IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 15, Issue 5 Ser. II (May 2021), PP 22-25
www.iosrjournals.org

Changes in Haematological Parameters of Aluminium-Exposed Rats Treated With Natural Bee Honey

[1]LISA ILOBEKEMEN EKAKITIE; [2]*OSUVWE CLEMENT ORORORO; [3]JOEL OKPOGHONO
[1]*Department of Biochemistry, Afe Babalola University, Ondo State, Nigeria.*
[2]*Department of Chemical Sciences, Faculty of Science, Edwin Clark University, Kiagbodo, Delta State, Nigeria*
[3]*Department of Chemical Sciences, Faculty of Natural and Applied Sciences, Novena University, Ogume, Delta State, Nigeria*

Abstract
Given the high exposure rate of humans to Aluminum (Al) and it toxic effects, this study examined changes in haematological parameters of aluminium-exposed rats treated with natural bee honey. Thirty Wistar rats weighing 150±5.50g were used for this study. They were randomly divided into 6 groups, (n=5): Group 1 (control), Group 2: $Al(NO_3)_3$ only; group 3, 4, 5 and 6 were also given $Al(NO_3)_3$ and then treated with 10 %, 25 %, 50 % and 100 % bee honey daily respectively. $Al(NO_3)_3$ was administered, intraperitoneally at a dose of 6.5 mg/kg. The treatment lasted for 14 days. Al-induced anemia was manifested via significant reduction in heamoglobin (Hb), Red Blood Cell (RBC) and Packed Cell Volume (PCV). Conversely, exposure to Al caused significant increase in White Blood Cell (WBC) count compared to control. However, treatment of Al-exposed rats with natural bee honey reversed the anaemic condition as evidenced by significant improvement in the values of haemoglobin, RBC and PCV and brought about significant reduction in WBCC. The antioxidant effect of bee honey was higher at 50% formulation. The result point to the potent antioxidant effects of honey against Al toxicity and strongly suggests that bee honey can be used to ameliorate Al-induced anemia.

Keywords: *Haematology, oxidative stress, Natural Bee Honey, Aluminium nitrate*

Date of Submission: 06-05-2021 Date of Acceptance: 20-05-2021

I. Introduction

Aluminum (Al), a non-essential trace element, is present abundantly in the earth's crust and It's extensive use in phosphate binders, dialysis, antiperspirants, vaccines adjuvants, preparation and storage of foods, cigarettes, antacids, and immunotherapy brings it in contact with humans easily. As a ubiquitous element, Al is found in cosmetics, medicines, cheese, tea and other manufactured foods[1-4]. Al exposure to humans has been shown to occur mostly through inhaled air and drinking water as it is often used in water purification[5,6].

Al has a biological half-life of up to seven years and can bio-accumulate in liver, kidney, bone and brain where its toxic effects are manifested due to its ability to induce oxidative stress via increased levels of free radicals and decreased levels of antioxidants following its exposure[7]. Its neurotoxicity, hepatotoxicity, and its ability to disturb reproductive hormones have been demonstrated[8]. Though studies on the effects of Al on the hematological system are limited, it has been shown that Al affects blood cells as it can be deposited in bone at sites of new growth thus exhibiting negative effects on hematopoiesis. Its effects on iron metabolism has been linked to its influence on iron absorption in the intestine, hindrance of iron's transport in the serum and displacement of iron's binding to transferring[9].

Studies on the amelioration of metal toxins have shifted in recent years to the exploration of natural antioxidant compounds as against synthetic ones. Thus, several natural products such as honey propolis, resveratrol, quercetin, royal jelly, gingerol, saffron, Nigella sativa, melatonin with potent antioxidant effects against the toxic effects of Al and other metals have been screened by researchers[10-13].

