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AN EVALUATION OF ANTI-DIABETIC EFFECTS OF EDIBLE OILS ON ALLOXAN INDUCED RATS WITH SAFETY PROFILE ANALYSIS

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ABSTRACT

Edible oils are a great source for nutrient and culinary purposes. Plant derived edible oil could be considered as a source of remedy against Diabetes Mellitus. Because being plant derivatives; these oils are sources of numerous compounds which can be used as a therapeutic agent to ameliorate diabetes mellitus. Our aim is to identify anti-diabetic activity of edible oils, so that these oils can be used in meditative purpose. In our study alloxan was induced in rats by an by intraperitoneal injection at a dose of 150mg/Kg body weight and oils were fed to the rats at a dose of 2ml/kg. We measured blood glucose level, and safety profile by measuring SGOT, SGPT and creatinine on diabetic and non-diabetic rats before and after administration of the extract. After measuring the blood glucose level, it was found that oils are capable of providing hypoglycemic efficacy in diabetic rats significantly. Safety profile was investigated by checking SGOT, SGPT and creatinine levels. It was seen that though all oil can improve the diabetic condition, still there are some differences in their strength. Furthermore, in healthy individual rats, no oil can significantly alter normal physiological state. It can, therefore, be inferred that certain edible oils could be used as a good alternative therapy to treat diabetes.

KEYWORD: Edible Oil, Diabetes Mellitus, Alloxan, Hypoglycemic Effect.

INTRODUCTION

Diabetes Mellitus (DM) is one of the most common lifestyle diseases. Type 2 diabetes had global prevalence estimate of 2.8% in the year 2000 and is projected to be 4.4% in 2030.[1] It is responsible by the abnormality of carbohydrate metabolism which is associated with lower insulin level in blood or impercipient of target organs to insulin.[1] It can be classified into two categories: Type 1is an insulin-dependent diabetes mellitus (IDDM) when body can not generate any insulin. It mostly occurs in children, young and adults. In whole diabetes disease, Type 1 diabetes is 5–10% of diabetes. It leads to inability to release insulin results in low rates of glucose uptake into muscles and adipose tissue.[2]

Preventing type 2 diabetes (T2D) is possible mainly through lifestyle adjustments. Large prospective studies have shown remarkable reductions in T2D incidence through combinations of dietary and physical activity modifications.[3,4] Reduced T2D incidence rates have also been found more recently in the PREDIMED follow up study, which also demonstrated key benefits of the Mediterranean diet (MD) such as adherence in reducing cardiovascular disease and mortality rates.[5,6]

Edible oils are an essential part of balanced diet which comprises almost 25% of total calorie intake.[7] People consume oils for three purposes: as energy source, as a structural component and to make powerful biological regulators.[8] Nowadays, oils from plant source have gained immense popularity than animal fat due to its special feature of unsaturation. The major quality attributes of edible oils can be evaluated by determining the free fatty acid (FFA), peroxide value and iodine value, which indicate the extent of hydrolytic and oxidative rancidity of the oil and degree of unsaturated fatty acids, respectively.[9] Oils are mainly composed of three types of fatty acids-saturated (SFA), monounsaturated (MUFA) and polyunsaturated(PUFA) fatty acids that are usually consumed by the people.

Nigella sativa has many beneficial properties such as an anticancer, anti-inflammatory, and antidiabetic effects. Furthermore, the seeds of *N. sativa* are broadly used in the medication of various diseases like bronchitis, diarrhea, rheumatism, and skin disorders.[10]

Coconut oil has been renowned for its medicinal and nutritional value. Studies on the biological effects of coconut oil have proven that it ameliorates oxidative stress by boosting the antioxidant defense system, mopping up free radicals and reducing lipid

peroxidation.[11,12] It has also been reported to suppress microbial and viral activities[13], promote weight loss and enhance thyroid function.[14]

Brassica juncea has attracted much attention due to its various beneficial effects. Its antioxidant activity has been proven both in vitro and in vivo.[15]

Glycine max (soybean) is a enriched source of vegetable protein and polyphenols and it is considered as an exclusive and complete food because of its rich nutrient content.[16] In animal studies, it was found that is flavones in *Glycine max* ameliorate glucose tolerance and exert an antidiabetic effect.[17] Another report showed that there is an inverse correlation between *Glycine max* consumption and incidences of some degenerative diseases such as diabetes.[18]

Sunflower oil or *Helianthus annuus L.* is a coarse, stout and erect annual plant 1-3 meters high. Helianthus annuusL. is a folk remedy for bronchitis, carbuncles, catarrh, cold, colic, epistaxis.[19]

MATERIALS AND METHODS

Chemicals

Oils were collected from collected from Khaas Food Privet Limited, Dhaka bangladesh.

