The effect of cage density on the quality of broiler chicken meat

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Abstract. One of the maintenance management of Broilers is the regulation of cage density. In the tropics, cage density affects comfort in a cage, high temperature and humidity are the main causes of stress in chickens. Cages with inapropriate densities have a negative impact on meat production and quality performance. The study aims to identify cage density to the quality of broiler chicken meat. The study used a completely randomized design with 3 treatments, namely density 8, 10 and 12 tails per square meter, each treatment was repeated three times. The result showed that the difference in cage density in the maintenance of broiler chicken up to the age of fine weeks did not affect meat quality. It is recomended maintenance with a density of 12 tails broiler chicken up to age of 5 weeks can be done without affecting the quality of meat.

1. Introduction
Cage density effect on the comfort of livestock. This is because the density of cage affects the temperature and humidity within the enclosure. In tropical temperatures and high humidity can be a major cause of stress in chickens. Stress resulted in a decrease in the production and quality of meat. Standard density of laying hens pullet is 15 kg/m² or the equivalent of 6 to 8 broiler chickens and 12 to 14 laying hens pullet [1]. Enclosure that its density is less is a waste of energy production that is supposed to be a lot of wasted because many chicken move. Cages that are too dense to make chicken uncomfortable and increase competition in getting feed, drinking water or oxygen. The rivalry caused growth to be non-uniform especially on chicken broiler males and females [2], and the productivity of the chicken is not optimal.

Density of the cage that of carcass, especially on the chest and thighs [3]. The uncomfortable circumstances also causes chicken wounded by friction with the sides of the enclosure and pecking each other. The negative impact of too high a density effect on body weights will, foot pad lesion, bruising, fights and stress [4]. The density of the cage is too low to cause the waste of space and chickens move so much energy wasted. The muscles that many activities will have an effect on the physical quality of the meat [5].

Meat is food that has the potential danger of biological, physical and chemical [6]. The meat should be secure and independent Studio hazardous materials. Biological impurities can be caused by microorganisms. The growth of microorganisms in meat can lead to physical or chemical changes, so the meat is not feasible it is consumed. Microorganisms that grow on the meat can come from a period during the maintenance. Livestock management will determine the quality of livestock products [7]. High density enclosures will result in excreta that can contaminate chicken and feathers live through...
high levels of ammonia. Maintenance of broiler chickens with good cage management is expected to be able to produce good quality meat. Cages that are too dense cause chickens to be uncomfortable and increase competition in getting feed, drinking water and oxygen, causing fights and stress. Competition is one factor that result in low carcass quality.

Based on this, research need to be done to determine the quality of broiler chicken meat that is maintained at different cage densities. The purpose of the research was done to identify cage density and its effect on meat quality. Provide information on density optimum enclosure to produce quality meat is good.

2. Materials and methods

2.1. Research methods
The research was conducted at Experimental Stations and at Basic Science Laboratory Faculty of Agriculture, Warmadewa University. The location on Tanjung Bungkak, Sumerta, Denpasar. Time research begins in May until December 2017. Research using Random Design complete with 3 treatments and 3 replicates at each treatment, each replay contains 3 chickens. The treatments in the study were 8, 10 and 12 tails per square meter enclosure (P1,P2,P3).

2.2. Implementation of the research
Ration and drinking water are given twice a day in \textit{ad-libitum}. Vaccination is done twice, at the age of 4 and 28 days. Chicken is maintained until the age of 5 weeks. Samples cut at the end of the study were one that weighed close to average weight in each experimental unit.

2.3. Variabel observed
Observed variables are Temperature and Humidity in the morning at 07.00, noon at 12.00 and afternoon at 17.00 Middle Indonesia Time, Potential Hydrogen (pH), Water Holding Capacity [8], Shrink Cooking and Total Microbial (TPC) [9]. The results of microbial total analysis compared to the Indonesia National Standard (SNI 3924:2006) with a maximum limit of impurities 1x10^6 cfu/g.

3. Results and discussion
Different cage density had no effect (P>0.05) against temperature and humidity of the enclosure as well as on the physical quality of broiler chicken meat which consists of water holding capacity, pH, shrink cooking and total microbial.

3.1. Temperature and humidity
Temperature and humidity in the cage are very important for livestock comfort and function of physiological processes [10]. In table 1 shows daily temperature and humidity average is 27.20°C and 80.52% in the morning, 32.95°C and 67.63% during the day, and 29.30°C and 75.15% in the afternoon. Results of the study illustrates, when temperature increases it will be followed by a decrease in humidity. Temperature and humidity within the enclosure of the research was still able to tolerate by the body of the chicken, although during the day there is a trend of rising temperature on density enclosure 12 chickens/m^2. Chickens do not have difficulty in disposing of her body heat to the outside environment. The higher the density of the cage was getting a lot of heat and water vapor are released into the enclosure environment enclosure [11]. According to Adiwinarto on the environmental temperature over 34°C, chickens have difficulty in disposing of the heat especially when accompanied by high humidity [12].
Table 1. The average temperature and humidity at different cages densities.

| Density     | Morning          | Noontime         | Afternoon         |
|-------------|------------------|------------------|-------------------|
| 8 chicken/m²| 27.14/80.11 a    | 32.32/67.22 a    | 29.00/79.00 *     |
| 10 chicken/m²| 27.22/80.67 a   | 32.53/67.67 a    | 29.17/74.22 a     |
| 12 chicken/m²| 27.23/80.78 a   | 34.17/68.00 a    | 29.74/74.23 a     |

*) The same letter in the same column signifies different is not real (P>0.05).

