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Der Pharmacia Lettre, 2012, 4 (3):811-814
(http://scholarsresearchlibrary.com/archive.html)

Scholars Research Library
ISSN 0975-5071
USA CODEN: DPLEB4

Saponins from *Solanum anguivi* fruits exhibit hypolipidemic potential in *Rattusnovergicus*

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ABSTRACT

The quest for save herbal remedy for the management of cardiovascular diseases prompted this investigation and itis aimed at determining the effect ofSaponin from Solanum anguivi fruits on serum lipid profile - a risk factor in thedevelopment coronary heart disease (CHD).Thirty six (36) rats(Rattusnovergicus) of average weight (125± 12g) were divided into six (6) groups of six animals each designated as A (n=6, 2.0ml distilled water), B (n=6, 20mg/kg saponin), C (n=6, 40mg/kg), D (n=6, 60mg/kg), E (n=6, 80mg/kg), and F (n=6, 100mg/kg). Saponin was administered orally once daily to groups B,C,D,E and F for (21) days.Serum lipid profile was determined usingdiagnostic kits. The result showed an initial significant increase ($p<0.05$) in weights of the treated animalswhen compared with thecontrol but by the third week, the increase was not significant. A significant reduction ($P<0.05$) in serum Triglycerides, total Cholesteroland Low-Density Lipoprotein(LDL) was observed while High-Density Lipoprotein (HDL) was significantlyincreased. The dose dependent effects of saponin from Solanum anguivi fruit on serum lipid profile is very crucial, as it may reduce the risk of developingCHD. Saponin from Solanum anguivi fruits has hypolipidemic potential which is one of the greatest risk factors contributing to the prevalence andseverity of coronary heart diseases.

INTRODUCTION

After the industrial revolution, the human diet has changed from unrefined whole grains and vegetables with high fiber to refined grains with low fiber content and more animal products. These changes beside the reduced physical activity of human due to mechanization caused an increase in the risk of some chronic diseases related to diet and lifestyle like obesity, diabetes, cardiovascular and heart related diseases. During the past decades many studies have focused on improving lipid profiles (as one of the most important risk factors of chronic diseases) by planning a better diet or introducing herbal treatments (1).

Hyperlipidemia has been ranked as one of the greatest risk factors contributing to the prevalence andseverity of coronary heart diseases (2). Coronary heart disease(CHD), stroke, atherosclerosis andhyperlipidemia are the primary cause of death (3). Hyperlipidemia is characterized by elevated serum oftotal cholesterol, low density lipoprotein, very low density lipoprotein and decreased high densitylipoprotein levels. Hyperlipidemia associated lipid disorders are considered to cause atheroscleroticcardiovascular disease (4). Among these hypercholesterolemia and hypertriglyceridemia are closelyrelated to ischemic heart disease (5). Elevated LDL cholesterol and decreased highdensitylipoprotein (HDL) cholesterol in the plasmahave been independently associated with increasedrisk for

CHD(6). Obese people tend to have relatively high triglyceride and low HDL-cholesterol. Obesity alsoraises the LDL cholesterol levels. High level of plasma triglycerides is also considered a risk factorfor CHD (7).

Solanum anguivi belongs to the family *Solanaeceae* and is called "IgbaYirin" in south western part of Nigeria.*Solanum anguivi* is a nourishing vegetable and can be eaten raw or cooked and its fruits are readily available in most of our local markets where herbs are sold (8). In many countries, *Solanum anguivi* is a medicinal plant used to cure sicknesses. In Nigeria, the fruits of *Solanum anguivi*is claimed to reduce the risk of atherosclerosis which is usually associated with hypertension.

Saponin is a class of chemical compounds, one of many secondary metabolites found in natural sources (9). Saponin from different plant sources vary widely in their toxicity. This study is therefore aimed at investigating the effect of saponin from Solanum anguivi fruits on lipid profiles of rats.

