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Original Research Article

Potential Risk Factors Associated with Broiler Welfare of Commercial Flocks in Turkey: Welfare of the Chickens just Prior to Pre-slaughter Catching on Farms

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ABSTRACT

This study aimed at assessing broiler chicken welfare in commercial flocks just prior to pre-slaughter catching on farms, in Turkey. For this purposes seven broiler farms including 28 flocks from two Turkish broiler company were inspected. Each of the studied flocks had identical management programs for broiler. Data was collated over a one year period on four separate occasions to identify any possible seasonal effects. One hundred birds in each flock were assessed for various welfare parameters based on physical and production-related measures. Mean flock slaughter age on the day of visit was 43 days and mean body weight was 2.35 kg in the flocks. Average mortality and feed conversion ratio were calculated as 3.03 and 1.82, respectively. Light instensity, temperature and heat stress index inside the house were highest during the summer visits. The humidity was higher during the winter months, ammonia fluctuated through the year inside the house. There were significant differences for all welfare scores of the birds raised in different flocks ($P<0.05$) in different season, except gait score. A seasonal effect was observed on gait score. Male and female birds in all flocks had almost similar welfare scores. As conclusion, it can be said that the flocks investigated in this study had reasonably good welfare scores and there is the potential for further improve using new legislation and better implementing existing welfare assurance schemes.

Keywords: Broiler welfare, Flocks, Pre-slaughter catching

INTRODUCTION

The welfare of chickens in broiler production is a major, global consumer concern and comprising both physical and mental health includes the hunger and disease (Dawkins *et al*. 2004, Anonymous 2012, Petek and Orman 2013, De Jong *et al*. 2013) . There has been a strong seasonal, age, housing condition and sex effects on main welfare issues in broiler production (Haslam *et al*. 2007, Bassler *et al.* 2013, Petek 2013, Petek and Orman 2013, Petek *et al*. 2015). Litter quality, age and length of the dark period at three weeks of age were the predominant risk factors for prevalence of contact dermatitis, lameness and fear of humans for broiler (Bassler *et al*. 2013). Animal husbandry and management factors from farm to slaughter have been shown to be key components involved in the appearance of the injuries or lesions in broiler flocks (Grist and Rizvi 2011, Petek *et al*. 2014, Kittelsen *et al*. 2015). During the pre-slaughter activities, broilers are exposed to a variety of stressors (Jacobs *et al*. 2017). Any reduction in these stressors and risk factors will have positive effects on bird health and help reduce financial losses due to mortality, injury and subsequent down grading of carcasses.

Turkey is the 8thbroiler chicken meat producer in the World (Anonymous 2015) and is actively working to raise the welfare of both red and white meat animals on Turkish farm and abattoirs. New legislation regarding farm animal welfare during transport has been launched by the government (Anonymous 2011, Anonymous 2014a, Anonymous 2014b). Despite these improvements there is still the same concerns about welfare of production animals in Turkey as well as the rest of the World. In Turkey, a few studies have focused on envrionmentral and managing impacts on animal welfare. However, no detailed scientific literature on broiler chicken welfare assesment in commercial flocks have been published, yet. This study aimed at assessing broiler welfare on commercial flocks and identify the potential risk factors associated with stress, injury and mortality of broilers during pre-slaughter catching, transportation, lairage and slaughtering of broiler flocks in Turkey. The data presented here concentrates of the welfare of broilers just prior to on farm catching in the farm. A subsequent publication will deal with welfare of broilers during post-farm pick-up including transport, lairage and slaughter.

MATERIALS AND METHODS

The study was carried out on twenty-eight flocks across seven farms belonging to two Turkish broiler companies. These companies currently slaughter over 15 % of the national broiler production of Turkey. During the survey, data was collated over a one year period on four separate occasions to account for any seasonal effect.

