Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(2): 1491-1494
© 2020 JEZS
Received: 07-01-2020
Accepted: 09-02-2020

M Anna Anandh
Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Department of Livestock Products Technology, Veterinary College and Research Institute, Tirunelveli, Tamil Nadu, India

Corresponding Author:
M Anna Anandh
Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Department of Livestock Products Technology, Veterinary College and Research Institute, Tirunelveli, Tamil Nadu, India

Effect of rearing systems on meat quality characteristics of beltsville small white Turkey (*Meleagris gallopavo*) meat

M Anna Anandh

Abstract
The study was conducted to determine the effect rearing systems (Intensive system - full confinement), semi intensive system - partial confinement and partial day scavenging and free range system – all day scavenging) on meat quality characteristics and sensory acceptability of Beltsville Small White turkey (*Meleagris gallopavo*) meat. Significantly (p>0.05) better pH, water holding capacity, cooking loss, and fragmentation index values were observed in Beltsville Small White turkey meat reared under intensive system of management followed by semi intensive system and free range system of management. Non significantly lower drip loss was observed in Beltsville Small White turkey meat reared under intensive system of management. Significantly (p>0.05) higher moisture and lower fat and non significantly higher protein contents were observed in Beltsville Small White turkey meat reared under intensive system of management. Sensory attributes scores of the turkey meat were significantly (p>0.05) higher for Beltsville Small White turkeys reared under intensive systems of management except flavor scores. Thus, it can be concluded that, intensive system of management is more suitable for production of highly acceptable meat from Beltsville Small White turkey with better physico – chemical properties.

Keywords: Turkey, Beltsville small white, rearing systems, meat, quality, sensory attributes

Introduction
The turkey (*Meleagris gallopavo*) is a well known bird in western countries and commercial turkey farming is becoming popular in India and farmers started to show interest in rearing turkey birds (Anna Anandh *et al.*, 2012) [1]. Recently, the consumption of turkey meat is increasing worldwide and a similar trend is also emerging in India. Turkey meat has tremendous commercial viability because of its low fat and cholesterol content in comparison to red meat and other poultry meat. The carcass quality traits are influenced by strain, age at slaughter, the nutritional regime and rearing systems (Brake *et al.*, 1993; Roberson *et al.*, 2003; Laudadio *et al.*, 2009) [5, 18, 14]. However, studies on influence of different rearing systems on meat quality and sensory characteristics have received limited consideration among researchers and information on influence of rearing system on meat quality and sensory characteristics of different varieties of turkeys are also not available in Indian hot humid climatic condition. A good quality meat possesses tenderness, juiciness and desirable flavour which depend on the physico-chemical properties like pH, water holding capacity, cooking loss, color, proximate composition and various other chemical constituents of meat (Lawrie, 1985) [15]. Hence, the present study was conducted to determine the effects of rearing system on the meat quality characteristics and sensory attributes of Beltsville Small White turkeys.

Materials and Methods
Source of turkey meat
The study was conducted at Turkey Research Unit of Tamil Nadu Veterinary and Animal Sciences University - Regional Research Centre, Pudukkottai, Tamil Nadu. Beltsville Small White turkeys reared under intensive system (full confinement), semi intensive system (partial confinement and partial day scavenging) and free range system (all day scavenging) of management were slaughtered at the end of the week 16 of age. Eight Beltsville Small White turkeys (4 males and 4 females) from each group were selected for slaughter studies by following standard procedures. They were individually weighed after overnight fasting (except for water) and then slaughtered. The turkeys were killed by cutting the jugular vein and carotid artery on one side of the neck near atlanto occipital joint. After bleeding the carcasses were

scalded at 58±2 °C for 2 min, handpicked and manually eviscerated. The meat separated from the carcasses and meat cut into small chunks and then Beltsville Small White turkey meat was stored at frozen temperature (-18±2 °C) until physico – chemical and sensory evaluation.

Physico – chemical analysis

pH

The pH of the raw turkey meat samples were determined by homogenizing 10 gm of sample with 50 ml distilled water with the help of tissue homogenizer for 1 min. The pH of the suspension was recorded by immersing the combined glass electrode of digital pH meter.

