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Publications 2024
ONLINE ISSN: 2992-5460
PRINT ISSN: 2992-6041

NEWPORT INTERNATIONAL JOURNAL OF RESEARCH IN MEDICAL SCIENCES (NIJRMS)

Volume 5 Issue 2 2024

https://doi.org/10.59298/NIJRMS/2024/5.2.05771

Effects of Rauwolfa vomitoria (Akata) and Olax subscorpioidea (Asaja) Roots on Hematology of Chicken Type II Collagen-Freund's Adjuvant-induced Rheumatoid Arthritis in Albino Rats

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ABSTRACT

This study evaluated the effects of ethanol and aqueous root extracts of *Rauwolfia vomitoria* and *Olax subscorpioidea* on Chicken type II collagen in Complete Freund's Adjuvant-induced arthritis in albino rats. A total of 225 albino rats, weighing between 120-200 g, were used and divided into 15 groups of 15 rats each. Rheumatoid Arthritis (RA) was induced by administering 0.1 ml of Chicken type II-Complete Freund's Adjuvant into the left hind paw. The study duration was 32 days, during which the arthritic rats were treated with *Rauwolfia vomitoria* and *Olax subscorpioidea* root extracts at doses of 400 mg, 600 mg, and 800 mg/kg body weight. The sub-lethal toxicity study revealed significant increases ($P<0.05$) in WBC, platelet, and differential counts, along with significant reductions ($P<0.05$) in RBC count, PCV, and HB in the adjuvant-induced arthritic rats compared to the negative control group. However, treatment with the plant extracts (groups 4-15) significantly reversed these trends towards normal levels compared to the untreated arthritis group (group 2) within the 32-day period. The ameliorative effects of the extracts were both time- and dose-dependent ($P<0.05$). This study concludes that the ethanol and aqueous root extracts of *Rauwolfia vomitoria* and *Olax subscorpioidea* effectively ameliorate arthritis symptoms in albino rats, potentially due to the presence of active chemical constituents. These findings provide scientific evidence supporting the therapeutic use of these plant extracts in managing arthritis.

INTRODUCTION

The use of plants as medication cannot be overemphasized. Plants have continued to play a primary role in the treatment, management and cure of diseases, relieve of pain and management of human health over the years [1]. Recently, the use of traditional African medicine in treatments and remedies is now better appreciated from researchers especially in the Western world. This interest in the use of plants in disease management and treatment could be due to the rising cost of orthodox drugs. In general terms, medicinal plants are plants that produce constituents that exert ameliorative effects and these constituents differ from one plant to plant. *Rauwolfia vomitoria* is a known shrub or small tree of about 8m tall which belongs to the Kingdom Plantae. .*Rauvolfia vomitoria* is used by Nigerian traditional healers to treat psychiatric patients [2]. It is also applied in the management of arthritis by local inhabitants of rural areas in Nigeria. In Democratic Republic of Congo, *Rauvolfia vomitoria* can be used in the management of leprosy. The bark can be used as an emetic and purgative (to induce vomiting). Its extracts made from its root, leaves, stem back etc are used in the treatment of inflammation [3], it exerts antipyretic properties [4], anti-diabetic effect and anti-cancer effect (due to the B-carboline alkaloid, alstonine), [5]. On the hand *Olax subscorpioidea* is a tree with hemiparasitic, often glabrous alternate. It can be used in ethnomedicine for the treatment of various ailments such as veneral diseases (Neiseriamgonorrhea), rheumatism, febrifuges, arthritis, antipyretics, liver disease, heart disease and helps reduce fat during pregnancy. It can also be used in the treatment of cutaneous, subcutaneous, parasitic infection and as genital stimulant/depressants [6].Rheumatoid arthritis (RA) is a disease condition that causes chronic inflammation of the joints. It is autoimmune in nature. Rheumatoid arthritis may be characterized by cartilage and bone deformities and systemic features, including cardiovascular, pulmonary, psychological, and skeletal disorders synovial inflammation and swelling, polyarticular inflammation of synovial tissue, that leads to pain, swelling, and joints stiffness of the hands, wrists, and feet in particular, autoantibody production (rheumatoid factor and anti–citrullinated protein antibody [ACPA]), [7] . Rheumatoid arthritis causes functional limitations and may progress to destruction

of the joint and equally extra-articular disease. Rheumatoid arthritis is referred to as a systemic illness, because it can affect multiple other organs of the body and is sometimes known as rheumatoid disease [8]. Normocytic or microcytic anemia is relatively most common feature associated with Rheumatoid Athritis. The effects of proinflammatory cytokines: tumor necrosis factor alpha (TNF-α), interferon gamma (IFN-γ), interleukin-1 (IL-1), and interleukin-6 (IL-6) are related to the development of anemia [9]. Anemia in RA occurs as a result of iron deficiency, associated with increased hepcidin production, which is a recognized key factor of this disease. Hepcidin is a peptide hormone which is produced by the liver. It inhibits the absorption of intestinal iron, iron release from macrophages and hepatocytes and transport of placental iron. These mechanisms however decrease iron delivery. The main mediator of hepcidin increase in inflammation is IL-6 [10]. The IL-6–dependent STAT-3 pathway and the unfolded protein response–associated cyclic AMP response element-binding protein-H (CREBH) pathway are responsible for the signal transduction pathways that regulate hepcidin during inflammation and endoplastic reticulum stress [11]. Using disease modifying anti rheumatic drugs (DEMARDS) like methotrexate, leflunomide, hydroxychloroquine and sulfasalazine are known to have common side effects such as loss of appetite, a sore mouth, feeling of ill health, diarrhea, headaches and hair loss [12], [13]. In addition, the use of biologics such as etanercep, adalimumab, certolizumab for biological treatments is a new form of treatments for rheumatoid arthritis [14]. They too are not without side effects which include mild skin reactions at the site of injections, infections, feeling sick, an increased body temperature and headaches [15]. The cost of these drugs are quite high, hence many sufferers of arthritis resort to using locally available plant herbs to manage or treat their ailments. This approach has produced many positive results which is the reason why it is becoming the general practice in our society today. However, though the Olax subscoripoidea and *Rauwolfia vomitoria* plant extracts have been successfully used for the treatment of arthritis, by the local people, to the best of our knowledge there is yet no scientific reports on their toxicological properties and labouratory based evidence of their anti-arthritis potentials.

Materials and Methods

Materials

Plant Materials

Rauwofia vomitoria and Olax Subscorpoidea roots were sourced from Ndi-Nwali Village in Izzi Local Government Area of Ebonyi State in South-Eastern Nigeria. Professor Kate Nnamani, a botanist at Ebonyi State University in Abakaliki's Department of Applied Biological Sciences, verified the authenticity of the plant. A portion of the root samples were kept at the Department of Applied Biological Science's herbarium.