Alloxan was bought from Sigma Aldrich, Germany. Semi-Automated Clinical Chemistry Analyzer- Humalyzer 3000, originated from USA was bought from Trades worth Limited to measure SGOT, SGPT and Creatinine. SGOT, SGPT and Creatinine measuring kits were brought from Plasmatic Laboratory Product Ltd of UK. Glucometer Alere GI of Alere Inc, originated from USA was purchased from Shahbag, Dhaka, Bangladesh.

Experimental design and Animal Handling

70 adult male Wistar rats with body weight of 130-155 gram were collected from the Department of Pharmacy of Jahangirnagar University, Savar, Dhaka, Bangladesh. After that rats were kept under controlled temperature (25◦C) and 12±1h light/dark cycle at the Institute of Nutrition & Food Science, University of Dhaka. Standard fed pellet diet and water were fed. At the beginning of the study, the rats were kept there for 10 days for acclimatization. Then body weights were measured and animals were randomly divided into 14 groups and each group contained 5 rats.

Group 1: Normal control. (N)

Group 2: Alloxan injected control (A).

Group 3: Alloxan injected treated with 3ml/kg body weight *Nigella sativa* (N.S).

Group 4: Alloxan injected treated with 3ml/kg body weight *Olea europaea* (O.E).

Group 5: Alloxan injected treated with 3ml/kg body weight *Helianthus annuus* (H.A).

Group 6: Alloxan injected treated with 3ml/kg body weight *Cocos nucifera* (C.N).

Group 7: Alloxan injected treated with 3ml/kg body weight *Glycine max* (G.M).

Group 8: Alloxan injected treated with 3ml/kg body weight *Brassica nigra* (B.N).

Group 9: Treated with 3ml/kg body weight of *Nigella sativa* (N.S).

Group 10: Treated with 3ml/kg body weight of *Olea europaea* (O.E).

Group 11: Treated with 3ml/kg body weight of *Helianthus annuus* (H.A).

Group 12: Treated with 3ml/kg body weight of *Cocos Nucifera* (C.N).

Group 13: Treated with 3ml/kg body weight of *Glycine max* (G.M).

Group 14: Treated with 3ml/kg body weight of *Brassica nigra* (B.N).

In day, fasting blood glucose levels of all rats were measured. As diabetes was not induced then, glucose was found normal in all rats. Then alloxan was injected in rats belonged to group 2, 3. 4, 5, 6, 7, and 8 at a single dose of alloxan 150 mg /kg body weight via intraperitoneal route.[20,21] Then blood glucose level was checked at day14 and diabetes was induced all rats those who were treated with alloxan.

Then treatment was started and other than rats belonged to group 1 and 2 all belong to different group were treated with their respective oil blood glucose level was checked regularly once in a week up to day 42.

Statistical Analysis

The data were expressed as mean±SD. We used SPSS 16 software to assess the data. Here we assa data via “One Way Anova T Test” of SPSS 16 software were used to determine the whether the difference in physiological condition belong different groups are statistically significant ($p>0.05$) or not. Here level of significance was set at $p<0.05$, when p value was found smaller than 0.05 the intra group difference was considered as statistically significant.

