

# BIOTECHNOLOGY IN ANIMAL HUSBANDRY

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# THE EFFECT OF TRANSPORTATION ON BROILER MEAT pH AND TENDERNESS

H. A.W. Lengkey<sup>1</sup>, J. A. Siwi<sup>1</sup>, P. Edianingsih<sup>1</sup>, F. J. Nangoy<sup>2</sup>

<sup>1</sup> Universitas Padjadjaran, Bandung, Indonesia

<sup>2</sup> Universitas Sam Ratulangi, Manado, Indonesia

Corresponding author : lengkeyhendronoto@gmail.com

Original scientific paper

**Abstract :** 180 broilers, five weeks old broilers were used to asses the effect of transportation on broiler meat pH and tenderness, has been carried in Bandung, Indonesia. Using Completely Randomized Design (CRD), with five levels (P-0 slaughter at the farm, P-1 one hour transportation before slaughter, P-2 two hours transportation before slaughter, P-3 three hours transportation before slaughter, and P-4 four hours transportation before slaughter) and four times replications. Results indicated the meat pH are between 6.33 – 6.63. Even the result shows that the pH values increase when the transportation time more longer, but this results are between the normal meat pH (between 5.2 – 6.6). The meat tenderness were between 124.75 – 176.50 mm/g/10 sec. The meat tenderness was decreased when the transportation was prolonged.

**Key words:** broiler meat pH, tenderness, transportation.

## Introduction

A substantial amount of research about the factors influencing the sensory quality of meat. Sometimes there are relationships between ultimate pH, and sensory traits of meat (tenderness, juiciness, and flavor), but increasing ultimate pH was shown to have detrimental effects on color. Therefore, pre-slaughter conditions which affect muscle glycogen level at slaughter and subsequent ultimate pH, could affect the sensory quality of meat. This study was designed to evaluate the possibility of controlling the sensory quality of meat by varying the transportation of broiler.

Handling and transportation, besides improving the animal productivity also will improve the meat quality. Losses during handling and transport will cause losses to the meat industry. Because of the rough handling and transportation will cause stress and the meat quality will affected, that induced some problems, such as dark cutters, carcass shrinkage, even the death losses and morbidity in the long

distance rough transportation. Meat quality defects will affect the marketing of the meat. Losses during handling and transport are due to bruises, dark cutters, death and pale soft exudatives (PSE).

Transport may involve individual and large groups animals. During transportation, animals interact with the physical facilities around them, and the biotic environment which consists of both conspecifics and stockpersons (*Gonyou, 1993*). Loading poultry onto transport vehicle, movement is accomplished by more attractive route, and also by providing more space, better lighting, or some feature that involve individual. The response of animals to handling and transport depends on their sensory capabilities (*Kilgour and Dalton, 1984*). Broilers are reared in large group in environmentally controlled, and then transported from growing sites to the slaughter plant.

Rearing conditions has significant effect on quality of carcass; also for size and conformation of carcass, problems with legs, skin damages, the parameters of carcass quality (*Škrbić, et. al. 2009*). Fresh meat must look good to the consumer, when selecting meat for purchase. Therefore color and textural characteristics are critical important, the most typical color of poultry meat, is gray-white to dull red. Some of the loss of protein hydration caused by pH decline and rigor mortis is recovered during subsequent storage of meat. Lowering of muscle pH due to the accumulation of lactic acid is one of the most significant postmortem changes. Tenderness, juiciness, color and flavor may be influenced by changes occurring during conversion of muscle to meat. Carcass that have rapid pH decline, are often results in the stress animal, that are fatigue, excitement, restraint and shock; and are slaughtered before have sufficient time to replenished the muscle glycogen stores, will results in a high ultimate pH (*Aberle, et al, 2001*). Several steps in the marketing process, loading onto trucks, transportation, have severity of effects on the meat quality. The negative attributes of high temperature-low pH combinations are associated with improvements in meat tenderness. Ante- and pre-slaughter stresses influence the quality of poultry meat. Transport for up to six hours, did not significantly influence the tenderness of chicken breast and thigh meat. However, birds in crates on waiting lorries may be subjected to temperatures 10 to 12°C higher than ambient in warm climates area, showed the toughness of breast meat increased in heat-stressed birds (*Froning et al. 1978; Gschwindt and Ehinger, 1978; and Ehinger and Gschwindt, 1981 in Cross and Overby, 1988*).

Transportation of poultry is a complicated multifactorial stressful and traumatic event and in order to understand its impact on the bird, stress must be well defined and understood (*Elrom, 2000*). Transportation is considered a major stressor for farm animals and might have deleterious effects on health, well-being, performance, and ultimately, product quality. Livestock are transported by land, sea and air. During transport, animals are exposed to environmental stresses including heat, cold, humidity, noise, motion and social regrouping. Transportation involves a series of handling and confinement situations (*Tarrant and Grandin,*

2000). When consumers assess meat quality, most rank tenderness before juiciness and flavor. In carcass, muscle pH and color are indicators of tenderness. Water holding capacity and keeping quality are related to pH (*Wythes, et al., 1982*). When the physical stresses associated with transportation can have important effect on meat quality.

The objectives of this research are to find the effect of transportation on broiler meat pH and tenderness.

## Materials and Methods

180 broilers were used for this study, using Completely Randomized Design (CRD), with five levels (P-0 slaughter at the farm, P-1 one hour transportation before slaughter, P-2 two hours transportation, P-3 three hours, and P-4 four hours transportation) and four times replications. The broiler were transported in the crate 100cm x 60cm x 30cm (l x w x h), and in each crate for 18 broilers. The broilers were transported in the car, and the speed average is 50-60 km/hr; transported to the slaughterhouse for 1 hours, 2 hours, 3 hours and 4 hours. This treatment was four time replicates. P-0, the broilers was slaughter at the farm, P-1 was slaughter after one hours transportation, P-2 after 2 hours transportation, P-3 after 3 hours transportation, and P-4 after 4 hours transportation. And then muscle pH and the meat tenderness was checked. Sensory analysis was carried out on samples cooked in the pan at a temperature of 70°C. Tenderness were scored using Universal penetrometer 1/10 TH MM DV. The meat pH used Jenway pH meter type 3310.

