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Research Article

Antihyperlipidemic Studies of Solvents Extract of Adansonia Digitata Fruit Pulps

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Abstract

This research investigates anti-hyperlipidemic ability of solvents extracts of *Adensonia digitata* fruits pulps in diet induced hyperlipidemic rats. Rats were induced with hyperlipoidemia by administration of high lipid enriched feeds for a period of 6 weeks. A total of thirty-six albino rats were used for the study, they were placed into six groups of six rats each. Group one and two were normal control and positive control group respectively, while group three, four, five and six were induced with hyperlipidemia and administered with 250 mg/kg of each extract (i.e., n- hexane, chloroform, ethyl acetate and residue) respectively. Two weeks after extract administration, the rats were sacrificed and blood samples were collected for biochemical analysis. Significant increase ($p < 0.05$) in the serum TC, TG, and LDL-C were observed in hyperlipidemic control rats compared to normal control. After extracts administration, a significant decrease ($P < 0.05$) in TC, LDL–C, TG was observed in ethyl acetate administered group compared to other extract and hyperlipidemic control groups. The study demonstrated that ethyl acetate extract *Adansonia digitata* fruit pulp extract possesses strong anti-hyperlipidemic bio active compound. Sub-chronic toxicity of the active ethyl acetate extract reveals no toxicity on liver and kidney tissues. Further researches on the extract should dwell on isolation and characterization bioactive compound (s).

Keywords: *Adansonia digitata;* Fruit pulp; Hyperlipidemia; Lipid profile; Kidney and Liver

Introduction

Traditional medicine (local medicine or complementary medicine) is some medical knowledge structure which was developed over eras within various cultures before the age of contemporary medicine. The World Health Organization [1] describes folk medicine as the health techniques, methods, information and belief incorporating the use of plant, animal and/or mineral based medications, divine therapies, physical techniques and exercises, applied either exceptionally or in amalgamations to cure, identify and avoid illness or maintain well-being. Traditional medicines include practices such as phyto medicine which is an aspect of indigenous medicines, the use of congregated plant parts to make juices, bandages or powders that supposedly effect cures and preventions. These medicinal plants, which are often referred to as folk medicines, need to be appraised, given due appreciation and industrialized so as to improve their efficiency, safety, accessibility and wider application at low cost [1].

Adansonia digitata, baobab (called kukah by many ethnic groups in Nigeria), belongs to the Malvaceae family and is the most prevalent of the *Adansonia* species on the African region, it is usually

grown in hot, dry savannah region Africa continent [2]. The baobab is a local food plant in Africa. The tree has been suggested to possibly improve nutrition and food insecurity as well as foster rural growth and maintain land care [3].

The plant is a versatile tree species widely used for nutrition and medicine. The baobab fruit pulp is probably the most significant foodstuff from the plant due its unique architecture. It can be mixed in water or milk to make a juicy beverage, a pottage, a fermenting agent in traditional brewing, or as a supernumerary for cream of tartar in baking. The pulp was reported to be rich in vitamin C content and calcium. The fruit is 15 to 20 centimetre long. It has 50% extra calcium than spinach, rich in antioxidants, and has three times the vitamin C of an average orange. Thus, it is referred to as a super fruit [4]. The United States Food and Drug Administration generally recommended the safety of baobab dried fruit pulp as a food ingredient in 2009 [5].

Hyperlipidemia is the manifestation of high levels of lipids and/or lipoproteins fractions in the blood [6]. Basically, it is divided into familial (primary) caused by specific hereditary irregularities or acquired (secondary) caused by other underlying sickness that lead to changes in blood lipids and lipoprotein concentrations [7]. Hyperlipidemia has a complex pathophysiology consisting of various genetic, lifestyle and environmental factors [8]. It is not a disease but a metabolic imbalance that can lead to several ailments, most particularly cardiovascular diseases. The rising trend of obesity as well as modifications in lifestyle and environmental factors have make lipid disorders a global medical and public health threat. This necessitate the search for alternative medicines with higher efficacy, less toxic and readily available. Recent study by Alhassan., *et al.* [9] demonstrated that *Adansonia digitata* aqueous fruit pulp extract possesses anti-hyperlipidemic activity. The present study evaluates anti-hyperlipidemic potentials of solvents extract of *Adansonia digitata* fruit pulp.

