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Different Type of Applicatio n Edible Coatings Technique on Beef of Physcochemical an Sensory Quality

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Abstract: This study aimed to determine the best technique of application of edible coatings (spraying, spreading, or dipping) on beef carried out sensory quality, then performed in coated to physicochemical analyses (pH, moisture content, WHC, cooking loss, and color). This study aimed to determine the best technique of application of edible coatings (spraying, spreading, or dipping) on beef carried out sensory quality, then performed in coated to physicochemical analyses (pH, moisture content, WHC, cooking loss, and color). The beef was coated with different coating techniques spraying, brushing, and dipping then stored at 27°C for 8 hours. At the end of the storage period, the treatments exhibited the best sensory analyses (texture surface and under, odor, physical deviation, and discoloration). The best sensory analysis is the spraying of coatings technique is spraying. The results that the application of the edible coatings technique on beef maintaining the best physicochemical quality are pH 5,59; the moisture content of 68,26%; WHC of 43,71%; cooking loss of 34,28%; and color indicated by *L*, a*, and b**.

Keywords: Beef; Technique application; Edible coating; Casein; Chitosan

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Introduction

The beef characteristics are fresh red, fine fiber and yellow fat (Buege, 2001). The reduction of beef quality can be known from changes in color, taste, aroma and even rot. Beef damage is generally caused by poor handling to provide a chance of life for the growth and development of damaging microbes that have an impact on reduced storage and loss of nutritional value. Beef preservation is crucial as an effort to extend the shelf life, both for fresh and processed meat. The natural preservation as a safe protection for food is edible coatings. Edible coatings improve the gas and moisture barriers, mechanical properties, sensory perceptions, convenience, and microbial protection and prolong the shelf life of various products (Krochta, 2002; Janjarasskul, 2001). Other applications of its use include health benefits by incorporating nutrients such as vitamins, minerals and bioflavonoids within the film matrix (Park et al., 2001; Larotonda et al., 2005; Park and Zhao, 2006) In addition, the biodegradable and eco-friendliness of edible films and coatings are other desirable benefits associated with their use (Sirascusa, 2008). Coatings are a particular form of films directly applied to the surface of materials and are regarded as part of the final product (Han and Gennadios, 2005). On the other hand, edible films are obtained from food grade film genic suspensions that are usually cast over an inert surface, which after drying can be placed in contact with food surfaces.

Nowadays, eco-friendly and edible packaging namely edible coating has been developed. Edible coating as a thin layer on edible material, usually applied as a liquid with varying viscosity on the surface of food products by spraying, spreading and dipping technique. Polysaccharides, proteins, and lipids are the main polymers used for the manufacture of edible coatings (Shilpi et al., 2016). Edible coatings to extend the

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shelf life of beef. Considering the large number of potential protective beef. According to Apriliyani, et al., 2020, when applied to raw chicken breast during an accelerated storage test at 7°C, adding catechin to the casein-chitosan edible coating improved its antioxidant capacity. The importance of this study is to determine the effect of using edible coatings of casein and chitosan on beef with long storage as a way of handling livestock products that are easily damaged. This study aimed to determine the best technique of application of edible coatings (spraying, spreading, or dipping) on beef carried out sensory quality, then performed in coated for sensory quality and physicochemical analyses (pH, moisture content, WHC, cooking loss, and color).

Method

Preparation and Application Edible Coating on Beef

The materials used edible coatings were casein (Merck), chitosan (Makmur Sejati), glycerol (Merck), beeswax (Rimba Raya), aquades, and acetic acid. Casein and chitosan solution with ratio of 1:3 (ml/ml) then hand mixed for 10 min and stored at 27°C for 8 hours. The material used in this study was meat from cattle (beef) cut to size 6x4x1 cm, that part *Longissimus dorsi* muscle is used was the muscle back section. Beef was bought at traditional markets (Oro-oro Dowo Market in Malang City). Application different technique of edible coatings with spraying (ECS), brushing (ECB), and dipping (ECD). The edible coating spray technique is done traditionally, where the coating solution is put in a spray bottle. The edible coating dipping technique is done by pinching the meat and dipping it in the coating solution while the basting technique is done using a soft brush, all done evenly on the surface of the meat and then drained for 30 minutes. The sensory (texture surface and under, odor, physical deviation, and discoloration), pH, moisture content, Water Holding Capacity, Cooking Loss, and Color of the coated beef were then analyzed. The research area presented in Figure 1. This study were three treatments with three replications.

