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REJUVENATIVE AND PROPHYLACTIC EFFECTS OF MORINGA ON LEAD-INDUCED HEART TISSUE DAMAGE IN ADULT MALE WISTAR RAT MODELS

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ABSTRACT

Moringa is a plant that is rich in antioxidants and other substances with vital health benefits. Previous reports have indicated the healing effects of *moringa* in instances of trauma to body tissues. This experiment was aimed at investigating the potency of the prophylactic as well as the rejuvenative effects of *Moringa* phytochemical extracts on lead-induced tissue damage to the hearts of adult male Wistar rats. A total of 25 ($n=25$) adult male Wistar rats were used for the investigation; these were divided into five groups labelled A-E, each group comprising five animals ($n=5$). Animals in Group A served as control while those in Groups B - E animals served as tests. Animals in Group B were administered *moringa* leaf extract only; Group C animals were administered lead only; group D animals received lead and *moringa* concurrently while group E animals received lead for the first half of the treatment period and subsequently *moringa* extracts for the other half. All administrations lasted 16 days; using dosages of 50mg/kg body weight of lead and 100mg/kg body weight of *moringa*. Animals were sacrificed by cervical dislocation at the completion of administration and the hearts of the animals were excised and processed for histological demonstrations using the eosin and haematoxylin staining techniques. The heart tissues' homogenates were also assayed for creatinine kinase as a marker of cardiac tissue trauma. Results showed that *Moringa* when administered concurrently or subsequently with lead prevented to a large extent toxicological trauma and histoarchitectural disruption of the heart tissue.

Keywords: Heart Lead toxicity, *Moringa*, Regenerative, Prophylactic

INTRODUCTION

Moringa oleifera belongs to the Moringaceae family. It is a plant native to the western and sub - Himalayan region, India, Asia Minor, Pakistan, Africa, Malaysia and Arabia (Mughal et al., 1999; Somali et al., 1984). It is now distributed in the Philippines, Cambodia, Central, North and South America and the Caribbean Islands (Morton, 1991). Its common names are: Sajina, the horseradish tree, drumstick tree, benzolive tree, kelor, marango, mlonge, moonga and mulangay. In Nigeria, the plant

is found in the Northern, Southern, Western and Eastern parts of the country and is known as "Zogale" in Hausa, "Gawara", in Fulani, "OkweOyibo" in Igbo and "Ewe Igbale" in Yoruba (Williams *et al.*, 2013).

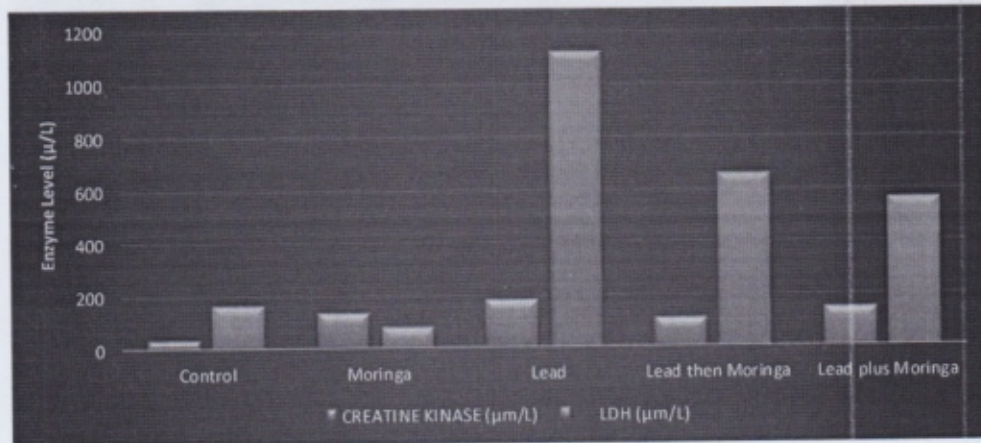
The plant is claimed to have many nutraceutical such as nutritional supplement, anti-inflammatory, anticancer, antihypertensive, antibacterial and antiasthma properties (Williams *et al.*, 2013; Animashaun *et al.*, 2013; Adejumo *et al.*, 2012; Fahey, 2005; Fuglie, 2000). In vitro studies and other studies in animal models of human disease confirmed that the plant is a rich source of several phytochemical compounds including antioxidant, anti-inflammatory, and antineoplastic; and micro- and macronutrients (Goyal *et al.*, 2007; Anwar *et al.*, 2007).

On the other hand; lead is one of the non-essential elements that are found in the human body. Lead is the most common of known toxic chemicals and people become exposed to this element in many ways. Lead pipe is used to convey water to homes, lead can be found in paints though such use has been banned. Lead toxicity affects both the old and the young, but children are the most susceptible to the lethargic effect of lead poisoning.

