



Phytosterol Promotes Liver Health, Metabolic Function and Cardiovascular Regulation by Decreasing Liver Enzymes, Serum Cholesterol and Nitric Oxide Levels in Wistar rats

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ABSTRACT

Liver enzymes level and cardiovascular indices are veritable indicators of health and disease state in experimental animals. The present study investigated the role of phytosterol on liver health, metabolic function and cardiovascular indices in Wistar rats. 15 healthy male rats were grouped and treated as follows for 28 days: Group I was the control, and animals in this group were allowed unhindered access to rat chow and water. Group II rats received 1000mg/kg while Group III received 2000mg/kg body weight of phytosterol. On the 29th day, blood was collected through direct cardiac puncture for the determination of serum liver enzyme levels and lipid parameters. Significantly lower values of liver enzymes and lipid parameters were observed amongst Groups 2 and 3 rats administered graded doses (1000mg/kg and 2000mg/kg body weight) of phytosterol relative to control (Group 1) rats ($p < 0.05$): suggesting a potential protective effect of phytosterol against liver damage and cardiovascular insult.

Keywords: Phytosterol, liver enzymes, cholesterol and nitric oxide.

INTRODUCTION

Most plant-derived bioactive ingredients, like phytosterols, is receiving needed attention worldwide for the treatment of possible liver damage and cardiovascular dysfunction [1] [2]. Medicinal plants derived products with proven therapeutic efficacies are being rigorously explored in our immediate environment [3]. Most herbal interventions have shown promising antioxidant, hypolipidemic and cardio-protective effects [4] [5] [6].

Structurally similar to cholesterol are phytosterols which have shown great promise in the maintenance of plant cell membranes stability, with its elementary sources as vegetable oils etc. [7].

Literature suggests possible modulatory and therapeutic effects of phytosterol on various systems [8] [9]. Many plant-derived compounds influence intracellular and molecular interactions with various applicable receptors, and by so doing regulate gene expression, and modulate enzymatic pathways [10] [11]. The above-described potentials can promote or hinder intracellular interplay and communication, thereby minimizing potential disequilibrium and dysfunction [12]. Despite the above highlighted effects, its promotion of liver health, metabolic function and cardiovascular regulation is not maximally explored yet in rodents. Thus, the need for the present study to investigate the role of phytosterol on liver health, metabolic function and cardiovascular indices using male Wistar rats as experimental models.

MATERIALS AND METHODS

Phytosterol Purchase

Phytosterol used for the study was obtained from Wakunaga, America Co., Mission Viejo, CA92691 U.S.A. Tween 80 served as dissolution solvent for capsules which were subsequently prepared into 1000 and 2000mg/kg body weight.

Procurement and Handling of Purchased Rats

15 healthy male Wistar rats (100-250g) were purchased from our university animal house. Purchased animals were housed in scientifically recommended and appropriate plastic cages, of one compartment per experimental group, animals were acclimatized for two (2) weeks, and subsequently used for the study. Animals were cared for under standard laboratory protocols and practices [13].

Citation: Saronee F, Kolawole T. A., and Nkpurukwe C. I. (2026). Phytosterol Promotes Liver Health, Metabolic Function and Cardiovascular Regulation by Decreasing Liver Enzymes, Serum Cholesterol and Nitric Oxide Levels in Wistar rats.

Journal of e-Science Letters.

DOI: <https://doi.org/10.51470/eSL.2026.7.2.06>

Received: 07 January 2026

Revised: 06 February 2026

Accepted: 05 March 2026

Available: April 03 2026

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Ethical Approval

Ethical approval was obtained from PAMO University of Medical Sciences Research, Grants and Ethics Committee referenced PUMS/REC/2025030.

Toxicity Study

Phytosterol toxicity level was reported to be >3000mg/kg by Carlos and Ma'rcia-regina, (2017) [14] and Saronee et al., (2024) [15]

Study Design

Fifteen (15) healthy male rats were procured and grouped and treated as follows for 28 days: Group I was the control, and animals in this group were allowed unhindered access to rat chow and water. Group II rats received 1000mg/kg while Group III received 2000mg/kg body weight of phytosterol.