Honey is used widely in folk medicine for treatment of various ailments and in wound healing. It has been shown to have anti-inflammatory, antioxidant, anemia, hepato-renal protective properties[14-18]. Studies showed that honey have a protective effect in aluminum toxicity[4,10]. Both enzymatic and nonenzymatic antioxidants such as flavonoids, catalase, and other polyphenols are abundant in honey. Honey also contains vitamins and has been reported to be significantly effective against cadmium, lead, nickel, arsenic, mercury and chromium toxicities[15,19,20]. Thus, this study examined changes in haematological parameters of aluminium-exposed rats treated with natural bee honey.

II. Materials And Methods

Chemicals and reagents

All chemicals and reagents used were of analytical grade and were all purchased from BDH chemical laboratory England

Experimental animals and Bee honey

Thirty Wistar rats weighing 150±5.50g were used for this study. The rats, obtained from the Animal House of the Faculty of Basic Medical Sciences, Delta State University, Abraka, were divided into 6 groups, n = five and acclimatized for one week in standard laboratory conditions before the commencement of the experiment. The experimental rats were house in a plastic cage constructed with wire gauze and were fed grower's mash and were given free access to tap drinking water. Natural bee honey was obtained from trusted dealers in Abraka main market in Delta State, Nigeria.

Preparation of $Al(NO_3)_3$ solution

Ten grams of $Al(NO_3)_3$ was dissolved in one litre of distilled water. Toxicity was induced by injecting 6.5 mg/kg of $Al(NO_3)_3$intraperitoneally.

Experimental Design

$Al(NO_3)_3$ was given to animals of groups 2-6 for the induction of toxicity, and group 1 was taken as experimental control. After 24 h of $Al(NO_3)_3$ intoxication, rats of group 3, 4, 5 and 6 were administered 10 %, 25 %, 50% and 100 % natural bee honey (2.5 g/kg) for 14 consecutive days as follows:

Group 1: Control
Group 2: $Al(NO_3)_3$ control
Group 3: $Al(NO_3)_3$ + 10 % bee honey
Group 4: $Al(NO_3)_3$ + 25 % bee honey
Group 5: $Al(NO_3)_3$ + 50 %bee honey
Group 6: $Al(NO_3)_3$ + 100 % bee honey

Twenty four hours after the last treatment, the rats were sacrificed by cervical dislocation and blood samples were obtained by cardiac puncture.

Biochemical assay: estimation of haematological parameters: Haematological parameters: red blood cell count (RBC), packed cell volume (PCV), haemoglobin concentration (Hb), Platelets and white blood cell count (WBC) were analyzed with the Sysmex Automated Haematology Analyzer, KX-21N (Japan) using whole blood and pre-diluted blood samples.

Calculation and statistical analysis: Results are presented as Mean ± SD. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) software. The one-way analysis of variance (ANOVA) was utilized in comparing the degree of significance of different parameters estimated and the difference between mean were considered to be significant at $p< 0.05$.

III. Results

The changes in haematological parameters of aluminium-exposed rats treated with *different concentration of* natural bee honey is presented in Table 1.

Aluminum significantly reduced heamoglobin (Hb) level, Red Blood Cell (RBC) and Packed Cell Volume (PCV) compared to the control but significantly increased White Blood Cell (WBC) count. Treatment of aluminum-exposed rats with 10% bee honey caused significant increase in PCV, but no significant difference was observed in Hb, WBC and RBC compared to rats exposed to Al alone. Conversely, treatment of aluminum-exposed rats with 25%, and 50% bee honey caused insignificant increase in Hb, PCV and RBC and a significant reduction in WBC compared to rats exposed to Al alone. Administration of 50% bee honey to aluminum-exposed rats restored the Al-induced changes in Hb, WBC, RBC and PCV to levels comparable to the control animals, whereas administration of 100% bee honey had no significant ameliorative effect on Al-induced changes on the hematological parameters examined.