Animals

The total number of 225 female albino rats were used. These were bought from the department of Animal Science, University of Nigeria Nsukka, Enugu State, Nigeria. The animals were acclimatized for a period of 14 days and were giving free access to food and water.

Methods

Preparation of the plant extracts

Contaminants in the plant samples were washed off under flowing tap and air dried under a shade. The laboratory milling machine was used to grind the plant roots and were sifted using 0.25 mm sieve. Eight hundred grams of *Rauwolfia vomitoria* and olax subscorpoidea dried powdered root samples were soaked in 2000 ml of ethanol and deionized water respectively for 48 hours respectively. They were subjected to successive extraction by the use of a water bath at 50^0 C until the solvents were completely removed; the percentage yield was obtained and extracts used for analysis.

Induction of arthritis in albino rats

The method described by [16], was adopted in the induction of arthritis in rats by injecting of 0.1 ml of chicken type II collagen-complete Freund's adjuvant (CFA) into the left hind paw of the rats. The paw size of the rat groups was measured twice weekly before and after adjuvant administration, and paw inflammation severity was assessed using a qualitative scoring system. By day 10, arthritis had fully developed. Rats with no visible swelling were scored 0, mild redness and individual digit inflammation was scored 1, moderate redness and ankle swelling was scored 2, and severe redness and paw inflammation was scored 3. Rats with a score of 3 were considered to have arthritis and were used for subsequent experiments.

Treatment of Rheumatoid Arthritic rats with plant extracts

In all, 225 female rats weighing 150–210 g were used in this study. Exactly 15 groups of 15 female albino rats each were formed from the distribution of the rats. The standard drug, indomethacin, was prepared as a solution using normal saline (standard control). The standard drug Indomethacine was dissolved in normal saline. Group I served as normal control (without induction of arthritis and treatment), Group 2 served as arthritic control (negative control), Group 3 was treated with indomethacine (positive control) the standard anti - arthritic drug, Groups 4 - 6 were induced with arthris and were treated with ethanolic extract of the root of *Olax subscoripoidea*at 400, 600 and 800 mg/kg body weight for 32 days from the induction day, Groups 7 and 9 were induced with arthritis and received *Olax subscoripoidea*aqeous root extract at 400, 600, 800 mg/kg body weight treatment for 32 days from the induction day. Groups 10 – 12 were induced with arthritis and received *Rauwofia vomitoria* ethanol root extract at 400, 600 and 800 mg/kg body weight for 32 days from

ONLINE ISSN: 2992-5460
PRINT ISSN: 2992-6041

the day of induction. Groups 13-15 were induced with arthritis and received *Rauwolfia vomitoria* aqeous root extract at 400, 600 and 800 mg/kg body weight for 32 days from the day of induction.The body weight changes and inflammatory index were observed twice weekly. A qualitative scoring system was used to assess the severity of paw inflammation. The absence of any visible swelling was given a score of 0, mild redness and inflammation of individual digits, regardless of the number of affected digits was given a score of 1, moderate redness and swelling of the ankle.

Samples preparation and Analysis

Three albino rats from each group (Group 1-15) were sacrificed on days 10, 18, 25 and 32 and blood samples were collected in EDTA anticoagulant bottles. Estimation of haemoglobin (Hb) concentration (haemiglobincyanide ICSH, 1996). Haematocrit or Packed Cell Volume (PCV) (ICSH 1980). Total erythrocyte count (RBC count) [17]. Total leucocyte count [17],

Statistical Analysis

The Statistical Analysis System (SAS) windows version 9.0 was used to estimate the fundamental statistics, means, standard deviation, and ranges of the observed values. Means ± SD of 12 replicates were used to express the data. When a value was $p<0.05$, it was deemed statistically significant.

RESULTS

Effect of of *Rauwolfia vomitoria* and *Olax subscorpiodea* ethanol and aqueous root extracts on white blood cell (WBC) count of rats.

Effect of *Rauwolfia vomitoria* and *Olax subscorpiodea* ethanol and aqueous root extracts on white blood cell (WBC) count of rats is presented in Table 1 WBC count increased significantly ($p<0.05$) in the arthritic groups when compared to the negative group (normal control group). However the WBC count reduced progressively ($P<0.05$) in all the groups treated with the plants extracts towards the level found in the normal control and the standard drug group when compared to the untreated arthritic group. The effect was both time and dose dependent.

Table 1: Effect of *Rauwolfia vomitoria* and *Olax subscorpioidea* aqueous and ethanol root extracts on white blood cell count of adjuvant induced arthritic rats.

	DAY 10 ($x10^9$/L)	DAY 18 ($x10^9$/L)	DAY 25 ($x10^9$/L)	DAY 32 ($x10^9$/L)
1	12500 ± 0.00^{g}	12625 ± 0.20^{c}	12550 ± 0.01^{b}	12400 ± 0.02^{b}
2	$13500\pm0.10^{c,b}$	15250 ± 0.20^{a}	16500 ± 0.06^{a}	17500 ± 0.06^{a}
3	12700 ± 0.20^{f}	$12400\pm0.42^{d,c}$	12100 ± 0.00^{c}	12001 ± 0.01^{c}
4	13796 ± 1.10^{a}	13175 ± 0.36^{b}	12797.5 ± 1.00^{b}	$11200\pm0.00^{f,g}$
5	12852 ± 0.00^{f}	$12300\pm0.21^{d,c,e}$	$12102\pm0.01^{e,d}$	11052 ± 0.03^{g}
6	12776 ± 1.00^{f}	11558 ± 0.42^{f}	11300 ± 0.05^{g}	10655 ± 0.02^{h}
7	$13200\pm0.20^{e,d}$	12615 ± 0.07^{c}	$12430\pm0.00^{c,d}$	12450 ± 0.01^{b}
8	$13350\pm0.13^{c,d}$	$12150\pm0.71^{d,e}$	$11925\pm0.07^{e,f}$	$11705\pm0.02^{d,c}$
9	12785 ± 1.20^{f}	$12500\pm0.69^{d,c}$	$11600\pm0.06^{g,f}$	$11380\pm0.03^{f,e}$
10	13600 ± 0.00^{b}	13050 ± 0.13^{b}	$12700\pm0.02^{c,b}$	$11100\pm0.02^{f,g}$
11	12850 ± 0.01^{f}	$12300\pm0.42^{d,c,e}$	$12100\pm0.00^{e,d}$	11050 ± 0.01^{g}
12	11775 ± 0.01^{h}	11575 ± 0.07^{f}	11300 ± 0.02^{g}	10643 ± 0.01^{h}
13	13100 ± 0.02^{e}	$12300\pm0.00^{d,c,e}$	$12200\pm0.00^{e,d}$	12000 ± 0.02^{c}
14	13300 ± 0.02^{d}	12000 ± 0.00^{e}	$11900\pm0.00^{e,f}$	$11650\pm0.03^{d,e}$
15	11800 ± 0.02^{h}	11400 ± 0.01^{f}	11450 ± 0.10^{g}	10450 ± 0.01^{h}

