PHYSICAL CHARACTERISTIC CHANGE DUE TO DIFFERENCE OF AGE, MUSCLE TYPE, COOKING TIME AND TEMPERATURE COMBINATION IN NATIVE CHICKEN MEAT

PERUBAHAN KARAKTERISTIK FISIK AKIBAT PERBEDAAN UMUR, MACAM OTOT, WAKTU DAN TEMPERATUR PEREBUSAN PADA DAGING AYAM KAMPUNG

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ABSTRAK

Penelitian bertujuan untuk mengetahui karakteristik fisik daging ayam kampung akibat perbedaan umur, macam otot, kombinasi waktu dan temperatur perebusan. Penelitian dilakukan dalam 3 tahap yaitu tahap survei, pemeliharaan ayam dan uji kualitas fisik daging. Dua puluh ekor ayam jantan kampung masing-masing terdiri dari 10 ekor ayam kampung umur 3 bulan dan 6 bulan diproses menjadi karkas. Karkas dibelah dua dan diambil sampel daging dari bagian dada (*Pectoralis superficialis*) dan bagian paha (*Biceps femoris*), masing-masing belahan dada dan paha dipotong menjadi 5 bagian (mentah, 80°C: 30 menit; 80° C:60 menit, 90°C; 30 menit, dan 90°C; 60 menit). Variabel yang diamati pH, daya ikat air, susut masak dan keempukan daging. Pengaruh perbedaan umur, macam otot, kombinasi waktu dan temperatur perebusan dianalisis dengan rancangan acak lengkap pola faktorial 2 x 2 x 5. Hasil penelitian menunjukkan bahwa umur, macam otot, kombinasi waktu dan temperatur perebusan yang berbeda berpengaruh terhadap perubahan karakteristik fisik daging ayam kampung. Terdapat interaksi diantara ketiga faktor pH, daya ikat air, susut masak dan keempukan daging. Daya ikat air dan pH meningkat dengan bertambahnya umur, sedangkan susut masak dan keempukan daging mengalami penurunan. Otot dada memiliki pH, daya ikat air dan susut masak yang lebih rendah dan keempukan daging yang tinggi daripada otot paha. Waktu perebusan yang lama pada temperatur tinggi menyebabkan menurunnya pH dan susut masak serta meningkatnya daya ikat air dan keempukan daging.

Kata kunci: ayam kampung, umur, macam otot, waktu dan temperatur perebusan, karakteristik fisik daging

ABSTRACT

The study was conducted to investigate physical characteristic changea due to differences of age, muscle type, cooking time and temperature combination in native chicken meat. Twenty male native chickens were used (10 chickens of 3 months and 10 chickens of 6 months old). The chickens were processed into carcasses. All carcasses were split into two sides, *i.e.* breast (*Pectoralis superficialis*) muscle and thigh (*Biceps femoris*) muscle. Each muscle was cut into 5 combination of tretments : fresh; 80°C, 30 minutes cooking; 80°C, 60 minutes cooking, 90°C, 30 minutes cooking and 90°C, 60 minutes cooking, respectively. The physical characteristic changes of meat were focused on pH, water-holding capacity, cooking loss and tenderness. The treatment effect of different ages, muscle type, cooking time and temperature combination were analysed by 2 x 2 x 5 factorial of analysis of variance. The results indicated that chicken age, muscle type, cooking time and temperature combination affected significantly on physical property of native chicken meat. There were interactions between three factors of treatment on pH, water-holding capacity, cooking loss and meat tendeness. Increasing age of chicken enhanced the pH and water-holding capacity of meat significantly, however, it descreased cooking loss and meat tenderness. The breast muscle has higher pH, water-holding capacity and cooking loss, and has lower meat tenderness than those of thigh muscle. The increasing time of cooking, decreased pH, and cooking loss significantly occured at the high temperature. The increasing time of cooking enhanced water-holding capacity and meat tenderness.

Key words: native chicken meat, age, muscle type, cooking time and temperature, physical characteristic.

INTRODUCTION

Native Chicken is a fowl species that are widely farmed by many rural communities; it is a potential source of animal protein. Along with public awareness about the importance of nutrition, in order to meet these needs must be balanced with adequate compliance and the meat quality. Many factors can affect the meat quality, either physical or chemical qualities. These factors include age, muscle type and cooking method (Lawrie, 1979; Swatland, 1984; Soeparno, 1990).

