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Full Length Research Paper

Haematological Values of Broilers Managed on Titanium Dioxide Treated Litter

[1*]Adamu, Y. A.; [2]Usman A.; [1]Mera, U. M.; [3]Abubakar, M. B; [4]Bello, A.; [5]Umaru, M.A.

[1]Department of Veterinary Medicine, Usmanu Danfodiyo University, Sokoto
[2]Department of Animal Production, SAAT, Federal University of Technology, Minna
[3]Department of Veterinary Microbiology, Usmanu Danfodiyo University, Sokoto
[4]Department of Veterinary Anatomy, Usmanu Danfodiyo University, Sokoto, Nigeria.
[5] Department of Theriogenology and Animal production, Usmanu Danfodiyo University, Sokoto, Nigeria

Abstract

An experiment was conducted to study the effect of TiO_2 applied in 0g/m^2, 30g/m^2, 60g/m^2 and 120g/m^2 concentration, as a litter treatment agent on litter bacteriology, haematology, ammonia emission and ammonia lesions on broilers fed standard commercial diet and water *ad lib* on wood shavings based deep litter system at a depth of 6cm and 16birds/m^2. Litter samples were collected weekly for ammonia while tissue samples were collected at the seventh week for histology and blood samples were also collected via cardiac venipuncture for haematology and blood chemistry. The result showed that RBC and WBC were significantly (P<0.05) elevated in 0g/m^2TiO_2 treatment (3.86x10^{12}, 2.93x10^{12}, 3.01x10^{12}, 2.34x10^{12} and 27.16x10^9, 26.41x10^9, 21.47x10^9, 21.84x10^9) respectively. MCH and MCV were significantly (P<0.05) elevated (28.60pg, 34.26pg, 30.96pg, 44.71pg and 87.42fl, 103.41fl, 93.62fl, 134.52fl) in the 120g/m^2TiO_2litter treatments. There was a significant (P<0.05) elevation in serum sodium (132.27mEq/l, 135.07mEq/l, 135.33mEq/l, 138.67mEq/l); potassium (4.12mEq/l, 4.18mEq/l, 4.03mEq/l, 4.47mEq/l); globulin (1.23g/dl, 1.85g/dl, 1.35g/dl, 2.47g/dl) and conjugated bilirubin (5.11mg/dl, 5.52mg/dl, 5.55mg/dl, 6.07mg/dl) in 120g/m^2TiO_2 litter treatment. There was no significant difference (P>0.05) in ammonia even though 60g/m^2TiO_2 litter treatment retained more ammonia (29.77, 29.25, 33.16, 30.01). It was concluded that TiO_2 is beneficial as a litter treatment agent especially at 60g/m^2 rate.

Keywords: Ammonia, Titanium dioxide, Broiler, Litter, Haematology.

INTRODUCTION

Poultry are kept with variable economic importance and their production in many countries has become increasingly specialized and integrated into a dynamic industry of major national and international significance (Jordan and Pattison, 1996). The importance of poultry to Nigeria's national economy cannot be overemphasized, where it has shown a significant effect on the national economy with about 10% of Nigerians engaged in poultry production, mostly on subsistence and small or medium-sized farms (Okonkwo and Akubuo, 2001). Investment in broiler enterprises has become attractive because of low production cost per unit compared to other types of livestock and has a short production cycle (Nwajiuba and Nwoke, 2000, Sani *et al*., 2000). However, high stocking density in modern poultry house may lead to reduced air quality with high concentrations of aerial pollutants such as ammonia (Curtis and Drummond, 1982; Maghirang *et al.,* 1991; Feddes and Licsko, 1993), whose concentrations sometimes exceed recommended occupational limits (Kristensen and Wathes, 2000) and may adversely affect poultry health and production. Poultry litter is considered one of the major sources of pollutants in poultry houses that needs to be addressed seriously especially because of its high nitrogen content; some of which is in ammonia form (Mitchell and Donald, 1995; Sloan *et al.,* 1996) and primarily in the form of uric acid that microorganisms can readily decompose to form ammonia which then escapes into the air under favorable environmental

