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Research Article

GROWTH PERFORMANCE AND MEAT QUALITY OF TURKEY BIRDS PRODUCED BY THE SMALL-HOLDERS IN SOUTH 24 PARGANAS DISTRICT OF WEST BENGAL, INDIA

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ABSTRACT: Turkey farming is an emerging and market linked enterprise in India. Farmers residing in peri-urban areas of Kolkata rear small flocks of turkey birds. The present study was planned to evaluate the growth pattern and carcass characteristics of Beltsville Small White turkey birds reared in backyard system with supplemental feeding of locally available grains, crop residues and vegetable wastes. A total of 160 numbers of turkey poults were studied for growth up to 140 days. After the trial period, carcass traits and meat quality were evaluated after slaughter. The results showed that Beltsville Small White turkey birds attained 4762 g of body weight on 140th day. The asymptote weight was found to be 11431.41 g. The maturing rate of experimental turkey birds was 0.074 g/day. The average dressing percentage of male and female birdswere recorded as 66.68 and 67.08. The lipid peroxidation value was found to be 0.221 MDA mg/Kg meat. The reduced value of lipid peroxidation in experimental turkey meat might be due to backyard turkey rearing system with supplemental feeding with greens. Moisture, crude protein and ether extract of turkey meat samples in the present study were respectively 69.12%, 20.46% and 9.55%. High growth rate, favourable carcass traits and meat quality of the Beltsville Small White turkey breed might be the key factors for its suitability and sustainability under small holder farming system in peri-urban areas of Kolkata.

Keywords: Beltsville Small White, Carcass traits, Gompertz's model, Meat quality, Small holder, Supplemented feeding.

INTRODUCTION

Turkey (*Meleagris gallopavo*) is a large poultry bird and famous for its lean meat with multiple human health benefits [1]. Although America and Europe contribute more than 80% in global turkey meat production, turkey rearing is also gradually gaining momentum in Asian countries [2, 3] due to the birds' adaptability in diverse climate, increasing consumer demand for value added meat and better profitability compared to broiler farming. In India, turkey rearing remains primarily a backyard venture where small holders with limited land resources are engaged in turkey farming with small flocks [4]. In South 24 parganas district of West Bengal, existing poultry growers have found an alternative livelihood opportunity through market linked turkey farming, an innovative backward-forward linkage model [5]. Majority of the turkey growers rear 'Beltsville Small White' breed for its adaptability in this region. The turkey growers raise the poults in dual feeding system in which the birds are kept on regular mash diet along with home-made kitchen supplementation and seasonal vegetable wastes like pumpkin strands, crushed tomato, cauliflower leaves, potato peels, etc.

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Genetic strain, management condition, feed composition - are key determining factors for growth in poultry birds [6]. Farming system and feeding pattern may critically impact growth and meat characteristics in turkey birds. Faster growth and superior carcass characteristics of turkey poults is always closely related to increased farm income [7]. There is dearth of literatures on body growth and meat characteristics of turkey birds reared under backyard farming system in coastal agro-climatic zone. Considering the importance of emerging turkey rearing enterprises by small holders in peri-urban areas surrounding Kolkata city, the present study aims to explore the growth pattern and meat quality of Beltsville Small White' turkey birds in backyard farming system with home-made kitchen supplementation and vegetable wastes in South 24 Parganas district of West Bengal.

MATERIALS AND METHODS

Locale and time of research

Present study was conducted at two villages namely Joykrishnapur and Kusthia at Sonarpur developmental block in South 24 Parganas district of West Bengal, India during July - December 2022. Sasya Shyamala Krishi Vigyan Kendra (Farm Science Center) of South 24 Parganas is regularly organizing Front Line Demonstration (FLD) program on 'Scientific Turkey Rearing with Marketing Linkage' in the above-mentioned villages since 2016 through technology convergence model.

