Acute Toxicity and Effect of Ethanolic Extract of *Curcuma longa* on Haematological Indices in Albino Rats

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ABSTRACT

This experiment examines ethanolic extract of Curcuma longa rhizome for acute toxicity, phytochemical and elemental constituents and haematological indices in albino rats using standard laboratory procedures. Lorke's method is used to evaluate the acute oral toxicity of the plant using twelve rats. Administration of 2900 mg/kg maximum dose did not produce mortality or general signs of toxicity for 24 hours. Fifteen rats grouped randomly into three groups (A, B and C) and blood sample collected from the tail vein of each of the rats for the determination of some hematological indices were weighed and used for the study. All the rats in group A, B and C were treated orally with the ethanolic extract using 200mg/kg, 400mg/kg and 600mg/kg respectively daily for 21 days. Blood samples were collected from the tail vein of the rats at the end of every week and were analysed for mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC). The ethanolic extract of Curcuma longa rhizome is found to contain chemically active compounds of pharmacological importance like cardiac glycoside, terpenoids, saponins, flavonoids, anthraquinones, carbohydrate and soluble starch. The elemental analysis of the extract reveals the presence of iron, zinc, calcium, manganese, magnesium, chlorine, sodium, potassium and sulphate. The extract was observed to have no significant effect on MCV values; however it significantly increased the MCH and MCHC values in week three of treatment in the treated rats thus the plant can be effectively used in the management of anemia.

Keywords: *Acute toxicity, Curcuma longa, haematological indices, phytochemical, elemental.*

INTRODUCTION

Turmeric (*Curcuma longa)* is a plant of the family *Zingiberaceae*, well-known as the ginger family and consists of about 70 species. *Curcuma longa* is a rhizomatous herbaceous perennial plant commonly grown in Nigeria (Usman *et al.*, 2009). India is the major producer, consumer and exporter of turmeric. It is grown majorly in India, Myanmar, Nigeria, Pakistan, Sri Lanka, Indonesia, Bangladesh, Taiwan and China. The world production of turmeric is estimated to be about 600,000 tonnes, of which India accounts

for 78 per cent (Anona, 1999). Scientists are increasingly recognizing the significance of various spice-crops, especially turmeric. Turmeric plays a significant role in the food industry, as a replacement of synthetic colouring, also being used for its medicinal and pharmacological qualities (Scartezzini and Speroni, 2000). It is rich in yellow food pigment called curcuminoid (6%) and essential oils (5%) (Nunes, 1989). The primary active constituent of turmeric and the component responsible for its vibrant yellow colour is curcumin, first identified in 1910 (Lampe and Milobedzka, 1913). Turmeric has drawn much attention due to its important medicinal potential (Cousins, Adelberg, Chen and Rieck, 2007). Mazumder, Raghavan, Weinstein and Pommier (1995) establish that curcumin has an antiviral activity, being a HIV-1 integrase inhibitor (IC50 = 40μm) and recommended that curcumin analogs possibly be developed as anti-AIDS drugs. Data reveal that curcumin prevented the replication of HIV-1 integrase protein. Eigner and Scholz (1999) report that curcumin was claimed for anti-HIV-1 and HIV-2 activities in a recent patent application.

Turmeric has been used in ethno-medicines as a household treatment for various diseases, which include biliary disorders, anorexia, cough, diabetic wounds, hepatic disorders, rheumatism and sinusitis (Ammon *et al*., 1992). In Pakistan, such information has been compiled and reported by Shinwari (2010) and Gilani *et al* (2010). In old Hindu medicine, it was widely used for the management of sprains and swelling caused by injury (Ammon and Wahl, 1991). In addition to being used to treat some common diseases, *Curcuma* species show some medicinal properties for the management of snake bites (Ratanabanangkoon, Cherdchu and Chudapongse, 1993) and as an anti-tumor (Baatout et al., 2004). The World Health Organization has endorsed the use of this spice (Vavilova, 1990). Turmeric also demonstrated antifungal properties (Afaq, Adhami and Ahmad, 2002). It has been highly examined for its biological activities including anti-inflammatory and antiarthritic (Chandra and Gupta, 1972), antioxidant (Toda et al., 1985), antimicrobial (Lutomski, Kedzia and Debska, 1974), antileishmanial (Gomez, Alegrio, Leon and Lima, 2002), hepatoprotective (Kiso et al., 1983), anticancer (Kuttan, Bhanumathy, Nirmala and George, 1985), vasodilator (Sasaki et al., 2003), hypolipidaemic (Dixit, Jain and Joshi , 1988), antiplatelet (Srivastav et al., 1995), hypoglycaemic (Arun and Nalini, 2002), choleretic (Deters et al., 1999), immunomodulatory (Antony, Kuttan and Kutta, 1999), neuroprotective (Rajakrishnan, Visvanathan, Rajasekharan and Menon, 1999), antidepressant (Yu, Kong and Chen, 2002) and efficient in Alzheimer's disease (Park and Kim, 2002).

