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ORIGINAL ARTICLE

Effects of *Solanum aethiopicum* Fruit on Plasma Lipid Profile in rats

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ABSTRACT

To investigate the effects of the inclusion of graded levels of S. aethiopicum fruit in the feed of rats on plasma lipid profile. 20 male and 20 female rats were grouped into four groups of 5rats each per sex and fed on diets containing 0%, 4%, 8% and 12% S. aethiopicum fruit for 28days. Thereafter, the plasma triacylglycerol, cholesterol, HDL cholesterol, VLDL cholesterol and LDL cholesterol were estimated. Atherogenic and coronary indexes were also calculated. The diets resulted in a significant (p<0.05) reduction in plasma cholesterol, triacylglycerol, LDL cholesterol and VLDL cholesterol. A significant (p<0.05) increase in HDL cholesterol was also observed. The fruit also caused a significant (p<0.05) reduction in atherogenic and coronary risk indexed with female rats having better reduction. This work demonstrated the ability of S. aethiopicum fruit to improved the lipid profile of the plasma thereby lowering the risk of cardiovascular diseases.
Key words: Solanum aethiopicum, Lipid profile, Atherogenic index, Coronary risk index

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INTRODUCTION

Solanum aethiopicum, commonly called African eggplant or garden egg, is among the oldest vegetables indigenous to tropical Africa [1]. It is widely cultivated across west Africa especially for its nutritional, medicinal and economic values of the leaves and fruits. The fruit may be consumed freshly raw, dried, cooked and in salad form. It is one of the most important vegetable crops in West Africa as it is consumed daily and remains a source of income for many rural dwellers [1].

In indigenous medicine, *S. aethiopicum* has a wide range of utilization form weight reduction to treatment of several ailments including asthma, allergic disease, swollen joint pains, gastro-esophageal reflux disease, constipation and dyspepsia. Scientific studies have supported the traditional use of this plant in treating inflammation, asthma, glaucoma, diabetes and excessive weight gain [1]. The fruit is easily eaten as snack and it has been reported to be high in phytochemicals like saponins, flavonoids, tannins and ascorbic acid [2].

Studies have shown that dyslipidemia-associated non-communicable diseases like diabetes and obesity are on the increase in the developing world and a continuous study is required to identify indigenous plant materials that can mitigate against, or at least useful in management of, dyslipidemia [3,4,5]. Hence, the investigation of the influence of the consumption of *S. aethiopicum* fruit on plasma lipid profile is of interest.

MATERIAL AND METHODS

Collection and Identification of specimens:

Fruits of *S. aethiopicum L.* were purchased from Mile 12 market in Lagos, Southwest Nigeria. The fruits were identified and authenticated in the Department of Biological Sciences of Covenant University by a botanist, Dr. C. A. Omohinmin. Voucher specimens were also deposited at the Department. The fruits were selected and thoroughly washed in water to remove dirt and unwanted particles. The stalks were removed and the edible portion of the fruits was dried and included the rat feed.

Experimental design:

20 male and 20 female wistar strain albino rats (obtained from the Federal University of Agriculture Abeokuta, Nigeria) weighing about 100g were distributed into four groups for each sex. The rats were

acclimatized for 1week after which 5 rats per sex were allotted into each group and feed and water provided *ad libitum* throughout the experimental period. The diets of the rats were composed according to AIN 93 standard with the three with dried ground garden eggs fruit supplementation as described below:

Group 1: 0% *S. aethiopicum* fruit (0% SAF). Group 2: 4% *S. aethiopicum* fruit (4% SAF). Group 3: 8% *S. aethiopicum* fruit (8% SAF). Group 4: 12% *S. aethiopicum* fruit (12% SAF).

After 28days of feeding on the experimental diets, the rats in each group were fasted for 18 hours and sacrificed after light ether anaesthesia.

All the animal treatments were carried out in accordance with the principles of laboratory animal care of the NIN guide for Laboratory Animal Welfare as contained in the NIN guide for grants and contracts, vol. 14, No. 3, 1985.