Birds and their management

A total of 160 numbers day-old' Beltsville Small White' turkey birds procured from State Poultry Farm, Tollygunge, Kolkata, India were equally distributed to 16 beneficiaries. Only experienced poultry farmers were chosen for this study. Body weight of 160 turkey birds were recorded weekly up to 20th week (Marketing age) using digital weighing balance in the morning before giving any feed. Birds were maintained under backyard system of rearing. During first few days of brooding, birds were fed with starter mash mixed with boiled chicken egg (1 egg per 10 chicks). All the birds were fed commercial broiler starter mash (CP: 24% and ME: 2900 Kcal/Kg; Epic Feed) up to the age of 8 weeks. From 8 weeks onwards, all the birds were fed with broiler finisher mash (CP: 15% and ME: 3200 Kcal/Kg; Epic Feed). Mash feeds were given in restricted feeding mode - once in the morning and in the evening. Average feed quantity given in the first week was 12 g per day per chick. Gradually the feed quantity was increased over the ages and average 90g per day per bird was given on 20th week when the lot was marketed. Home-made kitchen supplements (Boiled mixture of broken rice, rice bran and green gram wastes in equal proportions) was given from 3rd week onwards @ 70-100 g per bird per day. Herbs and succulent leaves (Azolla, water hyacinth and tulsi leaves) were also given from 3rd week onwards @ 15 - 25 g per bird per day.Vegetable wastes (pumpkin wastes, tomato wastes, carrot tops, cauliflower leaves etc.) were given adlib from 4th week onwards. Routine deworming with broad-spectrum anthelmintic and vaccination program against Ranikhet and Avian Pox were followed in the turkey flocks as per the standard practice. No growth promoter is separately added in the feeds during the trial.

Sampling and analysis of meat quality

Birds were slaughtered manually on 140th day. Two turkey birds from each household were sampled randomly and accordingly a total of 32 birds were represented for this study. Carcass traits from male and female birds were recorded separately for whole carcass and for individual cut up parts (Breast, Thigh, Drumstick, Wing, Neck and giblets). Dressing percentage was calculated by the following formula :

Dressing % = [(Dressed weight ÷ Live weight) × 100].

Physio-chemical parameters of the breast meat sample were measured as per the standard methods. Breast meat (about 15 g) was collected from the carcass for determination of pH. It was measured after 45 minutes of slaughter (pH_{45min}) using a handheld pH meter (EUTECH, UK). Drip loss of the meat sample (about 30 g) was analysed by gravimetric method [8]. Lipid peroxidation of the meat samples was measured spectrophotometrically [9] and expressed as MDA (mg)/kg meat. All the meat samples were analysed in triplicates.

Proximate composition of the meat samples was carried out by the standard procedure [10]. Moisture, crude protein (CP), ether extract (EE) and total ash (TA) was estimated on wet basis. Micronutrient (Fe, Cu, Zn and Mn) content of the turkey meat samples were analyzed by using Atomic Absorption Spectrophotometer (Analyst 200, Perkin Elmer, USA) [11]. All the analyses were done in duplicate.

Statistical analysis

Data were statistically analysed for mean and standard error using SPSS v.20 program (SPSS Inc, Chicago, IL). Body weight prediction curve was constructed by Curve Expert 1.4 program [12] for Windows using Gompertz's non-linear regression model. The mathematical expression in Gompertz's model is:

$$W_t = A^{-e^{B-kt}}$$

$$Wi = A/e$$

$$ti = B/k$$

$$MGR = Wi \times k$$

Where, Wt is the predicted weight (g); A is the asymptomatic weight (g) when time goes to infinity; B is the constant of integration; k is the maturing rate (g/day); t is the time unit (day), and e is the natural constant (2.72). Wi is the weight of inflection; ti is the time of inflection and MGR is the maximum growth rate (g/day).

Student t test [13] was used to compare the carcass characteristics between male and female turkey birds.

RESULTS AND DISCUSSION

Body growth of experimental turkey birds upto the marketing age (140 days) are presented in Table 1. Results revealed that on average birds attained 3590 g on 112th day and finally reached 4762 g on 140th day. In a separate experiment, 3202 g of body weight was reported [14] on 112th day for white coloured male turkey reared under semi-intensive system. Birds reared under semi-intensive system are more likely to be exposed in fluctuating environment. Increased exercises in the yard and variable feed resources may cause sub optimal growth under semi-intensive farming. The higher body weight of birds described in the present study might be due to the difference in the production system. Pulses and their by-products are rich in protein and can be fed to poultry and other livestock as a source of protein and antioxidant activities [15]. Feeding of green gram wastes along with broken rice for turkey poults in the present study might have positive influence on body growth. The edible succulent vegetables can modulate different body systems positively, by reduction of oxidative stress [16, 17], by direct and indirect antimicrobial activities [18, 19] or by performing immuno-modulation and other related effects [20, 21] in different vertebrate species.

