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Toxicological evaluation of the aqueous whole plant extract of *Aerva lanata* (l.) Juss. ex Schult (Amaranthaceae)

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ABSTRACT

Ethnopharmacological relevance: *Aerva lanata* (L.) of the family Amaranthaceae is a Nigerian medicinal plant used traditionally for the management of lithiasis, headache, renal disorder, haematemesis, bronchitis, nasal bleeding, cough, scorpion stings, fractures and spermatorrhoea. Studies that show the pharmacological basis for some of such uses have been reported. There is, however, no scientific report on its toxicity profile to the best of our knowledge.

Aim of the study: This study was therefore aimed at investigating the toxicity profile of the aqueous extract of *Aerva lanata*.

Materials and Methods: Acute toxicity tests for the extract administered orally at 1–30 g/kg and intraperitoneally at 0.1–2 g/kg were carried out in albino mice; while a sub-chronic toxicity test was done by daily oral administration of the extract at 40–1000 mg/kg to albino rats for 90 days. Anthropometric, biochemical and haematological parameters' assessments as well as vital organs histological examinations were performed in the sub-chronic toxicity study.

Results: The LD_{50} of the extract for oral and intraperitoneal acute toxicity tests were 22.62 g/kg and 0.432 g/kg respectively. The extract produced apparent changes in body weights of both male and female rats and significantly ($p < 0.05$) increased the weights of lungs, brain and pancreas of female rats while reducing the weight of testes in male rats. Haematological parameters were also altered with total leukocytes significantly ($p < 0.05$) increased and platelets significantly ($p < 0.05$) reduced in female rats; while neutrophils significantly ($p < 0.05$) increased in male rats. The extract (40–1000 mg/kg) produced significant ($p < 0.05$) reduction of serum alanine transaminase concentration in both male and female rats. Aspartate transaminases and albumin were also significantly ($p < 0.05$) reduced in both male (at 1000 mg/kg) and female (at 200 mg/kg) rats. Alkaline phosphatase was also significantly ($p < 0.05$) reduced in female rats at 200 mg/kg of the extract. Substantial alterations of creatinine, urea and uric acid were also observed. Triglyceride and cholesterol concentrations were significantly increased in male rats but decreased in female rats. At 1000 mg/kg, the extract significantly elevated catalase and superoxide dismutase levels with no effect on malondialdehyde levels. It also reduced sperm count and motility of male rats. Mild to moderate cellular changes in the brain, kidney, liver, lungs, spleen and testes of treated rats were observed on histological examinations. Significant changes in biochemical and haematological parameters were also noted in treated animals when compared to control animals 30 days after cessation of treatment.

Conclusion: The overall findings of this study suggest that the aqueous extract of *A. lanata* is relatively safe on acute oral exposure, moderately toxic on acute intraperitoneal administration and is relatively safe with antioxidant actions on prolonged exposure. It however shows potentials for toxic effects such as cellular damage to organs, dyslipidaemia and reduction in male reproductive capacity. Caution must therefore be applied in its use on a long term basis.

1. Introduction

Aerva lanata (Family – Amaranthaceae) locally known as "*ewe aje*" in Yoruba is distributed throughout Tropical India, Arabia, Tropical Africa, Sri Lanka, Philippines and Java (Guha Bakshi, 1984). The plant is widely used in various ailments and disease conditions. It is used as

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Table 1.
Pharmacological activities of *Aerva lanata*.

S/N	Pharmacological activities	References
1	Antiasthmatic	Kumar et al. (2009)
2	Anticancer and Antitumor	Zapesochnaya et al. (1992); Valsaraj et al. (1997); Nevin and Vijayammal (2003, 2006); Jose et al. (2001); Balasuriya and Dharmaratne (2007); Siveen and Kuttan (2011); Raihan et al. (2012); Bhanot et al. (2013); Bharitkar et al. (2014)
3	Antidiabetic	Vetrichelvan and Jegadeesan (2002); Deshmukh et al. (2008); Krishnan et al. (2009); Rajesh et al. (2012); Agrawal et al. (2013); Riya et al. (2014a), (2014b)
4	Antidiarrhoeal	Joanofarc and Vamsadhara (2003); Singh et al. (2011a), (2011b), (2012)
5	Antifertility	Savadi and Alagawadi (2009)
6	Antihelminthic	Rajesh et al. (2010); Anantha et al. (2010); Singh et al. (2011a), (2011b)
7	Anti-HIV	Gujjeti and Mamidala (2014)
8	Antiinflammatory, Analgesic and Antinociceptive	Vetrichelvan et al. (2000); Venkatesh et al. (2009); Sharma et al., (2010, 2011); Kamurthy et al. (2013);
9	Antimicrobial	Valsaraj et al. (1997); Perumal et al. (1999); Chowdhury et al. (2000); Prasad et al. (2009); Fagbohun et al. (2010); Suresh et al. (2010); De Britto et al. (2011); Srujana et al. (2012); Dinnimath and Jalalpure (2013); Farjeen et al. (2014)
10	Antioxidant	Balasuriya and Dharmaratne (2007); Ragavendran et al. (2012); Raihan et al. (2012); Ramachandra et al. (2013); Kumar et al. (2013)
11	Anti-ulcer	Indukuri et al. (2013)
12	Antiurolithiatic	Soundararajan et al., (2006, 2007); Arthi et al. (2012); Nirmaladevi et al. (2013); Thangarathinam et al. (2013)
13	Diuretic	Majmudar et al. (1999); Vetrichelvan et al. (2000); Kumar et al. (2005); Herath et al. (2005); Sharma et al. (2010); Sridhar et al. (2014)
14	Hepatoprotective	Majmudar et al. (1999); Nevin and Vijayammal (2005); Manokaran et al. (2008); Ramachandra et al. (2011); Anantha et al. (2012);
15	Immunomodulatory	Nevin and Vijayammal (2006); Siveen and Kuttan (2012a) (2012b)
16	Nephroprotective	Shirwaikar et al. (2004); Soumya et al. (2011)

