

## The Effects of Environmental Temperature on Chicken Meat Specification

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**Abstract:** The effects of environmental temperature on chicken meat quality was determined on a total of 10 flocks reared and processed under commercial conditions. The following classes of birds were considered: light size and medium size, represented by females slaughtered at 40 and 52 days old, respectively, whereas heavy size were 57 days old male broilers. After slaughter, 15 carcasses per flock (n = 150) were randomly collected during winter (n = 75) and summer (n = 75) seasons and used at 24 h postmortem to determine breast (pectoralis major) pH and histopathologically evaluation. Furthermore, pectoralis minor muscles were used to determine lipid, protein, moisture and ash content.

**Key words:** Temperature • Broiler Chicken • Histopathology • Meat quality

### INTRODUCTION

New food sources and raw matters are reclaimed by the quick and uncontrolled increase of human population and of its higher life standards, as well. Meat is found on the top of food matters and nutrition resources, providing high nutritional and biological value, being also easy to be produced. Numerous animal species, breeds and hybrids are raised and used by humans for obtaining meat as raw matter and food, under proper conditions. Poultry and, especially, poultry hybrids could provide high quality meat at large amounts, at relatively low prices. It is already

Known that the poultry meat has dietetic features and can be easily processed at a large variety of specific products.

Now a days, consumer's demands has changed considerably in the market forms for poultry, from a whole bird commodity to cut-up, deboned meat and ready-to-eat further processed products, has resulted in a change of quality expectation. The major poultry meat quality attributes are appearance, texture, juiciness, flavor and functionality [1,2]. Further processing, increases meat functionality in relative importance, especially because of its key role in determining the sensory quality of complex ready-to-eat products. Traditionally, less consideration has been given to the functional properties of poultry meat such as water holding capacity and texture [3]. With regard to the environmental temprature, breast meat from

birds slaughtered during summer exhibited a paler and less red color, lower pH and a higher content of moisture and a lower content of protein and ash. In compare to medium and heavy birds, light broilers produced meat with higher values of moisture and lower pH and ash. These results indicate that broiler breast meat undergoes a depression of its functionality and quality during warm weather. While, some other studies showed that low rearing temperature decreased growth performance but had no significant effect on carcase quality [4]. Meanwhile, breast meat quality attributes in the market,determined some differences. Paleness, often referred to pale, soft, exudative (PSE) or PSE-like meat [5]. Some researchers have indicated that significant variations in breast meat color exist during processing as well as at the retail level, depending on the flock, type of birds, processing factors and seasonality [6-10]. Genetics also has been reported as a relevant factor for determining quality characteristics of the meat [11,12]. The environmental conditions during transport and holding of the birds have been shown to affect processing yield and meat quality [10,13-15]. This, however, did not significantly affect the incidence of appearance defects or the commercial grading of the livers. The percentage of fat loss during the cooking of canned livers was significantly reduced when the transport duration was increased. This effect could not be explained on the basis of the current knowledge for determining the technological quality of fatty liver [16].

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During the summer months, high antemortem temperatures can affect muscle acidification, or rigor development and subsequent meat quality via adrenal or other physiological responses or simply by fatigue of the birds [17-19]. Our study was about evaluation of poultry meat specification which rearing and slaughtering during warm and cold environmental temperature.

## MATERIALS AND METHODS

The study was conducted on a total of 10 flocks of broiler chickens (Aryan strain) reared under commercial conditions in 10 different farms. The birds varied in sex and age at slaughter time. They denided to three groups base on their weight. light (1.2 kg) and medium (1.5 kg) classes of birds were represented by females slaughtered at an average age of 40 and 52 days old respectively, whereas heavy male broilers (2 kg) were 57 days old. Moreover, the flocks were fed corn-soybean multiphase diets or wheat/sorghum-soybean diets. Prior to slaughter, broilers were subjected to a total feed withdrawal of 8 to 12 h, including a holding time at the processing plant of 2 to 3 h. The birds were subsequently processed under commercial conditions using electrocution (120 V, 200 Hz) as the stunning system. After chilling, 15 carcasses per flock ( $n = 150$ ) were randomly collected and used for subsequent meat quality evaluation during cold ( $n = 75$ ) and warm ( $n = 75$ ) seasons. After sloughtering small piece of pectoralis majour at the meadle of breast was cut and immersed in 10% buffered formalin to preserve and then processing to embed with paraffin. After sectioning and staining with hematoxyline and eosin, evaluated studied by light microscope. Approximately 2.5 g of breast meat was removed from the cranial end of each fillet, minced by hand, homogenized in 25 mL of a 5 mM iodoacetate solution with 150 mM potassium chloride for 30 s and the pH of the homogenate was determined using a pH meter calibrated at pH 4.0 and 7.0. Finally, pectoralis minor muscles were frozen for subsequent determination of lipid, protein, moisture and ash content. The chemical composition (moisture, protein, lipid and ash content) was carried out on frozen pectoralis minor muscles. The percentage of moisture was determined in duplicate according to the Association of Official Analytical Chemists [20] procedure. Protein content was determined using a standard Kjeldahl copper catalyst method [20]. Total lipids were measured using the chloroform methanol procedure [21]. Ash content was determined using the procedure described by the AOAC [20].

