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Comparative Effects of Aqueous and Ethanolic Leaf Extracts of *Gongronema latifolium* on Serum Kidney and Liver Biomarkers of Normal Male Rats

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ABSTRACT

In the south eastern part of Nigeria the use of *Gongronema latifolium* leaves as part of food and herbal medicine has been on the increase. This study was undertaken to compare the effects of aqueous and ethanolic extracts from *Gongronema latifolium* (Asclepiadaceae) leaves on some kidney and liver biomarkers of normal male rats. The animals were distributed into two sets of two groups. Each set had its control administered normal saline while the other groups in the two sets were administered 200 mg kg^{-1} of ethanolic and aqueous leaf extracts. The extracts were administered in normal saline for three weeks. The serum Total Protein (TP), Alkaline Phosphatase (ALP), Alanine Transaminase (ALT), Aspartate Transaminase (AST), Albumin (ALB) and Bilirubin levels were evaluated after every seven days. Kidney biomarkers were also evaluated in the same vein by determining the level of serum urea, creatinine, sodium ions (Na^+) and chloride ions (Cl^-) in serum. The aqueous extract showed little or no effect on the liver and kidney biomarkers. The hepatotoxic nature of the ethanolic extract was shown by the significant increases in levels of ALT, AST, Bilirubin and ALP which was buttressed by the significant reduction in TP and ALB. The Urea and Creatinine levels increased significantly with prolonged administration. This pattern was also observed with Cl^- and Na^+ which increased from the 14th day suggestive of kidney impairment. In view of these results, it was suggestive that the ethanolic extract from *Gongronema latifolium* leaves had hepatotxic and nephrotoxic potentials.

Key words: Biomarkers, hepatotoxic, nephrotoxic, serum, *Gongronema latifolium*, kidney impairment

INTRODUCTION

The south-eastern inhabitants of Nigeria are known for their high consumption of vegetables. Some of these vegetables form part of foods consumed on special conditions, including ill health and times of convalescence. This stresses the role of plants in the life of man from past till date. As

an old companion of man, it has provided food, shelter, wealth and has helped to maintain a relatively disease free state when properly utilized as herbal medicine (Nwangwu *et al*., 2010). Although, modern medicine may be available in developing countries but the use of herbs for treatment of diseases has often maintained popularity for historical and cultural reasons (Nwangwu *et al*., 2009). The use of herb in treatment of diseases has gained grounds world wide, making traditional medicine an inevitable global discuss. This practice calls for research into pharmacological activities of plants secondary metabolites and has improved modern pharmacotherapeutics around the world (Nwaogu *et al*., 2007). Though, some medicinal plants serve as food, they contain secondary metabolites that influence biological processes and reverse disease states (Ugochukwu *et al*., 2003) also they have less side effects (Karim *et al*., 2011).

Gongronema latifolium (Asclepiadaceae) bush buck, an edible rainforest plant native to south Eastern part of Nigeria, has been widely used in folk medicine as spice and vegetable (Morebise *et al*., 2002) for maintaining blood glucose levels. Ugochukwu *et al*. (2003) showed the antioxidative effect of extracts from *G. latifolium* leaves. *G. latifolium* leaf extract has been found to enhance haemoglobin formation (Latunde-Dada, 1990) and its high magnesium content has been suggested to explain the blood pressure lowering properties (Mensah *et al*., 2008). The antibacterial activity of the leaf extract was reported (Nwinyi *et al*., 2008). *G. latifolium* leaf extracts was demonstrated to have anti-ulcer, analgesic and antipyretic properties (Akuodor *et al*., 2010). *G. latifolium* aqueous extract has also been shown to possess antifungal activities (Ogbebor *et al*., 2007) while the antimalarial potentials by De Madureira *et al*. (2002), Masaba (2000) and Tona *et al*. (2004).

This study evaluated the effects of aqueous and ethanolic extracts from *G. latifolium* leaves on serum Total Protein (TP), Alkaline Phosphatase (ALP), Alanine Transaminase (ALT), Aspartate Transaminase (AST), Albumin (ALB) and Bilirubin levels in normal male rats. Kidney biomarkers were also evaluated by determining the level of serum urea, creatinine, sodium ions (Na^+) and chloride ions (Cl^-) in normal male rats.