Native chicken is one potential source of meat protein as a source of complete protein. Chicken is superior in terms of resistance to disease, poor environmental conditions, maintenance requirements that do not require the heavy, slow growth, low egg production and meat (Buckle *et al.*, 1978). According Sarengat (1980) and Kingston (1979) is one of the native chicken breeds are included in the Phylum Chordata, Class Aves, Subclass Neornithes, the Sub-family Phasianinae, genus *Gallus, Gallus* varius Species, *Gallus Gallus*, *Gallus Gallus lavayetti* and *sonnerati.*

According Setiyono (1987), the chemical composition has a close relationship with physical meat quality of the meat. It was argued further that the variation the largest meat component on the amount of fat. Fat meat has been recognized as the physical the meat quality varies component so much determined by fat content. In addition, the protein is the meat tissue arrangement has a very large role to changes meat characteristics value. Kinds of muscles associated with the amount of connective tissue and muscle function that may differ in producing lactic acid. Both of these will affect the pH, water binding capacity, cooking losses and tenderness of meat (Bouton *et al.*, 1971; Lawrie, 1979). Cooking has effect to changes chemical composition and physical characteristics of beef showed that cooking can alter the chemical composition meat, which is protein. Length of cooking affects the solubility of collagen, while the temperature influences the strength miofibrilar.

The structure of meat proteins changed by heat will affect pH value, water binding capacity, cooking losses and tenderness of meat depending on time and temperature cooking (Soeparno, 1990; 1992 a). Period of cooking in a water bath varied from 30 minutes to 24 hours. Cooking temperatures also vary from 45 to 90°C, 80°C temperature is the ideal temperature for cooking meat (Soeparno, 1994).

The study aimed to determine physical characteristics of chicken meat due to the effect of cattle age difference (in accordance with market conditions), muscle types, the combination of time and by testing the boiling temperature, pH, water binding capacity, cooking losses and tenderness of meat. In addition the study also to test the interaction effect of differences in age, muscles type, boiling time and temperature combinations to change the physical characteristics of the native chicken meat.

MATERIALS AND METHODS

This study uses native chicken males aged 3 and 6 months of maintenance and know how their origins. The average weight range chicken age 3 months and 6 months respectively, are 630.95 and 907.21 grams.

Chemicals used in this study are the ingredients for proximate analysis (moisture, protein, fat and ash) and histological preparation. Other ingredients are chicken feed in the form BR I, BR II, maize and rice bran.

Equipment used for the treatment of water-bath and thermometer as well as equipment for the proximate analysis (moisture, protein, fat and ash), collagen, and histological preparation of meat.

The methods of data acquisition was done by interview with chicken seller in the stalls and restaurants are using questionnaire tools, while sampling was conducted by "purposive sampling" (Mantra and Kasto, 1982) to cook the chicken seller who has a lot of people have sympathizers Magelang city area and surrounding areas. Locations of fried chicken restaurants are performed at fried chicken restaurant Bu Tatik, Panjiwo and Mbok Sabar. Then evaluate interview to determine the age range chicken that will be used as research material and to determine cooking method by referring to previous studies.

Maintenance native chicken is until age 6 months. Cutting the chicken is done in 2 stages in age 3 months and 6 months. Before cutting, weighing is done to determine live weight of each chicken. There are 20 male chicken tail of each 10 chicken for 3 months and 6 months, cutted become carcass (Wihandoyo, *et al.*, 1981). Carcass is split into two and taken samples of meat from the breast and thigh muscle which consists of pectoralis superficialis and Biceps fermoris each 10 sample as a replication to physical quality test of meat as the main data and chemical composition test and histology performed 3 meats as supporting data replication. From 10 cleavage and thighs are 10 parts, each half cut into 5 parts (raw, 80°C: 30 minutes, 60 minutes, 90°C, 30 min, and 90°C; 60 minutes).

Sample boiling method includes the steps carried out as follows: the samples for testing objectively weighed boiling, put into polyethylene plastic bags are clipped tightly around the sample. Samples then cooked by dipping the whole in a water bath at boiling temperature and duration of the controlled (in accordance with the treatment). Boiled samples shaped rectangular blocks weighing approximately 50 grams. Boiling was carried out at 80 and 90°C respectively for 30 and 60 minutes. After boiling over, plastic bags and samples taken from water bath and cooled in flowing water at room temperature. Cook dried meat sample surface with blotting paper without the pressure and weighed again to determine cooking loss. Then cook the meat samples stored overnight for testing the next objective.

RESULTS AND DISCUSSION

Results showed that the pH value and water binding capacity increased with increasing age of cattle, while the shrinkage value and tenderness cook meat decreased. pH value, water binding capacity, shrinkage and tenderness of meat cooked chicken 3 months in a row is 5.92; 27.10%, 16.12%, and 0.76 kg/cm2. Muscle types also influence changes the physical characteristics of meat value.

pH value, water binding capacity and cooking losses and lower chest muscle tenderness higher than thigh muscle. pH value, water binding capacity and shrinkage of muscle tenderness and cook san chest

respectively 5.75, 28.75%, 12.90%, 0.65 kg/cm2. The value of the physical characteristics of meat have caused temperature change combination treatment and boiling time at 80°C to 90°C and duration 30 to 60 minutes, causing increase pH value and shrinkage of cooked meat tenderness, whereas the water binding capacity decreased. PH value at the boiling 80°C, 30 minutes, 80°C, 60 minutes, 90°C, 30 minutes, 90°C, 60 minutes in a row is 5.9; 6.08, 5.99 and 6.06. Score tied power in boiling water 800C, 30 minutes, 800C, 60 minutes, 90°C, 30 minutes, 90°C, 60 minutes in a row is 29.51, 29.36, 18.55 and 27.71%.