RESULTS

Change in body weights

For group C, initial body weight was 138.14±6.244438, and final body weight was 152±5.412947. For group A, initial body weight was 142.3±4.633034, and final body weight was 126.46±3.619807. For group A+N.S, initial body weight initial 143.66±5.271907, and final body weight was 141.24±4.894691. For group A+O.E, initial body weight initial 146.84±5.945418, and final body weight was 141.84±5.721713. For group A+H.A, initial body weight initial 143.22±7.002642, and final body weight was 140.64±10.1734. For group A+C.N, initial body weight initial 145.18±5.169816, and final body weight was 131.8±3.472031. For group A+B.N, initial body weight initial 148.68±3.742593, and final body weight was 148.6±4.514421. For group A+G.M, initial body weight initial 145.16±5.586412, and final body weight was 149.28±7.07651. For group N.S, initial body weight initial 143.7±8.546637, and final body weight was 159.7±8.375858. For group O.E, initial body weight initial 143±6.894926, and final body weight was 154.9±6.307139. For group initial body HA weight initial 146.48±7.349626, and final 161.16±8.07267. For group C.N, initial body weight initial 145.04±6.672181, and final 143.72±4.43982 For group B.N, initial body weight initial 142.98±6.224709, and final 156.18±4.378584. For group G.M, initial body weight initial 154.02±7.601776, and final 161.98±6.142638. The results are shown in Figure 1.

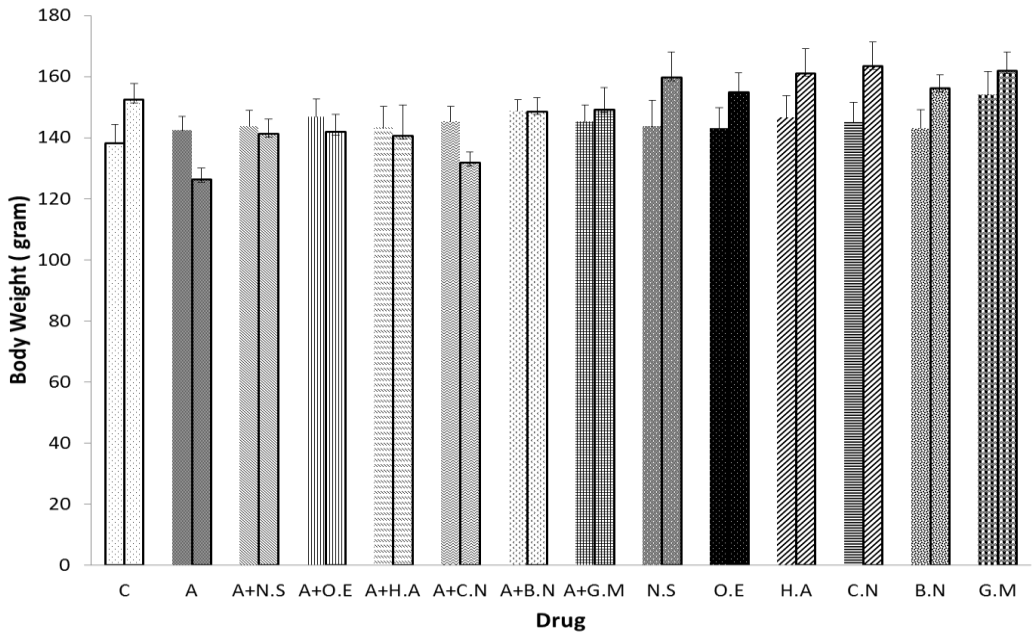

Figure 1: Comparision between the average body weight (mean±standard deviation) of rats belong to 6 groups at day one and day thirtyfive just before sacrifice.

Change in blood glucose level

In control group, initially blood glucose level was observed 2.72± 0.204939 and after 35days, it was 2.8 ± 0.070711. But the average initial blood glucose level of alloxan induced untreated rats was 2.84±0.228035 and at day 35 it was 2.8 ±1.314534. For group A+N.S, initial blood glucose level was 2.9±0.212132, then alloxan was injected. After 14 days o blood glucose level raised to 20.24±1.443991 and after 21 days of N.S treatment, at day 35 blood glucose level was reduced to 12.76±0.963328.

For group A+O.E, initial blood glucose level was 2.76±0.31305, At day 14 days blood glucose level raised to 19.68±1.637681 due to alloxan induction. After 21 days of O.E treatment, at day 35 blood glucose level was reduced to 15.08±0.8228.

For group A+H.A, initial blood glucose level was 2.76±0.31305, then alloxan was injected and then blood glucose level raised to 20.44±1.69 at day 14. Then 21 days of H.S treatment, at day 35, blood glucose level was reduced to 15.5±1.007472.