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Data Collection
One hundred birds in each flock were assessed just prior to being caught on farm at the time of processing. Each bird was inspected for various welfare parameters as well as collecting the performance data for each of the flocks (Sejian *et al*. 2010, Anonymous 2012b). The birds were assessed on the same day for all parameters including gender by the same assessor. The following data relating to farm management and housing were collected for each flock:

Production related measures
The age of birds, farm mortality and feed consumption for each flock was obtained using farm records. Individual live body weights of the birds were measured at the same time as the welfare assessment was made.

Physical measures (Animal-based measures)
For each bird; walking ability (*gait score*), feather cover (*plumage score*), breast dirtiness (*feather cleanliness score*) and foot-pad lesion score were measured using an individual sample scoring system (Anonymous 2013a). Data collection was carried out at four different locations within the broiler shed with the randomly selected birds being scored for all measures. Walking ability was assessed first by the scoring system developed by Kestin *et al*. (1992). The assesment is based on how birds walk on a specific surface. The assesment scale is divided into six levels, as follows:

0 - sound bird; 1 - the bird moves fast, but a slight walking deficiency is observed; 2 - the bird moves fast, but there is significant walking deficiency; 3 - the bird moves fast, but it presents an important deficiency; 4 - the bird moves with serious difficulty; 5 - the bird barely moves and often uses the wings for crawling.

The gait score 3 or above was evaluated as lame birds. After assessing walking ability the same birds were then carefully picked up to assess all other welfare parameters. Feather coverage of each bird was scored on a scale of 1 to 3 (Gyles *et al*. 1962).

Plumage score 1: indicated hens with poor feathering with a large amount of visible skin; Plumage score 2: indicated hens with medium feathering; Plumage score 3: described hens with good feathering showing some adult feathers.

The breast dirtiness or feather cleanliness were scored visually from 1 (very clean) to 8 (very dirty) as reported by Wilkins *et al*. (2003). The visual ranking system used to score foot pad lesions indicated as; Score 0 for no lesion present with mild discoloration, Score 1 for a mild lesion (minor superficial lesion), Score 2 for a medium lesion (moderate hyperkeratozis) and Score 3 for a severe lesion (deep and large epithelial necrosis) (Pagazaurtundua and Warris, 2006).

Environmental parameters
On the day of sampling, dry bulb temperature, wind chill factor, relative humidity, heat stress index, dew point, wet bulb temperature, inside ammonia concentrations were recorded using a pocket weather meter (*Kestrel, 3500; Industrial Scientific, ProGasBadge*). Inside light levels for each flock were measured using light meter (*Extech, HD450*) at the time of welfare assessment. All environmental recordings were measured by the same person at 25 cm above the ground at three different locations of the house (geometric center, and both ends of the houses) to provide an average figüre for the flock and house.

Statistical analysis
Gait score, feather cover, breast dirtiness and food pad lesion data were analysed by ANOVA using the SPSS® computer software 13.00 (Spss 2004). The mean separation was performed using the Duncan test (Snedecor and Cochran 1989). We considered season, sex, and farm interaction as sources of variation.

RESULTS

The Main hybrid breed used in the flocks was Ross and Cobb 500 which were housed in windowed deep-litter sheds with no enrichment and no outdoor access. Light regime in all flock consisted of both day light and artificial light. Main bedding material used in the flocks was rice hull. Stocking density was range from 14 to 17 birds/m^2. The average flock capacity was 24,260 in this study (flock sizes ranged from 6500 to 43.500 broilers). All houses were provided with automatic drinkers, feeders, litter substrate and tunnel ventilation systems, continuous lighting program with artificial light and natural lighting (Table 1).

Table 1. Management practices of broiler production system in Turkey.

Item	
Breed	Fast growing, (Ross PM3, Cobb 500)
Housing type and floor	Windowed, Deep-litter
Stocking Density, birds/m^2	14-17 birds
Outdoor Access	No
Light-Regime	Day-light and artficial light; 1h of uninterrupted darkness per 24 h
Enrichment	No
Average number of birds housed	24,260
Bedding / litter material	Rice hull

In current study, mean flock slaughter age on the day of visit was 43 days and mean body weight was 2.35 kg. Average calculated mortality including dead and culled birds was 3.03% in the flocks. The average feed conversion ratio were calculated as 1.82 (Table 2).

