

The pH level of Broiler chicken fillet after being given the treatment with different immersion periods from 30-120 minutes varies from pH 6.6 to pH 7.1, which means that the fillet is still edible and healthy to consume. Forrest *et al.* (1975) stated that the pH level of chicken meat after being

slaughtered and processed is 6.8, which will keep decreasing into isoelectric point (5.0-5.2) between 30minutes to 4.5 hours in a room temperature. The high speed of decreasing acidity of the chicken meat may decrease the capacity of water content, which is affected by the increasing of the composed actomyosin contraction, thereby draining the juice from the chicken meat (Lawrie, 1996). The higher the pH level, the darker the colour and the dryer the surface of the chicken meat, since the water binding capacity of the meat juice with the protein is high (Lawrie,1996; Foegeding*et al*., 1996).

This study indicates that there is an increasing pH level of the Broiler chicken fillet on the various concentrations of the sap solution extracted from banana stem, compared to the control group. This is presumably caused by the occurrence of equilibrium between the concentration of the sap with the Broiler chicken fillet which has reached its maximum value and cause the rising acidity during immersion period. The rising pH level of the Broiler chicken fillet is influenced by the changes in the sarcoplasmic protein denaturation. The addition of the sap solution and the increasing of immersion period may trigger hydrolysis and protein denaturation, thus changes the concentration of H+ ion. Furthermore, hydrolysis and denaturation may lead to the loss of the acidic group, which results in the increasing of OH- ion concentration and pH level (Lawrie, 1996).

The rising of pH level of Broiler chicken filet is also caused by the reduced ATP and glycogen level in Broiler chicken fillet is inversely proportional with the pH level during the immersion period. According to Afrianto and Liviawaty (2005), the rising of pH level is caused by the decreasing of glycogen level and the remaining ATP in the Broiler chicken fillet. Later on, the hydrolysis of the remaining ATP cannot reduce the pH level because the lactic acid resulted from the ATP hydrolysis is just in a small amount.

The decreasing of glycogen level of the chicken meat is caused by the condition of the livestock which tends to be active before being slaughtered. The decreasing of glycogen level also affects the amount of the resulted lactic acid anaerobically which later reduce the pH level (Young *et al*, 2004).

a. The Water Content of Broiler Chicken Fillet

Figure 3 shows the result of water content screening test based on the concentration of the sap solution extracted from banana stem.

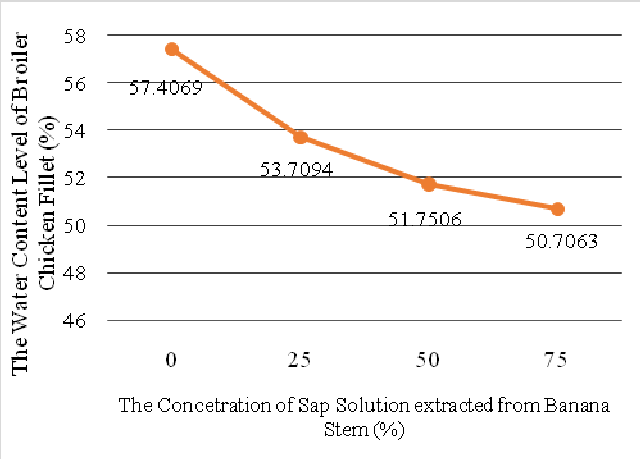

Figure 3: The Water Content of Broiler Chicken Fillet based on the Concentration of the Sap Solution extracted from Banana Stem

Figure 3 shows that there is the decreasing of water content in the treatment group compared to the control group (0%). Moreover, the decreasing of water content in the treatment group is inversely proportional with the decreasing of the concentration of the sap solution extracted from banana stem. The average water content in the control group is 57.4069 %. Meanwhile, the average water content in 25% concentration is 53.7094 %; the average water content in 50% concentration is 51.7506%, and the average water content in 75% concentration is 50.7063%.

The result of Univariate Analysis of Variance on Bonferroni Post Hoc Tests shows the significant difference of water content between the control group and the treatment groups based on the concentration of the sap solution, which is p-value= 0.000 ($p < 0.05$). The highest difference sequentially can be seen between control (0%) with consentration 75% (Mean Difference = 6,7006*) and the lowest difference can be seen in consentration 25% with Mean Difference = 3,6975*. In other words, the concentration of the sap solution is immersely proportional with the water content of the Broiler chicken fillet after being immersed.