MATERIALS AND METHODS

This study was carried out between March and September 2010, when the rainy season was at its peak.

Plant material: Fresh leaves of *G. latifolium* were harvested from a local farm in Uyo, Akwa Ibom State, Nigeria and were identified at the Department of Botany, University of Port Harcourt, Port Harcourt, Rivers State, Nigeria. They were sorted, washed, air dried at room temperature and milled into powder. The solvent extraction was carried out using soxhlet extractor with water and ethanol as solvents. The extracts were concentrated to about 10% of the original volume using a rotary evaporator (BUCHI, type RE111, Rotavapor).

Experimental animals: The experimental animals were all male Wister rats which weighed between 118-170 g used were kept at the animal house of the Department of Biochemistry, College of Health Sciences, Igbinedion University, Okada. The animals were housed in well ventilated cages, at room temperature and 12 h light and 12 h dark cycle for the period of experiment. They were given water and food *ad libitum* throughout the duration of the experiment.

Experimental design: The animals were randomly selected and grouped. There were a total of four groups with fifteen animals per group. The animals were distributed into two sets of two groups. Each set had one group which served as control while the other groups in the two sets were administered ethanolic and aqueous leaf extracts. The control groups were administered normal saline while the other groups were administered 200 mg kg^{-1} of the ethanolic and aqueous extracts twice daily for three weeks. The ethanolic and aqueous extracts were administered in normal saline orally. Five animals from the controls and test groups were fasted and sacrificed every seven days by cervical dislocation and the blood samples collected by cardiac puncture.

The experiments and procedures employed in this study were reviewed and approved by the Animal Care Committee of the College of Health Sciences, Igbinedion University, Okada, Edo State, Nigeria.

Biochemical assays: Total Protein (TP), Alkaline Phosphatase (ALP), Alanine Transaminase (ALT), Aspartate Transaminase (AST), Albumin (ALB), Bilirubin, Urea, Creatinine, Sodium ion and Chloride ion levels in serum of normal rats were evaluated using assay kits (Randox Laboratories LTD. United Kingdom BT29 4QY).

Statistical analysis: The results obtained in the research were expressed as Mean±Standard deviation. The difference between mean values were analysed by Microsoft Excel XL toolbox (2.6 version), using One-way ANOVA and Bonferroni-Holm posthoc test at $p<0.05$ level of significance.

RESULTS

The result obtained in Table 1 showed that the aqueous extract of *G. latifolium* had little or no effect on the serum ALT, AST ALP, TP, Albumin and Total Bilirubin levels of normal rats when compared with their controls on 7th, 14th and 21st days of the experiment. The changes observed in Table 1 were found not to be significant.

The ethanolic extract of *G. latifolium* significantly influenced the serum ALT, AST ALP, TP, Albumin and Total Bilirubin levels of normal rats when compared with their controls on 7th, 14th and 21st days of the experiment as seen in Table 2. The serum AST and ALP levels increased significantly throughout the duration of the experiment when compared with their controls. The increase was most expressed on day 14th where the AST serum level of rats administered extract was 15.00 (U L^{-1}) compared with the control which was 8.70 (U L^{-1}). While the most significant increase was observed on the 7th day for serum ALP levels in rats administered extract (15.25 U L^{-1}) compared with the control (10.50 U L^{-1}). ALT serum level increased most

Table 1: The effect of aqueous extracts of *G. latifolium* on plasma Total Protein (TP), Total Albumin (ALB), Total Bilirubin and serum enzymes activities

Days		ALT (U L^{-1})	AST (U L^{-1})	ALP (U L^{-1})	TP (g dL^{-1})	ALB (g dL^{-1})	T.BIL (g dL^{-1})
7th	Control	4.75±0.65	4.82±0.160	14.75±1.890	3.50±0.00	1.48±0.46	0.15±0.010
	Extract	4.50±0.35	5.00±0.082	14.00±1.870	3.50±0.00	1.52±0.22	0.15±0.010
14th	Control	14.20±0.54	8.16±1.130	17.50±2.082	3.70±0.24	1.78±0.26	0.27±0.020
	Extract	14.34±0.65	7.84±0.430	17.00±3.460	3.54±0.31	1.78±0.18	0.26±0.015
21th	Control	15.83±0.76	8.11±0.100	19.67±1.530	3.00±0.20	2.40±0.17	0.28±0.000
	Extract	15.63±0.48	8.32±1.030	19.00±1.150	3.05±0.10	2.30±0.38	0.28±0.030