Corresponding Author Email: yunusaadamu2000@gmail.com; Tel: +2348064654506

conditions (Moore *et al.,* 1996). High levels of atmospheric ammonia in poultry houses cause decreased growth rate (Carlile, 1984; Caveny and Quarles, 1978; Carveny *et al.,* 1981), damage to respiratory tract (Anderson *et al.,* 1964b; Carlile, 1984; Nagaraja *et al.,* 1981), a rise in Newcastle disease (Anderson *et al.,* 1964b), increased incidence of air sacculitis (Kling and Quarles, 1974; Oyetunde *et al.,*1976), increased incidence of *Mycoplasma gallesepticum* (Sato *et al.,* 1973), ammonia burns and increased incidence of keratoconjunctivitis (Bullis *et al.,* 1950; Faddoul and Ring rose, 1950). There has been a growing interest in research in reducing ammonia volatization from poultry litter and houses, especially through litter amendments using various agents (Sanjays and Persons, 2006; Line, 2002; Luka-McCafferty, 2002; McCrory and Hobbs, 2001; McWard and Taylor, 2000; Moore *et al.,* 2000; Pope and Cherry, 2000; Terzich, 1998; Amon *et al.,* 1997). Titanium dioxide (TiO_2) a photocalyst with strong oxidative potential (Jenny, 2004), whose photo-catalytic properties have led to extensive research into its potential uses as a disinfectant, antibiotic, biological sensor, tumor cell killing agent, and a gene targeting device (Thurn*et al.,* 2011), was used as a litter amendment agent using wood shaving as a litter material in this study; to evaluate the possible haematologic changes in broilers raised on titanium dioxide treated litter based on the fact that hematological parameters have been reported to provide valuable information on the health status of animals (Kral and Suchy, 2000) and also useful in diagnosis and disease management programs (Ladokun *et al.,* 2008).

MATERIALS AND METHODS

Study population and groupings

Two hundred and forty number Day Old Chicks which have been vaccinated against Marek's disease and New castle disease were obtained from a reputable hatchery in Nigeria and placed on Titanium dioxide treated wood shavings based litter material at a stocking density of 16 birds/m^2 in the experimental poultry pen of the Department of Veterinary Theriogenology, and Animal Production Usmanu Danfodiyo University, Sokoto. Routine vaccination and medication were administered and the birds were fed with standard commercial broiler feed (Hybrid feed)^{R} water ad libitum.

The birds were randomly allotted into four treatments/groups with three replicates per treatment in a completely randomized design and kept for seven weeks. Each replicate of a group comprises twenty birds and titanium dioxide was applied to the litter according to the treatments and prior to chick placement (Table 1).

In each of the replicates; titanium dioxide was weighed using electronic scale (Shimadzu BW12KH, Shimadzu incorporation, Japan) and then thoroughly mixed with the litter before it was evenly spread on the floor at a depth of approximately 2 inches; prior to placement of the birds. At the end of every week, litter from each replicate was turned and mixed thoroughly using a hand shovel and 20g of the litter sample collected for ammonia determination according to the method of AOAC (2000).

Collection of blood sample

At the end of the 7th week, Blood samples were collected from each group of birds for Hematological analysis. The blood samples were analysed for blood count, hemoglobin concentration, red blood cell indices, liver function test and kidney function test. Red blood cell and total white blood cell counts were determined using improved Neubauer haemocytometer, as described by Dacie and Lewis (1991) and as adopted by Uko *et al.* (2000). Packed Cell volume (PCV) was determined using microhaematocrit method (Benjamin, 1985), Haemoglobin was determined using cyanmethaemoglobin method (Cole, 1986). Mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentrations were determined arithmetically (Jain, 1986). Data collected was subjected to Analysis of Variance of SPSS® 15.0. Differences in means was separated using Duncan procedure (Steel and Torrie, 19) at P=0.05.

