Antioxidative Stress Potential of Piperine in the Gastrocnemius Muscle of High Fat Diet and Sucrose Induced Type 2 Diabetic Rats

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Abstract: Introduction: Piperine is an alkaloid present in black pepper of chemical formula (C17H19N03) and diabetes, a chronic health condition that affects how your body turns food into energy.
Aim and objective: To evaluate antioxidative stress potential of Piperine in the gastrocnemius muscle of high fat diet and sucrose induced type 2 diabetic rats.
Materials and Methods: Albino rats of Wistar strain are induced type 2 diabetics with a high fat diet and are are divided into groups to test the effectiveness of the drug metformin with piperine along with control rats.
Results and Conclusion: As compared to control, fasting blood glucose and serum insulin was elevated in diabetes induced rats. Piperine treated animals exhibited a significant decrease in the level of fasting blood glucose and serum insulin. The group treated with piperine showed significant increase in CAT and SOD thus proving the anti diabetic property of the piperine. When compared to diabetic rats there is a slight decrease in FBG and serum insulin and increase in CAT and SOD.
We can conclude that piperine can be also used as a herbal remedy for diabetes and that intake of herbal extracts rich in phytonutrients as a part of regular diet can ensure holistic health.

Keywords: Piperine, Diabetes, Novel Method, Fasting Blood Glucose, Innovative Technique.

1. INTRODUCTION

The alkaloid piperine and its isomer chavicine are what give black pepper and long pepper their pungent flavor. It has been applied in various traditional medical practices. Piperine is commonly extracted from black pepper using organic solvents like dichloromethane due to its limited solubility in water(1). Piperine content in commercial white and black peppers ranges from 5-10% to 1-2% in long pepper. Additionally, chavicine, an isomer of piperine, can be produced by treating a

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concentrated alcoholic black pepper extract with an alcoholic potassium hydroxide solution to remove resin.(2) The insoluble residue is separated from the solution, which is then allowed to stand overnight. The alkaloid slowly crystallizes from the solution throughout this time.

By combining piperidine and piperonyl chloride, piperine has been created. Diabetes is a chronic condition brought on by either insufficient insulin production by the pancreas or inefficient insulin utilization by the body. A hormone called insulin controls blood sugar levels. (3)Uncontrolled diabetes frequently causes hyperglycemia, also known as high blood glucose or raised blood sugar, which over time can seriously harm many different bodily systems, including the neurons and blood vessels.(4). Age-standardized diabetes mortality rates increased by 3% between 2000 and 2019. Diabetes-related death rates rose 13% in lower-middle income nations. (5).

Diabetes affects an estimated 77 million people (1 in 11 Indians), making India the world's second most affected country behind China.Furthermore, 700,000 Indians died of diabetes, hyperglycemia, renal disease or other consequences of diabetes in 2020. India accounts for one in every six (17%) diabetics worldwide. (As of October 2018, India's population accounted for around 17.5% of the global total.According to the International Diabetes Federation, this figure is expected to rise to 134 million by 2045. Our team has extensive knowledge and research experience that has translate into high quality publications (6–15))(16–25)). The aim of this study is to evaluate the antioxidative stress potential of Piperine in the gastrocnemius muscle of high fat diet and sucrose induced type 2 diabetic rats.

2. METHODS AND MATERIALS:

Chemicals:

All chemicals and reagents used in this study were purchased from Sigma Chemical Company St. Louis, MO, USA; Invitrogen, USA; LPO, SOD, CAT and hydrogen peroxide ELISA kits were procured from Abbkine, (Bldg C17, Optics Valley International Biomedicine Park, Wuhan, China. 430223).

Animals:

Healthy adult male albino rats of Wistar strain (Rattus Norvegicus) weighing 180 to 200 g (100 days old) maintained as per the National Guidelines and Protocols approved by the Institutional Animal Ethical Committee (IAEC No: BRULAC/SDCH/SIMATS/IAEC/07-2019/028 dated 13.07.2019) were used in the present study. Animals were housed in polypropylene cages under specific humidity (65%‡5% and temperature (21 °C#2 °C) with constant 12 h light and 12 h dark schedule at Biomedical Research Unit and Lab Animal Center (BRULAC), Saveetha Dental College & Hospitals, Saveetha Institute of Medical & Technical Sciences, Chennai - 600 077. They were fed with a standard rat pellet diet (Lipton India).

Experimental Design:

Wistar strain of Adult male albino rats (150-180 days old) with 180-200g body weight
were split into five groups randomly. Each group consisted of 6 animals.
Group I-control rats;
Group II- High fat diet induced Type-2 diabetic rats;
Group III-Type-2 diabetic rats administered orally with piperine (40 mg/kg, b.wt/day
for 30 days), for 30 days;
Group IV-Type-2 Diabetic rats treated orally with metformin (50 mg/kg, b.wt/day for
30days.
Group V- Control with piperine (40 mg/kg, b.wt/day for 30 days).

