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The Effect of Poultry Preslaughter Fasting and Condition on the Quality of Meat and Luncheon Processed in Syria

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ABSTRACT

Broilers chicken welfare has been a challenge for the poultry industry and proper management is a topic to be aware to avoid the stressful conditions that can lead to compromise meat quality, as in the case of Pale, Soft and Exudative (PSE) meat. Several pre-slaughtering factors are related to broiler PSE meat formation, particularly transport, lairage and slaughtering conditions. The aim of this work was to evaluate the influence of chicken transportation time and lair before slaughtering on the occurrence of PSE meat and the quality of meat and canned meat processed locally under commercial transportation conditions in the Syrian winter, 150 chickens were tested and submitted to 13-hour pre-slaughter fasting periods in average. Deboned breast meat was submitted to the following analysis: pH, Drip Loss (DL), Water Holding Capacity (WHC) and Emulsion Stability (ES). The results show that 20% of meat considered as PSE meat that did not affect the quality attributes of the luncheon prepared under local commercial management before slaughtering.

Key words: Pale, soft and exudative meat, poultry, meat quality, pre-slaughtering, Syria

INTRODUCTION

The food consumption pattern has changed over the last decades, with consumers becoming more and more aware of food quality attributes. Nowadays, quality attributes include not only nutritional and sensory aspects, but also food safety, environmental and animal during rearing. Members of the industry have tried to maintain their markets by addressing these new consumer interests (Contreras-Castillo *et al*., 2007).

Before slaughter, while the chickens are still on the farms, their feed is withdrawn and they submitted to a Feed Withdrawal (FW) period that aims to reduce the gastrointestinal contents and consequently fecal contamination of the carcass during transport and evisceration. Although, 10-12 h of FW is sufficient to minimize carcass contamination and yield loss (Contreras-Castillo *et al*., 2007; Wabeck, 1972; Veerkamp, 1986). Wabeck (1972) suggested Eight hour as the minimum time to empty the broilers' gastrointestinal contents. Weight loss of the birds during the period between FW and processing is called as live shrink or shrinkage (Bilgili, 2002). After broilers have been without feed for more than 6 h, they begin to draw moisture and nutrients from their own body tissues and this weight loss may then affect edible yield (Northcutt, 2010).

The degree of shrinkage caused by FW (SFW) is affected by bird age, gender, diet density, house environmental control, ambient temperature, length of FW, transportation and plant holding conditions (Bilgili, 2002). Feed withdrawal periods are linearly correlated with carcass yields before and after carcass chilling (Lyon *et al*., 1991). Broiler dehydration during FW and transport, besides causing weight loss, may affect the physical and chemical characteristics of the meat. Several events preslaughter have an influence on poultry processing efficiency including feed and water withdrawal, catching methods, transportation system, distance to the plant and plant holding conditions, which are significant factors affecting poultry slaughter quality (Bilgili, 1995). Because of the increase in volume of deboned chicken cuts and further processing, the effects of FW on fillet pH, tenderness, cooking weight loss and chemical composition have become the focus of attention for several researchers (Contreras-Castillo *et al.*, 2007; Ali *et al.*, 1999; Berri, 2000).

Murray and Rosemberg (1953) reported that glycogen concentration is related to pre-slaughter fasting. Glycogen concentration is lowest when a 16 h fasting period is applied and increases 33% between 1 and 10 h when birds are re-fed with ground corn. Mellor *et al.* (1958) evaluated the relation between glycogen and pH and found that chicken meat with high glycogen concentration presented pH 6.2 therefore the highest glycogen level was related to more acid meat as low pH 24 post mortem is related to PSE meat (pale, soft, exudative). According to Kotula and Wang (1994) glycogen levels decrease as fasting time increases as they found that zero and 36 h of fasting resulted in glycogen values at zero hour post mortem of 7 mg g^{-1} and 3.5 mg g^{-1}, respectively. According to Gonzalez *et al.* (2007) rest showed a direct effect on temperature ($p<0.05$), diminishing acidity, reflected though hot and cold carcass pH as compared to the group of quail without rest. Castro (2006) asserted that higher PSE frequency relates to very short fasting periods, as there is high glycogen availability in the muscle. Therefore, fasting is related to meat pH and influences the incidence of PSE in chicken meat (Komiyama *et al.*, 2008).

Muscle is made up of 65-80% of water that exists in either the free, immobilized, or bound form. A product's water-holding capacity is primarily determined through exposing the product to external forces such as cutting, heating, grinding, or pressing (Hedrick *et al.*, 1994). Since, water is a polar molecule, it can become associated with electrically charged reactive groups on the muscle proteins, resulting in a strong attraction and immobilization known as bound water. Bound water will continually attract other water molecules, resulting in immobilized water. Immobilized water has less order and thus a lower attraction to the reactive groups. Free water is held only by surface tension and can be easily removed with little physical force such as the shrinking of myofibrils during the development of rigor mortis. Rapid pH decline in a high temperature carcass results in denaturant and shrinking of myosin and reducing filament spacing (Offer, 1991). Consequently, water is expelled from the cells and lost as purge or drip loss. Products processed from PSE meat not only have lower water binding capacity (lower yields), but also exhibit the reduced cohesiveness (Solomon *et al.*, 1998; McCurdy *et al.*, 1996; Daigle, 2005).

