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The Changes of Temperature and pH of Bali and Landrace Porks After Slaughtered

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Abstract. Pigs are critical livestock in providing animal protein for some people in Indonesia and are the third contributor to animal protein sources after poultry and cattle. Pigs is are one of the essential commodities in terms of nutritional, socio-cultural, and economic aspects. The change of pH level dramatically affects the quality of the meat because the pH value affects the tenderness, water holding capacity, and color of the meat. In principle, low temperature withering or high temperature affects to the speed or slowness of the pH decrease rate. This study aimed to determine rate of decrease the temperature and pH of the Bali and Landrace porks after slaughtered. The study design was purposive sampling. The samples used were the pork originated from 32 sample of the psoas major muscle of Bali and landrace pigs, consisting of 16 bali pigs and 16 landrace pigs. The data from the laboratory tests were analyzed by comparison with the statistical test of variance (ANOVA) with SPSS program. The results showed that the decrease in acidity level (pH) in Bali pork was p = 0.000 and Landrace pork was p = 0.003 which had a significantly different effect (P 0.05). It can be concluded that the decrease in pH and temperature of bali and landrace pigs can affect the quality of pigs after slaughtered.

Keywords: Temperature; Acidity Level (pH); Bali pig; Landrace pig

I. INTRODUCTION

Pigs are critical livestock in providing animal protein for some people in Indonesia and they are the third contributor to animal protein sources after poultry and cattle. Pig farming is generally intensive, confined in cages with handling using advanced technology and economic considerations to provide better production [2]..

Before slaughtered, the condition of livestock must be healthy and fresh. Therefore, after the pigs arrive at the slaughterhouse, they must rest until they are fresh again. Before slaughtering, pigs should fast for 24 to 48 hours. Resting livestock intends so that livestock is not stressed, resulting in maximum blood flow, and sufficient energy is available so that the rigor mortise process runs perfectly.

Resting livestock is vital since unrest livestock will produce dark-colored meat, commonly called dark-cutting meat, due to their stress (Beef Stress Syndrome). Hence, adrenaline hormone secretion increase disrupts glycogen metabolism in muscles. The cutting method is stunning by using an electric shock. There are two stunning methods, i.e., low voltage with alternating current at a frequency of 50 cycles/minute, 75 Volt voltage, 250 mA current for 10 seconds, and high voltage, with a voltage of 200 to 400 volts for 2 seconds [7].

Meat is defined as all animal tissues and products resulted from the tissue processing suitable for consumption and does not impose health problems for those who consume them [22]. Pigs is one of the essential commodities in terms of nutritional, socio-cultural, and economic aspects. The pig carcass industry has good economic prospects as pig farming is relatively easy to develop, with high reproductive power to meet market demand. In quantity, producers are also expected to provide quality pigs [30].

According to Lawrie [13], the final pH of the meat indicates good meat quality. Meat with a pH between 5.5-5.7 (normal pH) has a bright red color. The acidity (pH) level highly affects the quality of the meat because the pH value affects the tenderness, water holding capacity, and color of the meat [31]. The pH value of meat will be determined by the amount of lactate produced from glycogen during the anaerobic glycolysis process. It might be limited if glycogen is depleted due to fatigue, hunger, or fear of the animal before slaughter [4].

According to Lawrie [13], decreased pH value will affect the physical properties of meat. High meat temperatures can affect postmortem muscle pH reduction and decrease water-binding capacity due to increased muscle protein denaturation and increased water transfer to the extracellular space. It is reinforced by Soeparno [22], stating that the ambient temperature (storage) was related to the post mortem carcass pH decrease. According to Soeparno [22], the normal condition of the final pH of meat (ultimate normal pH) measured 24 hours from the time of slaughter was around 5.4 to 5.8. In principle, low-temperature or high-temperature withering affects the speed or slowness of the pH decrease rate. Withering at low temperatures decelerates the rate of pH drop while withering at higher temperatures can accelerate the rate of pH drop. Based on the description above, it is imperative to show the temperature and pH drop rate in Balinese and landrace pigs after slaughtering.

