Effects of drinking water sources on performance and carcass indices of broiler chickens

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Abstract

Water samples were taken from four different sources (Well, stream, borehole and treated). Chemical and bacteriological analyses of samples carried out to determine, lead, cadmium, manganese, aluminium, sodium, bacteria counts and isolates revealed that mineral elements were significant (P<0.05) among water samples from four different sources except for lead. Apart from the treated water sample; results of the bacteria counts and isolates revealed that the water samples contained some levels of bacteria species (Klebsiella oxytoca, Pseudomonas aeniginosa, Bacillus subtilis, Streptococcus faecalis and Enterobacter cloacae). Then an experiment was carried out to investigate the effects of the water sources on broiler performance and carcass parameters. Except for the birds on the treated water that had significant (P<0.05) weight gain among the water sources; generally, the performance indices were not significantly (P>0.05) affected by the treatments. Carcass parameters were not significantly (P>0.05) affected by the treatments except for the neck. Hence, this investigation tends to reveal that the outcome of the chemical and bacteria analysis o the water samples did not have significant (P>0.05) effect on broilers performance an carcass growth. Therefore, within the limit of this study; in terms of period an location, any of the investigated water samples is good for broiler consumption withou any detrimental effect to their wellbeing.

Key words: Water quality, broiler performance, carcass

Introduction

Water is the most critical nutrient that we consciously supply to birds (Leeson and Summer, 1997). This tends to reveal the relevance of water in the wellbeing and performance of poultry chickens. Bird's water intake depends on feed intake, ambient temperature and salt/mineral content (Hulzenbosch, 2004). Mc Donald *et al* (2002) mentioned that water is vital to the life poultry as they will die more rapidly if deprived of water than deprived of feed. Broiler drinks a great deal of water; during its lifetime, a 2.3 kg broiler will consume about 8.2 kg of water, compared to approximately 4.6 kg of feed (Lacy, 2002).

Pesti ***et al.*** (1985) estimated the daily wa consumption of broilers by multiplying age of the bird in days by 6 ml. Water h to maintain homeostasis by participatin reactions and physiological changes w control pH, osmotic pressures, electr concentrations and other funct necessary for life (Scott *et al.*, 1982). W and feed consumption rates interdependent, so reduced water intal also lead to reduced feed intake. The r *thumb for water intake is that water in* usually 1.5 to 2 times feed intake. Wa of less than 5.9 was harmful t performance (Carter, 1987). Howe recent work of Watkins *et al*

Table 1: JOSEPH AYO BABALOLA UNIVERSITY TEACHING AND RESEARCH FARM MEDICATION AND VACCINATION PROGRAMME FOR POULTRY

Period	Medication	Vaccination
Day 1-5	Give only glucose and vitamin the first day, follow with antibiotics and vitamins.	I/O Vaccination at first day on the farm to cancel out hatchery error
Day 6-11	Preventive treatment against coccidiosis	1st IBDV Vaccination at day 7
Day 14	Watch out for coccidiosis and treat	2nd IBDV Vaccination
Day 21	Watch out for infections and treat accordingly	1st NDV Lasota Vaccination
Day 28	-	3rd IBDV Vaccination
Week 6	-	2nd NDV Lasota or Kamarov
Week 7	Antibiotic and Vitamins (On Vet. recommendation)	
Week 8	-	Fowl pox Vaccination
Week 12	1st Deworming/ Delousing (On Vet. recommendation)	
Week 16	-	3rd NDV Lasota or Kamarov
Week 17-18	Delousing (Vet. recommendation)	
Week 19 upwards	-	NDV Vaccination booster at this period consults your Vet. Doctor

reported that lowered pH of drinking water to 3,4 or 5 had no significant improvement on average weights, feed conversion or water consumption of broiler chicken. This tends to show that birds are very tolerant to a wide range of water pH. Since the critical role of water cannot be undermined in a poultry farm; efforts should be geared towards its proper management. In-line with this, Brian (2009) suggested that water quality should be checked regularly; about once a year. However, Hulzenbosch (2004) had earlier advised that drinkers should be cleaned regularly or birds do it by closing the water supply everyday for a short period; birds thus have the opportunity to finish the water and the feed residues in the drinker. **Watkins** (2008) advised that water supplies should be tested if there are noticeable changes in colour, odour or taste, any flooding near the well, person or animal becomes sick from waterborne disease, persistent poor flock performance and loss of pressure in water system. Consequently, this study tends to examine the effects of water on broiler performance and carcass parameters with focus on the major available water sources in Joseph Ayo Babalola University Teaching and Research Farm.