Table 2: The effect of ethanolic extracts of *G. latifolium* on plasma Total Protein (TP), Total Albumin (ALB), Total Bilirubin and serum enzymes activities

Days		ALT (U L^{-1})	AST (U L^{-1})	ALP (U L^{-1})	TP (g dL^{-1})	ALB (g dL^{-1})	T.BIL (g dL^{-1})
7th	Control	10.00±0.00	5.00±0.00	10.50±1.00	3.68±0.15	1.60±0.00	0.12±0.01
	Extract	10.00±0.00	6.43±0.33*	15.25±0.50*	2.53±0.05*	1.75±0.19	0.13±0.02
14th	Control	6.38±0.15	8.70±0.63	14.00±1.63	3.78±0.22	1.75±0.19	0.10±0.01
	Extract	8.78±1.34*	15.00±0.00*	19.00±1.15*	2.08±0.30*	1.08±0.34*	0.14±0.01*
21th	Control	6.13±0.15	8.23±0.25	17.33±1.15	3.60±0.53	2.10±0.26	0.11±0.01
	Extract	8.10±0.17*	10.03±1.08*	21.67±2.89*	1.80±0.00*	1.57±0.12*	0.13±0.00*

Values * given as Mean±Standard deviation had significant differences when compared with the control ($p<0.05$). n = 5

Table 3: The effect of aqueous extracts of *G. latifolium* on serum urea, Creatinine, sodium ion and Chloride ion levels in normal male rats

Days		Urea (mg dL^{-1})	Creatinine (mg dL^{-1})	Sodium (mg dL^{-1})	Chloride (mg dL^{-1})
7th	Control	15.25±2.50	0.20±0.08	119.00±1.15	77.00±2.45
	Extract	13.80±3.90	0.16±0.09	121.00±1.23	77.80±1.79
14th	Control	19.50±1.92	0.40±0.12	112.50±3.79	71.25±2.99
	Extract	19.20±1.10	0.44±0.06	113.00±3.00	70.20±1.79
21th	Control	20.67±1.16	0.43±0.06	108.00±2.65	71.33±1.16
	Extract	19.50±1.00	0.68±0.13	108.00±2.16	70.75±1.89

significantly on the 14th day with 8.78 (U L^{-1}) for extract administered rats and 6.38 (U L^{-1}) for the control. The same pattern was observed with increase in the Total Bilirubin serum level of rats administered extracts (0.14 g dL^{-1}) when compared with the control (0.10 g dL^{-1}) on the 14th day of the experiment. There was also a significant reduction in the serum ALB levels on the 14th and 21st days, reaching peak reduction value of 1.75 g dL^{-1} for rats administered extract compared with 1.08 g dL^{-1} for control rats on the 14th day. While the serum Total Protein decreased significantly throughout the duration of the experiment, showing the most significant decrease on the 14th and 21st days when compared with their controls.

Table 3 showed slight changes in the serum levels of Urea, Creatinine, Sodium ion (Na^+) and Chloride ion (Cl^-) of normal rats administered aqueous extract of *G. latifolium* which was not significant on the 7th, 14th and 21st days of the experiment when compared with their controls. The urea serum levels increased on these three days but were not significant. Though not significant, the serum creatinine reduced on the 7th day but increased on the 14th and 21st days. There were non-significant increases on the 7th and 14th in Sodium ion (Na^+) serum level while Chloride ion (Cl^-) showed very little change.

The ethanolic extracts of *G. latifolium* increased the serum urea, Creatinine, sodium ion and Chloride ion levels in normal male rats as seen in Table 4. The serum Na^+ and Cl^- increased on7th, 14th and 21st days when compared with their controls. This increase was only significant for chloride ion on the 14th and 21st days when compared with their controls. The most significant change in serum Cl^- value of 83.25 mg d^{-1} was observed on the 14th day when compared with the 70.5 mg d^{-1} control. Serum creatinine levels progressively increased significantly for the 7th, 14th and 21st days when compared with their controls. From Table 4, serum creatinine value of 0.27 mg d^{-1} was observed to be most significant on the 21st day when compared with the control value of 0.13 mg d^{-1}. The serum urea levels in Table 4 showed similar pattern of progressive significant increases for the 7th, 14th and 21st days when compared with the control and was also most significant on the 21st day at concentration of 20.0 mg d^{-1} compared with 12.330 mg d^{-1} of the control.

