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Research Article

ASSESSMENT OF ANTI-OBESITY ACTIVITY OF TECTONA GRANDIS LEAVES ON BUTTER INDUCED HYPERLIPIDEMIA IN MICE

JAKKA LAKSHMI PRASANNA*, NAKKA MADHAVA RAO, BADDIGAM VENKATA SAI KUMAR REDDY

Department of Pharmaceutics, A.M. Reddy Memorial College of Pharmacy, Narasaraopet, Andhra Pradesh, India.
Email: purnageetha15@gmail.com

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ABSTRACT

Objective: Obesity is one of the world's leading problems, which is major cause of cardiovascular diseases. During COVID-19 pandemic many young children and all age group people are getting challenged by obesity due stagnant life style. To treat such life-threatening disorder natural remedies acquire prior position, plant produces a good deal of secondary metabolites which have a benefited mankind in various ways, including treatment of diseases. The present research work was focused on developing a natural remedy using *Tectona grandis*, an ancient plant with number of proven activities in traditional medicine.

Methods: In the literature survey, it was found that flavonoids, sterols, tannins, and alkaloids shown promising effects to tackle obesity by various mechanisms, *T. grandis* has shown the presence of saponins, alkaloids, flavonoids, proteins, and amino acids. With the above evidence, this plant has been selected for screening of its antiobesity activity against high-fat diet induced obesity in mice. Studies were conducted using aqueous extract of *T. grandis* leaves (AETG) on high-fat diet (butter) induced model of hyperlipidemia in mice. During 21 days' time period AETI low and high doses were induced to respective animal groups along with butter where atorvastatin has been taken as standard drug. Butter enhanced the cholesterol and triglyceride, low-density lipoprotein (LDL) levels.

Results and Discussion: At the end of 21 days, blood samples were collected from the animal through retroperitoneal route. Biochemical parameters of AETG have been compared with that of standard drug group of animals. The test results were almost similar and for some particular parameters such as LDL and very low-density lipoprotein, AETG shown good results than standard drug results.

Conclusion: In congruence with these results, it may be confirmed that due to the presence of phytoconstituents such as saponins, flavonoids, proteins, terpenoids, amino acids, and alkaloids in the aqueous extract of *T. grandis*, it could be responsible for the observed significant anti-obesity activity.

Keywords: Obesity, AETG, High-fat diet, Antiobesity, Atorvastatin.

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INTRODUCTION

According to the WHO, overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. A body mass index (BMI) over 25 is considered overweight, and over 30 is obese [1].

Overweight and obesity are major risk factors for a number of chronic diseases, including cardiovascular diseases such as stroke, diabetes, and its associated conditions including blindness, limb amputations, and the need for dialysis, musculoskeletal disorders including osteoarthritis. Obesity is also associated with some cancers, including endometrial, breast, ovarian, prostate, liver, gallbladder, kidney, and colon. The risk of these non-communicable diseases increases even when a person is only slightly overweight and grows more serious as the BMI climbs. The WHO defines over weight as a BMI equal to or more than 25, obesity as a BMI equal to or more than 30.

Statins are a class of prescription medicines that have been used for decades to the lower low density lipoprotein cholesterol (LDL-C) in the blood [2]. Medicines in the statin class include atorvastatin, fluvastatin, lovastatin, pitavastatin, pravastatin, rosuvastatin, and simvastatin.

Atorvastatin is a high efficacy and one of the most widely used lipid lowering medication [3,4]. The efficacy and safety of atorvastatin have been testified by more than 200 randomized controlled trails, with most sufficient clinical evidence among all statins [5]. Atorvastatin is a reversible and competitive inhibitor of 3-hydroy-3-methylglutaryl coenzyme A reductase, decreasing the *de novo* cholesterol synthesis [6], has been selected as standard drug for the present research.

Plant produces a good deal of secondary metabolites which have a benefited mankind in various ways, including treatment of diseases [7]. *Tectona grandis* belongs to the family *Lamiaceae*. The plant has been used for centuries as a medicinal plant, fruit part of the plant has been more valuable, has often been reported in several pharmacopoeias. Leaves of the plant have good levels of proteins, fat, fiber, and some vitamins such as thiamine, riboflavin, nicin, ascorbic acid, and B- carotene [8]. The leaves have proven hepatoprotective activity [9], antimicrobial activity [10], antibacterial [11], antioxidant [11-14], wound healing activity [15], anti-emetic activity [16], antihistaminic activity [17], etc.