White blood cell count of adjuvant induced arthritic rats treated with *Rauwolfia vomitoria* and *Olax subscorpioidea* ethanol and aqueous root extracts. OS= *Olax subscorpioidea*, RV= *Rauwolfia vomitoria*. 1= Negative control,2= positive control, 3= Standard control, 4= 400 mg/ kg RV aqueous extract, 5= 600 mg/kgRV aqueous extract, 6= 800 mg/kgRV aqueous extract, 7= 400 mg/kg OS aqueous extract,8= 600 mg/kg OS aqueous extract, 9= 800 mg/kg OS extract aqueous,10= 400 mg/kg RV ethanol extract,11= 600 mg/kg RV ethanol extract, 12= 800 mg/kg RV ethanol extract,13= 400 mg/kg OS ethanol extract,14= 600 mg/kg OS ethanol extract, 15= 800 mg/kg OS ethanol extract.* Means with the same letter are not significantly different

ONLINE ISSN: 2992-5460
PRINT ISSN: 2992-6041

Effect of of *Rauwolfia vomitoria* and *Olax subscorpiodea* ethanol and aqueous root extracts on RBC count of rats

The results are presented in Table 2. RBC levels in untreated arthritic rats were lower than the negative control and treated groups. Treatment with the plant extracts normalized the RBC levels to the level found in the control and standard drug treated groups.The effect of indomethacin, *Olax subscorpioidea* and *Rauwolfia vomitoria* aqueous and ethanol root extracts in normalizing the RBC count was more pronounced on day 32; 800 mg/kg aqueous extract of *Olax subscorpioidea* and 800 mg *Olax subscorpioidea* ethanol extracts were found to be ($p<0.05$) more effective in normalizing the RBC count than the other treatments.

Table 2: Effect of *Rauwolfia vomitoria* and *Olax subscorpioidea* aqueous and ethanol root extracts on RBC count of adjuvant induced arthritic rats

Treatments	DAY 10 ($x10^{12}$/L)	DAY 18 ($x10^{12}$/L)	DAY 25 ($x10^{12}$/L)	DAY 32 ($x10^{12}$/L)
1	277.50 ± 0.71^{a}	270.50 ± 0.71^{a}	276.00 ± 0.41^{a}	$272.50\pm0.54^{b,a,c}$
2	244.00 ± 0.41^{d}	218.50 ± 0.12^{f}	205.00 ± 0.24^{h}	190.00 ± 0.83^{g}
3	246.50 ± 0.12^{c}	$262.00\pm0.41^{c,b}$	265.00 ± 0.00^{b}	$268.00\pm0.49^{b,d,c}$
4	241.00 ± 0.41^{f}	251.00 ± 0.24^{d}	$254.50\pm0.36^{f,g}$	$257.50\pm0.71^{e,f}$
5	$243.00\pm0.41^{e,d}$	245.50 ± 0.28^{e}	$261.00\pm0.41^{c,d}$	$263.50\pm0.78^{e,d}$
6	$242.50\pm0.71^{e,d,f}$	252.00 ± 0.41^{d}	$264.00\pm0.66^{c,b}$	264.80 ± 0.19^{d}
7	$242.50\pm0.71^{e,d,f}$	$261.50\pm0.95^{c,b}$	$262.50\pm0.71^{c,b,d}$	265.00 ± 0.00^{d}
8	243.50 ± 0.71^{d}	$259.50\pm0.71^{c,b}$	$263.00\pm0.41^{c,b}$	$267.50\pm0.71^{d,c}$
9	243.50 ± 0.71^{d}	$261.00\pm0.00^{c,b}$	$263.50\pm0.71^{c,b}$	$274.00\pm0.90^{b,a}$
10	$241.50\pm0.71^{e,f}$	$250.00\pm0.00^{e,d}$	$257.50\pm0.12^{f,e}$	$258.50\pm0.12^{e,f}$
11	249.50 ± 0.71^{b}	257.50 ± 0.78^{c}	$259.50\pm0.12^{e,d}$	256.50 ± 0.19^{f}
12	$242.50\pm0.71^{e,d,f}$	$248.00\pm0.07^{e,d}$	252.50 ± 0.71^{g}	$263.50\pm0.36^{e,d}$
13	243.50 ± 0.71^{d}	262.50 ± 0.25^{b}	$263.00\pm0.00^{c,b}$	266.00 ± 0.00^{d}
14	244.00 ± 0.00^{d}	263.00 ± 0.24^{b}	$263.50\pm0.71^{c,b}$	$269.00\pm0.41^{b,d,c}$
15	243.50 ± 0.71^{d}	$261.50\pm0.71^{c,b}$	264.50 ± 0.71^{b}	275.50 ± 0.95^{a}

Red blood cell count of adjuvant induced arthritic rats treated with *Rauwolfia vomitoria* and *Olax subscorpioidea* ethanol and aqueous root extracts. OS= *Olax subscorpioidea*, RV= *Rauwolfia vomitoria*. 1= Negative control, 2= positive control, 3= Standard control, 4= 400 mg/ kg RV aqueous extract, 5= 600 mg/kgRV aqueous extract, 6= 800 mg/kgRV aqueous extract, 7= 400 mg/kg OS aqueous extract,8= 600 mg/kg OS aqueous extract, 9= 800 mg/kg OS extract aqueous,10= 400 mg/kg RV ethanol extract,11= 600 mg/kg RV ethanol extract, 12= 800 mg/kg RVethanol extract,13= 400 mg/kg OS ethanol extract,14= 600 mg/kg OS ethanol extract, 15= 800 mg/kg OS ethanol extract.