Fasting blood glucose levels (FBG) were analyzed in experimental rats. At the end of the study, experimental rats were anesthetized with 40 mg of sodium thiopentone per kg body weight. Through cardiac puncture, blood was collected and sera were separated and kept at -80°C. To clear the blood from various organs, 20 ml of isotonic sodium chloride solution was perfused by way of the left ventricle. Gastrocnemius muscle was immediately dissected and utilized for further study

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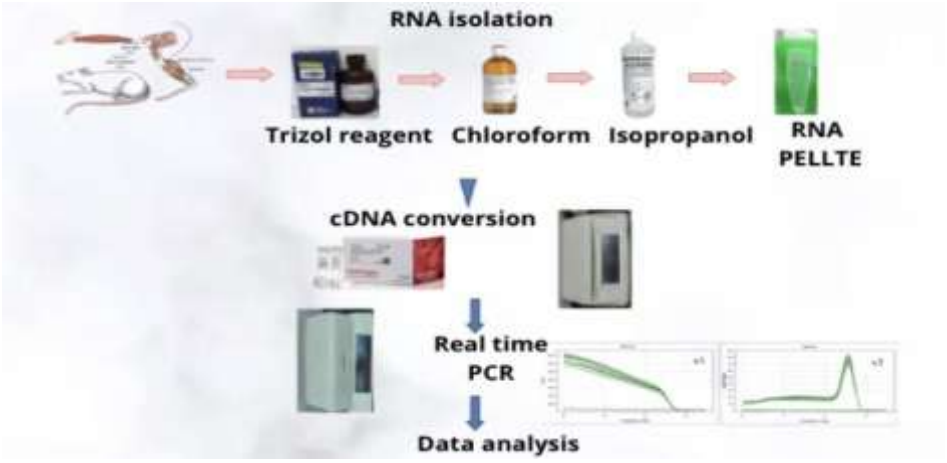


Fasting blood glucose (FBG)

Blood glucose was estimated using On-Call Plus blood glucose test strips (ACON Laboratories Inc., USA) after overnight fasting. Blood was collected by pricking the tip of the rat tail and results are expressed as mg/dl.

Homeostasis Model Assessment for Insulin Resistance (HOMA-IR) and Quantitative Insulin Sensitivity Check Index (QUICKI)

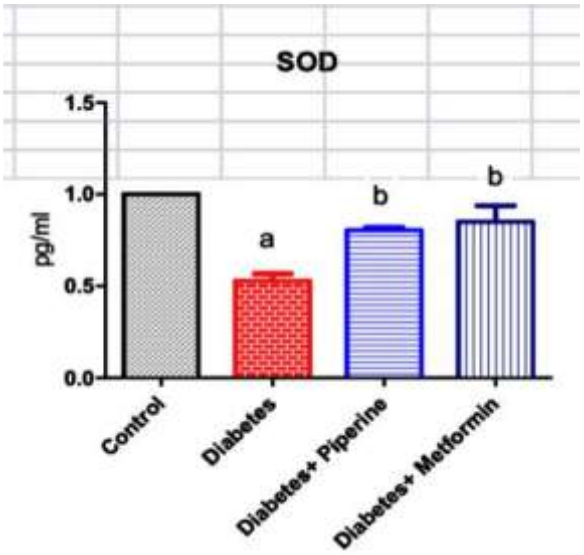
HOMA-IR was calculated using the formula (fasting blood glucose X fasting serum insulin/405) as per the method of Matthews et al (1985) and QUICKI was calculated using the formula 1/ (log fasting serum insulin + log fasting blood glucose) as per standardized method.

ELISA:

LPO, SOD, CAT and hydrogen peroxide were analyzed using Abbkine ELISA kits as
per the manufacturer's instructions.

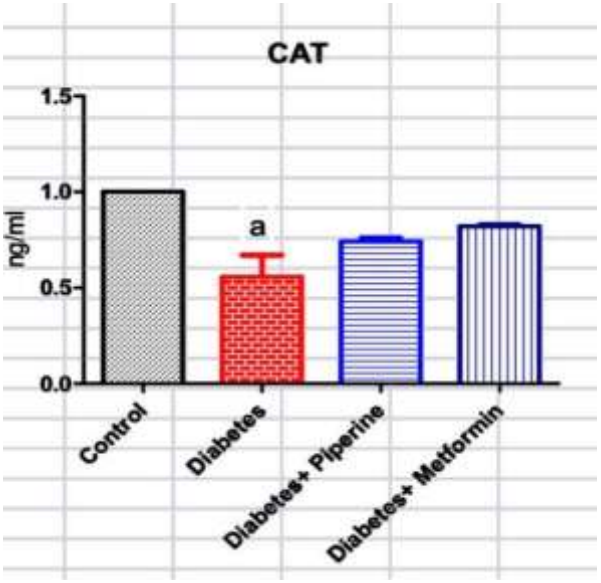
Results and Discussion:

the serum superoxide dismutase (s-SOD) activities in patients with diabetes mellitus (DM), as well as the relationship between s-SOD activities and microangiopathies are decreased in patients with diabetes mellitus and seen in graph 1 SOD levels are significantly decreased in (a). The group with diabetes+metformin has a significant increase composted to (a). The group has also increased significantly but not as much as diabetes+metformin.



