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Original Article

Carcass characteristics, immune response and organ weight influenced by different house zones in sexed broilers

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Abstract
The aim of study was to examine carcass characteristics and organ weight in sexed broilers maintained over three different house zones (Pad, Central and Fan) having 4 feeding regimes from 0-10, 11-20, 21-34 and 35-42 days with CP levels of 21, 20, 18 and 17%, respectively. At the termination of the trial, all the treatment groups received the same weighed average of 19 % crude protein and 2800 Kcal/kg energy. At 6th week of age, 6 birds / treatment group were slaughtered and internal organ weights and carcass characteristics were examined. Statistical analysis of data through CRD under factorial arrangement and comparison of mean using DMR test with the help of SAS 9.1 revealed significant effect ($P<0.05$) of different house zones on organs weight and slaughter characteristics . The anti-body titer of ELISA for IBD and HI for ND were significantly affected by three house zones. The overall results suggested that the broilers reared near pad zone had better dressing percentage and carcass yield.
Keywords: Broiler, organ weight, carcass characteristics.

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INTRODUCTION

Environment control has made the maximum expression of genetic potential possible in broilers (Kao *et al.,* 2011) and harsh environmental conditions have a negative impact on the health and performance of poultry (Dawkins *et al.,* 2004; Estevez, 2007). In winter season minimum ventilation is used to ensure necessary air flow required to provide fresh air containing optimum concentration of oxygen, keeping good air quality and improving animal welfare (Czarick *et al.,* 2012). Air renewal is necessary to keep the ambient temperature at appropriate level in the house during brooding by removal of excessive humidity from the environment in order to keep the litter dry and reduce the obnoxious gases concentration (Cordeiro *et al.,* 2010).

There is the unique relationship between temperature and humidity but these parameters of ventilation vary in the house with some fluctuations (Czarick, 2012) affecting body weight, feed intake and FCR of the broilers in different housing zones. It has been reported that when birds are exposed to low ambient temperature maximum body weight (1.5 to 2.2 kg) could be achieved between 28 to 35 day (Simmons *et al.,* 2003; Dozier *et al.,* 2005). However, high temperature has also been reported to have adverse effect on broiler growth performance e.g. body weight gain and FCR (Ahmad *et al.,* 2005).

High humidity exerts damaging effect on performance, wellbeing, growth rate and feed consumption of broiler (Daghir, 2009) causing heavy productive losses (Francesch *et al.,* 2004) adversely affecting the respiratory epithelium of the broilers (Kristensen *et al.,* 2000) resulting into desquamation of respiratory epithelium. It is documented that 70% humidity is a good indicator for minimum ventilation (Czarick *et al.,* 2012) leading to maximum broilers growth. However, low humidity causes dusty conditions, making the birds susceptible for respiratory diseases (Czarick *et al.,* 2012).

The preceding discussions, present evidence that temperature and humidity may

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vary in different areas of the house which may ultimately affect the growth performance of broilers. Keeping this in view the present study was undertaken to evaluate the growth performance of broiler maintained under three housing zones.

MATERIALS AND METHODS

The present study was conducted at Poultry Research and Training (PRTC) Centre, Ravi Campus, University of Veterinary and Animal Sciences, Lahore, Pakistan.

For this purpose, 720 commercial (Hubbard) day-old broiler chicks of both the sexes were allocated to rear in different housing zones (Fan, Central and Pad Zone). The birds were subjected to initial adaptation period of one week and then were randomly divided into 18 experimental units of 20 chicks each. The experimental birds were maintained in environmentally controlled broiler house under littered floor and each treatment was replicated for three times. All the birds were divided into four phases. 1st phase ended at 10th day, followed by 2nd, 3rd and 4th phases at 20th, 34th and 42nd days of age with CP levels of 21, 20, 18 and 17 percent, respectively. The experimental plan is presented in Table I.

The weighted average of crude protein (CP 19%) and metabolizeable energy (2800Kcal/kg) consumed by the birds in all the treatment groups remained the same at the end of experimental period of 42 days whereas feed and water were offered ad-libitum throughout the experimental period. The birds were maintained with optimum conditions of temperature, humidity and ventilation as per recommendations. The ingredients composition and nutrient profile of the experimental broiler rations have been presented in Tables II and III.

