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Effect of *Sesamum indicum L.* Seed Oil Supplementation on the Kidney Function Parameters of Hypercholesterolemic Rats

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Abstract

Twenty four male rats weighing between 120-130 g were randomly assigned into four groups. Group A was fed normal diet; Group B, C and D were fed hypercholesterolemic diet (i.e. 20% fat + 1% cholesterol) for two weeks to establish hypercholesterolemia. Thereafter, Group B were maintained on hyper diet, while C and D were fed 5% and 10% *Sesamum indicum* oil supplemented diet for four weeks. Plasma was collected and analyzed for the activity of alkaline phosphatase (ALP) and concentrations of urea, creatinine, sodium, and potassium. The kidney was removed, decapsulated, weighed, homogenized, centrifuged and ALP activity was determined inthe supernatant. Significant increase (P<0.05) was observed in the activities of alkaline phosphatase in the kidney and serum and also in concentrations of urea, creatinine, sodium, potassium of the hypercholesterolemic rats compared to the normal control. Supplementation with *Sesamum indicum* seed oil at 5% and 10% levels resulted in significant decrease (P<0.05) in the activity of alkaline phosphatase and concentrations of urea, creatinine, sodium, and potassium. The implications of this result are highlighted.

Keywords: Hypercholesterolemia; *Sesamum indicum;* Alkaline phosphatase; Kidney function parameters

Introduction

Leading to 27.1% of death on earth, cardiovascular disease remains the leading cause of death on the globe for more than a decade [1]. Control of cardiovascular risk factors is thus imperative for reducing the morbidity and mortality of the global population [2]. The primary cause of these vascular diseases is atherosclerosis and subsequent formation of lesions inside the coronary and cerebral arteries [3]. Pathogenesis of atherosclerosis is multifactorial and many modifiable and non-modifiable risk factors have been identified [4]. These risk factors collectively contribute to the development, progression and rupture of atherosclerotic plaques [5]. Of the modifiable risk factors, hypercholesterolemia which is estimated to cause 4.5% of global death and 2.0% of global disability adjusted life years [6] is the most important [7]. Extreme levels of blood cholesterol accelerate atherogenesis and lowering high blood cholesterol reduces the incident of Coronary heart disease [8].

Botanical dietary supplements can improve cardiovascular health and prevent atherosclerosis at several steps [9]. Dietary recommendations for reducing cardiovascular diseases have been focused on the change or reduction in fat or cholesterol intake [10]. One of the strategies for obtaining a tailor-made diet for this disease is the use of foods that contain nutrients which reduce intestinal cholesterol absorption [11]. *Sesamum indicum Linn* belongs to the family *Pedaliaceae* and several lines of evidence from traditional to modern medicine have confirmed its various medicinal properties [12-14]. This plant contains significant amount of diverse phytochemicals [15] which have been shown to serve as promising natural antioxidants for both food preservation and medicinal applications [13] (Table 1).

Sesamum indicum L. Seed Oil, which constitutes about 55% of the seed [16], has 80% of its fatty acid content composed of oleic and linolenic acids and 16% saturated fatty acid [17-19]. It has been appreciated for its antihypercholesterolemic ability [18,20]. However, no study has been conducted to relate *Sesamum indicum* oil's antihypercholesterolemic ability to the reversal of kidney dysfunction characteristic of severe hypercholesterolemia [21]. This study thus evaluates the effect of *Sesamum indicum* (benniseed) oil on kidney functions of albino rats induced with hypercholesterolemia.

	A	B	C	D
Corn Starch	290	130	280	230
Soya Meal	510	510	510	510
Sucrose	100	100	100	100
Vitamin-mineral mix	50	50	50	50
Soya bean oil	50	200 (20%)	-	-
Benniseed oil	-	-	50 (5%)	100 (10%)
Cholesterol	-	10 (1%)	10 (1%)	10 (1%)

Table 1: Diet Compositions after the Establishment Hypercholesterolemia. (g kg^{-1}).

Materials and Methods

Collection of sample

Sesame seeds were purchased from Oja-Oba market in Ado-Ekiti. It was identified and authenticated at the Herbarium Section of Plant Science Department, Ekiti State University, Ado-Ekiti, Nigeria. It was cleaned, washed and sundried.

Extraction of oil

Oil was extracted using Soxhlet extractor and n-hexane as the solvent (bpt 40-60°C).

Experimental procedure

Twenty four male albino rats were randomly assigned into four

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groups (A, B, C and D) comprising of six rats each. Group A served as the normal control while group B, C and D served as the test group. Initially, animals in groups (B, C and D) were fed with 20% fat + 1% cholesterol for two weeks to establish hypercholesterolemia. Thereafter, rats in groups C and D were treated with feed supplemented with 5% and 10% *Sesamum indicum* seed oil respectively. They were maintained on this dietary regimen for four weeks and their weights monitored.