In the literature survey, it was found that flavonoids, sterols, tannins, and alkaloids shown promising effects to tackle obesity by various mechanisms [18], *T. grandis* has shown the presence of saponins, alkaloids, flavonoids, proteins, and amino acids. With the above evidence, this plant has been selected for screening of its antiobesity activity against high-fat diet induced obesity in mice.

MATERIALS AND METHODS

Plant material collection and authentication

The plant material of *T. grandis* leaves used for the investigation was collected from A M Reddy Memorial College of Pharmacy premises, Narasaraopet, Guntur Dt. The plant was identified and authenticated by P.SATYANARAYANA RAJU Department of botany from Acharya Nagarjuna University, Nagarjuna Nagar, Guntur, 522510, Guntur Dt, Andhra Pradesh.

Preparation of extract

The leaves of *T. grandis* were collected and shade dried at room temperature and grinded coarsely before extraction. The leaves were extracted by hot maceration using distilled water. The resulting extract was collected into air tight container. Thus, the prepared extract was used for further pharmacological evaluation.

Experimental animals

Healthy male adult albino mice stains 20–30 g were selected for the study, obtained from Hyderabad. The animals were housed properly under 12:12 h light and dark cycle and fed with proper food and water. National CPCSEA guidelines were strictly followed and all the studies were approved by the Institutional animal ethical committee.

Preliminary phytochemical evaluation

The aqueous extract of *T. grandis* leaves (AETG) was subjected to preliminary phytochemical analysis to assess the presence of various phytoconstituents. It revealed the presence of saponins, flavonoids, glycosides, amino acids, and alkaloids. All these tests were performed at A. M. Reddy Memorial College of pharmacy, Narasaraopet, Guntur, Andhra Pradesh.

Obesity inducer

For the present study, butter was mainly used to induce obesity in animals. 400 mg of butter/kg body weight dissolved in 10 ml of buffered saline was administered.

Test drug preparation

The two doses of test **(**AETG low dose and high dose) and standard drug atorvastatin are soluble in water, so were dissolved in distilled water and administered to the respective animal groups per oral. All the test concentrations were prepared freshly before administering to the animals. Butter was administered after 30min of test drug administration to all groups.

Animal groups

Group-1 was considered as control group which received only the vehicle.

Group-2 was considered as the high fat diet group which received the butter.

Group-3 was considered as first testing group and received the test extract that is AETG 250 mg/kg weight per oral along with butter.

Group-4 was considered as second test group and received the test extracts that is AETG 500 mg/kg weight per oral along with butter.

Table 1: Preliminary photochemical tests

S. No.	Photochemical tests	Inference
1.	Test for alkaloids	+ve
2.	Test for flavonoids	+ve
3.	Test for amino acids	+ve
4.	Test for proteins	+ve
5.	Test for saponins	+ve
6.	Test for terpenoids	+ve

Group-5 was considered as standard group which received the standard drug atorvastatin (10 mg/kg) along with butter.

Body weight

Body weight of the animals was recorded every week before administering of the test drugs.

Sample collection

At the end of 21st day, blood was collected from the retro orbital plexus after overnight fasting and then was centrifuged and the serum was obtained and was estimated for the total cholesterol, LDL, very low-density lipoprotein (VLDL), and HDL.

Biochemical parameters

On the 21st day of the methodology that is after the last test drug administration, the mice were anesthetized with diethyl ether and the blood samples were collected from retro orbital puncture using capillary tube into clotting tubes. Serum samples were analyzed at Jayanti laboratory at Jayanti Hospital, Palnadu Road, Vinukonda, Guntur, Andhra Pradesh.

RESULTS

Tables 1 and 2.

DISCUSSION

Obesity is the major and health problem in India and developing countries, which lead to important risk factors such as atherosclerosis and stroke. Obesity increases the likelihood of other diseases. Obesity evokes the damages in various tissues, which in turn, deregulate the cellular functions leading to damage to various pathological conditions.

Atorvastatin is a high efficacy and one of the most widely used lipid lowering medication [3,4]. The efficacy and safety of atorvastatin have been testified by more than 200 randomized controlled trails, with most sufficient clinical evidence among all statins.[5] Atorvastatin is a reversible and competitive inhibitor of 3-hydroy-3-methylglutaryl coenzyme A reductase, decreasing the *de novo* cholesterol synthesis[6], regulate LDL, VLDL-C levels has been selected as standard drug for the present research.