Researches [22] showed that Gompertz's model can accurately describe correlation between body weight and age of turkey birds. Table 2 depicts the growth parameters deduced from Gompertz's growth curve (Fig. 1). Asymptote weight (A) value calculated in the present study is 11431.41 g. It is the maximum weight that could be achieved by 'Beltsville Small White' turkey birds in their life span when reared under experimental conditions. In an experiment with Large White turkey breed, it was observed that the values of asymptote weight for male and female turkeys were as 19131.25 g and 14213.13 g respectively under intensive system [23]. Inflection weight (Wi) and inflection time (ti) are two growth variables that describe a shift from growth acceleration to retardation. In the present study, Wiand ti values are 4202.72 g and 21.16 days respectively. There is paucity of literatures for comparing the inflection weight and inflection time in different turkey genotypes in different farming systems. Maximum growth rate (MGR) of Beltsville Small White turkey breed is calculated as 311.001 g/day in the present trial. Results revealed that maturing rate (k) of experimental turkey birds is 0.074 g/day which is better than broiler chicken [24]. Growth rate is an important economic feature for commercial birds and present study indicates that turkey farming has good prospect over broiler farming provided there is good marketing support. High R2 value (0.99) denotes reliability of the Gompertz's model for determining the growth parameters.

Dressing percentage and weight of cut up parts/ organs of male and female Beltsville Small White turkey at slaughter is tabulated in Table 3. Average dressing percentage of male and female bird is recorded as 66.68 and 67.08 respectively without any significant ($p>0.05$) difference. In an experiment with 3 turkey genotypes (B, H and BXH), Previous experiment reported carcass yield in the range of 71.6 to 78.1 indicating that dressing percentage widely vary due to the strain/breed difference of turkey [25]. Another trial [26] showed 76.77% carcass yield in Beltsville Small White turkey breed reared in experimental farm. The difference in dressing percentage might be due to the different grow-out conditions and slaughter methods involved. The present study further showed that sex significantly ($p<0.05$) influenced carcass traits (Table 3) in turkey birds. The results of organ (liver, heart and gizzard) weights are similar to the turkey birds supplemented with dietary herbal plants [20].

Physio-chemical characteristics of meat is presented in Table 4. pH is an important indicator of meat

Table 1. Body Weight (Mean ± SE) of Turkey birds.

Age (days)	Body weight (g)
7	80.6 ± 0.4
14	148±11.13
21	205.4±9.7
28	319.6±43.61
35	485±40.12
42	600.4±41.71
49	786±34.58
56	947.4±21.01
63	1100±41.83
70	1516±62.83
77	1830±88.88
84	2034±68.96
91	2212±83.14
98	2750±83.66
105	3140.8±74.46
112	3590±64.03
119	3736±77.48
126	3960±53.38
133	4190±105.35
140	4762±66.36

Table 2. The growth parameters for body weight in turkey birds as deduced by Gompertz's model.

Variables	Values
A	11431.41
B	1.566
k	0.074
Wi	4202.72
ti	21.16
MGR	311.001
R^2	0.99

A: Asymptotic weight (g); B: constant of integration; k: maturing rate (g/day); Wi: weight of inflection (g); ti: time of inflection (days). MGR: maximum growth rate (g/day); R2: Coefficient of determination.

quality [27]. In the present study, pH_{45mins} of turkey meat is recorded as 5.85. This result is in agreement with a previous experiment [28] where pH value was 5.92 in Beltsville Small White turkey breed reared under free range system. Drip loss of meat is another important variable used to predict suitability of meat during processing. The mean value of drip loss from Beltsville Small White turkey meat was found to be 2.22% in the present trial and the result corroborates with past studies [28]. TBARS value is commonly used to measure lipid peroxidation in meat. This parameter is particularly important for meats used in frozen and value-added sector. Lipid peroxidation value (TBARS) in breast muscle of Beltsville Small White turkey was 0.221 MDA mg/Kg meat in the present study. TBARS value presented in our study is lower than observed by another study [29] in turkey (HybridXL) breast muscle (0.35 MDA mg/Kg). Less TBARS value indicates less lipid peroxidation in experimental turkey meat, and this might be due to intensive rearing system with supplemental feeding with greens. This supplemental feeding is unique in small holder turkey production and might be responsible for enhanced antioxidant status of meat.

Table 5 depicts proximate composition and micronutrient status of turkey meat. Moisture, crude protein and ether extract of turkey meat samples in the present study were respectively 69.12%, 20.46% and 9.55%. According to a study [28] on proximate composition of Beltsville Small White turkey meat under 3 different rearing system, moisture and protein was reported as 73.47% and 21.52% respectively in turkey meat under semi intensive system of rearing. This difference in moisture and protein % might be due to the prevailing feeding practices. Meat is a great source of trace minerals that play critical role in human health and immunity [1]. Mean content of Fe,

Table 3. Dressing % and weight (Mean±SE) of cut up parts/organs at slaughter.