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ONLINE ISSN: 2992-5460
PRINT ISSN: 2992-6041

Table 3: Effect of of *Rauwolfia vomitoria* and *Olax subscorpiodea* ethanol and aqueous root extracts on hemaglobin count (Hb) of rats

	DAY 10 (g/dl)	DAY 18(g/dl)	DAY 25(g/dl)	DAY 32(g/dl)
1	25.73±1.63^{a}	26.59±0.32^{a}	25.40±0.53^{a}	26.41±1.34^{a}
2	15.93±0.10^{f}	14.88±0.00^{g}	12.11±0.18^{h}	10.66±0.01^{h}
3	23.04±0.87^{b}	24.20±0.07^{b}	24.54±0.40^{b}	25.83±0.23^{b,a}
4	16.68±1.56^{f}	22.79±0.22^{d}	22.97±0.67^{g}	25.10±0.53^{e,c,d}
5	19.94±0.26^{d}	22.88±0.03^{d}	23.58±0.28^{f,e,d}	23.70±0.07^{g}
6	18.40±0.13^{e}	23.64±0.01^{c}	23.85±0.52^{c,e,d}	24.77±0.46^{e,d}
7	20.91±0.09^{d,c}	21.41±0.79^{f}	23.35±0.00^{f,e,g}	23.78±0.10^{g}
8	21.20±0.00^{c}	23.12±0.01^{d}	23.58±0.20^{f,e,d}	24.56±0.06^{e,f}
9	21.31±0.00^{c}	23.65±0.08^{c}	24.05±0.08^{c,b,d}	25.34±0.17^{b,c,d}
10	18.23±0.49^{e}	22.80±0.08^{d}	23.19±1.12^{f,g}	25.17±0.36^{e,c,d}
11	19.95±0.27^{d}	22.84±0.06^{d}	23.57±0.27^{f,e,d}	24.69±0.08^{e}
12	18.38±0.02^{e}	23.66±0.06^{c}	23.20±0.13^{f,g}	24.01±0.88^{g,f}
13	21.81±0.25^{c}	21.86±0.19^{e}	23.34±0.00^{f,e,g}	23.85±0.16^{g}
14	21.30±0.00^{c}	23.11±0.00^{d}	23.59±0.20^{f,e,d}	24.59±0.00^{e,f}
15	21.32±0.00^{c}	23.71±0.01^{c}	24.11±0.01^{c,b}	25.58±0.16^{b,c}

The results are presented in Table 3. Arthritis condition caused a time-dependent reduction of Hb concentration that was significant ($P<0.05$) in arthritic rats. However, treatment with plant extracts caused time dependent normalization of the Hb concentration to the value found in the normal control which is comparable to the standard drug. The effects of treatment with 800 mg/kg *Olax subscorpioidea* ethanol extract was more significantly ($P<0.05$) pronounced.

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ONLINE ISSN: 2992-5460
PRINT ISSN: 2992-6041

Table 4: Effect of *Rauwolfia vomitoria* and *Olax subscorpioidea* aqueous and ethanol root extracts on PCV level of adjuvant induced arthritic rats.

Treatments	DAY 10 (%)	DAY 18 (%)	DAY 25 (%)	DAY 32 (%)
1	42.50 ± 0.71^{a}	42.51 ± 0.71^{a}	42.43 ± 0.71^{b}	$42.53\pm0.71^{f,e}$
2	$32.50\pm0.71^{e,d}$	29.50 ± 0.71^{i}	26.00 ± 2.83^{f}	22.50 ± 0.71^{g}
3	$35.50\pm4.95^{c,d}$	$38.50\pm0.71^{f,e}$	46.00 ± 0.00^{a}	48.00 ± 0.00^{a}
4	$36.00\pm0.00^{b,c,d}$	37.00 ± 0.00^{g}	$39.50\pm0.71^{e,d}$	41.00 ± 2.83^{f}
5	$37.00\pm1.41^{b,c}$	$39.00\pm1.41^{f,e,d}$	$42.00\pm1.41^{c,b}$	$47.00\pm2.83^{b,a}$
6	31.00 ± 1.41^{e}	$39.50\pm0.71^{c,e,d}$	45.50 ± 0.71^{a}	$46.50\pm0.71^{b,a}$
7	$38.00\pm1.41^{b,c}$	$38.00\pm0.00^{f,g}$	38.00 ± 1.41^{e}	$43.50\pm0.71^{d,e}$
8	$38.00\pm0.00^{b,c}$	$39.00\pm1.41^{f,e,d}$	$41.50\pm2.12^{c,b}$	$45.50\pm0.71^{b,c}$
9	$38.50\pm0.71^{b,c}$	$40.50\pm0.12^{c,b}$	42.50 ± 2.12^{b}	$44.50\pm2.12^{d,c}$
10	$36.50\pm0.71^{b,c}$	33.50 ± 0.71^{h}	$40.50\pm2.12^{c,d}$	$46.50\pm2.12^{b,a}$
11	$37.50\pm6.36^{b,c}$	$40.00\pm0.00^{c,b,d}$	42.50 ± 0.71^{b}	$47.00\pm10.4^{b,a}$
12	$38.50\pm0.71^{b,c}$	$40.50\pm0.71^{c,b}$	45.00 ± 0.00^{a}	$47.00\pm0.00^{b,a}$
13	$37.50\pm0.71^{b,c}$	$38.00\pm0.00^{f,g}$	38.50 ± 0.71^{e}	$44.50\pm0.71^{d,c}$
14	$38.00\pm1.41^{b,c}$	$39.00\pm1.41^{f,e,d}$	42.50 ± 2.12^{b}	$46.00\pm0.00^{b,c}$
15	$39.50\pm0.71^{b,a}$	41.00 ± 1.41^{b}	42.50 ± 3.54^{b}	48.00 ± 0.00^{a}

Packed Cell Volume of adjuvant induced arthritic rats treated with *Rauwolfia vomitoria* and *Olax subscorpioidea* ethanol and aqueous root extracts. OS= *Olax subscorpioidea*, RV= *Rauwolfia vomitoria*. 1= Negative control, 2= positive control, 3= Standard control, 4= 400 mg/ kg RV aqueous extract, 5= 600 mg/kg RV aqueous extract, 6= 800 mg/kg RV aqueous extract, 7= 400 mg/kg OS aqueous extract,8= 600 mg/kg OS aqueous extract, 9= 800 mg/kg OS extract aqueous,10= 400 mg/kg RV ethanol extract,11= 600 mg/kg RV ethanol extract, 12= 800 mg/kg RV ethanol extract,13= 400 mg/kg OS ethanol extract,14= 600 mg/kg OS ethanol extract, 15= 800 mg/kg OS ethanol extract.

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ONLINE ISSN: 2992-5460
PRINT ISSN: 2992-6041

Table 5: Effect of *Rauwolfia vomitoria* and *Olax subscorpioidea* aqueous and ethanol root extracts on platelet count of adjuvant induced arthritic rats treated

Platelet count of adjuvant induced arthritic rats treated with *Rauwolfia vomitoria* and *Olax subscorpioidea* ethanol and aqueous root extracts. OS= *Olax subscorpioidea*, RV= *Rauwolfia vomitoria*. 1= Negative control, 2= positive control, 3= Standard control, 4= 400 mg/ kg RV aqueous extract, 5= 600 mg/kg RV aqueous extract, 6= 800 mg/kg RV aqueous extract, 7= 400 mg/kg OS aqueous extract,8= 600 mg/kg OS aqueous extract, 9= 800 mg/kg OS extract aqueous,10= 400 mg/kg RV ethanol extract,11= 600 mg/kg RV ethanol extract, 12= 800 mg/kg RV ethanol extract,13= 400 mg/kg OS ethanol extract,14= 600 mg/kg OS ethanol extract, 15= 800 mg/kg OS ethanol extract.

