Application of sweet basil (Ocimum basilicum) on physical and organoleptic qualities of chicken meatballs

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Abstract. Leaves of sweet basil (Ocimum basilicum) are categorized as a tonic spice in culinary and also often used as herbs. The use of sweet basil leaves is usually dried as a spice to give a distinctive flavour to the cuisine. This study aimed to determine the effect of sweet basil leaves (Ocimum basilicum) application with different percentages on the physical and organoleptic qualities of chicken meatballs. This study used a Complete Randomized Design with 4 treatments and 5 repetitions. The treatments in this study consisted of different percentages of sweet basil leaves powder at P0: 0%, P1: 2%, P2: 4%, and P3: 6%. After chicken meatballs were cooked and stored at room temperature for 24 hours, then the measurement of physical and organoleptic qualities was carried out. The obtained results showed that the addition of sweet basil leaves had a real effect (P<0.05) on cooking loss, pH value, aroma, flavour linking, and basil flavour of chicken meatballs. However, there was no significant effect (P>0.05) on the water content. It is concluded that the application of sweet basil leaves (Ocimum basilicum) at 4% could effectively improve and retain the physical and organoleptic qualities of chicken meatballs for 24 hours.

1. Introduction
Sweet basil (Ocimum basilicum) is commonly used as cooking spice because it has a light, sweet and refreshing flavour. There are several types of basil leaves in Indonesia including sweet basil and lemon basil. Various studies about the utilization of sweet basil spices that are very useful for health and food have been done. Sweet basil contains phytochemicals and antioxidants so it could be applied to functional foods [1]. Sweet basil also contains natural antioxidants and anti-inflammation [2]. The addition of 2% and 4% sweet basil essential oil have potential to be used as a natural antioxidant additive in meat [3]. The addition of sweet basil at 6% could increase content, fat, pH, and protein but does not affect the appearance of hamburgers [4]. According to [5] sweet basil contains antimicrobial and anti-fungal compounds. Additionally, the potential of spices in Indonesia could be used to improve the quality of food because it is practical and easy to obtain [6].
Chicken meatballs are included as processed meat products. The main purposes of food processing are to extend shelf life, add taste, and improve food quality. Meatballs are culinary that commonly found in Indonesia. However, in the process of making, meatballs are usually mixed with different chemical compounds such as borax, sodium biborate, sodium pyroborate, and sodium tetraborate to make it chewy and more durable so that meatballs are considered as less healthy food. Aside from that, the addition of chemical compounds into meatballs could increase the risk of cancer. Therefore, the utilization of spices including sweet basil leaves to improve physical and organoleptic qualities in order to extend shelf life of food should be done. In various studies that have been presented, it is reported that sweet basil contains antioxidants and antibacterial. Furthermore, sweet basil leaves could add fresher taste to food products and could be applied directly by processing it into powder.

This study was conducted to determine the best percentage of sweet basil leaves powder that could be applied to the manufacture of chicken meatballs. The physical quality of pH, cooking loss, and water content were tested in the laboratory. Organoleptic test of aroma, flavour linking, and basil flavour were conducted by using well-trained panelists. Physical and organoleptic tests were accomplished after meatballs stored at room temperature between 27 °C to 30 °C for 24 hours.

2. Methods

2.1. Materials and equipments
The materials used in this study were 500 gram fresh sweet basil leaves (Ocimum basilicum), 1500 gram chicken breast, aqua dest, and KCL. The equipment used in this study were pH meter, moisture meter, penetrometer, electric scale, pot, butcher knife, volumetric flask, pipette, plastic bag, cooler, rope, sieve, and measuring cup.

2.2. Preparation of chicken meatballs
The processing method of chicken meatballs was referring to [7]. Meatballs were prepared from 1 kilogram chicken breast, 100 gram tapioca flour, 1 grain egg, 6 gram pepper, 5 cloves garlic, 6 gram STTP, 10 gram salt, and ice cubes. The chicken meat and ice cubes were grounded with a blender, afterwards mixed with garlic and fine pepper. The ground meat was mixed evenly with tapioca flour, egg, and STTP. The meat dough was rounded then boiled for 20 minutes in boiling untill cooked through.

