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EVALUATION OF THE EFFECTS ON BLOOD PARAMETERS OF WISTAR RATS CHALLENGED WITH BACTERIA

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Abstract
The effects on blood parameters of wistar rat challenged (infected) by oral inoculation of *Arthrobacter* sp., *Citrobacter* sp., *Micrococcus* sp., *Pseudomonas* sp., and *Staphylococcus aureus* was evaluated. A total of 18 rats divided in 6 groups (5 experimental groups and 1 control) of 3 rats each were used in the study. In cases, full blood counts were determined using haemological analyser by Mindray, Germany after 7 days. The study found out that the highest mean values are 54.2 fL (MCV), 20.2 pg (MCH), 40.0 g/dl (MCHC), 19.0 % (RDW-CV), 34.4 fL (RDW-SD), 693 x 10^9 /L (PLT), 9.7 fL (MPV), 15.1 (PDW) and 0.529 % (PCT). Generally, the MCV, MCH, MCHC, MPV and PCT recorded values lower than that observed in the control rats while RDW-CV, RWD-SD, PLT and PDW values were generally higher than values observed in control rats. Though individual bacterium inoculation showed slight variations in blood parameters from the control values, yet, the test animals survived without signs of infection all through the study indicating that there no threat to their blood system. Activities that introduce bioaerosol should be controlled thereby creating a healthy business environment.

Keywords: Bacteria, Bioaerosol, Blood, Inoculation, Wistar

Introduction
Bioaerosols are defined as airborne particles consisting of living organisms such as microorganisms or originating from living organisms, such as metabolites, toxins or fragments of microorganisms (Ambrose *et al*., 2015). Sources of bio-aerosols include large quantities of manure, animals, and feed; increase in the microbial load within the production environment; livestock harbour a variety of zoonotic pathogens; many pathogens are excreted with faeces; unregulated waste dumps; sewage treatment plant, etc. (Herman, 2007, Madl, 2003). Once suspended in the air column, microorganisms have the opportunity to travel long distances with the help of wind and precipitation, increasing the occurrence of a widespread disease by these microorganisms (Aladejana *et al*., 2020). However, Jaenicke (2005) showed that the portion of bioaerosols constituting ambient aerosols ranges from 5% to 80%. Airborne microorganisms are ubiquitous in the atmosphere. With this increased awareness of the roles of bioaerosols in atmospheric components, bio-aerosols were originally notable due to their effects on health (Ambrose *et al*., 2015).
Blood which is a vital special circulatory tissue is composed of cells suspended in a fluid intercellular substance (plasma) with the major function of maintaining homeostasis (Isaac *et al*., 2013). Haematological components, which consist of red blood cells, white blood cells or leucocytes, mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration are valuable in monitoring feed toxicity especially with feed constituents that affect the blood as well as the health status of farm animals (Oyawoye and Ogunkunle, 2004). According to Peters *et al*. (2011),

previous reports stated that parameters such as mean corpuscular haemoglobin are major indices for evaluating circulatory erythrocytes, and are significant in the diagnosis of anaemia and also serve as useful indices of the bone marrow capacity to produce red blood cells as in mammals (Awodi *et al*., 2005; Chineke *et al*., 2006). Furthermore, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration indicate blood level conditions. A low level is an indication of anaemia (Aster, 2004).

Blood constituents change in relation to the physiological conditions of health (Togun *et al*., 2007). These changes are of value in assessing response of animals to various physiological situations (Khan and Zafar, 2005). According to Afolabi *et al*. (2010), changes in haematological parameters are often used to determine various status of the body and to determine stresses due to environmental, nutritional and/or pathological factors.

Recently, diverse hematological and inflammatory factors have been widely considered as markers of bacterial infections with abundant evidence to support their usefulness in the preliminary diagnosis of infections (Markanday, 2015; Akya *et al*., 2019). Research has shown that platelets also contribute to the inflammatory response (Togan *et al*., 2015; Afyon & Artuk, 2016). Changes in hematological markers are commonly observed as a result of bacterial infection. Hematological markers, including white blood cell count, platelet count (PLT), mean platelet volume (MPV), platelet distribution width (PDW), red cell distribution width (RDW), neutrophil to lymphocyte ratio (NLR), platelet to lymphocyte ratio (PLR), monocyte to lymphocyte ratio (MLR), and CRP test, have been used in the preliminary diagnosis of brucellosis, along with serological tests (Afyon and Artuk, 2016). The assessment of blood parameters is very necessary because, they are important proxy indicators useful in the assessment of immune status, therapeutic purposes and monitoring of disease progression and treatment outcome for proper patient management. This study therefore was conducted to evaluate the effect of bacteria isolated from outdoor air around the Polytechnic business centre area on selected blood parameters in wistar rats; this can give an idea of the pathogenic status of the organisms and the likely health status of the persons who are always within the area.