Table 1. Water Levels at Muscle Chest and Thigh Meat Native Chicken Age 3 and 6 Months boiled at Temperature 80 and 90°C with Boiling 30 and 60 minutes (%)

Age (month)	Muscle Characteristic	Raw and Cooked Meat					Mean
		Raw	80°C,30	80°C,60	90°C,30	90°C,60	
3	Breast	73,54	65,5	67,27	60,74	66,81	
	Thigh	74,32	66,7	66,01	61,42	66,89	66,92[f]
6	Breast	71,45	62,94	63,92	62,89	65,56	
	Thigh	72,44	62,77	61,15	60,8	62,93	64,69[e]
	Mean	72,94[d]	64,48[b]	64,59[bc]	61,46[a]	65,55[c]	

Breast Meat Mean : 65,55[ns]
Thigh Meat Mean : 66,06[ns]

Ns : Not significantly different
a, b,c, d, : Values in the same row with different superscript, differ significantly (P <0.01).
e, f : Values in the same row with different superscript, differ significantly (P <0.01). The interaction was not significantly different.

Cook in boiling water shrinkage value of 80°C, 30 minutes, 80°C, 60 minutes, 90°C, 30 minutes, 90°C, 60 minutes respectively were 15.34, 11.86, 20.16 and 21.28%. While the value of beef tenderness on boiling 80°C, 30 minutes, 80°C, 60 minutes, 90°C, 30 minutes, 90°C, 60 min are respectively 0.67, 0.75, 0.72 and 0.83 kg/cm2.

The water content of chicken meat age 3 months is higher than chicken meat age 6 months. The results are consistent with the opinion Soeparno (1990) which states that muscles of young cattle have a relatively high water content and decreases with increasing maturity. As a result the protein concentration increases with maturity. According to Lawrie (1995), along with increasing age, increasing Nasarkoplasma less significant or very little while the water content and the stroma also decline. Fat storage in accordance with the increasing age of cattle was also influenced by water content. There was negative relationship between fat and moisture content, when the fat content increases, water content in carcass will go down. This is in accordance with Lawrie (1979) opinion that the water content in carcass has a negative correlation with fat content and has positive relationship with protein content.

Kinds of muscles have no significant water content, but there is a trend decline in water levels in chest muscles. This is apparently due to the influence of fat storage by muscle that many activities like your thigh muscles. Water content has a negative relationship with fat content (Lawrie, 1979).

The boiling effect of water content were significantly ($P < 0.01$). Boiling can cause shrinkage of meat so much water out of the meat, besides too much water evaporates during boiling. Loss water from raw meat and cooked meat had been followed by decline in the space between groups of muscle fibers and between individual fibers and tendon's diameter depreciation.

Table 2. The Protein Level at Chest Muscle and Thigh Meat Native Chicken Age 3 and 6 Months boiled at Temperature 80 and 90°C With Boiling 30 and 60 minutes (%)

Age (month)	Muscle Charac teristic	Raw and Cooked Meat					Mean
		Raw	80°C,30	80°C,60	90°C,30	90°C,60	
3	Breast	22,05	27,12	25,89	26,43	26,29	
	Thigh	20,06	28,30	29,81	29,31	28,39	$26,36^{ns}$
6	Breast	20,99	25,01	24,81	26,69	25,55	
	Thigh	18,99	23,3	26,60	2,65	25,66	$23,11^{ns}$
	Mean	$20,52^{a}$	$26,02^{b}$	$26,64^{bc}$	$27,02^{c}$	$26,47^{b}$	

Breast Meat Mean : $24,13^{ns}$
Thigh Meat Mean : $25,27^{ns}$

^{Ns} : Not significantly different
^{a,b,c,} : Values in the same row with different superscript, differ significantly ($P < 0.01$).
The interaction was not significantly different

The water loss rate and muscle fibers shrinkage will be faster with preliminary stages of cooked meat from the thigh meat raw and it will continue to run (Daines and Locker, 1974). Boiling temperature water content at 90°C for 30 minutes, significantly different ($P < 0.05$) with water content in the treatment 80°C, 30 min, and 80°C, and 90°C 60 minutes, 60 minutes. Water loss is higher at boiling temperature 90°C for 30 minutes showed that the meat condition was less able to bind water, but the flesh is flesh component changes so that the meat be able to withstand water.