Six birds from each treatment groups were randomly picked up and slaughtered by Halal Muslim method, for obtaining data on slaughter characteristics, antibody titer and blood biochemical profile. Individual chick body weight was taken on a weekly basis from each experimental replicate. Weekly gain was calculated as follows:

Weekly gain = present body weight (g) - body weight of previous week (g).

Table I: Experimental plan.

Groups	Housing Zones	Sex	Replicate
A	Fan Zone	Male Female	3 × 2 × 3=18 Housing Zones=3 Sex=2 Replicate=3 No of bird/Replicate = 20
B	Center Zones	Male Female	
C	Pad Zones	Male Female	

At 42 days of age 2 birds per replicate were picked up randomly and slaughtered by Halal method and data for following parameters were observed

a) Slaughter characteristics
b) Internal organs weight
c) Blood chemistry
d) Immune response

a) Slaughtering characteristics

1. Weight before slaughter (g)
2. Weight after slaughter (g)
3. Dressing percentage with giblets
4. Breast Yield (%)
5. Leg quarter weight (%)
6. Giblets yield (%)
   i. Liver weight (%)
   ii. Heart weight (%)
   iii. Gizzard weight (both when filled and empty) (%)
7. Spleen weight (%)
8. Keel length (cm)
9. Shank length (cm)
10. Pancreas weight (%)

b) Internal organs

- Intestinal weight (%)
- Intestinal length (cm)
- Abdominal fat weight %

c) Blood chemistry

Sixteen birds from each treatment group and total of 48 birds were selected at the 42 day of experiment and slaughtered by Halal method and 5cc blood was taken in heparinized vaccutainers. Serum extraction was performed by centrifugation. Serum was shifted to new test tubes and stored at -20°C for the determination of following parameters.

1. Blood glucose level
2. Blood cholesterol level
3. Blood urea level

Table II: Ingredients composition of experimental diets.

Ingredient (%)	Crude Protein (%)				
	21	**20**	**19**	**18**	**17**
Maize	35.13	54.85	46.53	58.70	57.97
Rice polish	0.00	5.00	7.00	6.00	10.00
Wheat bran	1.00	3.00	3.50	4.00	3.40
Canola meal	15.00	6.05	11.00	1.67	0.00
Rapeseed meal	4.00	4.00	3.00	4.00	4.00
Soybean meal	15.65	16.00	17.00	17.50	17.07
Corn Gluten meal	1.20	1.60	1.27	1.60	0.57
Poultry byproduct meal	0.00	2.00	1.00	1.00	1.00
Fish meal	2.00	2.50	3.00	0.00	0.00
Marble chips	0.80	0.55	0.30	0.73	0.73
DCP	0.80	0.53	0.80	1.12	1.13
Lysine sulphate	0.57	0.48	0.50	0.53	0.52
DL methionine	0.09	0.18	0.10	0.19	0.20
Threonine	0.06	0.05	0.02	0.08	0.08
Molasses	0.63	2.50	3.50	2.25	2.95
Premix	0.24	0.43	0.30	0.26	0.13
Salt	0.18	0.23	0.25	0.32	0.20
Phyzyme	0.05	0.05	0.05	0.05	0.05
Rice broken	22.60	0.00	0.00	0.00	0.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table III: Nutrient composition of experimental diets.

ME (Kcal/kg)	2800	2800	2800	2800	2800
CP (%)	21.00	20.0	19.00	18.11	17.1
Fat (%)	3.00	4.11	4.10	3.79	4.25
Fiber (%)	4.65	4.31	4.80.	4.14	4.42
Calcium (%)	0.88	0.82	0.80	0.78	0.77
Phos. avail. (%)	0.44	0.4	0.40	0.4	0.4
Lysine dig. (%)	1.17	1.05	1,05	0.99	0.95
Meth dig. (%)	0.50	0.49	0.48	0.46	0.45
M+C dig. (%)	0.80	0.77	0.76	0.72	0.69
Argin dig. (%)	1.20	1.1	1.1	1.02	0.98
Threo dig. (%)	0.70	0.66	0.65	0.63	0.59
Tryp dig. (%)	0.20	0.18	0.17	0.16	0.15
Isoleu dig. (%)	0.70	0.68	0,65	0.62	0.56
Valine dig. (%)	0.83	0.76	0.70	0.68	0.64

d) Immune response

Sixteen birds from each treatment group and total of 48 birds were selected at 42nd day of trail. Five cc blood was taken at 42nd day of age in heparinized vaccutainers for immune response against New castle disease and infectious bursal disease.

