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Article

Response of broiler to supplementation of potassium chloride during summer

Rezwan Ahmed Rahi, Sumaiya Afrin*, Md. Abdur Rahman Howlider and Md. Shawkat Ali

Department of Poultry Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

*Corresponding author: Sumaiya Afrin, Department of Poultry Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. E-mail: sumaiyaafrin62@yahoo.com

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Abstract: A total of 90 day old as hatched Cobb 500 broilers had free access to a pre-starter diet (crumble) from day old to 14 days of age. A starter diet (pellet) was provided up to end of the experiment. Broilers were allocated to 0 (control), 0.2 or 0.4% of potassium chloride (KCl) in drinking water and reared up to 500, 1000 or 1500g target weights to vary the rearing period. The study was aimed at to assess broiler performance (growth and meat yield) altered by KCl supplementation in drinking water in a hot and humid summer. KCl had no effect ($p>0.05$) on growth and meat yield characteristics of broilers except feed conversion ($p<0.05$) at different target weights. In most of the growth and meat yield parameters, KCl had no interactions ($p>0.05$) with target weights. However, 0.4% KCl level slightly improved feed intake, growth rate and performance index. Increasing level of KCl tended to increase most of the major meat yield characteristics. On the basis of results of this study, it may be concluded that, supplementation of KCl in drinking water in summer improved the feed conversion of broilers. However, further experiments using several doses of KCl may be conducted to confirm the appropriate doses of supplementation.

Keywords: KCl; broiler performance; summer

1. Introduction

Poultry industry is growing very fast in Bangladesh since 1999. Elevated ambient temperature is still a major limit to growth and meat yield of broilers in summer (Charles *et al*., 1978; Fox, 1980; Howlider and Rose, 1987; Arjona *et al*., 1989). Reduced feed intake, growth rate, feed conversion, dressing yield, breast meat yield, total meat yield and increased carcasses fat deposition and mortality are the immediate consequences of rearing broilers in a hot humid summer (Cowan and Michie, 1978; Howlider and Rose, 1987; Geraert, 1998). Broiler growth, meat yield and profitability are more severely affect by high temperature if it is accompanied by higher relative (RH) humidity (Charles *et al.,* 1978). Profitability of broiler farming during summer is reducing day by day for sudden heat stroke of broilers. Miah (2004) provided an estimation of Tk. 1240 million losses resulting for summer stress in broilers. For reducing the summer stress scientists are applying different methods and seeking for new and safest method for broilers as well as consumer. In this regard, supplementation of potassium chloride has shown potentiality to reduce summer stress in broiler.

Potassium and chloride, the most abundant intracellular cation and anion, involved in many metabolic processes, including nerve conduction, excitation contraction in muscles, regulate cell volume and acid-base balance. Consequently, changes K+ homeostasis profoundly affect cellular functions (Their, 1986). The thermo tolerance of broilers exposed to acute heat stress could be improved to some extent by supplementing either in diet with K salts (Ahmad *et al*., 2005) or drinking water with KCl (Smith and Teeter, 1987). Ahmad *et al*. (2008) investigated Supplementing drinking water with 0.6% KCl reduced panting-phase blood pH to 7.31 and significantly increased live weight gain by 14.5 ($P<0.05$) and 7.9% ($P<0.05$) at 28 and 42 days of age respectively. An improved (P<0.05) feed conversion and lowered body temperature were noted in groups supplemented with 0.6% KCl as compared to control and 0.3% KCl. Borges (1997) also suggested that supplementing KCl in the feed of broilers resulted in improved weight gain. Supplementation of potassium chloride (KCl) in poultry diet is not normally practiced in Bangladesh. Based on these findings, it has been postulated that drinking an electrolyte solution rich in K+ might elicit favorable changes in the physiological adjustments of broilers during summer in Bangladesh. The purpose of this study was to assess broilers growth and meat yield altered by KCl supplementation in drinking water during summer.