In the literature survey, it was found that flavonoids, sterols, tannins, and alkaloids shown promising effects to tackle obesity by various mechanisms [19], *T. grandis* has shown the presence of saponins, flavonoids, proteins, terpenoids, amino acids, and alkaloids. With the above evidence, this plant has been selected for screening of its anti-obesity activity against high-fat diet induced obesity in mice.

High cholesterol is also referred to as hypercholesterolemia. Cholesterol is a fatty substance that is important part of the outer lining of cells in the body of the animals [20]. Cholesterol is also found in the blood circulation of humans. It is also a precursor for the synthesis of steroid hormones. High levels of cholesterol can increase the risk of heart disease. Cholesterol is synthesized in all animal tissue. Increased amount of cholesterol leads to cardiovascular diseases particularly coronary heart disease (CHC) [21]. Total cholesterol levels of AETG high dose were recorded as 180±1.48 and standard drug shown 161.50±1.26, in general controlling of cholesterol by AETG 161.50±1.26 is said as good reduction.

Table 2: Effect of Tamarindus indica on bio-chemical parameters

S. No.	Groups	Total cholesterol (mg/dl)	Triglycerides (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)
1.	Group I (control)	156±1.56	112.0±49.58	62.0±1.58	90±44	25±1.45
2.	Group II (butter induced)	244.50±1.48	360.0±1.60	41.0±1.62	170±1.75	78.16±1.68
3.	Group III (AETG 0.5 ml)	202.91±1.28	187±1.39	42±1.48	112±1.71	34±1.58
4.	Group IV (AETG 1 ml)	180±1.48	168.50±1.58	40±1.58	110±1.68	36±1.52
5.	Group V (std atorvastatin)	161.50±1.94	162.54±1.58	38.48±1.41	120±0.60	41±1.53

LDL: Low density lipoprotein, VLDL: Very low density lipoprotein

Triglycerides are a type of fat in the blood stream and in fat tissue. These are small enough to enter into the arterial wall and thus have the potential to accumulate and cause atherosclerosis [21-23]. Looking at TG level of both AETG and standard drug is almost similar 168.50±1.58 and 162.54±1.58, here just six points difference was observed.

HDL-C are inversely correlated with clinical events resulting from atherosclerosis, instead HDL protects against cardiovascular disease by regulating cholesterol efflux from tissue and modulating inflammation [24]. In case of HDL-C, AETG 40±1.58 could not reach the value of Standard drug 38.48±1.41. Hence, the study was ensuring to lower the HDL-C of AETG in a protecting way.

LDL is a risk factor and places a role at several steps of atherosclerosis. LDL is called LDL because LDL particles tend to the less dense than other kinds of cholesterol particles. Increase in evidence as revealed that the concentration and the size of the LDL particles more powerfully relates to the degree of atherosclerosis progression than the concentration of cholesterol contained within all the LDL particles. Perhaps, it was observed that the test drug AETG 110±1.68 is able to bring down the LDL level very much than standard drug 120±0.60.

VLDL transports cholesterol and triglycerides within the body, and are associated with increased risk of CHC. It was observed good reduction in VLDL level with AETG (36.0±1.52) than standard drug 41±1.53.

CONCLUSION

In congruence with these results, it may be confirmed that due to the presence of phytoconstituents such as saponins, flavonoids, proteins, terpenoids, amino acids, and alkaloids in the aqueous extract of *T. grandis*, it could be responsible for the observed significant anti-obesity activity. Hence, the present study proven that the AETG exhibited significant anti-obesity activity.

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AUTHOR'S CONTRIBUTIONS

All the authors were self-contributed to bring out the success of the present research work.

CONFLICT OF INTEREST STATEMENT

No.

AUTHORS' FUNDING

No.