Materials and Methods

Material

Experimental animals

Experimental animals of both sexes weighing between 80g to 120g were obtained from animal house of Biological Sciences Department, Yobe State University, Damaturu. The rats were kept in well-ventilated aluminium cages in the animal house and were allowed free access to food and water. Principle of laboratory animal care and ethical guidelines for investigation of experimental pain in conscious animals were followed throughout the period of the study [10,11].

Collection, identification and extraction of the plant material

Adansonia digitata fruit pulps were collected from Yobe State University, Damaturu. It was taken to Plant Biology Department of Bayero University Kano for identification by a taxonomist. A voucher number of BUK HAN0036 was given. It was then shade dried and ground into fine powder using electric blender. Five hundred grams of the powder was subjected into sequential extraction using different solvents of varying polarity (Hexane, Chloroform, Ethyl acetate and Methanol) using sonication technique. The extract from each solvent was concentrated by complete evaporation of the solvent to yield Hexane, Chloroform, Ethyl acetate and Methanol extract labelled as E2, E3, E4 and E5 respectively.

Methods

Induction of hyperlipidemia

A revised method of Vesselinvitch., *et al.* [12] was employed in the induction of hyperlipidemia in rats. Fully grown rats were given high fat diet formulation for a period of six weeks. The diet was made by blending pure cholesterol, palm oil and grower mash feed in a percentage ratio of 2:20:78 by mass. Increase in Body weight of rats was noted weekly.

Grouping and treatment of experimental hyperlipidemic rats

Thirty-six albino rats were placed into six groups of six rats each.

- **Group I:** Normal control
- **Group II:** Hyperlipidemic control
- **Group III:** Hyperlipidemic, administered with 250 mg/kg of hexane extract (E2)
- **Group IV:** Hyperlipidemic, administered with 250 mg/kg of chloroform extract (E3)
- **Group V:** Hyperlipidemic, administered with 250 mg/kg of ethyl acetate extract (E4)

- **Group VI:** Hyperlipidemic, administered with 250 mg/kg of residue (E5).

At the end of experimental period (two weeks), the rats were euthanized and blood samples were collected into a labelled centrifuge tube, centrifuged and the serum obtained was used for analysis of lipid profile indices.

Toxicological studies of most active extract

A total of 20 male albino rats were used and they were divided into four groups of five rats each. The extract was administered daily orally to the rats in groups II to IV at a dose of 100mg/kg, 200mg/kg and 300mg/kg body weight. Group I rats serve as control. All the rats were sacrificed after 28days of extract administration, blood samples were collected and centrifuged for analysis of liver and kidney functions indices. Aspartate aminotransferase (AST) and Alanine Aminotransferases Assay (ALT) were assayed using Reitman and Frankel method [13], Alkaline Phosphatase (ALP) activity assayed using the method developed by Rec [14], Bilirubin by method of Tietz [15] and Total protein was determined by Tietz method [16].

Statistical analysis

Data were presented as mean ± standard deviation and analyzed using ANOVA, with p value (<0.05) considered significant followed by Tukey's post hoc test. GraphPad Instat3 Software was used to analyze the data [17].

Results and Discussion

Results

Figure one shows the average weight gain in rats after six weeks of feeding on normal diet and high lipid diet respectively. A significant increase ($p < 0.05$) in body weight was recorded in high lipid fed rats compared to rats administered with normal diet which may be due to the successful induction of hyperlipidemia, hence becomes obsessed.

Administration of the extract shows in reduction in body weight in rats administered with ethyl acetate extract, followed chloroform extract, then the residue and finally hexane extract. This shows ethyl acetate extract to slow down the progression of weight gain as a result high fats diet feeding.