2. Materials and Methods

An experiment designed with 90 day old as hatched Cobb 500 broiler had free access to a pre-starter diet (crumble) from day old to 14 days of age. A starter diet (pellet) was provided up to end of the experiment. The pre-starter diet contained ME 2950 kcal/kg, CP 21.00, CF 5.00, Ca 1.00, available phosphorus 0.45%. Whereas, the starter diet contained ME 3000 kcal/kg, CP 20.00, CF 5.00, Ca 0.95, available phosphorus 0.45%. Broilers were allocated to 3 levels of potassium chloride (KCl) and 3 replications for each level of KCl. Ten broilers constituted each replication. Broiler diets supplemented with 0, 0.2 and 0.4% potassium chloride were supplied throughout the experimental period. The records were kept on initial live weight, growth, feed intake, feed cost and survivability growing them up to some given target weights (TW); 500, 1000 and 1500g. All the broilers had exposure to a continuous lighting of 23h and 1h dark period every day. Rice husk at a depth of 5cm was used as litter material. All broilers had free access to continuous drinking facilities. Floor space for each broiler was 900cm2. The live weight of broilers was monitored for each pen to reach some given TW. A routine vaccination was performed to all broilers against New Castle and Gumboro diseases. From each replication, 3 broilers weighing average of pen weights were randomly selected for further analysis. The selected broilers were fasted for about 8 hours before slaughtering. They were defeathered, eviscerated, dressed and removed unnecessary organs and debris. The meat components of the carcass were stripped out to show the overall effects on meat yield and their comparison among treatment combinations. The major meat yield characteristics recorded were dressed yield, total meat, breast meat, dark meat, thigh meat, drumstick meat, wing meat and trimmed meat. The meat yield related data were on feather, neck (length and weight), blood loss, liver, heart, head, spleen, abdominal fat, gizzard, length and weight of elementary tract. Dissection of carcass was recorded for each broiler was performed by the procedure of Jones (1984). All data either recorded or calculated were for a 3(KCl) x 3(TW) factorial experiment in CRD with multiple observation per cell (replication). All the meat yield data were converted into percentage of individual live weight prior to statistical analysis. A GENSTAT computer package was used for statistical analysis.

3. Results

3.1. Growth performance

Regardless of potassium chloride (KCl) level in drinking water increased growth (p<0.001) at increasing target weights (TW) (Table 1). However, KCl and its interaction with TW did not alter growth. Day old chick (DOC) weights were similar in control and on KCl supplementary diets (p> 0.05). Rearing of broilers from 500 to 1000g and 500 to 1500g increased feed intake by 128% and 270% (p<0.001). However, there was also a significant increase of feed intake by 62% for reaching the target weight from 1000 to 1500g per broiler. Feed conversion ratio (FCR) as the negative indicator of feed conversion efficiency (FCE). Increasing KCl level at increasing TW was linearly improved feed conversion efficiency (FCE). Survivability was not influenced by KCl, TW and by their interactions. The difference of feeding cost against the TW was highest in control diet and linearly increased for the increase of KCl. Only one broiler died between 1000 and 1500g TW on supplementing 0.4% KCl which was considered not to be associated with the KCl (Table 1).

3.2. Meat yield characteristics

The major and important meat yield characteristics (Table 2) reveal that dressing yield, total meat, breast meat, dark meat, thigh meat, drumstick meat, trimmed meat, abdominal fat, liver, neck, heart, head and blood were significantly increased linearly with increasing TW (p<0.001) and not influenced by the level of KCl and KCl did not interact with TW (p>0.05). However, wing meat, drumstick bone, thigh bone, wing bone, neck, spleen did not significantly differ for KCl, TW and their interaction (p>0.05).

Table 1. Growth performance of broilers at different target weights (TW) supplemented with potassium chloride (KCl) in drinking water.