Treatments	DAY 10 (x10^9/L)	DAY 18 (x10^9/L)	DAY 25 (x10^9/L)	DAY 32 (x10^9/L)
1	165.50±2.12^{h}	164.50±0.71^{e}	165.23±2.83^{f}	165.00±1.41^{e,d}
2	177.50±0.71^{a}	180.50±3.54^{a}	185.50±1.71^{a}	188.00±0.00^{a}
3	172.00±0.00^{e,d}	167.00±1.41^{d}	166.50±2.12^{f,e}	162.00±2.83^{f}
4	174.00±0.00^{c,b}	168.50±0.71^{c,b}	168.50±0.71^{c,b}	167.00±1.41^{c,b}
5	174.50±0.71^{b}	168.50±0.71^{c,b}	168.00±0.00^{c,b,d}	167.50±0.71b
6	171.50±0.71^{e,f}	168.00±0.00^{c,b,d}	167.50±0.71^{c,e,d}	166.50±0.71^{c,b}
7	170.50±0.71^{f}	169.00±0.00^{b}	169.00±0.00^{b}	166.50±2.12^{c,b}
8	173.00±0.00^{c,d}	168.00±0.00^{c,b,d}	168.00±0.00^{c,b,d}	167.50±0.71^{b}
9	168.50±0.71^{g}	168.00±0.00^{c,b,d}	167.00±1.41^{e,d}	166.00±0.00^{c,d}
10	174.00±0.71^{c,b}	167.50±0.71^{c,d}	167.50±0.71^{c,e,d}	166.50±2.12^{c,b}
11	174.50±0.00^{b}	167.50±0.71^{c,d}	167.50±0.71^{c,e,d}	166.00±1.41^{c,d}
12	171.50±0.71^{e,f}	167.50±0.71^{c,d}	167.00±1.41^{e,d}	167.00±0.00$^{c.b}$
13	170.50±0.00^{f}	168.50±0.71^{c,b}	168.50±0.71^{c,b}	167.00±1.41^{c,b}
14	173.00±0.71^{c,d}	168.50±0.71^{c,b}	168.00±0.00^{c,b,d}	167.50±0.71^{b}
15	168.50±0.71^{g}	168.00±0.00^{c,b,d}	167.50±0.71^{c,e,d}	164.00±0.00^{e}

* Means with the same letter are not significantly different

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Publications 2024
2992-6041
ONLINE ISSN: 2992-5460
PRINT ISSN:

Table 6: Effect of *Rauwolfia vomitoria* and *Olax subscorpioidea* aqueous and ethanol root extracts on lymphocyte count of adjuvant induced arthritic rats

Treatments	DAY10 (%)	DAY18 (%)	DAY25 (%)	DAY32 (%)
1	33.50±0.71^{e}	33.50±2.12^{h}	34.50±0.71^{j}	36.50±0.71^{d,c}
2	46.50±2.12^{c}	56.00±2.83^{a}	64.50±0.71^{a}	79.00±1.41^{a}
3	42.50±2.12^{d}	38.00±0.00^{g,e,f}	35.50±2.12^{i}	36.00±1.41^{d,e}
4	56.50±0.71^{a}	47.00±0.00^{b}	43.00±1.41^{b}	29.00±1.41^{g}
5	54.00±0.00^{b,a}	43.00±2.83^{c}	42.00±0.00^{c}	32.50±0.71^{f}
6	52.50±3.54^{b}	40.00±0.00^{d,e}	38.00±1.41^{e,d}	30.00±0.00^{g}
7	53.50±0.71^{b}	43.00±0.00^{c}	42.50±0.71^{c,b}	42.20±0.71^{b}
8	52.00±2.83^{b}	40.00±0.00^{d,e}	38.50±2.12^{d}	41.00±0.00^{b}
9	52.00±2.83^{b}	39.00±0.00^{d,e,f}	37.50±0.71^{e,f}	37.50±0.71^{c}
10	45.00±1.41^{d,c}	41.00±1.41^{d,c}	36.50±0.71^{g,h}	35.00±1.41^{e}
11	44.50±0.71^{d,c}	38.00±0.00^{g,e,f}	35.50±0.71^{i}	35.50±0.71^{d,e}
12	43.00±1.41^{d}	36.00±0.00^{g}	35.50±0.71^{i}	36.00±0.00^{d,e}
13	45.00±1.41^{d,c}	46.00±2.83^{b}	37.00±1.41^{g,f}	36.00±2.83^{d,e}
14	44.00±1.41^{d,c}	43.00±4.24^{c}	36.00±1.41^{I,h}	35.00±0.00^{e}
15	42.50±0.71^{d}	37.50±0.71^{g,f}	35.50±0.71^{i}	35.00±0.00^{e}

Lymphocyte count of adjuvant induced arthritic rats treated with *Rauwolfia vomitoria* and *Olax subscorpioidea* ethanol and aqueous root extracts. OS= *Olax subscorpioidea*, RV= *Rauwolfia vomitoria.* 1= Negative control, 2= positive control, 3= Standard control, 4= 400 mg/ kg RV aqueous extract, 5= 600 mg/kg RV aqueous extract, 6= 800 mg/kgRV aqueous extract, 7= 400 mg/kg OS aqueous extract,8= 600 mg/kg OS aqueous extract, 9= 800 mg/kg OS extract aqueous,10= 400 mg/kg RV ethanol extract,11= 600 mg/kg RV ethanol extract, 12= 800 mg/kg RV ethanol extract,13= 400 mg/kg OS ethanol extract,14= 600 mg/kg OS ethanol extract, 15= 800 mg/kg OS ethanol extract.
* Means with the same letter are not significantly different

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Publications 2024
2992-6041
ONLINE ISSN: 2992-5460
PRINT ISSN:

Table 7: Effect of *Rauwolfia vomitoria* and *Olax subscorpioidea* aqueous and ethanol root extracts on monocyte count of adjuvant induced arthritic rats.