High water binding power was allegedly due to changes in the form of gelatin and gel can hold water. A significant difference in water loss also occurs between the boiling temperatures 80°C for 30 minutes with boiling temperature 90°C for 60 minutes. This indicates that time factor and extreme temperatures affect water content.

Soeparno (1994) states that the collagen in meat miofibril binds together and disintegrated by heat treatment. Boiling meat for 60 minutes at temperature 80°C to degrade collagen which had been experiencing magnitude and shrinkage (Cassens, 1971), and at higher temperatures cause softening of the connective tissue with collagen into gelatin conversion (Lawrie, 1979).

Deatherage and Hamm (1960) suggested that the

conversion of collagen into gelatin at temperature 90°C. Their opinions also in accordance with the fact age 6 months water content is very small increase in moisture chicken meat's content than age 3 months. The content of collagen in the connective tissue of young animals is lower than the older animals (Lawrie, 1995), thus increasing the water content was higher in young chicken.

Research's result on protein content showed that the age, muscle type and their interaction did not affect protein content. Temperature effect on meat protein content is increased very significantly (P <0.01). Meat protein content increased at temperatures up to 90°C boiling for 30 minutes, protein content decreased with an extended boiling time to 60 minutes. The increase in protein content due to the influence of temperature and boiling time is affected by lossing water during boiling. Meat chemical composition may change due to warming (Judge *et al.*, 1989) argues that cooks the meat will have a protein content, fat and ash are higher than fresh meat as a result of lossing fluids lost during cooking.

Meat protein content increased sharply after the boiling temperature 90°C for 30 minutes, this situation has not been anticipated for protein denaturation are perfect, especially against protein types with temperature stable, this is reflected by a low protein content in meat is boiled over much longer till 60 minutes long, which means factors 90°C boiling at temperatures affect the protein content of meat, this situation is presumably related to increased levels of water on these cooking conditions. Amount obtained in the cooking liquid will increase further if the meat is cooked at temperature 107 and 155°C (Lawrie, 1995). This illustrates some protein damage, with amino acid damage that occurs in this temperature range. At temperatures above30% is followed by shrinkage of collagen tissue that contributes to drainage sachoplasm exterior direction of room between muscle fibers (Offer and Trinick, 1983).

Research results showed that age, muscle type, boiling time and temperature significantly affected the fat meat content (P <0.05), while the interaction between three factors showed no significant difference. Fat content of meat chickens aged 3 months and 6 months showed significant differences (P <0.0) at boiling temperature 90°C for 30 minutes.

Similarly, lipid contents in breast and thigh muscles. This difference was expected because the melting fat is blocked by protein associated with lipid particles, this is reflected by high protein content in these conditions. Differences in water content, protein and fat can be caused by differences in energy utilization and muscle function. Activities closely related to the utilization of energy (Mountney, 1976). Muscle is more active; especially thigh contains more fat as an energy source for metabolism. Chest muscles largely composed of white fibers which have physical contractions nature, glycolytic metabolism and glycogen high relatively (Judge *et al.*, 1989).

PH value of chicken meat significantly different from age 3 months with a pH value of chicken meat aged 6 months (P <0.05). Differences in pH, which is higher in chicken meat due to age 6 months, different age cuts can affect muscle glycogen and produce lactic acid

produced in anaerobic glikolisin. According to Soeparno (1994), glycogen reserves in young cattle are lower than older cattle. PH variation posmoren muscle, muscle glycogen reserves, meat ultimate pH, stress before slaughter, giving hormones and certain drugs, the individual animal, kind of muscle, electrical stimulation and enzyme activity. In certain muscle's animals tissue stores glycogen as an energy source. After the animal is cut muscle glycogen will experience glikolisis enzymatically and will produce lactic acid which will cause change meat pH (Forrest *et al.*, 1975). Lactic acid's accumulation will stop after the glycogen reserves become exhausted (Soeparno, 1994). Low muscle glycogen reserves causing anaerobic glycolysis process is limited and resulted in pH decrease is very small because relatively little lactic acid formation (Miller *et al.*, 1963). The mean pH of breast muscle (pectoralis superficialis) and thigh (Biceps femoris) respectively 5.7463 and 6.2051 indicate significant differences ($P < 0.05$). This difference is caused by differences in muscle activity between these muscles; this is associated with glycogen content. Muscle glycogen content and type can affect the pH. Pectoral muscle contains less fat and water, whereas higher protein content. Thigh muscle contains more glycogen is low and they contain more fat as energy sources for metabolism (Judge, 1987; Soeparno, 1992d). Thigh muscles also have a tonic contractile property with a low glycolytic metabolism (Judge, *et al.*, 1989), the solution glikogen also low so that lactic acid formation less than pectoral muscle (Bechtel, 1986). Lactic acid low causing pH increase (Miller *et al.*, 1963), so that breast muscle pH higher than thigh muscle.

