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Physical and Chemical Characteristic of Halal Gelatin Extracted from Buffalo Hide with Addition of Pineapple Rind at Different Ratio

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ABSTRACT
The production of halal gelatin from buffalo hide waste, which came from an animal being slaughtered according to Islamic law, by adding pineapple rind as an extraction agent was an alternative to produce halal gelatin. The availability of buffalo hide in Riau Province is stable and its hide has high protein content. This research was conducted to produce and determine the characteristics of halal gelatin from buffalo hide using solution of pineapple skin in terms of their physical and chemical properties. The Completely Randomized Design (CRD) was the experimental design used with consist of 3 treatments and 4 replications. The treatment was ratio hide: pineapple rind solution, namely 3:1, 3:2, 3:3 w/v. The parameters observed were yield, viscosity, color, pH, ash content and moisture content. The results showed that immersion of buffalo hide in the solution of pineapple rind at different ratio gave highly significant increased the viscosity and ash content of gelatin but not significant effect to yield percentage, color, pH and moisture of gelatin. The yield percentage ranging from 5.99-7.33%, pH 4.83-4.85, viscosity was 1.95-2.20 cP, color 0.54-0.71 absorbance unit, ash 0.25-, 032% and moisture 9.97-9.99%. It can be concluded that the best treatment was ratio 3:2 and 3:3 according to had viscosity, pH, color, ash and moisture in line with the standard of gelatin by Gelatin Manufacture Institute of America (GMIA).

Keywords: *buffalo hide, chemical properties, halal gelatin, pineapple rind, waste*

1. Introduction

Indonesia is one of the importing gelatin countries. The problem that arises was not of all imported gelatin was produced by halal procedure due to origin of hide material and the animal slaughtering techniques that were not accordance with Islamic law. The production of halal gelatin from buffalo hide waste, which came from an animal being slaughtered according to Islamic law, by adding pineapple rind as an extraction agent was an alternative to produce halal gelatin.

The availability of buffalo hide is high in Riau Province because there are three regencies which have the highest number of registered slaughtered cattle, i.e. buffalo, namely: Kampar Regency, Kuantan Singingi Regency and Pekanbaru city. According to Badan Pusat Statistik of Riau Province 2017, the number of slaughtered of buffalo in 2015 at Kampar Regency was 7,797 heads, in Kuantan Singingi Regency was 782 heads and in Pekanbaru City was 731 heads. According to Badan Pusat Statistik of Riau Province 2017, the number of slaughtered buffalo in 2015 at Kampar Regency was 7,797 heads, in Kuantan Singingi Regency was 782 heads and in Pekanbaru City was 731 heads. As a result, hide is available as the by-product of buffalo slaughtering. Processing buffalo hide into gelatin is one of the ways to increase the added value of hide.

Raw skin is divided into two groups, namely the group of hide derived from large animals such as cattle, buffaloes, horses, known as hide, and the group of skin derived from small animals such as goats, rabbits, and reptiles, known as skin. The hide from large animal has more protein content than the skin of small animals (Rafika et al., 2016).

Gelatin is a product derived from extraction of collagen, bone and other tissues by using acids, bases or enzymatic process (GMIA, 2012). According to Remawati (2016), the gelatin derived bovine hide that extracted by acetic acid 0.2 M had value of viscosity 30 cP, yield was 6.29 %, pH value was 5.6, water content 63.51 %, and ash content was 0.3%. Mulyani et al., (2017) had studied on gelatin producing from buffalo hide by using different acid solution (hydrochloric acid, citric acid and acetic acid) at various concentrations. The produced yield percentages were 6.22%, 6.52% and 6.79%, respectively. The research on gelatin producing from buffalo hide waste by using pineapple rind extract has not been reported, so this research is urgent to conduct.

According to Kumaunang (2011), the pineapple rind contains bromelain enzymes about 0.07 Unit/ml.

Bromelain is protease enzyme which has the properties of hydrolyzing proteins (Dubey et al., 2012). Protease enzymes will break up the peptide bonds of collagen proteins (Suhermiyati & Setyawati, 2008).

The production of pineapple in Riau Province in 2015 was 74.389 ton (BPS Riau Province, 2017). The high production of pineapple in Riau Province also produces high pineapple rind, which can be used as a source of crude bromelain. This pineapple rind could use to extract gelatin from buffalo hide. This research was conducted to produce and determine the characteristics of halal gelatin from buffalo hide using solution of pineapple rind in terms of their physical and chemical properties.

2. Materials and methods

The material used in this research was 7 kg buffalo hide from the traditional slaughterhouse in Bangkinang. The slaughtering method must be according to Islamic law. The pineapple rind came from traders on Jalan Rimbo Panjang, Kampar and distilled water.

The research method was the experiment with Completely Randomized Design (CRD) as experimental design with 3 treatments and 4 replications. The treatment was the ratios hide: pineapple rind solution, namely 3:1, 3:2 and 3:3 g/v. The parameters observed were yield, viscosity, color, pH, ash content and moisture content.

2.1. Preparation of hide

The preparation of buffalo hide were conducted as follow : The buffalo hide was cleaned by using water and then continued to remove the hair by burning it with smal fire on the surface of hide. This process aimed to removed the lipid in the hide. Then, the hide was cut in to small cubes (size of 2-4 cm) and finally, the small cubes were rinsed by the water repeatedly until clean.

2.2. Preparation of pineapple rind extract

The preparation of pineapple rind extract was carried out as follows: the waste of pineapple rind was cleaned from dirt by using water. Then, the pineapple rind was cut into small pieces. The pieces of rind and distilled water were put into a blender with a ratio of 1:1 and followed by grinding for about 5 minutes. Furthermore, the pineapple rind juice was filtered by gauze to get the filtrate of pineapple rind. Then, this filtrate was dissolved in distilled water according to the ratio in the treatment.

2.3. Process of gelatin extraction

Procedure of gelatin extraction from buffalo hide were carried out as follows: an amount of 300 g of the cleaned hide was soaked in the pineapple rind extract according the research treatment (ratio of buffalo hide: solution of pineapple rind extract, namely P1 300:100, P2 300:200 and P3 300:300 w/v). Amount of distilled water were added in P1 and P2 were 200 ml and 100 ml, respectively. Percentages of pineapple rind extract were added in the treatment respectively about 33.33% (P1), 66.67% (P2) and 100% (P3). The soaking process was held at room temperature in about 20 hours. Then, hide was rinsed by distilled water. The extraction process was began by placing the hide in a glass jar and adding 1000 ml of distilled water, then heating it in a shaker waterbath at 70˚C for 2 hours. The gelatin solution will be produced from this heating process. The gelatin solution was then filtered to separate the gelatin solution and buffalo hide. The next process was placing the gelatin solution in the refrigerator until gelatin became hardening. Then, the hard gelatin was dried using an oven at 105˚C for 24 hours. Then the dried gelatin was ground using a blender and was sieved until it formed flour.

2.4. The parameter observed

The parameter observed in this research were physical and chemical properties of gelatin. The physical properties were analysis of yield percentage (GMIA, 2013), viscosity (GMIA, 2013), color (Schrieber & Gareis, 2007). The chemical properties were pH value (GMIA, 2013), moisture (AOAC, 2005), and ash content (AOAC, 2005).

2.5. Data Analysis

Data statistically analyzed by analysis of variance to know the effect of the treatment towards the parameter observed. If the treatment showed significant effect, it will be continued to post hoc analysis by Duncan Multiple Range Test (DMRT) at α 0.05.

3. Result and discussion

The pineapple rind extract contains proteolytic enzyme, known as bromelain. The activity of crude enzyme in the pineapple rind extract in this research was 0.071-0.076 unit/ml. This enzyme activity was similar to the research of Kumaunang et.al. (2011), the enzyme activity in pineapple rind solution was 0.071 unit/ml.

3.1. Physical properties (Yield percentage, viscosity, color)

Data on yield percentage, viscosity and color of gelatin from buffalo hide that was soaked in pineapple rind extract at different ratios were shown in Table 1. The analysis of variance showed that the treatment of buffalo hide and pineapple rind extracts at different ratio had significant effect on increasing the viscosity of gelatin but did not significantly affect the yield percentage and the color of gelatin. DMRT analysis showed that gelatin made with buffalo hide and pineapple rind extract at ratio 3:2 and 3:3 had significantly higher viscosity than gelatin made from buffalo hide and pineapple rind extract at ratio 3:1. This means that the increase of concentration

pineapple rind extract from 33.33% to 66.67%-100% can increase the viscosity of gelatin.

The increasing of viscosity related to increasing of gelatin concentration at ratio 3:2 and 3:3 of buffalo hide and pineapple rind extract as an effect from proteolytic activity of bromelain enzyme in the pineapple rind extract. But, both of ratios could not give the increasing of yield percentage of gelatin significantly. This indicated that the concentration of pineapple rind extract should be greater and ratio of hide and pineapple rind extract should be varied in order to improve the yield percentage of gelatin.

Table 1. Physical properties of halal gelatin from different ratio of Buffalo hide and pineapple rind extract

Experiment	Value (unit)
Yield Percentage	
3:1	5.99±2.02%^{ns}
3:2	8.69±1.57%^{ns}
3:3	7.33±1.36%^{ns}
Viscosity	
3:1	1.95±0.02 cP^{a}
3:2	2.14±0.11 cP^{b}
3:3	2.20±0.14 cP^{b}
Color	
3:1	0.54±0.01au ^{ns}
3:2	0.65±0.05 au ^{ns}
3:3	0.71±0.02 au ^{ns}

Note: different superscript in the same column showed significant effect (α0.05), ns showed not significant effect. Data was shown as mean ± standard deviation.

The yield percentage of gelatin in this research was similar to the yield percentage of gelatin from buffalo hide which was soaked in pineapple solution for 12-96 hours, which result the yield percentage about 5.29-6.20% (Gozali, 2018). This research emphasized that soaking time for 20 hours could produce the yield percentage of gelatin similar to soaking time for 96 hours, and both of fruit and rind of pineapple extract showed similar enzymatic activity in hydrolysis of buffalo hide.

The similar phenomenon also reported by Mulyani et al. (2017) that the yield percentage of gelatin did not significantly increased when buffalo hide was soaked in a different acid (hydrochloric citric, and acetic acids at concentrations of 0.3, 0.6, 0.9, 1.2, and 1.5 M, respectively). The yield percentage ranged from 6.30-29.27%. Another research by Kurnia (2015) reported that the soaking of bone of bovine head in 5% hydrochloric acid solution for 10, 15 and 20 days did not significantly affect the increase yield percentage, and gave the percentage 6.22%, 6.52% and 6.79%, respectively.

Viscosity was a measure of the physical properties of gelatin which is strongly related to gel strength. Viscosity analysis was done to determine the level of viscosity of gelatin as a solution at certain concentrations and temperatures (GMIA, 2013). The viscosity of gelatin in this research was higher than viscosity of gelatin from beef hide that was soaked in hydrogen chloride acid at 3% and 5%, which showed the maximum viscosity of 1.79 cP (Rapika et al., 2016). The value of the viscosity of this research met the gelatin standards by GMIA (2012) which are 1.5-7.5 cP.

Color of gelatin in this research was measured by using spectrophotometer and was reported in absorbance unit. The color of gelatin ranging from 0.54, 0.65, 0.71 absorbance unit. The color of gelatin produced was yellowish. According to GMIA (2012), the color of gelatin depends on two factors. First, the nature of the raw material used and source of the gelatin represents a color (skin, or bone), and second, extraction process of gelatin. Gelatin from pork skin have less color than those made from bone or hide of cattle (beef, buffalo, horse). Furthermore, color does not influence the properties of gelatin or reduce its functions. The standard of color of gelatin was less color – yellow. The color of gelatin from buffalo hide in this research was yellowish and match with GMIA (2012).

