Original article

Effect of Turmeric (Curcumin) Supplementation to Prevent Weight Loss in Type I Diabetic Rats

Javaria Latif[1], Saima Mukhtar[2], Sobia Niaz[3], Zoobia Irum[4], Shaista Hussain[5], Shahid Saeed[6]

[1]Associate Professor, Department of Physiology, CMH Institute of Medical Sciences Bahawalpur, [3]Associate Professor, Department of Physiology, Rahbar Medical and Dental College, Lahore, [3]Associate Professor, Department of Physiology, Gujranwala Medical College, Gujranwala, [4]Assistant Professor, Department of Pharmacology, CMH Institute of Medical Sciences Bahawalpur, [5]Associate Professor, Department of Physiology, Rashid Latif Khan University Lahore, [6]Associate Professor, Department of Physiology, Fatima Jinnah Medical University Lahore

Correspondence to: Javaria Latif, Email: tojavaria@gmail.com

ABSTRACT

Background: Curcuminoids in turmeric plants reduce the oxidative stress of diabetes and improve glucose utilization, so are helpful to prevent weight loss in diabetics. This study determined the weight loss-preventing effect of turmeric in type I diabetic rats and compared the groups.

Subjects and methods: In this randomized controlled trial, alloxan was administered intraperitoneally to produce type-I diabetes. Forty-five albino rats were divided into control group A, diabetic group B and diabetic-treated group C with fifteen animals in each. Turmeric powder was given in a dosage of 300mg/kg body weight through oral gavage method to group C rats after induction of diabetes. Body weights of all rats were recorded by digital scale at baseline, end of 8th week and end of 12th week. Analysis of quantitative data (body weight) was done by using SPSS version 24, applying paired t-test and one-way ANOVA.

Results: The average weight of the control group remained stable (mean weight 181 ± 16 g in the 12th week) and the weight change was not statistically significant (p-value = 0.393). The diabetic group showed a gradual decrease in body weight (mean weight 178 ± 18 g in the 12th week) which was statistically significant (p-value <0.001). The diabetic group treated with turmeric powder showed weight stability (mean weight 198 ± 24 g at 12th week) and the decline of body weight was statistically not significant (p-value = 0.063).

Conclusion: Type I diabetes causes a significant reduction in body weight. Turmeric powder could be used as a weight-stabilizing agent in diabetics.

Keywords:

Type I diabetes, Weight loss, Alloxan, Turmeric powder, Rats

INTRODUCTION

Type I diabetes is categorized by complete deficiency or lack of insulin and increased blood glucose level due to pancreatic beta cell destruction.[1] It evolves from genetic malfunction and different environmental factors leading to the activation of cell-mediated immunity.[2,3] Incidence of type I diabetes is rising in both developed and developing countries[4,5] and worldwide prevalence of diabetes is now almost 537 million diabetic adults.[6]

In type I diabetes, glucose utilization decreases causing hyperglycemia and subsequent weight loss.[7,8] Due to the stress of hyperglycemia, insulin deficiency and metabolic imbalance there is a loss of appetite and the body also starts burning fats and proteins to meet the energy needs leading to subsequent weight loss in type I diabetics.[9] The increased metabolic rate due to insulin deficiency is also the causative agent for weight loss and further progression of type I diabetes.[10]

Turmeric is found to have wide spectrum therapeutic effects as anti-diabetic, hypolipidemic and anti-oxidant along with improvements in weight and metabolic status.[11,12] Curcumin, the active constituent of turmeric causes restriction of NF-kB signalling and down regulates the production of cytokines and C-reactive proteins thereby exerting anti-inflammatory effects[13,14]. Curcumin also alters the expression of genes involved in energy metabolism and has good influence on stabilizing the body weight of diabetics by reducing the oxidative stress of diabetes and improving in utilization of glucose as an energy source.[15,16]

In the present study we used turmeric powder oral supplementation (300 mg/Kg body weight) in addition to a normal synthetic diet to type I diabetic rats to determine the weight loss-preventing effects of turmeric.[17]

SUBJECTS AND METHODS

This study involved an animal experiment using a randomized controlled trial design, carried out at the Physiology department of Postgraduate Medical Institute Lahore. Total duration of study was four

Conflict of interest: The authors declared no conflict of interest exists.
Citation: Latif J, Mukhtar S, Niaz S, Irum Z, Hussain S, Saeed S. Effect of turmeric (Curcumin.) supplementation to prevent weight loss in Type I diabetic rats. J Fatima Jinnah Med Univ. 2024; 18(1):29-32.