diuretic and antihelmintic, antidiabetic, expectorant and in the treatment of lithiasis (Chopra et al., 1956; Tripathi et al., 1996; Gupta and Neeraj, 2004). It is used for arresting haemorrhage during pregnancy, uterus clearance after delivery and to prevent lactation (Yoga et al., 1979; Vedavathy and Rao, 1990; Sudhakar and Chetty, 1998). The plant extract is also used to treat nasal bleeding, cough, scorpion stings, fractures and spermatorrhoea (Mukerjee et al., 1984; Girach et al., 1994; Mallik et al., 2012). The flowers of *A. lanata* are used in dysentery, diarrhoea and bronchitis (Shah and Gopal, 1985). The seeds are used in rheumatism and bronchitis (Rajesh et al., 2011) while the leaves are used as antimalarial, in fever, to expel stones from kidney and as an antidote for scorpion sting, spermatorrhoea, urinary troubles and as an antirheumatic (Hemadri et al., 1980; Kakrani and Saluja, 1994; Vijayakumar and Pullaiah, 1998). The roots are used in headache, scabies, cough, as demulcent, diuretic, to cure diarrhoea, jaundice, cholera, dysentery and in snake bite (Bedi, 1978; Raj and Patel, 1978; Singh, 1993; Joshi, 2000). *A. lanata* has been widely investigated for its various pharmacological activities (Table 1).

The many medicinal properties of *A. lanata* have been found to be due to the presence of numerous secondary metabolites such as flavonoids, alkaloids, steroids, polysaccharides, tannins, saponins etc (Chandra and Sastry, 1990; Afaq et al., 1991; Zapesochnaya et al., 1992).

Despite the various studies on the medicinal uses of *A. lanata,* there is no literature on its toxicological profile except it toxicological effects on the renal structure and function as evaluated by Herath et al. (2005). This study, therefore, evaluates the safety profile of the aqueous extract of the whole plant of *A. lanata* with acute and sub-chronic toxicity tests in rodents.

2. Methodology

2.1. Plant material

The fresh mature whole plant of *Aerva lanata* bought from Alade market of Somolu in the Lagos metropolis was identified by Mr T. K. Odewo in the Department of Botany and Microbiology, University of Lagos, Nigeria. The specimen was deposited in the Lagos University Herbarium (LUH) with voucher specimen number LUH 3266.

2.2. Extraction

The fresh mature whole plant of *A. lanata* was air dried at room temperature. The dried plant was chopped into small fragments and soaked in distilled water in a conical flask over a 48 h period. The mixture was periodically shaken to ensure maximum extraction. The extract was then filtered and the filtrate was oven-dried at 40 °C to give a residue (yield: 6.61% w/w). The dried extract was reconstituted in distilled water before evaluation.

2.3. Animals

Sixty (60) albino rats (140–250 g) and 60 albino mice (20–30 g) of both sexes were used for the study. The animals were obtained from Laboratory Animal Centre of the College of Medicine, University of Lagos, Nigeria and maintained under standard laboratory conditions (12 h light/dark cycle, temperature of 22 ± 2 °C) with free access to standard pellet food (Ladokun feeds, Ibadan) and water. The animals were allowed to acclimatize to the laboratory conditions for seven days prior to the experiments. The experimental procedures were carried out in accordance with the OECD guidelines for testing of chemicals (2009).

2.4. Acute toxicity studies

The acute toxicity (LD_{50}) was estimated orally and intraperitoneally in albino mice according to the method of Miller and Tainter (1944). For both routes of administration, the mice were randomly divided into six equal groups (A–F) where groups A served as the control groups and received water 10 ml/kg body weight. The treated groups (B–F) of the oral route of administration were administered *A. lanata* at 10,000, 15000, 20000, 25,000 and 30,000 mg/kg while those of the intraperitoneal route of administration were administered *A. lanata* at 100, 250, 500, 1000 and 2000 mg/kg body weight. The animals were monitored for gross morphological and behavioural changes over 2 h following extract administration and mortality recorded after 24 h. The LD_{50} was determined using probit-log analysis.

2.5. Sub-chronic toxicity studies

Sixty (60) albino rats of both sexes were randomly allotted to four