Blood was collected by cardiac puncture into a tube containing heparin as anticoagulant. The plasma was separated from the erythrocyte by centrifuging the whole blood at 1500rpm for 10minutes.

Biochemical analyses

Plasma triacylglycerol [6] and total cholesterol [7] were determined by colorimetric methods after enzymatic reaction with peroxidase (Cromatest(R) diagnostics, Joaquim Costal, Montgat, Barcelona, Spain) while HDL-Cholesterol was also determined colorimetrically after HDL was isolated as described by Gidez *et al*. [8]. Very Low-density lipoprotein and Low-density lipoprotein cholesterol were estimated by the Friedewald formula [9]. Coronary Risk Index (CRI) and Atherogenic Index (AI) were estimated as described by Rotimi *et al*. [10].

Statistical analysis

Data analyses were performed using SPSS software (SPSS 15.0 for Windows, SPSS Inc, Chicago, IL). All data are expressed as mean±SEM. Analysis of variance was used to test for differences between the groups. Duncan's multiple range test was used to determine the significance of differences among the mean values at the level of $P<0.05$.

RESULT

In both male and female rats. Consumption of *S. aethiopicum* resulted in significant ($p<0.05$) reduction in plasma triacylglycerol as depicted in Fig. 1. This reduction was however not dose dependent and no significant ($p>0.05$) was observed between male and female rats in each treatment group. Although a similar response was observed for plasma cholesterol (Fig. 2), female rats fed with 4% and 8% *S. aethiopicum* fruit had significantly ($p<0.05$) lowered levels of plasma cholesterol.

Fig. 3 shows that inclusion of *S. aethiopicum* fruit in feed of rats resulted in dose-dependent significant ($p<0.05$) increase in HDL cholesterol level especially in the male rats. The significant ($p<0.05$) decrease observed in VLDL cholesterol (Fig. 4) was however not affected by the level amount of the *S. aethiopicum* in the feed. Although a similar result was observed for LDL cholesterol, a significant ($p<0.05$) difference was however, observed between two sexes with female rats having significantly ($p<0.05$) lower levels in all the treatment groups (Fig. 5).

There was a significant ($p<0.05$) reduction in coronary risk and atherogenic indexes in the rats (Fig. 6 and Fig. 7). Sex difference was however observed with female rats having significantly ($p<0.05$) lower coronary risk and atherogenic indexes.

DISCUSSION

This present study investigated the improvement of plasma lipid profile of male and female normal rats by *S. aethiopicum*. Dyslipideamia is known to be indicated by elevated plasma triacylglycerols, total cholesterol, LDL-cholesterol and VLDL-cholesterol with a concomitant reduced level of HDL-cholesterol. Dietary management with fruits has long been recommended as part of the scrupulous controls necessary to prevent and/or manage dyslipidaemia [11, 12]. Hence, it is apparent from the results presented in this study and from results reported by other authors that fruits like *S. aethiopicum* have plasma lipid lowering effects. Edijala *et al*. [13] carried out an experiment with hypercholesterolemic rats fed *S. melongena*, oat and apple and reported that *S. melongena* had more hypolipidemic effect than apple and oat.

There are two sources of cholesterol namely; exogenous source from the diet and endogenous source where its synthesis is *de novo*. The efflux of cholesterol form these two sources into the plasma has been reported to be influenced by dietary factors. *S. aethiopicum* fruits has been reported to be rich in some of these dietary factors like saponins, alkaloids, flavonoids and tannins as well as dietary fiber [13].

Many studies have reported the ability of saponins to reduced plasma lipids [14,15,16]. Elekofehintimi *et al*. [17] reported that the hypolipidemic effect of saponin could be due to several mechanisms, which include decrease in fatty acid, enhanced LDL receptors, activation of LCAT and lipase as well as the inhibition of acetylCoA caboxylase [17].