REFERENCES

1. Alasmari HD, Al-Shehri AD, Aljuaid TA, Alzaidi BA, Alswat KA. Relationship between body mass index and obesity awareness in school students. J Clin Med Res 2017;9:520-4. doi: 10.14740/jocmr2987w, PMID 28496554
2. Carbonell T, Freire E. Binding thermodynamics of statins to HMG-CoA reductage. Biochemistry 2005;44:11741-8. doi: 10.1021/bi050905v, PMID 16128575
3. Li J, Chen YP, Li X, Armitage J, Feng F, Liu JM, *et al*. Use of secondary preventive medications in patients with atherosclerotic disease in urban China: A cross-sectional study of 16, 860 patients. Chin Med J (Engl) 2012;125:4361-7. PMID 23253702
4. Gao F, Zhou YJ, Hu DY, Zhao YX, Liu YY, Wang ZJ, *et al*. Contemporary management and attainment of cholesterol targets for patients with dyslipidemia in China. PLoS One 2013;8:e47681.
5. Adams SP, Tsang M, Wright JM. Lipid lowering efficacy of atorvastatin. Cochrane Database Syst Rev 2012;12:CD008226.
6. Ye YC, Zhao XL, Zhang SY. Use of atorvastatin in lipid disorders and cardiovascular disease in Chinese patients. Chin Med J (Engl) 2015;128:259-66. doi: 10.4103/0366-6999.149226, PMID 25591572
7. Kamsu GT. Chuisseu DP, Gasting D, Chegaing SP, Feudjio HB, Famen LC, *et al*. Toxicological profile of the aqueous etraction of *Tectona grandis*. L. F.(*Verbenaceae*) Leaves: A medicinal plant used in the treatment of typhoid fever in traditional Cameroonian medicine. J Toxicol 2021;2021:6646771.
8. Asdaq SM, Nayeem N, Abida, Alam MT, Alaqel SI, Imran M, *et al*. *Tectona grandis* L.F: A comprehensive review on its patents, chemical constituents, and biological activities. Saudi J Biol Sci 2022;29:1456-64. doi: 10.1016/j.sjbs.2021.11.026
9. Sachan K, Singh PK, Ashwlayan VD, Singh R. Evaluation of hepatoprotective activity of *Tectona grandis* linn. Int J Pharm Res 2014;2:105-8.
10. Lanka S, Paimala. Antimicrobial activities of *Tectona grandis* leaf and bark extracts. EJPMR 2017;4:245-8.
11. Ogunmefun OT, Ekundayo EA, Akharaiyinand FC, Ewhenodere D. Phytochemical screening and antibacterial activities of *Tectona grandis*. L.f.(*Teak*) leaves on microorganisms isolated from decayed food samples. Trop Plant Res 2017;4:376-82.
12. Kushwah AS, Kaur P, Ramandeep S. *In-vitro* antioxidant potential and phytochemical screening of *Tectona grandis* Linn. leaves. IJPMR 2013;1:33-8.
13. Ghareeb MA, Shoeb HA, Madkour HM, Refaey LA, Mohamed MA, Saad AM. Antioxidant and cytotoxic activities of *Tectona grandis* linn. leaves. IJP 2014;5:143-57.
14. Krishna MS, Nair AJ. Antibacterial, cytotoxic and Antioxidant potential of different extracts from leaf, bark, and wood of *Tectona grandis*. IJPSDR 2010;2:155-8.
15. Varma SB, Giri SP. Study of wound healing activity of *Tectona grandis* linn leaf exacts on rats. Anc Sci Life 2013;32:241-4.
16. Khan RA, Siddiqui SA, Azhar I, Ahmed SP. Preliminary screening of methanol and butanol extracts of *Tamarindus indica* for antiemetic activity. J Basic Appl Sci 2005;1:51-4.
17. Tayade P, Borde SN, Jagtap SA. Effect of *Tamarindus indica* Linn. Against isolated goat tracheal and guinea pig ileum preparation. Int J Compr Pharm. 2010;2:1-3.
18. Gundamaraju R, Mulaplli SB, Ramesh C. Evaluation of anti-obesity activity of *Lantana camara Var* Linn. by progesterone induced obesity on albino mice. Int J Pharmacogn Phytochem Res 2013;4:213-8.
19. Amatayakul K, Sivasomboon B, Thanangkul O. A study of the mechanism of weight gain in medroxyprogesterone acetate users. Contraception. 1980;22:605-22.
20. Berteri RA. Risk of coronary artery heart disease. Health Screen 2003;1:28-9.
21. Nordestgaard BG, Varbo A. Triglycerides and cardiovascular disease. Lancet 2014;384:626-35. doi: 10.1016/S0140-6736(14)61177-6, PMID 25131982
22. Nordestgaard BG, Wootton R, Lewis B. Selective retention of VLDL, IDL, and LDL in the arterial intima of genetically hyperlipidemic rabbits *in vivo*. Molecular size as a determinant of fractional loss from the intima-inner media. Arterioscler Thromb Vasc Biol 1995;15:534-42. doi: 10.1161/01.atv.15.4.534, PMID 7749867
23. Goldberg IJ, Eckel RH, McPherson R. Triglycerides and heart disease: Still a hypothesis? Arterioscler Thromb Vasc Biol 2011;31:1716-25.
24. Navab M, Reddy ST, Brian J. HDL and cardiovascular disease: Atherogenic and atheroprotective mechanisms. Nat Rev Cardiol 2011;8:222-32.