Effects of domestic effluent utilisation on the blood characteristics of grower pullets

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Abstract

Two hundred 10-weeks old golden Hubbard grower chickens were randomly assigned to four water treatments: tap water (TW), alum treated domestic sewage (ATDS), secondary treatment domestic sewage (STDS) and raw domestic sewage (RDS). Each treatment was replicated twice with 25 birds per replicate. The trial lasted for 9 weeks. The experimental waters were analysed to determine their quality, water consumption by the chickens in each treatment was measured to assess their acceptability and the effects of water treatments on hematological and serum biochemical constituents over time were evaluated. The sequence of water quality in decreasing order is TW, ATDS, STDS and RDS. The effect of the water treatments on water consumption of the chickens was not significant ($p > 0.05$). The packed cell volume, haemoglobin, serum total protein, serum albumin, serum globulin, serum calcium and serum phosphorus of the birds were not significantly different ($p > 0.05$) at each bleeding throughout the experiment. While the blood constituents evaluated all had values within the normal limits, the concentrations of calcium in the sera of the bird receiving ATDS were slightly lower at weeks 5 and 9. The chickens on any of the treatments suffered no apparent harm. The physiological constitution of the chickens at this stage of growth appears to be able to accommodate the differences in the chemical and physical compositions of the domestic sewage effluents without disrupting the animal health.

Keywords: Domestic sewage effluents, blood constituents, grower chickens.

Introduction

Water is an essential nutrient for normal physiological functioning of farm animals, particularly poultry. A lack of drinking water can seriously retard growth and impair egg production. This is particularly true in tropical countries where deprivation can lead to death of poultry within a very short period of time (Smith, 1990). The very thirsty animal has the appearance of having shrunk upon itself. In the last stages of thirst, blood circulation becomes

impossible and the animal dies partly because of its inability to perform efficiently functions such as excretion, regulation of blood temperature, maintenance of acid-base balance, regulation of water balance, defense, transport of food materials which it would have normally performed (Aspinall, 1976). Blood contains about 70% water and it is important to have an adequate and regular water supply since blood becomes more viscous with increase in watering intervals. (Aganga *et al*, 1989).

It is clearly evident that lack of requisite water supply to livestock, and poultry in particular can be serious limiting factor in production and their survival. It is thus necessary to find alternative sources of drinking water for them because of the worsening competition between man and domestic animals for the available conventional water supply in Nigeria, and other developing countries. The possibility of using sewage and effluent as drinking water sources for laying chickens has been suggested (Shoremi *et al*, 1990). There has been a report by Sridhar (1980) on the pathogens normally found in the domestic sewage, namely *Faecal streptococci*, *Total coliforms*, *Trichuris trichura*, *Salmonella spp.*, *Hymenolepis nana*, *Entamoeba histolytica*. There has been no information on the effects of using this type of water on blood constituents of the domestic chickens. The study reported here was therefore undertaken to investigate the effect of domestic sewage effluent utilization by replacement chicks on some blood characteristics at the grower's phase.

Materials and Methods

A total of two hundred, 10 week – old replacement pullet chickens were randomly divided into four equal treatments in a deep litter house where the study was conducted. The four experimental treatments were tap water (TW) which served as the control, alum treated domestic sewage (ATDS), secondary treated domestic sewage (STDS) and raw domestic sewage (RDS). Each treatment group consisted of fifty grower pullets equally shared into two replicates. The source of tap water and the domestic sewage effluents was the International Institute of Tropical Agriculture, Ibadan, Nigeria.

The chemical and the biological treatments the experimental waters were subjected to are as reported in a previous communication by Shoremi *et al* (1993). All incoming raw sewage passes through a comminutor (for screening), which cuts, into smaller pieces solid waste to allow its flow with sewage, which then passes on to the clarifier where it is sieved before it

enters the aeration tank for the aerobic oxidation of the organic matter present. Finally, sewage flows from the aeration tank into the chlorine contact basin where the sewage effluent is disinfected by the addition of calcium hypochlorite to give STDS. Forty litres of STDS was collected into a plastic jerry can, while the same quantity of RDS was collected after screening into another jerry can at each collection. ATDS was obtained by collecting 39.84 litres of RDS in plastic buckets and coagulating it with 160 mls of 10% alum stock solution. The clear water obtained after 15 minutes gave ATDS, which was drained into another jerry can. Both ATDS and RDS were disinfected by using calcium hypochlorite to a residual level of 3mg l^{-1} . Daily provision of water to the chickens was done by using calibrated white plastic water drinkers to measure the quantities of each of the experimental waters supplied to the chickens. A measuring cylinder was used to determine the unconsumed water 24 hourly and daily water consumption obtained by difference. The chemical analysis of the water treatments was determined as recommended by the American Public Health Association (1985). Grower's mash of the same quality and composition compounded at the Feedmill, University of Ibadan, Nigeria was fed to the chickens irrespective of their water treatment group. The grower's mash was analysed for its nutrients using standard methods of analysis (A.O.A.C., 1990). It contained 94% dry matter, 18.20% crude protein, 4.00% crude fibre, 3.20% ether extract, 10.20% ash and 64.4% nitrogen-free extract. The general health status of the birds was monitored daily by visual examination.