II.MATERIALS AND METHODS

This study was observational, observing and directly measuring the body size of Bali and landrace pigs at the traditional pig slaughtering place of Mr. Mangku in Banjar Ulapan, Blahkiuh Village, Abiansemal District, Badung Regency.

The measurement procedure for pH and temperature of Bali and Landrace pigs were electrocuting before slaughted. Thirty minutes after electrocution, the innards or organs were cleaned. After cleaning the viscera or organs, the psoas major (central spine) was taken as many as 40 grams for each Bali and landrace pigs, respectively. Forty grams of Bali pork were divided into four, and with weighed 10 grams. The same procedure for 40 grams of landrace pigs was also done. The muscle of psoas major were divided into four, and with each weighed 10 grams. Bali and landrace porks were grounded/mashed in a mortar and added with 10 ml of distilled water. Subsequently, 10 ml of pork was put into a beaker glass. The first Balinese and landrace pork pH were measured at 30 minutes, the second was at 50 minutes, the third Bali was at 70 minutes, and the fourth was at 90 minutes after slaughtered. Minute 0 was recorded as the normal pH of pig muscle before slaughtering. The pH measurement of the pork was repeated four times using a digital pH meter. Each measurement was read the number indicated by the pH meter, and the temperature after the number constant.

The data from the test were calculated for the average value and standard deviation. The data were, then analyzed in comparison of the variance analysis (ANOVA) test [17]. The pork testing results are objectively described quantitatively in tables and graphs.

III.RESULTS AND DISCUSSION

Anesthesia time

Sixteen Balinese and landrace pork samples were taken from the psoas major muscle (central spine) from the traditional slaughterhouse of Mr. Mangku, located at Banjar Ulapan 2, Blahkiuh Village Abiansemal District, Badung Regency, regardless of sex and weight of the pork sample.

The examination results of the acidity (pH) and temperature degree of Bali and landrace pork originating from traditional slaughterhouses are presented in the table below.

Tabel 1. pH Test of Bali and Landrace Pigs

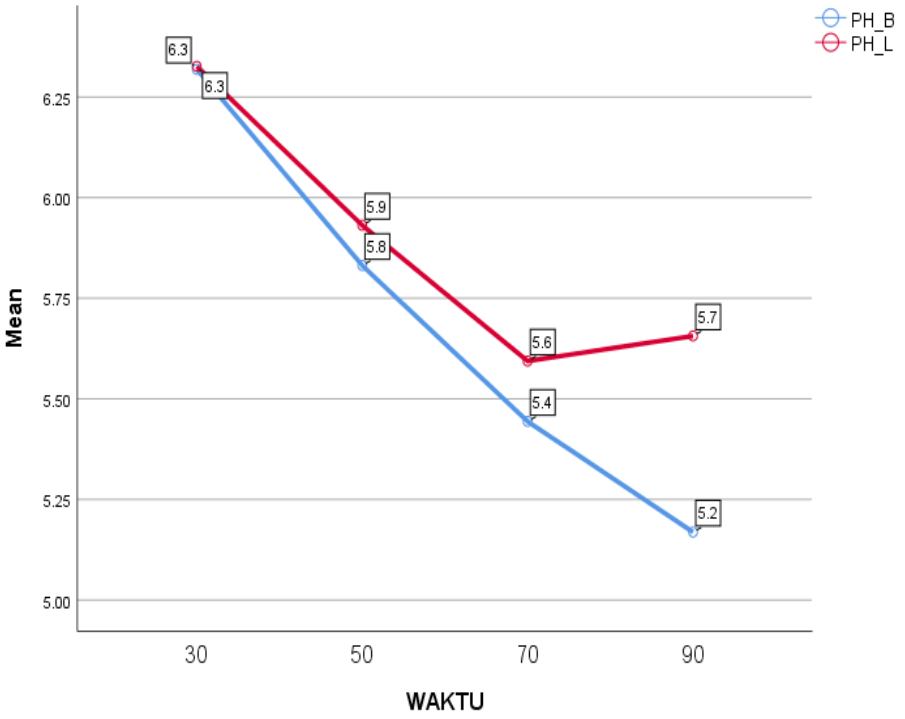

Figure 4.1 Line Diagram, Bali and landrace pigs from a traditional slaughterhouse against pH value

