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The Effect of Additional Leavening Agent on Physical and Sensorial Qualities of Fried Beef Meatballs

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ABSTRACT
This study aims to determine the effect of the leavening agent on the physical and sensorial qualities of fried beef meatballs. The leavening agent used in this research was baking powder (NaHCO3+C4H4O6) as T1, baking soda (NaHCO3) as T2, and SAPP or sodium acid pyrophosphate (Na2H2P2O7) as T3 and control without leavening agent addition as T0. Physical qualities were observed: pH value, crunchiness, hardness, and sensorial qualities: color, odor, taste, texture, and acceptability. The data were analyzed using Oneway Anova and if there was a mean difference, it would be further tested using Duncan's Multiple Range Test (DMRT). Moreover, sensory quality was analyzed by non-parametric analysis with Kruskal and Wallis Test. The results showed that the addition of baking powder, baking soda, and SAPP significantly affected ($P<0.05$) pH value, crunchiness, hardness, color, despite no significant effect on the odor, taste, texture, and acceptability. Based on the research, T3 with 0,3% concentration showed a higher ($P<0.05$) pH value at 6.8, crunchiness value at 190.51 than other treatments. T3 in this regard, could be one of the alternative leavening agents to be used in fried beef meatballs.

Keywords: *Beef meatball, Baking powder ($NaHCO_3+C_4H_4O_6$), Baking soda ($NaHCO_3$), SAPP. ($Na_2H_2P_2O_7$).*

1. INTRODUCTION

Fried meatballs (basreng) are a form of innovation from livestock products. Meat is easily consumed by people from various circles and has high nutritional value. Beef is the meat that is most often used in making meatballs because of its soft texture. All types of meat can be used as processed meatball products such as chicken, fish, pork. Fried meatballs are crunchy but chewy and have a savory taste.

Some additives that are still widely used by the community have not been certified, so that some additives can be harmful to health. Leavening agent additives can be categorized as crunchy additives if these additives can add crunch from processed products such as lowering water content, improving texture, and expanding dough. Additives that are safe to use as safe additives are baking powder, baking soda ($NaHCO_3$), and SAPP or sodium acid pyrophosphate ($Na_2H_2P_2O_7$). Treatment using baking powder, baking soda, and SAPP significantly affected on the crunchiness.

The use of baking powder, in principle forms CO_2 gas so that the crackers expand when fried. The higher concentration of baking powder or developer will make the cracker dough expand which results in the crunchy texture of the crackers. This can affect because the gas released together with air and water vapor is trapped in the cracker mixture [1]. The use of baking soda on texture is when $NaHCO_3$ is added to the dough it will produce carbon dioxide gas, causing an increase in volume and producing a crunchy texture [2]. The use of SAPP or sodium acid pyrophosphate ($Na_2H_2P_2O_7$) can give results as a crunchy material for fried foods. The use of these additives will produce crispy and dry results [3]. The effect of baking soda, baking powder, and SAPP or sodium acid pyrophosphate ($Na_2H_2P_2O_7$) can add crunchiness to the meatballs but is still safe for consumption. Therefore, the study was aimed to determine the most optimal leavening agent using baking soda, baking powder, and SAPP on the physical and sensorial qualities of fried beef meatballs.

Table 1. The average value of the physical qualities of fried beef meatballs with the addition of leavening agent

Value	Leavening agents			
	T0	T1	T2	T3
pH	6.80±0.00^{c}	6.90±0.00^{b}	7.50±0.10^{a}	6.80±0.00^{c}
Crunchiness	72.91±18.00^{b}	52.45±20.42^{b}	49.23±26.80^{b}	190.51±5.29^{a}
Hardness	23.34±15.04^{b}	45.14±28.64^{b}	44.56±17.49^{b}	467.20±56.36^{a}

$^{a\,b\,c}$ different superscript letters on the same line indicate significant differences (P<0.05).
T0: control; T1: 0.3% baking powder; T2: 0.3% baking soda; T3: 0.3% SAPP

2. MATERIALS AND METHOD

The tools used in making fried beef meatballs are digital scales, meat grinder, chopper, meat slicer, stainless steel knife, cutting board, spoon, scoop, basin, tray, pot, pan, and stove. The tools used in the physical quality test are digital scales, pH meters, 50 ml beakers, 50 ml measuring glass, and stopwatch. The tool used in the sensory quality is a questionnaire sheet for sensory testing. The ingredients used in making fried beef meatballs are beef, tapioca flour, sago flour, eggs, salt, flavoring, garlic, pepper, baking powder, baking soda ($NaHCO_3$), Sodium acid pyrophosphate ($Na_2H_2P_2O_7$), onions, lime leaves, celery leaves, water, and cooking oil. Materials used in the physical quality test are samples of fried beef meatballs, aqua dest, and phosphate buffer solution pH 7. The materials used in the sensory quality test are fried beef meatballs samples.

The meat used in this study is beef that has been cut into small pieces and finely ground using a meat grinder machine. Ground beef, tapioca flour, eggs, salt, flavor enhancer, garlic, pepper, scallions, lime leaves, celery leaves, baking powder, baking soda, SAPP or sodium acid pyrophosphate were weighed according to the predetermined formulation, The ingredients were mixed until homogeneous using a mixer for 5 minutes, and the dough was added with cold water gradually. The total treatment was conducted in this study consisting of the T0 (control) treatment group; T1 (0.3% baking powder); T2 (0.3% baking soda); T3 (0.3% SAPP). The meatball dough was entered in an oval-shaped plastic that has been food-grade using a plastic triangle. The average meatball weight before boiling was 112 grams. The meatball dough in the plastic was boiled at 80ºC of water for 20 minutes. for 20 minutes. The cooked meatballs were lifted and drained. The average meatball weight after being boiled was 128 grams. The beef meatballs were entered in the refrigerator until stiff. Frozen meatballs were cutted using a meat slicer with a thickness of ± 3 mm. The meatball slices were fried in a vacuum fryer until cooked or golden brown at 80º for 20 minutes. The cooked fried beef meatballs were lifted and put in the spinner for 5 minutes. Fried beef meatballs were tested physically and sensory. The data were analyzed using One-Way Anova and if there was a mean difference, it would be further tested using Duncan's Multiple Range Test (DMRT). Moreover, sensory quality was analyzed by non-parametric analysis with Kruskal and Wallis Test.