There is evidencing in the literature that catching often results in injury, especially when many birds are caught with maximum haste by the catching team. Leandro (2001) identified and quantified losses when comparing both manual and mechanized catching (16.5-7%, respectively). The authors found bruising in thighs, legs and breasts of up to 25% of the harvested birds due to handling, catching transportation and unloading at the processing plant. However, most damage in the carcass was found during catching in the breast (11%), thighs (33%) and wings (38%). Hip dislocation occurs when birds are caught in the broiler sheds and loaded into the transportation crates. Birds are usually held by one leg and several birds are held in each worker hand. If one or more birds start flapping their wings, their hip twists, the femur detaches and a subcutaneous hemorrhagic are produced, killing the bird. Dead birds with dislocated hip often have blood in the mouth, which was coughed up from the respiratory tract. Sometimes, too much haste caused this damage by the catchers (Baracho *et al.*, 2006).

There are several factors that affect meat quality , the storage period up to 4 days in chiller and 30 days in freezer could satisfactorily maintain the buffalo meat quality (Kandeepan and Biswas, 2007), the supplementation of diet with L-carnitine has positive effects on blood triglyceride and meat quality in Japanese quail (Parizadian *et al.*, 2011), the using canola oil with high level of ω-3 fatty acids could influence fatty acid profile and improved meat quality (Salamatdoustnobar *et al.*, 2008), the broilers fed with the diet containing probiotics was found better in terms of feed efficiency, growth and meat quality (Bansal *et al.*, 2011), Feeding of red ginger phytobiotic feed additive increased productive performance, carcass and meat quality of broiler (Herawati and Marjuki, 2011), whereas, the addition of enzyme did not significantly impact meat quality traits (pH, cooking loss, water holding capacity, shear force and colour attributes) (Zakaria *et al.*, 2010). Supplementation of drinking water with various levels of ascorbic acid did not significantly improve meat quality characteristics of broiler chicken reared in open-sided or closed housing at high ambient temperatures (Kadim *et al.*, 2009).

The objective of the current work was to evaluate the influence of chicken transportation and lair under commercial management before slaughtering on the quality of meat and canned meat processed locally.

MATERIALS AND METHODS

Animals and management: This experiment was carried out in the winter season of (2010), birds were collected during 5-7 h and placed in boxes (n = 9) with dimensions of 772×570×303 mm and subjected to road conditions in an open truck at 11°C for transport periods of 3-5 h. Upon arrival at the slaughterhouse, birds were subjected to lairage under natural ventilation for 2-4 h before slaughtering. Broilers were killed manually. This included cutting, the carotid artery and jugular vein, followed by scalding, feathering, eviscerating and removing the breast muscle samples, which were kept refrigerated at 4°C for further analysis.

In this study, 150 broilers were tested and the injury percentage during catching was calculated.

pH measurements and Samples classification: Meat pH was directly measured in the pectorals major muscle using a pH metro (Ama-Digit) coupled to a probe electrode, The initial (pHi) and final (pHf) pH were measured at 15 min and 24 h postmortem at 4°C in triplicate, as reported by Olivo *et al.* (2001). Samples were classified as PSE or normal meat samples based on previously established parameters associated with pH (Oba *et al.*, 2009). PSE samples presented values of pH = 5.80 and normal meat samples had values of pH>5.80 (Kissel *et al.*, 2009).

Water-holding capacity (WHC) measurement: To determine water holding capacity 2 g meat cubes were placed between two circles of filter paper placed on two glass plates. A 10 kg weight was placed on the top glass plate for 5 min, after which samples were weighed, as the quantity of water loss was calculated as the difference between initial and final weights (Kissel *et al.*, 2009; Hamm, 1960).

Drip loss (DL) and emulsion stability (ES): Drip loss was determined by keeping breast fillet under conditions that simulate retail sales. Samples were placed on polystyrene trays, covered with permeable plastic film and stored at 3±1°C for 72 h.

Drip Loss (DL) was calculated as the difference between initial and final weights (Komiyama *et al.*, 2008; Hamm, 1960; Northcutt *et al.*, 1994). Emulsion Stability (ES) was measured immediately after the cutter phase as described in Kissel *et al.* (2009). The ES was measured according to the method described by Lin and Zayas (1987). Briefly, 25 g of the emulsion meat was weighed in centrifuge tubes, subjected to a thermal treatment of 70°C for 30 min and centrifuged at 4000 rpm for 3 min. The measured supernatant was expressed in percent of emulsion stability.

Statistical analysis: The results were analyzed using the statistical 6.0 program. A Student's t-test was performed at the level of 5% probability in order to observe significant differences between the PSE and normal meat formulations. Significant association were identified when a p-value of less than 0.05 was observed.