Blood samples were individually taken from 5 identified birds by replicate (i.e. 10 birds per water treatment by piercing their right jugular vein using sterilized needles and syringes between the hours of 07.00 and 10.00. This was done at the start of the study (Week 1) and at weeks 5 and 9. Blood samples collected in labeled ethylene diamine tetra-acetic acid bottles were analysed for packed cell volume

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(PCV) and haemoglobin (Hb) using the procedures described by Kaneko (1989) and Vankampen and Zijlstra (1961), respectively. The sera obtained from clotted blood samples were analysed using the standard methods recommended for total protein (Henry *et al.*, 1974), albumin (Doumas *et al.*, 1971) and phosphorus (Kitson and Mellan, 1944). Globulin was obtained by difference from the total protein and albumin values while serum calcium was determined by Atomic Absorption Spectrophotometer.

The study was arranged factorially as a completely randomised design using the method described by Duncan (1955). The results obtained were analysed for statistical significance using the analysis of variance technique (Snedecor and Cochran, 1967).

Results and Discussions

The quality and chemical constituents of the experimental waters presented in Table 1 showed that TW had the highest quality whereas RDS was of the lowest quality. This is because, when compared with the maximum allowable concentrations, the lower the values obtained for the water quality variables (with the exception) the higher the quality of the experimental waters for drinking purpose. For most of the variables determined, the values obtained in respects of TW showed that it is a higher quality drinking water than the other water treatments. ATDS, STDS and RDS follow it in that order. At no point during the physiological growth phase under consideration was RDS, which had the least drinking water quality standard found to have any detrimental effect on the health of the chickens as they all appeared healthy. In addition, no mortality was recorded for the experimental duration in any of the water treatment groups.

Table 1 Water quality indices and chemical constituents of experimental waters supplied to chicken at growers phase (range of 12 samples).

Characteristics	Experimental Waters				Potable water*
	TW	ATDS	STDS	RDS	
pH	7.20-7.60	4.00-4.80	7.80-8.30	6.30-6.60	6.5 - 8.5 ¹
Turbidity (FTU)	5.00	10.00-20.00	25.00-35.00	35.00-50.00	5.0 ¹
Oxidizable organic matter (mg/litre)	12.40-60.80	40.50-51.60	69.40-83.20	149.70-188.00	-
Total Solids (mg/litre)	15.90-20.00	32.20-39.70	49.50-65.60	447.40-498.40	1000.0 ¹
Suspended Solids (mg/l)	5.00	10.00-15.00	15.00-20.00	25.00-35.00	-
Hardness (mg/litre)	78.30-87.50	118.00-127.40	60.90-71.80	112.80-120.60	500.0 ¹
Calcium (mg/litre)	16.00-21.40	24.50-28.60	17.70-23.80	9.60-12.60	-
Magnesium (mg/litre)	11.50-15.55	12.50-15.00	6.70-12.80	4.86-7.70	-
Sodium (mg/litre)	7.30-8.70	18.00-22.10	25.50-32.80	14.90-18.70	200.0 ¹
Chloride (mg/litre)	14.50-19.50	25.10-29.70	11.90-17.80	47.10-55.00	250.0 ¹
Ammonia -N (mg/litre)	0.55-0.90	6.10-8.65	15.40-18.80	17.45-21.00	2.0 ²
Phosphorus (mg/litre)	0.05-0.20	1.75-2.40	8.50-10.50	3.55-5.50	5.0 ³

*UNESCO/WHO (1992): Maximum allowable concentrations of some water quality variables

¹WHO

²USSR

³EC

The effect of interaction between the experimental waters and duration of intake of water consumption is presented in Table 2. The interaction had no significant effect ($p>0.05$) on any of the experimental groups. Water intake by the birds however, increased from week 1- 9 in all treatment groups. This can be attributed partly to the apparent increase in activities of grower pullets. In most avian species, water intake on absolute terms increases with age although water consumption per unit weight decreases. The feed intake of these grower chickens has already been reported to increase

progressively as they advanced to the point-of-lay with no significant difference ($p>0.05$) in weekly intake amongst the groups (Shoremi *et al*, 1993). The water intake by the grower pullets receiving RDS was comparatively lower than for the grower pullets receiving TW, ATDS and STDS throughout the period of investigation. This observation suggests that TW, ATDS and STDS were more acceptable as drinking water sources for growers most probably because of their higher quality, which has already been explained above.