Table 4: The effect of ethanolic extracts of *G. latifolium* on serum urea, Creatinine, sodium ion and Chloride ion levels in normal male rats

Days		Urea (mg dL^{-1})	Creatinine (mg dL^{-1})	Sodium (mg dL^{-1})	Chloride (mg dL^{-1})
7th	Control	11.75±2.36	0.30±0.00	126.75±4.57	75.75±4.36
	Extract	17.25±3.20*	0.40±0.08*	132.25±2.87	81.25±8.54
14th	Control	14.50±2.65	0.23±0.05	121.75±2.22	70.5±2.520
	Extract	20.25±2.06*	0.38±0.10*	127.75±2.63	83.25±5.38*
21th	Control	12.33±2.52	0.13±0.06	120.00±2.00	73.67±1.16
	Extract	20.00±2.00*	0.27±0.06*	127.00±1.00	84.00±2.00*

Values * given as mean±standard deviation had significant differences, when compared with the control ($p<0.05$). n = 5

DISCUSSION

The influence of extracts from *G. latifolium* leaves on normal albino rats were clearly expressed by the ethanolic extract group. The results from Table 1 suggests that the aqueous extract had little or no effect on the serum ALT, AST, ALP, TP, ALB and T.BIL levels when compared with their controls. In the ethanolic extracts groups as shown in Table 2, the serum ALT, AST, ALP and T.BIL levels increased significantly. These increases were most significant on the fourteenth days but for the serum ALP levels which was most at the seventh day. The results obtained does not agree with the study of Nwangwu *et al.* (2010) which showed significant reductions in ALT, AST, ALP, ALB and T.BIL and increase in TP at the same extract concentration. These increases seen in Table 2 were clear demonstration of cellular leakage and loss of functionality of membrane integrity (Saraswat *et al.*, 1993). The presence of xenobiotics in the form of extract in experimental animals could cause derangement of biochemical processes (Uboh *et al.*, 2010), increasing or decreasing the activities of AST and ALT which are indicators of liver injuries (Edet *et al.*, 2011). These injuries could have been caused by free radical and peroxidants which are implicated in the pathogenesis of toxic liver injuries (Jalalpure *et al.*, 2003). The works agrees with the report of Emeka and Obidoa (2009) which showed the substantial presence of phytosterols in *G. latifolium* leaf extracts. Therefore, the metabolism of phytosterols could be the source of the free radical (Burns *et al.*, 2000) which caused the compromise of the membranes of hepatocytes leading to leakage of enzymes and increases in the serum liver biomarkers. This reason may also be adduced for the significant serum ALP increase in the experiment which is noticeable with most liver problems (Nuhu and Aliyu, 2008). Hyperbilirubinaemia may be the first and sometimes the only manifestation of liver disease (Nuhu and Aliyu, 2008). This increase as seen in Table 2 could be attributed the saponin content of *G. latifolium* (Baumann *et al.*, 2000).

The decrease in serum TP observed with the ethanolic extract in this study is a function of the reduced ALB. The functional role of ALB makes it a reliable marker for diagnosis liver disease (Benoit *et al.*, 2000). The decrease could have resulted from a concomitant decrease in the number of cells responsible for ALB synthesis in the liver in agreement with Omotuyi *et al.* (2008) or a direct interference with the albumin-synthesizing mechanism in the liver as obtainable in mammalian cells or a combination of both.

Creatinine and urea are major catabolic products of carbohydrate and protein metabolism, respectively. Increases in serum urea levels as seen in Table 4 might be the effect of nephrotoxicity of *G. latifolium* ethanolic leave extract indicative of impaired kidney function (Afolayan and Yakubu, 2009). Abdulazeez *et al.* (2010) stated that renal failure leads to retention of creatinine and other non-protein nitrogenous constituents of the blood which may be responsible for the increases observed with the ethanolic extract groups in this study. These increases appreciated with prolonged administration of ethanolic extract, suggesting bioaccumulation of some components as causes of nephrotoxicity.