Materials and Methods

Five stock bacteria (*Arthrobacter* sp., *Citrobacter* sp., *Micrococcus* sp., *Pseudomonas* sp. and *Staphylococcus aureus*) isolated from the outdoor bioaerosol around the business centre within Captain Elechi Amadi Polytechnic, Rumuola, were used for the study. The experiment involved seventeen (17) weighed adult *wistar* rats. The *wistar* rats for the study were purchased from the Animal House, Biochemistry Department, University of Port Harcourt, Choba. The rats were acclamatised for a period of seven (7) days in the laboratory of Science Laboratory Technology Department, Captain Elechi Amadi Polytechnic, Rumuola, before the commencement of the experiment and maintained on formulated feed. Adequate water was provided during the study. Animal experiments and housing procedures was performed in accordance to the animal care and ethical rules. The pure culture of each bacterial isolates was suspended in 0.95% normal saline corresponds to 0.5 McFarland which corresponds to 1.5×10^8 bacterial suspension/ml. The *wistar* rats were divided into six (6) groups of three rats each. Each group was then orally inoculated with each of the bacteria in triplicates. The sixth group that was not inoculated constitutes the control. The inoculated rats and the control groups were allowed for fourteen (14) days. At the end of the experiment, the rats were sacrificed and blood samples collected into EDTA bottles for full Blood Count Analysis.

The Full Blood Count (Complete Blood Count) analysis was done employing the Automated Analyser (Fully Automated) (Mindray BC 2800, China) at Rockstone Medical Laboratory Services, Borokiri, Port Harcourt, Rivers State, Nigeria. The Automated Analyser (Mindray BC 2800, China) aspirates the required quantity of blood, quantifies it and classifies and describes cell populations using both electrical

and optical techniques such as photometric methods and electrical impedance (Coulter Principle) as described by Graham (2003). Twenty microlitre (20µl) of capillary sample from EDTA bottle is added with 1.6ml of diluents from the analyser to pre-dilute the sample. The pre-diluted sample is presented to the analyser which will aspirate 0.7ml of the sample for further dilution. After dilution the cell volumes fall into different ranges. A fluidic system in the analyser prepares the diluents and pre-diluted moles, counts blood cells measures Haemoglobin (HGB) concentration and dispenses the diluents. The colour LCD display unit of the automated analyser shows the different parameters analysed while a thermal recorder prints out the results (Red Blood Cells count, Packed Cell Volume, White Blood Cells count and Haemoglobin value). The operating temperature is between 15ºC – 30ºC (Graham, 2003). All the data obtained during the study period was analyse using Mean and presented in Table 1.

Results

The results of selected blood parameters values of wistar rats inoculated with bacteria isolated from outdoor aerosols are presented in Table 1. The results reveal that the mean red cell volume (MCV) ranged from 50.7 - 54.2 (fL) with 53.0 fL as control value; mean cell haemoglobin (MCH) ranged from 19.1 - 40.9 pg with 19.6 pg as the control value; mean cell haemoglobin concentration (MCHC) ranged from 37.4 - 40.0 (g/dl) with 37.0 (g/dl) as the control value; Red cell distribution - Coefficient of variance (RDW-CV) ranged from 16.2 - 19.4 % with 17.3 % as the control; ; Red cell distribution width – standard deviation (RDW-SD) ranged from 28.9 - 34.4 fl with 31.7 fL as the control; Platelet count (PLT) ranged from ranged from 450 x 10^9/L - 693 x 10^9/L; Mean platelet volume (MPV) ranged from 8.3 - 9.7 fL; Platelet distribution width (PDW) ranged from 14.3 - 15.1, and Plateletcrit (PCT) ranged from 0.16 - 0.529 %.