Treatments	DAY10 (%)	DAY18 (%)	DAY25 (%)	DAY32 (%)
1	0.50±0.01^{e}	0.50±0.01^{e}	0.50±0.00^{e}	0.50±0.00^{d}
2	2.00±0.00^{c}	2.50±0.00^{a}	6.00±0.01^{a}	6.50±0.00^{a}
3	2.00±0.00^{c}	1.50±0.00^{c}	1.00±0.00^{d}	1.00±0.00^{c}
4	2.50±0.02^{b}	2.00±0.02^{b}	1.50±0.02^{c}	1.00±0.02^{c}
5	2.50±0.02^{b}	2.00±0.01^{b}	2.00±0.02^{b}	1.00±0.00^{c}
6	1.50±0.01^{d}	1.00±0.01^{d}	1.00±0.01^{d}	0.50±0.02^{d}
7	2.00±0.01^{c}	2.00±0.02^{b}	1.00±0.01^{d}	1.00±0.02^{c}
8	2.00±0.00^{c}	1.50±0.00^{c}	1.00±0.01^{d}	0.50±0.01^{d}
9	1.50±0.00^{d}	2.00±0.00^{b}	2.00±0.00^{b}	0.50±0.02^{d}
10	2.50±0.02^{b}	2.00±0.01^{c}	2.00±0.02^{b}	1.50±0.01^{b}
11	3.00±0.01^{a}	2.50±0.02^{a}	1.50±0.00^{c}	1.00±0.02^{c}
12	2.50±0.02^{b}	2.00±0.00^{b}	1.50±0.02^{c}	1.00±0.01^{c}
13	2.00±0.00^{c}	1.00±0.00^{d}	1.00±0.01^{d}	0.50±0.00^{d}
14	2.00±0.01^{c}	1.50±0.01^{c}	1.00±0.01^{d}	1.00±0.01^{c}
15	2.50±0.00^{b}	1.50±0.01^{c}	1.00±0.02^{d}	0.50±0.00^{d}

Monocyte count of adjuvant induced arthritic rats treated with *Rauwolfia vomitoria* and *Olax subscorpioidea* ethanol and aqueous root extracts. OS= *Olax subscorpioidea*, RV= *Rauwolfia vomitoria*. 1= Negative control, 2= positive control, 3= Standard control, 4= 400 mg/ kg RV aqueous extract, 5= 600 mg/kgRV aqueous extract, 6= 800 mg/kgRV aqueous extract, 7= 400 mg/kg OS aqueous extract,8= 600 mg/kg OS aqueous extract, 9= 800 mg/kg OS extract aqueous,10= 400 mg/kg RV ethanol extract,11= 600 mg/kg RV ethanol extract, 12= 800 mg/kg RVethanol extract,13= 400 mg/kg OS ethanol extract,14= 600 mg/kg OS ethanol extract, 15= 800 mg/kg OS ethanol extract.
* Means with the same letter are not significantly different

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Publications 2024
2992-6041
ONLINE ISSN: 2992-5460
PRINT ISSN:

Table 8: Effect of *Rauwolfia vomitoria* and *Olax subscorpioidea* aqueous and ethanol root extracts on neutrophil count of adjuvant induced arthritic rats.

Treatments	DAY10 (%)	DAY18 (%)	DAY25 (%)	DAY32 (%)
1	44.50 ± 0.71^{f}	43.50 ± 0.71^{i}	44.50±0.71g	40.50 ± 0.71^{k}
2	$65.00\pm0.00^{b,a}$	72.50 ± 0.54^{a}	82.50 ± 0.54^{a}	87.50 ± 0.54^{a}
3	55.00 ± 2.83^{e}	$53.00\pm0.00^{g,h}$	45.00 ± 0.00^{g}	$41.50\pm0.71^{j,k}$
4	$64.00\pm1.41^{b,a,c}$	61.50 ± 2.12^{c}	57.50 ± 0.71^{b}	50.00 ± 0.00^{c}
5	$64.00\pm1.41^{b,a,c}$	58.50 ± 0.71^{e}	$50.50\pm0.71^{e,d}$	$45.00\pm0.00^{h,g}$
6	$62.50\pm0.71^{d,c}$	$54.00\pm1.41^{g,f,h}$	47.50 ± 0.71^{f}	$46.00\pm0.00^{f,g}$
7	$62.50\pm0.71^{d,c}$	56.00 ± 1.41^{f}	54.50 ± 0.71^{c}	54.00 ± 0.00^{b}
8	61.50 ± 2.12^{d}	$55.00\pm1.41^{g,f}$	48.50 ± 0.71^{f}	$47.00\pm0.00^{f,e}$
9	61.00 ± 0.00^{d}	52.00 ± 2.83^{h}	44.00 ± 4.24^{g}	$43.50\pm0.71^{h,i}$
10	65.50 ± 0.71^{a}	64.50 ± 0.71^{b}	55.50 ± 0.71^{c}	$49.00\pm1.41^{d,c}$
11	$63.00\pm1.41^{b,d,c}$	58.50 ± 4.95^{e}	54.00 ± 1.41^{c}	$46.00\pm0.00^{f,g}$
12	$62.00\pm1.41^{d,c}$	$53.50\pm0.71^{g,h}$	48.50 ± 2.12^{f}	$42.50\pm0.71^{j,i}$
13	$64.00\pm1.41^{b,a,c}$	65.50 ± 0.71^{b}	52.00 ± 1.41^{d}	$48.00\pm2.83^{d,e}$
14	$64.00\pm1.41^{b,a,c}$	$61.00\pm1.41^{d,c}$	$49.00\pm1.41^{e,f}$	$43.50\pm0.71^{h,i}$
15	$62.50\pm0.71^{d,c}$	$59.00\pm0.00^{d,e}$	45.50 ± 0.71^{g}	$42.50\pm0.71^{j,i}$

Neutrophil count of adjuvant induced arthritic rats treated with *Rauwolfia vomitoria* and *Olax subscorpioidea* ethanol and aqueous root extracts. OS= *Olax subscorpioidea*, RV= *Rauwolfia vomitoria*. 1= Negative control, 2= positive control, 3= Standard control, 4= 400 mg/ kg RV aqueous extract, 5= 600 mg/kg RV aqueous extract, 6= 800 mg/kg RV aqueous extract, 7= 400 mg/kg OS aqueous extract,8= 600 mg/kg OS aqueous extract, 9= 800 mg/kg OS extract aqueous,10= 400 mg/kg RV ethanol extract,11= 600 mg/kg RV ethanol extract, 12= 800 mg/kg RV ethanol extract,13= 400 mg/kg OS ethanol extract,14= 600 mg/kg OS ethanol extract, 15= 800 mg/kg OS ethanol extract.
* Means with the same letter are not significantly different

Table 9: Effect of *Rauwolfia vomitoria* and *Olax subscorpioidea* aqueous and ethanol root extracts on basophil count of adjuvant induced arthritic rats