Variable	**KCL**	**TW (g)**				**SED and Significance**		
		500	**1000**	**1500**	**Mean**	**KCL**	**TW**	**KCLXTW**
Rearing period (day)	0.0	14.67	22.00	28.01	21.56	0.203NS	0.203***	0.249NS
	0.02	14.33	21.67	28.02	21.33			
	0.04	14.00	21.67	27.67	21.11			
	Mean	14.33	21.78	27.89	21.33			
DOC weight (g/broiler)	0.0	42.26	42.24	42.26	42.25	0.204NS	0.204NS	0.249NS
	0.02	42.34	42.34	42.34	42.34			
	0.04	41.90	41.90	42.23	42.01			
	Mean	42.17	42.16	42.28	42.20			
Feed intake (g/broiler)	0.0	621.80	1377.30	2200.60	1399.90	20.670NS	20.670***	35.810
	0.02	595.00	1323.60	2200.50	1373.00			
	0.04	559.20	1349.60	2177.10	1361.90			
	Mean	592.00	1350.10	2192.70	1378.30			
Growth rate (g/broiler/day)	0.0	33.56	45.14	52.76	43.82	0.446NS	0.446***	0.773NS
	0.02	33.76	45.00	53.21	43.99			
	0.04	33.07	45.35	53.38	43.94			
	Mean	33.46	45.17	53.12	43.92			
FCR (feed intake/weight gain)	0.0	1.26	1.39	1.49	1.38	0.010*	0.010***	0.013NS
	0.02	1.23	1.36	1.48	1.35			
	0.04	1.21	1.37	1.48	1.35			
	Mean	1.23	1.37	1.48	1.36			
Survivability (%)	0.0	100.00	100.00	100.00	100.00	0.907NS	0.907NS	1.571NS
	0.02	100.00	100.00	100.00	100.00			
	0.04	100.00	100.00	96.67	98.89			
	Mean	100.00	100.00	98.89	99.63			
$Feeding cost (Tk/broiler)	0.0	27.67	61.29	97.93	62.29	1.011***	1.011***	1.751***
	0.02	34.50	71.70	114.82	73.67			
	0.04	40.56	85.28	131.56	85.80			
	Mean	34.25	72.75	114.77	73.92			
Performance Index	0.0	40.69	74.28	102.88	72.62	0.762NS	0.762***	1.302NS
	0.02	42.25	74.24	102.11	72.87			
	0.04	41.47	74.33	103.85	73.22			
	Mean	41.47	74.28	102.95	72.90			

+NS, Non-significant; *****, p<0.05; *******, p<0.001; all SED's are against 18 error degrees of freedom; $, Feeding cost= cost of feed and KCl

Table 2. Meat yield characteristics (%) of broilers at different target weights (TW) supplemented with potassium chloride (KCl) in drinking water.

Variable	KCL	TW (g)				SED and Significance		
		500	1000	1500	Mean	KCL	TW	KCLXTW
Sample live weight (g/broiler)	0.0	513.40	1029.00	1532.00	1024.90	6.804NS	6.804***	11.850NS
	0.02	518.80	1008.00	1508.00	1011.60			
	0.04	500.70	1021.00	1531.00	1017.70			
	Mean	511.00	1019.40	1523.80	1018.10			
Dressing yield	0.0	61.25	69.82	71.16	67.41	1.017NS	1.017***	1.762NS
	0.02	63.03	70.34	69.10	67.49			
	0.04	66.58	70.11	69.84	68.85			
	Mean	63.62	70.09	70.03	67.92			
αTotal meat yield	0.0	28.638	33.77	36.58	33.01	0.775NS	0.775***	1.342NS
	0.02	30.14	33.38	35.48	33.00			
	0.04	30.42	32.40	37.67	33.50			
	Mean	29.75	33.18	36.58	33.17			
Breast meat	0.0	12.11	14.00	16.42	14.18	0.564NS	0.564NS	0.978NS
	0.02	12.50	13.09	16.58	14.05			
	0.04	12.83	12.98	16.65	14.16			
	Mean	12.48	13.36	16.55	14.13			
Breast meat	0.0	15.07	17.84	18.33	17.08	0.455NS	0.455***	0.788NS
	0.02	16.37	18.52	17.54	17.48			
	0.04	16.49	17.41	19.04	17.65			
	Mean	15.97	17.92	18.30	17.40			
Breast : Dark meat	0.0	0.81	0.79	0.90	0.83	0.038NS	0.038***	0.066NS
	0.02	0.77	0.71	0.95	0.81			
	0.04	0.78	0.75	0.88	0.80			
	Mean	0.79	0.75	0.91	0.81			
Thigh meat	0.0	7.56	8.37	8.95	8.29	0.288NS	0.288**	0.500NS
	0.02	8.09	8.51	8.77	8.46			
	0.04	8.25	8.13	9.20	8.52			
	Mean	7.97	8.33	8.98	8.43			
Drumstick meat	0.0	5.01	6.19	6.11	5.77	0.201NS	0.201***	0.348NS
	0.02	5.50	6.86	6.15	6.17			
	0.04	5.46	6.07	6.52	6.02			
	Mean	5.32	6.38	6.26	5.99			
Wing meat	0.0	2.49	3.28	3.27	3.01	0.221NS	0.221NS	0.382NS
	0.02	2.78	3.15	3.62	3.85			
	0.04	2.79	3.21	3.32	3.12			
	Mean	2.69	3.21	3.07	2.99			
Trimmed meat	0.0	1.51	1.93	1.83	1.76	0.194NS	0.194*	0.335NS
	0.02	1.28	1.77	1.36	1.47			
	0.04	1.09	2.01	1.99	1.70			
	Mean	1.29	1.91	1.73	1.64			
Abdominal fat	0.0	0.53	1.18	1.32	1.01	0.121NS	0.121***	0.209NS
	0.02	0.67	1.11	1.30	1.02			
	0.04	0.64	0.86	1.22	0.91			
	Mean	0.61	1.05	1.28	0.98			