The loss of body fluids containing less sodium and water intake restriction, or excessive intake of sodium may lead to a rare condition of hypernatremia (Kang *et al*., 2002). This does not agree with the results of this work where water was given *ad libitum* and as such could not have been responsible for the increased sodium level shown in Table 4. Eleyinmi (2007) showed that *G. latifolium* leaves are rich in sodium ion which may contribute to increased sodium levels with prolonged administration or the extract may have compromised the ability of the kidney to excrete adequate sodium from tubular fluids (Saba *et al*., 2009). The increase serum chloride ion was not different in pattern when compared with serum sodium ion levels in this work, suggesting similar mechanism as both are known to have similar transmembrane transport.

CONCLUSION

The ethanolic extract of *G.latifolium* demonstrated nephrotoxic and hepatotoxic potential which was not the case with the aqueous extract. This therefore suggests that care should be taken in the use of the ethanolic extracts in treatment for the reasons of its counterproductive consequences resulting possibly from bioaccumulation as a consequence of prolonged administration. Further works should be emphasized on the fractionation of the extract with the view to identifying and possibly eliminating the toxic elements.

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REFERENCES

Abdulazeez, A.M., C.A. Awasum, Y.S. Dogo and P.N. Abiayi, 2010. Effect of *Peristrophe bicalyculata* on blood pressure, kidney and liver functions of two kidney one clip (2K1C) hypertensive rats. Br. J. Pharmacol. Toxicol., 1: 101-107.

Afolayan, A.J. and M.T. Yakubu, 2009. Effect of *Bulbine natalensis* baker stem extract on the functional indices and histology of the liver and kidney of male Wistar rats. J. Med. Food, 12: 814-820.

Akuodor, G.C., M.S. Idris-Usman, C.C. Mbah, U.A. Megwas and J.L. Akpan *et al*., 2010. Studies on anti-ulcer, analgesic and antipyretic properties of the ethanolic leaf extract of *Gongronema latifolium* in rodents. Afr. J. Biotechnol., 9: 2316-2321.

Baumann, E., G. Stoya, A. Volkner, W. Richter, C. Lemke and W. Linss, 2000. Hemolysis of human erythrocytes with saponin affects the membrane structure. Acta Histochem., 102: 21-35.

Benoit, R., D. Breulille, F. Rambourdin, G. Bayle, P. Captain and C. Obled, 2000. Synthesis rate of plasma albumin is a good indicator of liver albumin synthesis in sepsis. Am. J. Physiol. Endocrinol. Metab., 279: E244-E251.

Burns, D., W.F. Renolds, G. Buchanan, P.B. Reese and R.G. Enriquiez, 2000. Assignment of 23C spectra and investigation of hindered side-chain rotation in lupeol derivatives. Magn. Reson. Chem., 387: 488-493.

De Madureira, M.D.C., A.P. Martins, M. Gomes, J. Paiva, AP. da Cunha and V. do Rosario, 2002. Antimalarial activity of medicinal plants used in traditional medicine in S. Tome and Principle Islands. J. Ethnopharmacol., 81: 23-29.

Edet, E.E., I.J. Atangwho, M.I. Akpanabiatu, T.E. Edet, F.E. Uboh and E. David-Oku, 2011. Effect of *Gongronema latifolium* leaf extract on some liver enzymes and protein levels in diabetic and non-diabetic rats. J. Pharm. Biomed. Sci., 1: 104-107.

Eleyinmi, A.F., 2007. Chemical composition and anti-bacteria activities of *Gongronema latifolium*. J. Zhenjiang Univ. Sci. B, 8: 352-358.

Emeka, E.J.I. and O. Obidoa, 2009. Effect of a long term consumption of a diet supplemented with leaves of *Gongronema latifolium* Benth. on some biochemical and histological parameters in male albino rats. J. Biol. Sci., 9: 859-865.

Jalalpure, S.S., M.B. Patil, N.S. Prakash, K. Hemalata and F.V. Manvi, 2003. Hepatoprotective activity of fruits of *Piper longum* L. Ind. J. Pharm. Sci., 65: 363-366.

Kang, S.K., W. Kim and M.S. Oh, 2002. Pathogenesis and treatment of hypernatremia. Nephron, 92: 14-17.

Karim, A., M. Nouman, S. Munir and S. Sattar, 2011. Pharmacology and phytochemistry of Pakistani herbs and herbal drugs used for treatement of diabetes. Int. J. Pharmacol., 7: 419-439.