According to previous studies, *Moringa oleifera* has protective and regenerative effect against lead-induced damage to various tissues in animal models including the lung (Owolabi *et al.*, 2013), liver (Ghazal *et al.*, 2012), testis (Owolabi *et al.*, 2012a) and bone marrow cells (Owolabi *et al.*, 2012b). This study is thus aimed at investigating the healing and prophylactic effects of *Moringa oleifera* against lead-induced toxicity on the heart of the animal models.

MATERIALS AND METHOD

A total of 25 (n=25) adult male Wistar rats, which were bred in the institutional animal holding facility were used for the investigation. These were divided into five groups of five animals each (n=25) and the groups labelled A-E. The group A served as control; group B animals were administered moringa leaf alcoholic extract only; Group C animals were given lead only; group D animals received lead and moringa leaf alcoholic extract concurrently while group E animals received lead for half treatment period and thereafter moringa extract for the other half. Equal dosages of lead and moringa per kilogram body weight were administered across the animal groups as described, being 50mg/kg body weight and 100mg/kg body weight respectively. The administration period was 16 days. Animals were sacrificed by cervical dislocation at the completion of administration and the hearts of the animals were excised and processed for histological demonstrations using the eosin and haematoxylin staining techniques (Baker, 1962). The heart tissues' homogenates were assayed for creatinine kinase and lactate dehydrogenase as markers of cardiac tissue integrity and trauma.



RESULTS

Figure 1: Levels of Creatinine Kinase and Lactate Dehydrogenase in the Heart Tissues

Chart showing the levels of creatinine kinase and LDH enzymes in the homogenates of the hearts of the experimental animals. The lead-poisoned group had the highest levels of both creatinine kinase and lactate dehydrogenase. The moringa-treated group had lactate dehydrogenase level lower than the control. Moringa extract-treated groups had creatinine kinase and LDH groups lower than the lead poisoned-groups.

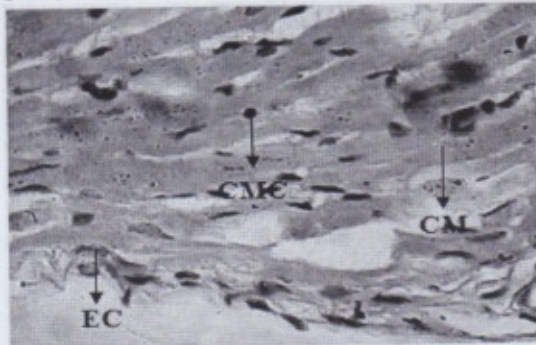


Plate A: Photomicrograph of the heart of adult male Wistar rats in the control group using routine haematoxylin and eosin stain technique (x300).

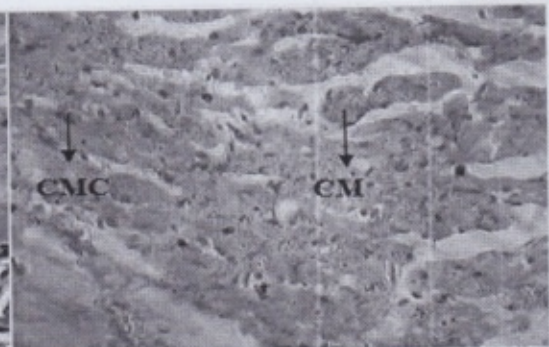


Plate B: Photomicrograph of the heart of adult male Wistar rats in the moringa extract-treated group using routine haematoxylin and eosin stain technique (x300).

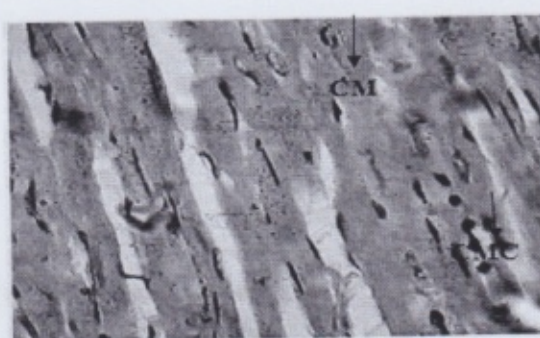


Plate C: photomicrograph of the heart of adult male Wistar rats in the lead-treated group using routine haematoxylin and eosin stain technique (x300).

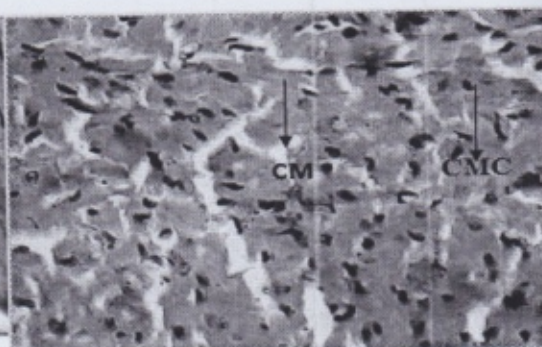


Plate E: photomicrograph of the heart of adult male Wistar rats in the group administered Moringa and lead simultaneously using routine haematoxylin and eosin stain technique (x300)



Plate D: Photomicrograph of the heart of adult male Wistar rats in the group administered lead and Moringa leaf extract simultaneously group using routine haematoxylin and eosin stain technique (x300).