Table 2. Mean performance data of the flocks.

Performance data	**Mean ± SEM**
Flock slaughter age, day	43.00 ±1.46
Body weight (day of visit)	2.35 ± 0.19
Mortality (dead and culled birds), %	3.03 ± 0.32
Feed conversion ratio	1.82 ± 0.01

Envrionmental parameters obtained inside the chicken house in this study are presented in table 3. As expected light instensity, temperature and heat stress index were highest during the summer visits. Whilst humidity was higher during the winter months, ammonia fluctuated through the year.

Table 3. Average environmental parameters inside the broiler houses.

Season/ Parameter	**Spring**				**Summer**				**Fall**				**Winter**			
	Mean	SE	Min.	Max	Mean	SE	Min.	Max	Mean	SE	Min.	Max	Mean	SE	Min.	Max
Light Intensity, *Lx*,	20.5	1.01	12.3	40.9	72.37	2.32	40.5	140.9	20.58	1.04	12.5	31.5	32.37	1.45	6.2	49.7
Air ammonia, *ppm*	16.83	0.09	1.0	41.0	11.83	0.08	3.0	23.0	20.53	0.11	0.0	62.0	13.16	0.08	0.0	94.00
Dry bulb Temperature, *C*^{o}	17.94	0.11	10.6	26.6	26.53	0.12	23.6	28.4	22.60	0.10	16.6	27.8	19.16	0.10	9.8	27.1
Relative humidity, *rH*	63.78	1.12	54.1	75.8	66.48	1.90	55.0	76.1	67.60	2.01	60.7	75.2	69.25	2.34	47.6	85.0
Wind chill	17.94	1.01	10.3	26.6	26.50	2.01	23.7	28.4	22.57	1.90	16.6	27.5	19.15	1.090	9.5	27.5
Heat stress index	17.64	0.08	9.7	28.0	28.58	0.09	25.2	33.4	23.14	0.12	16.2	29.5	19.49	0.10	9.0	32.90
Wet bulb temperature, *C*^{o}	13.69	0.08	7.7	20.7	21.78	0.07	20.1	25.3	18.22	0.08	13.6	22.2	15.60	0.09	6.7	26.2

Table 4 shows the prevalance of lameness, moderate or severe food pad dermatitis, internal litter temperature and relative humidity for the study. It was found that mean prevalence of lameness (gait score 3 and above) were 3.15%. Whereas moderate or severe foot pad dermatitis (score 2 or 3) were calculated as 47.85% in the flocks. The internal litter temperature and relative humidity were 30.68 C^o and 67.16 %, respectively.

Table 4. Prevalance of lameness, moderate or severe food pad dermatitis, internal litter temperature and relative humidity in the flocks (Mean ±SEM).

Lameness (lame birds, gait score 3 or above), %	3.15 ±0.09
Moderate or severe food pad dermatitis, %	47.85 ±3.10
Internal litter temperature, C^o	30.68 ±2.11
Internal litter relative humidity, %	67.16 ±5.12

The mean welfare scores are given in Table 5. There were no significant season, sex or farm effects on gait scores although there was an interaction between season and farm ($P < 0.001$). Farm, season and sex all had

effects on feather cover but there were significant interactions between season x farm ($P < 0.001$) and sex x farm ($P = 0.023$). Both season and farm had significant effects on breast dirtiness but there was interaction between season x farm ($P < 0.001$). Both season and farm had significant effects on foot pad lesions but there was interaction between season x farm ($P < 0.001$) and between sex and farm ($P < 0.001$).

Table 5. Mean welfare scores of the birds examined in this study (mean ± SEM).