Figure 4 below shows the screening test result on water content of the Broiler chicken fillet.

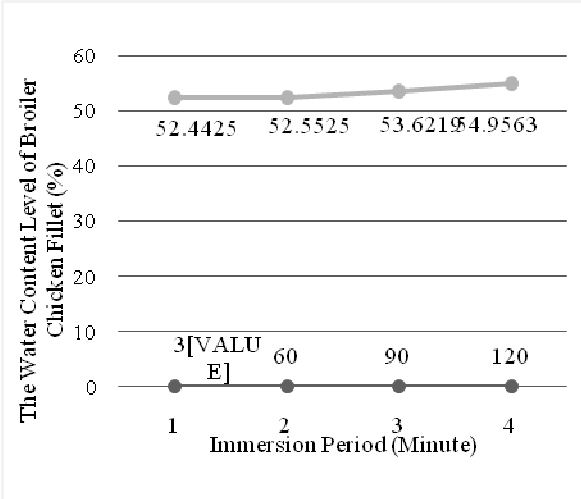

Figure 4 shows that the average water content of Broiler chicken fillet after being immersed for 30 minutes, 60 minutes, 90 minutes, and 120 minutes are 52.45 % 52.55%, 53.62%, and 54.95%, respectively. In other words, the increasing of the water content is directly proportional with the increasing of immersion period.

The result of Bonferroni test shows that there is no significant difference on the water content of the Broiler chicken fillet after being immersed for 30 minutes and 60 minutes, with p-value = 1.000 ($p > 0.05$). However, the significantly different level of water content shows up between the 90 minutes and 120 minutes with the 30 minutes of immersion, in which each period has p-value = 0.000 ($p < 0.05$). The biggest difference occurs during the 120 minutes of immersion, with the value of Mean Difference = 2.5138 *.

This study proves that the longer the fillet being immersed in the sap solution, the more significantly different the increasing of water content of the fillet.

The result of Tests of Between - Subjects Effects shows that the resulted R squared score = 0.984, which indicates that 98.4% concentration and immersion period contribute to the water content of Broiler chicken fillet, while the rest 1.6% is influenced by other unexamined factors. The high level of water content is one ofthe supporting factors to the development of fungi and microorganism (Ketaren, 1989). The high level of water content will easily damage the health quality of chicken

meat. The result of water content analysis shows that the higher the concentration of the sap solution, the lower the decreasing of the water content. On the other hand, the longer the immersion period, the higher the increasing of the water content.

The decreasing of water content in the treatment group along with the increasing of the concentration of sap solution is presumably caused by the antibacterial properties of the sap solution. The antibacterial compounds may bind and penetrate into the tissue of Broiler chicken meat and inhibit the damage process of the protein structure. The damage process of protein structure is known to cause the increasing of water content in Broiler chicken fillet. Saponin is one of the active antibacterial compounds in the sap of banana stem which is eneficial in reducing the surface tension of bacterial cell wall and damage the permeability of the membrane (Harborne, 2006).

The decreasing of the water content in treatment group and the increasing of the concentration of sap solution are also caused by the osmosis of the matters. According to Kuntoro et al (2007), osmosis may decrease the level of water content. The water will easily come out of the matters of the sap solutions, while some of the water may come back into the matters through diffusion process. The sap extracted from banana stem is expected to contain hygroscopic compounds which will be able to bind water into the food products and lower the water activity of the matters (Rodrigues, A. E. and Mary A. M. 2007).

This study shows that there is the decreasing of the water content in treatment group along with the the increasing of the concentration of sap solution extracted from banana stem. It indicates that there is a different osmotic pressure between the Broiler chicken fillet containing low level of water content and the sap solution extracted from banana stem containi high level of water content. As a result, more water easily moves from the Broiler chicken fillet to the sap solution extracted from banana stem, thus decrease the level of water content of Broiler chicken fillet even more.