Table 2. Duncan Test Results of Balinese and Landrace Pork pH Change Post-Slaughtering

Time	Balinese Pig	Landrace Pig
30	6.31^{c}	6.32^{b}
50	5.83^{b}	5.93^{ab}
70	5.44^{a}	5.59^{a}
90	5.16 ^{a}	5.65^{a}

Note: Different letters towards the column indicate a significant difference (P <0.05). Otherwise, the values with the same letter indicate an insignificant difference.

Duncan test results in Table 2 show that the pH of Bali and landrace pork decreased. A significant decrease (P<0.05) was found in Bali and landrace pork after slaughtered at 30, 50, 70, and 90 minutes. The comparison between the pH decrease in Balinese and landrace pigs at 30 minutes showed a significant difference (P<0.05), while the pH decrease at 50, 70, and 90 minutes did not show a significant difference (P<0,05).

Table 3. Temperature Test of Balinese and Landrace Pigs

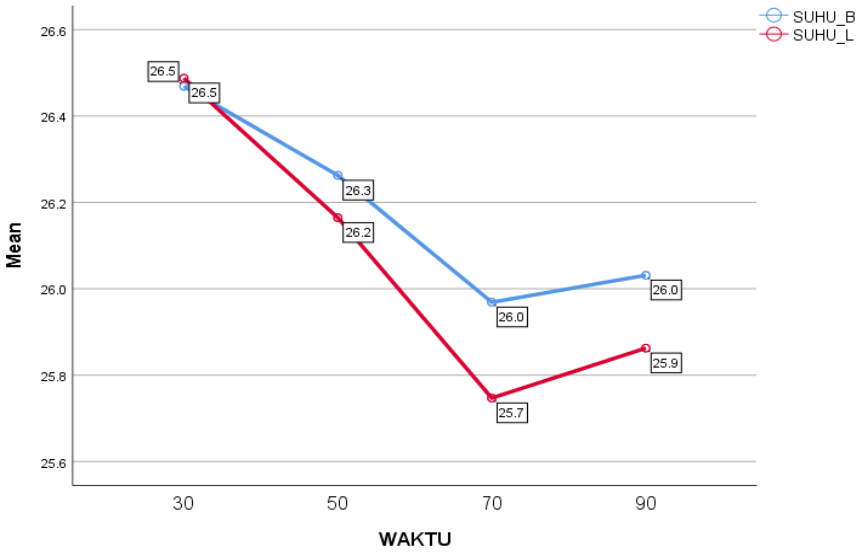

Figure 4.2 Line Diagram, Balinese and landrace pigs from a traditional slaughterhouse against temperature values

Table 4. Duncan Test Results of Balinese and Landrace Pork Temperature Change Post-Slaughtering

Time	Balinese Pig	Landrace Pig
30	26.4[a]	26.4[a]
50	26.2[a]	26.1[a]
70	25.9[a]	25.7[a]
90	26.0[a]	25.8[a]

Note: Different letters towards the column indicate a significant difference (P <0.05). Otherwise, the values with the same letter indicate an insignificant difference.

Duncan test results in Table 4 show that the temperature decrease of Balinese and landrace pork was insignificant. An insignificant decrease (P>0.05) was found in Balinese and landrace pork after slaughtering at 30, 50, 70, and 90 minutes.

V. CONCLUSION

Based on the study results, it can be concluded that the acidity level (pH) decrease of Bali and landrace pigs was decrease significantly different (P<0.05), while the temperature decrease of Bali and landrace pigs was non-significantly different (P>0.05).