3.2. Chemical properties

Data on pH value, moisture and ash content of gelatin from buffalo hide that was soaked in pineapple rind extract at different ratios were shown in Table 2. The analysis of variance showed that the treatment of buffalo hide and pineapple rind extracts at different ratio had no significant effect on the pH value and moisture of gelatin but had significant effect to increasing ash content of gelatin. DMRT analysis showed that gelatin were made of buffalo hide and pineapple rind extract at ratio 3:2 and 3:3 had significantly higher ash content than gelatin made from buffalo hide and pineapple rind extract at ratio 3:1. This means that the concentration increase of pineapple rind extract can increase the ash content of gelatin. The ash content of gelatin was influenced by material processing (GMIA, 2012). At higher concentrations of pineapple rind, the mineral of pineapple rind diffuse to buffalo hide during soaking at beginning of gelatin processing. The mineral content of pineapple rind also contributes in ash content of gelatin. According to Romelle et al. (2016), the pineapple rind had ash content about 4.39 %, calcium 8.30 mg/100 g, zinc 6.46 mg/100 g, iron 25.52 mg/100 g and manganese 5.32 mg/100 g. According to GMIA (2012), the ash content of gelatin varies on the type of raw material and the method of processing. Pork skin gelatins contain small amounts of chlorides or sulfates. On the other hand, gelatin from bone and hide of cattle contain primarily calcium salts of those acids which are used in the neutralization after liming. The ash content of gelatin in this research was lower than those from Mulyani et al. (2017). The ash content of gelatin from buffalo hide was soaked in a different acid (hydrochloric, citric, and acetic acids at

concentrations of 0.9, 0.5, and 1.5 M) with values of 0.56%, 0.62% and 2.67%, respectively.

The pH value of gelatin in this study was not affected by concentrations of pineapple rind extract. However, the pH value of gelatin met GMIA standards for type A gelatin, ranged from 3.8-5.5 (GMIA, 2012) and in line with the Indonesian National Standard. The moisture of gelatin in this research met the moisture standard in GMIA, ranged from 8-13%. The moisture of gelatin in this research was differ than those from Mulyani et al. (2017). The moisture of gelatin from buffalo hide was soaked in a different acid (hydrochloric, citric, and acetic acids at concentrations of 0.9, 0.5, and 1.5 M) with values of 7.08%, 4.41% and 11.09%, respectively.

Table 2. Chemical properties of halal gelatin from different ratio of Buffalo hide and pineapple rind extract

Experiment	Value (unit)
pH	
3:1	4.83±0.05 ^{ns}
3:2	4.83±0.10 ^{ns}
3:3	4.85±0.17 ^{ns}
Moisture	
3:1	9.97±0.11% ^{ns}
3:2	9.96±0.15% ^{ns}
3:3	9.99±0.18% ^{ns}
Ash	
3:1	0.25±0.04%^{a}
3:2	0.30±0.01%^{b}
3:3	0.32±0.02%^{b}

Note: different superscript in the same column showed significant effect (α 0.05), ns showed not significant effect.

4. Conclusion

The pineapple rind extract has a good potential as hydrolysis agent of buffalo hide at the ratios of buffalo hide and the pineapple extract 3:2 and 3:3 since it could produce halal gelatin with viscosity, color, pH value, moisture and ash content that meet with gelatin standard, GMIA. This research recommended the next research to increase the concentration of pineapple rind and improve ratio of buffalo hide and pineapple rind extract variety in order to increase the yield percentage of gelatin produced.

References

AOAC. Association of Official Analytical Chemists. (2005). Official Methods of Analysis. Association of Official Analytical Chemists, Inc. Arlington. Virginia,USA.

BPS. Badan Pusat Statistik Provinsi Riau. (2017). Provinsi Riau dalam Angka 2017. Retrieved January 2, 2018 from http://riau.bps.go.id.

Dubey, R., Reddy, S., & Murthy, N. Y. S. (2012). Optimizing of Activity of Bromelain. *Asian Journal of Chemistry, 24(*4), 1429-1431. www.asianjournalofchemistry.co.in.

GMIA. Gelatin Manufacture Institute of America. (Revised January 2012). *Gelatin Handbook*. Members of the GMIA. http://www.gelatin-gmia.com.

GMIA. Gelatin Manufacture Institute of America. (2013). *Standard Testing Methods for Edible Gelatin.* Official Procedure of the GMIA, Inc. (Revised July 2013). http://www.gelatin-gmia.com.

Gozali, R. (2018). Sifat Fisik Geatin dari Kulit Kerbau dengan Lama Perendaman Berbeda dalam Larutan Buah Nanas. *Skripsi*. Program Studi Peternakan, Universitas Islam Negeri Sultan Syarif Kasim Riau. Pekanbaru.

Kumaunang, M. (2011). Aktivitas Enzim Bromelin dari Ekstrak Kulit Nenas (*Anenas Comosus)*. *Jurnal Ilmiah Sains Program Studi Kimia FMIPA*. Universitas Sam Ratulangi, Manado. *11*(2). http://ejournal.unsrat.ac.id

Kurnia, S.G. (2015). Kualitas Fisik Kimia dan Gelatin Tulang Kepala Sapi dengan Lama Perendaman yang Berbeda Menggunakan Asam Klorida. *Skripsi*. Program Studi Peternakan. Universitas Islam Negeri Sultan Syarif Kasim Riau. Pekanbaru.

Mulyani, S., Setyabudi, F. M. C. S., Pranoto, Y. & Santoso. U. (2017). Physicochemical Properties of Gelatin Extracted from Buffalo Hide Pretreated with Different Acids. *Korean Journal Food Science Animal Resources*. *37*(5), 708-715.

Rapika, Zulfikar & Zumarni. (2016). Kualitas Fisik Gelatin Hasil Ekstraksi Kulit Sapi dengan Lama Perendaman dan Konsentrasi Asam Klorida (HCL) yang Berbeda. HCL 3% dan 5%. Jurnal Peternakan. *13*(1), 829-8729.

Remawati. (2016). Ekstraksi dan Karakteristik Gelatin dari Kulit Sapi Menggunakan Metode Hidrolisis Asam. *Skripsi*. Fakultas Kedokteran dan Ilmu Kesehatan. Universitas Islam Negeri Syarif Hidayatullah. Jakarta.

Romelle, F. D., Ashwini, R. P., Manohar, R. S. (2016). Chemical Composition of Some Selected Fruit Peels. *European Journal of Food Science & Technology. 4*(4), 12-21. www.eajournals.org.

Suhermiyati. S. & Setyawati, S. J. (2008). The Potency of Pineapple Waste to Increase the Quality of Tuna Fish Waste for Poultry feedstuffs. *Animal Production*. *10*(3), 174-17.

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Principal Component Analysis (PCA) Method for Classification of Beef and Pork Aroma Based on Electronic Nose

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ABSTRACT
There are several testing processes for consuming meat products. Organoleptic evaluation is an evaluation based on color, texture, smell, and taste. This research aims to find out the response pattern of 10 gas sensor array contained in the electronic nose against the odor pattern of beef and pork base on a smell. The classification method used is using the Principal Component Analysis (PCA) method. This method is expected to simplify the test of differences in beef and pork based on the aroma. The meat used is standard consumption beef and pork that has been sold in supermarkets. The samples of beef and pork are then ground until smooth. After that, it is weighed for about 1 ounce. The meat samples were tested using an electronic nose consisting of 10 gas sensors. The multivariate analysis method was used to classify the aroma of beef and pork. The results of the data processing showed that the aroma classification of beef and pork which was indexed by the electronic nose was perfect. Based on the PCA method, the proportion of PC1 is 93.4%, and PC2 is 4.9%. From the second cumulative number, the value of the first PC was obtained 98.3%. This value indicates that by using only 2-dimensional data, it can represent ten dimensions of data. The loading plot shows that the MQ-138 and MQ-3 sensors are the most powerful sensors in testing samples of beef and pork.

Keywords: *Array Sensor, Classification, Electronic Nose, PCA.*

1. Introduction

Humans need protein for the development and regeneration of cells in their needs. Protein has a function to form cells in the body. Protein is an important food source for growth. One source of protein comes from foods that contain meat. Protein from meat can be sourced from beef, goat, pork, and so on. For Muslims consuming pork is prohibited. Pork is very popular in various countries. This pork contains fat that is higher than beef. In Indonesia, the amount of pork is limited and the price is much lower than beef. Therefore, there are some cases of forgery of beef using pork or even beef mixed with pork (Berna, 2010).

Al Qur'an has mentioned 4 times about the prohibition of consuming pork and other meat slaughtered not by the name of Allah SWT. among others in QS. al-Baqarah (2): 173, QS. al-Ma'idah (5): 3, QS. al-An'am (6): 145, QS. an-Nahl (16): 115.

There are several methods to test the quality of meat, including chemical testing, physical testing, microbiological testing, and sensory evaluation. Physical examination includes temperature, acidity (pH), water activity, and water binding capacity — testing of light intensity and mechanical tests to determine the texture of meat. The instruments used in the physical analysis were digital thermometers, pH meters, hygrometers, lux meters, and meat texture measuring instruments (Rudnitskaya & Legin, 2008; Che Man et al., 2011; Nurjuliana et al., 2011). Based on human sensory organs such as the appearance of flesh, color, texture, smell, and taste. Based on the aroma, fresh meat should smell slightly sour due to the formation of acid, namely lactic acid. Whereas when the flesh decays, it produces an unpleasant odor caused by the degradation of bacteria from meat proteins, such as a mixture of sulfur, mercaptan, etc (Carmel et al., 2003; Arshak et al., 2004; Che Man et al., 2011; Nurjuliana et al., 2011; Falasconi et al., 2012; Jha et al., 2014; Loutfi et al., 2015; Xu et al., 2016).

Electronic Nose is an instrument or measuring device made of chemical sensors combined with a pattern recognition system (Gardner, 1994). The main principle of an electronic nose is to imitate the humans' sense of smelling. The electronic nose receptor consists of several chemical sensors that produce electrical signals. These electrical signals are then analyzed by pattern recognition software. This pattern recognition software is connected with the part of brain

that can classify and remember smell or aroma (Penza & Cassano, 2003; Men et al., 2011; Wilson & Baietto, 2011; Peng et al., 2014;).

China is one of the largest meat-producing countries in the world. Concerns about food security arose from the rapid growth of the meat industry. They pay more attention to the quality of the meat. The application of conventional test methods for meat quality is limited by many factors, such as longer time to prepare samples and conduct testing. A sensor matrix is built with several gas sensors made for testing. Samples were tested to detect freshness of beef. The results showed that the air sensors of TGS2610, TGS2600, TGS2611, TGS2620 and TGS2602 that were made by Tianjin Figaro Electronic Co., Ltd. could be used to determine the level of freshness. The TGS2442 sensor is not suitable because it has a strong reaction to tainted beef. The relationship between the output of several sensors and the storage time of beef is linear, but the decay of beef cannot be detected clearly (Nurjuliana et al., 2011; Dang et al., 2014; Zhang & Tian, 2014; Xu et al., 2016).

Principal Component Analysis (PCA) is a method used to reduce the amount of data when a correlation occurs (Tazi et al., 2016; Tazi et al., 2017; Tazi et al., 2018). The aim is to find the base part whose combination is linear with the origin variable which explains each sensor. PCA projects a data matrix that initially has high dimension to the lowest dimension (3 dimensions or 2 dimensions) without losing the required information. The relationship between samples can be visualized by plots of each main component (Li et al., 2007; Peris & Escuder-gilabert, 2009; Wang et al., 2010; Che Man et al., 2011; Haddi et al., 2011; Nurjuliana et al., 2011; Loutfi et al., 2015; Upadhyay et al., 2017).

From these various backgrounds, researchers wanted to find out the response pattern of an array of 10 gas sensors (electronic nose) to the odor pattern of beef and pork. Data processing method was used to find out its classification using the Principal Component Analysis (PCA) method. The introduction of this pattern is expected to be able to simplify the test of the difference between beef and pork based on the aroma.

2. Materials and methods

This research is about the way to classify the aroma of pork and beef. The pattern recognition using the Principal Component Analysis Method is used as an analysis of the smell responses of the electronic nose. The research data collection and processing were carried out at the sensor laboratory of the Department of Physics, Faculty of Science and Technology, State Islamic University of Maulana Malik Ibrahim Malang.