Similarly in group A+C.N, initial blood glucose level was 2.76±0.31305, alloxan was injected and within 14days blood glucose level was raised to 21.66±2.161712 and day 35 blood glucose level was reduced to 16.46±1.379493 due to 21 days of C.N treatment.

For group A+B.N, initial blood glucose level was 2.76±0.31305, alloxan was injected and blood glucose level was raised to 21.81±0.892749 within day 14. At day 35 blood glucose level was reduced to 17.34±0.7436 for 21 days of B.N treatment.

For group A+G.M, initial blood glucose level was 2.76±0.31305, alloxan was injected and due to alloxan injection, blood glucose level raised to 21.96±1.907354 within 14 days. and at day 35 blood glucose level was reduced to 17.68±1.37186.

For N.S group initial blood glucose level was 2.8 ±0.192354 and at day 35 blood glucose level was 2.88±0.319374.

For group O.E, initial blood glucose level was 3.02 ±0.258844 and in final day blood glucose level was 2.78±0.216795.

For group H.A, initial blood glucose level was 2.68±0.238747 and at day 35 blood glucose level was 2.94±0.230217.

For group B.N, initial blood glucose level was 2.9±0.187083 and before sacrifice blood glucose level was 3.02 ±0.178885.

For group G.M, initial blood glucose level was 3.08±0.258844 and at day 35 blood glucose level was 2.96±0.219089.

For group C.N, initial blood glucose level was 2.98±0.277489 and prior to 35 blood glucose level was 2.9±0.308221. The results are shown in Figure 2.

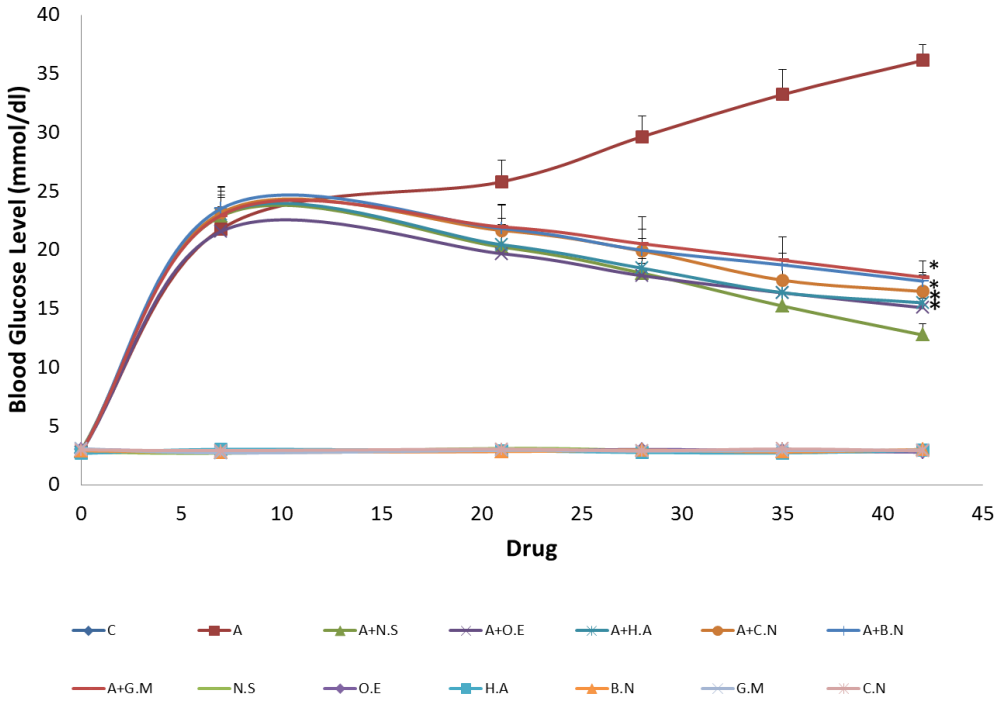

Figure 2: Blood glucose level of six groups from day zero to day thirty five. The data were expressed as mean± standard deviation. * Expresses the significant change.