Materials and Methods

Experimental water:

Four different sources of water: well, stream, borehole and treated water were the experimental treatments. The well water was sourced from the well at the Joseph Ayo Babalola University Teaching and Research Farm. The well has a depth of

3.75m. Stream water was sourced from the Stream that runs adjacent to Teaching and Research Farm. The borehole water was from the borehole (40.00m depth) that serves the University water packaging plant and some part of the University community. The treated water (water already subjected to the certified treatment procedure for table water packaging) was from the water packaging plant of "JABU® Water".

Analysis of water:

Samples of experimental water were collected for analysis using sterilized glassware containers. Chemical and bacteriological analyses of water were carried out to determine, lead, cadmium, manganese, aluminium, sodium, bacteria counts and isolates (Stephenson, 2008).

Management of chicks and Experimental lay-out:

The Ninety-Six (96) day-old unsexed Arbor Acres broiler-chicks used were supplied by Amo Farm Seberer Hatchery Limited, Awe, Oyo State, Nigeria. The chicks, with average weight of 40.63g were randomly assigned into four treatments (water sources) of three replicates with 8 chicks per replicate in a completely randomized design after balancing for weights. The chicks were brooded and raised in 12 equi-dimensional pens (1m x 1m). The average ambient temperature at the experimental site was 28°C. The birds under each treatment were fed the same commercial broiler starter (22% CP and 2900 kcal/Kg ME) and finisher (18% CP and 2900 kcal/Kg ME) diets. Both feeds and the experimental water were offered *ad-libitum*. The routine medication and vaccination programme as outlined by the University Teaching and Research farm (Table 1) were observed for the birds. The trial lasted 8 weeks (between 14th March and 9th May 2011; at the on-set of the rainy season), during which the records on average weekly weight gain, average daily water and feed consumption were kept. From these, water-feed ratio and feed conversion ratio were computed.

Carcass Parameters:

After slaughtering and bleeding, the carcasses were scalded at 65°C in water bath for 30seconds before defeathering. The defeathered chickens were later eviscerated. The carcass parameters measured during this study included (%) dressed weight, (%) eviscerated weight, thigh, drumstick, shank, breast, back, wing and head. All the carcass characteristics were expressed as g/kg body weight except the dressed and eviscerated weights, which were expressed as percentages of the body weights.

***Statistical Analysis*:**

Data collected on the performance and carcass parameters were subjected to analysis of variance and the treatment means separated by Duncan's multiple range test using SPSS package (2001).

Results

Water quality:

Tables 2, 3 and 4 present the quality parameters of the water samples in terms of chemical elements, bacteria counts and isolates respectively. In Table 2, the mineral elements content of the water samples were significantly different ($P<0.05$) from one another; except the lead (Pb) concentration values that were similar. Borehole water had the highest sodium concentration value (0.4395±0.0035mg/100ml) while the lowest value (0.2365±0.0021mg/100ml) was obtained for stream water. Highest aluminium concentration value (0.089±0.0027mg/100ml) was found in treated water and the lowest (0.0223±0.0065mg/100ml) in the well water. Treated water had the highest concentration of cadmium

Table 2: Chemical elements of water samples

Parameters	Well water	Borehole water	Stream water	Treated water
Sodium (mg/100ml)	0.3110±0.0014[b]	0.4395±0.0035[d]	0.2365±0.0021[a]	0.3555±0.0007[c]
Aluminium (mg/100ml)	0.0223±0.0065[a]	0.0654±0.0207[bc]	0.0380±0.0126[ab]	0.089±0.0027[c]
Cadmium (mg/100ml)	0.0017±0.0001[a]	0.0020±0.0002[ab]	0.0026±0.0005[ab]	0.0027±0.0003[b]
Lead (mg/100ml)	0.0225±0.0007	0.0281±0.0034	0.0223±0.0042	0.0240±0.0011
Manganese (mg/100ml)	0.0043±0.0001[a]	0.0080±0.0003[c]	0.0058±0.0005[b]	0.0058±0.0001[b]