Linkages can be explained temperature and humidity, the higher the effective temperature humidity felt cock getting high too. Instead, the chicken will experience temperatures colder than the temperature of the environment, when humidity is low.

3.2. Potential hydrogen (pH)
Potential hydrogen (pH) measurement is aimed at knowing the basicity and acidity on food products. Meat pH conditions effect on the structure of development and solvency of the protein, the protein will condition the water holding capacity, the "juiciness" emulsion, power, ability to form gels, violence, color and shelf life. Maintenance of the enclosure with a density of broiler chickens is different, does not affect the pH value of meat (P>0.05). The range of the pH value of the study was 5.8 to 5.93 (still in the normal range) can be seen in Table 2.

The average value of the final pH of chicken meat range from 5.4 to 6.0 [5]. The normal pH value of broiler chicken meat between 5.96 up 6.07 [13]. The pH value can indicate deviations of quality meat as it pertains to the connective power of the water and save time. Meat with low pH (pH 5.1 to 6.1) are preferred to maintain the quality of the meat [14].

3.3. Water holding capacity
Average of water holding capacity on research is still classified as normal between 23.29% up 36.19% (Table 2). Statistical tests show that the density of a different cage on maintenance of chicken broiler until the age of 5 weeks had no effect against the binding of water resource of flesh (p>0.05) as shown in Table 2. According to Alvarado and McKee power tie chicken broiler water age 6-7 weeks about 22.19 up 28.54 [15].

Table 2. Physical quality of broiler chicken age 5 weeks at different density.

| Density     | Variable          |
|-------------|-------------------|
|             | pH    | Water holding capacity (%) | Shrink cook (%) | TPC |
| 8 chicken / m²| 5.85 a | 36.19 a | 31.01 a | 2.0 x 10⁵ a* |
| 10 chicken / m²| 5.92 a | 26.58 a | 34.58 a | 7.4 x 10⁴ a   |
| 12 chicken / m²| 5.93 a | 23.29 a | 31.77 a | 7.7 x 10⁴ a   |

*) The same letter in the same column signifies different is not real (P>0.05).

The ability of meat to retain water is influenced by several factors, among others, pH [16]. Water holding capacity or water that is stuck inside the muscle increased in line with the rise in pH [17]. Hartono et al. states that the binding power of the water is also affected by the pH of the meat. The high of pH value can improve water binding power [18]. On the contrary, the low pH value of meat causes the structure of the meat to open, thereby reducing the binding power of the water.

3.4. Shrink cook
Shrink cook meat is one of the determinant of the quality of the meat that is important, because it is related to the amount of water lost as well as nutrients that dissolve in water due to the influence of
ripening. The value of reduced cook's research is not affected by the difference in density of the enclosure (P>0.05) reduced values, the range of research still includes normal cookware, namely 31.10% up 34.58% with an average of 32.45% can be seen in Table 2.

Cooking losses are related to the binding power of the water and the pH of the study. Water holding capacity has a positive relationship with the pH value of the meat and the percentage of shrinkage. It is supported by Alvarado and McKee that, cook also influenced by reduced pH [15].

3.5. Total Plate Count (TPC)
The results of the research in Table 2, the range of total microbial meat 7.4 x 10^4 to 2.0 x 10^5 CFU/g. This shows chicken broiler 5 weeks being maintained on a different enclosure, density. The microbial content does not exceed the maximum limit of microbial impurities 1 x 10^6 CFU/g, as defined by the National Standardization Agency [19]. Microbial contamination of meat destroyer generally starts from the moment the maintenance, through water, air or skin contact with excreta, then contamination may occur when cutting cattle to consumption. On the research of microbial contamination, can be minimized, at the time of maintenance due to the condition of the base enclosure does not tarnish due to the maintenance of good governance.

The body temperature, pH and stress at the moment is the observance of the internal factors that influence colonization of microbes [20]. The pH of the meat has a positive relationship with the growth of bacteria, the higher the pH of the meat will be followed an increase in the total bacterial colonies.

4. Conclusions
Difference of cage density 8, 10 and 12 tail per square meter cages in the maintenance of broiler chickens up to the age of 5 weeks, does not affect the quality of the broiler chicken meat so that it can be classified standard. Maintenance of broiler chicken with a density of the cage 12 tail per square meter can be recommended without reducing the quality of meat.

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