Safety Profile Study (Liver function test)

In group C SGOT Level was 42.8 ±2.6832, In group A SGOT Level was 102.46±3.389. In group A+ N.S SGOT Level was 46.78±2.3467. In group A+ O.E SGOT Level was 48.18±2.458. In group A+ H.A SGOT Level was 51.32±3.2205. In group A+ C.N SGOT Level was 51.62±2.2264. In group A+ B.N SGOT Level was 54.54±4.4258. In group A+ G.M SGOT Level was 58.86±3.17822. In group A+ SGOT Level was 42.76±3.8958. In group N.S SGOT Level was 40.40±4.7558. In group O.E SGOT Level was 42.68±1.47377. In group H.A SGOT Level was 41.84±2.5432. In group B.N SGPT Level was 44.4±1.8520. In group In C.N, SGOT Level was 33.88±0.92844. The results are shown in Figure 2.

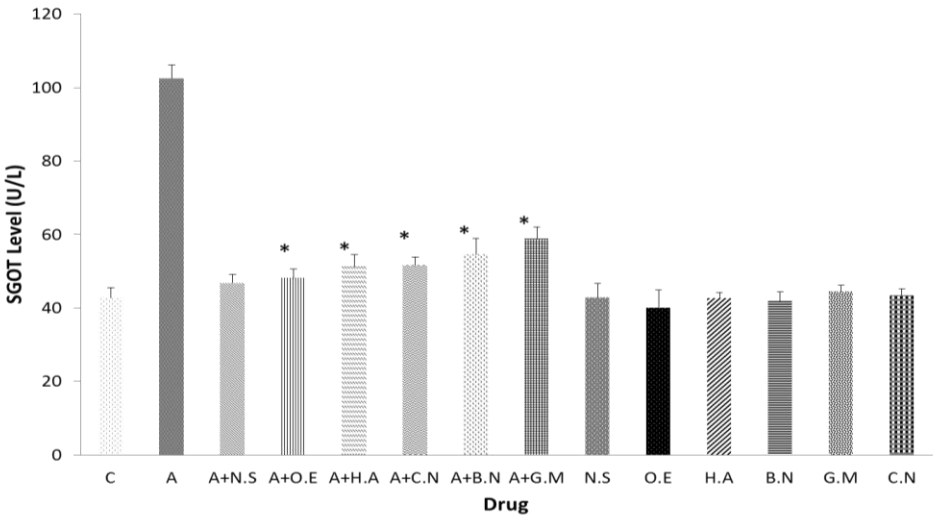

Figure 3: Camparision of SGOT level (U/L) of rats, of 14 groups at day thirty five after sacrifice. * Expressing the significant change.

In group C SGPT Level was 32.38±1.889973545. In group A SGPT Level was 93.12±3.244533865. In group A+N.S SGPT Level was 36.92±2.554799. In group A+O.E SGPT Level was 39.76±1.525778. In group A+H.A SGPT Level was 42.56±1.880957. For group A+C.N SGPT Level was 42.28±5.50745. In group A+B.N SGPT Level was 47.26±2.252332. In group In N.S SGPT Level was 32.26±1.82291. In group O.E SGPT Level was 28.8±2.206808. In group H.A SGPT Level was 31.86±2.717168. In group B.N SGPT Level was 29.52±4.079461. In group G.M SGPT Level was 28.86±4.224098. In group C.N, SGPT Level was 33.88±0.92844. The results of SGPT levels are shown in Figure 4.