RESULTS

The results show that the mean of Food Withdrawal (FW) period was 13 h and the bruising was in thighs, legs and breasts of up to 2% of the harvested birds due to handling, catching and transportation.

The pH of the samples during 24 h postmortem showed that 80% of the samples considered as normal meat (pH>5.80) and 20% of the samples considered as PSE meat (pH = 5.8). The pH values were different in the two samples ($p<0.05$).

The results indicate that the mean of Water Holding Capacity (WHC) were 62% and 20% of samples were less than 60% (59%) and these samples considered as PSE meat whereas, 80% of samples were more than 60% (65-62-61-63%) and these samples considered as normal meat according to (Kissel *et al.*, 2009).

The mean of the drip loss of all samples were 5.5%. The drip loss of 20% of the samples were more than 6% (6.1%) and these samples considered as PSE meat according to Jensen *et al.* (1998), whereas the drip loss of 80% of the samples were less than 6% (5.3-5.4-5.4-5.4%) and these samples considered as PSE meat according to Jensen *et al.* (1998). The emulsion stability (ES) value of PSE meat (10.5%) was significantly higher than in normal meat (7.6-7.8-7.7-7.8%). The mean of ES value was less (1.9%) when starch and isolated soy protein were added, the condition of PSE promoted a lower ES ($p<0.05$) as a result of the denaturation of myofibril proteins.

DISCUSSION

As shown in Table 1 the pH of the fillets at 24 h postmortem showed values that varied from 5.77-5.95, the pH values were different in PSE and normal meat ($p<0.05$). The pH range of

Table 1: Meat quality parameters of broilers submitted to different fasting periods of different farms

Farm No.	FW (h)	Temperature (°C)	Injury (%)	pH	WHC (%)	DL (%)	ES without addition (%)	ES with addition (%)
1	16	8	2	5.77	59	6.1	10.5	2.2
2	10	11	3	5.95	65	5.3	7.6	1.7
3	12	14	1.5	5.92	62	5.4	7.8	1.7
4	14	12	1.5	5.86	61	5.4	7.7	1.8
5	13	10	2	5.88	63	5.4	7.8	1.8
Average	13	11	2	5.88	62	5.5	8.3	1.9

FW: Food withdrawal, WHC: Water holding capacity, DL: Drip loss, ES: Emulsion stability picture of the possible influence 5.79-5.84 has been reported for FW periods of 3, 6, 12 and 18 h by Kotula and Wang (1994) and suggested that 8 h of FW would differences observed among the pH values do not provide a clear of FW time on pH. In general, the results of the current study agree with those of other authors (Kotula and Wang, 1994) and lead to the conclusion that pH is probably not affected only by FW time.

According to Komiyama *et al.* (2008), meat pH was significantly influenced ($p = 0.05$) by the different fasting period. The lowest values were obtained in the meat samples of birds submitted only to 4 h pre-slaughter fasting and there were no significant differences ($p>0.05$) in pH (evaluated in different periods) among the remaining pre-slaughter fasting periods (8, 12 and 16 h). Castro (2006) analyzed meat pH eight hours after slaughter, also did not detect any effect ($p>0.05$) of the different pre-slaughter fasting periods, with pH values between 5.71 and 5.77.

In this study, values of WHC did not differ significantly between the two formulations: PSE and normal meat. Similar results were observed by Kissel *et al.* (2009), the WHC of PSE and normal meat were (60.6-65.9%), respectively and similar results were observed in Delicatessen Rolls that were produced from normal and PSE turkey meats (Daigle, 2005).

Table 1 shows that, in luncheon formulations without ingredients, the ES value of PSE luncheon was significantly higher than in the luncheon made with normal meat. The ES value was even higher when starch and isolated soy protein were added, which suggests that soy protein acts synergistically as an emulsifier. This improves the final product's ES, as previously observed by Wang *et al.* (2000). Similar results were observed by Kissel *et al.* (2009).

In this study value of Drip loss after 16 h of withdrawal period was 6.1%, in another study with birds submitted for 16 h of pre-slaughter fasting and transported for three km the drip loss was 4.88% (Komiyama *et al.*, 2008).

When birds are submitted to stress, their body temperature increases muscle pH decreases due to lactic acid production in the muscle. This situation of low pH and high temperature in the muscle lead to higher post mortem protein breakdown, with consequent higher tissue water loss therefore higher meat tenderness cause by protein breakdown (Ali *et al.*, 1999), but under low ambient temperature (11°C) such as in winter in Syria it difficult to increase their body temperature, this conclusion enhance the broiler transportation at low ambient temperature in the field. Future research should be using these research results to study the effect of different temperature during broiler transportation, according to geographic distributions, in the meat quality.

Apparently under the conditions of these experiments, the birds never submitted to stressful harsh conditions and therefore the meat remain in good statues after birds slaughtering.

CONCLUSION

The association of longer Preslaughter Fasting period and PSE meat did not seem to follow negative parameters under the conditions of this experiment. Although, the technological functional properties of broiler PSE meat are weak, they are strengthened by the addition of normal meat and other luncheon ingredients.

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