3. RESULT AND DISCUSSION

3.1. Physical Qualities

The physical qualities of fried beef meatballs with the addition of baking powder ($NaHCO_3$+$C_4H_4O_6$), baking soda ($NaHCO_3$), and SAPP or sodium acid pyrophosphate ($Na_2H_2P_2O_7$) on pH value texture profile analysis (crunchiness, hardness) were presented in Table 1.

3.2. Ph Value

The addition leavening acid significantly affected on the pH value of fried beef meatballs (P<0.05). The factors that affected the pH value were the cooking process and the ingredients, such as beef, tapioca flour, sago flour, and crunchy ingredients. Siregar and Wikarsa [4] stated that the addition of sodium bicarbonate ($NaHCO_3$) will impact on increasing the pH value due to a decrease in total acid. The mixing of acids and bases was caused a binding reaction, the acid was bound by alkaline sodium bicarbonate to form a pH-neutralizing salt. The increase of the pH value WAS due to the nature of sodium bicarbonate which can bind acids and forming salts. The salt can neutralize and increase the pH value. Baking powder has a lower acidity than baking soda [5]. The addition of SAPP or sodium acid pyrophosphate ($Na_2H_2P_2O_7$) did not increase significantly. this is because SAPP has a neutral pH naturally. SAPP was contained more H+ ions than the rest of the phosphoric acid. The concentration in phosphoric acid is still low can increase the level of acidity in the solution [6]. The pH value of processed meat products depend of the pH value of basic essential ingredients [7].

Table 2. The average score of color, taste, aroma, texture, and acceptability of fried beef meatballs with the addition of leavening agent

Variable	Leavening agents			
	T0	T1	T2	T3
Color	3.73±0.79[a]	3.45±0.82[a]	2.55±0.69[b]	3.28±0.47[a]
Odor[ns]	3.27±1.00	3.27±1.00	3.18±0.40	3.27±0.90
Taste[ns]	3.45±0.82	3.27±0.79	2.90±0.70	3.00±0.77
Texture[ns]	2.64±0.92	3.00±0.77	2.64±1.12	2.73±1.19
Acceptabillity[ns]	3.09±0.70	3.18±0.75	2.81±0.87	3.02±0.79

[a b c] different superscript letters on the same line indicate significant differences (P<0.05), [ns] Non-significant,
T0: control; T1: 0.3% baking powder; T2: 0.3% baking soda; T3: 0.3% SAPP

3.3. Crunchiness

The addition of leavening agent significantly affected on the crunchiness value of fried beef meatballs (P<0.05). The addition of SAPP in T3 had the highest crunchiness value compared to theother treatments. The primary factor of crunchiness is water content. The addition of baking powder would decrease water content because it produce CO_2 gas when it meets the water and heat during the cooking process, It formed the air cavities and occurred the evaporation [8]. Baking soda bicarbonate ($NaHCO_3$) has the function of binding water molecules. The molecular structure of $NaHCO_3$ can trap water and the proteins contained in the water molecules. The addition of SAPP on food products would cause the soft and porous texture, so the water evaporation becomes easier during the drying process [9]. Phosphates are used in meat products for several reasons, such as changing and or stabilizing water holding capacity, improving texture and sensory properties [10]. Water content is one of the factors that can affect the texture of food [11].

3.4. Hardness

The addition of leavening agent significantly affected the hardness value of fried beef meatballs (P<0.05). The addition of leavening agent on T3 had a higher hardness value than the other treatments. The addition of baking powder, baking soda, and SAPP was caused the fried beef meatball harder. Water content is one of the factors that can affect the texture of food. The increasing of water content would increase the hardness [12].

3.5. Sensory Qualities

The sensory qualities of fried beef meatballs include tests of color, odor, taste, texture, and acceptability with the addition of baking powder ($NaHCO_3$+$C_4H_4O_6$), baking soda ($NaHCO_3$), and SAPP or sodium acid pyrophosphate ($Na_2H_2P_2O_7$) were presented in Table 2.

The color score of fried beef meatballs added with baking powder ($NaHCO_3$+$C_4H_4O_6$), baking soda ($NaHCO_3$), and SAPP or sodium acid pyrophosphate ($Na_2H_2P_2O_7$), was significant (P<0.05). In contrast, the odor, taste, texture, and acceptability were non-significant. The addition of sodium bicarbonate was caused a duller color in the meat product [13]. The addition of baking powder and baking soda was not affected the odor value. The addition of sodium bicarbonate was caused a bitter taste in the meat product [14]. Herpandi et al [3] added that the addition of NaHCO3 was caused tasteless and bitterness.

4. CONCLUSION

The addition of baking powder ($NaHCO_3$+$C_4H_4O_6$), baking soda ($NaHCO_3$), SAPP or sodium acid pyrophosphate ($Na_2H_2P_2O_7$) can increase the pH value, crunchiness, and hardness of fried beef meatballs. Fried beef meatballs with the addition of baking powder, baking soda, SAPP did not affect the aroma, taste, texture, and acceptability. The addition of leavening agent using SAPP has the best results on pH values and crunchiness.

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