RESULTS AND DISCUSSION

Haematological profile of Broilers

Haematological profile of broiler chickens managed on Titanium dioxide treated litter as shown in Table 3. The Red Blood Cell count of broilers on litter not treated with titanium dioxide (0g/m^2) was $3.86\pm0.69\times10^{12}$/l, it was $2.93\pm0.42\times10^{12}$/l for broilers on litter 30g/m^2 titanium dioxide, and it was $3.01\pm0.51\times10^{12}$/l for broilers on litter treated with 60g/m^2 titanium dioxide, while it was $2.34\pm0.58\times10^{12}$/l for broilers on litter treated with 120g/m^2 titanium dioxide. The result indicated that broilers raised on litter not treated with titanium dioxide (0gm^{-2}) had significantly ($P<0.05$) highest red blood cell count while broiler birds raised on litter containing 120gm^{-2} titanium dioxide had significantly ($P<0.05$) lowest red blood cell count among litter treatments. Red blood counts from broilers raised on litter treatments of 30gm^{-2} and 60gm^{-2} did not differ significantly ($P>0.05$) from each other but were significantly ($P<0.05$) lower than red blood cell count obtained from broilers raised on untreated litter; and significantly ($P<0.05$) higher than red blood cell count obtained from broilers raised on 120gm^{-2}.

Table 1. Distribution of Birds, Treatment and Quantity of Titanium Dioxide applied on the Litter

Treatment	Number of Birds	Concentration of Titanium dioxide (g/m^2)
1.	3×20=60	0
2.	3×20=60	30
3.	3×20=60	60
4.	3×20=60	120

Number of Birds = (P × Q) =Z, where P= number of Replicates; Q= number of Birds per replicate and Z= number of birds per Treatment.

Table 2. Ammonia and Nitrogen (means± S.D) Content of Titanium Dioxide Treated Broiler Litter Titanium Dioxide Treatment

Parameter	$0gm^{-2}$	$30gm^{-2}$	$60gm^{-2}$	$120gm^{-2}$
Ammonia (ppm)	29.77±9.91	29.25±9.70	33.16±11.31	30.01±9.82
Nitrogen (%)	2.98±0.99	2.92±0.97	3.32±0.11	3.00±0.98

Table 3. Haematological (means± S.D) Parameters of Broiler Birds managed on Titanium Dioxide Treated Litter Concentration of titanium dioxide

Parameter	$0gm^{-2}$	$30gm^{-2}$	$60gm^{-2}$	$120gm^{-2}$
RBC($x10^{12}$/l)	$3.86±0.69^a$	$2.93±0.42^b$	$3.01±0.51^b$	$2.34±0.58^c$
WBC($x10^9$/l)	$27.16±5.79^a$	$26.41±5.52^a$	$21.47±6.31^b$	$21.84±2.71^b$
Hb (g/dl)	9.43±1.69	9.83±1.84	9.03±1.99	9.63±1.88
PCV (%)	28.87±5.63	29.67±5.59	27.27±5.93	29.07±5.73

Values in table are means± S.D of observations. Letters in superscripts represent significant differences in the mean

White blood cell count of broiler on titanium dioxide free litter ($0g/m^2$) was $27.16±5.79×10^9$/l, it was $26.41±5.52×10^9$/l for broilers on litter treated with $30g/m^2$ titanium dioxide, and $21.47±6.31×10^9$/l for broilers on $60g/m^2$ titanium dioxide treated litter and it was $21.84±2.71×10^9$/l for broilers on $120g/m^2$ titanium dioxide treated litter (Table 3). The white blood cell count of broilers raised on litter material treated with $30gm^{-2}$ did not differ significantly (P>0.05) from that of those on untreated litter (P<0.05). However, the white blood cell count obtained from broilers raised on $60gm^{-2}$ and $120gm^{-2}$ titanium dioxide treated litters were lower respectively in white blood cell count obtained from broiler birds raised on $60gm^{-2}$ there was no significant difference (P>0.05) from white blood cell count obtained from those raised on $120gm^{-2}$ titanium dioxide treated litter respectively.

