The effect of kecombrang leaves (*Etlingera elatior*) addition and meat storage length on the meat decomposition, microstructure, and sensory quality

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Abstract. This study aims to investigate the effect of *kecombrang* leaves (*Etlingera elatior*) on the decomposition, microstructure and sensory quality of meat at the refrigerator temperature. This study was conducted with three treatments i.e. control 0% (P1), powder 7.5% (P2) and fresh 7.5% (P3), with storage time of 0, 3 and 6 days, for each treatment. Variables measured included the decomposition, microstructure and sensory quality. The initial decomposition used the Eber test. Microstructure used Hemactosiline-Eosin (HE). The data of decomposition and microstructure were descriptively analyzed. Sensory quality data were analyzed by Kruskal-Wallis hedonic test. The results showed that there was an initial decomposition on the 3rd day for control (P1) and preservation with dry *kecombrang* leaves (P2), whereas for fresh *kecombrang* (P3) no decomposition occurred up to 6th day. The microstructure of meat began to damage on the 3rd day in P1 and P2 and more severe in 6th day of storing, whereas in P3 to 6 days storage there was relatively no damage. *Kecombrang* leaves had significant effect (P<0.05) on color, aroma and acceptability, but no significant effect on the taste and texture. In is concluded that *kecombrang* powder is most effective.

1. Introduction

Beef is one of the livestock commodities needed to meet animal protein from livestock. The beef has to meet the meat quality requirements, namely safe, healthy, wholeness and halal. Beef is highly nutritious so it is good for the growth and development of microbes. The growth and development of microbes can cause discoloration, odor and even decomposition. A common way to maintain the quality of meat is by storing it at refrigerator temperature. Storage at the temperature of the refrigerator cannot kill all microbes, but only inhibits its growth. Therefore, a preservation effort is carried out on beef stored in refrigerator temperatures to reduce the number of microbes and prevent damage to meat.

Preservation of meat can be done for example by adding preservatives agent. Additions of preservatives agent sometimes used are preservatives which are not recommended for food. Therefore, there is a need for alternative natural preservatives that are safer for preserving meat. One ingredient that can be used as a natural preservative is the kecombrang plant (*Etlingera elatior*). Kecombrang contains antimicrobials, such as alkaloids, flavonoids, polyphenols, steroids, saponins and essential oils. Almost all parts of kecombrang plants contain polyphenols which have antimicrobial activity [1]. Some researchers previously used kecombrang flower for preservation of ground beef [2], kecombrang stems for preservation of tofu, fish and fish meatballs [2-3].
Kecombrang which has antibacterial activity, is a perennial (seasonal) plant. Kecombrang grows and develops well when planted in the shade, the soil requires aeration and enough water [4]. As a seasonal crop, the availability of kecombrang generally fluctuates according to the pattern of the season, where in the rainy season the production is abundant and otherwise is limited to the dry season. One alternative, which can help overcome to provide kecombrang throughout the year so that the kecombrang is made in the form of (dry) flour kecombrang. Therefore, kecombrang in the form of kecombrang flour as an alternative to fresh kecombrang so as to provide preservation of meat so as not to cause damage to the good nutrition makes the meat easily damaged as a result of microbiological, chemical and physical processes. One form of damage is a decomposition.

This research aims to determine the effect of fresh and dried leaves kecombrang on the beginning of decomposition, microstructure and sensory quality of beef at refrigerator temperature.

2. Material and methods

2.1. Material

This research has been conducted at the Meat Science and Technology Laboratory, Department of Animal Products Technology, Faculty of Animal Science, Gadjah Mada University from December 2017 to January 2018.

The material used in this study was beef, Kecombrang leaves, label paper, tissue, methylated, cotton, vacuum plastic and distilled water. The tools used in this study are measuring cups, tube racks, test tubes, erlenmeyer, cotton, aluminum foil, analytical scales, knives, blenders, ropes, pans, stoves and stopwatches.

This study used Simpo beef aged two to four years in the Silverside section of the femoral Biceps muscle weighing 1500 g. Preparation of meat samples (meat weighed 1500 g, cut into 3 parts). The first part was the control P1, the second part was the dry leaf (kecombrang flour) P2 and the third part was the fresh leaf P3, the five replications for each treatment.