Latunde-Dada, G.O., 1990. Effects of processing on iron levels and availability from Nigerian vegetables. J. Sci. Food Agric., 53: 355-361.

Masaba, S.C., 2000. The antimalarial activity of *Vernonia amygdalina* Del. (Compositae). Trans. R. Soc. Trop. Med. Hyg., 94: 694-695.

Mensah, J.K., R.I. Okoli, J.O. Ohaju-Obodo and K. Eifediyi, 2008. Phytochemical, nutritional and medical properties of some leafy vegetables consumed by Edo people of Nigeria. Afr. J. Biotechnol., 7: 2304-2309.

Morebise, O., M.A. Fafunso, J.M. Makinde, O.A. Olajide and O.E. Awe, 2002. Antiinflammatory property of the leaves of *Gongronema latifolium*. Phytother. Res., 16: S75-S77.

Nuhu, A.A. and R. Aliyu, 2008. Effects of *Cassia occidentalis* aqueous leaf extract on biochemical markers of tissue damage in rats. Trop. J. Pharm. Res., 7: 1137-1142.

Nwangwu, S.C., F. Ike, M. Olley, J.M. Oke and E. Uhunmwangho *et al.*, 2009. Effects of ethanolic and aqueous leaf extracts of *Landolphia owariensis* on the serum lipid profile of rats. Afr. J. Biochem. Res., 3: 136-139.

Nwangwu, S.C.O., U.C. Nwangwu, S.J. Josiah and C. Ezenduka, 2010. Hepatoprotective and hypolipidemic potentials of aqueous and ethanolic leaf extracts of *Gongronema latifolium* on normal male rats. J. Sci. Eng. Technol., 17: 9572-9583.

Nwaogu, L.A., C.S. Alisi, C.O. Ibegbulem and C.U. Igwe, 2007. Phytochemical and antimicrobial activity of ethanolic extract of *Landolphia owariensis* leaf. Afr. J. Biotechnol., 6: 890-893.

Nwinyi, O.C., S.C. Nwodo and O.A. Olayinka, 2008. Evaluation of antibacterial activity of *Pisidium guajava* and *Gongronema latifolium*. J. Med. Plants Res., 2: 189-192.

Ogbebor, N.O., A.T. Adekunle and D.A. Enobakhare, 2007. Inhibition of *Colletrotrichum gloeosporioides* (Penz) Sac. causal organism of rubber (*Hevea brasiliensis* Muell. Arg.) leaf spot using plant extracts. Afr. J. Biotechnol., 6: 213-218.

Omotuyi, I.O., S.C. Nwangwu, O.T. Okugbo, O.T. Okoye, G.C. Ojieh and D.M. Wogu 2008. Hepatotoxic and hemolytic effects of acute exposure of rats to artesunate overdose. Afr. J. Biochem. Res., 2: 107-110.

Saba, A.B., O.A. Oridupa and S.O. Ofuegbe, 2009. Evaluation of haematological and serum electrolyte changes in Wistar rats administered with ethanolic extract of whole fruit of *Lagenaria breviflora* Robert. J. Med. Plants Res., 3: 758-762.

Saraswat, B., P.K. Visen G.K. Patnaik and B.N. Dhawan, 1993. Anticholestic effect of picroliv, active hepatoprotective principle of *Picrorhiza kurrooa*, against carbon tetrachloride induced cholestasis. Ind. J. Exp. Biol., 31: 316-318.

Tona, L., R.K. Cimanga, K. Mesia, C.T. Musamba and T.de Bruyne *et al.*, 2004. *In vitro* antiplasmodial activity of extracts and fractions from seven medicinal plants used in the democratic republic of Congo. J. Ethnopharm., 93: 27-32.

Uboh, F.E., I.E. Okon and M.B. Ekong, 2010. Effect of aqueous extract of *Psidium guajava* leaves on liver enzymes, histological integrity and hematological indicesin rats. Gastroenterol. Res., 3: 32-38.

Ugochukwu, N.H., N.E., Babady, M. Cobourne and S.R. Gassett, 2003. The effect of *Gongronema latifolium* extracts on serum lipid profile and oxidative stress in hepatocytes of diabetic rats. J. Biosci., 28: 1-5.