Mean±SD

a,b,c,d: Means with different superscript in the same row are significant ($P<0.05$)

WW= Well water, BW= Borehole water, SW= Stream water and TW= Treated water

(0.0027±0.0003 mg/100ml) and the lowest concentration value (0.0017±0.0001 mg/100ml) in well water. Manganese concentration values was found to be equally high in treated and stream water samples (0.0058±0.0001mg/100ml and 0.0058±0.0005 mg/100ml respectively) with well water having the lowest manganese concentration value (0.0043±0.0001 mg/100ml). In Table 3, stream water had the highest bacteria counts of 1.50x 10^6 CFU/ml while the borehole water recorded the lower bacteria counts (3.20x 10^3 CFU/ml).Treated water was practically devoid of bacteria. In Table 4, only the treated water sample was without bacteria isolates; all the other samples contained more than one bacterium isolates. *Pseudomonas aeniginosa*, *Bacillus subtilis* and *Streptococcus faecalis* were found in well water. Only *Pseudomonas aeniginosa* and *Bacillus subtilis* were found in the borehole water while the stream water contained five bacteria isolates; *Klebsiella oxytoca, Pseudomonas aeniginosa, Bacillus subtilis, Streptococcus faecalis* and *Enterobacter cloacae.*

Performance record:

Table 5 presents the performance indices for the broiler birds reared on the experimental treatments (four water sources). In all the performance parameters; only weight gain was significantly ($P<0.05$) affected by the four different water sources. The birds on treated water significantly ($P<0.05$) had the highest weight gain (15.10±0.08g/bird/day) among the water sources; while birds on other water sources exhibited identical weight gain.

Carcass parameters:

Table 6 presents carcass parameters of broilers reared on different water sources.

Table 3: Total bacteria counts from water samples

Water samples	Bacteria load
Well water	2.50x 10^4 CFU/ml
Borehole water	3.20x 10^3 CFU/ml
Stream water	1.50x 10^6 CFU/ml
Treated water	Nil

Table 4: Bacterial isolates from water samples

Water samples	Isolates				
	1	2	3	4	5
Well water	-	+	+	+	-
Bore hole	-	+	+	-	-
Stream water	+	+	+	+	+
Treated water	-	-	-	-	-

Key: - = Absent; + = Present

Probable organisms:

1 = *Klebsiella oxytoca* (Commonly found in animal dung)

2 = *Pseudomonas aeniginosa* (Commonly found in poultry litter)

3 = *Bacillus subtilis* (Commonly found in the soil)

4 = *Streptococcus faecalis* (Commonly found in animal dung)

5 = *Enterobacter cloacae* (Commonly found in animal dung)

Treatment had no significant (P>0.05) effect on carcass parameters except for neck values.

Discussion

The presence of investigated chemical elements in all the water samples indicated that drinking water cannot be totally devoid of chemical elements. However efforts should be made to keep them within the standard of drinking water quality for poultry (Fairchild and Ritz, 2009); tolerable levels that will not compromise performance and wellbeing. The highest concentration of sodium in borehole water and its lowest concentration in stream water agreed with the report of Folorunso *et al.* (2011). Heavy metals; cadmium, lead and aluminium found in the water sample: contradicted the absence of heavy metal reported by Folorunso *et al.* (2011) in related study. This might be due t differences in the vulnerability of the wat sources to pollutants and the type underlying rock in the areas. The highe bacteria counts and isolates recorded f stream water might be due to its hi vulnerability to pollutants a contaminants through poor disposal of fa effluent; that favours bacteria grov Records of bacteria counts and isolate well and borehole water samples reve poor sanitary activities around the w sources. However, the overall results o water quality fall below the maxi