Legend: CM = Cardiac Muscle Fibre, CMC = Cardiac Muscle Cell, EC = Endothelial Cell

Figure 2: Histological photomicrographs of the heart tissues of the experimental animals: Plate A (Group A photomicrograph) shows normal cardiac muscle and endothelial cells. Plate B (Group B photomicrograph), presents general histoarchitecture that bears resemblance to the control group. Plate C (Group C photomicrograph) presents cardiac muscles cells nuclei with polymorphic appearance; also the bundles of muscle cells appear relatively less compact. Plate D (Group D photomicrograph) presents mild morphological disruptions of the general histoarchitecture and polymorphic cardiac muscle cells nuclei are observed. Plate E (Group E photomicrograph) shows that the general histoarchitecture and cellular morphology have improved over Plate C (Group C photomicrograph)

DISCUSSION

Creatine kinase is a popular marker of heart tissue functions and abnormal elevation of this enzyme relative to the heart have been reportedly associated with heart muscle anomalies and diseases including myocardial injury, myocardial infarction and similar heart problems (Kemp *et. al.*, 2004). Abnormal elevation of lactate dehydrogenase is also associated with myocardial injury (Kemp *et. al.*, 2004).

Creatine Kinase assay results (Figure 1) show that the control group had the lowest level of the enzyme. This is also lower than its levels in the lead-exposed group C as well as the treated groups D and E. This is an indication that the animals in the control group were normal relative to the treated groups. The animals in group B, administered moringa leaf extract only, interestingly a higher level of the enzyme than in the control group. This suggests that Moringa administration alone influences the enzyme level in the heart. Group C animals had the highest level of creatinine kinase. This abnormally elevated level of the enzyme portrays the deleterious effect of lead on the heart. Groups D and E had fairly lower levels of the enzyme when compared with the lead-treated group and this suggests that *Moringa oleifera* had ameliorative and prophylactic effects in its administration to the heart of the rats. Interestingly, Group D (treated with moringa after lead poisoning) had a slightly lower level of the enzyme than in Group B (when moringa is solely administered). Whether the increase in the enzyme level in Group B against Group A is of negative effects would have to be established by a number of molecular or biochemical methods. The effects of the extracts in groups D and E however could not restore the enzyme levels to the control group level.

LDH level in the control Group A was low compared to its levels in Groups C, D and E. The moringa extract-treated group had the lowest LDH level. This suggests that not only would Moringa ameliorate damage done to the heart tissue by lead poisoning, it also maintains biochemical integrity of the heart tissues. Group C had an abnormally high LDH level and this is an indication of the adverse effect of lead exposure on the heart. Groups D and E had lower LDH levels compared with group C, this also corroborates the results from the creatinine kinase test that Moringa could ameliorate damage done by lead to heart tissues.

Histological observations (Figure 2) in this investigation correspond with the biochemical observations. Photomicrograph of the Group A animals cardiac muscle (Control Group) illustrated as Plate A shows that the cardiac muscle and endothelial cells appear normal and this is considered the standard reference. The photomicrograph of the Group B animals (administered moringa leaf extract only), Plate B, presents general histoarchitecture that bears resemblance to the control group. In Plate C- the photomicrograph of the animal in the Group C (administered lead only); cardiac muscles cells nuclei appear polymorphic. Though no gross histomorphological disruption is observed, individual cells morphology varies

considerably within the tissue, and this being peculiar to this group shows signs of trauma from lead assault. The bundles of muscle cells also appear relatively less compact. In Plate D- photomicrograph of the heart of the Group D animals (administered lead first and thereafter Moringa); mild morphological disruptions of the general histoarchitecture polymorphic cardiac muscle cells nuclei are observed. Observations of the photomicrograph of the Group E animals (Plate E), where moringa was administered concurrently with lead to the animals shows that the general histoarchitecture and cellular morphology appear to have improvement over group C. This observation suggests that moringa has prophylactic or protective effects. Altogether, the observations agreed with the work of Sunisa *et al.*, (2012), that the administration of the Moringa reduced the level of effect of the lead to the heart tissue.

CONCLUSION

Moringa when administered either concurrently with lead or after lead poisoning ameliorated the toxic effects of lead on the heart tissue. The toxicological trauma and histoarchitectural disruption of the heart tissue were ameliorated and observable. Thus moringa has both rejuvenative and prophylactic effects on lead-induced toxicity to heart tissue in adult male Wistar rat models.

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