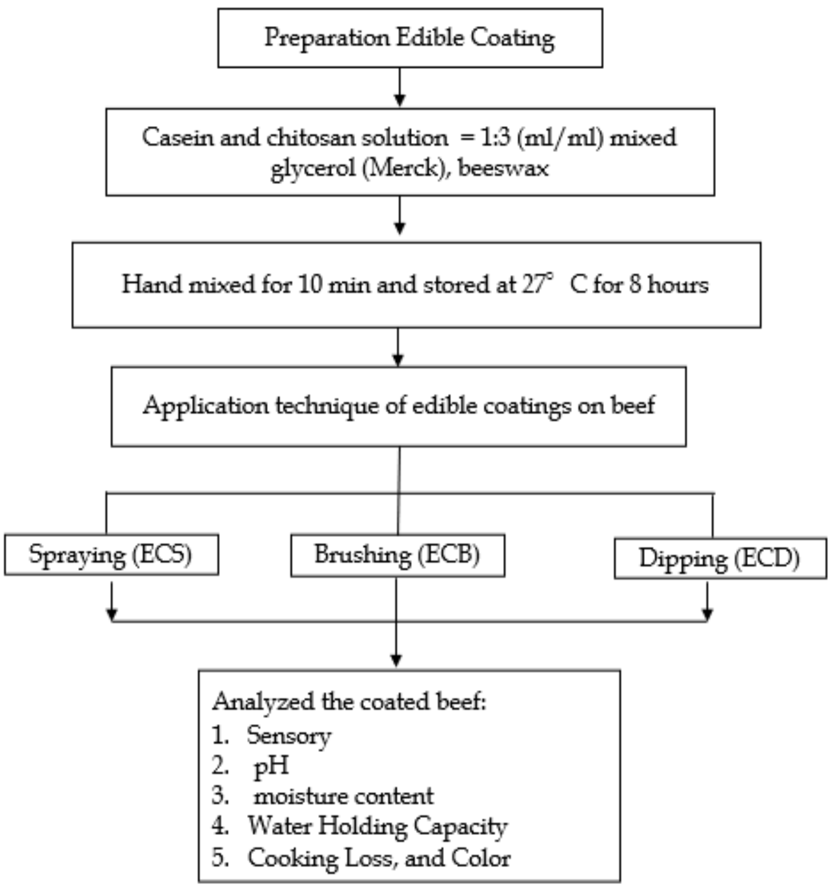

Figure 1. Preparation and Application Edible Coating on Beef

Sensory analyses

Samples from each formulation were randomly assigned for sensory evaluation. Beef was cut into pieces of uniform size and served based on treatment to 10 panelists. The panel consisted of staff who were selected in preliminary sessions and trained (two sessions) in the products and terminology (Colmenero et al., 2003) A description of attributes was discussed with the panel members. Panelists were asked to the following parameters (i.e., odor, texture surface and under, physical deviation, discoloration, and overall acceptability). Odor on a scale of 1 (off odor) to 4 (normal); color on a scale of 1 (dark) to 4 (normal); texture surface and under on a scale of 1 (slimy) to 4 (fresh), physical deviation on a scale of 1 (dark) to 4 (normal), and discoloration a scale of 1 (dark) to 4 (normal).

Physicochemical analyses

1) *pH*

The pH meter is neutralized to the aquades pH 6.8 - 7. The tip of the pH meter stuck in three parts of the muscle. The pH value will be recorded on the monitor screen, then averaged.