Haemoglobin concentration of broiler on litter not treated with titanium dioxide ($0g/m^2$) was 9.43±1.69g/dl, it was 9.83±1.84g/dl for broilers on $30g/m^2$ titanium dioxide treated litter, 9.03±1.99g/dl for those on $60g/m^2$ treated litter, and was 9.63±1.88g/dl for broilers on $120g/m^2$ titanium dioxide treated litter (Table 3). The haemoglobin concentration of broiler birds from both titanium dioxide treated litter groups and untreated group did not differ significantly (P>0.05). There was no much different in the PCV of broilers managed on titanium dioxide free and those on litter treated groups (Table 3). The result shows that there was no significant difference (P>0.05) in both relative and absolute neutrophil count, absolute monocyte count, and absolute eosinophil count in the broilers across different concentrations of titanium dioxide litter treatments (g/m^2) but the absolute lymphocyte count in birds raised on $60g/m^2$ titanium dioxide treated litter was significantly (P<0.05) lower than absolute lymphocyte count obtained from broilers raised on $30g/m^2$ titanium dioxide treated litter. The absolute lymphocyte counts obtained from broiler birds raised on $0g/m^2$ titanium dioxide treated litter and broilers raised on $120g/m^2$ titanium dioxide treated litter were not significantly (P>0.05) different but are comparable to absolute lymphocyte counts obtained from broilers raised on both $30g/m^2$ titanium dioxide treated litter and $60g/m^2$ Table 4.

The mean corpuscular haemoglobin of broilers on litter not treated with titanium dioxide ($0g/m^2$) was 28.60±7.97pg; it was 34.26±8.47pg for broilers on litter treated with $30g/m^2$ titanium dioxide, 30.96±9.62pg on litter treated with $60g/m^2$ titanium dioxide and 44.71±17.65pg for broilers on litter treated with $120g/m^2$ titanium dioxide (Table 5). The Mean corpuscular haemoglobin was significantly (P<0.05) higher in broiler birds raised on $120gm^{-2}$ titanium dioxide treated litter compared to the values obtained from broiler birds

Table 4. Differential Leucocytes count of Broilers managed on Titanium Dioxide treated litter Concentration of titanium dioxide

Parameter	0gm^{-2}	30gm^{-2}	60gm^{-2}	120gm^{-2}
Neutrophils (%)	40.27±18.28	29.93±20.39	38.53±19.06	35.52±15.72
Neutrophils (X109/l)	11.57±7.34	8.60±7.42	8.89±6.53	7.21±3.40
Monocyte (%)	0.13±0.52	1.00±1.73	0.27±0.70	1.20±3.61
Monocyte (X109/l)	0.03±0.13	0.25±0.44	0.07±0.17	0.27±0.76
Eosinophil (%)	2.80±4.59	1.33±3.18	0.67±1.44	1.33±2.89
Eosinophil (X109/l)	0.74±1.25	0.38±0.92	0.18±0.39	0.30±0.63
Lymphocyte (%)	56.67±18.82	67.73±20.23	60.53±20.19	64.13±15.59
Lymphocyte (X109/l)	14.78±4.60^{ab}	17.17±4.23^{a}	12.34±4.58^{b}	14.07±4.20^{ab}
Basophil (x10^{9}/l)	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

Values in table are means ± S.D of observations. Letters in superscripts represent significant differences in the mean

Table 5. Haematologic Indices of Broilers managed on Titanium Dioxide Treated litter Concentration of titanium dioxide

Parameter	0gm^{-2}	30gm^{-2}	60gm^{-2}	120gm^{-2}
MCH (pg)	28.60±7.97^{b}	34.26±8.47^{b}	30.96±9.62^{b}	44.71±17.65^{a}
MCHC (g/dl)	32.82±1.80	33.13±0.24	33.08±0.61	33.15±0.46
MCV (fl)	87.42±24.66^{b}	103.41±41.25^{b}	93.62±29.18^{b}	134.52±52.69^{a}

Values in table are means ± S.D of observations. Letters in superscripts represent significant differences in the mean

titanium dioxide free litter, 30gm^{-2} and 60gm^{-2} titanium dioxide treated litter respectively.

Mean corpuscular haemoglobin concentration of broilers on litter not treated with titanium dioxide (0g/m^2) was 32.82±1.80g/dl, 33.13±0.24g/dl for broilers on litter treated with 30g/m^2 titanium dioxide, and it was 33.08±0.61g/dl for broilers on litter treated with 60g/m^2 titanium dioxide, while it was 33.15±0.46g/dl for broilers on litter treated with 120g/m^2 titanium dioxide. There was no significant difference (P>0.05) in their mean corpuscular haemoglobin concentration.