Table 1: Selected Blood Parameters Values of Wistar rats inoculated with Bacteria Isolated from Outdoor Aerosol

	Sample/Organism/Results Obtained					
	Control	***Arthrobacter***	***Citrobacter***	***Micrococcus***	***Pseudomonas***	
Staphylococcus					**sp.**	**sp.**
sp.	**sp.**	***aureus***				
MCV (fL)	53.0	54.2	52.0	51.0	50.7	51.2
MCH (pg)	19.6	20.2	19.5	19.1	40.9	19.1
MCHC (g/dl)	37.0	37.8	37.6	37.5	40.0	37.4
RDW-CV (%)	17.3	19.0	18.2	19.4	16.2	17.2
RDW-SD (fL)	31.7	34.4	32.0	32.9	28.9	30.1
PLT (x 10^9/L)	378	638	609	641	450	693
MPV (fL)	8.9	8.7	8.7	8.3	9.7	8.7
PDW	14.4	14.5	14.4	14.3	15.1	14.8
PCT (%)	0.325	0.22	0.184	0.529	0.16	0.34

Key:
MCV: Mean red cell volume; MCH: Mean cell haemoglobin; MCHC: Mean cell haemoglobin concentration; RDW-CV: Red cell distribution - Coefficient of variance; RDW-SD: Red cell distribution width – standard deviation; PLT: Platelet count; MPV: Mean platelet volume; PDW: Platelet distribution width; PCT: Plateletcrit (procalcitonin)

Discussion

Blood can act as a pathological and physiological indicator of animal health (Jorum *et al*., 2016). In this study, the MCV, MCH, MCHC, MPV and PCT generally recorded values lower than that observed in the control rats. Reduction in hematological indices might be due to blood loss via hemorrhagic gastritis and active bleeding peptic ulcers, impairing iron absorption as a result of chronic gastritis, deficiency of iron and vitamin B12 secondary to chronic and atrophic gastritis (Halle & Timerga, 2020). Havelaar *et al*. (2000) reported with one or more pathogens there was a significant decrease in the baseline level of several parameters such as MCH and MCHC, related to red blood cell; this might indicate anaemia induced by experimental conditions. Al-Zamely and Falh (2011) had earlier reported lower PCT values in rats induced with bacteria**.** According to Hamzeh-Cognasse *et al*. (2015), the reduced platelet count was associated with the aggregation of platelet in the infection site following platelet binding by haemostatis-related receptors. MPV is the most commonly used method to measure platelet size (Sevket *et al*., 2014). Platelet activation indicator is MPV which is central to processes involved in coronary heart diseases and endothelial dysfunction (Demirkol *et al*., 2012).

The RDW-CV, RWD-SD, PLT and PDW values were generally higher than values observed in control rats. Platelets are small pieces of cytoplasm detached from the cytoplasm of mature megakaryocytes in the bone marrow (Yin *et al*., 2022). In addition, the main function of platelets is to coagulate and stop bleeding and to repair damaged blood vessels (Zinellu *et al*., 2021). These results show that the composition of platelets in the blood of rats changes with a decrease in platelet count and increases in plateletcrit and the distribution of platelet size in the blood. This may indicate that coagulation and hemostasis functions may be affected in the low hypoxic environment at high altitudes, with a risk of bleeding (Yan *et al*., 2023). PDW which indicates changes in platelet size is correlated with the activity of the platelet. Changes in this index have been reported as a marker to evaluate various inflammatory and infectious diseases (Togan *et al*., 2015). Red blood cell distribution width (RWD) measure reflects the extent of anisocytosis, a condition that is characterized by pronoumced heterogeneity in the volume of circulating erythrocyctes (Lappi *et al*., 2016) and may act as prognostic factor in several diseases (Uffen *et al*., 2019). Elevated RDW is associated with an increased risk for the morbidity or mortality of a plethora of non-communicable and communicable diseases or conditions (Chaudhury *et al*., 2019). Reduction in hematological indices might be due to blood loss via hemorrhagic gastritis and active bleeding peptic ulcers, impairing iron absorption as a result of chronic gastritis, deficiency of iron and vitamin B12 secondary to chronic and atrophic gastritis (Halle and Timerga, 2020). The study reveals changes in the selected blood parameters, yet there was no sign of infection observed in the animals under study. This might be due to the amount of bacteria dose used to challenge the rats. Generally, these blood parameters due to their changes are good indicators of health in man and animal and also their immune response responses to bacterial infection is very vital.