2) *Moisture content*

Measuring water content principal drying was perfomed the material at 105ºC in an oven until achieved a constant weight. The weight difference before and after drying is the amount of water evaporated. The samples were carefully weighed 1-5 grams, then placed on a petri dish which had previously known the dry weight. Then, put into the oven at 100-105ºC for 3-5 hours. Afterward, it was chilled in the exicator, then weighed when it was cold.

$$\text{Water Content (\%)} = \frac{w1-w2}{w1-w0} \times 100\% \quad (1)$$

Note: Wo = constant weight of Petri dish; W1 = Weight of sample + cup; and W2 = Weight of final sample

3) *Water Holding Capacity*

The holding capacity of the water was performed by the appropriate method of press with the instructions of Hamm, a sample of 0.3 g. The sample was placed on between 2 filter papers Whatman 42. Furthermore, samples pressed between two plates with a weight of 35 kg for 5 minutes using a modification device 22 Filter Paper Press. Filter paper was placed under tracing paper and the area was formed drawn (Abustam, 2012) after that the sample was scanned later calculated the area of meat and the total area. The water holding capacity was calculated by the following formula:

$$WHC = \frac{D}{T} x\ 100\% \quad (2)$$

T

Note: D = Area of Meat; T = Total Area

4) *Cooking Loss*

The cooking loss testing procedure can be done by means of a sample as much as 20 grams wrapped in plastic clips and then put in measuring cup and cooked using water bath for 15 minutes with temperature 70ºC. After boiling the sample is removed and cooled. After The sample is removed from the plastic and the remaining water is stuck to the surface of the meat dried using suction paper without pressing. Furthermore, the sample is weighed (Soeparno, 2009). The cooking loss capacity was calculated by the following formula:

$$\text{Cooking Loss} = \frac{W1-W2}{W1} x\ 100\% \quad (3)$$

W1

Note:
W1 = weight before cooking
W2 = weight after cooking

5) *Colour*

Color measurements were made on the dorsal side of the fillets with a Minolta Spectrophotometer CM-700d (Konica Minolta Inc., Ramsey, NJ). Measurements were recorded as the average of 3 readings and expressed in terms of values for lightness (L*), redness (a*), and yellowness (b*).

Data analysis

The data had been collected was analyzed using descriptive test. The sensory properties chosen were especially the most relevant to quality or most sensitive to changes in quality taste, aroma, texture, and data condition the results of the study were analyzed with descriptive tests analytic namely research methods focus on problem solving actual problems and subsequently data had originally been compiled, explained later analyzed.

Result and Discussion

Sensory quality

Sensory assessment conducted on coated beef was a hedonic quality test with a scalar method which includes an assessment of odor, color, texture (surface and under), physical deviation and overall accetabillity. Scalar test results for raw beef and buffalo can be seen in Table 1.

Table 1. Sensory quality of coated beef

Samples	ECS	ECB	ECD
Odor	3	3	3
Color	3	3	3
Surface Texture	3	2	2
Under Texture	3	2	2
Physical Deviation	4	2	2
Overall accetabillity	4	3	2
Total	20	15	14

Note: ECS = spraying, ECB = brushing, ECD = dipping
Parameters: Odor on a scale of 1 (off odor) to 4 (normal); Color on a scale of 1 (dark) to 4 (normal); texture surface and under on a scale of 1 (slimy) to 4 (fresh), physical deviation on a scale of 1 (dark) to 4 (normal), and discoloration a scale of 1 (dark) to 4 (normal).