pH values showed significant differences exist all treatments boiling. pH value increased with increasing time and temperature boiling ($P < 0.05$). Boiling the meat at temperature 80°C for 30 minutes is to increase raw meat pH by 0.14 units, from boiling for 30 minutes to 60 minutes longer until 0.13 units. Boiling the meat at temperature 90°C for 30 minutes to increase the pH by 0.18 units of raw meat and boiling for 60 minutes increased by 0.07 units. To increase the raw meat pH value with increasing boiling temperature. Boiling at 80°C for 30 minutes to increase the pH of 0.14 units of raw meat, from 80°Cto 90°C increased by 0.04 units. While boiling crude registration at 80°C for 60 minutes to increase the pH of raw meat by 0.27 units, from 80°Cto 90°C decreased 0.02 pH units but not real.

Increasing the pH of meat because of the time and temperature can be caused by boiling liquids lost during boiling meat and is associated with damage proteins structure that can cause a number of asidik groups so that the pH increased lost and the meat becomes less able to bind water. pH increased meat cooked meat is affected by fluid loss and decreasing the water binding by proteins of meat, and the free asidik group loss (Deatherage and Hamm, 1960).

The interaction between age and muscle types showed highly significant differences pH, this means that the effect of the combination of factors is large. The differences are expected because of differences in the rate of postmortem pH decline. Muscle growth is hampered by the limited size of muscle fibers at different ages. This is closely related to lactic acid produced (Soeparno, 1994).

Table 3. pH Level Chest Muscle and Thigh Meat Native Meat Age 3 and 6 Months boiled at Temperature 80 and 90°C With Boiling 30 and 60 Minutes

Age (month)	Muscle Charac teristic	Raw and Cooked Meat					Mean
		Raw	80°C,30	80°C,60	90°C,30	90°C,60	
3	Breast	5,66	5,57	6,08	5,87	5,82	
	Thigh	5,95	6,30	6,34	6,42	6,14	$5,38^{e}$
6	Breast	5,64	5,48	5,64	5,49	6,28	
	Thigh	5,97	6,23	6,26	6,18	6,03	$5,92^{f}$
	Mean	$5,81^{a}$	$5,89^{b}$	$6,08^{d}$	$5,99^{c}$	$6,07^{d}$	

Breast Meat Mean : $5,73^{h}$
Thigh Meat Mean : $5,57^{g}$

^{a,b,c,d} : Values in the same row with different superscript, differ significantly ($P<0.01$).
^{e,f,g,h} : Values in the same row with different superscript, differ significantly ($P<0.01$).
The interaction was not significantly different

The interaction between age and boiling it shows a very real difference to pH. This is closely related with occurrence chemical changes in meat proteins because of poaching. The loss due to boiling asidik group will determine the increase in pH of cooked meat (Deatherage and Hamm, 1960).

Differences age determine the fat content that have a negative relationship with protein. The old cattle contain more fat and water and lower protein content than young cattle (Soeparno, 1992c; Wismer -Pederson, 1971).

The interaction between age, muscle type and boiling it shows that pH is a very real difference between muscles may depend on age and poaching level. In this research cooked meat pH between boiling temperature and time combinations, showing a highly significant difference in linear and quadratic. Increased protein denaturation at high temperature, this is reflected by the low water binding capacity at this temperature. Reduced power due to boiling water binding is associated with the asidik group (Lawrie, 1979). The loss due to boiling asidik group will determine increasing cooked meat pH (Hamm, 1964). Decrease in pH approximately 5.4 to 5.5 or lower mean isoelectric point of myosin has been achieved. With the achievement of this isoelectric point there will be meat and protein fibrils shrinkage will lose ability to bind water and meat into a loose structure (Soeparno, 1994). The increase in meat pH can also occur due to boiling relatively long. The increase in pH due to long boiling occurs due to chemical changes in meat proportion and meat loss the fluids (Judge *et al.*, 1989).

Power bind influenced strongly by water rate and decrease in pH, whereas pH changes associated with changes in the microstructure of meat including contraction when cattle are still alive (Lawrie, 1979; Soeparno, 1990). Increasing age may increase the proportion of dry matter and lower water (Thillman et al., 1984). The proportion of dry meat that most dominated by proteins, whereas meat protein associated with the bound water content in it so that the water content also increased (Soeparno, 1992d).