2.1. Sample preparation

The samples in this study are beef and pork back part which is regular consumption. Beef is taken from 2 different farms. Pork is also taken from two different farms. The samples are not explicitly treated, for example, being stored in a chamber with a specific gas content. Beef and pork that have been bought weighing 1 ounce are then ground using a blender. Milled meat samples are ready to be used as test samples. The meat is placed in the laboratory with normal air condition. The condition of the air space during data collection is set on uncontrolled room temperature and humidity. This research is about how to classify the aroma of pork and beef. Pattern recognition techniques using the Principal Component Analysis Method are used as an analysis of the smell response of the electronic nose. The research data collection and processing was carried out at the sensor laboratory of the Department of Physics, Faculty of Science and Technology, Universitas Islam Negeri Maulana Malik Ibrahim Malang.

2.2. Pre-processing and Processing Data

Data retrieval for each loop is done with a duration of seven minutes. The period of collecting and purging is set to 30 seconds each. The data produce about 840 lines x 10 data sensors. Eight hundred forty data generated by the electronic nose, only the last 600 data were taken. The 600 data consists of 300 data in collecting process and 300 data in purging process. The gas sensor array data generated is dynamic data in the form of collecting and purging data which cannot be directly processed using the statistical method. This is because collecting data and purifying data itself is sinusoidal. The numerical method is used to obtain the sinusoidal area of the data.

2.3. PCA method processing

The data acquisition of the odor sensor system consists of 10 gas sensors. Therefore, the data generated is Multivariate data with ten column dimensions. The way to measure the success of this tool is by testing the ability of the device in obtaining meat aroma data then classify it based on the group. The Principal Component Analysis method is perfect for using in processing multivariate data and organizing data distribution. This method creates new data that is built from covariance, eigenvectors, and eigenvalues from the data. PCA groups data covariances by ordering eigenvalues from the highest to the lowest. The covariance value of the data matrix with the highest eigenvalue is covariance data that syncs the entire data with the highest approach. By using PC1 and PC2 data, you can see the 2-dimensional classification of PCA method processing.

3. Result and discussion

The sensor arrays used have responded to all compounds that contribute to odor. Each sensor can respond to more than one compound. For example, the MQ-138 gas sensor can sense Aldehyde, Ketone, Alkanoate, Alkanol, Esther, and Ether. Ten sensors have been used in this electronic nose so that they can respond to a variety of different gases. This can

increase the sensitivity of the device.

3.1. Score Plot Data

From Table 1, obtained 2 of the first largest eigenvalue, namely eigen-1 value = 1.9855 and eigen-2 value = 0.1044. By using the eigenvalue of each PC, the proportions of each PC can be determined. From the large eigenvalue obtained, the cumulative proportion value of PC-1 is 91.45%, PC-2 is 6%, and PC-3 is 0.9%.

Loading Plot shows the contribution of all variables used. This study demonstrates the difference in response from all sensors. In Figure 1, the sensor that has a loading plot with the longest positive line is the most critical sensor. The sensor that has the longest positive line is the MQ-2 gas sensor. This sensor has the most significant role or influence in distinguishing samples. The gases that can be responded by MQ-2 are H2, Volatile Organic Compounds (VOCs / Aldehyde, Ketone, Alkanoate, Alkanol, Esters, Ether), LPG, Propane, Alcohol, Methane, CH4, CO, ISO-Butane. Nine other sensors also continued to contribute when collecting data, but their contribution was smaller.

Table 1 Eigenvalue, Proportion and Cumulative

Eigenvalue	Proportion	Cumulative (%)
1.9855	0.914	91.45%
0.1044	0.060	97.45%
0.0163	0.009	98.35%
0.0075	0.004	99.5%
0.0057	0.003	99.7%

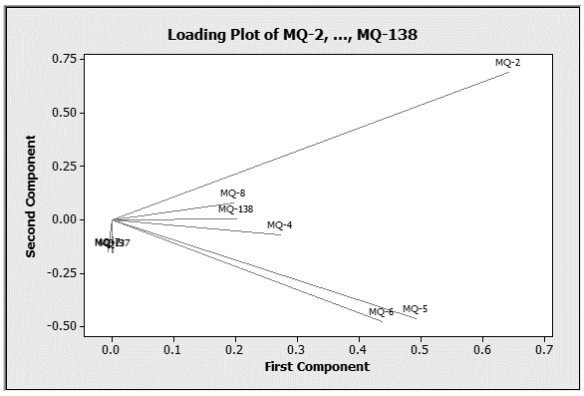

Figure 1. Loading plot of the array sensor

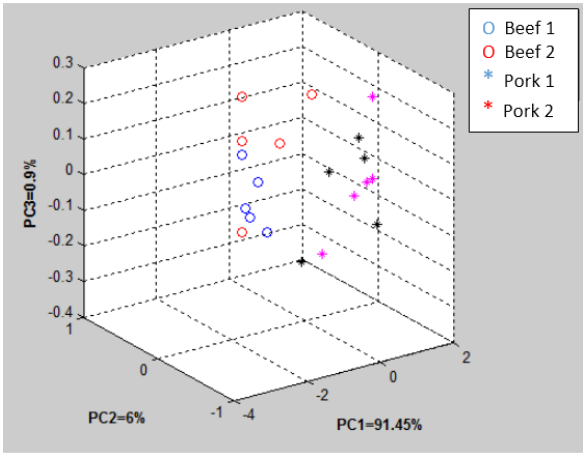

Figure 2. Score Plot of Beef and Pork Meat

The score plot in Figure 2 is used to determine the differences in the schemes of the aroma of beef and pork. The data plot is a 3D plot with coordinates PC1, PC2, and PC3. From the figure, PCA charts are divided into two groups, namely beef, and pork. The round-shaped data points are beef data, and star-shaped ones are pork data.

Figure 2 shows that there are differences in the pattern between the aroma of beef and pork. This can be seen from the separation between the two groups of data. When viewed in each group, 10 points indicate many samples. There are differences in patterns between beef 1 and beef 2. Likewise with pork 1 and pork 2. This is because those meats were purchased from 2 different sellers. It is possible that separate animal feed can affect the aroma of the meat.

4. Conclusion

Based on the research data, it can be concluded that the electronic nose sensor response can distinguish two groups of beef and pork data. The aroma of beef shows two groups according to the location of purchase, as well as the smell of pork. This is caused by several factors including the types of animals and animal feed. The PCA method gives the results of the first 3 PC cumulative values of 98.35%.

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References

Arshak, K., Moore, E., Lyons, G. M., Harris, J., & Clifford, S. (2004). A review of gas sensors employed in electronic nose applications, *24*(2), 181–198. http://doi.org/10.1108/02602280410525977

Berna, A. (2010). to Food Analysis, 3882–3910. http://doi.org/10.3390/s100403882

Carmel, L., Levy, S., Lancet, D., & Harel, D. (2003). A feature extraction method for chemical

sensors in electronic noses, *93*, 67–76. http://doi.org/10.1016/S0925-4005(03)00247-8

Che Man, Y. B., Rohman, A., & Mansor, T. S. T. (2011). Differentiation of lard from other edible fats and oils by means of Fourier transform infrared spectroscopy and chemometrics. *JAOCS, Journal of the American Oil Chemists' Society*, *88*(2), 187–192. http://doi.org/10.1007/s11746-010-1659-x

Dang, L., Tian, F., Zhang, L., Kadri, C., & Yin, X. (2014). Sensors and Actuators A : Physical A novel classifier ensemble for recognition of multiple indoor air contaminants by an electronic nose. *Sensors & Actuators: A. Physical*, *207*, 67–74. http://doi.org/10.1016/j.sna.2013.12.029

Falasconi, M., Concina, I., Gobbi, E., Sberveglieri, V., Pulvirenti, A., & Sberveglieri, G. (2012). Electronic Nose for Microbiological Quality Control of Food Products, *2012*. http://doi.org/10.1155/2012/715763

Haddi, Z., Amari, A., Ould Ali, A., El Bari, N., Barhoumi, H., Maaref, A., Bouchikhi, B. (2011). Discrimination and identification of geographical origin virgin olive oil by an e-nose based on MOS sensors and pattern recognition techniques. *Procedia Engineering*, *25*, 1137–1140. http://doi.org/10.1016/j.proeng.2011.12.280

Jha, S. K., Hayashi, K., & Yadava, R. D. S. (2014). Neural , fuzzy and neuro-fuzzy approach for concentration estimation of volatile organic compounds by surface acoustic wave sensor array. *Measurement*, *55*, 186–195.

Li, C., Heinemann, P., & Sherry, R. (2007). Neural network and Bayesian network fusion models to fuse electronic nose and surface acoustic wave sensor data for apple defect detection, *125*, 301–310. http://doi.org/10.1016/j.snb.2007.02.027

Loutfi, A., Coradeschi, S., Kumar, G., Shankar, P., Bosco, J., & Rayappan, B. (2015). Electronic noses for food quality : A review. *Journal Of Food Engineering*, *144*, 103–111. http://doi.org/10.1016/j.jfoodeng.2014.07.019

Men, H., Liu, H., Pan, Y., Wang, L., & Zhang, H. (2011). Electronic Nose Based on an Optimized Competition Neural Network, 5005–5019. http://doi.org/10.3390/s110505005

Nurjuliana, M., Che Man, Y. B., & Mat Hashim, D. (2011). Analysis of lard's aroma by an electronic nose for rapid Halal authentication. *JAOCS, Journal of the American Oil Chemists' Society*, *88*(1), 75–82. http://doi.org/10.1007/s11746-010-1655-1

Peng, L., Zou, H., Bauer, R., Liu, Y., Tao, O., Yan, S. Jiang, G. (2014). Identification of Chinese Herbal Medicines from Zingiberaceae Family Using Feature Extraction and Cascade Classifier Based on Response Signals from E-Nose, *2014*.

Penza, M., & Cassano, G. (2003). Application of principal component analysis and arti ® cial neural networks to recognize the individual VOCs of methanol / 2-propanol in a binary mixture by SAW multi-sensor array, *89*, 2–9. http://doi.org/10.1016/S0925-4005(03)00002-9

Peris, M., & Escuder-gilabert, L. (2009). Analytica Chimica Acta A 21st century technique for food control : Electronic noses, *638*, 1–15. http://doi.org/10.1016/j.aca.2009.02.009

Rudnitskaya, A., & Legin, A. (2008). Sensor systems , electronic tongues and electronic noses , for the monitoring of biotechnological processes, 443–451. http://doi.org/10.1007/s10295-007-0298-1

Tazi, I., Choiriyah, A., Siswanta, D., & Triyana, K. (2017). Detection of Taste Change of Bovine and Goat Milk in Room Ambient Using Electronic Tongue. *IJC*, *17*(3), 422–430.

Tazi, I., Triyana, K., & Siswanta, D. (2016). A Novel Arduino Mega 2560 Microcontroller-Based Electronic Tongue for Dairy Product Classification. *AIP Conference Proceedings*, *170003*, 21–26.

Tazi, I., Triyana, K., Siswanta, D., Veloso, A. C. A., Peres, A. M., & Dias, L. G. (2018). Dairy products discrimination according to the milk type using an electrochemical multisensor device coupled with chemometric tools. *Journal of Food Measurement and Characterization*, *0*(0), 0.

Upadhyay, R., Sehwag, S., & Mishra, H. N. (2017). Electronic nose guided determination of frying disposal time of sunflower oil using fuzzy logic analysis. *Food Chemistry*, *221*, 379–385. http://doi.org/10.1016/j.foodchem.2016.10.089

Wang, B., Xu, S., & Sun, D. (2010). Application of the electronic nose to the identification of different milk flavorings. *Food Research International*, *43*(1), 255–262.

Wilson, A. D., & Baietto, M. (2011). Advances in Electronic-Nose Technologies Developed for Biomedical Applications, 1105–1176. http://doi.org/10.3390/s110101105

Xu, L., Yu, X., Liu, L., & Zhang, R. (2016). A novel method for qualitative analysis of edible oil oxidation using an electronic nose. *Food Chemistry*, *202*, 229–235. http://doi.org/10.1016/j.foodchem.2016.01.144

Zhang, L., & Tian, F. (2014). Analytica Chimica Acta A new kernel discriminant analysis framework for electronic nose recognition. *Analytica Chimica Acta*, *816*, 8–17.