Determination of Serum Liver Enzymes, Cholesterol and Nitric Oxide Levels

Serum liver enzymes level was determined as previously described by Wallach, (2007) [16]. Cholesterol level was assessed using Randox Biosciences kits. Nitric oxide level of experimental rats was estimated using Griess reagent as formerly described by Singh et al., (2015) [17].

Data Analysis

SPSS was used to determine mean and standard error of mean (SEM). ANOVA test determined changes in mean values in all animal groups, a post hoc test was also done with LSD. Data were presented as mean \pm standard error of mean and a p-value <0.05 considered statistically significant.

RESULTS

In the first table below, significantly lower values of liver enzymes were seen in Groups 2 and 3 rats given low and high doses of phytosterol relative to Group 1 animals (p<0.05): suggesting a possible protective effect of phytosterol against liver damage.

Table 1: Effects of Phytosterol on Liver Enzymes

Groups	Treatment	Aspartate aminotransferase (Iu/l)	Alanine aminotransferase (Iu/l)	Alkaline Phosphatase (Iu/l)
GROUP 1	Control	193.75 \pm 0.01	152.05 \pm 0.12	261.22 \pm 0.01
GROUP 2	Low Dose Phytosterol Group (1000mg/kg)	183.92 \pm 0.10*	149.20 \pm 0.16	241.02 \pm 0.11*
GROUP 3	High Dose Phytosterol Group (2000mg/kg)	178.01 \pm 0.01*	128.76 \pm 0.40*	219.12 \pm 0.14*

Values expressed as Mean \pm SEM. n=5. * = significant compared to Group 1 (Control) (p<0.05)

Table 2 highlights clear significant and dose-dependent changes in serum cholesterol and nitric oxide levels amongst treatment Groups (Groups 2 and 3 rats) administered 1000mg/kg and 2000mg/kg body weight of phytosterol compared to control (Group 1) rats (p<0.05). Our findings suggest a possible regulatory role of phytosterol on cardiovascular health, metabolic function, and vascular integrity.

Table 2: Values of Phytosterol Administration on Serum Cholesterol and Nitric Oxide level

Groups	Treatment	Cholesterol (mg/dl)	Nitric oxide (umol/l)
GROUP 1	Control	3.73 \pm 0.01	86.01 \pm 0.11
GROUP 2	Low Dose Phytosterol Group (1000mg/kg)	3.65 \pm 0.02	85.61 \pm 0.10*
GROUP 3	High Dose Phytosterol Group (2000mg/kg)	2.56 \pm 0.012*	77.55 \pm 0.12*

Values expressed as Mean \pm SEM. n=5. * = significant compared to Group 1 (Control) (p<0.05)

DISCUSSION

Elevated liver enzyme concentration in blood reflects increased membrane permeability and cell rupture [18]. Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) are indicators of progressive liver damage and hepatocellular regression [19]. AST activity cuts across the liver, heart, kidney, brain and skeletal muscles, although ALT activity is limited to the liver [18] [20]. Both AST and ALT levels increase in liver inflammation and hepatorenal dysfunction [18]. Hence, the observed significant reduction in AST, ALT and ALP levels in this study following phytosterol treatment suggests a potential beneficial outcome.

In spite of differences in study design and methodology, findings from this study validate previous reports from our center on the modulatory functions of some bioactive compounds, medicinal plants and likely derivatives [9] [21] [22] [23]. The reported significant reduction in serum cholesterol and nitric oxide levels following administration of phytosterol points to possible beneficial efficacy.

However, the precise mechanism of action of phytosterol is presently unclear.

In conclusion, significantly lower values of liver enzymes and lipid parameters observed following phytosterol treatment are indicative of a potential protective effect of phytosterol against liver damage and cardiovascular insult.

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