Water holding capacity

Water holding capacity of the raw turkey meat sample was measured as per the procedure reported by Wardlaw *et al*. (1973) [21]. 20 gm of minced meat was placed in centrifuge tube. 30 ml of 0.6M NaCl was added to the tube and the mixture was stirred for 1 min with a glass rod. The tube was then kept in refrigerator temperature (4±2 °C) for 15 min., stirred for 1 min and then centrifuged at 5000 rpm for 15 min. The supernatant was measured and water holding capacity (as ml of 0.6M NaCl retained by 100 gm of meat) was expressed in percentage.

Cooking loss

The method was based on the emulsion stability test reported by Baliga and Madaiah (1971) [4] with slight modifications. 20 gm small pieces of turkey meat samples were rolled into balls and placed in polyethylene bags. The samples were cooked at 80±2 °C in a thermostatically controlled water bath for 20 min. After draining out of the exudate, the cooked mass was cooled and weighed again. The cooking loss was calculated as percentage weight loss.

Drip loss

Small cut pieces of turkey meat samples immediately weighed. The sample was placed in polyethylene bag and sealed. After a storage period (usually 24 hr) at chill temperature (4±2 °C), samples were blotted and again weighed. DL was calculated using the following formula

$$\text{Drip loss (\%)} = \frac{\text{Weight loss}}{\text{Initial weight}} \times 100$$

Fragmentation index

Fragmentation index values were determined by the procedure outlined by Davis *et al*. (1980) [9]. 10 gm of 7 mm cubes of cooked frozen turkey meat sample were added to 50 ml of cold sucrose (0.24 M) and potassium chloride (0.02 M) solution in a 100 ml centrifuge tube. After 5 min, sample was blended for one min at full speed in tissue homogenizer. The resulting homogenate was filtered through a pre weighed muslin cloth. The residue and muslin cloth were blotted twice on Whatman No. 1 filter paper and the residue was allowed to air dry at 50±2 °C for 5 hr. The FI was reported as weight in gm x 100.

Proximate composition

The moisture, protein and fat contents of turkey meat samples were determined by standard methods using hot air oven, kjeldahl's assembly and soxhlet extraction apparatus, respectively (AOAC, 1995) [3].

Sensory evaluation

Sensory evaluation was conducted with semi-trained panelists. Cooked Beltsville Small White turkey meat samples were served to the panelists. The sensory attributes like appearance and colour, flavour, juiciness, tenderness and overall palatability were evaluated on 9 - point descriptive scale (where in 1 - is extremely undesirable and 9 - is extremely desirable) as suggested by Keeton (1983) [13]. To cook the meat, the meat samples were taken from the freezer and thawed overnight in a chiller at 4±2 °C. The meat samples were then cooked using the moist cooked in water at 80±2 °C for 20 min.

Statistical analysis

The data generated from each experiment were analyzed statistically by following standard procedures (Snedecor and Cochran, 1989) [19] for Analysis of Variance (ANOVA) comparing the means and to determine the effect of treatment by using SPSS-16 (SPSS Inc., Chicago, IL., USA). The level of significant effects, least significant differences were calculated at appropriate level of significance (p<0.05).

Results and Discussion

Meat quality characteristics

Table 1: Effect of rearing systems on meat quality characteristics of Beltsville Small White turkey meat (Mean ± SE)

Meat quality characteristics*	Free range system	Semi intensive system	Intensive system
pH	5.92 ±0.25 [a]	6.26±0.22 [b]	6.45±0.20 [c]
Water holding capacity (%)	20.32±0.17 [a]	27.28±0.15 [b]	32.84±0.12 [c]
Cooking loss (%)	27.82±0.21 [a]	25.68±0.15 [b]	23.33±0.17 [c]
Drip loss (%)	2.48±0.12	2.20±0.14	2.14±0.12
Fragmentation index	710.20±0.18 [a]	520.10±0.15 [b]	410.70±0.12 [c]

*Number of observations: 4

Means bearing same superscripts row-wise do not differ significantly (p<0.05).