Statistical analysis

The data were analyzed using analysis of variance (ANOVA) technique in completely randomized nested design with two factors (Steel *et al.* 1997). Comparison of means was worked out using Duncan's Multiple Range (DMR) test (Duncan, 1955).

RESULTS AND DISCUSSION

Statistical analysis revealed that bird grown in the pad area showed significant ($P<0.05$) difference in overall means as well as in weekly trend of body weight (table I). The highest body weight was observed in pad area (2266.81±53.41g) followed by middle (2053.13±16.47g) and fan area (1779.63±13.31g) of house because even a small variations in humidity and temperature reduce feed intake which ultimately resulted efficient growth. Similar results were found by Mcgovern *et al.* (2000) and Blahova *et al.* (2006) who observed that cooler environment with less air temperature improves body weight of broilers while Ross (2010) reported less maintenance energy requirement for birds reared at thermo-neutral zone, whereas Blakely *et al.* (2007) reported that any fluctuation in temperature resulted stunted growth of the broilers.

The results revealed that live, dressed, proventiculus, liver, bursa, lungs, spleen, gall bladder and intestinal weight, breast and thigh meat yield and shank length of the birds were significantly ($P<0.05$) affected by different housing zones while different housing zones had no significant effect on weight after bleeding, blood (% of live weight), gizzard (filled, empty), digesta, kidney, pancreas and heart weight, abdominal fat and intestinal length (Table II-IV). Similarly, in other studies significant effect of different housing zone on dressed weight (Ratsaka *et al.,* 2012), breast meat yield (Sogunle *et al.,* 2008), and liver weight (Santos *et al.,* 2008, 2012) have been observed. The overall results showed that the broilers reared near pad zone had better dressing percentage and carcass yield.

Table IV: Effect of different housing zones on liver, after bleeding, dressed and blood weight % in sexed broilers.

Parameters	Live Weight (g)	Weight After Bleeding (%)	Dressed Weight (%)	Blood Weight (%)
Sexes				
Male	1948.61±31.52	96.50±0.26	63.26±0.24	4.91±0.18
Female	2004.17±34.06	95.82±0.52	63.15±0.23	5.25±0.12
Housing Zones				
Fan area	1927.08±48.62^{b}	95.56±0.29	62.86±0.23^{b}	4.91±0.25
Central area	2045.83±41.58^{a}	95.22±0.76	62.67±0.21^{b}	5.25±0.16
Pad area	1956.25±24.32^{ab}	96.70±0.28	64.09±0.31^{a}	5.08±0.15
Sexes × Housing Zones				
Male × Fan area	1889.29±60.94	96.60±0.46	62.58±0.33^{b}	4.73±0.42
Male × Central area	2058.33±85.06	95.84±0.56	62.78±0.26^{b}	4.95±0.30
Male × Pad area	1959.38±31.36	96.66±0.37	64.04±0.37^{a}	5.06±0.18
Female × Fan area	1980±80.34	96.50±0.33	63.25±0.27^{ab}	5.18±0.17
Female × Central Area	2041.67±49.05	95.01±1.00	62.64±0.27^{b}	5.36±0.19
Female × Pad Area	1950±40.08	96.80±0.39	64.18±0.58^{a}	5.12±0.27

Different superscripts on different values show significant difference ($P< 0.05$).

Table V: Effect of different housing zones on breast, thigh, gizzard (filled and empty) weight % in sexed broilers.

Parameters	Breast yield (%)	Thigh yield %	Gizzard Filled (%)	Gizzard Empty (%)
Sexes				
Male	19.99±0.17	25.56±0.09	3.01±0.08	1.99±0.07
Female	20.46±0.21	25.60±0.10	3.05±0.11	2.01±0.09
Housing Zones				
Fan area	20.37±0.24	25.65±0.12	3.11±0.13	2.10±0.13
Central area	20.41±0.24	25.44±0.13	3.03±0.11	2.02±0.09
Pad area	19.89±0.22	25.64±0.10	2.95±0.10	1.88±0.07
Sexes × Housing Zones				
Male × Fan area	19.82±0.27^{bdc}	25.41±0.16^{b}	3.11±0.10	2.10±0.14
Male × Central area	19.58±0.16^{dc}	25.53±0.24^{ab}	3.09±0.29	2.05±0.26
Male × Pad area	20.29±0.28^{abc}	25.70±0.12^{ab}	2.89±0.13	1.86±0.06
Female × Fan area	21.13±0.32^{a}	25.99±0.15^{a}	3.11±0.31	2.10±0.26
Female × Central area	20.69±0.29^{ab}	25.41±0.16^{b}	3.00±0.12	2.01±0.08
Female × Pad area	19.10±0.12^{d}	25.52±0.17^{ab}	3.08±0.19	1.92±0.18

Different superscripts on different values show significant difference (P< 0.05).