Preparation of serum and kidney homogenate: At the end of the experiment, rats were fasted overnight, anaesthesized and blood samples were collected by cardiac puncture into lithium-heparin bottles. It was centrifuged at 3,000 rpm for 10 min and the plasma was separated and kept until required for analysis. The kidneys were removed, de-capsulated, homogenized and centrifuged at 3,000 rpm for 20 mins. The supernatant was collected for further analysis.

Biochemical analysis*:* From the serum, the concentrations of urea, creatinine, sodium, potassium and alkaline phosphatase were measured and from the kidney homogenate, concentration of alkaline phosphatase were measured.

Statistical analysis: The results are expressed as Median ± Interquartile ranges. Kruskal-Wallis Test [22] was used to test for differences in the groups. Differences were considered to be statistically significant at $P<0.05$.

Results and Discussion

Sesamum indicum Linn Oil has been demonstrated to reduce hypercholesterolemia by significantly decreasing TC, TG, LDL and LDL/HDL ratio, and significantly increasing the HDL-C [18] and by maintaining normal circulatory levels of apoA and apoB, SGOT, SGPT, glucose and insulin [20] in animals induced with hypercholesterolemia. This study tests the ability of *Sesamum indicum* oil in preventing the impairment of kidney functions caused by hypercholesterolemia and presents a pliable means by which *Sesamum indicum* oil reduces blood cholesterol levels in cases of hypercholesterolemia. Hypercholesterolemia has been implicated in the impairment of kidney functions [21]. This is evident in Table 2 as hypercholesterolemia induced by 1% cholesterol in the diet of male albino rats led to kidney dysfunction measured by the increase in the concentrations of urea, creatinine, sodium and potassium in the blood.

Urea is a byproduct from protein breakdown. About 90% of urea produced is excreted via the kidney [23]. In kidneys, urea is filtered out of blood by glomeruli and is partially reabsorbed with water [24]. Meanwhile, Creatinine which is commonly measured as an index of glomerular function [25] is a waste product from muscle creatine that is used as energy source during muscle contraction. The normal range of serum creatinine is 0.2-0.8 mg/dl for rats [26] and like urea, it is excreted exclusively through the kidney. Damage to the kidney will thus render the kidney inefficient to excrete both urea and creatinine, therefore causes their accumulation in the blood [27]. Hence, a higher than normal level of blood urea and creatinine will indicate kidney damage. The most frequently used clinical indices for estimating renal function depends upon concentration of urea in the serum. It is useful in differential diagnosis of acute renal failure and renal conditions where blood urea nitrogen is increased [28]. As indicated in Table 2, feeding hypercholesterolemic rats with 5% and 10% Benniseed (*Sesamum indicum)* oil significantly reduced the rising serum urea but not creatinine levels. The inability to reduce creatinine level may be in part because creatinine levels in the blood will not be raised above the normal range until 60% of total kidney function is lost [27]. Urea and creatinine have been reported to be less reliable markers for kidney function [29].

Another tool for accessing damage to kidney is serum electrolytes The test for electrolytes includes the measurement of sodium, potassium, chloride and bicarbonate levels [30]. Although sodium is the most concentrated electrolyte in the extracellular fluid [31], Potassium is the most convincing electrolyte marker of renal failure [32,33]. The combination of decreased filtration and decreased secretion of potassium in distal tubules during renal failure cause increase plasma potassium [32]. As indicated in Table 2, feeding hypercholesterolemic rats with 5% Benniseed (*Sesamum indicum*) oil significantly reduced the rising serum sodium and potassium concentrations of the rats. Thus implying that supplementation with 5% beniseed oil helps to ameliorate the injury imposed on the kidney by the hypercholesterolemic diet.

Yet another tool for diagnosing damage to the kidney like other internal organs is marker enzymes [33-35]. Alkaline phosphatase is a marker enzyme for the plasma membrane and endoplasmic reticulum [36] of the tissue studied. It is often employed to assess the integrity of plasma membrane [33] since it is localized predominantly in the microvilli of the bile canaliculi, located in the plasma membrane. The significant increase in the Serum ALP activity of the hyper-diet group B in Table 3 following the administration of hypercholesterolemic diet may be due to *de novo* synthesis of the enzyme molecules. Since alkaline phosphatase hydrolyses phosphate monoesters, the enzyme's hyperproduction could constitute a threat to the life of the cells that are dependent on a variety of phosphate esters for their vital process, as it may lead to indiscriminate hydrolysis of phosphate ester metabolite of the liver, an important biochemical symptom of cytolysis. Consequently, this may adversely affect the facilitation of the transfer of metabolites across the cell membrane [37].