Tannins like other polyphenolic compounds also possess a variety of other biological activities, such as reduction of plasma lipids, which might be due to the up-regulation of LDL receptor expression [18] inhibition of hepatic lipid synthesis [19] and lipoprotein secretion [20] and increase in cholesterol elimination via bile acids [21]. These could have synergistically accounted for our observations as a decrease in LDL-cholesterol and triacylglycerols levels as a result of *S. aethiopicum* fruit consumption. The decrease observed in plasma total cholesterol level could also be due to the exogenous regulation. Saponins are known to inhibit intestinal cholesterol absorption by binding to bile acids thereby leading to increased bile acid excretion [22,23]. The consequence of this is elevated HDL-cholesterol as a result of reverse cholesterol transport. This is consistent with our findings as the rats fed *S. aethiopicum* fruit had elevated HDL-cholesterol. It is also worth noting that saponins have been reported to lower the expression of HMG-CoA reductase at both mRNA and protein levels [22,23]. Consequently, endogenous cholesterol synthesis is reduced and cholesterol is mobilized from extra-hepatic tissues to the liver for bile acid biosynthesis. This is often indicated by an increase in HDL-cholesterol.

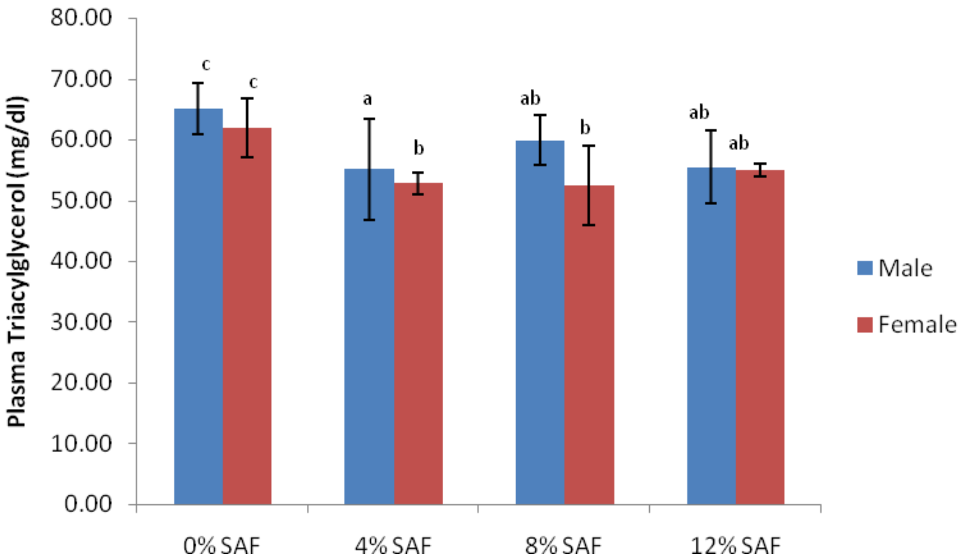

Figure 1: Effects of the *S. aethiopicum* fruit on plasma triacylglycerol of the male and female rats (Bars with different alphabet labels are significantly different at $P<0.05$).

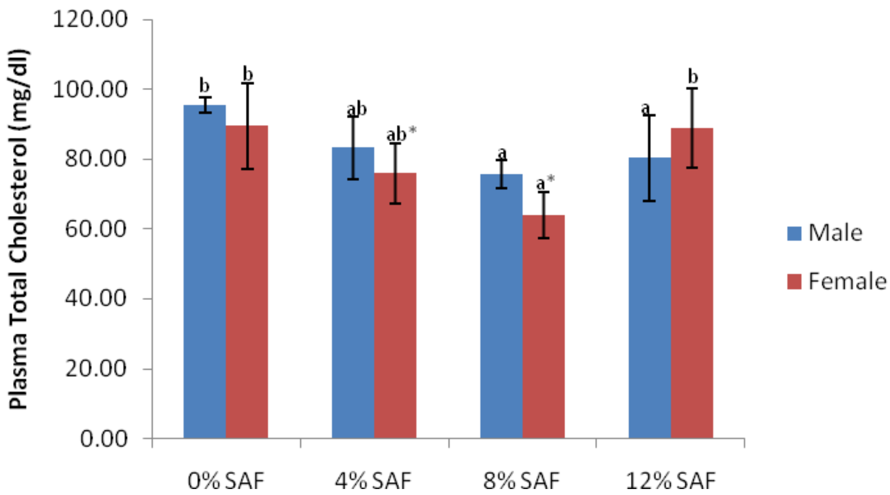

Figure 2: Effects of the *S. aethiopicum* fruit on plasma cholesterol of the male and female rats (Bars with different alphabet labels are significantly different at $P<0.05$).