Table 1: CHANGES IN HAEMATOLOGICAL PARAMETERS OF ALUMINIUM-EXPOSED RATS TREATED WITH *DIFFERENT CONCENTRATION OF* NATURAL BEE HONEY

Experimental group	Hemoglobin (mg/dl)	White blood count (WBC) ($x10^9$/L)	Red blood count (RBC) ($x10^{12}$/L)	Packed cell volume PCV (%)
Group 1	48.14 ± 7.18 [a]	10.65 ± 4.51[a]	36.03 ± 4.57 [a]	45.10 ± 4.70 [a]
Group 2	24.26 ±11.04 [b]	27.22 ±11.45[b]	17.11 ± 5.87 [b]	23.40 ± 1.09 [b]
Group 3	26.24 ± 5.68 [b]	23.50 ± 9.62[b]	20.30 ± 4.03 [b]	32.60 ± 4.08 [c]
Group 4	35.45 ± 5.76 [c]	15.34 ± 1.53[c]	28.28 ± 3.09 [c]	38.00 ± 4.12 [c]
Group 5	44.42 ± 3.97 [a]	10.16 ± 7.78[a]	35.26 ± 7.89 [a]	41.00 ± 2.21[a]
Group 6	23.53 ± 2.65 [b]	28.34 ± 2.3[b]	15.14 ± 5.18 [b]	24.00 ± 2.10 [b]

Values are represented in mean ± SD. n=5. Mean values with different superscript alphabet in the same column differ significantly at p<0.05. **Experimental Groups:** Group 1; Control; Group 2: Aluminum nitrate control; Group 3: Aluminum nitrate + 10 % honey; Group 4: Aluminum nitrate + 25 % honey; Group 5: Aluminum nitrate + 50 % honey; Group 6: Aluminum nitrate + 100 % honey.

IV. Discussion

In this study, changes in haematological parameters of aluminium-exposed rats treated with natural bee honey were examined. The significant increase in WBC, and significant decrease in RBC, PCV, Platelets and Hb values due to Al administration as observed in this study are indicative of the toxic effects of Al and is in agreement with previous reports[5, 11,21, 22]. The decreased RBC may explain the reduction in PCV and the reduction in the values of haemoglobin, RBC and PCV seen in this study suggests that the treatment induced an anaemic condition. Aluminum-induced anemia could have resulted from hemolysis caused by the generation of free radicals leading to the degradation of the cell membrane; alteration in iron level caused by aluminum or Al-induced iron deficiency[9,11].

Treatment of Al-exposed rats with natural bee honey reversed the anaemic condition as evidenced by significant improvement in the values of haemoglobin, RBC and PCV. This agrees with reported antioxidant effects of honey which may have helped in restoring changes in hematological parameters induced by aluminum exposure. Bhalchandra *et al.*[23] also showed the ameliorative role of bee honey against *cisplatin* induced alteration in hematological parameters in male wister albino rat and Achuba and Nwokogba[24] showed the ameliorative effect of honey supplementation on heamatological parameters of wistar albino rats fed hydrocarbon contaminated diets.

The result of this study also depicted significant (P<0.05) Al-induced increase in white blood cell count (WBCC). White blood cells are primarily concerned with the defense of the body against foreign substances and this is mainly achieved through leucocytosis and antibody production[25]. The observed increase in WBCC in Al-exposed rats compared to control may be due to physiological response of the body to the Al toxicity, which is manifested via increased oxidative stress (OS) and reactive oxygen species (ROS)[7]. Thus, the increase in white blood cell counts suggests induction of the immune system defensive mechanism. However, treatment with natural honey significantly (P<0.05) reduced the observed increase in WBCC close to the values obtained in control rats, an indication of the health promoting effects of bee honey. Other reports have indicated that bee honey have active biological ingredients and antimicrobial, anti-inflammatory and antioxidant activities, which is effective against Al toxicity[4,10,26,27]. Fihri *et al.*[18] also showed that honey has anemia and hepato-renal protective activity in lead toxicity. This may be due to the antioxidants presence in honey that may prevent free radicals in Al toxicity. However, treatment of Al-exposed rats with 10 % and 100 % concentration of honey had no significant difference on the haematological parameters examined compared to rats maintained on Al alone. Bee honey at the concentration of 50 % showed better antioxidant property.

