Available online at http://www.journalijdr.com

IJDR

International Journal of
DEVELOPMENT RESEARCH

ISSN: 2230-9926

International Journal of Development Research
Vol. 06, Issue, 04, pp. 7500-7504, April, 2016

Full Length Research Article

EFFECTS OF VARIED SEASONS ON PRODUCTIVE PERFORMANCES OF BOVANS BROWN AND KOEKOEK CHICKEN BREEDS IN SOUTH WELLO ZONE, ETHIOPIA

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ARTICLE INFO

Article History:
Received 13th January, 2016
Received in revised form
21st February, 2016
Accepted 19th March, 2016
Published online 27th April, 2016

Key Words:
Average daily gain, Feed,
Interaction effects,
Main effects,
Temperature.

ABSTRACT

This study was conducted to assess the effect of season (cold, hot and main rainy seasons) on the performances in Bovans Brown (BB) and Koekoek (Kk) chickens. The result revealed that effect of breed on feed intake per bird per day (gm) (FIg/b/d) was significant ($P<0.05$) and more pronounced in BB, the effect on average daily gain (gm) (ADG), feed conversion ratio (FCR) and mortality was also significant ($P<0.05$) but more pronounced in the Kk breed. Among the seasons ADG and RT was significantly ($P<0.05$) higher, and FCR was significantly ($P<0.05$) better during the hot season (HSe). There was a significant ($P<0.05$) breed by season interaction for FIg/b/d, ADG, FCR, RT and mortality. In all the seasons BB breed had higher FIg/b/d and in the main rainy season the Kk breed had higher ADG and mortality and better FCR. Further, Kk breed had higher RT in the HSe. In conclusion, koekoek breed was better performed when reared to three months of age which can be expressed in terms of ADG and FCR, but the higher mortality affected the survival rate of this breed that was associated with the poor quality of the chicks especially during the MRS and this in turn influenced the feed consumption of the breed.

INTRODUCTION

Tropical and developing countries often rely on exotic germplasm for breeding purposes. They however have climatic conditions, production systems, and markets different from those where animals were evaluated. Thus, the Genotype by Environment (G×E) interaction can cause a reduced efficiency of their genetic improvement programs. Genotype by environment interaction is usually described as a situation in which different genotypes (breeds, lines, or strains) respond differently to different environments (Sheridan, 1990). With the rapid development of the poultry industry worldwide, especially in developing countries, importation of temperate-zone high-performance stocks to hot regions is on the rise. The adaptability of the exotic breeds under the climate of tropical areas is a great problem for their susceptibility to heat and diseases than the local chickens. The environmental conditions under which poultry are kept and imbalanced diets do not permit to express the full genetic potentials of exotic breeds. Therefore, a suitable stock is necessary that will thrive well under all existing natural hazards in the rural free range condition (Barua, *et al.,* 1998). On the other hand, the main effects of exposure of homeothermic animals to heat are changes in the normal standard of rectal temperature. Rectal temperature can be considered the best isolated criterion to judge heat tolerance and it is an important efficiency indicator in the homeothermy maintenance facing the thermal environment. Rectal temperature can also be used to assess heat stress impacts (Spiers, *et al.,* 2004). Generally, it is expensive to build and operate climatic controlled facilities to conduct seasonal stress factor studies. This problem can be prevented by conducting studies in natural environments. Therefore, the present study was undertaken to assess the effect of seasons on the performances and rectal temperature in BB and Kk chicken breeds.

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MATERIALS AND METHODS

Experimental Site: The research was conducted in Kalu district Kombolcha town, South Wello Zone-Ethiopia; located 375 Km north East of Addis Ababa. The site has an altitude of

1810 to 1839 m and the average temperatures ranging between 12.5 to 18.15^{O}C and average annual rain fall (RF) ranges from 750 to 900mm (Archives of Kalu district of Agriculture).