Conclusion and Recommendations

In this study, the MCV, MCH, MCHC, MPV and PCT recorded values lower than that observed in the control rats while RDW-CV, RWD-SD, PLT and PDW values were generally higher than values observed in control rats. Though individual bacterium inoculation showed slight variations in blood parameters from the control values, yet, the test animals survived without signs of infection all through the study indicating that there no threat to their blood system. Activities that introduce bioaerosol should be controlled thereby creating a healthy business environment.

References

Afolabi, K. D., Akinsoyinu, A. O., Olajide, R., & Akinleye, S. B. (2010). Haematological parameters of the Nigerian local grower chickens fed varying dietary levels of palm kernel cake. Proceedings of 35th Annual Conference of Nigerian Society for Animal Production. p.247.

Afyon, M. & Artuk, C. (2016). Could mean platelet volume be a useful marker for infectious diseases? A review of literature. *Medicine*,*5*(4): 1059-1062.

Aladejana, O. M., Oluyege, J. O., Olowomofe, T. O., Obayemi, I. E. & Oluyege, D. E Multiple Antibiotic Resistance of Airborne Bacteria in Outdoor Markets in Ado-Ekiti Metropolis. *Sciendo*, 1-9, DOI: 10.2478/sjecr-2020-0042.

Al-Zamely, H., & Falh,S. Z. (2011). The Effect of Experimental Escherichia coli Infection on Some Blood Parameters and Histological Changes in Male Rats. *The Iraqi J. Vet. Med., 35*(2): 22–27.

Ambrose, I., Nweke, C. O., Umeh, S. C. I. & Braide, W. (2015). Prevalence of bio-aerosols in the outdoor air environment in Uyo Urban, Akwa Ibom State, Nigeria. *International Research Journal of Microbiology*, *6*(2): 012-019.

Akya, A., Rostami-Far, Z, Chegene Lorestani, R., Khazaei, S., Elahi, A., Rostamian, M., Andayeshgar, B., & Ghadiri, K. (2019). Platelet indices as useful indicators of urinary tract infection. *Iran Journal of Pediatrics Hematology and Oncology*, 9(3): 159–165.

Aster, J. C. (2004). Anaemia of diminished erythropoiesis. In: *Robbins and Cotran Pathologic Basis of Disease*, V. Kumar, A. K. Abbas, N. Fausto, S. L. Robbins, & R. S. Cotran (Eds.), (7th ed.). Saunders Co. Philadelphia. p638-649.

Awodi, S., Ayo, J. O., Atodo, A. D., & Dzende, T. (2005). *Some haematological parameters and the erythrocyte osomotic fragility in the laughing dove* (*Streptopella senegalensis*) *and the village weaner bird* (*Ploceus cucullatus*) (p.384-387). Proceedings of the 10th Annual Conference of Animal Science Association of Nigeria.

Chineke, C. A., Ologun, A. G., & Ikeobi, C. O. N. (2006). Haematological parameters in rabbit breeds and crosses in humid tropics. *Pakistan Journal of Biological Sciences*, *9*(11), 2102-2106.

Chaudhury, A., Miller, G. D., Eichner, D., Higgins, J. M. (2019). Single-cell modeling of routine clinical blood tests reveals transient dynamics of human response to blood loss. *eLife*, *8*: 1–12.

Demirkol, S., Balta, S., Unlu, M., Yuksel, U. C., Celik, T., *et al*. (2012). Evaluation of the mean plateletvolume in patients with cardiac syndrome X. *Clinics (Sao Paulo, Brazil)*, 67(9): 1019-1022.

Graham, M. D. (2003). The Coulter Principle: Foundation of an Industry. *Journal of Laboratory Automation*, *8*(6): 72-81.

Halle, K., & Timerga, A. (2020). Evaluation of Haematological Parameters of Helicobacter Pylori-Infected Adult patients at Southern Ethiopia: A Comparative Cross-sectional Study. *Journal of Blood Medicine*, *13*: 77-84.