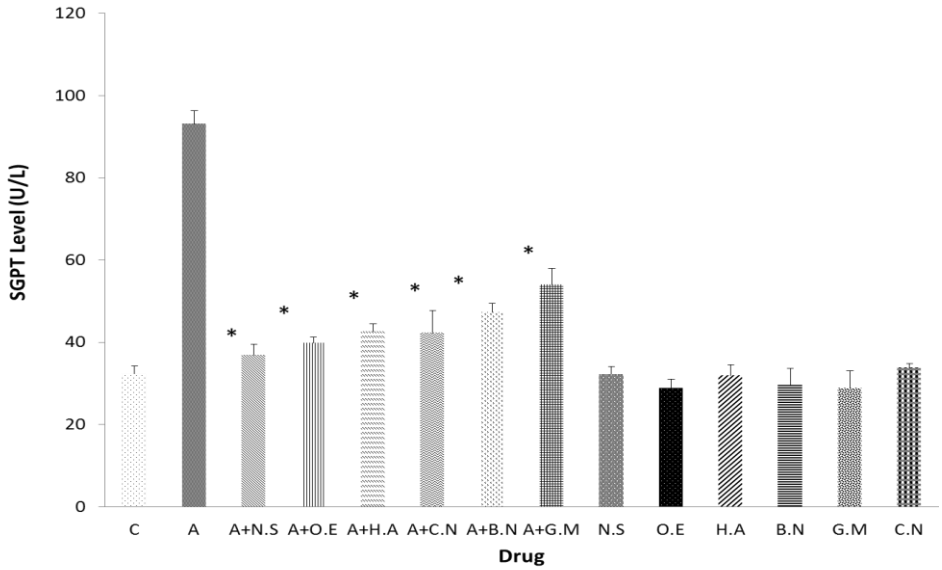

Figure 4: Camparision of SGPT level (U/L) of rats, belonged to 14 groups at day thirty five after sacrifice sacrific. * Expreses the significant change.

Safety Profile Study (Kidney functioning Test)

For C average creatinine level was 0.66±0.089443. For A, average creatinine level was average 2.48±0.192354 For A+N.S, average creatinine level was average 1.28±0.109545. For average creatinine level was A+ O.E, average 1.46±0.089443. For A+ H.A, average creatinine level was average 1.46±0.114018. For A+ C.N, average creatinine level was 1.6±0.114018.For A+B.N, average creatinine level was 1.2±0.122474. For A+G.M, average average creatinine level was 1.64±0.181659. For N.S, average 0.68±0.178885. For O.E, average 0.64±0.114018. For H.A, average creatinine level was 0.7 ±0.1 For C.N, average creatinine level was 0.62±0.083666. For B.N average creatinine level was 0.66±0.167332. For G.M, average creatinine level was 0.78±0.083666.The results are shown in Figure 5.

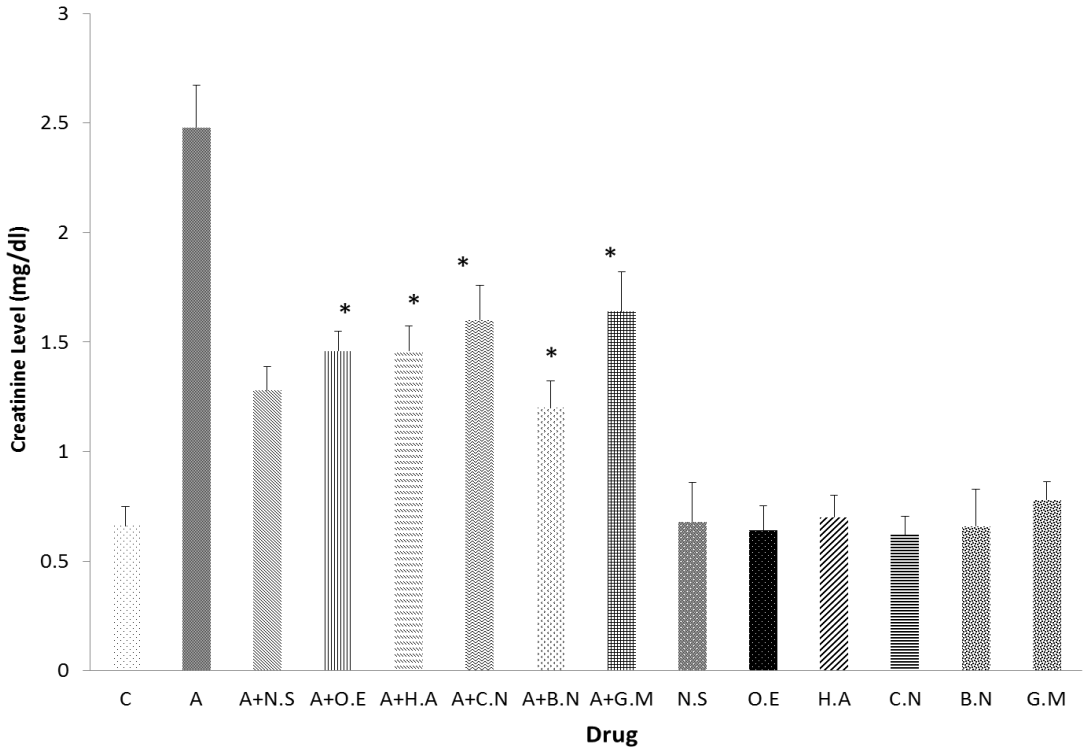

Figure 5: Camparision of Creatinine level (mg/dl) of rats, belong to 14 groups at day thirty five after sacrifice sacrific. * Expreses the significant change.