The increasing level of water content from the long immersion period is possibly caused by the rupture of the cell structure of Broiler chicken fillet due to the long immersion period of the fillet in the sap solution. According to Soeparno (2005), the immersion process may cause the meat to swell, then it will shrink, and disintegrate eventually. The swelling process occurred to the microstructure of the sap solution may lead it to get into the meat tissue. The more the immersion period, the bigger the swelling before it bursts out. The rupture of the microstructure swelling may cause shrinkage, as the water leaks off the chicken meat. The level of water content in the chicken meat is on of the supporting factors for developing microorganisms (Ketaren, 1989). Thus, it can be concluded that the higher the water content, the easier the Broiler chicken fillet to decay.

b. Total Plate Count (TPC) of Broiler Chicken Fillet

The screening test for measuring total plate count (TPC) is conducted before and after Broiler chicken fillet being immersed in the sap solution for various immersion periods and in various concentrations of the sap solution. The Figure 5 shows the measurement data of total plate count (TPC) based on the various concentrations of sap solution extracted from banana stem:

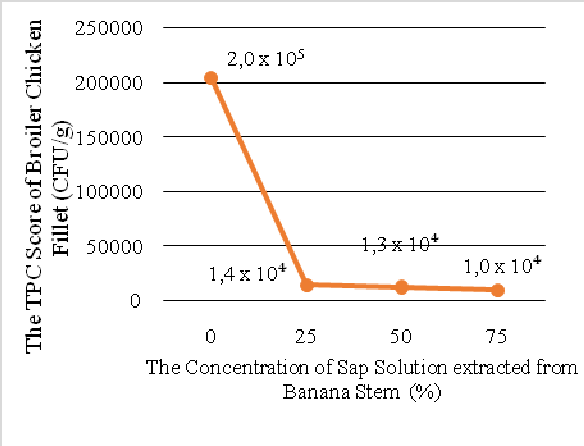

Figure 5 : The Average TPC based on Various Concentrations of the Sap Solution

Figure 5 shows the average total plate count (TPC), in which the highest TPC score can be found in the control group, which is 2.0 x 105 CFU / g, while the lowest TPC score can be found in 75% concentration solution, which is 1.0 x 104 CFU / g. This data shows that the TPC score of Broiler chicken fillet being immersed in the sap solution is inversely proportional with the concentration of the sap solution.

The result of Bonferroni test shows that the significantly different TPC score of Broiler chicken meat based on the various concentrations of sap solution is p-value <0.05. The biggest difference can be found in 75% concentration (Mean Difference = 193,256.25 *), while the lowest can be found in 25% concentration (Mean Difference = 188,875.00 *). This study shows that the concentration of sap solution is inversely proportional with the TPC score of Broiler chicken fillet.

Figure 6 below shows the result of TPC screening test of Broiler chicken fillet based on various immersion periods in the sap solution extracted from banana stem:

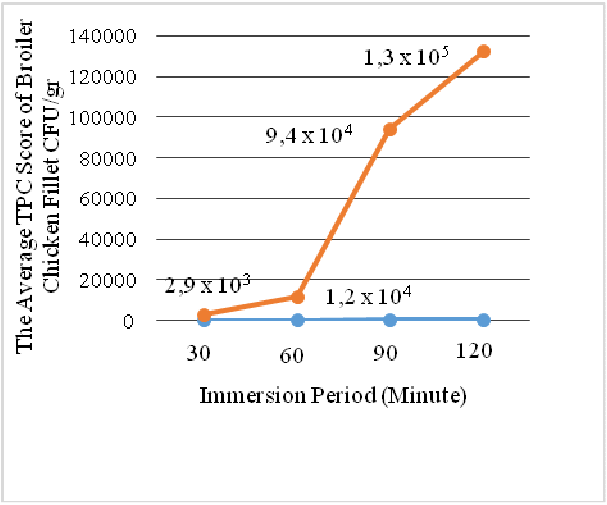

Figure 6. The Average of ALT based on the Concentration of the Sap Solution extracted from Banana Stem

Figure 6 shows that, based on the average TPC, the highest TPC score of Broiler chicken fillet can be found during 120 minutes of immersion, which is 1.2 x 10^3 , while the lowest can be found

during 30 minutes, which is 2.9 x 10^3 CFU/gr.