Ajaiyeoba *et al*. (2008) report the larvicidal and insect repellant properties of the extract. The rhizome has been suggested for anaemia, measles, sprains, boils, scabies, sore eyes (Bakhru, 1997), smallpox, chicken pox, insect bites, as a food purifier and anthelmintic (Nadkari, 1976). Al-Noori *et al*. (2011) report the beneficial effects of dietary *Curcuma longa* powder to improve some blood parameters of Broiler Chickens, there was a significant increase in haemoglobin, leucocytes, but no significant effect on erythrocytes. Kumari *et al*. (2007) reported increased hemoglobulin level in curcumin fed broiler birds. Inclusion of turmeric rhizome powder into the basal diets at 42 days of age significantly increased blood haemoglobin of chickens (Emadi Kermanshahi and Maroufyan, 2007).

Puneet *et al* (2011) also report that haemoglobulin levels increased with soluble curcumin supplement of healthy volunteers. Yadav and Jain (2010) report a statistically non-significant change in the RBC and WBC counts, haemoglobin and haematocrit values observed in female albino rats administered with aqueous extract of *Curcuma longa* rhizome. In mice, administration of Curcumin and *Curcuma longa* increased erythrocyte, PCV, MCV and decreased MCH, MCHC (Sharma V., Sharma C., and Sharma S. , 2011). Blood indices are specifically meant for erythrocytes, and the indices include; mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC). The number, shape, volume and colour of the red erythrocytes indicate the quality of blood. Blood indicies have diagnostic value in determining the type of anaemia (Sembulingam K. and Sembulingam, P. 2006).

Mean Corpuscular Haemoglobin (MCV) is the average volume of a single erythrocyte. When MCV increases, the cell is known as macrocyte and when it decreases, the cell is called microcyte. MCV is more in pernicious anaemia and megaloblastic anaemia in which the RBCs are macrocytic in nature. MCV is less in microcytic anaemia (Sembulingam K. and Sembulingam, P. 2006). Mean Corpuscular Haemoglobin (MCH) is the quantity or amount of haemoglobin present in one erythrocyte. It decreases or remains normal in pernicious anaemia and megaloblastic anaemia, in which RBCs are macrocytic and normochromic or hypochromic. It decreases in hypochromic anaemia (Sembulingam and Sembulingam, 2006). Mean Corpuscular Haemoglobin concentration (MCHC) is the concentration of haemoglobin in one erythrocyte. It is the amount of haemoglobin expressed in relation to the volume of one RBC. It is the most important absolute value in the diagnosis of anaemia. It decreases in iron deficiency anaemia in which, RBCs are microcytic and hypochromic (Sembulingam K. and Sembulingam, P. 2006).

Considering the high consumption and therapeutic effect of turmeric in some parts of Nigeria and other parts of West Africa and its ethno-medicinal usage, this study was carried out to investigate the acute toxicity, phytochemical and elemental components, and effect of ethanolic extract of *Curcuma longa* on some Haematological indices (Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Mean Corpuscular Hemoglobin Concentration (MCHC) in albino rats.

MATERIALS AND METHOD

Plant collection and extraction: *Curcuma longa* rhizomes were obtained from Oye Ekiti market in Ekiti State, Nigeria in the month of October 2012. The sample was identified and authenticated by a taxonomist in the Department of Biological Sciences, University of Maiduguri. The sample was air dried at room temperature. It was pulverized into powder using pestle and mortar and then stored in a plastic container. One kilogram of the sample was submitted to the Chemistry Department, University of Maiduguri for extraction and phytochemical analysis. Digested sample was collected from the Chemistry Department University of Maiduguri and was submitted to NAFDAC (National Agency for Food, Drug Administration and Control) Maiduguri, Borno State for elemental analysis. 250g of

the dried powder plant material was extracted using Soxhlet extractor and 5 liters of 95 percent ethanol, with a yield of 51.6g. Concentration of the yield was done by the *in vacuo* model. This was properly labeled and stored in a refrigerator at 4^0C until required.