Table VI: Effect of different housing zones on digesta, proventriculus, liver and kidney weight % in sexed broilers.

Parameters	Digesta Weight (%)	Proventriculus Weight (%)	Liver Weight (%)	Kidney Weight (%)
Sexes				
Male	1.10±0.05	0.43±0.01	1.97±0.54	0.23±0.02
Female	1.03±0.05	0.43±0.01	1.87±0.04	0.21±0.01
Housing Zones				
Fan Area	1.12±0.08	0.77±0.56	1.94±0.06^{ab}	0.22±0.02
Central Area	1.01±0.05	0.43±0.01	1.82±0.05^{b}	0.21±0.02
Pad Area	1.07±0.07	0.44±0.01	2.01±0.06^{a}	0.23±0.02
Sexes × Housing Zones				
Male × Fan Area	1.21±0.11	0.44±0.02^{ab}	1.99±0.08	0.20±0.03
Male × Central Area	1.04±0.05	0.42±0.04^{ab}	1.77±0.05	0.22±0.05
Male × Pad Area	1.02±0.08	0.43±0.01^{ab}	2.03±0.09	0.27±0.02
Female × Fan Area	1.01±0.11	0.37±0.02^{b}	1.86±0.09	0.25±0.03
Female × Central Area	1.00±0.07	0.44±0.02^{ab}	1.83±0.07	0.20±0.02
Female × Pad Area	1.15±0.12	0.47±0.02^{a}	1.98±0.06	0.16±0.02

Different superscripts on different values show significant difference (P< 0.05).

Table VII: Effect of different housing zones on pancreas, heart, bursa and lungs weight % in sexed broilers.

Parameters	Pancreas Weight (%)	Heart Weight (%)	Bursa Weight (%)	Lungs Weight (%)
Sexes				
Male	0.57±0.37	0.41±0.01	0.09±0.01	0.37±0.01
Female	0.49±0.32	0.41±0.01	0.11±0.01	0.34±0.01
Housing Zones				
Fan Area	0.77±0.56	0.40±0.01	0.09±0.01	0.32±0.02^{b}
Central Area	0.64±0.48	0.41±0.01	0.10±0.01	0.35±0.01^{b}
Pad Area	0.19±0.01	0.42±0.01	0.11±0.01	0.41±0.01^{a}
Sexes × Housing Zones				
Male × Fan Area	1.18±0.96	0.42±0.01	0.09±0.01^{ab}	0.32±0.02^{b}
Male × Central Area	0.15±0.02	0.37±0.03	0.06±0.01^{b}	0.39±0.02^{ab}
Male × Pad Area	0.20±0.01	0.41±0.01	0.09±0.01^{ab}	0.42±0.02^{a}
Female × Fan Area	0.18±0.01	0.38±0.02	0.09±0.02^{ab}	0.33±0.04^{ab}
Female × Central Area	0.80±0.65	0.42±0.01	0.11±0.01^{ab}	0.33±0.02^{ab}
Female × Pad Area	0.18±0.01	0.42±0.01	0.14±0.02^{a}	0.38±0.01^{ab}

Different superscripts on different values show significant difference (P< 0.05).

Table VIII: Effect of different housing zones on spleen, gall bladder, abdominal fat and intestinal weight % in sexed broilers.

Parameters	Spleen Weight (%)	Gall Bladder Weight (%)	Abdominal Weight (%)	Intestinal Weight (%)
Sexes				
Male	0.06±0.01	0.07±0.01	1.23±0.08	5.28±0.25
Female	0.05±0.01	0.07±0.01	1.20±0.09	5.06±0.25
Housing Zones				
Fan Area	0.06±0.01	0.06±0.01	1.36±0.13	5.30±0.34^{ab}
Central Area	0.05±0.01	0.09±0.01	1.21±0.13	4.60±0.35^{b}
Pad Area	0.05±0.01	0.07±0.01	1.07±0.02	5.61±0.20^{a}
Sexes × Housing Zones				
Male × Fan Area	0.07±0.01^{ab}	0.05±0.01^{b}	1.43±0.19	5.61±0.51^{a}
Male × Central Area	0.06±0.01^{ab}	0.10±0.01^{a}	1.31±0.22	4.07±0.36^{b}
Male × Pad Area	0.04±0.01^{ab}	0.08±0.01^{ab}	1.02±0.02	5.45±0.28^{ab}
Female × Fan Area	0.04±0.01^{b}	0.07±0.01^{ab}	1.27±0.17	4.87±0.36^{ab}
Female × Central Area	0.05±0.01^{ab}	0.88±0.01^{ab}	1.18±0.16	4.78±0.45^{ab}
Female × Pad Area	0.08±0.01^{a}	0.05±0.01^{b}	1.16±0.05	5.93±0.15^{a}