The result of Bonferroni test shows that the significantly different TPC score of Broiler chicken meat based on the various concentrations of sap solution is p-value <0.05. The biggest difference can be found in 75% concentration (Mean Difference = 193,256.25 *), while the lowest can be found in 25% concentration (Mean Difference = 188,875.00 *). This study shows that the concentration of sap solution is inversely proportional with the TPC score of Broiler chicken fillet.

The result of Between - Subjects Effects test shows that p = 0.000 (p <0.005), which means that various concentrations of sap solution and various immersion periods may affect the pH level Broiler chicken fillet. The R squared = 0.997 indicates that 99.7% concentration and immersion period has contributed to the TPC score of the fillet, while the rest 0.3% is influenced by other unexamined factors.

The result shows that the higher the concentration of the sap solution, the lower the TPC score of Broiler chicken fillet. This result goes along with the study conducted by SitiZulaekah and NurEndang W. (2005), which shows that the lower the concentration of the sap solution extracted from banana stem banana juice, the higher amount of bacteria in the sample of hard-boiled salted egg being immersed in various concentrations of the sap solution. The decreasing TPC score is caused by the active ingredients contained in the sap solution, including polyphenol, flavonoid, anthraquinone, tannin, and saponin which have antiseptic properties. Tannin, saponin, and flavonoid also have antibacterial properties. The toxicity mechanism of tannin includes damaging the cell membranes of bacteria. Tannin can induce the formation of complex molecule against the enzyme or microbial substrate and the formation of tannin molecule against the metal ion which is able to increase its own toxicity. The activity of tannin is shown by the shrinkage process of cell wall or cell membrane which may damage the permeability of the cell itself. The damaged cell permeability may prevent the living activities of the cell and inhibit (even stop) the development of the cell (Ajizah: 2004). Furthermore, the antibacterial property of tannin allows it to precipitate proteins by reacting with the cell membrane, inactivate the enzyme, and destroy / inactivate the genetic material function of the cell since tannin presumably has the similar effect as phenolic (Masduki: 1996).

Flavonoid consists of a large group of polyphenolic compounds that can be found in almost all kinds plants used for food products. Flavonoid has widely become the research subject from its antibacterial activity. Having an antibacterial property, saponin may cause the protein and enzyme to leak out of the cell (Akiyama, 2001). The surfactant of saponin is able to reduce the surface tension of the bacterial cell wall and damage the permeability of cell membrane. It may further cause leakage on the cytoplasmic membrane, so that the cytoplasm may leak out of cell and result in the death of the cell. Therefore, the active ingredients of the sap solution extracted from banana stem may reduce the TPC score of Broiler chicken fillet, along with the increasing of the concentration of sap solution.
Moreover, phenolic has the ability to migrate from the liquid phase of the cell membrane to the fat phase, which may reduce the surface tension of the cell membrane. Later on, it may denature the protein and damage the permeability of the cell membrane, thus turning the cell into lysis; which is why phenolic functions as an antibacterial compound (Reed, 1982).

In her research, Susanti (2008) finds that phenolic reacts with protein through hydrogen bond, which may damage the protein structure mostly composing the structure of the cell wall and cytoplasmic membrane. The instability of the cell wall and cytoplasmic membrane may damage the permeability, the active transport, as well as the control of protein composition. Furthermore, it may trigger the macromolecules and ions to leak out of cell, cause the cell to lose its original form, cause lysis, and therefore reduce the TPC score of Broiler chicken fillet.

The increasing of TPC score of Broiler chicken fillet after being immersed in longer period is caused by the inactivity of the active ingredients of the sap solution which is no longer unable to inhibit the bacterial activity and development. Thus, there is an increasing amount of microorganism in the fillet. The microorganism that can survive in the Broiler chicken fillet is the particular kinds of microorganism which is able to develop in a certain substrate (Nugroho, 2007).

CONCLUSION

This research found that there is a significant relationship between the sap solution extracted from banana stem and the pH level, water content, and Total Plate Count (TPC) of Broiler chickens fillet. To sum up, the sap solution extracted from banana stem is a useful alternative in enhancing the nutritious quality of Broiler chicken fillet.

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