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Na-Alginate Utilization of Brown Algae (*Sargassum* sp.) as A Halal Edible Film Basic Materials

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ABSTRACT
Edible films made of Na-alginate from brown algae have great potential to be developed as brown algae have a fairly high abundance in Indonesia but have not been widely used. Therefore, this study is conducted by making edible films made from Na-alginate modified by the addition of hydrocolloids carrageenan and glycerol plasticizier. The addition of carrageenan biopolymers is the property of the produced Edible film. The use of glycerol as a plasticizer aims to improve the properties of elasticity of Edible films. This research method consists of two stages. First stage is the isolation and characterization of Na-alginate, and second is the preparation and characterization of making edible films. Na-alginate characterization results in yield of 25.68%, 10.84% moisture content, and 23.79% ash content. The carrageenan on the Edible film formula affects the characterization of the resulting films. The value of water absorption from 333.13% to 335.45% and the elongation of 26.26% to 33.34%, and the declining value of tensile strength of 8.93 MPa to 4.17 MPa and young's modulus values of 0.34 MPa to 0.22 MPa with the addition of carrageenan on an Edible film formula.

Keywords : *Brown algae, Edible films, Glycerol, Carrageenan, Na alginate.*

1. Introduction

Product packaging based on the development of organic or biodegradable plastic materials today was developed. One form of developing biodegradable plastic is edible film. The development of environmentally friendly edible film can be applied to food packaging that can provide better product quality, can extend the durability of food products, and can be eaten directly, so that this packaging does not cause pollution to the environment.

On the other hand, the manufacture of biodegradable plastics often uses basic ingredients derived from animal fat. Animal fats are often used mainly from domestic animals such as cattle, goats and pigs. Collagen originating from cows and goats has a high selling price, in contrast to collagen derived from pork which is cheaper and easier to find. This has caused many producers of biodegradable plastic packaging products to use collagen derived from pigs. This becomes a problem for Muslims who consume these products. The problems that arise, namely in terms of halal. Therefore, start developing a type of packaging that is derived from natural materials that fit into the category of halal food. One of the natural materials that can be used as a basis for making edible film is brown algae.

Brown algae is one of the abundant natural resources in Indonesia. This abundance of resources can support economic growth and increase potential in the field of research. One type of brown algae that can be used is Sargassum sp. The growth of Sargassum sp in Indonesia is spread in several waters such as Sumatra, Java, Bali and Kalimantan.

The population of Sargassum sp, a species of alginate-producing brown algae, is quite a lot. The alginate content in Sargassum sp brown algae ranges from 8-23% depending on the conditions of regrowth (Anggadiredja, Zantika, H, & S, 2006). The use of alginates in Indonesia is quite wide, including in the fields of industry, pharmacy and food. With insulation and modification, alginate can be used as a thin film used as a membrane wrapper or packaging material for food products.

Edible film alginate is formed by evaporation of alginate solutions followed by binding of calcium salts (Fehragucci, 2012). The alginate film produced will have good barrier properties against O_2 at low temperatures, can inhibit lipid oxidation in packaged products, and can improve the taste and texture of the product. In addition to these properties, edible films have the disadvantage that alginates can be easily damaged when drying, but can be anticipated by adding plasticizers and other biopolymers that can cover the lack of edible film alginates.

Plasticizier is a low molecular weight material added in a compound with the aim of increasing elasticity,

namely by changing the physical and mechanical properties of this compound. Plasticizier commonly used in making edible films is glycerol as hydrophilic and low molecular weight.

Carrageenan is a polysaccharide compound and also a hydrocolloid compound consisting of potassium, sodium, magnesium, and potassium sulfate esters with 3.6 galactose anhydridogalactose copolymers (Winarno, 1996). Carrageenan has hydrophilic properties, namely the basic ingredients of edible film as a good barrier to oxygen, carbon dioxide and lipids. Besides, carrageenan has also been widely used in the food sector for food packaging, cleaning products, fatty foods, and drug capsules.

Based on the above, a study was conducted to determine the characteristics of alginate edible film with glycerol and the addition of carrageenan biopolymers. The use of alginate as a raw material for edible film because alginate has a polymeric component in the form of polysaccharides (carbohydrates) that are thermoplastic in nature, so that it has the potential to be formed or printed as edible films that fall into the halal food category. In addition, the selection of carrageenan as a hydrocolloid mixture aims to determine the effect of hydrocolloid hydrophilic addition on the edible properties of the film produced. The use of glycerol as a plasticizier and the addition of carrageenan biopolymer as a hydrocolloid mixture are expected to provide a synergistic interaction, so that the characteristics of edible films become better (Farag et al. 2015).

2. Materials and methods

2.1. Materials

The main material used in this experiment was brown algae obtained from the beach of Minajaya Sukabumi. The other material used at the experiment were HCl 1% and 15%, Na_2CO_3 2%, aquadest, NaOH 0,5% and 10%, H_2O_2 10%, Isopropyl Alcohol, $CaCl_2$ 0,2 M, glycerol plasticizier, carrageenan, and Whatmann filter paper.

2.2. Extraction of Na-Alginate from brown-algae

Algae are dried and soaked using 1% HCl with a ratio of 1:30 w/v (algae: HCl) until 1 hour, and then washed using aquadest to neutral pH. The preparation result of algae was soaked in 0.5% NaOH, then extracted using Na_2CO_3 2% with a ratio of 1:30 w/v at a temperature of 60-70 ° C for 2 hours. After that, filtration is carried out to separate the residue and filtrate. Then the obtained filtrate was blanched using 10% H_2O_2 while stirring and allowed to stand for 30 minutes. The Alginic acid is formed by adding 15% HCl until pH of the sample to 2-3. Furthermore, the alginic acid formed is converted to Na-alginate by adding 10% NaOH to neutral pH. Then the separation is done by adding 1:2 v/v isopropyl alcohol. After that, filtering sample and drying used the oven for about 24 hours until the moisture content was 12%. The next process was grinding using a grinder to obtained Na-alginate powder and then analyzed the physical and chemical properties. The characterization of the chemical structure of Na- Alginate used Fourier transform infrared (FTIR) technique.

2.3. Fabrication of Edible Film

A 5 g of Na-alginate and 100 ml of aquadest were stirred slowly until a homogeneous solution was formed. After that, an 0.5 M CaCl2 was added with a ratio of 1:10 v/v and then mixed until homogeneous. The ca-alginate solution is divided into 2 variations, namely solution without addition carrageenan and solution with the addition carrageenan and mixed until homogeneous. After that, added 10% glycerol until an edible film solution formed.The characterization of the chemical structure of the edible film used Fourier transform infrared (FTIR) technique.

2.4. The Mechanical characterization

The film thickness was measured using a screw micrometer. The average thickness was determined by measuring thickness at 5 different points at the film. The tensile strength was measured the Testometric Tensile (M350-10AT) at Balai Besar Tekstil. The sample clamped with a tensile testing machine. Next, record the thickness and initial of the sample length. Samples are pulled at a speed of 100 mm/minute until break. This tensile strength test was carried out on three samples of the edible film which were then averaged. The tensile strength of the edible film can be calculated using Eq. (1)

$$\tau = \frac{F\,max}{A} \qquad (1)$$

where τ is tensile strength (MPa), F_{max} is maximum stress (N), and A is cross-section area (mm^2).

The elongation measurement method was the same as tensile strength testing. The elongation was expressed as a percentage and can be calculated using Eq. (2)

$$\text{The elongation (\%)} = \frac{the\ strain\ when\ break\ (mm)}{the\ initial\ length\ (mm)} \times 100\% \qquad (2)$$

The elasticity (modulus young) is obtained from the divide between tensile strength and elongation.

2.5 Water Resistance characterization

The first step of water resistance characterization was weighing the initial mass of the edible film (Wo). Furthermore, the edible film soaked in aquadest for 10 seconds. Then the sample is removed from aquadest and the water on surface of the film is removed with a paper tissue. The water resistance by the sample was calculated by the Eq (3).

$$\text{Water (\%)} = \frac{W-Wo}{Wo} \times 100\% \qquad (3)$$

where W is the weight of wet edible film and W_o is the weight of dry edible film.

3. Result and discussion

3.1. *Characterization of Na-alginate that resulting from extraction*

Na-alginate-making process is done by extracting dried brown algae that has been sorted. the extraction aims to release alginate from cellulose and separating it from other components in order to obtain pure Na-alginate. Na-alginate obtained will be used in the next stage as a raw material edible film.

a. The yield value of Na-alginate

The yield of Na-alginate showed the percentage of alginate extracted from brown algae which binds to sodium ions. The percent yield of Na-alginate in this study produced a value of 25.69%. This yield value is smaller than the research carried out by Wahyu Musholaeni (Wahyu Mushollaeni, 2011) with a percent yield of 30.5%.

The difference in percent yield can be caused by the viscosity of the filtrate produced after a different extraction process. This is because the imperfect filtering process causes the alginate extract to remain in the residue. In addition, the stirring technique is less than perfect during the refining process so that Isopropanol cannot attract alginate properly and the resulting percent yield is lower.

b. Water content of Na-alginate

The results of the analysis of water content in Na-alginate produced in this research that is equal to 10.84% (w/w). When compared with Na-alginate produced by Haerunnisa that is equal to 12:45%, the water content of Na-alginate generated in this study are smaller (Haerunnisa, 2008). However, the value of the water content of the research has been qualified set by the FCC (1993) that is less than 15%. Types of algae used and native habitat of the algae can cause the value of the water content of each of the different algae.

Water content in Na-alginate can also be influenced by the addition of isopropyl alcohol compound as a purifying agent in the process of extraction, drying and storage of Na-alginate powder. Isopopil has the ability to bind water in the alginate solution so that the alginate can settle, but in the process can allow the water that is still bound to the sediment that may affect the value of the water content.

c. Ash content of Na-alginate

The ash content is a representation of the various components of the inorganic or mineral contained in a food. In Table 1. The ash content contained in the Na-alginate extraction results, showed the presence of mineral salts or anorganic compounds with 22.06% value. The ash content values was close to the ash content value that has been determined by Haerunnisa (2008) that is 23.27%. This value also meets FCC standards that can be seen in Table 1. Similarly with the water content, ash content is very important to determine the degree of purity of the product.

The composition of brown algae minerals depends on the presence of seawater mineral salts. In general, the most composition of the mineral salts are halogen compounds (Br and I), as well as sodium and chlorine compounds in the relatively low number. The ash content can also be affected by the immersion process using HCl which is less than optimal. This soaking process aims to eliminate the salts or other impurities contained in the sample to be processed.

d. Viscosity

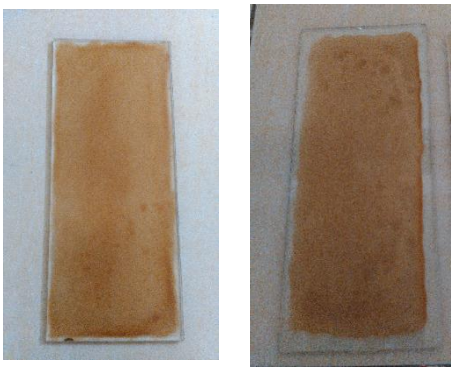
The viscosity of Na-alginate will describe the quality of Na-alginate itself because generally in the alginate industry it is used as a thickener and emulsifier. In this study, the extracted viscosity of alginate was 36 cPs. The standard viscosity of alginate in 1% alginate solution at 25℃ is 10-1000 cPs, so the viscosity value obtained in this study is still in the standard viscosity for Na-alginate. The viscosity of Na-alginate is influenced by the pH of Na-alginate. The viscosity of Na-alginate will increase at pH> 6 and not stable at pH 10. The pH value of the extraction of alginate is equal to 8.2 so the value of the viscosity obtained is not too high.

Table 1. Physical Properties of Na-alginate from Extraction

Parameter	Na-alginate trial	Food Chemical Codex (FCC) in 1995
% yield	25.68%	
Water content	10.84%	> 15
Ash content	23.79%	18-27
viscosity	36 cPs	
pH	8.2	

3.2. Characteristics of Edible Film

The preparation of edible film-making is done by changing the Na-alginate into Ca-alginate beads with the addition of CaCl2. Edible films produced in this study are transparent brown as shown in Figure 1. This is caused by brown alginate powder. Each edible film produced has a different thickness. edible film Ca-alginate + Carrageenan has a higher thickness compared to edible film Ca-alginate, with an average thickness of 0.058 and 0.044 mm, respectively. Edible film Ca-alginate + carrageenan has a more flexible nature than edible film Ca-alginate. This can be caused by the addition of carrageenan so that it will affect the physical and mechanical properties of edible film.