Phytochemical determination: Dried powder of the plant was screened for the presence of carbohydrate, tannins, phlobatannins, anthraquinone, saponins, cardiac glycoside, terpenes and steroids, flavonoids and alkaloids using standard phytochemical procedures as described by Trease and Evans (2002).

Elemental determination: Air-dried sample (15 grams) of *Curcuma longa rhizome* was weighed into an acid – washed porcelain crucible and placed in a furnace for three hours at 550^oC. The crucible was removed from the furnace and cooled in a dessicator. The ash sample (0.5 gram) was digested in a 250 ml beaker with 20 ml of 2M nitric acid and 10 ml of 35% hydrogen peroxide and heated on a hot plate in a fume cupboard until a clear digest was obtained. The content was then filtered after cooling and deionized water added and made up to 100 ml in a volumetric flask for elemental determination using sp-9-single beam atomic absorption spectrophotometer (Philip/PyeUnicam Ltd, England). The elemental concentrations were determined by a standard calibration curve method (Sunderman, 1973; Kolthoff and Elving, 1976).

Acute toxicity study: Lorke's method was used to evaluate the acute oral toxicity of *Curcuma longa* using twelve rats. The method involved two phases, phase l and 2. In phase 1, three treatment groups with three rats each were used. They were administered 10mg/kg, 100mg/kg and 1000mg/kg of the extract respectively per group. They were observed for mortality or general signs of toxicity for 24 hours. In phase 2, three treatment groups of one animal each were treated with 1600 mg/kg, 2900 mg/kg and 5000 mg/kg of the extract respectively, and observed for 24 hours. The rats of body weights between 175 and 210 g were kept in plastic rat cages and allowed to adapt to the laboratory environment for two days before the commencement of the experiment. The rats were fed with pelletized poultry grower's mash feed (Vital Feeds, Jos, Nigeria) and water was made available liberally. The animals were handled in accordance with the International Guiding Principles for Biochemical Research involving Animals (C.I.OM.S., 1985).

Extract administration and blood collection: Fifteen rats were weighed and used for this study. They were grouped randomly into group A, B and C. Blood sample was collected from the tail vein of each of the rat for the determination of some haematological indices (Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH), Mean corpuscular haemoglobin concentration (MCHC). The blood values at day zero prior to extract administration served as the control reading. The rats in group A, B and C orally received 200mg/kg, 400mg/kg and 600mg/kg respectively of the ethanolic extract of *Curcuma longa* rhizome daily for 21 days. Body weights of the rats were obtained prior to extract administration which ranged from 114.2g to 244.0g. Blood samples were collected from the tail vein of the rats at the end of every week for three weeks for haematological analysis, prior to subsequent extract administration.

Determination of haematological indicies: The determination of the haematological indices was done using the blood sample collected from the tail vein of rat and was analyzed immediately using Mindray BC-2800 vet Automated Haematology Analyzer.

Statistical analysis: The data collected were presented as mean ± standard deviation (SD). One way analysis of variance (ANOVA) was used to analyze the differences between the means. P d" 0.01 were considered significant (Armitage, 1980). GraphadInstat® version 3.0 (2003) statistical computer software was used.

RESULTS AND DISCUSSION

Phytochemical contents of *Curcuma longa* rhizomes: Phytochemical analysis of ethanolic extract of *curcuma longa* rhizomes are shown on table 1. The results revealed the presence of carbohydrate, soluble starch, anthraquinones, cardiac glycosides, terpenoids, saponin glycosides and flavonoids.

Elemental contents of extract of *Curcuma longa* rhizomes: The results of the element analysis of *Curcuma longa* is presented on table 2. The result shows that chloride (153.2mg/l) had the highest concentration followed by potassium (16.6mg/l), sodium (7.15mg/l), sulphur (1.97mg/l), iron (1.68mg/l), calcium (1.26mg/l), magnesium (0.32mg/l), zinc (0.25mg/l), manganese (0.21mg/l), lead and copper (0.10mg/l).