2.2. Methods

2.2.1. Making a kecombrang leaf preservation agent. Kecombrang leaves are washed, then cut and blended to produce fresh Kecombrang leaf powder. Fresh Kecombrang leaves (with a level of 7.5%) then put into 150 ml of aquadest. Kecombrang leaves are washed, then cut into pieces. After that, the drying process is carried out using an oven at 60 °C for 10 hours. After drying, Kecombrang leaves are mashed using a blender. Then sifting is done. Kecombrang leaf flour that has been produced is then put into: 150 ml aquadest [5].

2.2.2. Meat preservation. Beef; 500 g each, were put in a control solution (distilled water), a solution of flour kecombrang (7.5%) and a solution of fresh kecombrang leaves (7.5%). Soaking was done for 2 hours. The meat which has been immersed in the treatment solution is removed, then stored at refrigerator temperature with a pan and in a vacuum plastic.

2.2.3. Data collection. The data includes the process of decomposition, microstructure test and test sensory quality of meat. Each test was carried out in 3 treatments (control, flour leaves and fresh leaves) and each treatment consisted of 3 replications. Observation of meat quality was carried out on days 0, 3 and 6.

The meat samples were observed for decomposition test [6] and microstructure test. The stages in making meat preparations consist of tissue preparation (meat), dehydration and purification, paraffin infiltration (paraffinization) and blocking, tissue cutting and staining stages [7]. Sensory testing using the Kruskall-Wallis hedonic method.
The data obtained were analyzed using descriptive analysis for decomposition and microstructural of meat. Sensory quality data were analyzed by the Kruskal-Wallis and Duncan New Multiple Range Test.

3. Result and discussion

3.1. The initial decomposition of beef

The level of decomposition (eber test) of beef with the treatment of giving kecombrang leaves at room temperature is presented in Table 1.

| Treatments | Replication | Storages length (day) |
|------------|-------------|-----------------------|
|            |             | 0 | 3 | 6 |
| P1         | 1           | - | + | + |
|            | 2           | - | + | + |
|            | 3           | - | + | + |
| P2         | 1           | - | + | + |
|            | 2           | - | + | + |
|            | 3           | - | + | + |
| P3         | 1           | - | - | - |
|            | 2           | - | - | - |
|            | 3           | - | - | - |

P1: control, P2: Kecombrang leaf flour, P3: Fresh kecombrang leaves
(+) the initial process of decomposition occurs
(-) No the initial process of decomposition occurs

The results showed that in the control (P1) and the addition of dried kecombrang leaves on the 3rd day of storage the refrigerator temperature had shown the occurrence of decomposition, while the addition of fresh kecombrang leaves (P3) to 6th day of storage had not shown any initial decomposition. The damage to the chemical component of the leaves of Kecombrang in the process of making dried Kecombrang leaf flour, so that in the treatment using dried kecombrang leaves P2, the effect on preventing damage to meat is lower than the treatment using fresh kecombrang leaves. Denaturation and degradation of meat can be caused by enzymes present in the meat itself [8], oxidation processes [9], and also due to microbes [10-11].

3.2. Beef microstructure

Transverse microstructure of control meat (A), dried kecombrang leaf treatment (D) and wet kecombrang leaf (G) on day 0 showed no different conditions, but along with the storage length, the gap between muscle fibers widened. The longer the storage process of meat protein degradation by proteolytic enzymes is greater, so the ability to bind water decreases, as a result the gap between muscle fibers is getting bigger. This may be related to the level of damage due to greater microbial spoilage, which results in damage to meat microstructure, as shown in Table 2 about meat spoilage. Protein denaturation and degradation due to treatments result in decreased protein water binding capacity, so that the diameter of muscle fibers becomes smaller and the gap between muscle fibers becomes wider [8,12,13].
Figure 1. Microstructure of transverse section with addition of kecombrang leaves as preservation agents at different storage times: (A) Control at 0 day; (B) Control at 3rd day; (C) Control 6th day; (D) Dried kecombrang leaves at 0 day; (E) Dried kecombrang leaves at 3rd day; (F) Dried kecombrang leaves at 6th day; (G) Fresh kecombrang leaves at 0 day; (H) Fresh kecombrang leaves at 3rd day; dan (I) Fresh kecombrang leaves at 6th day. The red field shows muscle fibers and white indicates the gaps of muscle fibers.