Odor

Odor is important in influencing consumers selection and liking of food. Odor and/or flavor aromatics also are volatile compounds and have been described as cowy, grainy, serum/ bloody, livery, browned, and burnt. The odor of casein-chitosan on beef did not contribute to overall beef odor. Lipid oxidation affects color, texture, nutritional value, taste, and aroma leading to rancidity, which is responsible for off-flavors and unacceptable taste, which are important reasons for consumer rejection. The development of oxidative rancidity in meat begins at the time of slaughter, when blood flow is interrupted, and the metabolic processes are blocked (Lima et al., 2013). Beef which has experienced spoilage especially on red meat will smell bad, the smell of beef is an influence a mixture of triacylglycerol lipolytic enzyme activity, oxidative rancidity of unsaturated fatty acids and protein degradation products that accumulate in fat tissue. Protein degradation products meat can be known from the release of gases ammonia (NH_3), and hydrogen sulfide (H_2S) as well rotten methyl mercaptan. The release of these gases is sourced from amino acids a meat protein constituent containing NH groups, S groups and CH_3 groups in combination with other compounds (Merthayasa et al., 2015).

Color attributes

Color attributes of beef coated tends bright cherry-red color. The application of edible coatings (spraying, spreading, or dipping) showed result of the protein, myoglobin, which turns into oxymyoglobin and produces the bright color when it comes in contact with oxygen. Preservatives became necessary for transporting meat for long distances without spoiling of texture, colour and nutritional value after the development and rapid growth of super markets (Nychas et al., 2008). The aims of preservation methods are to inhibit the microbial spoilage and to minimize the oxidation and enzymatic spoilage. Current meat preservation methods are broadly categorized into three methods are controlling temperature, controlling water activity and use of chemical or bio preservatives (Zhou et al., 2010). A combination of these preservation techniques can be used to diminish the process of spoilage (Bagamboula, 2004).

Texture attributes

Each technique application edible coating showed different texture (surface also under). Application of edible coatings on beef showed tends spoiled, sticky or slimy to the touch. If beef has developed these characteristics, it should not be used. Texture is the hallmark of fresh meat objective. Muscle texture can be divided into two categories, rough texture with large fibrous bonds, and fine texture with small fibrous bonds (Soeparno, 2009). This trait is understood by consumers visually and palpated. The texture, taste, and general acceptability of the cooked beef patties were all improved by using an active coating solution. Meat tenderization was caused by proteolytic enzymes acting on myofibrillar proteins (Shin et al., 2017).

Physical deviation and overall acceptability

Physical deviation and overall acceptability as visual appearance. The results showed the best sensory quality in application of edible coatings with the spraying. Physical deviation seen by surface condition like as sliminess and greening. Spoilage of meat products occurs generally in three types are sliminess, souring, and greening (Osman and Bozoglu, 2016). Beef was coated with casein-chitosan solutions and different of coating technique (spraying, brushing, and dipping) then stored at 27°C for 8 hours as environmental factors. The influence of environmental factors (product composition and storage conditions) on the selection, growth rate and metabolic activity of the bacterial flora is presented for meat.

Panning, fluidized bed, dipping, and spraying are common procedures to applicate a coating in the food (Andrade, et al., 2012). The dipping process might cause issues with product respiration and storage. In addition, the disadvantageous of dipping procedure is that the fluid might dilute the food's outer layer, so reducing its functioning (for example for fruits and vegetables) could have their natural wax covering removed after dipping (Lin and Zhao 2007). Debeaufort and Voilley (2009) state that spray coating is the most widely utilized method for applying food coatings. A spray system uses a set of nozzles to expand the surface area of the liquid by forming droplets and distributing them across the food surface area. The key advantages of this technology are homogeneous coating, thickness control, and the ability to apply multiple layers (Ustunol 2009).

Physicochemical analyses

Data on Physicochemical of Coated Beef are shown in Table 2

Table 2. Physicochemical of Coated Beef

Samples	pH	Moisture Content (%)	Water Holding Capacity (%)	Cooking Loss (%)
ECS	5.58	64.49	28.78	33.28
ECB	5.98	62.28	29.39	32.26
ECD	5.87	64.28	31.42	32.28