## Results and Discussion

### Broiler Meat pH

**Table 1. Broiler meat pH after transportation**

	P-0	P-1	P-2	P-3	P-4
I	6.36	6.36	6.54	6.25	6.70
II	6.40	6.40	6.63	6.50	6.58
III	6.26	6.24	6.51	6.64	6.64
IV	6.30	6.56	6.20	6.73	6.60
Total	25.32	25.56	25.88	26.12	26.52
Average	6.33	6.39	6.47	6.53	6.63

From Table 1, the meat pH are between 6.33 – 6.63. The normal meat pH values are between 5.2 – 6.6; so these results are between the normal meat pH. Even the result shows that the pH values increase when the transportation time is

longer. The environmental stress factor can result in changes in the metabolites of muscle. Transportation of poultry marketing can be one of the most severe segments of the process. Muscle tissue shrinkage and reduction of dressed carcass weight can result from uncomfortable or prolonged transportation. These changes in turn, are responsible for differences in the ultimate properties of meat. Many related changes in meat quality and product performance result from alterations in tissue pH. Resting animals before slaughter allows them to recover from the journey, adapt to the surroundings and replenish muscle glycogen concentrations. Rest usually reduces pH values in sheep and beef carcasses (*Shorthose, 1977 in Wythes et al, 1982*). High pH values can occur, if animals do not rest adequately because of noise, abattoir activities and other disturbances. With careful attention to handling and transport, producers should be able to sell the maximum weight of bruise-free, tender meat. The changes of meat color, depends on the meat pH. In carcasses, muscle pH and color are indicators of tenderness. Water holding capacity and keeping quality are related to pH. An increase or decrease of the pH, will increase the intensity of the color changing when the meat was cooked. (*Wythes, et al., 1982*).

### Broiler Meat Tenderness

**Table 2. The effect of treatment on tenderness (mm/g/10sec)**

	P-0	P-1	P-2	P-3	P-4
I	180	163	128	142	121
II	171	169	150	129	134
III	189	152	142	123	120
IV	166	147	151	129	124
Total	706	631	571	523	499
Average	176.50	157.75	142.75	130.75	124.75

From Table 2, the meat tenderness was between 124.75 – 176.50 mm/g/10 sec. The meat tenderness was decreased when the transportation was prolonged. When the broiler was slaughter at the farm, the tenderness are higher (176.50 mm/g/10 sec), and then gradually decrease as the transportation was prolonged. The broiler that transported for 4 hours, the meat tenderness was 124.75 mm/g/10sec. The skill of driver and the quality of the road appear to be more important in determining transport stress and losses value than the distance traveled (*Tarrant and Grandin, 2000, in Smith, et al. 2004*).

Tenderness of meat is distinctly important to the consumer, and many factors influence tenderness. It is known and widely recognized that meats may vary greatly in tenderness. Tenderness of broilers is rarely a problem because they are young when slaughtered. Rough transportation is detrimental to meat quality. Of the various attribute (tenderness, juiciness and chewiness), which contribute to



the texture of poultry meat, tenderness has attracted the most attention to the consumers. Processing factors might thus be expected to play an important role in influencing meat tenderness. When arrived at the slaughterhouse in an exhausted state which could be related to fatigue, after long transportation. After 4 hours journey, the broiler were more fatigue than the broiler were not transported. That is why, the broilers transported for 1 hours will decrease the tenderness compared to the broilers that was slaughter at the farm. As the transportation was prolonged, then the tenderness was decreased. Tenderness score in calves was lower in calves transported for 11h than for 1 h (*Fernandez, et. al., 1996*). According to *Nicol and Saville-Weeks (1993)*, the improving of handling and transportation will increase the tenderness of the poultry meat, because the poultry were less stressful. Improvements in welfare during handling and transport procedures will improve and reduce losses associated with poor carcass quality (*Eldridge et al., 1982*).

## Conclusion

Careful transportation, with good maintenance of handling and transport facilities in all parts of the harvesting chain will significantly reduce the level of bruising and improve meat quality. Improving the transport system, e.g. need better vehicles and careful transportation system, will improve the meat quality since birds have to travel for longer distance.

## Uticaj transporta na pH i mekoću mesa brojlera

*H. A.W. Lengkey, J. A. Siwi, P. Edianingsih, F. J. Nangoy*

## Rezime

180 brojlera, uzrasta pet nedelja, su korišćeni u oceni uticaj transporta na pH i mekoću mesa brojlera, urađena je u Bandungu, Indonezija. Koristeći potpuno slučajni dizajn ogleda (Completely Randomized Design - CRD), sa pet nivoa (P-0 klanje na farmi, P-1 sat transporta pre klanja, P-2 dva sata transporta pre klanja, P-3 tri sata transporta pre klanja, i P-4 četiri sata transporta pre klanja), i četiri ponavljanja. Rezultati pokazuju pH mesa između 6.33 – 6.63. Rezultati takođe pokazuju da se pH vrednosti povećavaju kada prevoz traje duže vreme, ali to su rezultati između normalne vrednosti pH mesa (pH između 5.2 – 6.6). Vrednosti za mekoću mesa su između 124.75 - 176.50 mm/g/10 sec. Vrednosti za mekoću mesa se smanjuju sa povećanjem dužine transporta.

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