Factors	Gait	Feather cover	Breast dirtiness	Foot pad lesion
Season				
Spring	0.335±0.104	1.709±0.039^{d}	4.519±0.076^{b}	1.797±0.065^{d}
Summer	0.250±0.074	1.168±0.044^{a}	3.350±0.081^{a}	0.399±0.074^{a}
Fall	0.341±0.044	1.338±0.026^{b}	3.408±0.048^{a}	0.913±0.042^{b}
Winter	0.324±0.094	1.168±0.055^{a}	3.625±0.102^{a}	1.537±0.091^{c}
Sex				
Male	0.358±0.059	1.331±0.025	3.760±0.046	1.103±0.041
Female	0.265±0.047	1.497±0.030	3.810±0.058	1.194±0.054
Farm				
1	0.301±0.058	1.223±0.034^{d}	4.006±0.048^{b}	1.383±0.056^{a}
2	0.316±0.096	1.281±0.056^{d}	3.497±0.060^{c}	0.934±0.093^{c}
3	0.320±0.061	1.636±0.035^{a}	3.291±0.045^{c}	0.835±0.059^{c}
4	0.427±0.068	1.309±0.040^{c}	4.466±0.051^{a}	1.161±0.066^{b}
5	0.198±0.119	1.788±0.084^{a}	2.141±0.066^{d}	0.708±0.014^{d}
6	0.198±0.283	1.423±0.068^{b}	4.614±0.039^{a}	1.650±0.113^{a}
7	0.323±0.082	1.386±0.048^{b}	4.808±0.061^{a}	1.583±0.079^{a}
ANOVA				
Season	0.443	0.001	0.001	0.001
Sex	0.799	0.010	0.545	0.672
Farm	0.607	0.001	0.001	0.001
Season x sex	0.364	0.916	0.100	0.297
Season x farm	0.001	0.001	0.001	0.001
Farm x sex	0.098	0.023	0.297	0.001
Season x farm x sex	0.641	0.222	0.334	0.225
SEM	0.039	0.019	0.037	0.032
General	0.316±0.039	1.410±0.019	3.784±0.037	1.146±0.032

a-d: within columns, values with different superscript letters differ significantly ($P<0.05$, $P<0.001$).

DISCUSSION

This present study focused on the welfare of broiler chickens in commercial flocks in Turkey. The most common hybrid breeds raised in the flocks were Ross PM_3 and Cobb 500. The type of breed that was used is accepted by animal scientists as one of the most important factors that influence animal welfare since the rapid growth rates cause physiological problems in birds related to cardiovascular disease and leg disorders (Dinev 2012, Dawkins and Layton 2012, De Jonge and Trijop 2013). In Turkey, almost all the birds in all flocks were fast growing and raised in windowed, deep-litter house with no enrichment. With respect to environmental enrichment, consumers perceive this as fairly important, whereas scientific evidence on the welfare implications is still a topic of discussion (Robins and Philips 2011). Light regime in all flock in this study consisted of natural light and artificial light with one hour of uninterrupted darkness each day. The average light intensity measured in the current study was similar and comparable to some other standards (Anonymous 2013b). However, the lighting pattern is different to welfare standards across the EU which requires six hours of darkness per day. Main bedding material was rice hull (Garcia *et al*. 2012, Garces *et al*. 2013) and stocking density was range from 14 to 17 birds/m^2 with no enrichment. This was under the maximum limit of EU permission for live body weight or bird number per square meter in broiler production (Stevenson 2012). Member States can house broilers to a maximum of 42 kg/m^2 if certain other criteria are fulfilled. The average size of the Turkish broiler flocks has increased compared to earlier reports (Petek 1999, Ozturk and Durmus 2002).

