Title: The toxicity profile of *Moringa oleifera* leaves and roots

By: Dr. Josephine Namuganwa Kasolo

Supervisors:
1. Prof. Jasper Ogwal Okeng, MakCHS
2. Prof. Gabriel Bimenya, MakCHS
3. Prof. Lonzy Ojok, COVB

ABSTRACT

Introduction: *Moringa oleifera* is a fast growing tree of significant, medicinal, nutritional and socio-economic importance. It is grown and and its leaves and roots are consumed by many people around the world as a medicine, vegetable and tea. Despite its wide use, *Moringa oleifera* leaves and roots do not have a well documented toxicity profile to guide the users of the plant.

Objectives: This study aimed at describing the toxicity profile of *Moringa oleifera* leaves and roots extracts in mice and rat models. It specifically established the protective phytochemical compounds in *Moringa oleifera* leaves and roots; determined the acute toxicity of *Moringa oleifera* leaves and roots in Swiss Albino mice and the sub-acute toxicity of *Moringa oleifera* leaves and roots in Swiss Albino rats.

Methods: It was an experimental study that harvested the leaves and roots from mature *Moringa oleifera* trees grown in Wakiso district of Central Uganda. The leaves and roots were air dried until constant weight was obtained. Extracts were obtained using ether, ethanol and water as solvents. Phytochemicals in the extracts were qualitatively identified using standard methods. The LD$_{50}$ of the ethanol and water extracts were determined using Swiss albino mice, while the sub-acute toxicity of the same extracts were determined by giving different daily oral doses of the extracts to Swiss albino rats for 30 days. Serum liver, kidney and heart enzyme toxicity
markers were determined after the 30 days. Histo-pathology examination was done on the liver, kidney and heart tissues of the experiment rats.

Results: Flavonoids, Steroids, Triterponoids, Saponins, Anthraquinones, Alkaloids and Reducing sugars were detected in *Moringa oleifera* leaves and roots extracts.

The leaves aqueous extract, leaves ethanol extract, roots aqueous extract, and roots ethanol extract had LD$_{50}$ of 16.1g/kg, 39.8g/kg, 15.9g/kg, and 17.8 g/kg respectively. The WBC, Cl$^-$, K$,\text{Ca}^{++}$, ALP, ALT, AST and total serum bilirubin significantly increased in all the rat groups that received leaves aqueous extract for 30 days, with p<0.002. In the rats that received roots ethanol extract had increased MCV and MCH in the group that received 1/8$^{th}$ lethal dose. The mean of $\text{Ca}^{++}$, $\text{PO}_4^{3-}$, ALP, ALT, AST were significantly increased in all the animals that received roots ethanol extracts. Histopathology results from the livers of the animals that received full lethal dose of leaves aqueous extract, showed vascular congestion with scattered focal necrosis, peri-vascular lymphocytosis, and scattered mononuclear cell infiltration. Those that received roots ethanol extract showed severe focal necrosis, interstitial oedema, diffuse and mature lymphocyte infiltration including interstitial heamorrhage. The hepatocytes were cloudy and swollen, with some apoptotic degeneration and severe fatty damage. The above findings on the livers are features of severe hepatitis.

The histopathology results of kidneys from the rats that received *Moringa oleifera* leaves extract full lethal dose showed features of glomerular congestion and expansion, plus mononuclear cellular infiltration; fibrosis around mildly atrophied tubules; hemorrhagic interstitium with lymphocytosis and mild fat degeneration. The kidneys from rats that received roots ethanol had tubules that showed features of glomerular and interstitial nephritis which included:
pronounced atrophy and necrosis; the glomeruli were expanded and highly cellular. There was interstitial oedema with mononuclear cell infiltration and haemorrhages; fibrosis in some areas with normal blood vessels.

The histopathology results of the heart from rats that received leaves aqueous extract full lethal dose showed features of myocardial cell degeneration (apoptosis) in patches with mild lymphocytosis while those from the rats that received roots ethanol full lethal dose showed severe focal myocarditis and normal blood vessels; diffuse mono nuclear cells infiltration more marked around vessels; some muscle degeneration progressing into fat degeneration plus macrophage infiltrate in the stroma were also observed. The livers, kidneys and heart of the rats that received ½ lethal dose and below showed no features of histological abnormalities.

Conclusion: *Moringa oleifera* leaves and roots contain phytochemical compounds that can cause toxicity in plant predators. The plant leaves aqueous and roots ethanol extracts are relatively non-toxic when given orally to mice as a single dose in 24 hours. However when given in single lethal doses orally to rats for 30 days, the extracts can cause toxicity to the liver, kidney and heart.

Recommendations: Further research should be done to explore the long term toxicity (chronic) profile of *Moringa oleifera* leaves and roots and also to establishing the time it takes for tissues to recover from the sub-acute and chronic use of *Moringa oleifera* leaves and roots.