VI. DISCUSSION

pH Test of Balinese and Landrace Pigs

The pH value is used to indicate the level of acidity and alkalinity of a substance. Animal muscle tissue has a pH value from 5.1 to 7.2, which decreases after slaughtering due to glycolysis and lactic acid production, affecting the pH. The degree of acidity (pH) of livestock meat varies depending on the treatment given. Based on the pH measurement results

presented in the table below, it is explained that the pH values of Balinese and landrace pigs at the traditional slaughterhouse of Mr. Mangku decreased significantly ($p < 0.05$).

A pH value decrease will occur after the livestock is slaughtered (post-mortem), that is, when the heart stops pumping blood, so that muscle tissue and other tissues no longer receive a blood supply. According to Soeparno [22], the pH value of meat is related to the type and species of livestock. In this study, the highest pH value discovered in Balinese pigs was 6.3, while the highest value in landrace pigs was 6.3. The lowest value in Balinese pigs was 5.2, while in landrace pigs was 5.6. These results indicate that the pH decrease in Balinese and landrace pigs is normal since it remained within the post-mortem pH range. The normal condition of meat with a pH of 5.2-5.7 is unfavorable for most bacterial growth. Most bacteria grow at a pH of 7.0, fungi at a pH of 2.0-8.0, while yeast can grow at a pH of 4.0-4.5 [22]

Buckle et al. [4] stated that in some livestock, pH decrease occurs one hour after the cattle are slaughtered and at the time of reaching rigor mortis. The pH value of the meat after the change in glycolysis to lactic acid ranges from 5.1 to 6.2 since glycogen, an energy source for muscle, will undergo a glycolysis process post-slaughtering and enzymatically produce lactic acid, decreasing pH value. The condition of livestock before slaughtering can affect glycogen levels in muscles. Stressed livestock before slaughtering will also affect the glycogen availability in the muscles, affecting the pH value of post-death meat.

Temperature Test of Balinese and Landrace Pigs

Based on the temperature measurement results presented in the table below, it is explained that the temperature decrease of Balinese and landrace pigs at the traditional slaughterhouse of Mr. Mangku was insignificantly different ($p < 0.05$).

The most critical factor regulating microbial growth is temperature. In general, the higher the temperature, the greater the growth rate of various bacteria. Many meat microorganisms will grow (a little or a lot) at all temperatures below 0°C to above 650°C. However, for certain microorganisms, excellent growth occurs at certain temperatures within a limited range. It is customary to divide meat-rotting organisms into three categories. Psychrophiles have optimum temperatures between -20°C and 70°C, mesophiles between 100°C and 400°C, and thermophiles from 430°C to 660°C. At cold temperatures under anaerobic conditions, the rotting flora of meat is dominated by pseudomonas and, in anaerobic conditions,

by lactobacilli bacteria. In this study, the highest temperature in Balinese pigs was 26.50°C, while the highest value in landrace pigs was 26.50°C. The lowest value in Balinese pigs was 26.00°C, while in landrace pigs was 25.70°C. These results indicate that the temperature decrease of Balinese and landrace pork is normal.

The increased body temperature post-slaughtering depends on the metabolic rate and duration of heat production and release. The muscle size and location in the body and the amount of fat or the deposition rate of body or carcass fat will affect the final temperature rise and the heat release rate. External factors affecting the temperature decrease rate of the meat carcass include the temperature of the cutting room, immersion in hot water, the cutting process duration, the initial temperature of cooling or withering, and the level of the body's energy supply [21]

The high level of Balinese lard is due to the Balinese pigs used in this study were traditionally reared by feeding leftover kitchen waste with high-fat content. The higher fat content of feed than pet pig feed causes higher fat content of Balinese pigs. It follows a statement by [24] that animals fed with high energy levels will have increased fat content. Landrace pigs have low-fat content since they are intensively reared and fed commercial feed. The feed consumed by the pig has a high protein content fulfilling the body's needs, causing fat to be used efficiently as energy. As a result, the fat utilized in the body is not too high [29]. In addition, to feed factors, the high-fat content of Balinese pigs is caused by breed differences between Balinese and landrace pigs. Balinese pigs are a fat type pig breed (lord type) that tends to store fat better than other pig breeds, such as the bacon type landrace pig.

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