Effect of rearing systems on meat quality characteristics of Beltsville Small White turkey are presented in Table 1. The mean ± SE pH value of Beltsville Small White turkey meat reared in free range, semi intensive and intensive system were found to be 5.92±0.25, 6.26±0.22 and 6.45±0.20, respectively. The pH value of Beltsville Small White turkey meat between each rearing system differ significantly (p>0.05) between them. Significantly higher pH value was found in Beltsville Small White turkey meat reared in intensive system of management followed by semi intensive and free range system. These findings are consistent with Castellini *et al*. (2002) [6] and Fanatico *et al*. (2007) [10] who reported lower pH in birds reared with outdoor access. It is reported that meat from poultry reared on outdoor access is characterized by lower pH indicating more glycogen in the muscle at slaughter, which then results in more lactate in the post-mortem process (Ponte *et al*. 2008) [17]. Our present results indicates the proper acidity and within the range of values corresponding to quality standards for non defective meat and pH value of 5.4 to 6.2 is normally considered to be of high quality meat (Woelfel *et al*.,2002) [22]. The mean ± SE water holding capacity of Beltsville Small White turkey meat reared in the free range, semi intensive and intensive systems were found to be 20.32 ±0.17, 27.28±0.15 and 32.84±0.12, respectively.

Water holding capacity of Beltsville Small White turkey meat were differ significantly (p<0.05) between rearing systems and value higher in intensive system of management followed by semi intensive and free range system. Castellini *et al.*,(2002)[6] also observed significantly lower water holding capacity in muscles of chickens allowed to use free ranges and they attributed poor water holding capacity in slow growing birds to their tissue being less mature metabolically at harvest than the fast growing birds. The mean ± SE cooking loss of Beltsville Small White turkey meat reared in the free range, semi intensive and intensive system were found to be 27.82±0.21, 25.68±0.15 and 23.33±0.17, respectively. Cooking loss value of Beltsville Small White turkey meat reared in the different rearing system differs significantly (p<0.05) between them. Significantly (p<0.05) lower cooking loss observed Beltsville Small White turkey meat reared in intensive system of management and significantly (p<0.05) higher cooking loss observed Beltsville Small White turkey meat reared in free range system of management. However, opposite results reported by Castellini *et al.,* (2002) [6] and Fanatico *et al.,* (2007) [10] who observed that birds reared in free range have lower cooking loss than birds reared intensive system. Alvarado *et al*. (2005) [2] reported that there was no difference in the cooking loss of meat produced in intensive and semi intensive system of management. Lower cooking losses in Beltsville Small White turkey meat reared in intensive system of management as compared to free range system of management of our present study might be attributed due to the superior water holding capacity. The mean ± SE drip loss value of Beltsville Small White turkey meat reared in the free range, semi intensive and intensive system were found to be 2.48 ±0.12, 2.20±0.14 and 2.14±0.12, respectively. Drip loss is a cytoplasmic fluid oozing out from meat. Drip loss value of Beltsville Small White turkey meat did not differ significantly between rearing systems and value non significantly higher in free range system of management followed by semi intensive and intensive system of management. The mean ± SE fragmentation index value Beltsville Small White turkey meat reared in the free range, semi intensive and intensive system were found to be 710.20±0.18, 520.10±0.15 and 410.70±0.12, respectively. Fragmentation index provides a potential method for identifying tough and tender beef carcasses (Culler *et al.*, 1978) [8]. Significantly (p<0.05) higher fragmentation index value was observed in Beltsville Small White turkey meat reared in free range system of management and significantly (p<0.05) lower fragmentation index value was observed in Beltsville Small White turkey meat reared in the intensive system of management. Fragmentation index values of Beltsville Small White turkey meat differ significantly (p<0.05) between rearing systems.

Proximate characteristics

Table 2: Effect of rearing systems on meat proximate characteristics of Beltsville Small White turkey meat (Mean ± SE)

Meat proximate characteristics**	Free range system	Semi intensive system	Intensive system
Moisture (%)	72.25 ±0.11 [a]	73.47±0.15 [b]	73.65±0.18 [b]
Protein (%)	21.09±0.14	21.52±0.12	21.80±0.12
Fat (%)	4.95±0.12 [a]	3.90±0.14 [b]	3.20±0.12 [b]

**Number of observations:4

Means bearing same superscripts row-wise do not differ significantly (p<0.05).