Table 2 *Interaction effect of drinking water and duration of intake on water consumption per chicken (l).*

Time (wk)	Experimental Waters			
	TW	ATDS	STDS	RDS
1	0.51	0.48	0.43	0.38
2	0.56	0.52	0.49	0.46
3	0.61	0.57	0.57	0.53
4	0.85	0.83	0.80	0.80
5	0.88	0.89	0.84	0.83
6	1.02	1.03	1.04	0.99
7	0.93	0.91	0.94	0.89
8	1.00	0.99	1.02	0.94
9	1.02	1.03	1.09	0.98

SE_{water intake} = 0.02

SE_{time} = 0.23

The concentrations of PCV, Hb (haematological indices) on one hand and serum total proteins, serum album, serum globulin, serum calcium, serum phosphorus (serum biochemical indices) on the other hand due to the interaction between the experimental waters and duration of water intake are presented in Table 3. Statistically, the concentrations of the haematological and the serum biochemical indices examined among the various treatments at weeks 1, 5 and 9 were not

significantly different ($p>0.05$). At each bleeding, the mean values obtained for the blood constituents of these birds on various water treatments increased. The means of blood values obtained were comparable among different treatment groups at each bleeding apart from the concentration of serum calcium for the ATDS at weeks 5 and 9, which were comparatively lower. Intake of aluminium compounds has effects on the excretion of phosphorus and calcium.

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Table 3 *Interaction effect of drinking water and duration of water intake on the blood constituents of grower chickens*

Blood Constituents	Bleeding period (wk)	Experimental waters			
		TW	ATDS	STDS	RDS
PCV (%)	1	25.00	24.70	25.30	25.54
	5	27.70	26.00	27.30	28.10
	9	28.50	27.00	28.00	30.00
Hb (g%)	1	7.10	6.70	7.65	7.25
	5	8.05	7.90	8.35	8.70
	9	9.10	9.40	9.80	10.30
Serum total Protein (g%)	1	3.95	3.80	3.65	3.75
	5	4.25	4.00	3.90	3.85
	9	4.60	4.40	4.05	3.90
Serum albumin (g %)	1	1.65	1.67	1.60	1.62
	5	1.76	1.71	1.70	1.70
	9	1.80	1.75	1.97	1.95
Serum Globulin (g%)	1	2.26	2.13	2.05	2.13
	5	2.49	2.29	2.20	2.15
	9	2.80	2.65	2.08	1.95
Serum Calcium (mg%)	1	7.95	7.60	7.75	7.25
	5	15.86	12.38	16.40	15.78
	9	26.15	18.45	26.00	26.00
Serum Phosphorus (g%)	1	4.65	4.60	5.00	4.50
	5	5.70	5.45	5.75	5.98
	9	6.55	6.42	6.69	6.85

SE water intake (PCV)	= 0.40 ;	SE time (PCV)	= 0.95
SE water intake (Hb)	= 0.19 ;	SE time (Hb)	= 0.72
SE water intake (Serum total protein)	= 0.10 ;	SE time (serum total protein)	= 0.13
SE water intake (Serum albumin)	= 0.01 ;	SE time (serum albumin)	= 0.07
SE water intake (Serum globulin)	= 0.11 ;	SE time (serum globulin)	= 0.07
SE water intake (Serum Ca)	= 0.94 ;	SE time (serum Ca)	= 4.72
SE water intake (Serum P)	= 0.07 ;	SE time (serum P)	= 0.56

This is achieved by causing increased excretion of faecal phosphorus, decreased excretion of urinary phosphorus and increase in urinary calcium thereby reducing the levels of both elements in serum. The mechanism involved has been described to be that of aluminium binding the inorganic phosphorus in the intestine and the resulting phosphorus depletion stimulate bone resorption (Cuisinier-Gleizes *et al.*, 1971) leading to an increase in urinary calcium. The

presence of aluminium in the ATDS is believed to influence the serum calcium level obtained as reported by Spencer *et al.*, (1982). The range of blood values obtained in respect of PCV (24.70–30.00%), Hb (6.70–10.30g%), total protein (3.65–4.60g%), albumin (1.60–1.97mg%), globulin (1.95–2.80g%), calcium (7.25–26.15mg%) and phosphorus (4.50–6.85mg%) were all within normal limits. It appears from the results that the physiological constitution of

chickens at the grower phase is capable of accommodating the differences in the quality of ATDS, STDS, and RDS. There was no reason to suggest a break down in physiological processes such as erythropoiesis, regulation of the acid-base balance of the blood, maintenance of the osmotic pressure and blood pressure, provision of antibodies and bone development, which the blood characteristics evaluated, were supposed to indicate. The results obtained in this study tend to support the use of the test waters in a situation where there is inadequate conventional water supply. The level of treatment applied to the domestic sewage in this study appears adequate to promote a healthy growth and development of the chickens. The need for some measure of treatment as in this study is necessary before the domestic sewage can be re-used in the face of growing shortage of conventional drinking water, as it is the case in Nigeria. This is because sewage contaminated water supplies are known to have caused epidemics (Kale et al. 1973) and the pathogenic microbes present make it unsafe for indiscriminate handling.

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