pH

The results showed the pH beef in application of edible coatings (spraying, brushing, or dipping) ranged of 5.39-5.98. The pH value beef is still in the pH range normal beef. The normal pH of meat ranges 5.3-5.9, depending on the rate of glycolysis postmortem as well as deep glycogen reserves muscle. The pH value meat and meat products in general ranged of 4.6 to 6.4 (Soeparno, 2009). According to Apriliyani, et al. (2021), The application of a casein-chitosan edible coating to broiler meat for 168 hours can keep moisture content, pH, lipid content and color. The factors affecting the pH value and shelf-life beef after slaughtering and during processing and storage are microbial spoilage, lipid oxidation and autolytic enzymatic spoilage (Dave and Ghaly, 2011). Over the course of the storage period, the mean pH of all treatments gradually increased. Elevated pH has a negative impact on product quality during storage, particularly in terms of sensory features including odor, color, and texture (Zhang, Wu, & Gou, 2016).

Moisture content

The results showed the moisture content in application of edible coatings (spraying, brushing, or dipping) ranged of 60.53-68.26%. Long storage will also affect levels water, which is the higher level of meat moisture content (Amertaningtyas, 2013). The determinants of beef quality are getting lower or acidic means the beef will experience faster decay. Almost all bacteria grow optimally at a pH of around 7, but pH for optimal growth is determined by stimulant work from various other variables.

Water Holding Capacity (WHC)

The results showed the WHC in application of edible coatings (spraying, brushing, or dipping) ranged of 28.78-43.71%. Table 1 shown an increase in WHC in beef coated between the ECS, ECB and ECD treatments. The higher the percentage of meat the higher the holding capacity of the water produced. Factors that influence the high WHC are water content, protein, and salt usage (Amertaningtyas, 2013). The highest mean of WHC was produced by the dyeing technique. One of the reasons the WHC value can be higher is due to the loosening of the structure of the meat, then the meat will absorb more which results in a high WHC value.

Cooking Loss

The results showed the Cooking Loss in application of edible coatings (spraying, brushing, or dipping) ranged scale of 32.26-33.28%. According to Khasrad (2010) the factors that affect the cooking loss of meat Some of them are the state of myofibril contraction, and muscle fibers. Short muscle fibers increase the cooking loss of beef. Coating technique by spraying gives the highest value than brushing and dipping techniques on cooking shrinkage. Cooking loss is amount of liquid in cooked meat, which if it has a low value, then will have more physical qualities better than meat that has value big cooking loss. Difference cooking losses from the data obtained, possibility also related to fat content in muscles, where muscles are contains fatter experience a higher fat loss at the time of cooking, and there are differences pH and WHC values or the WHC. The amount of cooking loss can be used to estimate the amount of juice in cooked meat.

Color Measurement

Data on Color of Coated Beef are shown in Table 3.

Table 3. Color of Coated Beef

Samples	Color		
	*L**	*a**	*b**
ECS	56.98	71.75	12.39
ECB	58.43	70.36	44.46
ECD	59.32	69.22	15.03

Table 3 shows the visible spectra (400–750 nm) classification analyses that the greatest average percentage of correctly classified color in application of edible coatings (spraying, spreading, or dipping). The highest for L* and a* on ECS. Edible coatings prepared with addition catechin modified and coatings technique with spraying causes normal color like as fresh beef. Exposure lighting because of myoglobin and oxymyoglobin with oxygen leads to the formation of metmyoglobin, a pigment that turns meat brownish-red. Normal color because beef coated are high-oxygen packaging, which encourages oxymyoglobin formation beneath the meat surface and improves raw color stability, can predispose ground beef to premature browning (Seyfert et al., 2005).

Conclusion

Spraying is the best technique of application of edible coatings which stored at 27°C for 8 hours and keep stable sensory analyses (odor, color, texture (surface and under), physical deviation and overall acceptability). Furthermore, spraying methods do not contaminate the coating solution, allow temperature control of the coating solution, and can help automate continuous manufacturing. The results that the application of edible coatings technique on beef maintaining the best physicochemical quality are pH 5.59; moisture content of 68.26%; WHC of 43.71%; cooking loss of 34.28%; and color that indicated by L*, a* and b*.

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