3.3. Longitudinal section microstructure

Microstructure of longitudinal section of meat with addition of kecombrang leaves as preservation agents showed change with the storage length, especially on control and adding dried kecombrang leaves (Figure 2). On the contrary, there was no change in the addition of fresh kecombrang leaves. The fresh kecombrang leaves have a better effect than control and the dried kecombrang leaves. The degree of damage to muscle fibers is related to the level of damage due to microorganisms. This can be seen in P1 and P2 who experience early decay faster turns out to have a higher level of damage to muscle fibers.
Figure 2. Microstructure of Longitudinal section of meat with addition of kecombrang leaves as preservation agents at different storage times: (A) Control at 0 day; (B) Control at 3rd day; (C) Control 6th day; (D) Dried kecombrang leaves at 0 day; (E) Dried kecombrang leaves at 3rd day; (F) Dried kecombrang leaves at 6th day; (G) Fresh kecombrang leaves at 0 day; (H) Fresh kecombrang leaves at 3rd day; dan (I) Fresh kecombrang leaves at 6th day. The red field shows muscle fibers and white indicates the gaps of muscle fibers.

3.4. Sensory quality
The addition of kecombrang leaves as preservation agents and storage length affected the color, aroma and acceptability, while the texture and taste were not affected. The acceptability of meat has decreased both in the control and dried leaves, but still in fresh kecombrang, although the score is lower due to aroma and color factors. The color score in P1 and P2 has decreased until a storage period of 6 days, conversely in P3 has increased. This could be due to the level of damage to P1 and P2 being greater with the duration of storage.
Table 2. Average sensory score of cooked meat with the treatment of adding kecombrang leaves with a storage length temperature of the refrigerator

| Variables | Storage length (day) |
|-----------|----------------------|
| 0         | 3                    | 6                    |
| P1        | P2                   | P3                   |
| Color     | 3.33±0.11            | 3.40±0.91            |
|           | 2.73±0.16            | 3.40±0.82            |
|           | 3.43±0.74            | 3.00±0.75            |
|           | 2.53±0.82            | 3.40±0.70            |
|           | 3.53±0.75            |
| Aroma     | 3.33±0.81            | 3.60±0.82            |
|           | 2.53±0.35            | 3.40±0.63            |
|           | 3.26±0.70            | 2.73±0.88            |
|           | 2.73±0.63            | 2.80±0.70            |
|           | 2.80±0.88            |
| Taste**   | 3.40±0.91            | 3.06±0.88            |
|           | 2.66±1.04            | 3.26±0.88            |
|           | 2.66±0.89            | 2.86±0.88            |
|           | 2.86±0.63            | 2.86±0.88            |
|           | 2.86±0.88            |
| Texture** | 3.26±0.96            | 3.60±0.82            |
|           | 2.66±1.04            |
|           | 3.26±0.88            |
|           | 3.06±0.88            | 3.26±1.03            |
|           | 3.06±0.88            | 3.06±0.88            |
|           | 3.06±0.88            |
| Acceptability | 3.26±0.96 | 3.46±0.74       |
|           | 2.66±1.17            |
|           | 3.53±0.74            |
|           | 2.86±0.63            |
|           | 2.86±0.63            |
|           | 3.06±0.63            |
|           | 2.73±0.83            |

a,b different superscripts within the same raw are significantly different (P<0.05)

The aroma of fresh kecombrang or pasta is very pungent and not so liked by the panelists, so that even though the initial decay test looks good, overall the panelists prefer preservation with kecombrang flour. The aroma is an important factor of all the determinants of flavor. The aroma is produced from volatile substances that are captured by the olfactory receptors that are behind the nose, which are then interpreted by the brain.

4. Conclusion

Preservation of fresh kecombrang leaves (P3) is better than kecombrang leaf flour (P2) and control (P1). It can maintain the sensory quality of beef, microstructure and not easily experience decomposition compared to other treatments stored. However, the panelists preferred and had better acceptance up to 6th days of preserving with kecombrang leaf flour than control and wet or pasta kecombrang leaves.

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