Table 4. The value of Tie Water Resources at Muscle Chest and Thigh Meat Native Chicken Age 3 and 6 Months boiled at Temperature 80 and 90°C With Boiling 30 and 60 Minutes (%)

Age (month)	Muscle Characteristic	Raw and Cooked Meat					Mean
		Raw	80°C,30	80°C,60	90°C,30	90°C,60	
3	Breast	38,29	27,43	24,25	14,22	27,56	
	Thigh	37,60	32,45	36,85	21,57	30,72	26,67[c]
6	Breast	24,23	29,56	24,14	18,03	25,09	
	Thigh	16,33	27,71	32,50	19,53	27,39	25,45[d]
	Mean	29,11[b]	29,29[b]	29,44[b]	20,84[a]	27,69[b]	

Breast Meat Mean : 22,86[e]
Thigh Meat Mean : 29,27[f]

[a,b,c,d,e] : Values in the same row with different superscript, differ significantly (P<0.01).
[c,d,e,f] : Values in the same row with different superscript, differ significantly (P<0.01). The interaction was not significantly different

Water binding power is the ability of meat proteins to tie the water (Soeparno, 1994). Influence of age on water belt is very real. The mean value of tie power chicken age 3 months is greater than 6 months that each as 33.548% and 27.104%.

In this study the water binding capacity is higher at age 3 months might contribute more influenced by fat content. According to Hamm (1964), the fat can be to loosen meat's microstructure, thus giving more opportunities to meat protein for binding water. Results of analysis showed that the fat content of chicken fat on age 3 months higher than 6 months so the power bunch of water on chicken meat age 3 months is greater than the water binding capacity of meat chickens aged 6 months.

Water binding capacity values were significantly different between breast and thigh muscles. The mean value of water binding capacity is lower chest muscle water binding power than the thigh muscle, respectively, are 28.75% and 31.90%.

Differences in activity and protein content between two muscles. Water binding power was influenced by pH, which depends on the species, age and muscle function (Soeparno, 1994). Muscles are often used for events (such as BF) correlated directly with shortening muscle fibers. This shortening of the muscle fibers will decrease the water binding capacity. Pectoral muscle having lower pH and higher protein content of these conditions cause the water binding capacity in muscle is also high. Bacus (1984) says that the water binding capacity is influenced by protein synthesis.

Almost all the water in tendon miofibril and it is tasteless in the space between the filaments of actin and myosin. The size of the space between the filaments has anything to do with pH, length sarkomer, and ionic strength (Offer and Trinick, 1983).

Shrinkage of cooked chicken meat age 3 months was significantly different from the chicken cooking shrinkage age 6 months (P <0.05). Shrinkage of cooked chicken meat age 3 months is higher than the shrinkage of cooked chicken 6 months caused by the fat content is lower than the shrinkage of cooked

chicken 6 months of age. Intramuscular fat meat is inhibiting fluid that comes out during boiling (Soeparno, 1994; Lawrie, 1995; Fletcher and Papinaho, 1996). According to Bouton *et al.* (1978), shrinkage decreases with increasing age of cooking fat.

Length time the boiling temperature 90°C did not affect cooking losses, it is reflected by the value of cooking shrinkage were not significantly different in these treatments but the increase in boiling temperature 80°C to 90°C showed significant differences (P <0.05) on the shrinkage of cooked meat . The length of time affected significantly (P <0.05) on meat boiled with 80°C temperature for 30 minutes and 60 minutes. Improved cooking shrinkage during boiling can be caused by changes in tissue structure and chemistry of meat proteins was mainly damage for proteins and sacoplasm miofibril, because long boiling will reduce the influence of muscle fiber length and shrinkage miofibril protein that forces the liquid freed meat (Bouton *et al.*, 1976; Soeparno, 1990).

Long cooking at temperature 90°C boiling will reduce the long muscle fibers (Soeparno, 1994), and decreased muscle fibers length will increase the shrinkage cooking (Bouton *et al* (1976) and Daines and Locker (1974) suggests that shrinkage is a function of cooking boiling temperature and time, and influenced by pH, the muscle fibers sarcomer long, piece of muscle fibers, miofibril contraction status, size and weight of meat samples and meat transection.

Tabel 5. Chest Muscle and Thigh Meat Loss Value for Native Chicken Age 3 and 6 Months boiled at Temperature 80 and 90°C with Boiling Time 60 Minutes (%)

Age (month)	Muscle Characteristic	Raw and Cooked Meat				Mean
		80°C,30	80°C,60	90°C,30	90°C,60	
3	Breast	18,57	10,76	22,57	30,06	
	Thigh	14,66	18,17	26,52	29,96	$17,13^{e}$
6	Breast	10,54	9,72	18,04	11,96	
	Thigh	17,82	18,28	13,51	13,15	$11,30^{d}$
	Mean	$15,40^{b}$	$14,23^{a}$	$20,16^{c}$	$21,28^{c}$	

Breast Meat Mean : $13,22^{f}$
Thigh Meat Mean : $15,21^{g}$

a,b,c,d,e : Values in the same row with different superscript, differ significantly (P<0.01).
d,e,atau f,g : Values in the same row with different superscript, differ significantly (P<0.01). The interaction was not significantly different

Bouton *et al.* (1971) and Deatherage and Hamm (1964) showed that meat boiled at temperature 80°Cand 270°C during 90 minutes of cooking experience shrinkage as 43.4% and 44.9%.