Parameter	Male	Female	Statistical Significance (p)
Dressing %	66.68±0.45	67.08±0.3	0.51
Eviscerated Carcass (g)	3472.5±89.57	2285±135.92	0.001
Breast(g)	892±10.55	659±41.04	0.006
Thigh (g)	552.5±36.62	334.25±17.07	0.004
Drum Stick (g)	564.75±12.75	357.5±26.04	0.002
Wing (g)	483±16.7	306.75±15.89	0.000
Neck (g)	238.75±11.38	134.5±8.53	0.01
Heart (g)	21.75±1.31	14.75±1.88	0.01
Liver (g)	80±2.27	48.75±2.35	0.002
Gizzard (g)	136±10.53	94.25±3.59	0.01

Cu, Zn and Mn in the meat samples were respectively 2.01 mg/100g, 0.13 mg/100g, 1.45 mg/100g and 0.09 mg/100g respectively. The micro mineral data could not be compared due to dearth of literature. However, Fe content in turkey meat (2.01 mg/100 g) was found to be higher than that of poultry meat (0.78 mg/100 g) [30]. Similar report of higher Fe content in turkey meat than chicken meat was also observed in previous experiments [31]. Cu content of poultry meat was reported in the level of 0.13 mg/100 g which is similar to the Cu content in turkey meat [11]. Poultry breast meat contains zinc at the level of 0.7 mg/100 g

Table 4. Physio-chemical characteristics (Mean±SE) of meat from turkey birds.

Variables	Values
$pH_{45\ min}$	5.85±0.03
Drip loss (%)	2.22 ± 0.69
TBARS value (MDA mg/Kg meat)	0.221 ± 0.03

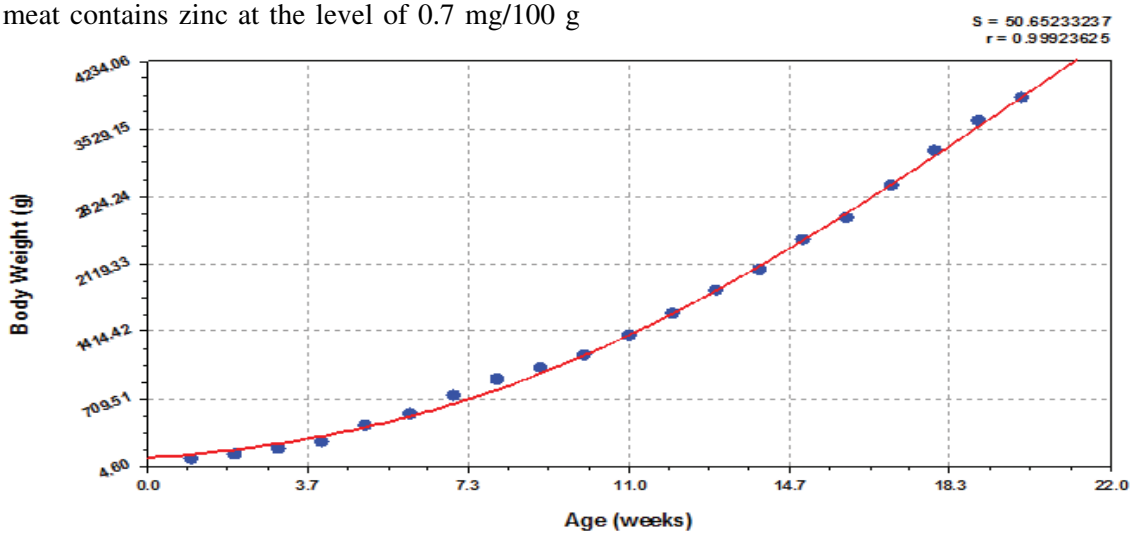

Fig. 1. Body weight curve of turkey birds.

Table 5. Proximate composition and micronutrient content (Mean±SE) of turkey meat.

Moisture(%)	CP (%)	EE (%)	TA (%)	Fe (mg/100 g)	Cu (mg/100 g)	Zn (mg/100 g)	Mn (mg/100 g)
69.12±0.36	20.46±0.20	9.55±0.15	0.82±0.04	2.01±0.4	0.13±0.01	1.45±0.12	0.09±0.02

[32]. Our study reveals that turkey meat contains higher zinc content than chicken meat.

CONCLUSION

Small holder turkey production system in and around peri-urban areas of Kolkata mega city provides an alternative livelihood avenue for many farmers. Present study characterises growth pattern of Beltsville Small White turkey breed reared by small holders in this area. The fascinating growth rate of this turkey breed under supplemental feeding system aimed for production cost optimization may open up a great possibility for viable turkey production in this area. Favourable carcass traits and meat quality also indicates suitability of the Beltsville Small White turkey breed for large scale adoption by small holders in South 24 Parganas district of West Bengal.

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