Different superscripts on different values show significant difference (P< 0.05).

Table IX: Effect of different housing zones on shank, intestinal length and HI for ND, ELISA for IBD in sexed broilers.

Parameters	Shank Length (cm)	Intestinal Length (cm)	HI for ND	ELISA for IBD
Sexes				
Male	6.20±0.11	175.83±6.53	5.66±0.21	1233.02±173.49
Female	5.77±0.19	170.77±9.12	5.61±0.19	1672.72±194.32
Housing Zones				
Fan Area	5.78±0.28	169.25±7.18	5.08±0.23^{b}	1176.10±273.90
Central Area	5.99±0.13	179.66±7.90	5.58±0.24^{b}	1655.91±213.67
Pad Area	6.18±0.14	170.99±13.09	6.25±0.22^{a}	1526.59±187.51
Sexes × Housing Zones				
Male × Fan Area	6.20±0.14^{a}	169.92±9.24	5.28±0.35^{bc}	1421.83±133.71^{b}
Male × Central Area	6.15±0.28^{a}	177±16.91	5.66±0.61^{bc}	2580.45±388.15^{a}
Male × Pad Area	6.21±0.21^{a}	180.56±10.95	6±0.28^{ab}	1437.51±197.67^{b}
Female × Fan Area	5.21±0.62^{b}	168.30±11.97	4.80±0.24^{c}	2232.08±460^{ab}
Female × Central Area	5.94±0.15^{ab}	180.55±9.19	5.55±0.25^{bc}	1347.73±212.70^{b}
Female × Pad Area	6.11±0.15^{a}	151.85±33.11	6.75±0.31^{a}	1704.74±415.13^{ab}

Different superscripts on different values show significant difference (P< 0.05)

Table X: Effect of different housing zones on glucose, cholesterol and urea in sexed broilers.

Parameters	Glucose (mg/dl)	Cholesterol (mg/dl)	Urea (mg/dl)
Sexes			
Male	176.71±7.96	106.27±6.96	9.67±0.48
Female	172.85±6.94	92.56±5.61	9.88±0.47
Housing Zones			
Fan Area	181.37±10.90	109.13±8.43	8.80±0.14^{b}
Central Area	163.31±10.82	92.50±6.90	10.65±0.59^{a}
Pad Area	179.66±3.26	96.62±7.96	9.88±0.68a^{b}
Sexes × Housing Zones			
Male × Fan Area	199.72±8.27^{a}	112.55±12.48	8.77±0.51
Male × Central Area	116.85±33.82^{c}	106.16±15.57	10.10±0.86
Male × Pad Area	179.02±4.17^{ab}	100.81±10.11	10.31±0.91
Female × Fan Area	155.70±21.56^{b}	104.35±10.83	8.84±0.71
Female × Central Area	178.79±6.53^{ab}	87.94±7.56	10.84±0.70
Female × Pad Area	180.95±5.49^{ab}	88.25±13.13	9.03±0.93

Different superscripts on different values show significant difference (P< 0.05).

The results revealed that the antibody titer of ELISA for IBD and HI fir ND were significantly affected by three house zones but had no effect on sex (Table V-X).

The blood biochemistry data revealed that the blood glucose and cholesterol levels are significantly affected by different house zones while blood urea level was not affected by different housing zones as well as sex (table VI). Similarly, significant effects of different housing zones on blood glucose and cholesterol (Aqil *et al*., 2009) have been observed.

Conclusions

Based on the findings of this study, it may be stated that maintenance of broilers near pad area exhibited better growth performance and carcass quality as compared to those reared near fan area. The birds kept in the pad area had better immune response. However, blood biochemistry parameters were not influenced by temperature zones.

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