The mean corpuscular volume of broilers on litter not treated with titanium dioxide (0g/m^2) was 87.42±24.66fl, it was 103.41±41.25fl for broilers on litter treated with 30g/m^2 titanium dioxide, and it was 93.62±29.18fl for broilers on litter treated with 60g/m^2 titanium dioxide, while it was 134.52±52.69fl for broilers on litter treated with 120g/m^2 titanium dioxide. The mean corpuscular volume in broiler birds raised on 0gm^{-2} titanium dioxide treated litter did not differ significantly (P>0.05) from mean corpuscular volume obtained in broiler birds raised on both 30gm^{-2} titanium dioxide treated litter and 60gm^{-2} titanium dioxide treated litter. These values were however significantly (P<0.05) lower than mean corpuscular volume obtained from broiler birds raised on 120gm^{-2} titanium dioxide treated litter.

CONCLUSION

Based on the findings of this research, it could be concluded that titanium dioxide as a litter treatment agent, improved litter nitrogen retention hence has a potential of reducing ammonia volatization and improves moisture loss from litter. Titanium dioxide has proved to decrease total bacteria population of treated litter and could be used as means of reducing bacterial contamination of poultry litter so as to improve performance. Titanium dioxide as a litter treatment agent, significantly reduced ammonia associated lesions in bird and can be used at 60g/m^2 of litter.

REFERENCES

Amon M, Dobeic M, Sneath RW, Phillips VR, Misselbrook TH, Pain BF (1997). A farm-scale study on the use of clinoptilolite zeolite and De-odorase for reducing odour and ammonia emissions from broiler houses.*BioresourceTechnology 61:229*-237.

Anderson DP, Beard CW, Hanson RP (1964b). The adverse effects of ammonia on chickens including resistance to infection with Newcastle disease virus. *Avian Research*8:369–373.

Beker A, Vanhooser SL, Swartzlander JH, Teeter RG (2004). Atmospheric Ammonia Concentration Effects on Broiler Growth and Performance *Journal of Applied Poultry Research 13(1):5-9*

Bullis KL, Snoeyenbos GH, Roekel HV (1950). A keratoconjuctivities in chickens.*Poultry Science*. 29:386-399

Carlile FS (1984). Ammonia in poultry houses: A literature review. *World's Poultry Science Journal.* 40:99-113

Caveny DD, Quarles CL (1978). The effects of atmospheric ammonia stress on broiler performance and carcass quality. *Poultry Science*. 57:1124-1125

Caveny DD, Quarles CL, Greathouse GA (1981). Atmospheric ammonia and broiler cockerel performance.*Poultry Science* 60:513-516

Curtis SE, Drummond JG (1982). Air environment and animal performance. Pages 107–118 in Handbook of Agricultural Productivity. Volume 11: Animal Productivity. M. Rechcigl, ed. CRC Press, Boca Raton, FL.