CAT

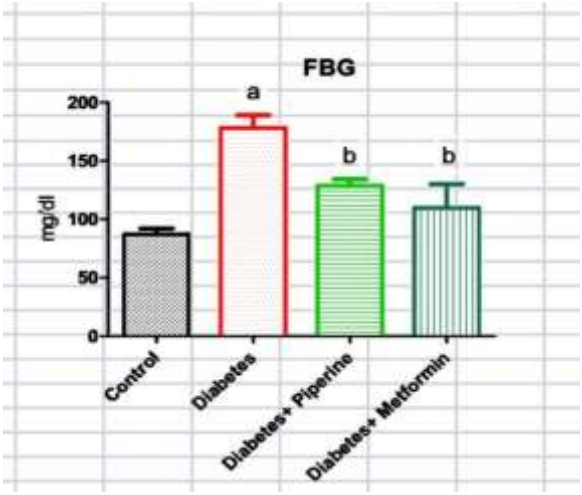
The CAT level in diabetic conditions is decreased as compared to the levels of diabetes+piperine and diabetes+metformin. The levels of control are elevated. The levels of Diabetes+Piperine are almost the same as Diabetes+Metformin but Diabetes+Metformin is slightly higher.



FBG:

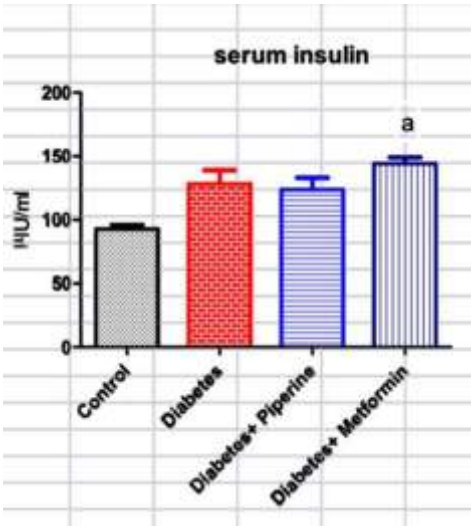
A fasting blood sugar test gauges the amount of glucose (sugar) in your system. Diagnosing prediabetes, diabetes, or gestational diabetes using this method is straightforward, safe, and typical.

The FBG levels in diabetic conditions is increased and is also seen the rats with diabetics (a).in case of diabetes+metformin the decrease in levels of FBG is significant and is nearly close to control.in the diabetes+piperine group a visible decrease in the FBG levels but not as much as diabetes+metformin(26).



Serum insulin

In the case of diabetes, diabetes+metformin and diabetes+piperine, the levels are quite similar. The levels of diabetes+piperine is much close to control as compared to diabetes and Diabetes+metformin.



Fasting blood glucose and serum insulin levels definitely were much higher in diabetes-induced rats compared to controls, for all intents and purposes contrary to popular belief. The level of fasting blood sugar and serum insulin significantly decreased in the piperine-treated rats in a subtle way. The group given piperine demonstrated a considerable rise in CAT and SOD, demonstrating the substance"s ability to kind of prevent diabetes, which mostly is quite significant. Our team has extensive knowledge and research experience that has translate into high quality publications (27), (28), (29), (30), (31,32), (33), (34), (35), (36), (37), (38), (39), (40).

The Piperine actually extract is effective in a lot of ways as we can specifically see the graph where there is a significant decrease in case of serum insulin and FBG and an increase in CAT and SOD This is a basically solid proof as suggesting that piperine kind of has antioxidative stress potential in it and can generally be used as alternative for metformin The only drawback is that piperine isn’t as kind of effective as metformin by a very short range yet it can be one of the herbal based

alternatives, definitely contrary to popular belief this can be a better herbal based alternatives.

3. CONCLUSION

We can infer that piperine can be utilized as a herbal therapy for diabetes and that consuming phytonutrient-rich herbal extracts as part of a regular diet will essentially assure basically overall health in a subtle way.

Conflict of Interest :
The authors hereby declare that there is no conflict of interest in this study.

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Author Contribution :
A) Praveen Jayachandran - contributed in designing the study, execution of the project, statistical analysis, manuscript drafting.
B) Dr. Selvaraj - contributed in designing the study, execution of the project, statistical analysis, manuscript drafting.
C) Dr.V.Vishnupriya - contributed in study design, guiding the research work, manuscript correction.
D) Dr. Gayathri R - study design, statistical analysis, manuscript proofreading and correction.
E) Dr. Kavitha S - study design, statistical analysis, manuscript proofreading and correction.

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