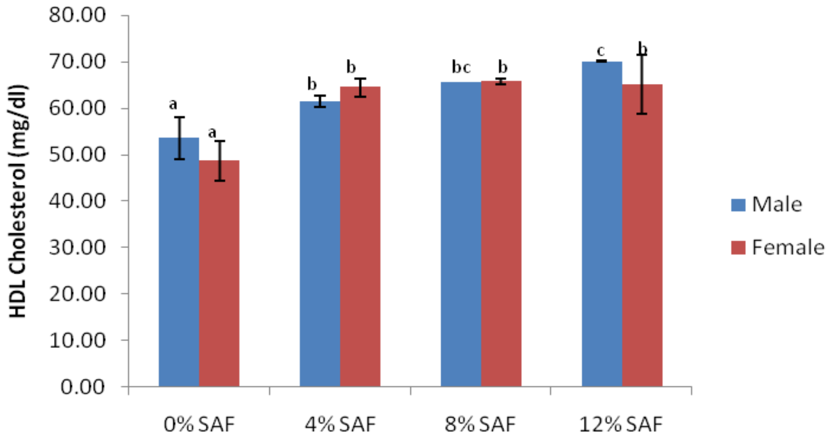

Figure 3: Effects of the *S. aethiopicum* fruit on plasma HDL cholesterol of the male and female rats (Bars with different alphabet labels are significantly different at *P*<0.05).

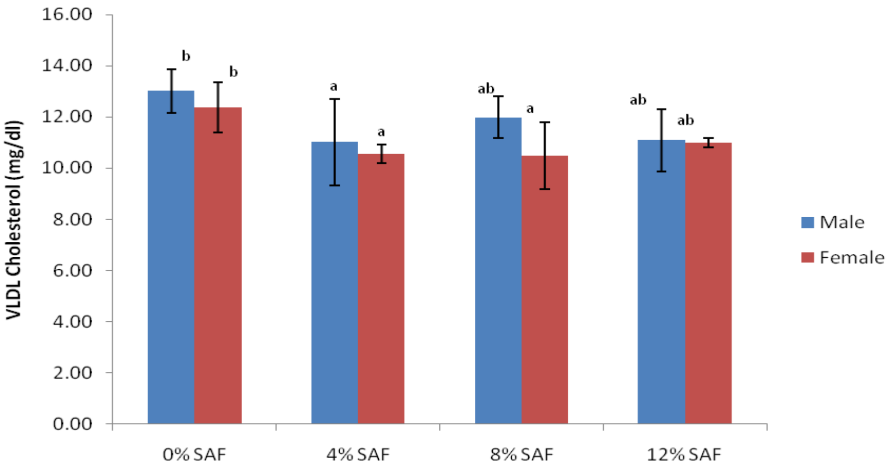

Figure 4: Effects of the *S. aethiopicum* fruit on plasma VLDL cholesterol of the male and female rats (Bars with different alphabet labels are significantly different at *P*<0.05).