Effects of rearing systems on proximate characteristics of Beltsville Small White turkey meat are presented in Table 2. The mean ± SE moisture, protein and fat percentage of Beltsville Small White turkey meat reared in the free range, semi intensive and intensive system were found to be 72.25±0.11,73.47±0.15 and 73.65±0.18, 21.09±0.14, 21.52±0.12 and 21.80±0.12 and 4.95±0.12, 3.90±0.14 and 3.20±0.12, respectively. Significantly (p<0.05) higher moisture content value was observed in intensive system of management and significantly (p<0.05) lower moisture content value was observed in free range system of management. Moisture content values of Beltsville Small White turkey meat reared in the intensive and semi intensive rearing system did not differ significantly between them. Non significantly higher protein content value was observed in intensive system of management and lower moisture content was observed in free range system of management. Protein contents of Beltsville Small White turkey meats were did not differ significantly between the rearing systems. Significantly (p<0.05) higher fat content value was observed in free range system of management and significantly (p<0.05) lower fat content value was observed in intensive system of management. Fat contents of Beltsville Small White turkey meats were did not differ significantly between semi intensive and intensive rearing systems but differ significantly (p<0.05) from free range system of management. There are many factors that affect fat, moisture, ash and protein content of meat, which includes feed rations, physical activity and genetics (Husak *et al.,* 2008) [12]. Michalczuk *et al.,* (2014) [16] also observed a similar tendency as that reported in our present study. They also did not confirm statistical significance of their results. Wang *et al.,* (2009) [20] found that nutrient composition (water, protein, and fat) of the chicken muscle were not influenced by the rearing system. However, Castellini *et al.,* (2002) [6] had reported that chickens raised with outdoor access have lower crude fat content as compared to chickens reared indoors.

Sensory characteristics

Table 3: Effect of rearing systems on meat sensory characteristics of Beltsville Small White turkey meat (Mean ± SE)

Sensory attributes***	Free range system	Semi intensive system	Intensive system
Appearance and colour	8.0± 0.02 [a]	8.0± 0.02 [a]	8.5± 0.05 [b]
Flavor	8.5± 0.04 [a]	8.5± 0.04 [a]	8.0± 0.02 [b]
Juiciness	7.5± 0.05 [a]	8.0± 0.02 [b]	8.5± 0.04 [c]
Tenderness	7.0± 0.01 [a]	8.0± 0.02 [b]	8.5± 0.02 [c]
Overall palatability	7.7± 0.03 [a]	8.1± 0.02 [b]	8.4± 0.03 [c]

***Number of observations = 32.

Sensory attributes were evaluated on a 9-point descriptive scale (wherein, 1 = extremely undesirable; 9 = extremely desirable).

Means bearing same superscripts (lowercase letters) row-wise do not differ significantly (p<0.05).

Effects of rearing systems on sensory characteristics of Beltsville Small White turkey meat are presented in Table 3.

The mean appearance, juiciness, tenderness and overall acceptability scores were significantly (p<0.05) higher in Beltsville Small White turkey meat reared in intensive system of management followed by semi intensive and free range system of management. However, significantly (p<0.05) higher flavor scores observed in Beltsville Small White turkey meat reared in free range system of management and significantly (p<0.05) lower flavor scores were observed in Beltsville Small White turkey meat reared in intensive system of management. The flavour scores of Beltsville Small White turkey meat reared in free range and semi intensive system did not differ significantly between them but both rearing system differ significantly (p<0.05) from intensive system of management. Overall acceptability scores for Beltsville Small White turkey meat reared in intensive system were significantly (p<0.05) higher followed by semi intensive and free range system. The results of sensory attributes of this experiment clearly indicate that all sensory attributes scores of Beltsville Small White turkey meat were higher for intensive systems of management except flavor scores. Fanatico *et al.*, (2006) [11] reported that confinement bird's chest meat was juicier than the meat from free range reared birds. Ponte *et al.*, (2008) [17] observed that meat from turkeys reared under confinement rearing system were tenderer than that raised in free range system. Similar findings have been observed by Chen *et al*. (2013) [7]. Husak *et al*., (2008) [12] reported no significant difference between organic, free range and conventional broilers in terms of chicken aroma, tenderness, chewiness and flavor. They also observed that conventional chicken thighs were tenderer and less chewy than chickens reared outdoors. Our present results indicated that Beltsville Small White turkey meat reared under intensive system of management had rated "very acceptable" whereas Beltsville Small White turkey meat reared under free range system had rated "moderately acceptable".

Conclusion

From these results, it is concluded that, rearing system had a very significant effect on meat quality characteristics of Beltsville Small White turkey turkeys and intensive system of management more suitable for production of highly acceptable turkey meat from Beltsville Small White turkey.