DISCUSSION

In the experiment implemented here, rats those were in group 1, 9, 10, 11, 13 and 14 showed increased body weight. On the other hand, decline in body weight were observed in rats belonged to group 2, 3, 4, 5, 6, 7, 8 and in 12. Different outcomes were perceived even though they were under the same food habit and proper care. Because weight reduction is a common feature in type I diabetes. But weight enhancement in rats belonged to group 1, 9,

10, 11, 13 and 14 evidenced that other than rats belonged to *Cocos nucifera* group no other rats can imparts weight reduction. Here it can be observed that other than *Cocos nucifera* treated group, weight reduction rate of rats are very tiny. In this way, we can express that oil can renounce one manifestation of type 1 diabetes group.

Statistical significance were demonstrated when the rats of test group 3, 4, 5, 6, 7 and 8 were assessed and contrasted with the rats of group 2. Alloxan controlled group demonstrated higher SGPT, SGOT and creatinine than other groups with dangerous alloxan impact. Though group 3, 4, 5, 6, 7 and 8 exhibited better outcomes than diabetic control group but the result was poorer than control group.

When the healthy rats were treated with oils, the experiment showed that the result of SGOT, SGPT, creatinine and blood glucose levels was practically indistinguishable to control group with no measurable importance. It was verified that our selected oils initiate hypoglycemia. Thus, when rats of the non-diabetic oil fed groups were compared with respective diabetic oil fed groups 6, statistical significance ($P<0.05$) was found, this could be the evidence of the fact that the diabetic oil fed rats are in worse condition than the group non diabetic oil fed rats. The condition didn't cause by the plant extract, it happened due to the destructive effect of alloxan. As non-diabetic extract treated group same repercussions of rats of group 1.

CONCLUSION

From the abovementioned results, it may be concluded that the certain plant derived edible oils can ameliorate the conditions of pathological parameters like SGOT, SGPT and Creatinine along with imparting anti-diabetic effect in diabetic rats. Additionally these parameters are found unchanged when non-diabetic rats were fed with *edible oil* with similar dose. We, thus, conclude that these herbal remedy can be incorporated for disease management of type I diabetes mellitus.

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AUTHORS' CONTRIBUTION: This work was carried out in collaboration among all authors. Author NAA, MS designed and write the research protocol. Author TJ, LRMDC, NA and MKH performed the test equally and analyze the data. Author NAA has taken care of the whole project during the research protocol. All authors meticulously read and approved the final manuscript.

REFERENCES

1. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. Diabetes Care, 2004; 27(5): 1047-1053.
2. Lehninger AL, Nelson DL, Cox MM. Principle of Biochemistry. New York: Worth Publishers, 2010.
3. Knowler W.C., Barrett-Connor E., Fowler S.E., Hamman R.F., Lachin J.M., Walker E.A., Nathan D.M. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N. Engl. J. Med., 2002; 346: 393–403.
4. Tuomilehto J., Lindström J., Eriksson J.G., Valle T.T., Hämäläinen H., Ilanne-Parikka P., Keinänen-Kiukaanniemi S., Laakso M., Louheranta A., Rastas M., et al. Finnish Diabetes Prevention Study Group. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. N. Engl. J. Med., 2001; 344: 1343–1350.
5. Estruch R., Ros E., Salas-Salvado J., Covas M.I., Corella D., Aros F., Gomez-Gracia E., Ruiz-Gutierrez V., Fiol M., Lapetra J., et al. Primary prevention of cardiovascular disease with a Mediterranean diet. N. Engl. J. Med., 2013; 368: 1279–1290.
6. Salas-Salvadó J., Bulló M., Estruch R., Ros E., Covas M.I., Ibarrola-Jurado N., Corella D., Arós F., Gómez-Gracia E., Ruiz-Gutiérrez V., et al. Prevention of diabetes with

Mediterranean diets: A subgroup analysis of a randomized trial. Ann. Intern. Med., 2014; 160: 1–10.