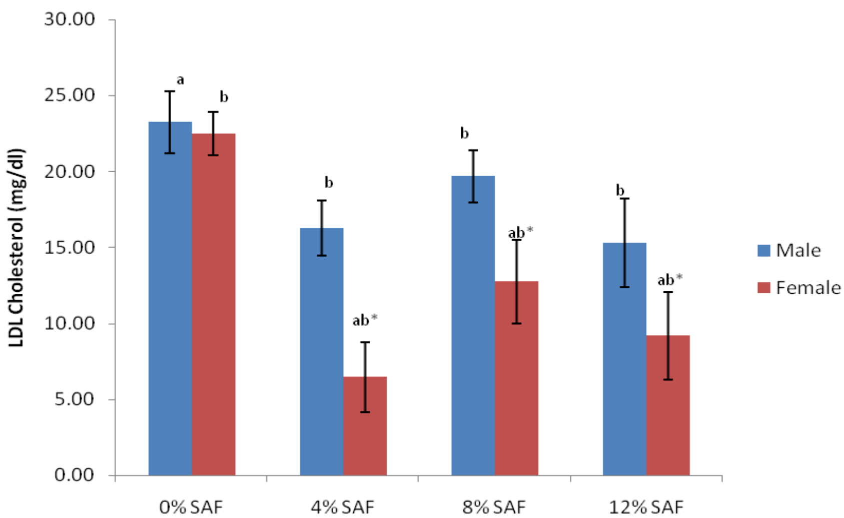

Figure 5: Effects of the *S. aethiopicum* fruit plasma on LDL cholesterol of the male and female rats (Bars with different alphabet labels are significantly different at *P*<0.05).

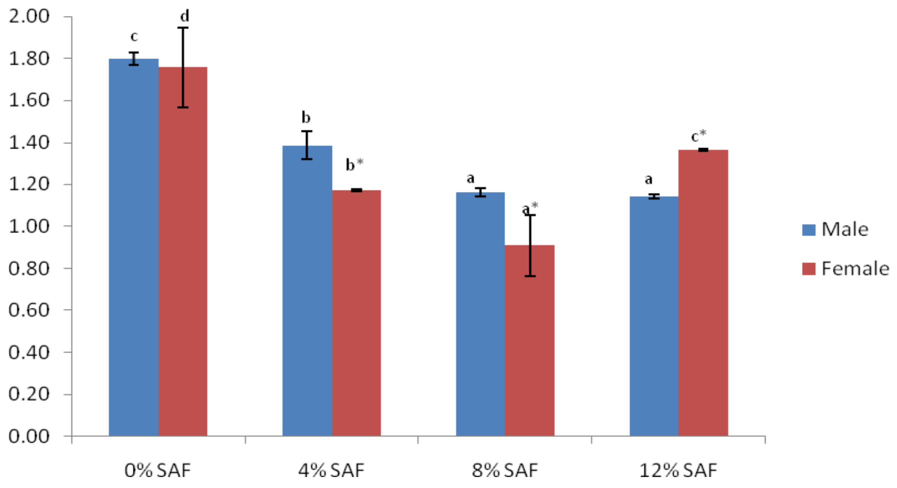

Figure 6: Effects of the *S. aethiopicum* fruit on coronary risk index of the male and female rats (Bars with different alphabet labels are significantly different at $P<0.05$).

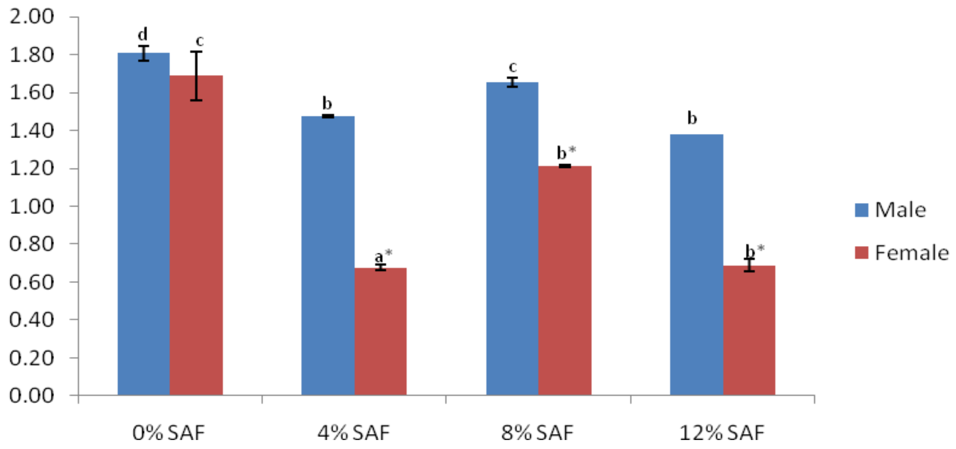

Figure 7: Effects of the *S. aethiopicum* fruit on atherogenic risk index of the male and female rats (Bars with different alphabet labels are significantly different at $P<0.05$).