Hamzeh-Cognasse, H., Damien, P., Chabert, A., Pozzetto, B., Cognazze, F. and Garraud, O. (2015). Platelets and Infections a complex interaction with bacteria. *Frontiers in Immunology*, 6: 82.

Herman, P. (2007). *Bioaerosols and/or droplets*. Belgian Biosafety Server. pp.1-4.

Isaac, L. J., Abah, G., Akpan, B., & Ekaette, I. U. (2013). *Haematological properties of different breeds and sexes of rabbits*. Proceedings of the 18th Annual Conference of AnimalScience Association of Nigeria. pp24-27.

Jaenicke, R. (2005). Abundance of Cellular material and proteins in the atmosphere, Science, *308*: 73.

Jorum, O. H., Piero, N. M. and Machocho, A. K. (2016). Haematological Effects of Dicholomethane-Methanolic Leaf extracts of *Cassia edulis* (Forsak) Vahl in Normal Rat Models. *Journal of Hematology and Thromboembolic Disease*, 5: 2.

Khan, T. A., & Zafar, F. (2005). Haematological Study in Response to Varying Doses of Estrogen in Broiler Chicken. *International Journal of Poultry Science*, *4*(10), 748-751.

Lippi, G., Mattiuzzi, C., & Cervellin, G. (2016). Learning more and spending less with neglected laboratory parameters: the paradigmatic case of red blood cell distribution width. *Acta Biomed*., *87*(3), 323–328.

Markanday A. (2015). Acute phase reactants in infections: evidence-based review and a guide for clinicians. *Open Forum Infectious Diseases*, 2(3): ofv098. doi: 10.1093/ofid/ofv098.

Madl, P. (2003). Instrumental development and design of a thermodenuder; Master thesis at Queensland University of Technology (Australia) in collaboration with Salzburg University (Austria).

Oyawoye, B. M., & Ogunkunle, H. N. (2004). *Biochemical and Haematological Reference values in normal experimental animals*. New York: Masson. pp212-218.

Peters, S. O., Gunn, H. H., Imumorin, I. G., Agaviezor, B. O., & Ikeobi, C. O. (2011). Haematological studies on frizzled and naked neck genotypes of Nigerian native chickens. *Tropical Animal Health Production*, *43*(3), 631-638.

Sevket, B., Sait, D., Murat, U. and Zekeriya, A. (2014) Mean platelet volume can be affected by many factors and should be assessed together with other inflammatory markers. *Platelets*, 25(5): 388-389.

Togan, T., Narci, H., Turan, H., Ciftci, O., Kursun, E., & Arslan H. (2015). The impact of acute brucellosis on mean platelet volume and red bloodcell distribution. *Jundishapur Journal of Microbiology*, *8*(2): e20039. doi:10.5812/jjm.20039.

Togun, V. A., Oseni, B. S. A., Ogundipe, J. A., Arewa, T. R., Hammed, A. A., Ajonijebu, D. C., & Mustapha, F. (2007). Effects of chronic lead administration on the haematological parameters of rabbits – a preliminary study. Proceedings of the 41st Conferences of the Agricultural Society of Nigeria. p341.

Uffen, J. W., Oomen, P., de Regt, M., Oosterheert, J. J., & Kaasjager, K. (2019). The prognostic value of red blood cell distribution width in patients with suspected infection in the Emergency Department. *BMC Emerg. Med*., *19*(1), 1–7.

Yan, C., Tian, D., Zhang, C., Zhang, Q., & Sun, Y. (2023). Evaluation of blood cellular and biochemical parameters in rats under a chronic hypoxic environment at high altitude. *Annals of Medicine*, *55*:1, 898-907.

Yin, C., Wang, Y., Mo. C., Yue, Z., Sun, Y., Hu, D. (2022). Influence of cardiopulmonary exercise test on platelet function in patients with coronary artery diseases on antiplatelet therapy. *BMC Cardiovascular Disorders*, *22*(1): 87.

Zinellu, A., Paliogiannis, P., Sotgiu, E., Mellino, S., Fois, A. G., Carru, C., & Mangoni, A. A. (2021). Platelet count and platelet indices in patients with stable and acute exacerbation of chronic obstructive pulmonary disease: a systematic review and meta-analysis. Chronic Obstructive Pulmonary Disease, *18*(2): 231–245.