V. Conclusion

The present study showed that Al at the administered dose induced anemia and changes in the haematological indices examined, but the treatment of Al-exposed rats with 25 % and 50 % concentrations of bee honey significantly reversed the Al-induced changes, with greater antioxidant effects observed at 50% formulation. Thus the result indicates that 50% bee honey can be used to ameliorate Al toxicity.

Conflict of interest

No competing interests to declare by the authors.

References

[1]. Nair A & Nair BJ, Comparative analysis of the oxidative stress and antioxidant status in type II diabetics and nondiabetics: A biochemical study. *J Oral Maxillofac Pathol*, 21 (2017) 394.

[2]. Sadhana S, S-Allyl-Cysteines Reduce Amelioration of Aluminum Induced Toxicity in Rats. *Am J Biochem Biotech*, 7 (2011) 74-83

[3]. Al-Hashem FH, Camel's milk protects against aluminum chloride-induced toxicity in the liver and kidney of white albino rats. *Am J Biochem Biotechnol*, 5 (2009) 98-108. DOI:10.3844/ajbbsp.2009.98.108

[4]. Newairy AS, Salama AF, Hussien HM & Yousef MI, Propolis alleviates aluminum-induced lipid peroxidation and biochemical parameters in male rats. *Food Chem Toxicol*, 47 (2009) 1093-1098. PMID: 19425229

[5]. Yousef MI & Salama AF, Propolis protection from reproductive toxicity caused by aluminium chloride in male rats. *Food Chem Toxicol*, 47 (2009) 1168-1175. PMID: 19425234

[6]. Bakour M, Noori S, Al-Waili EL, Menyiy N, Imtara H, Figuira AC, Al-Waili T & Lyoussi B, Antioxidant activity and protective effect of bee bread (honey and pollen) in aluminum-induced anemia, elevation of inflammatory makers and hepato-renal toxicity. *J Food Sci Technol*, 54 (2017) 4205–4212

[7]. Dzulfakar MA, Shaharuddin MS, Muhaimin AA & Syazwan AI, Risk assessment of aluminum in drinking water between two residential areas. *Water*, 3 (2011) 882–893

[8]. Kumar V & Gill KD, Oxidative stress and mitochondrial dysfunction in aluminum neurotoxicity and its amelioration: a review. *Neurotoxicology* 41 (2014) 154–166

[9]. Buraimoh A, Ojo SA, Hambolu JO & Adebisi SS, Effects of aluminum chloride exposure on the cerebral cortex of adult wistar rats was not transferable of the offspring. *Am Int J Contemp Res* 2 (2012) 294–303

[10]. Farina M, Lara FS, Branda˜o R, Jacques R & Rocha JB, Effects of aluminum sulfate on erythropoiesis in rats. *Toxicol Lett*, 132 (2016) 131–139

[11]. Shati AA & Alamri SA, Role of saffron (*Crocus sativus* L.) and honey syrup on aluminum-induced hepatotoxicity. *Saudi Med J*, 31 (2010) 1106–1113.

[12]. Al-Qayim M, Ghali L & Al-Azwai T, Comparative effects of propolis and malic acid on hematological parameters of aluminum exposed male rats. *Glob J Biosci Biotechnol*, 3 (2014) 6–11

[13]. Oda SS, The influence of Omega3 fatty acids supplementation against aluminum-induced toxicity in male albino rats. *Environ Sci Pollut Res Int* 223 (2016) 14354–14361

[14]. Sharma DR, Wani WY, Sunkaria A, Kandimalla RJ, Sharma RK, Verma D, Bal A & Gill KD, Quercetin attenuates neuronal death against aluminum-induced neurodegeneration in the rat hippocampus. *Neuroscience*, 324 (2016) 163–176