A B

Picture 1. a) Edible films Ca-alginate + Carrageenan b) Edible films Ca-alginate

a. Water resistance

The results of the analysis of the water resistance of edible Ca-alginate films showed that carrageenan affects the water resistance of edible films. Water absorption from the resulting film can be increased by the addition of carrageenan as a hydrocolloid mixture, its value can be seen in Table 2. Addition of carrageenan and glycerol plasticizer increases the water absorption value. This happens because carrageenan has a slightly hydrophilic nature. In addition, the addition of plasticizers can also be influential because plasticizers are hydrophilic so they can attract water molecules and form a large hydrodynamic water plasticizer. So with these results it shows that in this study, carrageenan as a hydrocolloid mixture provides poor water resistance to edible film material.

b. Mechanical Properties of Edible Films

Mechanical characteristics indicate the integration of edible film under stress conditions that occur during the formation process. Mechanical properties are influenced by the formulation of edible film that is Na-alginate, $CaCl_2$, carrageenan and glycerol. Carrageenan as a biopolymer mixed into Ca-alginate provides good mechanical properties for edible film. While the addition of glycerol as a plasticizer to the mixture can give plastic properties to the edible film material.

These three parameters were tested in this study have values greater than the previous research that has been done by Helmi Fehragucci (2012) for the Ca-alginate edible film that is the value of tensile strength 6.981 and elongation 2.03%. This can be caused by different concentrations of CaCl2. The use of the higher concentration of CaCl2 will cause the gel to be more stable, so that the value of the tensile strength obtained will be even greater. The edible film produced will be more rigid, this is because Ca-alginate forms hydrogen bonds with less water than Na-alginate

Edible films with high tensile strength will be able to protect the products they pack well from mechanical disturbances. The results of mechanical strength analysis showed that the addition of carrageenan influenced the tensile strength of the edible film produced. The resulting tensile strength decreased with the addition of carrageenan, from 8.93 MPa to 4.17 MPa. This can be caused by the slightly hydrophobic nature of carrageenan. In addition, the use of carrageenan concentrations used can also influence the tensile strength of edible films produced in this study. The commercial tensile strength of edible film is 15.53 MPa. Kroctha and Johnston (1997) state that the range of tensile strength values that can be applied to standard edible films is between 10-100 Mpa (Kroctha & Gago, 1997). Thus the value of the tensile strength of edible films produced in this study has not reached the value of standard edible film or commercial edible film values (<10MPa).

The measurement of extension is carried out together with the measurement of tensile strength. The extension test aims to determine the increase in the length of the edible film before finally breaking up. The percent value of the edible film extension in this study can be seen in Table 2. Addition of carrageenan can increase the extension value so that the film matrix becomes flexible. The values of tensile strength and extension are influenced by plasticizers. The characteristics of plasticizers will reduce the strength between molecules, thereby increasing the mobility of the biopolymer chain and increasing its mechanical properties. According to Kroctha (1997) the characteristics of standard edible films have an extension percentage of 10-50%. In this study the value of the extension of each edible film is included in the standard value. But with the increasing percentage (film extension), edible films are easier to stretch and expand. This can cause the surface of the film to become thinner so that the resulting edible film is torn or damaged more easily.

Table 2. Mechanical Properties *Edible films and Ca-Ca-Alginate Alginate + Carrageenan*

Type edible film	Absorption (%)	Tensile strength (MPa)	Elongation (%)	Young's Modulus (MPa)
Ca-alginate	333.13	8.93	26.26	0.34
Ca-alginate + Carrageenan	335.45	4.17	33,34	0.22
Coating commercial	75.52	15.53	19.53	0.79

The level of rigidity of edible films can be determined by measuring modulus young on edible films. Young modulus is a measure of the stiffness of a material. Young modulus is obtained from a comparison

between tensile strength and percent extension. From Table 2. It can be seen that the young modulus Ca-alginate non carrageenan value is higher than Ca-alginate with the addition of carrageenan, which are 0.34 MPa and 0.22 MPa, respectively. While the young modulus value of commercial edible films is 0.79 MPa. Small modulus values indicate that edible films are elastic. If the young modulus decreases, the flexibility of edible films increases. So that the young modulus of Ca-alginate shows that non-carrageenan Ca-alginate has a higher rigidity so it is not too flexible (Kramer, 2009). However, when compared with edible film Ca-alginate with edible film, commercial edible film has a higher stiffness value than the Ca-alginate edible film in this study.

The mechanical properties of the results of previous studies with the research conducted show that in this study the value of tensile strength is low, but the extension value is higher. Comparisons are also made with commercial edible film on the market. From the comparison with commercial edible film, the mechanical value and absorption of water were obtained far enough with the results of the edible film. This shows that the edible film mechanical value produced in this study has not been able to achieve the mechanical value of commercial edible film. In addition, the addition of carrageenan into edible film formulations can affect the mechanical properties of the edible film produced.

4. Conclusion

From the results of this study can be concluded as follows:

1. Na-Alginate from brown algae has the potential as a raw materials in making halal edible films
2. Characterization of Ca-alginate edible film in this study has a water absorption value of 333.13%, tensile strength of 8.93 MPa, elongation of 26.26%, and young modulus of 0.34 MPa.
3. The addition of carrageenan to the edible film Ca-alginate affects the edible properties of the film produced. The addition of carragean causes an increase in the value of water absorption to 335.45% and the elongation value to 33.34%, but the reduced tensile strength to 4.17 MPa and the young modulus to 0.22 MPa.

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References

Anggadiredja, Zantika, J., H, P., & S, I. (2006). *Rumput Laut.* Jakarta: Penebar Swadaya.

FCC. (1981). *Food Chemical Codex.* Washington DC: National Academy Press.

Fehragucci, H. (2012). *Pengaruh Penambahan Platicizer dan Kitosan terhadap Edible Film Ca-alginat.* Skripsi, Universitas Sebelas Maret, Surakarta.

Haerunnisa. (2008). *Analisa Kualitas Natrium Alginat Hasil Ekstraksi Untuk Minuman Suplemen Serat dalam bentuk Effervescent.* Skripsi, UIN Syarif Hidayatullah Jakarta, Jakarta.

Kramer, M. E. (2009). Structure and Function of Starch-Based Edible Films and Coatings. In M. E. Kerry C. Huber, *Edible Films and Coatings for Food Applications* (pp. 113-134). Springer.

Krochta, J.M., E.A., Baldwin, & M,Q. Nisperos-Carriedo. (1994). *Edible Coating and Film to Improve Food Quality*. New York: NY: Technomic Publishing Company.

Kroctha, G. M., & Gago, P. M. (1997). Denaturation Times an Temperatur Effect on Solubility, Tensile Properties, and OxygenPermeability of Ehey Protein Edible Film. *Journal an Food Science, 51*, 61-74.

Rusdiana, W. M. (n.d.).

Wahyu Mushollaeni, E. R. (2011). Karakterisasi Natrium Alginat dari Sargassum sp., Turbinaria sp. dan Padina sp. *Jurnal Teknologi dan Industri Pangan, XXII*(1), 26-32.

Winarno, F. G. (1996). *Teknologi Pengolahan Rumput Laut.* Jakarta: Sinar Harapan.

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Pig Sample Handling in Laboratory Scale

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ABSTRACT
Laboratory is enclosed space, a room or an outdoor as experiment and research place. How to handling sample is an important knowledge in laboratory especially pig sample. Such sample is not only haram but also najis, so it requires special treatment. Up to the present, there is still no clear procedure to handle pig sample properly in the laboratory. This study aimed to design proper procedures in handling pig sample for laboratory scale. We used a literature study and discussion with some stakeholders to gather information in order to generate insights for designing the procedure. The results include laboratory layout, organizing laboratory management, and retrieval techniques as well as handling procedure for the sample are proposed. In general, handling pig samples on a laboratory scale must be done with extra caution, detail, and aseptism

Keywords: *aseptic, halal, handling, laboratory, pig samples*

1. Introduction

The laboratory designed to do some activities such as education function, research and community service. The activities supported by the existence of an infrastructure to get optimal results. Laboratory management have a Head assisted by laboratory assistants for each laboratory room (Tone, 2007). According to Amna (2014) there is the role and function of laboratory are three, it is learning, experiments, and research. Laboratories are very important for science development and renewal. Various findings are obtained from research activities and can be applied to the community. Laboratories located in various places such as universities, hospitals, research institutions, industrial sites and others, need to be informed of research.

Research in the laboratory has operational standards in using tools and materials, some of which have critical points that must be attended. Knowledge of laboratory management both directly and indirectly is mandatory for laboratory users to minimize hazards and contamination.

One of important knowledge of laboratory management is handling sample management. Each sample could be managing for keeping from contamination. A hazard in handling a sample may spread the dangerous of microorganisms, disease or even samples that are haram. Management of samples, especially samples of unclean ingredients which are haram and najis sample, will become a problem if it doesn't have managing properly.

Recently there has been a lot of research on halal products. At present, halal is a global problem, many non-Islamic countries are importers of various types of products for Muslim countries. In addition, they provide halal products for Muslim tourists who come to their country. In fact, many people from non-Muslim communities consume halal products for their needs such as health and safety (Nurrachmi, 2017; Denyingyhot, et al., 2017; Nakyinsige et al., 2012; Hidayat, 2015). These factors make halal products as one of the important issues that are heavily studied in various countries, and so many research in laboratory scale are advanced.

Halal-base research beginning from anxiety public from unclean material contamination. On the other hand there is crucial problem with the halal research, i.e pig sample. Beside of that haram, pig is one of najis for muslim, there is a special management in handling pig sample for holding spread of contamination.

Pig is a type of ungulate animal with long or lobe nose, the animals originally from Eurasia. Sometimes also referred to as khinzir (Arabic). Pigs are omnivores, which means they consume both meat and plants. In addition, pigs are one of the mammals that almost all of their bodies can be utilized. Some of the bad qualities of pigs like, the most greedy and dirty animals in the class. Then the greed is unmatched by other animals, and likes to eat the carcass and its own feces; and they ate human waste. (Arifin, 2014).

In research related with pig sample, there are no laboratory operational standards or studies that specifically discuss the technique of handling it. This is very urgent that pig samples need careful and detail handling, no more contamination, equipment and other materials in the laboratory. The fatwa of MUI based on Qaidah fiqhiyyah, it explains that "If there is a thing, mixed between halal and haram, then haram wins". For this reason, it is necessary to conduct a study on how to handle pig in laboratory scale then could it become one of references in pig handling on laboratory scale.

2. Materials and methods

The materials are literature sources such as research journals, research data and books that support the information of this paper. The method used is descriptive method, discussion and study.

3. Result and discussion

Laboratory management is important according to the purpose of its procurement. Laboratory management includes activities of regulate, maintain, and effort for safety of laboratory users. A bad management of laboratory caused various problems that prevent laboratory users from carrying out research. According to Anggraeni (2013) these problems include structuring the layout of laboratory space that is not appropriate. A tidy inventory list caused undisciplined in using tools and materials; a bad laboratory managers who doesn't worked optimally lacking safety procedures in the laboratory. And one of the most important is handling various samples used in laboratory research.

Pig sample handling should be done in a specific room such as holding room for halal study research. This is intended for keeping in spread of contamination to other laboratory components. Pig sample handling could be a special attention for its tool management and infrastructure including the layout of the laboratory space, organizing laboratory management which includes administration of tools and materials as well as management of work safety in the laboratory. and the main thing for pig sample handling in more detail are as follows:

a. Laboratory Layout

Laboratory is a complex room because there are many factors that must be considered in the manufacturing process. Pig sample handling should conside matters that can reduce the risk of contamination such as the location of the laboratory, distance from other spaces, access to use waste disposal or sample burial, and the condition of the room. According to Anggraeni (2013), factors that need to be considered in laboratory layouts include the location of laboratory buildings and the size of space. Building location requirements are not located in the direction of the wind leading to settlement or other building, this is avoid the spread contamination by air; building are not built at the water sources and far away from other laboratories; and they must be easy to reach for control and facilitate other actions.