References

1. Anna Anandh M, Richard Jagatheesan PN, Senthil Kumar P, Paramasivam A, Rajarajan G. Effect of rearing systems on reproductive performance of turkey. Veterinary World. 2012; 5:226-229.
2. Alvarado CZ, Wenge RE, O'keefe SF. Consumer perception of meat quality and shelf-life in commercially raised broilers compared to organic free ranged broilers. Journal of Poultry Science. 2005; 84:129.
3. AOAC. Official Methods of Analysis. Association of Official Analytical Chemists, Washington, DC.1995.
4. Baliga BR, Madaiah N. Preparation of mutton sausage. Journal of Food Science. 1971; 36:607-610.
5. Brake J, Havenstein GP, Ferket PR, Rives DV, Giesbrecht FG. Relationship of sex, strain, and body weights to carcass yield and offal production in turkeys. Poultry Science. 1994; 74:161-168.
6. Castellini C, Mugnai C, Dal Bosco A. Effect of organic production system on broiler carcass and meat quality. Meat Science, 2002; 60:219-225.
7. Chen X, Jiang W, Tan HZ, Xu GF, Zhang XB, Wei S *et al*. Effects of outdoor access on growth performance, carcass composition and meat quality characteristics of broiler chickens. Poultry Science. 2013; 92:435-443.
8. Culler RD, Parrish FC, Smith GC, Cross HR. Relationship of myofibril fragmentation index to certain chemical, properties and sensory characteristics of bovine muscle. Journal of food Science. 1978; 43:1177-1180.
9. Davis GW, Dutson TR, Smith GC, Carpenter ZL. Fragmentation procedure for bovine longissimus muscle as an index of cooked steak tenderness. Journal of Food Science. 1980; 45:880-884.
10. Fanatico AC, Pillai PB, Emmert JL, Owens CM. Meat quality of slow and fast growing chicken genotypes fed low nutrient or standard diets and raised indoors or with outdoors access. Poultry Science. 2007; 86:2245-2255.
11. Fanatico AC, Pillai PB, Cavitt LC, Emmert JL, Meullenet JF, Owens CM. Evaluation of slower-growing broiler genotypes grown with and without outdoor access: Sensory attributes. Poultry Science. 2006; 85**:**337-343.
12. Husak RL, Sebranek JG, Bregedahl KA. Survey of commercially available broilers marketed as organic, free-range, and conventional broilers for cooked meat yields, meat composition, and relative value. Poultry Science. 2008; 87:2367-2376.
13. Keeton JT. Effect of fat and Nacl / Phosphate levels on the chemical and sensory properties of pork patties. Journal of Food Science, 1983; 48:878-881.
14. Laudadio V, Tufarelli V, Dario M, Emilio D, Vicenti A. Growth performance and carcass characteristics of female turkeys as affected by feeding programs. Poultry Science. 2009; 88:805-810.
15. Lawrie RA. Chemical and biochemical constitution of muscle. In: Meat Science. Permagon Press Inc., Elmsford, New York, 1985.
16. Michalczuk M, Lukasiewicz M, Lukasiewicz M, Zdanowska – Sasiadek Z, Niemiec J. Comparison of selected quality attributes of chicken meat as affected by rearing systems. Polish Journal of Food and Nutrition Sciences. 2014; 64:121-126.
17. Ponte PIP, Prates JAM, Crespo JP, Crespo DG, Mourão JL, Alves SP *et al*. Restricting the intake of a cereal-based feed in free-range-pastured poultry: effects on performance and meat quality. Poultry Science. 2008; 87:2032-2042.
18. Roberson KD, Rahn AP, Balander RJ, Orth MV, Smith DM, Booren BL *et al*. Evaluation of the growth potential, carcass components and meat quality characteristics of three commercial strains of tom turkeys. Journal of Applied Poultry Research. 2003; 12:229-236.
19. Snedecor GW, Cochran WG. Statistical methods. 8 th ed. Oxford and IBH Publishing Co., Calcutta, 1989.
20. Wang KH, Shi SR, Dou TC, Sun HJ. Effect of a free-range raising system on growth performance, carcass yield, and meat quality of slow-growing chicken. Poultry Science. 2009; 88:2219-2223.
21. Wardlaw FB, McCaskill LH, Acton JC. Effect of postmortem muscle changes of poultry meat loaf properties. Journal of Food Science. 1973; 38:421-424.
22. Woelfel RL, Owens CM, Hirschler EM, Martinez-Dawson R, Sams AR. The characterization and incidence of pale, soft, and exudative broiler meat in a commercial processing plant. Poultry Science. 2002; 81:579-584.