Acute toxicity: It was observed that after 24 hours, there was no mortality or general sign of toxicity in the experimental rats.

Effect of ethanolic extract of *Curcuma longa* rhizome on mean corpuscular volume (MCV) in albino rats: The MCV value of albino rats treated with various doses of ethanolic extract of *Curcuma longa* is presented on table 3. There was no significant difference between the MCV of treated animals and those of control with doses 200mg/kg, 400mg/kg and 600mg/kg respectively during the week of treatment.

Effect of ethanolic extract of *Curcuma longa* rhizome on mean corpuscular haemoglobin (MCH) in albino rats: The MCH values of albino rats treated with various doses of ethanolic extract of *Curcuma longa* are shown on table 4. There was no significant difference between the MCH of treated animals and those of control with doses 200mg/kg, 400mg/kg and 600mg/kg respectively during the week of treatment. However, during week three of treatment, at dose 200mg/kg, there was a significant ($P<0.01$) increase in the value of MCH compared to the control.

Effect of ethanolic extract of *Curcuma longa* rhizome on mean corpuscular hemoglobin (MCHC) concentration in albino rats: The MCHC values of albino rats treated with various doses of ethanolic extract of *Curcuma longa* are shown on table 5. There was no significant difference between the MCHC of treated animals and those of control with doses 200mg/kg, 400mg/kg and 600mg/kg respectively during the week of treatment. However, during week three of treatment, at dose 200mg/kg, there was a significant ($P<0.01$) increase in the level of MCHC compared to the control. It is a widely

accepted fact that consumption of plant food in adequate amounts is associated with numerous health benefits rooted in their various physiological effects as a result of their phytochemical and nutritional constituents (Hunter and Fletcher, 2002). The phytochemical screening of the ethanolic extract of *Curcuma longa* indicated the presence of cardiac glycosides, terpenoids, saponins, flavonoids, anthraquinones, carbohydrate and soluble starch. The results of this study correlate with previous studies by Chhetri *et al*., (2008) who had earlier reported that some active compounds such as flavonoids, glycosides, and terpenoids were present in ethanolic crude extract of turmeric while steroids, tannins, and alkaloids were absent. Some of these chemical constituents have many known therapeutic values, for instance flavonoids are recognized for their antioxidant, anticarcinogenic, antimicrobial and antitumour properties (Kandaswami, Paerkins, Solonik and Arzewiecki, 1994; Manikandan Senthilkumar, Rajesh and Suresh, 2006). And they might play a role in disease resistance (Salisbury and Ross, 1992). Antioxidants are radical scavengers which protect the human body against free radicals that may cause pathological conditions such as ischemia, anaemia, asthma, arthritis, inflammation, neurodegeneration, Parkinson's diseases, mongolism, ageing process and perhaps dementias (Polterait, 1997).This suggests that taking foods rich in flavonoids help to reduce the risk of heart diseases, and this is of great importance in pharmacology, medicine and human nutrition (Dathak and Iwu, 1991).

Glycosides are known to exert pronounced physiological action, even though they may be poisonous to animals and man (Frantisek, 1991). In modern day treatment of arterial fibrillation, flutter and congestive heart failure, cardiac glycosides remain the drug of choice (Umesh, 2010). Cardiac glycosides are cardioactive compounds belonging to triterpenoids class of compounds (Brian, Thomas-Bigger J. and Goodman, 1985). Their inherent activity resides in the aglycone portions of their sugar attachment. Their clinical effects in cases of congestive heart failure are to increase the force of myocardiac contraction (Brian, Thomas-Bigger and Goodman, 1985). They exert their hypotensive effect by inhibiting Na^+-K^+ ATPase. Cardiac glycoside acts on the heart muscles and increase renal flow (diuresis). They also act directly on the smooth muscle of the vascular system. They exert a number of effects on neural tissue and thus indirectly influence the mechanical and electrical activities of the heart and modify vascular resistance and capacitance (Olaleye, 2007).