2.3. Preparation of sweet basil leaves powder
Sweet basil is a fragrant spice so its utilization requires good handling. Sweet basil powder is commonly used as a dry sprinkle on pizza. The drying process of sweet basil leaves was done by sun-drying and mashed into powder form by using a blender.

2.4. Meatballs pH value
pH in food products such as meatballs is related to the growth of microorganisms. Measurement of pH value needed to be done to determine the physical quality of shelf life. The pH value of meatballs in this study was measured using pH meters [8]

2.5. Water content
The water content in processed meat products of meatballs is a substantial factor to show the physical quality of the product. The water content of meatballs is the amount of water that contained in meatballs. Measurement of water content in this study was performed by using a digital moisture meter.

2.6. Cooking loss measurement
Cooking loss of meatballs in this study was measured using the CSIRO method [9]. The measurement of cooking loss was performed by weighing meatball dough as the initial weight, meatball dough was boiled at 80-90 °C for 30 minutes, the final weight of meatballs was obtained by weighing meatballs after the boiling process.
Cooking loss formula = \( \frac{\text{initial weight} - \text{final weight}}{\text{initial weight}} \times 100\% \) (1)

2.7. Organoleptic test
Aroma, flavour linking, and basil flavour are important factors for consumers' acceptance. Organoleptic test of aroma, flavour linking, and basil flavour were performed to determine whether the aroma and flavour of chicken meatballs were preferred by all consumers or not. The organoleptic test in the study involved 15 well-trained panellists. Aroma used 5 point scores according to [4] i.e. (1) very offensive (2) offensive (3) intermediate (4) pleasant (5) very pleasant. Flavour linking used 5 point scores i.e. (1) dislike very much, (2) dislike, (3) Intermediate, (4) like, (5) very like much. Basil flavour used 5 point scores i.e. (1) very weak, (2) weak, (3) Intermediate, (4) Pleasant, (5) Very Pleasant.

2.8. Research design
The design used in this study was a Complete Randomized Design (CRD) with 4 treatments and repetitions. The treatment was distinguished by the percentages of sweet basil:
- \( P_0 = \) meatball dough added sweet basil powder 0%
- \( P_1 = \) meatball dough added sweet basil powder 2%
- \( P_2 = \) meatball dough added sweet basil powder 4%
- \( P_3 = \) meatball dough added sweet basil powder 6%

Then the data analyzed with Anova at a real level of 5% if it showed significant results then continued the BNT test to get the percentage of use of the best sweet basil powder in meat quality.

3. Results
The results of this study that have been tested on physical and organoleptic qualities in chicken meatballs could be seen in table 1 below

| Physical Quality | \( P_0 \) | \( P_1 \) | \( P_2 \) | \( P_3 \) |
|------------------|---------|---------|---------|---------|
| pH               | 6.28±0.13<sup>a</sup> | 6.27±0.15<sup>b</sup> | 6.16±0.13<sup>b</sup> | 6.18±0.10<sup>b</sup> |
| Water content    | 70.21±3.20 | 66.5±2.60 | 64.5±3.70 | 67.7±1.49 |
| Cooking loss     | 9.23±1.22<sup>a</sup> | 6.06±1.34<sup>b</sup> | 5.35±2.02<sup>b</sup> | 5.75±2.21<sup>b</sup> |

| Organoleptic Quality | \( P_0 \) | \( P_1 \) | \( P_2 \) | \( P_3 \) |
|----------------------|---------|---------|---------|---------|
| Aroma                | 2.93±0.46<sup>a</sup> | 3.73±0.50<sup>b</sup> | 4.00±0.74<sup>b</sup> | 3.00±0.62<sup>a</sup> |
| Flavour linking      | 3.06±0.50<sup>a</sup> | 3.60±1.00<sup>b</sup> | 4.06±0.50<sup>b</sup> | 2.83±1.50<sup>a</sup> |
| Basil flavour        | 1.13±0.50<sup>a</sup> | 3.66±1.00<sup>b</sup> | 4.66±0.50<sup>b</sup> | 3.46±0.46<sup>a</sup> |