Animals and Management: A total of 900 unsexed day-old chicks (DOC) were reared with a Completely Randomized Design (CRD) arrangement consisting of two breeds: BB and Kk and three seasons: CS, HSe and MRS (Table 1), with 6 treatments replicated into three. One hundred fifty chicks from each breed were assigned to CS, HSe and MRS. From hatch to 90-days age, they were raised on deep litter system with hay spread on the floor of the house.

One-month brooding period was adopted to all the 3 seasons and the brooder temperature was maintained at 32^{O}C during the first week using three 100-watt incandescent bulbs and gradually decreased thereafter by removing one bulb from each replication (pen) per week. The standard vaccination program was followed in all the treatments and birds were vaccinated once for Marek's disease on day 1, twice for Gumboro disease on day 21 and 28, three times for Newcastle disease (on day 7-HB1 on day 18 and 42 LaSota), once for fowl pox on day 56; and medications were given on regular basis to boost the immunity level of the birds.

Table 1. Breed structure and distribution of birds among the seasons

Seasons	Breeds	
	Bovans Brown (BB)	Koekoek (Kk)
Cold Season (CS)-October 21/2013-January 19/2014	150	150
Hot Season HSe)-March 25-June 22/2014	150	150
Main Rainy Season (MRS)-July 24 -October 21/2014	150	150

Table 2. Nutrient composition of commercial feed used for starters, growers, and pullets/cockerels during the experimental period

Diet	Starter	Grower	Pullets/Cockerels
Age	0-4 weeks	4-10 weeks	10-13 weeks
Nutrients			
Crude Protein (%)	20	18	16
Crude Fiber (%)	4.0	4.5	5.0
ME (kcal/kg)	2975	2875	2750
Crude fat (%)	4.0	3.7	3.5
Crude ash %	7.3	7.0	6.5
Methionine (%)	0.54	0.45	0.35
Lysine (%)	1.20	1.00	0.78
av Phosphorus (%)	0.50	0.48	0.45
Sodium (%)	0.16	0.15	0.15
Added vitamins per Kg of feed			
Vitamin A, IU	13000	10000	10000
Vitamin D_3, IU	3000	2000	2500
Vitamin E, mg	25	25	25

Table 3. Summary of the ANOVA of the effect of Br, Se and the interaction effects of Br*Se on FIg/b/d, ADG, FCR, RT and Mortality

Dependent Variables	Mean Square/Source			
	Br	Se	Br*Se	Error
FIg/b/d	34.72*	6.38	17.22*	2.99
ADG	7.71*	10.92*	2.62	0.74
FCR	3.81*	8.73*	2.53*	0.26
RT^{O}C	0.03	2.80*	0.17*	0.02
Mort	53.39*	9.50	15.72*	3.06
Mort%	213.56*	38.00	62.89*	12.22

*Significantly different at p<0.05; Br-Breed, Se-Season, Br*Se- Breed by Season interaction.

Table 4. LSM and SEM values for the main effects of Br and Se on FIg/b/d, ADG, FCR, RT and Mortality

Dependent variables	1.LSM 2.SEM	Br		Se		
		BB	Kk	CS	HSe	MRS
FIg/b/d	1	42.27a	39.49b	41.17a	41.73a	39.73a
	2	0.45	0.98	0.52	0.20	1.79
ADG	1	6.93b	8.24a	6.06b	8.09a	8.61a
	2	0.29	0.65	0.24	0.65	0.50
FCR	1	6.17a	5.25b	7.06a	5.31b	5.75b
	2	0.21	0.56	0.18	0.39	0.47
RT^{O}C	1	41.86a	41.94a	41.22c	42.58a	41.90b
	2	0.17	0.24	0.06	0.11	0.06
Mort	1	1.44b	4.89a	3.00a	2.00a	4.50a
	2	0.29	1.06	0.78	0.26	1.84
Mort%	1	2.89b	9.78a	6.00a	4.00a	9.00a
	2	0.59	2.12	1.55	0.52	3.68

- means with different subscript are significantly different from each other within the main effect.
LSM-Least squares means, SEM-Standard Error of the Mean.