MATERIALS AND METHODS

Plant materials

The fruits of *Solanum anguivi* were collected from Adekunle Ajasin University, Akungba Akoko horticultural garden. They were identified and authenticated at the herbarium of plant science and Forestry department, University of Ado Ekiti, Nigeria. The fruits were air dried and grounded into a powdery fine texture and stored at room temperature in air tight polythene bag prior to use.

Preparation and purification of Saponin extract

Saponin extract from *Solanum anguivi* fruitswas carried out as previously reported by (8).

Animal grouping

Thirty six albino rats of average weight 125±12g were obtained from Animal unit of Federal university of Technology, Akure Ondo state. They were divided into six groups of six animals each and allowed to acclimatize to experimental condition for two weeks. They were housed in clean cages and maintained under standard laboratory conditions (temperature 25 ± 2^0C with dark/light cycle 12/12h). They were fed *ad libitum* on rat pellets by (Top Feeds, Nigeria) and water. Groups A (control) was given distilled water, B, C, D, E and F were given daily oral dose of 20, 40, 60, 80, 100mg/kg body weight of saponin respectively for 21 days.

The rats were sacrificed by cervical dislocation and the blood collected into clean drybeakers and serum was prepared as described by (10). The serum levels of cholesterol, triglyceride, HDL-c and LDL-c were assayed by Randox commercial kit.

Statistical analysis

The data are expressed as mean± SEM. Statistical analysis was carried out by one-way analysis of variance (ANOVA). Differences were considered to be statistically significant when $p<0.05$.

RESULTS

The body weight gain of control rats and rats administered daily oral doses of Saponin from *Solanum anguivi* fruits for 21 days are presented in Table i below.The result showed an initial significant increase ($p<0.05$) in weights of the treated animals by first and second week of administration of saponinwhen compared with thecontrol but by the third week, the increase was not significant when compared to the control.

Table i. Effect of *S. anguivi* saponin on weight(g) of rats (n = 6, X ± SEM)

Groups	Week 0	Week 1	Week 2	Week 3
Control	169.64±11.77^b	168.96±11.55^b	170.31±8.51^a	172.86±7.69^a
20mg/kg	123.46±5.54^a	126.36±5,76^a	131.69±7.18^b	135.32±6.85^a
40 mg/kg	116.85±6.18^a	118.41±7.34^a	123.21±8.21^b	135.08±10.30^a
60 mg/kg	119.33±2.94^a	116.69±7.68^a	118.06±7.51^b	139.86±12.11^a
80 mg/kg	125.71±12.53^a	130.13±13.30^a	130.50±12.79^b	144.39±13.28^a
100 mg/kg	124.83±16.91^a	133.61±17.67^a	137.68±18.22^a	151.06±21.38^a

Values are expressed as mean±standard error mean (SEM). Values with different superscript are significantly different (P<0.05)

The administration of saponin from *Solanum anguivi* fruit at test doses significantly (P<0.05) lower the serum concentration of triglycerides, total cholesterol and lowdensity

lipoprotein (LDL) when compared with the control, while at these doses, saponin significantly (P<0.05)increase the serum concentration of high-density lipoprotein as depicted in Table ii.

Table ii. Effect of *S. anguivi* saponin on lipid profile of rats (n = 6, X ± SEM)

	Triglyceride (mg/dl)	Cholesterol (mg/dl)	HDL (mg/dl)	LDL (mg/dl)
Control	72.35±9.68^{b}	115±26.93^{b}	0.30±0.0046^{a}	8.53±5.12^{a}
20mg/kg	67.60±2.96^{b}	80.24±22.25^{ab}	0.57±0.0039^{d}	2.52±4.38^{a}
40 mg/kg	65.85±15.90^{b}	75.88±6.39^{ab}	0.50±0.0057^{cd}	2.02±3.93^{a}
60 mg/kg	52.76±6.14^{ab}	68.64±9.58^{ab}	0.44±0.0007^{bc}	3.17±3.10^{a}
80 mg/kg	49.52±9.62^{ab}	61.30±6.69^{a}	0.38±0.0020^{ab}	2.65±2.99^{a}
100 mg/kg	32.85±7.43^{a}	51.25±11.75^{a}	0.37±0.0008^{ab}	2.72±2.24^{a}

Values are expressed as mean± standard error ofmean (SEM). Values with different superscript are significantly different (P<0.05).