However the significant decrease ($P<0.05$) in the Serum ALP

	Control	1% Cholesterol	1% Cholesterol +5% beniseed oil	1% Cholesterol + 10% beniseed oil
Creatinine (µmol/L)	39.99 ± 5.97^a	49.05 ± 13.32^b	58.93 ± 11.54^c	65.99 ± 16.83^d
Urea (µmol/L)	10.13 ± 3.05^a	12.24 ± 1.05^c	10.98 ± 1.05^b	11.55 ± 2.16^b
Sodium (ppm)	161.39 ± 16.02^c	149.19 ± 27.79^b	111.22 ± 17.53^a	269.91 ± 46.87^d
Potassium (ppm)	11.07 ± 1.91^b	9.09 ± 1.82^b	4.65 ± 1.33^a	13.01 ± 2.55^c

Medians in the same row not followed by the same superscripts are significantly different ($P<0.05$)

Table 2: Effect of Sesamum indicum L. Seed Oil Supplementation on the Kidney Function Parameters of Hypercholesterolemic Rats.

	Control	1% Cholesterol	1% Cholesterol +5% beniseed oil	1% Cholesterol + 10% beniseed oil
KIDNEY ALP (U/mgprotein)	3293.65 ± 22.41b	3211.38 ± 21.60c	3113.09 ± 122.91a	3195.44 ± 42.91b
SERUM ALP (U/L)	523.76 ± 45.08c	1077.81 ± 20.19d	339.97 ± 21.10b	289.13 ± 14.21a

Medians in the same row not followed by the same superscripts are significantly different ($P< 0.05$)

Table 3: Effect of Sesamum indicum L. Seed Oil Supplementation on Kidney and Serum Alkaline Phosphatase Concentrations of Hypercholesterolemic Rats.

activities of the treated groups C (5% benniseed oil) and D (10% benniseed oil) shows a distinct correction of the assault caused by hypercholesterolemic diet in group B leading to a lower activity than even the Control (group A). Increase in serum ALP and a corresponding decrease in kidney alkaline phosphatase activities of the hypercholesterolemic rats can be suggestive of damage to the kidney leading to leakage to extracellular fluids [37]. However, on supplementing with *Sesamum indicum* oil, significant reduction in ALP activities was observed in the kidney with no corresponding increase in the serum thus suggesting that the benniseed oil appears to alleviate the assault inflicted on the kidney by the hypercholesterolemic diet.

Conclusion

In summary, findings arising from the present study suggest that *Sesamum indicum* oil can reverse kidney damage caused by hypercholesterolemia. This positive effect of *Sesamum indicum* oil further substantiates previous studies and jointly postulate therapeutic value of *Sesamum indicum* oil in clinical conditions associated with hyperlipidemia and hypercholesterolemia.