Treatments	DAY10 (%)	DAY18 (%)	DAY25 (%)	DAY32 (%)
1	0.50 ± 0.07^{f}	0.50 ± 0.00^{d}	0.50 ± 0.07^{c}	0.50 ± 0.07^{b}
2	2.10 ± 0.07^{c}	2.00 ± 0.00^{a}	2.00 ± 0.07^{a}	2.0 ± 0.00^{a}
3	1.00 ± 0.00^{e}	2.00 ± 0.00^{a}	0.50 ± 0.07^{c}	0.50 ± 0.00^{b}
4	1.00 ± 0.04^{e}	1.00 ± 0.00^{e}	0.50 ± 0.07^{c}	0.50 ± 0.07^{b}
5	2.00 ± 0.00^{c}	2.00 ± 0.00^{a}	1.00 ± 0.00^{b}	0.50 ± 0.07^{b}
6	1.00 ± 0.04^{e}	2.00 ± 0.00^{a}	0.50 ± 0.07^{c}	0.50 ± 0.07^{b}
7	2.00 ± 0.00^{c}	1.00 ± 0.00^{c}	0.50 ± 0.07^{c}	0.50 ± 0.00^{b}
8	2.00 ± 0.00^{c}	1.00 ± 0.00^{c}	1.00 ± 0.00^{c}	0.50 ± 0.07^{b}
9	2.00 ± 0.00^{c}	1.00 ± 0.00^{c}	1.00 ± 0.00^{b}	0.50 ± 0.07^{b}
10	1.50 ± 0.07^{d}	1.00 ± 0.14^{c}	0.50 ± 0.07^{c}	0.20 ± 0.00^{d}
11	1.50 ± 0.07^{d}	1.00 ± 0.00^{c}	1.00 ± 0.00^{b}	0.20 ± 0.00^{d}
12	1.50 ± 0.07^{d}	0.50 ± 0.07^{d}	0.50 ± 0.07^{c}	0.30 ± 0.00^{c}
13	2.00 ± 0.00^{c}	1.50 ± 0.07^{b}	0.50 ± 0.07^{c}	0.50 ± 0.07^{b}
14	3.00 ± 0.00^{a}	1.00 ± 0.00^{c}	1.00 ± 0.00^{b}	0.50 ± 0.07^{b}
15	2.50 ± 0.07^{b}	0.50 ± 0.07^{d}	1.00 ± 0.00^{b}	0.20 ± 0.07^{d}

Basophil count of adjuvant induced arthritic rats treated with *Rauwolfia vomitoria* and *Olax subscorpioidea* ethanol and aqueous root extracts. OS= *Olax subscorpioidea*, RV= *Rauwolfia vomitoria*. 1= Negative control, 2= positive control, 3= Standard control, 4= 400 mg/ kg RV aqueous extract, 5= 600 mg/kg RV aqueous extract, 6= 800 mg/kg RV aqueous extract, 7= 400 mg/kg OS aqueous extract,8= 600 mg/kg OS aqueous extract, 9= 800 mg/kg OS extract aqueous,10= 400 mg/kg RV ethanol extract,11= 600 mg/kg RV ethanol extract, 12= 800 mg/kg RV ethanol extract,13= 400 mg/kg OS ethanol extract,14= 600 mg/kg OS ethanol extract, 15= 800 mg/kg OS ethanol extract.
* Means with the same letter are not significantly different.

DISCUSSION

Effect of adjuvant induced arthritis on Hematological parameters

The effect induction of arthritis using adjuvant on hematological parameters in rats was also carried out. The results revealed an increase ($P<0.05$) in total white blood cell count (Table 1) in the rats that were induced with arthritic condition through injection of type II chicken collagen adjuvant. The level of WBC count increased progressively with the length of time of the study culminating on day 32. Our observation on the increase in white blood cell count on induction of arthritis using complete Freunds adjuvant is similar to the report of [18]. Rheumatoid arthritis is often associated with an increase in the WBC and this is due to the upsurge of IL-1 beta which increases the synthesis of both granulocytes colony stimulatory factor and macrophage colony stimulating factor and the release of IL-1 inflammation by the immune cells against invading microorganisms [19]. The increase in WBC counts can be attributed to the activation of the immune system against the invading microorganism. In this study, the adjuvant which comprises of *M. tuberculosis* and type II chicken collagen are responsible for the inflammation as evidenced by the influx of mononuclear cells into the joints of adjuvant-induced arthritic rats [20]. *Olax subscorpoidea* and *Rauwolfia vomitoria* may have suppressed the influx of leucocytes into the joints of the extract treated rats and this is marked by a reduction in total WBCs count. This showed the immune modulatory effect of *Olax subscorpoidea*, *Rauwolfia vomitoria* and the standard drug, indomethacin. [21], reported a decrease in WBC count on administration of *Olax subscorpoidea* ethanol extract on albino rat and that the effect of the extract did not have any adverse effect on platelet count and mean corpuscular haemoglobin on the rats. This report supports our result which showed a decrease in WBC count on administration *Rauwolfia vomitoria* and *Olax subscorpioidea* aqueous and ethanol extracts at 400, 600 and 800mg/kg bd wt.

The red blood cell count result presented in Table 2 revealed that its levels in untreated arthritic rats were lower than the negative control and treated groups. Anemic condition that results from iron