Foot bath containing formalin was also placed at the entrance of the house. On average 3679g/b commercial feed was offered up to 90-days of age, and its nutritional specification is given in Table 2. The feed offered and its nutritional specification was according to the management guide of the breeds. Clean water was provided *ad libitum* all the time. For all age groups vitamins, minerals and amino acid supplements were incorporated in the drinking water according to the manufacturer's recommendation.

Data Collection: The data included FIg/b/d, ADG, FCR, rectal temperature (RT^OC) and mortality. Average minimum and maximum ambient temperature (AT), average relative humidity (RH) and total rainfall (RF) for the CS, HSe and MRS were obtained from the Ethiopian meteorology station in Kombolcha town; hence the values were 10.1/25.6, 14.5/29, 13.9/27.3^OC; 56.5, 49, 60.5% and 33.8, 52, 199.8 mm respectively. The feed offered according to the management guide of the breeds determined FI (g/b/d). Average daily gain was obtained by dividing body weight gain with 88-day, and the body weight gain was determined as the difference between the final (90th day) and the initial (3rd day) weights taken during the experimental period on a sensitive scale. FCR was calculated as the proportion of the weight of feed eaten by a bird per day to their ADG. The FCR was determined at end of the study. Rectal temperature was taken twice at 60 and 90-day age, from five sample birds from each replication using digital thermometer. The mortality was determined by recording birds that died during the experimental period.

RESULTS AND DISCUSSION

The detail results of the performances, RT and mortality are presented in the ANOVA Table 3; and LSM and SEM of the main effects in Table 4, and the interaction effects in Table 5.

Feed Intake per bird per day (FIg/b/d): Significantly (P<0.05) higher feed intake per bird per day (FIg/b/d) was observed in BB chicken breed, in BB across the seasons and Kk breed during the HSe. This study reveals that the performance of breeds in terms of FI depends on the genetic makeup of the flock. The result agreed with those of (Taha, *et al.,* 2011) who found significant differences in FI among strains of chickens. Conversely the lower FIg/b/d of the Kk breed in the present study could be due to its higher mortality rate during the MRS, though better FIg/b/d was recorded in this breed during the HSe followed by the CS. This study showed significant (P<0.05) difference in the effect of breed by season interaction in FIg/b/d, BB perform better in all the seasons than Kk. Similarly, (Yakubu, *et al.,* 2007) noted genotype × season interaction had significant effects on FI parameter studied.

Average Daily Gain (ADGg): In this study Kk breed was significantly (P<0.05) superior in ADG to their BB counterparts. (Taha, *et al.,* 2011) obtained similar results using different strains and breeds. Conversely, (Ali, 2006) in Iraq revealed a non-significant differences between three broiler hybrids (Lohman, Ross and Hubbard) in their body weights.

Table 5. LSM and SEM values for interaction effects of Br*Se on FIg/b/d, ADG, FCR, RT and Mortality

Dependent variables	1.LSM 2.SEM	Br*Se					
		BB			Kk		
		CS	HSe	MRS	CS	HSe	MRS
FIg/b/d	1	41.77a	41.97a	43.07a	40.57ab	41.50a	36.40b
	2	0.53	0.33	1.24	0.84	0.17	1.82
ADG	1	6.16c	6.96bc	7.67abc	5.95c	9.21ab	9.55a
	2	0.08	0.29	0.56	0.51	0.88	0.20
FCR	1	6.78ab	6.05ab	5.68bc	7.34a	4.58dc	3.82d
	2	0.03	0.21	0.41	0.29	0.40	0.25
RT^OC	1	41.22d	42.36b	41.99c	41.21d	42.81a	41.80c
	2	0.14	0.07	0.04	0.02	0.06	0.07
Mort	1	1.67b	1.67b	1.00b	4.33ab	2.33b	8.00a
	2	0.67	0.33	0.58	0.88	0.33	2.08
Mort%	1	3.33b	3.33b	2.00b	8.67ab	4.67b	16.00a
	2	1.33	0.67	1.16	1.76	0.67	4.16

- means with different subscript are significantly different from each other within the two interaction effects