+NS, Non-significant; *****, p<0.05; ******, p<0.01; *******, p<0.001; all SED's are against 18 error degrees of freedom

4. Discussion

4.1. Growth Performance

The data presented in Table 1 indicated that Potassium chloride (KCl) supplementation in drinking water failed to show any significant ($p>0.05$) impact on rearing period, DOC weight, feed intake, growth rate and survivability. The current results contradict Ait-Boulahsen *et al.* (1995). They reported increased ($p<0.05$) feed intake with increasing KCl levels. Same feed conversion (FC) on experimental diet increased in almost in a linear fashion on 0.2 and 0.4% perhaps signify ($p<0.05$) that increased FC on KCl supplementation than that on control. The data impress that optimum level of KCl supplementation in drinking water appeared to be somewhere between 0.4% or higher. Such a dilemma; however, agree with Ahmad *et al*. (2008). They found an improved ($p<0.05$) FC at 0.6% KCl supplementation in drinking water as compared to control. In present study, feeding cost was significantly increased by almost 17 and 30% on 0.2 and 0.4% KCl supplementation respectively in comparison with control counterparts receiving no KCl. The information generated in this study dictates that the optimum level of KCl supplementation is yet to be determined using larger flock size and also by adding other interacting factors (age, sex, breed, nutrition status, diet composition and form). The increased rearing period with increasing live weight is very much well understood (Howlider and Rose, 1989). The rearing period and weight gain relations are shown by many previous investigators. It is very clear that in most of the growth parameters did not vary for supplementation of KCl in drinking water at various doses. Performance index (PI) seems to be functions of feed intake and feed conversion ratio differed in a high significance (Table 1). The result showed that PI significantly increased with increasing live weights.

4.2. Meat yield characteristics

The data obtained on broiler meat yield characteristics are narrated and compared (Table 2) among the broilers reared on iso-nitrogenous and isoenergitic diets with 0 (control), 0.2 or 0.4% KCl supplementation in drinking water. The information generated impresses that major and vital meat yield characteristics did not differ among broilers on supplementation of KCl in drinking water. The dressing yield, total meat, breast meat, dark meat, breast: dark meat ratio, thigh meat, drumstick meat, trimmed meat, abdominal fat, liver, neck, heart, head, feather, blood, shank and weight of elementary tract were linearly increased at heavier live weights. The data also reveal that KCl level in drinking water failed to show any difference in meat yield which could be explained by the variation of KCl. Moreover, KCl levels even could not show any interaction with target weights. The results are in accordance with Smith and Teeter (1987). They showed that KCl solutions increased water consumption of cyclically heat-stressed broilers but did not affect carcass dressing or feed efficiency. Similarly, Souza *et al.* (2002) did not report any effect of KCl supplementation on carcass response or abdominal fat.

Overall results obtained signify that KCl did not affect growth performance and meat yield characteristics except an increasing FC with increasing KCl level. But KCl had a tendency to slightly increase the performance of broiler. All broilers in this study did not receive any antibiotic, growth promoter and antioxidant as additives.

5. Conclusions

Supplemental KCl in drinking water had no impact ($p>0.05$) on feed intake, growth rate, survivability and performance index except feed conversion ($p<0.05$). In most of the growth parameters, KCl had no interaction with TW though increasing KCl level tended to slightly increase growth performance of broilers. The major and vital meat yield characteristics did not differ among broilers on supplementation of KCl in drinking water. Moreover, KCl levels did not interact with target weights to influence any growth and meat yield characteristics. However, increasing KCl had a tendency to slightly increase the broiler performance. Overall results on growth and meat yield may be slightly increased at 0.4% level of KCl in comparison with control. Such an assumption was made from the slight beneficial effect of 0.4% KCl on broiler performance. It may be recommended that either 0.4% KCl or higher may be useful in broilers. So, future experiment could be undertaken with different doses higher than 0.4% KCl.

Conflict of interest

None to declare.

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