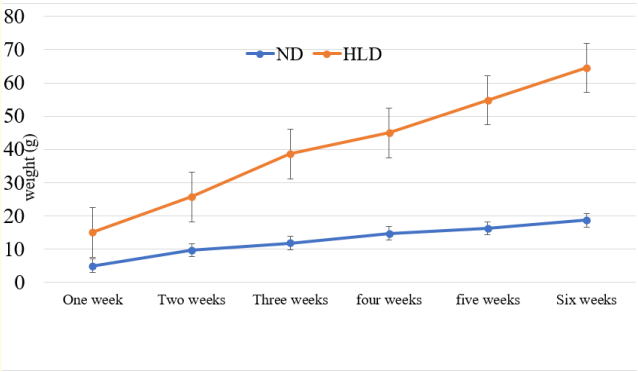

Figure 1: Average weight gain of rats feed on standard feed and high lipid diet for six weeks.

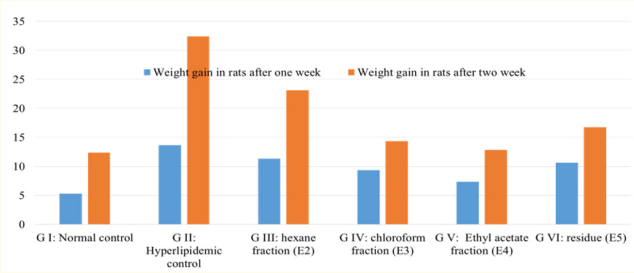

Figure 2: Body weight of hyperlipidemic rats after one and two weeks of solvents extract administration (E1, E2, E3 and E4).

The effect of administration of the extracts on lipid profile indices of hyperlipidemic rats was shown in figure 3. The result shows a significant increase ($p < 0.05$) in Total Cholesterol, LDL-Cholesterol and Triglycerides and a significant decrease ($p < 0.05$) in HDL-Cholesterol in hyperlipidemic control compared to normal control. After extract administration, a significant decrease ($P < 0.05$) in TC, LDL–C, TG was observed in ethyl acetate administered group compared to the hyperlipidemic control.

Sub chronic toxicity of the most active ethyl acetate extract on liver function indices (AST, ALT, ALP, DB, TB, TP and ALB) was presented in table 1. The result showed no significant difference in all parameters between the normal control and extract administered groups.

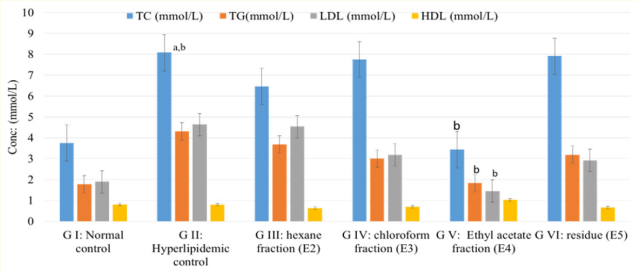

Figure 3: Lipid profile (TC, TG, LDL-C and HDL-C) of hyperlipidemic rats administrated with different solvents fractions (E1, E2, E3 and E4) for two weeks.

Values are presented as Mean ± standard deviation, (n = 5). Value bearing similar superscripts in a column are significantly different compared to each other ($p < 0.05$).

The effect of administration of the extract on serum concentrations of urea, creatinine and electrolytes (Na^+, Cl^-, K^+, HCO_3^-) was presented in table 2. No significant difference was observed between extract administered groups compared to normal control.

Values are presented as Mean ± standard deviation, (n = 5). Value having similar superscripts in a column are significantly different compared to each other ($p < 0.05$).

Group	ALT(IU/L)	AST(IU/L)	ALP(IU/L)	DB (mg/dl)	TB (mg/dl)	TP(g/dl)	ALB(g/dl)
Control	29.43 ± 2.90	23.89 ± 2.02	46.96 ± 1.85	0.34 ± 0.06	1.65 ± 0.16	7.01 ± 1.11	5.97 ± 0.16
100mg/kg	26.01 ± 1.72	24.26 ± 2.08	44.91 ± .3.04	0.47 ± 0.03	1.31 ± 0.34	7.16 ± 1.24	5.70 ± 0.82
200mg/kg	20.65 ± 1.73	25.50 ± 3.00	44.46. ± 4.04	0.98 ± 0.03	2.05 ± 0.38	7.86 ± 1.32	5.46 ± 0.33
300mg/kg	20.05 ± 2.63	24.70 ± 1.08	46.23 ± 2.05	1.4 ± 0.28	2.77 ± 0.10	5.63 ± 2.03	5.19 ± 0.95

Table 1: Liver function Indices of rats administered with ethyl acetate extract for four weeks.