Different Notation show real different (P<0.05)

3.1. pH value
pH value is a scale that indicate the acidity level of meat processed products. The pH value is very important factor to determine the physical quality of chicken meatballs. Based on the results of this study it is shown that the addition of sweet basil leaves had significant effect (P<0.05) on pH value of chicken meatballs. The average pH values on each treatment were 6.27±0.15 at \( P_0 \), 6.28±0.13 at \( P_1 \), 6.16±0.13 at \( P_2 \), and 6.18±0.10 at \( P_3 \). The decrease of pH value in meatballs after the addition of sweet basil leaves was thought to be the influence of sweet basil leaves that have weak acid properties. According to [10] the concentration of basil leaf extract at 4% and 8% in the manufacture of pindang fish tended to lower the pH value. According to [11,12] stated that basil leaf essential oil is a partially weak acid.

Based on the result, pH value at \( P_1 \), \( P_2 \), and \( P_3 \) were lower than the control or \( P_0 \). The standard pH value of meatballs according to [13] ranged from 5.5-7.2. According to[14] stated that meatballs with addition of rye bran have pH value from 6.06-6.09. According to the Indonesian National Standard, the normal pH value in meatballs ranged from 6-7. This implies the pH value of chicken meatballs in this
study falls into the normal category. The pH value is associated with shelf life of processed meat products, the lower pH value, the lower conditions that allow microbial growth, therefore increases shelf life. At this point, P2 and P3 treatments could be recommended to increase the shelf life of chicken meatballs.

3.2. Water content
Water content is one of the factors that affect physical quality of meat processed products. Based on the result of this study the value of water content on every treatment was not affected significantly (P>0.05). The average percentage of water content in this study in P0 or control was 70.21%, water content at P1 was 64.5%, the water content in P2 was 66.5% and water content at P3 was 67.7%. Although it did not noticeably different but could be seen that the percentage of water content in chicken meatballs without sweet basil compared to meatballs that added with sweet basil.

According to [15] the commercial beef meatballs in Malaysia have water content range from 63.25%-73.78%. The addition of rye bran caused water content in meatballs decreased from 64.82% to 57.77% [16]. Meanwhile the maximum water content of meatballs based on Indonesian National Standard 01-3818-1995 is 70.0%, it means the water content in the treatments P1, P2, and P3 are within the normal range although the result had no significant effect. The water content in meat processed products such as meatballs will influence the shelf life because microbes use water as a medium for microbial growth.

3.3. Cooking loss
Cooking loss is the shrinkage of fluids along with nutrients during cooking process hence reducing the weight of sample. Variance analysis showed that the addition of sweet basil leaves powder to chicken meatballs had significant effect (P<0.05) on cooking loss. The highest cooking loss was 9.23% at P0 or without treatment and the lowest cooking loss was 5.35% at P2. The higher percentage of cooking loss, the more nutrients and weight of sample that lost during cooking process. Good processed products must have low cooking loss. The percentage of cooking loss on treatments P1, P2, and P3 were lower than the control was presumably because sweet basil leaves powder were able to bind water. The properties of sweet basil leaves powder were rather dry and crunchy so it could absorb the water that was in the dough. It was noticeable between the control and the treatments before the boiling process that the addition of sweet basil leaves had absorbed water in the chicken meatballs dough.