Handling pig samples requires preparation space and storage space. These rooms have different functions: Preparation rooms are used for the preparation of tools and materials to be used in maintenance and experiments; and storage space used to avoid tools and materials. In addition, there must be a special room for storing pig samples such as special coolers to put pork samples into the freezer. This is based on consideration of the safety of various laboratory equipments and the convenience of laboratory users.

Supporting facilities are needed for laboratories specifically for pig samples, such as public facilities and specific facilities that are permanent in one place and will not be transferred to another laboratory. According to Wirjosoemarto et al (2004), it is explained that public facilities are facilities that can be used by all laboratory users such as lighting, ventilation, water, sinks, electricity, and gas. While special facilities in the form of equipment and furniture include user desks, material tables, chairs, blackboards, tool cabinets, material cabinets, first aid kits, firefighters, etc.

One of the crucial things is the washing place for the tools commonly used to support research, with at least two water channels recommended. The first place is used specifically for tools that has been a direct contact with pig sample. and the second place are for tools that never direct contact with pig sample. This will minimize contamination with other tools in one laboratory.

b. Organizing Laboratory Management

This context discusses the organization of managers, users and general rules of specific laboratory for pig sample handling that are important to know. The ability of managers and users to manage components in the laboratory is very important aspect. It is necessary for keeping managerial work in line. It takes people who are highly dedicated and has a special competencies to become a manager and laboratory user specifically for pig sample handling, and professional the laboratory.

One part of its management is archival equipment management tools and materials. Recording and grouping tools and materials according to their types are needed for tools and materials used constantly. An inventory book of specific tools and materials for the data collection process is necessary. Storing location based on the function and its benefit is one important things for carring out easily and reduce contamination of pig due to the touch of the hand.

In addition to reducing contamination, the archival equipment management process affects safety factors of work in the laboratory which causes amount of fatal accidents during laboratory user don't know yet about the safety procedures. Archival equipment management of tools and materials makes laboratory users easily to prevent any hazard component. Therefore, in specific laboratory for pig sample there are needed a safety instructions contain warning, instructions and prohibitions without exclude first aid kits, fire extinguishers as a work safety standard laboratory.

c. Techniques for Collecting and Handling the pig sample in the Laboratory

The technique of taking and handling pork samples

was adopted from the Ministry of Health of the Republic of Indonesia Directorate General of Disease Control and Environmental Health in 2013 regarding Specimen Collection Guidelines and Laboratory Examinations. The first thing to do is to take and send specimens before they are collected, universal precautions for taking specimens to prevent environmental contamination. Direct contamination during pigs sampling can be avoided by keeping no contact with the sample. Those are:

1. Washing hands using a soap or disinfectant before and after the experiment.
2. Using Personal Protective Equipment (PPE), the minimum that must be used:
   a. Comfortable clothes
   b. Rubber gloves
   c. Disposable mask
3. Sampling tools and materials:
   a. Sample bag
   b. Ice pack and Cold Box
   c. Name label
   d. Scissor
   e. Specimen Collection Form

Samples taken must arrive in the laboratory immediately after taking. Handling samples appropriately when shipping is of the utmost importance. It is strongly recommended that when sending specimens are placed in the cool box. After arriving at the laboratory, keep the sample in the -20^{o}C freezer with a separate place from the other samples.

d. Handling in the Laboratory

Pig sample as research objects in the laboratory can consist of any part such as blood, serum, faeces, plasma, urine, phlegm, feathers, nails, and others. Wet samples that are susceptible to microbial growth and other biological disturbances occur, the next step to prevent those things are needed the sample keep in dry and storing in a cooler with a minimum temperature of -20^{o}C to maintain the sample state until the DNA level remains good. This is an option because usually the sample experiences delays for certain reasons such as research that is difficult, gradual, and requires a long time span. Things that must be considered are as follows:

1. It is not permissible to allow this pig sample to be exposed to the air in an open container without cover
2. It is not permissible to store samples of pork in a place mixed with other ingredients. Use coolers, containers, handling equipment and even special bases for pig.
3. When checking the pork samples, it is not permissible to take action without wearing a laboratory coat, gloves and complete PPE.
4. Pig sample handling is always close to the water source where washing dirty tools specifically for pig samples so that it is easy to store the tools that have been used so that they are not scattered.
5. Check the pig sample properly in a few hours after taking to determine whether the storage and protection are in accordance with the initial position. If you get specimens at the same time, place the sample neatly in the cooler with the position of the pig sample to be used in the easiest position to reach.

In general, pig sample handling in research laboratory must be done with extra caution, detail, and aceptic condition. This pig sample is highly risky if doesn't has a right handling. The risk here refers to haram and it's najis for muslim.

4. Conclusion

Pig sample handling in research laboratory must be addressed includes laboratory layout, organizing laboratory management, and taking and handling the pig sample in the laboratory. In general, pig sample handling must be done with extra caution, detail, and aseptism.

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References

Anggraeni, Aprilianingtyas. 2013. Pengelolaan Laboratorium Biologi Untuk Menunjang Kinerja Pengguna Dan Pengelola Laboratorium Biologi Sma Negeri 2 Wonogiri. *Skripsi.* Jurusan Biologi Fakultas Matematika Dan Ilmu Pengetahuan Alam Universitas Negeri Semarang

Arifin, Zainal. 2014. Yang Diharamkan dari Babi Kajian terhadap Q.S. al-Baqarah Q) ayat 173. *Jurnal AL-Kaffah*. *2*(1)

Denyingyhot, Anat Phraephaisarn, C., Vesaratchavest, M., Dahlan, W., & Keeratipibul, S. (2017). Simultaneous Detection Of Three Forbidden Animals (Porcine, Canine, And Rat) In Halal Food By Using High Resolution Melting Analysis. *Scientific Bulletin Series F. Biotechnologies. 21*, 284–288.

Emda, Amna. 2014. Laboratorium Sebagai Sarana Pembelajaran Kimia dalam Meningkatkan Pengetahuan dan Ketrampilan Kerja Ilmiah. *Lantanida Journal*. *2*(2)

Hidayat, A. S., & Mustolih, S. (2015). Sertifikasi Halal dan Sertifikasi Non Halal pada Produk Pangan Industri. *Ahkam. 15*(2), 199–210.

Kementerian Kesehatan Republik Indonesia Direktorat Jenderal Pengendalian Penyakit dan Penyehatan Lingkungan. 2013. *Pedoman*

Pengambilan Spesimen dan Pemeriksaan Laboratorium

Mastika, Nyoman, P. Adyana, dan Gusti N A Setiawan. 2014. Analisis Standarisasi Laboratorium Biologi Dalam Proses Pembelajaran Di Sma Negeri Kota Denpasar. *e-Journal Program Pascasarjana Universitas Pendidikan Ganesha Program Studi IPA* : Vol 4

Nakyinsige, K., Man, Y. B. C., Sazili, a Q., Zulkifli, I., & Fatimah, a B. (2012). Halal Meat : A Niche Product in the Food Market. In 2012 2nd International Conference on Economics, Trade and Development IPEDR vol.36 (2012) © (2012) IACSIT Press, Singapore Halal *36*, 167–173.

Nurrachmi, R. (2017). The Global Development of Halal Food Industry: A Survey. TIFBR:Tazkia *Islamic Finance and Business Review*, *11*(1), 39–56.

Tone, Kamaruddin. 2007. Sistem Pengelolaan Manajemen Laboratorium Komputer Jurusan Sistem Informasi Uin Alauddin Makassar. *Jurnal Instek* : *2*(2)

Wirjosoemarto K, YH Adisendjaja, B Supriatno & Riandi. 2004. Teknik Laboratorium. FPMIPA. Universitas Pendidikan Indonesia.

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Management of Supply Chain Process for Meat Products

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ABSTRACT
The purpose of this study is to map the Halal Critical Point of Beef Products and a number of Processed Beef Products and also to create a Supply Chain Process Process Flow System for Meat products. Data and analysis of data explored in this study are stakeholders in the halal supply chain, namely authority institutions such as slaughterhouses (RPH), producers, logistics providers, operators, consumers, and the government by making questionnaires to identify important criteria and sub-criteria . The survey discussed consumer perceptions of halal supply chains of processed beef and beef products using the scoring method. Data processing results can then be analyzed using the Analytical Hierarchy Process (AHP) model. This study is expected to contribute to the selection of important criteria for halal supply chains for Meat products and their processed products, then contribute to the priority index using AHP (Analytic Hierarchy Process).

Keywords*: Beef, Halal Critical Point, RPH, Supply Chain and AHP*

1. INTRODUCTION

Beef derivative products have various forms because almost all parts of livestock can be processed into products that are worth selling. Food products derived from cattle that have been widely distributed in the community are quite diverse, for example processed meat, milk, yogurt, cheese, crackers and so on. In general, the derivative products from processed beef are mostly produced by business actors both from the industrial scale, small and medium enterprises (SMEs), as well as street vendors. Basically, people consume a lot of derivative products from processed beef. This is because cows are animals that have fairly complete nutritional value, so people consume them as food ingredients.

The price of beef products now is relatively expensive. The price increase due to the lack of availability of raw materials which causes increasing prices of food products from cattle, especially meat, to reach ± IDR 100,000/kg. This is also due to the large number of business actors engaged in the beef processing sector (Ministry of Industry, 2013).

This scarcity has caused limited supply in the market which has resulted in an increase in the price of beef products. This scarce supply and high selling price has resulted in the emergence of fraud so that problems arise guaranteeing the quality of halal and beef derivative products. Until now, most consumers still do not know the halal certainty and quality of the products they consume. Therefore, the concept of halal critical point mapping is needed in the process of producing beef derivative products. The problems that occur in the production of beef agroindustry products are:

1. Lack of halal assurance on the beef derivative products that have been widely distributed in community;
2. The flow of the supply chain process for processing beef products that is still not fulfill halal assurance
3. The absence of a halal critical point mapping that is integrated in the process of making beef-based products on the small and medium scale business.

The concept of halal is not limited to food itself, but also to cosmetics, pharmacy, financial services and banking, etc., even tourism (hotels, tours, etc.). According to Islamic law, to determine halal and prohibition does not have to be based on assumptions or feelings of likes and dislikes. If it is so, it is considered as *tahakkum* (making law in the name of Allah), which is strictly prohibited in Islam. Halal decisions on certain products carried out by people who do not have authority will only make the law incorrect. Consumption of halal products requires certain raw materials, additives, processes, handling and transportation to meet the criteria for halal terms as mentioned above. In addition, the industry must have a good system in order to ensure that the product meets these requirements and no errors are made during the production processes. The system called Halal Assurance System (SJH) is proposed by Apriyantono (2001). This system consists of several components namely:

1. Halal management standards and halal systems. Halal management is managing all

functions and activities needed to determine and achieve halal products. Halal systems are defined as organizational structures, responsibilities, procedures, activities, capabilities, and resources that together aim to ensure that the product, process or service will be satisfactorily stated or implied as its purpose, namely producing halal products. Basically, a halal system audit standard is conducted to determine the suitability of halal system elements with the specified requirements. The effectiveness of the halal system is applied to meet certain objectives and to verify that the non-conformities identified in the previous audit have been corrected according to the agreement.

2. Haram Analysis Critical Control Point (HRACCP). A system that can show critical points where unclean or *najees* ingredients can contaminate halal materials, as well as preventive ingredients that will be used for halal food production.
3. Halal database. This consists of a list of materials used for food production, information from the source and preparation of each of the materials mentioned in the list and halal status and other important information. To ensure that the industry has fulfilled the halal requirements in producing halal food, especially those who want to place a halal logo in its packaging, the industry must request assistance from dependence and acceptable halal certification organizations. Halal certification organizations will audit and certify their products, raw materials, additives, production facilities, administration and management. After the industry has received a halal certificate for its products, it can be used as a formal basis for implementing the halal logo. This certificate can also be used to state that the product is halal and hence products can be imported into muslim countries or sold to muslim consumers.