Saponins are glycosides of both triterpenes and steroids having hypotensive and cardiac depressant properties, and have been detected in over seventy plant families (Basu and Rastogi, 1967; Olaleye, 2007). They have been shown to possess beneficial properties by lowering the cholesterol level, have anti-diabetic and anticarcinogenic properties (Trease and Evans, 2002) as well as being used as an expectorant and emulsifying agent (Edeoga, Omosun and Uche, 2006). This could suggest that saponins may be responsible for the therapeutic effects of C*urcuma longa* against diabetes. Saponins bind to cholesterol to form insoluble complexes. Dietary saponins in the gut of monogastric combine with endogenous cholesterol excreted via the bile. This prevents cholesterol reabsorption and results in a reduction of serum cholesterol (Cheeke, 1971). Saponins have been found to be potentially useful for the treatment of hypercholesterolaemia which suggests that saponins

might be acting by interfering with intestinal absorption of cholesterol (Malinow, Mclaughin, Kohler and Livingstone, 1977a, 1977b). Saponins are reported as a major component acting as antifungal secondary metabolite (Onwuliri and Wonang, 2003). Saponins are also surface active agents which interfere with or alter the permeability of the cell wall and thus facilitates the entry of toxic materials or leakage of vital constituents from the cell (Onwuliri and Wonang, 2003). The biological activities of saponins range from the antibacterial, antileishmanial, antifungal, antimalarial, antiplasmodial, antiviral, to the antitumoral (Dinda, Debnath, Mohanta and Harigaya, 2010). Terpenoids have anti-hepatoxic properties, thus helping to prevent liver damage (cirrhosis); they equally have anti-microbial or anti-septic properties (Borokini and Omotayo, 2012). In this work the elemental analysis of the ethanolic extract of Curcuma longa leaves indicated the presence of iron (Fe), zinc (Zn), calcium (Ca), manganese (Mn), magnesium (Mg), chloride (Cl), sodium (Na), potassium (K), sulphate (SO_4). These elements play essential role in maintaining body physiology and immune status. Potassium is an important component of the cell and body fluid which helps in controlling heart rate and blood pressure. Manganese is used by the body as a co-factor for the antioxidant enzyme, superoxide dismutase. Iron is an important co-factor for cytochrome oxidase enzymes at cellular level metabolisms and required for red blood cell (RBC's) productions (Anon, 2012). Magnesium plays a structural role in bone, cell membranes, and chromosomes (Rude and Shils, 2006). Sulfur is a mineral that is present in every cell of the body. It plays a key role in liver metabolism and the function of the joint cartilage and keratin of the skin and hair. It is also critical for metabolism and anti-oxidant defense systems that protect the aging patterns of the brain (Anon, 2012). Chloride ions are known to be present in the red blood cells, it is important for the regulation of osmotic pressure.

Chloride help to maintain water and pH balances. They activate salivary amylase. Chloride provides the acid medium for the activation of the gastric enzymes and digestion in the stomach (Anon, 2012). Sodium is important for fluid distribution, blood pressure and electrical activity, like controlling the heartbeat by helping in its origin and maintenance (Anon, 2012). Zinc is found in cells throughout the body. It is needed for the body's defensive (immune) system to properly work. It plays a role in cell division, cell growth, wound healing, and the breakdown of carbohydrates (Anon, 2012). Iron functions in production of blood cells, production of Hemoglobin, protein synthesis, anti-oxidant, anti-cancer and immune system booster (Anon, 2012).

Calcium plays a role in strengthening bones and teeth, regulating muscle functioning such as contraction and relaxation, regulating heart functioning, blood clotting, transmission of nervous system messages and enzyme function (Anon, 2012). The administration of the extract at a dose of 2900mg/kg body weight orally did not produce death. This indicated a low toxicity level of the extract. Clarke, E. and Clarke, M. (1977) opine that any substance which LD_{50} in rats fell between 50 and 500mg/kg body weight should be regarded as very toxic, between 500mg/kg and 1000mg/kg as moderately toxic and above 1000mg/kg as of low toxicity. The prolonged administration (21 days) of the ethanolic extract of *Curcuma longa* rhizome appeared to have no significant effect on the mean corpuscular volume

(MCV) values of albino rats treated with the extract as compared to the control. There was no significant difference observed in the MCH of treated rats compared to the control during week one of extract administration. But during week three of the treatment, at dose 200mg/kg, there was a significant (P<0.01) increase in the level of MCH compared to the control. There was no significant difference observed in the MCHC of treated rats compared to the control during week one of extract administration. But during week three of the treatment, at dose 200mg/kg, there was a significant (P<0.01) increase in the level of MCHC compared to the control.