DISCUSSION

It is a widely accepted fact that cardiovascular disease is associated with hypertension (11) and elevated bloodlevels of low-density lipoprotein (LDL), total cholesterol, and triglycerides and, a low level of high density lipoprotein (HDL) is a risk factor for mortality from cardiovascular disease (12).Alterations in the concentration of major lipids like cholesterol, high-density lipoprotein cholesterol, lowdensity lipoprotein cholesterol and triglycerides could give useful information on the lipid metabolism as well as predisposition of the heart to atherosclerosis and its associated coronary heart diseases (13).

This study present the result of oral administration of saponin from *Solanum anguivi* fruits on lipid profiles of rats. *Solanum anguivi*saponin causes a significant decrease (P<0.05) in serum level of triglyceride, cholesterol, LDL and increase in HDL in a dose dependent manner. The observedhypotriglyceridemic effect might be dueto a decrease in fatty acid synthesis (14), enhanced LDL receptors, activation of LCAT andlipases (15) and also inhibition of acetyl-CoA carboxylase (16). The dose dependent decrease in serum total cholesterol could be due toa decrease in cholesterol absorption from theintestine, through binding to bile acids and an increase in faecal bile acids excretion. Another mechanism involved in lowering of total cholesterol might be related to the suppression of cholesterol biosynthesis by decrease in the HMG-CoA reductase activity which is the rate-limitingenzyme in the cholesterol biosynthetic pathway.

It is well known that hyperlipidemia is one of the major risk factors for arthrosclerosis. An increase in the concentration of lipids results in liberation of lysosomes and triggers cell degeneration. Majorcomponent of total cholesterol is LDL which is directly related to coronary artery disease. It is recognized as major artherogeniclipoprotein and primary target of lipid lowering therapy (17).

Moreover, it seemed that saponin from *Solanum anguivi* fruits has hypolipidemic potential. This may be an indication of progressive metabolic control of *Solanum anguivi* saponin on mechanisms involved in elimination of the lipids from the body (18).

HDL has recently been recognized to have several other important cardioprotective properties including the ability to protect LDL from oxidative modification (19). HDL may play a protective role in atherogenesis by preventing the generation on an oxidatively modified LDL and the mechanism action of HDL may involve exchange of lipid peroxidation products between the lipoproteins (20). Several enzymes are present on HDL: paraoxonase (an enzyme normally resident on HDL), lecithin: Cholesterol acyl transferase, platelet activating factor acetylhydrolase, phospholipase D and protease. Apolipoproteins, such as apolipoprotein AI, could also have enzymic activity (21). It has been suggested that a direct role for HDL in preventing atherosclerosis probably by an enzymic process is to prevent the accumulation of lipid peroxides on LDL(22). They also reported that paraoxonase is an example of an enzyme which might possibly be involved. Also, (23) reported that the oxidative hypothesis of atherosclerosis classically implies a central role for LDL oxidation.

However, the mechanism by which saponin from *Solanum anguivi* fruit exhibit hypolipidemic role is unknown. It is probably that *Solanum anguivi* saponin changed the rate of fatty acids oxidation in the liver and reduced the rate of triglycerides biosynthesis in rats (18).

However, the present data demonstrated that consumption of saponin from *Solanum anguivi* fruit lead to reduction in the risk of hyperlipidemic symptoms and heart diseases. This could be the reason why it is being used locally to treat hypertension in southern western part of Nigeria. It can be concluded from presented results that saponin from *Solanum anguivi* fruit, expressed hypolipidemic role. Moreover, additional investigation will be needed to characterize the various saponin in *Solanumanguivi* fruits and use the purified constituents for bioassay-directed experiments in hyperlipidemic organisms.

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