Another dietary factor that influences lipid profile is dietary fiber. Soluble fibers reduced the levels blood cholesterol in experimental animals [13] through mechanisms similar to that of saponins. In addition, soluble fibers could be fermented in the colon into short chain fatty acids which in turn lower the synthesis of cholesterol and triacylglycerols [10,24,25]. This could have also contributed to the reduced plasma total cholesterol, triacylglycerol, LDL-cholesterol and VLDL-cholesterol levels.
The necessity of reduced levels of these lipids in managing dyslipidemia, especially in atherogenic condition is well known [10]. Interestingly, *S. aethiopicum* fruit consumption resulted in reduction of coronary risk and atherogenic indexes with female animals having better response. This gender difference has been reported in both human and experimental animals with male being at higher risk of atherogenesis [26].
Our results therefore suggest that *S. aethiopicum* fruit may be beneficial in the dietary management of dyslipidemia.

REFERENCES

1. Anosike, C.A., Obidoa, O. & Ezeanyika, L.U. (2012) The anti-inflammatory activity of garden egg (Solanum aethiopicum) on egg albumin-induced oedema and granuloma tissue formation in rats. *Asian Pac J Trop Med*. 5, 62-66.
2. Chinedu SN, Olasumbo AC, Eboji OK, Emiloju OC, Arinola OK & Dania DI. (2011) Proximate and Phytochemical Analyses of *Solanum aethiopicum* L. and *Solanum macrocarpon* L. Fruits. *Res J Chem*. Sci. 1(3): 63-71.
3. Dalal, S., Beunza, J.J., Volmink, J., Adebamowo, C., Bajunirwe, F., Njelekela, M., Mozaffarian, D., Fawzi, W., Willett, W., Adami, H.O. & Holmes, M.D. (2011) Non-communicable diseases in sub-Saharan Africa: what we know now. *Int J Epidemiol*. 40, 885-901.