Table 1: Effect of the environmental temperature (winter and summer) on broiler breast

Item	Winter	Summer	SEM	P-value
	----- season -----	-----		
Number	75	75		
pH	6.01	5.97	0.01	0.03
Moisture	73.94	75.00	0.07	0.00
Protein	21.96	20.26	0.04	0.00
Lipid	1.16	1.20	0.02	0.28
Ash	1.43	1.34	0.01	0.00

**Statistical Analysis:** Separately evaluated by using 1-way ANOVA testing the season or the class of broilers as main effect, respectively.

Means were separated using Duncan multiple range test option of the SPSS ver.16.

## RESULTS

The effect of the environmental temperature (winter and summer) on broiler breast (Pectoralis major) meat quality traits is reported in table 1.

**Histopathology:** In microscopic point of view, pectoralis muscles' cells had shown more edematose in chincken which reared and slaughtered in warm weather condition rather than those which were reared and slaughtered in cold weather. So that they had paler color by the same staining method. The cells belong to winter rearing chickens are seen more condense and had lesser water in their composition. Connective tissue was seemed looser in summer chickens in compare with winter ones which leaded to reduction inter fiber spaces. Although surfaces of the summer muscles were always moist, but exudation was not seen. In compare with winter muscles, fibres from these muscles were straight, with no tears or splits. Most of the sarcomeres were of uniform length with well-defined striations, but occasionally alternate bands of contracted and stretched sarcomeres were seen within a fibre.

## DISCUSSION

The breast musculature is very developed in poultry, reaching 22-25% of the whole carcass weight, being influenced by species, breed, hybrid and gender. The pectoral musculature is represented by both superficial pectoral muscles (Pectoralis superficialis dexter and Pectoralis superficialis sinister) and by profound pectoral muscles. These muscles are involved in the wing

movement of all poultry species and breeds, having different dimensional, gravimetric, histological and physiological features. In meat-type hybrids, the pectoral muscle was especially studied as selection and genetic improvement character, reaching impressive sizes. Superficial pectoral muscles have a parallelogram shape with dimensions of 12-15 cm in length and 7-8 cm in width and weights of 300-320 grams (in the COBB-500 broiler chickens) [22]. As concerns the histological features, our investigations revealed a very interesting structural picture of the superficial pectoral muscles. Thus, the muscular fibres of these muscles are grouped in the second and the third order muscular fascicles. The myocytes from these muscles have cylindrical shape with ovoid ends and lengths of centimetres. The thickness of these cells has been estimated by the measurement of both large and small diameters, by the calculation of the average diameter. In samples issued from male chickens, the myocytes of the analysed muscle (PS) had a large diameter of  $39.58 \pm 0.63 \mu$  ( $v=16.01\%$ ), a small diameter of  $28.58 \pm 0.51 \mu$  ( $v=17.80\%$ ) and an average diameter of  $34.08 \pm 0.51 \mu$  ( $v=15.07\%$ ). The cross-sectional area had an average value of  $904.02 \pm 26.54 \mu^2$  ( $v=29.40\%$ ). It is well known that the diameter of muscle fibers increases as the age and the weight of the birds increase, thus changing the structural characteristics of the muscle [23]. This structural effect might also contribute to the differences found in shear values, which were higher in light birds. Smaller fiber diameters might allow a higher packaging density and increase toughness of the meat even if this effect was not confirmed in all species. Finally, the meat from light broilers had a higher content of moisture and ash, which can be related to the younger age at slaughter. In our study more edematose muscles in broiler breast meat obtained from chickens reared and processed under warm temperature (summer) is consequence to low water holding capacity. Muscular fibres are thinner in females, their density is higher and the pure muscular tissue proportion is higher to the prejudice of the connective tissues (lax and adipose). It is already known that there is an inverse proportion between the thickness and the density of muscular fibres from the skeletal muscles [24]. In respect to the broilers slaughtered during winter, the meat pH was lower during summer, which will results to indicate that broiler breast meat obtained from chickens reared and processed under warm temperature (summer) undergoes a significant deterioration in water holding capacity with respect to birds kept at cool temperature (winter). preslaughter handling and transport of broilers are stressful operations that might affect welfare and meat

quality and could increase numbers of deaths before slaughter [25] and also can affect postmortem metabolism of muscle and subsequent meat quality characteristics such as color, water holding capacity and texture During the summer months [18,26]. Heat stress-caused deterioration in growth performance, carcass characteristics, meat quality and meat colour stability of broilers [27]. Preslaughter exposures to heat reduced the oxidative stability of broiler muscle protein, which might be responsible for decreased protein functionalities such as gelation [28]. Birds kept at higher temperatures prior to slaughter had significantly lower ultimate pH values than birds subjected to cooler temperatures [15]. In a further study, using the low-resolution nuclear magnetic resonance technique, concluded that paler color of turkey muscles during summer with respect to those collected in winter is associated with differences in low resolution nuclear magnetic resonance transversal relaxation properties of the water molecules of the muscle. In this study, it was also reported that during summer, turkey breast meat exhibits a lower water holding capacity and an accelerated postmortem muscle metabolism, as indicated by the lower pH at 15 min postmortem [10]. The meat produced during summer is paler than that produced during winter [29].

In conclusion, the results found in this study indicate that broiler breast meat obtained from chickens reared and processed under warm temperature (summer) undergoes a significant deterioration in water holding capacity properties in respect with birds kept at cool temperature (winter). Moreover, the market class of birds may also play a role in determining variations in breast meat quality attributes, especially when comparing light- with medium- and heavy-size birds.

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