7. Zambiazi RC, Przybylski R, Zambiazi MW and MendoncaCB, Fatty acid composition of vegetable oilsand fats, B.CEPPA, Curitiba, 2007; 25: 111-120.
8. Llorent-Martinez EJ, Ortega-Barrales P, Fernadez-de-Cordova ML, Dominguez-Vidal A andRuiz-Medina A, Investigation by ICP-MS oftrace element levels in vegetable edible oils produced in Spain, Food Chemistry, 2011; 127: 1257-1262.
9. Chowdhury K, Obaid M, Lisa SA and Karim R, Evaluation on edible oil quality parameters as well asnutritional value of flaxseed (linseed) oil in Bangladesh, J Chem Bio Phy Sci., 2014; 5(1): 401-412.
10. A. Bamosa, "A review on the hypoglycemic effect of *Nigella sativa* and thymoquinone,"Saudi Journal of Medicine & Medical Sciences, 2015; 3(1): 2–7.
11. Nevin, K.G. and Rajamohan, T., Virgin coconut oilsupplemented diet increases the antioxidant status in rats. Food Chemistry, 2006; 99: 260-266.
12. Dosumu, O.O., Duru, F.I.O., Osinubi, A.A., Oremosu, A.A. and Noronha, C.C., Influence of virgin coco-nut oil (VCNO) on oxidative stress, serum testosteroneandgonadotropic hormones (FSH, LH) in chronic ethanolingestion. Agriculture and Biology Journal of North America, 2010; 1: 1126-1132.
13. Van Immerseel, F., De Buck, J. and Boyen, F., Medium-chain fatty acids decrease colonization and invasion through hilA suppression shortly after infection of chickens with Salmonella enterica serovar enteritidis. Applied and Environmental Microbiology, 2004; 70: 3582-3587.
14. Takeuchi, H., Sekine, S., Kojima, K. and Aoyama, T., The application of medium-chain fatty acids: Edi-ble oil with a suppressing effect on body fat accumulation. Asia Pacific Journal of Clinical Nutrition, 2008; 17: 320-324.
15. Jenkins DJ, Kendall CW, Marchie A, et al. Type 2 diabetes and the vegetarian diet. Am J Clin Nutr., 2003; 78: 610S–6S.
16. Mezei O, Banz WJ, Steger RW, Peluso MR, Winters TA and Shay N. Soy isoflavones exert antidiabetic and hypolipidemic effects through the PPAR pathways in obese Zucker rats and murine RAW 264.7 cells. J Nutr., 2003; 133: 1238-1243.
17. Ademiluyi AO, Oboh G, Boligon AA and Athayde ML. Effect of fermented soybean condiment supplemented diet on α-amylase and α-glucosidase activities in Streptozotocin-induced diabetic rats. Journal of Functional Food, 2014; 9: 1-9.

18. Kim, H.Y., Yokozawa, T., Cho, E.J., Cheigh, H.S., Choi, J.S. and Chung, Y.H., In vitro and in vivo antioxidant effects of mustard leaf (*Brassica juncea*). Phytother. Res, 2003; 17(5): 465–471.
19. Duke JA, Wain KK. The Medicinal Plants of the World, Computer index with more than 85,000 enteries. London UK: Longman, 1981.
20. Yin, Peipei & Wang, Yu & Yang, Lingguang & Sui, Jinling & Liu, Yujun. Hypoglycemic Effects in Alloxan-Induced Diabetic Rats of the Phenolic Extract from Mongolian Oak Cups Enriched in Ellagic Acid, Kaempferol and Their Derivatives. Molecules, 2018; 23: 1046. 10.3390/molecules23051046.
21. Sharma, S.B.; Nasir, A.; Prabhu, K.M.; Murthy, P.S.; Dev, G. Hypoglycaemic and hypolipidemic effect of ethanolic extract of seeds *Eugenia jambolana* in alloxan-induced diabetic rats. *J.Ethnopharmacol*, 2003; 85: 201-206.