Table 5: Performance of broilers reared on different drinking water sources

Water sources				
Parameters	WW	BW	SW	TW
Weight gain(g/bird/day)	14.54±0.37^{b}	14.56±0.35^{b}	14.39±0.26^{b}	15.10±0.08^{a}
Feed intake (g/bird/day)	82.86±60.96	75.02±53.08	78.25±54.44	78.19±54.28
Water intake(ml/bird/day)	204.11±102.32	184.71±90.41	192.53±91.68	187.94±92.32
Water-feed ratio(ml/g)	2.90±1.00	2.91±1.04	2.87±0.94	2.79±0.93
Feed conversion ratio	3.11±1.38	5.16±3.67	5.44±3.80	5.18±3.59

Mean±SD

a, b: Means with different superscript in the same row are significant (P<0.05)

WW= Well water, BW= Borehole water, SW= Stream water and TW= Treated water

Table 6: Carcass parameters of broilers reared on different water sources

	Water sources			
Parameters	**WW**	**BW**	**SW**	**TW**
Live weight(kg)	2.30±0.13	2.12±0.25	2.22±0.26	2.33±0.42
% Eviscerated weight	78.33±1.86	75.64±1.11	79.41±3.99	78.57±3.11
Head(g/kg bodyweight)	23.00±2.03	25.22±0.63	23.68±0.81	23.84±2.23
Neck (g/kg bodyweight)	35.43±5.85 ^{a}	36.03±2.60 ^{a}	43.82±2.33 ^{b}	41.17±3.21 ^{ab}
Wing (g/kg bodyweight)	96.30±3.72	105.43±2.20	107.88±9.33	94.83±9.12
Breast (g/kg bodyweight)	198.60±31.12	182.14±7.42	181.18±18.32	200.36±17.31
Back (g/kg bodyweight)	164.40±7.15	155.01±7.19	160.59±15.99	160.43±26.82
Thigh (g/kg bodyweight)	118.71±11.25	110.40±15.63	121.32±6.35	110.66±1.33
Drumstick(g/kg bodyweight)	93.28±9.32	90.20±2.56	94.65±8.35	88.81±4.51
Shank (g/kg bodyweight)	41.82±7.36	44.57±3.48	45.72±3.08	42.40±3.99

Mean±SD

a, b: Means with different superscript in the same row are significant ($P<0.05$)

WW= Well water, BW= Borehole water, SW= Stream water and TW= Treated water

acceptable level presented by Fairchild and Ritz (2009) for poultry.

The effects of the water samples on the performance parameters were only significantly felt on the weight gain; with the birds on treated water having the highest weight gain. This could be as a result of the observed differences in the water quality (Quiroz, 2008). Hence, treated water seems to promote better weight gain in broiler. However, overall performance outcome shows that the birds slightly exhibited similar performance under the four water sources considered in this study and also the quality of the water could not undermine the wellbeing of the birds. Hence, it confirmed the report of Agriculture and Agri-Food Canada (2010) that under practical conditions, most water mineral contaminants including heavy metals would not necessarily present serious health problems in poultry. Carcass parameters were not significantly affected by the treatments except for the neck. Notwithstanding, overall carcass growth tends to show that the four sources of water virtually contributed equally to carcass growth. This study tends to reveal that the outcome of the chemical and bacteria analysis of the water samples did not significantly affect broilers performance and carcass growth. This showed that the level of detected sodium, aluminum, cadmium, lead and manganese were within the values presented by Fairchild and Ritz (2009). Similarly, impact of total bacteria counts and the identified organisms were not significant due to low threshold value or non pathogenicity of the identified organisms. Hence, within the limit of this study; in terms of period and location, any of the investigated water samples is good for broiler consumption without any detrimental effect on their wellbeing. In spite of this, further contamination of the water sources should be avoided; specifically well water, borehole water and stream water that were found to contain various load of bacteria species resulting from animal dung/ litter and soil contamination.

However, Agriculture and Agri-Food Canada (2010) reported that though birds' health might not be affected by water contaminants but their potential impact on product quality should not be ignored, as some compound may be deposited in eggs, meat, or liver. In line with this report and the outcome of this study, further investigation on haematology, organs and carcass of broilers should be embarked upon to investigate possible damage that could occur due to water contaminants.

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