The definition of food according to Law Number 7 of 1996 is everything derived from biological and water sources, both processed and unprocessed, which are intended as food or drinks for human consumption, including food additives, food raw materials, and other materials used in the process of preparing, processing and or making food or drinks (Gemasih, et al 2014). Whereas halal means everything that is permitted, which is detached from the prohibition, and permitted by Allah SWT, while haram is something that is forbidden by Allah SWT with a definite prohibition, where the person who violates it will be punished in the here after and sometimes punished also in the world (Qardhawi, 2002 in Saputra, 2006).

The assurance system, halal is the highest concept of any other quality assurance, which includes Hazard Analytic Critical Control Points (HACCP), SOPs, GMP / GAP / GFP / GDP / GTP / GCP, and General Decisions and Quality Policies in General (Purnomo, 2013).

Halal can be said as the most important part of every quality assurance. This is because halal is inherent in any other quality assurance. As the highest quality assurance, halal is one of the good requirements in making food products. Therefore, halal products are certainly having high quality standard. Illustration of the importance of halal so it becomes the highest part of any others quality assurance concept can be seen in Figure 1 as follows.

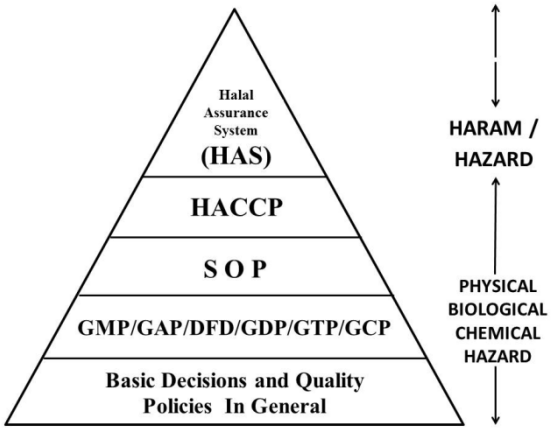

Figure 1. Halal as the highest Quality Assurance (Source: Dahlan in Purnomo, 2013)

In the Government Regulation of the Republic of Indonesia Number 69 of 1999 on the Article 1, halal food defines as food that does not contain elements or ingredients that are haram or prohibited for consumption by muslims, both concerning food raw materials, food additives and other supporting materials including ingredients from food processed through genetic engineering and food irradiation, and whose management is carried out in accordance with the provisions of Islamic religious law. With these regulations issued, halal assurance is the most important requirement in creating food products in Indonesia, where the majority of the population is muslim.

Halal Assurance for Slaughterhouse

Animals must be treated properly to avoid pressure before being slaughtered. Stunning should not kill animals before they are slaughtered, do not harm animals, do not cause permanent damage to the body/organs and are examined by supervisors. The Stunning method must be regularly validated and verified by LPPOM MUI. Mechanical cutting carried out in a factory or abattoir must follow a number of Islamic rules such as stating "*Bismillahi Allahu Akbar or Bismillahir Rahmaanir Rahiim"* when pressing the machine button.

The slaughterhouse system must have written procedures to ensure traceability of halal-certified meat. This system must obtain evidence that the meat is produced from halal animals, cut into the right halal method in cutting facilities that are in accordance with halal requirements.

There are some procedures for handling products made from materials and facilities that do not meet the criteria of LPPOM MUI, such as (a). Non-conformity products may not be sold to muslim consumers, (b). If a non-conformity product has been distributed, it must be withdrawn.

Internally, slaughterhouses must have written procedures for internal audits scheduled at least twice a year. Internal audit must be carried out by independent and competent personnel. The results of internal audits must be reported to all relevant departments responsible for monitoring activities. Corrective action must be carried out within the time limit and must be able to resolve internal audit findings. A summary of the results of the internal audit must be sent to LPPOM MUI and the implementation of internal audits must be documented.

Halal Critical Point

Halal critical point is an area/place/position which is considered prone to be halal. Determination of halal critical points in the product manufacturing process is carried out by conducting a search of each process activity. This search is useful for identifying critical points that cause unbalance of the produced products. In the production process of making halal products, halal critical points can be defined and mapped by looking at the Standard Operating Procedure (SOP) of each activity that occurs in it. According to LPPOM-MUI (2008), the SOP for halal production is done by looking at:

1. Making worksheets must refer to formulas and material matrices known by LPPOM-MUI.
2. Materials that can be used in halal production are only contained in the list of materials that LPPOM-MUI has already known and have obtained halal passes.
3. Material is ensured to be free from unclean contamination and unclean ingredients.
4. The production line is confirmed to only be used for halal materials.
5. If the production line is also used for materials that have not been certified halal, then the cleaning procedure is sure to eliminate/avoid products from cross contamination.
6. If there are products that are not certified to contain pork derivatives, the equipment and production line are certainly completely separated.
7. It must be ensured that the production area must not have materials or goods that are not used for production.
8. Production records are well and completely documented.

The critical point of halal in the product manufacturing process, in general, can follow from the prohibited tipping point of the Haram Analysis Critical Control (HrACCP) product, but a halal-haram product can follow the principle followed by Hazard Analysis Critical Control Points (HACCP) but in this case aimed at efforts to prevent the entry of unclean ingredients into the production system as early as possible (Estuti, 2005). According to Apriyantono et al. (2003) in Estuti (2005) the application of Haram Analysis Critical Control Points (HRACCP) consists of six components, namely:
1. Identify all ingredients which are unclean and *najis*. 2. Identify critical control points. 3. Establish monitoring procedures. 4. Make corrective actions. 5. Make a document-recording system. 6. Make verification procedures.

In controlling the halal critical point, control is carried out on each process flow until the end of the product manufacture. Determination of halal critical point control begins at each stage of the process up to the consumers who consider the halal products and how to prevent the entry of illicit materials in the production process to the final product (Apriyantono et al., 2003 in Estuti (2005).

Halal Supply Chain on Beef

Basically the supply chain process of beef products and derivatives is divided into two sectors, namely the upstream sector and the downstream sector. The upstream sector is a sector that acts as the procurement of cattle to reach slaughtering houses (RPH), while for the downstream sector is a sector that acts as the procurement of beef to reach the procurement of processed/derivative products. Supply chain flow of beef-based products with the relevance of entities that play a role in them. The linkages of entities/actors that play a role in the supply chain process of beef products and their derivatives consist of several different and interconnected actors in each of their sectors.

Supply Chain Process Flow in Slaughtering house

Slaughterhouse (RPH) is a unit of facilities and facilities dedicated by the government as a location for specially designed slaughterhouses in accordance with SNI 01-6159-1999. Judging from the substance of ownership, RPH is grouped into two: government-owned slaughterhouse (UPTD RPH) and non-government owned slaughterhouse (private).

Actors who play a role in the two types of RPH are relatively similar, consisting of RPH employees, slaughterers, and actors from the downstream and upstream sectors. Judging from the process, RPH employees are actors who act as control holders of all activities that occur in the RPH, including management, supervision and maintenance. In

accordance with the ownership status of RPH, the employees are divided into two, namely official staff (UPTD Government RPH) and non-official employees (Private RPH).

Each employee has a specific task from each process starting from the arrival of the cow, the cutting process to the process of sending beef. Butchers are entities that act as slaughterers. In the process of slaughter, the slaughterer must have special criteria that are in accordance with the Islamic *Shari'a*, ie the perpetrator must be Muslim, *balig* and understand how the slaughter process is good without any elements of torture. Each RPH is required to have a slaughterer who has been recognized by the MUI with proof of certificate as a professional slaughterer and in accordance with special criteria. This is because it will provide Assurances to RPH to produce halal meat products.

Halal Critical Control Point in Slaughtering house

The halal critical control point is a control position where the lighting will be prohibited to appear. Basically, the halal critical control points of beef-based products originate from slaughterhouse, the halal of a beef product can change if further handling and processing occurs. Animal Slaughtering house (RPH) are a starting point for halal critical control points from beef-based products. In this position, RPH is dedicated as an initial location with the potential for the emergence of halal critical points. Slaughtering and handling carried out by RPH are the main factors that must meet the quality, health and halal quality standards. The halal critical control point in the dominant RPH lies in, first, the religion of the slaughterer (Islam), the knowledge of the slaughterer, the behavior of the slaughterer (*baligh*/adult), and the cleanness of the slaughterer.

Secondly, the type of commodity of animals slaughtered in RPH; thirdly, the differentiation of slaughter facilities and infrastructure if RPH has a type of non-halal slaughterhouse commodity (pig); fourth, the method of slaughter in accordance with the Islamic *Shari'a* and subsequent handling. Basically, slaughterers in slaughterhouses are required to be Muslim. Besides, the slaughterer must also have knowledge of how to slaughter according to Islamic *Shari'a*, have good behavior (adult), and pay attention to cleanness in each process.

Types of animals can be categorized as critical control points if there are shelters and slaughterhouses in addition to halal animals. With an explanation of the types of animals, it is very clear that the differentiation of facilities and infrastructure must be different between halal and non-halal animals. This difference is one of the halal critical control points that must be considered in the cutting process. The most visible halal critical control point is the slaughter method that must be carried out in accordance with the Islamic *Shari'a*, namely by reciting prayers (*BismillahiAllahu Akbar*) and deciding three channels, namely the respiratory tract, food and blood with one cut.

Mapping of Halal Critical Points

Slaughterhouse (RPH) is a place to slaughter livestock dedicated by the government as a facility to support food security in an area with the building that meet certain requirements and techniques.

From the results of the halal critical point mapping, it can be stated that the RPH is an initial critical control point for the product that will be produced if the product uses animal meat. The halal critical control points of slaughterhouses are seen from the types of animals and the process of slaughter of animals carried out in accordance with Islamic *Shari'a* as well as safe and good handling (avoiding dirt and *najees*). Types and sources of data to map halal critical points in the process flow supply chain this beef-based agroindustry product uses primary data and secondary data.

1. Primary data is obtained through direct observation with interview techniques for actors related to mapping starting from Slaughtering house (RPH), meat markets, beef-based product processing industries (meatballs), and expert respondents who have science in this mapping.
2. Secondary data obtained from various sources, namely articles sourced from the internet media, textbooks, and data from the government related to the problems taken. The types and sources of primary data needed in this mapping and after that are described.

Secondary data is data needed in the initiation of understanding and studying networks that are related to the halal product chain process flow, while the primary data is the data needed as an understanding of the supply chain process framework for beef-based products.

With this data, it is expected to provide a halal critical point mapping in the supply chain process of beef-based products.

Urgency of Halal Critical Points

The supply chain of animal origin agroindustry products is divided into two sectors, namely the upstream sector and the downstream sector, the upstream sector starts from livestock entrepreneurs (cattle) to reach Slaughterhouse, while the downstream sector starts from RPH, markets/meat kiosks, to reach derivative processing. Mapping of halal critical points in the supply chain process of beef-based agroindustry products can be identified from each variable of machine, man, material, method, and money resources with factor weights and assessment of predetermined criteria for fulfilling the halal critical point. The state of halal critical point mapping in the supply chain process flow has factors that determine the halal according to

the weights that have been obtained using the Analytical Hierarchy Prosess (AHP) method.

Machine (facilities and equipment) is a resource that has the lowest average score of "good enough" in the mapping of halal critical points in the supply chain process of beef-based agroindustry products. The need for supervision management that is integrated with the right timeframe in the flow of the supply chain processes by looking at the halal critical point factor towards the resources used. The need to change the behavior of the entity can be taken by having extensive knowledge of halal products and a strong awareness in creating assurance and quality halal products. Government policies and strategies that have a developmental impact on the halal of beef-based agroindustry products, in order to improve halal products circulating in the community are necessary. Further mapping by adding locations to better reflect the state of halal critical point mapping in the supply chain of cattle-based agroindustry products as a whole is also necessary.

Criteria for Slaughterhouse (RPH) Registration are; producers must register all slaughterhouses that are in the same company, they must employ slaughterers who are Muslim and trained in the slaughter process in accordance with Islamic law (have slaughter certificates), the slaughter locations are far from farms and slaughter of pigs, they apply the standard of slaughter according to Islamic law.

2. METHOD AND MATERIAL

There were some stages that had been carried out in this study, namely: stage of literature study, stage of field studies and data collection, stage of data collection and information on halal critical points, stage of data processing, mapping analysis of AHP analysis, and stage of drawing conclusions and recommendations.