Data Analysis: The data analysis was done with SAS (2002) procedures with the General Linear Model (GLM) including the main effects of breed and season and all two-way interactions. Least squares means (LSM) employed for mean comparisons and Tukey's Studentized Range (HSD) Test was conducted to separate the means. The process employed the following models:

$$Y_{ij} = \mu + a_i + b_j + (ab)_{ij} + e_{ij}$$

Where Y_{ij} =The observation taken at the i^{th} breed and j^{th} season, μ=The overall mean of the population, a_i = The effect due to the i^{th} breed, b_j = The effect due to the j^{th} season, $(ab)_{ij}$ = The effect due to the interaction between the i^{th} breed and the j^{th} season and e_{ij} = Random error associated with the observation Y_{ij}.

Other authors such as (Thutwa, *et al.,* 2012) also reported insignificant strain differences in BWG. Significantly (P<0.05) lower ADG recorded in both breeds during the CS. Average daily gain in the MRS, HSe and CS are shown in Table 4. ADG was significantly (p<0.05) higher in the MRS followed by HSe and significantly (p<0.05) lower during the CS. Similar to the present study body weight was higher in the wet season compared with the hot-dry season (Yakubu, *et al.,* 2007). In contrast to the present study (Lu, *et al.,* 2007) concluded with respect to local Beijing You chickens, there was no difference between chickens exposed to different levels of temperatures with regard to BWG. On the other hand, Kk breed during the MRS followed by Kk during the HSe and then the BB during the HSe had significantly (P<0.05) higher in ADG. (Jesuyon and Salako, 2013) indicated significant (P<0.05) interaction between genotype and season in mean cock weight. Bovan nera cocks exhibited higher body weight

in late dry season while Isa Brown cock indicated higher weight in early dry season. This result negated the preliminary analyses of (Adebambo, *et al.,*2006) in which the effect of interaction of breed with season was not significant in the same environment.

Feed Conversion Ratio (FCR): Birds that have a low FCR is considered efficient users of feed. Accordingly, in the present study significantly better FCR observed in Kk, hot and MRS birds from the main effects and the interaction between Kk and MRS-Kk*MRS. The significant difference in the FCR during the grower period with higher means for Ross than Cobb (Yakubu, *et al.,* 2010) was consistent with the present study. Likewise, (Taha, *et al.,* 2011) reported that genotype affects FCR of broiler chickens. However, other authors (Thutwa, *et al.,* 2012) reported insignificant strain differences in FCR. On the other hand, feed efficiency varied depending on season of the birds reported by (Oguntunji, *et al.,* 2008) was in consistent to the present study. (Uzum and Oral Topluh, 2013) reported that season did not influence feed conversion, which disagreed with the results of this study. Regarding the interaction effects, unlike the present study (Rack, *et al.,* 2009) reported no significant interaction between season (late fall, spring, summer, and early fall) and genotype (a slow-growing: Gourmet Black and a fast-growing: (Cobb 500 × Cobb 500 broiler genotype). However, (Yalcin, *et al.,* 1997b) presented similar reports that the interactions between naked neck *(Na)* genotype and climate (G´C) affected feed efficiency (FE) in both sexes.

Rectal Temperature: There was no significant difference for RT among breeds, but significantly (P<0.05) higher RT was recorded during the HSe, followed by MRS and the lower RT was recorded during the CS. Again, the interaction between Kk and HSe-Kk*HSe showed significantly higher RT, followed by the interaction between BB and HSe-BB*HSe and significantly (P<0.05) lower RT was recorded in Kk*CS and BB*CS. Meanwhile the three seasons included under this study clearly differed in AT and RH. The average minimum and maximum AT and average RH of the CS, HSe and MRS recorded during the experimental period was 10.1/25.6, 14.5/29, 13.9/27.3^{O}C and 56.5, 49, 60.5% respectively. Accordingly, in the present study the RT was significantly higher, intermediate and lower during the HSe, MRS and CS respectively. The fact that performance (FI, ADG and FCR) was not affected by the 29 ^{O}C moderate AT and 49% RH observed during the HSe may relate to better thermoregulation capability of the two breeds compared to the heavier broiler chickens. Likewise, (Joachim, *et al.,* 2011) reported that high temperature accompanied by high humidity is more detrimental to layer performance than high temperature with low humidity. At the same time, constant high temperature of 30-32°C is more deleterious to birds than cyclic or alternating temperatures of 30-32°C by day and 25°C by night. Similar to the present study (Medeiros, 2001) revealed that the average RT of broiler chickens is around 41.5°C, ranging from 40.6 to 43.0°C, and the upper safety limit to maintain their survival is equal to 45°C.