Faddoul GP, Ringrose RC (1950). Avian keratoconjuctivitis. *Journal of*

Veterinary Medical Science. 45:492-493.
Feddes JJR, Licsko ZJ (1993). Air quality in commercial turkey housing.*Canadian Agricultural Enginneering Society Journal*. 35:147-150
Jain NC (1986). *Veterinary haematology* 4th ed. Lea – Febiger Publishers Philadelphia pp. 153 – 159
Jordan FTW, Pattison M (1996).Poultry Diseases. 4th Edn., W.B. Saunders, London.
Kling HF, Quarles CL (1974). Effect of atmospheric ammonia and the stress of infectious bronchitis vaccination on Leghorn males.*Poultry Science*. 53:1161–1165.
Kristensen HH, Wathes CM (2000). Ammonia and poultry welfare: a review. *World`s poultry Science Journal*. 56:235-245
Ladokun AO, Yakubu A, Otite JR, Omeje JN, Sokunbi OA, Onyeji E (2008). Haematological and serumbiochemical indices of naked neck and normally featheredNigerian indigenous chickens in a sub-humid tropicalenvironment.*International Journal of Poultry Science*, 7,55_58.
Line JE (2002). Campylobacter and Salmonella populations associated with chickens raised on acidified litter. *Poultry Science.*81:1473-1477.
Maghirang RG, Manbeck HB, Roush WB, Muir FV (1991). Air contaminant distributions in a commercial laying house.*Journal ofAmericaSociety ofAgriculturalEngineering*. 34:2171-2180.
McCrory DF, Hobbs PJ (2001). Additives to reduce ammonia and odor emissions from livestock wastes: A review. *Journal of Environmental Quality.* 30:345-355.
McWard GW, Taylor DR (2000). Acidified clay litter amendment. .*Journal of Applied Poultry Research.* 9:518-529.
Mitchell CC, Donald JO (1995). The value and uses of poultry manure as fertilizer. AL Cooperative Extension Services.
Moore PA Jr., Daniel TC, Edwards DR (2000). Reducing phosphorus runoff and inhibiting ammonia loss from poultry manure with aluminum sulfate. *Journal of Environmental Quality.* 29:37-49.
Moore PA Jr., Daniel TC, Edwards DR, Miller DM (1996). Evaluation of chemical amendments to reduce ammonia volatization from poultry litter. Poultry-sci-savoy, IL: Poultry science Association, Inc.vol 75(3): 315-320 47.8-AM33P
Nagaraja KV, Emery DA, Jordan KA, Sivanandan V, Newman JA, Pomeroy BS (1983). Scanning electron microscopic studies of adverse effects of ammonia on tracheal tissues of turkeys. .*American Journal of Veterinary Research*. 44:1530-1536.
Nwajiuba C, Nwoke E (2000). Inflation and the Poultry Industry in Nigeria: Implications for profitability. In: Orji, U.I., Mgbere, O.O. (eds) Proceedings of the 5th Annual Conference of the Animal Science Society of Nigeria. Port Harcourt, Nigeria, pp. 206-208.
Okonkwo WI, Akubuo CO (2001). Thermal analysis and evaluation of heat requirement of a passive solar energy poultry chick brooder in Nigeria. *Journal of Renewal Energy,* 9: 1.
Oyetunde OOF, Thomson RG, Carlson HC (1976). Aerosol exposure of ammonia, dust and *Esherichia coli* in broiler chickens. *The Canadian Veterinary Journal.19:187.*
Pope MJ, Cherry TE (2000). An evaluation of the presence of pathogens on broilers raised on Poultry Litter Treatment-treated litter.*Poultry Science.*79:1351-1355.
Rahman SA, Yakubu A (2005). Analysis of Poultry Production,Distribution and Consumption in parts of Nassarawa State, Nigeria.*International Journal of Natural and Applied Science*, 1(1): 1-4.
Sani RM, Tahir I, Kushwaha S (2000). Economics of Poultry Productionin Bauchi State: A case study of Bauchi Local Government Area, *Nigeria Journal Animal Production*, 27 (1): 109-113.
Sanjays PW, Persons, J (2006). North Carolina cooperative extension service, North Carolina state university, United States department of Agriculture and local government cooperating 2/06 JL/SSS E06-44598
Sato S, Shaya S, Kobayashi H (1973). Effect of ammonia on *Mycoplasma gallisepticum* infection in chickens. *National Institute of Animal Health Quarterly,* (Yatabe)13:45-53
Sims JT, Luka-McCafferty NJ (2002). On-farm evaluation of aluminum sulfate (alum) as a poultry litter amendment: Effects on litter properties. *Journal of Environmental Quality.* 31:2066-2073.
Sloan DR, Kidder G, Jacobs RD (1996). Poultry manure as fertilizer. Cooperative Extension Services. UF/IFAS
Terzich M, Quarles C, Brown J, Goodwin MA (1998a). Effect of Poultry Litter Treatment (PLT) on the development of respiratory tract lesions in broilers.*Avian Pathology: Journal of the World Veterinary Pathology Association.* 27:6, 566-569.
Thurn KT, Hans A, Tatjana P, Aiguo W, Eric MBB, Jeff CD, Gayle W (2011). Endocytosis of Titanium Dioxide Nanoparticles in Prostate Cancer PC-3M Cells. *Nanomedicine*.7 (2): 123–130.
Uko OJ, Usman A, Ataja MA (2001). Some biological activities of Garcinia kola in growing rats.*Vaternarski Archive* 7(5): 287 – 297

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