Table 1: Qualitative phytochemical constituent of ethanolic extract of *curcuma longa* rhizomes

Phytochemical constituent	Test	Result
Carbohydrate	Molisch's (General)	-
	Barfoed's (monosaccharide)	-
	Fehling's test (for free reducing sugars)	-
	Standard test for combined reducing sugar	-
	Standard test for ketoses	-
	Standard test for pentose	+
Soluble starch	Standard test for soluble starch	+
Tannins	Ferric chloride test	-
	Lead acetic test	-
Phlobotannins	Standard test for phlobaternnins	-
Anthraquinones	Borntrage's test (free anthraquinones)	+
	Combined anthraquinones	+
Cardiac glycosides	Salkowski's test	+
	Lieberman - burchard's test	+
Terpenoids	Standard test for terpenoids	+
Saponin glycosides	Frothing test	+
Flavonoids	Shinda's test	+
	Ferric chloride test	-
	Lead acetate	-
	Sodium hydroxide	-
Alkaloids	Dragendorff's reagent	-
	Meyers's reagent	-

Keys: - = Absent, + = Present ***Source:*** Experimentation, 2012

Table 2: Elemental content of extract of *Curcuma longa* rhizomes

Element	Concentration (mg/l)
Iron	1.68
Zinc	0.25
Calcium	1.26
Lead	0.10
Copper	0.10
Manganese	0.21
Magnesium	0.32
Chloride	153.2
Sodium	7.15
Potassium	16.6
Sulphur	1.97

Source: Experimentation, 2012

Table 3: Effect of ethanolic extract of *curcuma longa* rhizome on mean corpuscular volume in albino rats

Extract Dose(mg/kg)	Control/Day	Weeks of Treatment		
	0	1	2	3
200	51.90±0.75	53.82±3.66	52.60±4.30	54.46±4.22
400	54.28±0.83	57.02±2.49	56.80±1.75	55.98±2.57
600	57.44±7.21	61.40±5.51	57.76±5.75	57.55±1.20

KEY: x = Mean ± SD ** = Significant (P<0.01) increase as compared to control N = 5

Source: Experimentation, 2012

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Table 4: Effect of ethanolic extract of Curcuma longa on the mean corpuscular hemoglobin (mch) in albino rats

Extract Dose(mg/kg)	Control/Day	Weeks of Treatment		
	0	1	2	3
200	15.90±2.88	17.85±0.97	47.77±19.37**	18.76±2.13
400	18.12±0.39	18.56±0.70	18.14±1.40	17.90±2.53
600	19.24±2.97	20.15±1.90	19.26±1.94	18.95±0.63

KEY: x = Mean ± SD ** = Significant (P<0.01) increase as compared to control N = 5

Source: Experimentation, 2012

Table 5: Effect of ethanolic extract of *Curcuma longa* on the mean corpuscular hemoglobin concentration (mchc) in albino rats.

Extract Dose(mg/kg)	Control/Day	Weeks of Treatment		
	0	1	2	3
200	309.40±53.13	332.50±10.66	905.00±359.89**	346.00±31.79
400	334.60±5.94	326.60±6.10	321.60±21.60	316.33±29.77
600	335.40±14.63	329.00±1.41	334.00±5.19	319.00±1.41

KEY: x = Mean ± SD ** = Significant (P<0.01) increase as compared to control N = 5

Source: Experimentation, 2012

CONCLUDING REMARKS

Turmeric *(Curcuma longa)* is a rhizomatous herbaceous perennial plant of the ginger family, Zingiberacea. It is native to tropical southern Asia and thrives in temperature between 20^0C -30^0C (68^0F and 86^0F) and a considerable amount of annual rainfall to thrive. Its active ingredient is curcumin and it has a distinctly earthly, slightly bitter, slightly hot peppery flavour and a mustardy smell. The ethanolic extract of *Curcuma longa* rhizome was found to contain chemically active compounds of pharmacological importance like cardiac glycoside, terpenoids, saponins, flavonoids, anthraquinones, carbohydrate and soluble starch. The elemental analysis of the extract revealed the presence of iron, zinc, calcium, manganese, magnesium, chlorine, sodium, potassium and sulphate. The ethanolic extract of *Curcuma longa* rhizome was found to have high margin of safety, had no significant effect on MCV, but significantly increased MCH and MCHC in week three of treatment in the treated rats, thus the plant can be effectively used in the management of anemia.

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