According to [17] meatballs that had been applied with pomegranate extract had average cooking loss from 23.92%-24.21%. However, the percentage of cooking loss of meatballs added with green bean sprouts are 2.71% to 7.29% [18]. The percentage of cooking loss on the treatments P1, P2, and P3 were lower than the control. This means that meatballs with the addition of sweet basil were better because the nutrients loss during cooking process would be lower compared than the control. The best cooking loss in this study was 5.35% at P2. It is concluded that the addition of sweet basil leaves powder at 4% or P2 could be recommended to make a relatively low cooking loss on chicken meatballs.

3.4. Aroma
Based on the organoleptic test using 15 well-trained panelists obtained that chicken meatballs added with sweet basil leaves have a fresh aroma. Variance analysis found that meatballs with the addition of sweet basil had real effect (P<0.05) on the aroma of chicken meatballs. This was suspected because of the fresh aroma given by sweet basil leaves as one of the tonic spices. Sweet basil was commonly used as a spice in cooking food such as pasta and pizza. The aroma of Meatballs with 4% sweet basil leaves addition or P2 was preferred compared to control.

The preference of panelists had decreased alongside the addition of sweet basil leaves more than P2 or 4%. It is estimated that the more percentage of basil powder leaves added, the stronger aroma of the spices, so chicken meatballs were less preferred by the panelists. The aroma of sweet basil leaves is not too strong, but if applied more than 4% or P2, it would cover the distinctive aroma of chicken meatballs. Based on this, the use of sweet basil leaves for chicken meatballs that could be added to the dough of chicken meatballs is recommended as much as 4% or P2.
3.5. Flavour linking
Flavour linking is one of the factors that determine the acceptance of panelists. Panelists described the flavour of chicken meatballs whether would be accepted or not. The highest flavour linking score in this study was P2 which was 4.06. Variance analysis concluded that the addition of sweet basil leaves to chicken meatballs had a significant difference (P<0.05) on flavour linking with the average scores ranging from 2.93 to 4.06. Furthermore, the results of P0 and P3 were significantly different (P<0.05) from P1 and P2. In Table 1 it could be seen that the score of P0 was 3.20, then it increased on P1 to 3.40 and P2 got the highest score of 4.06. However, the score dropped back on P3 which was 2.93. In the P0 treatment produced range of flavour that quite preferred (intermediate). Meanwhile, in P2 were liked (like) but dropped back on P3 as became less preferred (dislike).

The cause of P2 became the most preferred by the panelists was thought because sweet basil leaves added a fresher flavour to the chicken meatballs without eliminating the distinctive flavour of chicken meat. After all, sweet basil was a tonic spice. However, this was different from the study of [19] that stated panelists usually like meatballs with a strong flavour. Flavour linking in P3 decreased allegedly because the addition of sweet basil caused the typical flavour of chicken meatballs to disappear and the flavour of sweet basil was more dominant so the panelists did not prefer it.

In addition to that, panelists were more accepting of chicken meatballs with 4% (P2) sweet basil leaves addition because of the flavour of meatballs were more savory and fresh. It is concluded that sweet basil leaves could improve flavour linking of meatballs. It was recommended the addition of sweet basil spices no more than 4% on chicken meatball dough.

3.6. Basil flavour
Sweet basil (Ocimum basilicum) has been used extensively to enhance the distinctive flavour and aromas of foods, such as salads, pizzas, meats, and soups [1]. Variance analysis found that meatballs with the addition of sweet basil leaves had a real effect (P<0.05) on the strength of sweet basil flavour. The best acceptance score of sweet basil flavour in chicken meatballs in this study was 4% (P2) followed by 2% (P2).

The distinctive flavour of sweet basil leaves made panelists preferred the flavour of chicken meatballs with 2% to 4% addition. Meatballs with the addition of sweet basil 2% to 4% were easily accepted by panelists. However, the panelists started to be less fond of the addition of sweet basil leaves at 6% (P3), it was thought that the flavour of sweet basil dominated the typical flavour of chicken meatballs. Meatballs that have a good taste are more accepted by consumers [20]

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