Group	Urea(mmol/L)	Crea (mmol/L)	Na^+(mmol/L)	K^+(mmol/L)	Cl^-(mmol/L)	HCO_3^- (mmol/L)
Control	42.85 ± 0.82	20.83 ± 4.31	103.47 ± 0.18	4.59 ± 0.54	96.59 ± 0.54	23.89 ± 3.45
100mg/kg	44.89 ± 4.18	21.22 ± 1.39	104.92 ± 2.86	4.30 ± 0.58	94.18 ± 2.35	21.78 ± 4.84
200mg/kg	43.12 ± 2.57	22.68 ± 1.42	103.83 ± 5.62	5.45 ± 1.21	95.49 ± 2.32	21.22 ± 4.22.
300mg/kg	44.10 ± 5.71	23.36 ± 0.25	105.00 ± 5.62	4.05 ± 0.56	97.88 ± 2.38	21.68 ± 1.90

Table 2: Kidney function Indices of rats administered with ethyl acetate extract for four weeks.

Discussion

Hyperlipidemia is a changeable risk factor of an important killer disease termed "cardiovascular diseases". Cardiovascular disease refers to a cluster of ailments that includes hypertension, coronary artery disease, peripheral artery disease, stroke, congenital heart disease, and heart failure. According to World Health Organization, it is the leading cause of death globally, accounting for nearly 17.9 million deaths in 2016 alone [18]. Increase in weight of high fats fed rats indicate successful induction of Hyperlipidemia, this was further confirmed by the significant increase in total cholesterol, triglyceride and LDL-Cholesterol in hyperlipidemic rats compared normal control, these findings are in line with the report of Vesselinvitch., *et al.* [12] and Alhassan., *et al.* [9]. Administration solvents extract shows ethyl acetate extract to lower the weight gain as well as decreases total cholesterol, triglyceride and LDL-cholesterol level, this echo well with the findings of Alhassan., *et al.* who reported aqueous extract of *Adansonia digitata* fruit pulps to possess strong anti-hyperlipidemic activity [9].

The activity of the exerted by ethyl acetate extract might be connected to the presence some bioactive compound(s) which might influence lipid metabolism thereby affecting the serum lipid profile indices as does by the statins (standard drug for Hyperlipidemia). The fall in level of serum Total cholesterol in ethyl acetate administered rats could be due to increased activity of enzyme

LCAT (lecithin cholesterol acyl transferase), an enzyme involved in esterification and mobilization of cholesterol in the plasma, while the decrease in serum triglycerides could be due to decreased accumulation and deposition in the adipose tissue, or it could be due to increased activity of lipoprotein lipase that involved in the uptake of TG rich lipoprotein by extra hepatic tissue [19].

Liver is a significant body organ that is actively involved in different metabolic pathways [20]. Hepatic impairment caused by chemicals or infectious agents is accompanied with destabilization of these metabolic functions and may lead to progressive liver fibrosis, cirrhosis and liver failure at last. Administration of the most active ethyl acetate extract showed no significant effects on liver function parameters within the administered doses. Thus, indicating no hepatotoxic effects of the extract.

Kidneys are the major organs in metabolizing toxic compound besides liver. It receives about 1200ml of blood per minute containing a lot of chemical compounds [21]. Therefore, damage to the kidneys can be determined by measuring the level of urea, electrolyte and creatinine in blood as an indicator of kidney damage. Therefore, damage to the kidney will make the kidney inefficient to excrete both urea and creatinine and causes their accumulation in the blood. The nontoxic effect of ethyl acetate extract at almost all the doses is evident by the non-alteration in kidney function parameters [22].

Conclusion

The study concludes that solvents extract *Adansonia digitata* fruit pulps possess strong anti-hyperlipidemic activity with ethyl acetate extract been the most active.

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