Tenderness of meat aged 3 months was not significantly different from chicken meat tenderness age 6 months due to accumulation of fat in meat chickens aged 3 and 6 months were similar. The value of chicken meat tenderness test the age of 3 months is lower than native chicken mean age of 6

months, meat age 3 months more tender than chicken meat 6 months because of connective tissue of young animals contain reticuline and crosslinking lower than older cattle. Meat tenderness and a lot of meat is determined by three components namely miofibril structure and contractions, connective tissue content and cross ties level, and the water power by protein binding of meat (Bouton *et al.*, 1971).

The effect of muscle kind of tenderness showed significant differences ($P < 0.05$). Tenderness and chest muscles (pectoralis superficialis) higher than thigh muscles (bicep femoris) because chest muscles are passive muscles, connective tissues contain less fat and more. Meat tenderness varies between muscles (Fletcher and Smith, 1992), muscles with larger miofibrilar structure and contain more connective tissue will be relatively more difficult. More thigh muscle movement still alive at that time, it shall contain more connective tissue and has a structure which is higher, so miofibrilar thigh muscle is more difficult than the chest muscles (Bouton and Harris, 1972). Tendon which is not used will atrophy physiologic. Histologically, there was reduction in the average diameter of tendon fibers. This reflects increase in the number of tendon with large diameter so that the texture becomes coarse. The rough texture will tend to the tendon cause to be more clay (Deatherage and Hamm, 1960). Beef elasticity is also determined by its fat. During growth, fat deposition occurred between muscles (inter-musculair), skin layer and between muscle fibers. Accumulation of fat can dissolve collagen so that flesh becomes softer (Carmichael and Lawrie, 1967; Wismer-Pederson, 1971; Swatland, 1984).

Raw meat tenderness showed significant differences with the boiled meat ($P < 0.05$). Boiling temperature significantly affect the tenderness of meat temperature to 90°C for 30 minutes and 60 minutes ($P < 0.05$). Meat tenderness and this increased sharply due to changes in protein structure which is reflected by low meat protein content of meat in boiling water with temperature 90°C for 60 minutes.

Histological meat picture showed that collagen does not appear to blend or a sharp increase compared with raw meat and meat is boiled at temperature 80°C. Meat tenderness due to changes meat proteins, miofibril allegedly have been damaged. Bouton and Harris (1972) also noted that cooking time affect softening of collagen, whereas the temperature boiling over to affect miofibril's texture. Boiling will cause changes in connective tissue meat's structure is more tender the meat will be the conversion of collagen into gelatin. Boiling at temperature 58°C relatively increased slowly meat tenderness. Increase temperature to 64°C collagen shrinkage reaction becomes faster and to maintain the elasticity can be done by extending the heating time.

At temperatures higher than 74°C shrink the collagen occurs rapidly and is followed by hardening protein that causes decreased meat tenderness, Bouton *et al.* (1971) and Deatherage and Hamm (1964) showed that meat boiled at temperature 80°Cand 270°C during 90 minutes of cooking experience shrinkage as 43.4% and 44.9%.

Tenderness of meat aged 3 months was not significantly different from chicken meat tenderness age 6 months due to accumulation of fat in meat chickens aged 3 and 6 months were similar. The

value of chicken meat tenderness test the age of 3 months is lower than native chicken mean age of 6 months, meat age 3 months more tender than chicken meat 6 months because of connective tissue of young animals contain reticuline and crosslinking lower than older cattle. Meat tenderness and a lot of meat is determined by three components namely miofibril structure and contractions, connective tissue content and cross ties level, and the water power by protein binding of meat (Bouton *et al.*, 1971).

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Table 6. The value of muscle tenderness at Breast and Thigh Meat Native Chicken Age 3 and 6 Months boiled at temperatures 80 and 90°C with Time Boiling 30 and 60 Minutes (%)

Age (month)	Muscle Characteristic	Raw and Cooked Meat					Mean
		Raw	80°C,30	80°C,60	90°C,30	90°C,60	
3	Breast	0,89	1,28	1,55	1,41	1,51	
	Thigh	1,89	1,68	1,89	1,95	1,86	$1,59^{e}$
6	Breast	1,51	1,61	1,28	1,35	1,61	
	Thigh	1,79	1,85	1,81	1,59	2,08	$1,65^{d}$
	Mean	$11,52^{a}$	$1,61^{b}$	$1,63^{b}$	$1,58^{b}$	$1,77^{c}$	

Breast Meat Mean : $1,40^{d}$
Thigh Meat Mean : $1,84^{e}$

^{a,b,c,d,e} : Values in the same row with different superscript, differ significantly ($P<0.01$).
^{c,d,e,f} : Values in the same row with different superscript, differ significantly ($P<0.01$). The interaction was not significantly different.