deficiency or low serum iron store in arthritic rats could also be as a result of the abnormal storage of iron in the reticulo-endothelial system and the inability of bone marrow to respond to anemia [22] and [23]. Susceptibility of erythrocytes to peroxide stress is heightened in various disease conditions like arthritis [24]. Hepcidin induction during inflammation requires IL-6 and rapidly induces hypoferraemia rapidly in man [10]. Hepcidin which is an acute phase reactant produced by the liver, is believed to play an important role in anemia mediated by cytokine. It is a peptide synthesized by hepatocytes and is thought to be the main iron-regulatory hormone as well as the key cause of anaemia in people with chronic disease. It inhibits the release of iron from macrophages in the spleen and the uptake of iron in the duodenum [25]. However, treatment with the plant extracts normalized the RBC levels to the level found in the control and standard drug treated groups. The effect of indomethacin, *Olax subscorpioidea* and *Rauwolfia vomitoria* aqueous and ethanol root extracts in normalizing the RBC count was more pronounced on day 32; 800 mg/kg aqueous extract of *Olax subscorpioidea* and 800 mg *Olax subscorpioidea* ethanol extracts were found to be significantly ($P<0.05$) more effective in normalizing the RBC count than the other treatments. As in the other haematological parameters, the effect increased as the time of exposure increased. The results of Hb level are presented in Table 3. Arthritis condition caused a time-dependent reduction of Hb concentration that was significant ($P<0.05$) in arthritic rats. Decrease in plasma iron was induced by IL-1 in association with the acute phase response [26]. In addition, there is a proposal that reduction in Hb concentration during arthritis results from reduced erythropoietin levels; a decreased response of the bone marrow erythropoietin and pre-matured destruction of RBCs [27]. However, treatment with plant extracts caused time dependent normalization of the Hb concentration to the value found in the normal control which is comparable to the standard drug. The effects of treatment with 800 mg/kg *Olax subscorpioidea* ethanol extract was more significantly ($P<0.05$) pronounced. This increase in Hb concentration due to *Olax subscoripoidea* and *Rauwolfia vomitoria* treatment further supports their anti–arthritic potentials [28]. Our result is in tandem with the result of the work carried out by [18]. They observed a reduction on RBC and Hb level on induction of arthritis on rats using complete Freund's adjuvant. However there was a reversal in this trend with treatment using their herbs. They linked the ameliorative effect of their plants to the presence of Phytoconstituents such as flavonoids, tannins, saponins which are effective reactive oxygen species (ROS) scavenges that may have arrested the disastrous effect of these ROS, hence annulling the pathogenic pathway of arthritis. Since our plants are also rich in these phytochemical constituents, it could then be said that the phytochemical components also exerted the same ameliorative effect thereby reversing the RBC level back to normal on administration. PCV level decreased (Table 4) in the arthritic rat groups. A low hematocrit level is a sign of a low red blood cell count. Our result is in agreement with the work of [29], who observed a decrease in PCV level on induction of arthritis using adjuvant. However, treatment of arthritic rats with indomethacin, *Olax Subscorpiodea* and *Rauwolfia vomitoria* aqueous and ethanol root extracts at various doses were able to normalize the PCV level with 800 miligram per kilogram body weight *Olax subscorpoidea* ethanol root extract being significantly ($P<0.05$) more effective than the other treatment groups; its effect was commensurable with indomethacin standard drug treatment as the effect was time and dose dependent. [29], reported an improved PCV level on treatment of arthritic rats owing to the phytochemical and antioxidants present in their plant extract. The result of their investigation supports our observation that a *Rauwolfia vomitoria* and *Olax subscorpioidea* aqueous and ethanol extracts also contain these phytochemical components in various amounts that worked to reverse the PCV level in the arthritic treated rats close to normal. Platelet count was high ($P<0.05$) in the arthritic groups (Table 5). A rise in platelet count may be caused by the activation of immune system against disease causing microorganism that has invaded it evidenced by the incursion of inflammatory mononuclear cells into the joints of arthritic rats [30]. However on treatment with plant extracts and indomethacin standard drug, the platelet count in all the treated groups decreased significantly ($P<0.05$) close to that of the negative control group. The results of the total and differential leukocyte count in the arthritic rats presented in Tables 6-9 revealed that the increase was significant ($P<0.05$). Treatment of arthritic induced rats with *Rauwolfia vomitoria* and *Olax subscoroidea* aqueous and ethanol extracts at the doses administered in this study was able to return the monocyte counts close that of the negative control group and is comparable to the standard drug. Treatment with 400 mg/kg bd wt *Olax subscorpoidea* aqueous extract was least in normalising Neutrophil count on day 32 while 800 mg/kg bd wt of *Rauwolfia vomitoria* ethanol extract and 800 mg/kg bd wt of *Olax subscopioidea* ethanol treatments were most effective. For the Lymphocyte count, treatment with 400 and 600mg/kg body weight *Rauwolfia vomitoria* aqueous were most effective while 400 and 600mg/kg body weight *Olax subscorpioidea* aqueous extract were least in their effect in normalising lymphocyte count. For Basophile count, the effect of treatment was most significantly ($P<0.05$) more effective on day 32 of the treatment period. Basophile count showed that 400 and 600 mg/kg bd wt *Rauwolfia vomitoria* ethanol extract and 800mg/kg *Olax subscorpioidea*

ethanol treatment were the most effective in bringing to normal the basophil count on day 32. T-lymphocytes have been known to play a central function in the disease onset and progression of rheumatoid arthritis. The lymphoid cells are the major cells found in the rheumatoid synovium. There is a moderate increase in lymphocyte count in arthritic condition [31]. Hematological results in this study showed that induction of rheumatoid arthritis resulted in significant leukocytosis and neutrophilia due to activation of the immune response to produce antibodies. These antibodies spread in the blood stream, identifies foreign particles and triggers inflammation. Administration of *Rauwolfia vomitoria* and *Olax subscorpoidea* extracts resulted in decreased hemoglobin level, leucopenia with neutrophilia, lymphopenia and eosinopenia [32]. *Mycobacterium tuberculosis* and chicken type II collagen present in the adjuvant are responsible for lymphocyte response and severe disturbance of the immune system which gives rise to increased generation of leukocytes. The decrease in leucocyte count in *Rauwolfia vomitoria* and *Olax subscorpoidea* treated groups showed its immunomodulation activities [33]. It is proposed that *Olax subsorpoidea* and *Rauwolfia vomitoria* phytochemical constituents like the flavonoids, saponins, vitamins and minerals in the course of treatment were able to successfully balance the Hb levels, WBC, RBC, PCV, ESR, CRP and platelet count resulting from severe stress on blood components caused by continuous secretion of reactive oxygen species and oxidation of circulatory proteins also. Our work is supported by the report of [34] that phytoconstituents play an important role in the enhancement of antioxidant capacity of the blood plasma thereby reversing abnormalities associated with hematological parameters on induction of arthritis and treatment with their plant extracts. This effect was also observed on treatment of adjuvant induced arthritis with *Olax subsorpoidea* and *Rauwolfia vomitoria* aqueous and ethanol root extracts.

CONCLUSION

In conclusion, the phytochemicals, vitamins, minerals and other principles that possess therapeutic potentials in *Rauwofia vomitoria* and *Olax subscorpoidea* (ethanol and aqueous) root extracts as was earlier reported may be responsible for the reverse in the adverse hematology results as seen in this study due to induction of arthritis in rats; it is possible that this may apply to man as it is currently being used by local health practitioners in the treatment of arthritis. The extracts from the two plants are relatively safe as up to 5000 mg/kg dose did not cause any death in the plants.

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CITE AS: Nkiru N. Ezeani (2024). Effects of Rauwolfa vomitoria (Akata) and Olax subscorpioidea (Asaja) Roots on Hematology of Chicken Type II Collagen-Freund's Adjuvant-induced Rheumatoid Arthritis in Albino Rats. NEWPORT INTERNATIONAL JOURNAL OF RESEARCH IN MEDICAL SCIENCES, 5(2):57-71 https://doi.org/10.59298/NIJRMS/2024/5.2.05771