4. Kapiga, S. (2011) Commentary: Non-communicable diseases in sub-Saharan Africa: a new global health priority and opportunity. *Int J Epidemiol* 40, 902-903.
5. Negin, J., Cumming, R., de Ramirez, S.S., Abimbola, S. & Sachs, S.E. (2011) Risk factors for non-communicable diseases among older adults in rural Africa. *Trop Med Int Health.* 16, 640-646.
6. Biggs, H.G., Erikson, J.M. & Moorehead, W.R. (1975) A manual colormetric assay of triglycerides in serum. *Clin Chem.* 21, 437-441.
7. Zlatkis, A., Zak, B. and Boyle, A.J. (1953) A new method for the direct determination of serum cholesterol. *J Lab Clin Med*. 41, 486-492.
8. Gidez, L.I., Miller, G.J., Burstein, M., Slagle, S. & Eder, H.A. (1982) Separation and quantitation of subclasses of human plasma high density lipoproteins by a simple precipitation procedure. *J Lipid Res.* 23, 1206-1223.
9. Friedewald, W.T., Levy, R.I. & Fredrickson, D.S. (1972) Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clin Chem*. 18, 499-502.
10. Rotimi, O.A., Olayiwola, I.O., Ademuyiwa, O. & Balogun, E.A. (2012) Effects of fibre-enriched diets on tissue lipid profiles of MSG obese rats. *Food Chem Toxicol*. 50(11): 4062-4067.
11. Broekmans, W.M., Klopping-Ketelaars, W.A., Kluft, C., van den Berg, H., Kok, F.J. & van Poppel, G. (2001) Fruit and vegetables and cardiovascular risk profile: a diet controlled intervention study. *Eur J Clin Nutr.* 55, 636-642.
12. Mirmiran, P., Noori, N., Zavareh, M.B. & Azizi, F. (2009) Fruit and vegetable consumption and risk factors for cardiovascular disease. *Metabolism* 58, 460-468.
13. Edijala J. K., Asagba S.O., Eriyamremu G. E. & Atomatofa U. (2005). Comparative Effect of Garden Egg Fruit, Oat and Apple on Serum Lipid Profile in Rats Fed a High Cholesterol Diet. *Pak J Nutr.* 4 (4): 245-249
14. Kersten, G.F., Spiekstra, A., Beuvery, E.C. & Crommelin, D.J. (1991) On the structure of immune-stimulating saponin-lipid complexes (iscoms). *Biochim Biophys Acta*. 1062, 165-171.
15. Whitehead, C.C., McNab, J.M. & Griffin, H.D. (1981) The effects of low dietary concentrations of saponin on liver lipid accumulation and performance in laying hens. *Br Poult Sci*. 22, 281-288.
16. Zhang, Y., Chen, K.J. and Yang, L.H. (2010) [Effects of panax quinquefolius saponin of stem and leaf on glucose-lipid metabolism and insulin signal transduction in insulin resistant model adipocytes]. *Zhongguo Zhong Xi Yi Jie He Za Zhi* 30, 748-751.
17. Elekofehinti OO, Adanlawo IG, Saliu J A, Sodehinde SA. (2012) Saponins from *Solanum anguivi* fruits exhibit hypolipidemic potential in *Rattus novergicus. Der Pharmacia Lettre*, 4 (3):811-814.
18. Lam, W.H., Kazi, A., Kuhn, D.J., Chow, L.M., Chan, A.S., Dou, Q.P. & Chan, T.H. (2004) A potential prodrug for a green tea polyphenol proteasome inhibitor: evaluation of the peracetate ester of (-)-epigallocatechin gallate [(-)-EGCG]. *Bioorg Med Chem*. 12, 5587-5593.
19. Theriault, A., Wang, Q., Van Iderstine, S.C., Chen, B., Franke, A.A. & Adeli, K. (2000) Modulation of hepatic lipoprotein synthesis and secretion by taxifolin, a plant flavonoid. *J Lipid Res.* 41, 1969-1979.
20. Borradaile, N.M., de Dreu, L.E., Barrett, P.H., Behrsin, C.D. & Huff, M.W. (2003) Hepatocyte apoB-containing lipoprotein secretion is decreased by the grapefruit flavonoid, naringenin, via inhibition of MTP-mediated microsomal triglyceride accumulation. *Biochemistry* 42, 1283-1291
21. Del Bas, J.M., Fernandez-Larrea, J., Blay, M., Ardevol, A., Salvado, M.J., Arola, L. & Blade, C. (2005) Grape seed procyanidins improve atherosclerotic risk index and induce liver CYP7A1 and SHP expression in healthy rats. *FASEB J*. 19, 479-481.
22. Raju, J. & Bird, R.P. (2007) Diosgenin, a naturally occurring steroid [corrected] saponin suppresses 3-hydroxy-3-methylglutaryl CoA reductase expression and induces apoptosis in HCT-116 human colon carcinoma cells. *Cancer Lett.* 255, 194-204.
23. Raju, J. & Mehta, R. (2009) Cancer chemopreventive and therapeutic effects of diosgenin, a food saponin. *Nutr Cancer.* 61, 27-35.
24. Chai, Y.M., Lim, B.K., Lee, J.Y., Kim, M.N., Park, M.R. & Rhee, S.J. (2003) Effects of manufactured soluble dietary fiber from Quercus mongolica on hepatic HMG-CoA reductase and lipoprotein lipase activities in epididymal adipose tissue of rats fed high cholesterol diets. *J Med Food* 6, 329-336.
25. Ramos, S., Moulay, L., Granado-Serrano, A.B., Vilanova, O., Muguerza, B., Goya, L. & Bravo, L. (2008) Hypolipidemic effect in cholesterol-fed rats of a soluble fiber-rich product obtained from cocoa husks. *J Agric Food Chem.* 56, 6985-6993.
26. Staprans, I. & Felts, J.M. (1989) A possible mechanism for accelerated atherogenesis in male versus female rats. *Arteriosclerosis* 9, 224-229.

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