But when heating at this temperature continued to increase and eventually gelatin formation would increase tenderness meat. According to Light *et al.*, (1985) and Soeparno (1990) that the meat had collagen shrinkage at temperatures between 60-70°C and becomes soft at temperature 90°C and with a relatively long period of the boiling can increase the tenderness of meat for a longer boiling will cause changes miofibril proteins are more dominant.

Age and muscle types have a significant effect on meat characteristics, interaction between age and muscle types showed significant differences in pH, water binding capacity, and tenderness. Chicken age 6 months has water binding capacity higher than 6 months chicken because higher fat content in chicken age 6 months. Fatty meats can lead to loosening the microstructure of meat more available for water-bound proteins (Hamm, 1964) so that a higher water binding capacity (Soeparno, 1992b). Meat tenderness showed significant differences between chickens aged 3 and 6 months. A native chicken slaughtered at an older age structure has a stronger connective tissue. Völler *et al.*, (1997) states that the denaturation of the triple helical structure of collagen bond can increase the tenderness of chicken meat as well as on the occurrence of protein's denaturation due to heating miofibril meat.

Based on the findings above, the differences in age, muscle types and boiling (boiling temperature and time combination) influence value change in physical characteristics of chicken meat. Interactions between age, muscle type and boiling time and temperature combinations significantly affected pH, cooking losses and tenderness of the meat while the water binding capacity had no significant effect, pH value of chicken breast muscle aged 3 months at boiling 80°C, 30 minutes; 80°C, 60 min, and 90°C, 30 min, and 90°C, 60 minutes, respectively, are 5.75, 6.08, 5.87, and 5.82. pH values of chicken breast muscle aged 6 months at boiling 80°C, 30 min, and 80°C, 60 min, and 90°C, 30 min, and 90°C, 60 minutes, respectively, are 5.48, 5.64, 5.49, 6.03 and 5.66. The value of water binding capacity of chicken breast muscle aged 3 months at

boiling 80°C, 30 min, and 80°C, 60 min, and 90°C, 30 min, and 90°C, 60 minutes, respectively, are 27.43, 24.25, 14.22; and 27.56%. Tie value water resources from chicken breast muscle aged 6 months at boiling 80°C, 30 min, and 800C, 60 min, and 90°C, 30 min, and 90°C, 60 minutes, respectively, are 29.56, 24.14, 18.03; and 25.09%. Shrinkage values of cooked chicken breast muscle aged 3 months at boiling 80°C, 30 min, and 80°C, 60 min, and 90°C, 30 min, and 90°C, 60 minutes, respectively, are 18.57, 10.76, 22.57, and 30 , 06%. Shrinkage values of cooked chicken breast muscle aged 6 months at boiling 80°C, 30 min, and 80°C, 60 min, and 90°C, 30 min, and 90°C, 60 minutes, respectively, are 10.54, 9.27, 18.04; and 11 , 96%. Chest muscle tenderness value of chicken meat at age 3 months boiling 80°C, 30 min, and 80°C, 60 min, and 90°C, 30 min, and 90°C, 60 minutes, respectively, are 1.28, 1.55, 1.41, and 1, 51 kg/cm2. Chest muscle tenderness value of chicken meat at age 6 months boiling 80°C, 30 min, and 80°C, 60 min, and 90°C, 30 min, and 90°C, 60 minutes, respectively, are 1.6, 1.28, 1.35 and 1.61 kg/cm2. Differences pH, water binding capacity and cooking losses between boiling temperature and time combinations were significantly different linear and quadratic. Linearly tenderness of meat was significantly different between time combination and temperature boiling. However, the quadratic is not significantly different. The best physical characteristics for chicken meat age 3 and 6 months performed at temperatures 90°C for 30 minutes.

The research concluded that age, muscle type and time combination, different boiling temperature has influence on changes in physical characteristics value of chicken meat. pH value and water binding capacity increased with increasing age of cattle, whereas the cooking shrinkage and decreased tenderness of meat value. Pectoral muscle has a pH, water binding capacity and lower cooking losses and tenderness higher than thigh muscles. Boiling temperature increase from 80 to 90°C and duration 30 to 60 minutes, causing pH value increase, cooking and meat tenderness, whereas the water binding capacity decreased.

The interactions between age, muscle type and time combination, temperature significantly affected the pH, cooking losses and tenderness of meat on the rate of water binding effect is not real.

Physical the chicken meat quality best for ages 3 and 6 months is boiling at temperature 90°C for 30 minutes. The lowest physical characteristics of chicken meat ages 3 and 6 months were treated meat on the boiling temperature 90°C for 30 minutes.

Further research is needed to evaluate the level of damage for physical and chemical meat quality stew that is used as raw material for making Gudeg, noodles, and chicken fried rice at shops and restaurants are fried chicken and Gudeg in Magelang district and surrounding areas.

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