In current study, we found that the internal litter temperature and relative humidity were 30.68 C^{o} and 67.16 %, respectively. It is difficult to give a figure for appropriate litter moisture in broiler house, but for chickens up to 4 weeks age it should be between 20-50 %, and 10-30 % in the last 2-3 weeks of growing period. Controlling litter moisture and maintaining good litter quality are the most important factors in avoiding ammonia problems and related welfare problems (Butcher and Miles 2011, Petek *et al*. 2014). To limit ammonia production and litter moisture averages between 25 to 35 percent in a well-managed broiler house (Asaniyan *et al*. 2007). Litter and air

quality can be improved using proper ventilation, heating, appropriate litter management such as proper litter material, increasing depth of litter (Petek *et al*. 2014). Moreover, slatted flooring or cage housing system might be a good option to avoid litter based problems (Shields and Greger 2013, *Petek et al*. 2015). Compare to other studies the ammonia levels in the broiler houses of this study, which varied between 11.83 to 20.33 ppm is similar to other studies with the poultry regulations (Estevez 2002; Anonymous 2007). In general, respiratory diseases increase with higher levels of ammonia and detrimental effect of ammonia is highly dependent on the exposure time. In the present study we found that light intensity, wind chill and heat stress index were close to being within the limits of the thermal comfort zone of broilers. (Purshwell *et al.* 2008; Anonymous 2013c).

The gait score is one of the main measure of locomotion deficiency in broiler. It was reported that good or poor gait scores were related to the poor environmental conditions inside the broiler houses (Cordeiro *et al*. 2009, Fernandes *et al*. 2012, Petek and Orman 2013). In the current study, the gait score was below one indicating birds could move quickly but had a slight impairment to their ability to walk. There were no significant effects of season, sex and farm on gait score. In the study, only 3% were found to have gait scores above three. The farm x season interaction had an effect on the gait score ($P<0.001$). The effect of farm on the gait score was only detected in wet season. In these farms there is a gradual increase in the rate of locomotion problems (Petek *et. al*. 2005).

In this study broiler raised in summer and winter had a better feathering compared to birds raised in spring and fall. The housing conditions have a major influence on the feather cover of the broilers. Normally, the feathering coverage increases with age and feather cleanliness score is poorer with age. We found that body weight was correlated with feather score, significantly (r:-0.413, $P<0.01$). The birds with the best feather condition were lighter than birds with less feather coverage. Edens *et al*. (2001) found that females approached full feathering at 35 d of age, but males lagged behind females even at 42 d. Along with the bird age poor feathering in broiler chickens may be due to inadequate nutrition, genetic inheritance and harsh envrionmental conditions. With spearman's correlation analysis it was observed that internal humidity was associated with severity of breast dirtiness (r:0.227, $P<0.05$) and feather score (r:-0.298, $P<0.01$). As humidity increased breast dirtiness and feather cover worsened. In general, plumage dirtiness is correlated with contact dermatitis and lameness for individual birds and may be associated with the environment and production system. In the current study, most of the birds had a score of 4 or 5 for the breast dirtiness. The average scores were 3.76 for males and 3.81 for females; 4.52 in spring, 3.35 in summer, 3.41 in fall and 3.63 in winter, respectively. All scores of breast dirtiness were deemed to be at a moderate level and typical for broilers housed on deep litter (Wilkins *et al*. 2003).

Animal welfare audits in Europe and United States often use foot, hock, and breast burns lesions as an indicator of housing conditions and the general welfare of the birds (Haslam *et al*. 2007, Anonymous 2010). The mean percentage of birds in all flocks with moderate or severe foot pad lesions was 47% in our study. Haslam *et al*. (2007) and De Jong *et al*. (2012) found moderate or severe foot lesions in 11 and 65% of the birds, respectively, whereas Bassler *et al*. (2013) found as 37%. Foot pad lesion can lead to a large economical losses because broilers with severe foot-pad dermatitis have slower weight gain and lower economical value due to carcass downgrading at processing plant. Hock, foot and breast lesions are primarily affected by: drinker design, feed composition, house temperature and relative humidity, litter type and quality, and stocking density (Bray and Lynn 1986, Tucker and Walker 1992, Petek *et al*. 2010 and 2014). In this study; there were a strong seasonal and farm effect on animal welfare traits (except gait score) and farm x season interaction was important for all welfare scores.

CONCLUSIONS

The measures of welfare used here indicate that the flocks investigated had reasonably good welfare. There is the potential for further improve using new legislation and production companies better implementing existing welfare assurance schemes.

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