In this study, a number of in-depth interview methods and data collection methods with questionnaires in the process of beef products are used. The questionnaire aims to facilitate the resource person in answering the questions asked. The format and contents of the questionnaire were adapted and developed based on the needs of data and information related to the questionnaire

Respondent data relating to the Halal Certification System are as follows:

1. Number of beef products that are Halal certified,
2. Demand for beef products in Makassar,
3. Amount of slaughterhouses in Makassar
4. Government policies and support

Identificationand Data Collection

The types and sources of data in this study were obtained from:

1. Primary Data is data obtained by conducting direct observations with interviews with leaders and employees, producers, consumers and many related elements (such as in the profession of respondents)
2. Secondary data is data obtained from several literatures, especially those related to the problems encountered in research as a theoretical foundation as well as supporting in writing.

In this study, the primary data is questionnaire data with data sources from a number of producers of beef products and slaughterhouses (RPH), namely:

1. Large-scale producer/ company
2. Medium-scale producers /companies
3. Small-scale producers /companies

Stages of Data Collection and Information on Halal Critical Points

Types and Sources of Data include Initiation of understanding and studying related networks in the process flow of halal production supply chain such as:

1. Data on the distribution of RPH locations
2. Data on local and imported beef production
3. Data on halal certified meatball products
4. Entities/stakeholders who play a role in the process of producing beef and derivative products
5. Data on RPH Facility Feasibility Checklist
6. The process of processing derivative products carried out by the meatball, shredded meat, sausage, and chips, processing industry also with well-known local culinary such as coto, konro, pallubasa and so on
7. Document flow related to supervision and quality assurance and halal in the production process
8. AHP weighting
9. Assessment data

Stages of the Data Processing

The data processing stage and the fixing of halal critical points consist of several processes. Data collection was done by survey method using interview and observations techniques directly at each entity and stakeholders in each process. At the time and after data collection, the determination of variables, factors and fulfillment criteria for halal critical points in the supply chain process flow can be carried out. Determination of variables, factors and compliance criteria for the halal critical point aims to find out which parts are the locations of the halal critical point of each supply chain process flow. After obtaining the variables, factors and criteria for fulfilling the halal critical point, the data processing can be carried out with the weighting method that has been determined and discussed by expert respondents who have knowledge related to this mapping using the Analytical Hierarchy Process (AHP) method.

AHP method has a function as a determinant of uncertainty perspective in comparing pairs on each

factor according to the number of indicators that have been determined and to determine which factors are the most influential and important in the mapping of halal critical points.

Weighting aims to determine the priority value of each halal critical point factor of each variable that has been determined from the results of determining the halal critical point.

In addition to determining weighting using the AHP method, respondents from experts and the research team are required to provide an assessment of each compliance criteria for the halal critical points that have been determined for each sample area to provide a mathematical description of the actual situation, which area includes the location of the Government Animal Slaughtering house (RPH), meat market location and industrial location for SMB scale packaging meatballs.

3. RESULTS AND DISCUSSION

Data Input

The input data to be entered will provide scores and weights as a result of the calculation of a number of formulations specified. The AHP weighting method and score setting design can be seen in the formula as follows:

Determination of the importance of the halal critical point factor weight score.

(Bn) = $NPriority$ AHPfn × 100%.....(1)

Where:

Bn = Importance of the halal critical point factor (%)

$NPriority$ AHP_fn= Score AHP (Expert) Priority Factors Of Each Variable

Determination of the conversion score of each factor:

nKon_fn = ΣnKPnp_fn

TotalKp × 5.....(2)

Where:

nKon_ fn = conversion score

nKPn_fn = Score of fulfillment criteria for each factor

Kp = Fulfillment criteria

Determination of factor score values of each respondent:

sf_fn = nKon_fn _rata x Bn…….....….(3)

Where:

sf_fn = Scores of each resource variable factor

The preparation of the assessment criteria for the fulfillment of the halal critical points will be based on the number of respondents involved.

Table 1: Scoring Factor Criteria

Scoring Factor Criteria			
Sample Area 1,2…n			Average
R1	**R2**	**R3**	
nKP1_ fn			
nKP2_ fn			
nKPn_ fn			

Scoring Factor Criteria			
SampleArea 1,2…n			Average
R1	**R2**	**R3**	
ΣnKPnp_fn			
nKPn_ fn			nKon_fn _rata

Note:

R = Respondent

nKon_fn _rata = Average conversion value from the respondent's assessment

Assessment is obtained by providing a range of scores 0 to 1 to give meaning to how fulfilled the fulfillment criteria for the established halal critical points. To see the rating scale of the predetermined criteria for compliance with the halal critical points, it can be seen in the following table.

Table 2: Rating Scale of Fulfillment Criteria

	The closer of Value 1 is, the higher of the fulfillment	Score	Criteria of Fulfillment Factors Score
Assessment of Fulfillment Criteria	↓	0	Not fulfilled
		0,1	The Score of the Fulfilled Fulfillment Criteria Based on the determined factors
		0,2	
		0,3	
		0,4	
		0,5	
		0,6	
		0,7	
		0,8	
		0,9	
		1	Fulfilled

Conversion assessment was obtained after an assessment of the criteria for fulfilling the halal critical point factor had been carried out. To find out the scale of conversion rating of the criteria for meeting the halal critical points can be seen in Table 3.

Table 3 : Conversion Scoring Scale

	Score	**Conversion Score Criteria**
Conversion Scoring	1	Very Not Ideal
	2	Not ideal
	3	Quite ideal
	4	Ideal
	5	Very ideal

In the assessment of conversion obtained, the score can be interpreted by the color level specified in the Table of Conversion Scoring Meaning by *Chroma*.

Table 4: Conversion Scoring Meaning by *Chroma*

0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5
*very not ideal → very ideal										

*The closer to the dark red color, the more ideal the assessment of the sample area.

Decisions in the assessment that have been obtained can be adjusted according to the assessment decision range in Table 5.

Table 5: Range of Conversion Assessment Decisions

Range	Decision	
1 < n < 2	Between very ideal and not ideal	// < 0.50 tend to be very not ideal and> 0.50 tend to be not ideal
2 < n < 3	Between not ideal and quite ideal	// < 0.50 tend to be not ideal and> 0.50 Tend to be quite ideal
3 < n < 4	Between quite ideal and ideal	// < 0.50 tend to be quite ideal and> 0.50 Tend to be ideal
4 < n < 5	Between ideal and very ideal	// < 0.50 tend to be ideal and > 0.50 tend to be very ideal

After obtaining the factor weight of each variable, the determination of the score of each factor is obtained from the multiplication of the average conversion score of the compliance criteria for the halal critical point with the weight score of each factor. AHP weighting given to each factor is done to find out which factors have the greatest score and the smallest score that can determine the priority of interest from each predetermined halal critical point factor of each variable. After getting the score on each variable factor, it can be summarized from the factor score value to determine the amount of the total score obtained, as an attempt to find out which variable has the highest or lowest score of reviewing the predetermined halal critical point factor. This total score is useful to find out the state of the variables in each sample area. The weighted design that has been formulated is presented in Table 6.

Table 6: Weighting Design

No	Variable	Factor	Priority Score by AHP Method	Value of Weight Interests Factor by AHP method %	Criteria of scoring factor	**Score**
1						
2						
n						
total						
Note of Total Score						

Notes:

1. nKon_fn _rata = The average conversion score from the respondent's assessment
2. NpriorityAHP_fn = Score of AHP Factor Priority (Expert).
3. Σ nKon_fn _rata ni = Amount of conversion average score of respondent's assessment criteria.$=1$
4. Σ $sf\_f=1$ = Total score for each variable factor.

ni

Notes:

Σ sf_fi

ni $=1$:

- Obtained Depending on the Scale of Assessment of Specified Factors.
- Classification of Groups Results of Total Assessment Depends on Total Divided on Number of Variables

After carrying out the weighting design, a plot of results can be done with variables, factors, weighting factors and scores that have been obtained.

Notes:

Σ sf_fi

ni $=1$:

- Obtained Dependence on the Scale of Assessment of Specified Factors.
- Classification of Groups Results of Total Assessment Depends on Total Divided on Number of Variables

After doing the weighting design, designing a plot of results with variables, factors, weighting factors and scores that have been obtained can be done. The description is presented in Table 7.

Table 7: Description of Total Scores

Range	Notes	Symbol
401 s/d 500	Very good	A
301 s/d 400	good	B
201 s/d 300	Good enough	C
101 s/d 200	Less good	D
0 s/d 100	Very bad	E

*obtained depends on the conversion rating scale

Considering the halal critical point factor in the supply chain process of beef-based agroindustry products is done by looking at 5 (five) influencing resources including machinery, people, materials, methods and money. These five resources are very influential to reflect how the state of the halal critical points of the products to be produced in each sample area.

4. Conclusions

By doing this research, some advantages can be drawn from the existence of halal certification on beef products, namely:

1. With a system of mapping, halal beef products and a number of processed beef offered, they will help in making halal certification policies.
2. Increased consumer trust in the available halal beef products.
3. There is a sense of security and consumer support in consuming halal beef products and a number of processed beef.

References

Apriyantono A, Hermanianto, dan Nurwahid. (2003) *Pedoman Produksi Halal*. Departemen Teknologi pangan IPB Bogor

Apriyantono, A. (2005). *Masalah Halal Kaitan antara Syar'i, Teknologi dan Sertifikasi*. Penerbit PT Kiblat Buku Utama. Bandung.

Badan Pusat Statistik Provinsi. (2012). Dalam Angka, *inFigurers.*

Daging Sapi Bermutu dan Halal di Indonesia. Jurnal Surya Agritama, *2*(1)

Dahlan, W. 2009. *Global Halal Food Market and Future Halal Science*

Hosen, M.N. (2008). *Panduan Umum Sistem Jaminan Halal LPPOM-MUI*. Lembaga Integrasi Pengolahan dan Diseminasi Statistik.

Jamaran, Irawadi. (2011). *Sosialisasi Halal Harus Ditingkatkan*. http://www.halalmui.org/index.php?option=com_content&view=article&id Accessed on 13th April, 2013 (in Indonesia)

LPPOM MUI. (2013). Profile LPPOMUI Pusat, Lembaga Pengkajian Pangan, Obat-obatan dan Kosmetik, Majelis Ulama Indonesia.

Majelis Ulama Indonesia. (2010). *Himpunan Fatwa Majelis Ulama Indonesia*. Jakarta: Sekretariat Majelis Ulama Indonesia

Nusran, Muhammad, Irawadi Jamaran, Taufik Nur, (2013). Analysis of Policy and Design for Acceleration of Halal Certification Program, Seminar Nasional Teknologi Industri (SNTI I 2013) Makassar Indonesia ISBN No: 978-602-14537-0-4

Nusran, Muhammad., et al., (2013). Analysis Of System Dynamics On The Role Of LPPOM MUI And Government In Implementation Of Halal Certification In Indonesia**,** *Proceedings of International Conference on Halal Issues and Policies, Halal Centre UMI*. ISBN: 978-602-18603-3-5

Purnomo, D. (2013). *Konsep Ketelusuran Jaminan Mutu Dalam Infrastruktur Logistik dan* Pustaka Binaman Pressindo, Jakarta.

Qardhawi, Y. (2002). *Halal dan Haram. Terjemahan A.S. Al-Falahi*. Robbani Press, Jakarta.

Saaty, T. L. (1993). *Pengambilan Keputusan Bagi Para Pemimpin: Proses Hirarki Analitik*

Saaty, T. L. (2011). *The Analytic Hierarchy Process. Planning, Proirity Setting, Resource*

Sampurno, (2001). Label Pangan dan Label Peran: Dalam Prespektif Peran, Tugas dan TanggungJawab BPOM. Badan POM, Jakarta

Situbondo. (2012). Available at http:// epetani.deptan.go.id/blog/jenis-jenis-sapi-potong-diindonesia-4037. Diaksestanggal 30 Oktober 2017.

Soeparno. (1994). *Ilmu dan Teknologi Daging*. Gadjah Mada University Press. Yogyakarta.

Yaqub, Ali Mustafa. (2009). *Kriteria Halal Haram*. Jakarta: Pustaka Firdaus

Zawanah, H Munir, dan A Muhaimin. (2008). *Halal: Antara tuntutan Agama dan Strategi*