References

1. World Health Organization (2014a) The 10 leading causes of death in the world, 2000 and 2010.
2. Levenson JW, Skerrett PJ, Gaziano JM (2002) Reducing the global burden of cardiovascular disease: the role of risk factors. Prev Cardiol 5: 188-199.
3. Lloyd-Jones D, Adams RJ, Brown TM, Carnethon M, Dai S, et al. (2010) "Heart disease and stroke statistics-2010 update: a report from the ''American Heart Association," Circulation 121: 948-954.
4. Joshi SC (2005) "Plant and plant products used as hypolipidaemic/ antiatherosclerotic agents: an overview," Proceeding of Zoological society of India 4:. 27-33.
5. Souza TD, Mengi SA, Hassarajani S, Chattopadhayay S (2007) "Efficacy study of the bioactive fraction (F-3) of Acorus calamus in hyperlipidemia," Indian J Pharmacol 39: 196–200.
6. World Health Organization (2014b) Raised Cholesterol. Global Health Observatory –risk factors.
7. Steinberg D (2002) Atherogenesis in perspective: hypercholesterolemia and inflammation as partners in crime. Nat Med 8: 1211-1217.
8. Grundy SM (1986) Comparison of monounsaturated fatty acids and carbohydrates for lowering plasma cholesterol. N Engl J Med 314: 745-748.
9. Mahmood ZA, Sualeh M, Mahmood SB, Karim MA (2010) Herbal treatment for cardiovascular disease the evidence based therapy. Pak J Pharm Sci 23: 119-124.
10. McCullough ML, Feskanich D, Stampfer MJ, Giovannucci EL, Rimm EB, et al. (2002) Diet quality and major chronic disease risk in men and women: moving toward improved dietary guidance. Am J Clin Nutr 76: 1261-1271.
11. Sudhop T, von Bergmann K (2002) Cholesterol absorption inhibitors for the treatment of hypercholesterolaemia. Drugs 62: 2333-2347.
12. Kapoor LD (2001) Hand Book of Ayurvedic Medicinal Plants, CRC Press, New York, NY, USA, 2001.
13. Namiki M (2007) Nutraceutical functions of sesame: a review. Crit Rev Food Sci Nutr 47: 651-673.
14. Gauthaman K, Saleem TSM (2009) "Nutraceutical value of sesame oil," Pharmacognosy Rev 3: 264-269.
15. Suja KP, Jayalekshmy A, Arumughan C (2005) "In vitro studies on antioxidant activity of lignans isolated from sesame cake extract," J Sc of Fd and Agric 85: 1779-1783.
16. Abou-Gharbia HA, Shahidi F, Shehata AAY, Youssef MM (1997) Effects of processing on oxidative stability of sesame oil extracted from intact and dehulled seeds. J Am Oil Chem Soc 74: 215.
17. Roma RB, Tabekhia MM, Williams JD (1979) "Phytate and oxalate contents in sesame seed (Sesamum indicum L.)," Nutr Rep Int 20: 25–31.
18. Ajayi OB, Braimoh J, Olasunkanmi K (2012) Response of Hypercholesterolemic Rats to Sesamum indicumLinn Seed Oil Supplemented Diet. J Life Sc 6: 1214-1219.
19. Njoku OU, Boniface JA, Obitte NC, Odimeywu DC (2010) Some nutriceutical potential of beniseed oil. Int J App Res Natural Products 24: 11-19.
20. Asgary S, Rafieian-Kopaei M, Najafi S, Heidarian E, Sahebkar A (2013) Antihyperlipidemic effects of Sesamum indicum L. in rabbits fed a high-fat diet. ScientificWorldJournal 2013: 365892.
21. Krolewski AS, Warram JH, Christlieb AR (1994) Hypercholesterolemia--a determinant of renal function loss and deaths in IDDM patients with nephropathy. Kidney Int Suppl 45: S125-131.
22. Kruskal W, Wallis WA (1952) «Use of ranks in one-criterion variance analysis». J Am Stat Assoc 47: 583-621.
23. Walmsley SJ, Broeckling C, Hess A, Prenni J, Curthoys NP (2010) Proteomic analysis of brush-border membrane vesicles isolated from purified proximal convoluted tubules. Am J Physiol Renal Physiol 298: F1323-F1331.
24. Corbett JV (2008) Laboratory tests and diagnostic procedures with nursing diagnoses; 7th Edn 90-107.
25. Treasure J (2003) Urtica semen reduces serum creatinine levels. J Am Herbal Guild 4: 22-25.
26. Weber DK, Danielson K, Wright S, Foley JE (2002) Hematology and serum biochemistry values of dusky-footed wood rat (Neotoma fuscipes). J Wildl Dis 38: 576-582.
27. Stevens LA, Coresh J, Greene T, Levey AS (2006) Assessing kidney function--measured and estimated glomerular filtration rate. N Engl J Med 354: 2473-2483.
28. Rosner MH, Bolton WK (2006) Renal function testing. Am J Kidney Dis 47: 174-183.
29. Vivanti A, Harvey K, Ash S, Battistutta D (2008) Clinical assessment of dehydration in older people admitted to hospital: what are the strongest indicators? Arch Gerontol Geriatr 47: 340-355.
30. Gowda S1, Desai PB, Kulkarni SS, Hull VV, Math AA, et al. (2010) Markers of renal function tests. N Am J Med Sci 2: 170-173.
31. Terry J (1994) The major electrolytes: sodium, potassium, and chloride. J Intraven Nurs 17: 240-247.
32. James S, Mitchel G (2006) Physiology and disorder of water electrolytes and acid base metabolism. In: Carl AB, Edward R, David E, editors. Tietz Textbook of clinical chemistry and molecular diagnostics. 4th edn. New Delhi: Elsevier Inc; 1747–1776.
33. Akanji MA, Olagoke OA, Oloyede OB (1993) Effect of chronic consumption of metabisulphite on the integrity of the rat kidney cellular system. Toxicology 81: 173-179.
34. Shahjahan M, Sabitha KE, Jainu M, Shyamala Devi CS (2004) Effect of Solanum trilobatum against carbon tetrachloride induced hepatic damage in albino rats. Indian J Med Res 120: 194-198.
35. Yakubu MT (2006) Aphrodisiac potentials and toxicological evaluation of aqueous extract of Fadogia agrestis (Schweinf. ExHiern) stem in male rats. (Ph. D. Thesis) University of Ilorin, Ilorin, Nigeria.
36. Martin P, Friedman LS (1992) Assessment of Liver Function and DiagnosticStudies. In: Hand Book of Liver Disease. Friedmann, L .S., E.B. Keeffe (Edn.), Churchill Livingstone, Philadelphia, 1-14.
37. Shipman KE, Holt AD, Gama R (2013) Interpreting an isolated raised serum alkaline phosphatase level in an asymptomatic patient. BMJ 346: f976.

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