Regarding breeds, no significant RT difference was found between the two breeds in the present study because the two breeds are not heavy breeds like those of broilers. (Deeb and Cahaner, 2002) for instance revealed that the intensive genetic selection for fast growth rate means that modern species of broiler chickens are very susceptible to heat stress. In addition, proper ventilation employed during the present study could play an important role in thermoregulation of the two breeds at moderate AT observed during the HSe. Accordingly, (Yahav, *et al.,* 2008) reported that efficient ventilation affects thermoregulation and, thereby, the performance of domestic fowl. Yet the interaction effects in Kk*HSe showed significantly (P<0.05) higher RT, followed by BB*HSe and significantly (P<0.05) lower RT was recorded in Kk*CS and BB*CS. The difference between the higher HSe and lower cold season RT was 1.6^{O}C for Kk and 1.08^{O}C for BB. From the observed RT of the present study Kk breed seems to be more sensitive to seasonal variation than the BB. Of course both breeds showed insignificant higher and lower RT during the hot and CS respectively. Body temperature of the normally fed broilers (BT1) increased by AT, i.e., it was higher in summer than in fall (Yalcin, *et al.,* 1997a) is in consistent with the present study. In general information on the interaction effect of season with breed on chickens RT and performance is scarce.

Mortality: Significantly (P<0.05) higher mortality was observed on the Kk breed in terms of number and percentage mortality and BB had the least mortality. Even though season was not affected mortality of the birds, it was affected by the interaction effect of breed by season with the highest mortality value recorded during the MRS in the Kk breed followed by during the CS in this same breed. Similarly, previous researchers had reported significant effect of breed on mortality rate (Yakubu, *et al.,* 2007; Reta, *et al.,* 2012). Unlike the present study where there is breed variation in their survival rate (Benyi, *et al.,* 2015) reported performance during the starter period (21-day) and grower period (35-day) shows that genotype did not affect mortality rate; indeed, the Kk chicks-especially those raised during the MRS were poor quality from the poultry farm where they were hatched. This result is in harmony with that of (Spiers, *et al.,* 2004) who found significant (P<0.01) strain by season interaction effects on mortality. The results showed that Dominant Black had the highest mean values in almost all the season subdivisions, Bovans Nera was second in that order, while Isa Brown recorded the lowest in all the seasons considered; but disagrees with the result obtained by (Mmereole, *et al.,* 2007) who reported genotype x season interaction effects were not significant (P<0.05) in influencing the mortality. During the present study cannibalism (toe picking) behaviour was observed in the Kk breed and identified as one of its causes of mortality.

Conclusions and Recommendation

It may be concluded that overall Kk chickens originated from the tropical region of Africa performed better when raised to 3-months age which can be expressed in terms of ADG and FCR. But the higher mortality during the MRS affected the survival rate of this breed which was associated with the poor quality of the chicks; the low survival rate in turn influenced their feed consumption. The higher ADG in the dual purpose breed like the Kk is expected one unlike the BB that is an egg type and lighter breed. In the present study the two breeds perform better during the MRS and HSe compared to CS that

is CS might be stressful to both breeds. There is a need to make further investigations on the response of the two breeds to the rearing environments as reflected by RT under controlled environmental conditions for extended periods.

Acknowledgment

The authors wish to thank the Department of Animal Production Studies and College of Veterinary Medicine and Agriculture under Addis Abeba University for supporting this research. This research was funded by Addis Abeba University and Wollo University.

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