[15]. Al-Waili N, Hozzein W, Badr G, Al-Ghamdi A, Al-Waili H, Salom K & Al-Waili T, Propolis and bee venom in diabetic wounds; a potential approach that warrants clinical investigation. *Afr J Tradit Complement Altern Med* 12 (2015) 1–11

[16]. Abubakar MB, Abdullah WZ, Sulaiman SA & Suen AB, A review of molecular mechanisms of the anti-Leukemic effects of phenolic compounds in honey. *Inter J Molecular Sci*, 13 (2012) 15054–15073.

[17]. Othman NH, Honey and Cancer: Sustainable Inverse Relationship Particularly for Developing Nations: A Review. *Evidence Based Complement Altern Med* http://dx.doi.org/10.1155/2012/410406 (2012)

[18]. Kolayli S, Can Z & Yildiz O, A comparative study of the antihyaluronidase, antiurease, antioxidant, antimicrobial and physicochemical properties of different unifloral degrees of chestnut (*Castanea sativa* Mill.) honeys. *J Enzym Inhib Med Chem* 20 (2016) 1–9.

[19]. Fihri AF, Al-Waili NS, El-Haskoury R, Bakour M, Amarti A, Ansari MJ & Lyoussi B, Protective effect of morocco carob honey against lead-Induced anemia and hepato-renal toxicity. *Cell Physiol Biochem* 39 (2016) 115–122

[20]. Gheldof N, Wang XH & Engeseth NJ, Identification and quantification of antioxidant components of honeys from various floral sources. *J Agri Food Chem*, 50 (2002) 5870– 5877.

[21]. Kishore RK, Halim AS, Syazana M. & Sirajudeen K, Tualang honey has higher phenolic content and greater radical scavenging activity compared with other honey sources. *Nutri Res*, 31 (2011) 322–325

[22]. Ghorbel I, Maktouf S, Kallel C, Ellouze Chaabouni S, Boudawara T & Zeghal N, Disruption of erythrocyte antioxidant defense system, hematological parameters, induction of pro-inflammatory cytokines and DNA damage in liver of co-exposed rats to aluminium and acrylamide. *Chem Biol Interact*, 236 (2015) 31–40

[23]. Bazzoni GB, Bollini AN, Herna´ndez GN, Contini Mdel C, Chiarotto MM & Rasia ML, In vivo effect of aluminum upon the physical properties of the erythrocyte membrane. *J Inorg Biochem*, 99 (2005) 822–827

[24]. Bhalchandra W, Alqadhi WY & Ninawe AS, Ameliorative role of bee honey and royal jelly against *cisplatin* induced alteration in hematological parameters in male wister albino rat. *Inter J Pharm Pharmaceu Sci*; 10 (2018) 110-114

[25]. Achuba FI & Nwokogba CC, Effect of honey supplementation on heamatological parameters of wistar albino rats fed hydrocarbon contaminated diets. *Biokemistri*, 27 (2015) 44–49.

[26]. Cheesbough M, District laboratory practice in tropical countries (Part II). Cambridge University Press Ltd, England. 2006

[27]. Baltrusaityte V, Venskutonis PR & Ceksteryte V, Radical scavenging activity of different floral origin honey and bee bread phenolic extracts. *Food Chem*, 101 (2007) 502–514.

[28]. AL-Waili N, Al Ghamdi A, Ansari MJ, Al-Attal Y, Al-Mubarak A & Salom K, Differences in composition of honey samples and their impact on the antimicrobial activities against drug multi-resistant bacteria and pathogenic fungi. *Arch Med Res* 44 (2013) 307–316.

LISA ILOBEKEMEN EKAKITIE, et. al. "Changes in Haematological Parameters of Aluminium-Exposed Rats Treated With Natural Bee Honey." *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*, 14(5), (2021): pp 22-25.