DOI: http://doi.org/10.37018/JFJMU/5641

months including acclimatization of animals and induction of diabetes and approval was sought from the animal sciences ethical committee of PGMI.

For this investigation, 45 albino rats of both sexes weighing an average of 150–250 g were chosen by simple random sampling with the balloting method. The sample size was calculated by using the resource equation method, based on the law of diminishing returns. The animals had their acclimatization period. The animals were provided with enough food and water daily. The animals were housed individually in iron cages that had ideal humidity and temperature (24 ± 2 °C).

Rats were acquired from the Animal house of the Department of Biological Sciences, Punjab University. We purchased an Alloxan vial from Merck Marker (Lahore), Pakistan and bought the rhizomes of the turmeric plant from a local herbal store.

The animals were split up into three groups of fifteen each: the normal control group (A), the diabetic group (B) and the diabetic group (C) that received the turmeric treatment. Animals of groups B and C were kept fasting for 12 hours and then intraperitoneally injected with a single dose of 150 mg/kg body weight alloxan in an infusion of 0.9% NaCl to develop diabetes. Control group A did not receive alloxan. After one week of alloxan injection, the diagnosis of diabetes was made with a glucometer by tail vein method. Animals in groups B and C having random blood glucose levels of ≥200mg/dl were considered diabetic with an average weight between 150-250 gm.

The turmeric plant's roots were cleaned, boiled and then left to air dry for two weeks. Then they were ground into a powder using an electric grinder after being further dried at 40°C. One week after alloxan was dispensed (baseline), a dose of 300 mg/kg body weight of turmeric powder was given to each of the 15 diabetic rats in group C for the next twelve weeks. The powder was dissolved in 4 ml of distilled warm water for each rat and was administered through a 5cc disposable syringe through the oral gavage method. [18] The rats of the other two groups (normal control and diabetic) were also given 4ml of distilled warm water daily orally for twelve weeks as a vehicle. All the rats had free access to a normal synthetic rat diet.

Body weight measurements of all the animals were taken by digital animal weighing scale and compared at baseline, after the 8th and 12th week.[19,20]

SPSS version 24.0 was used to enter and analyze data (quantitative), and mean±SD was used to express body weight measurements mean differences among groups A, B and C were found out, using one-way analysis of variance (ANOVA). A p-value of ≤ 0.05 was taken as statistically significant.

RESULTS

Two rats in group B (diabetic, untreated) expired five days before the completion of week 12. At baseline, the mean weight recorded for animals in the healthy control group was 180 ± 19 g with a mean serum glucose level of 90 ± 10 mg/dl which remained almost unchanged during twelve weeks and was 181 ± 16 g (mean serum glucose level 85 ± 12) at the end. The average weight of animals in groups B and C was 216 ± 18g (mean serum glucose 235 ± 10 mg/dl) and 201±23 g (mean serum glucose level 240 ± 20) respectively after induction of diabetes at the start of the experiment (baseline). The mean weight of animals of group C supplemented with turmeric powder remained almost stable during the experiment with an average weight of 198 ± 24 g (mean serum glucose level 145 ± 20) in the 12th week, depicting the prevention of weight loss. A gradual decline in the weight of animals in diabetic group B was recorded with an average weight of 203 ± 15 g (mean serum glucose level 290 ± 20) in the 8th week and 178 ± 18 g (mean serum glucose level 350 ± 30) in the 12th week respectively showing the diabetes-induced weight loss in this group, as presented in Table 1.

Comparison of the weight of animals of various groups in between given times by applying paired t-test showed that the changes for weight in group A were insignificant over the 8 weeks with a p-value 0.257, at 12th week with p-value 0.393 (Table 1) and between 8 and 12-week with p-value 0.901. The changes in weight in group B were highly significant and showed a gradual decrease in body weight which was diabetes induced, between three reading times, all with p-value <0.001 (table 1). In group C, weight declined but insignificantly (turmeric supplementation prevented weight loss), a bit till the 8th week with a p-value of 0.086 and till the 12th week, this decline was only 2.53g with a p-value of 0.063 (Table 1).

The average weights were shown to be statistically different for baseline (the beginning of the study), the eighth week, and the twelfth week, with p-values 0.001, 0.007 and 0.015, respectively, when the groups were compared using a one-way ANOVA at three reading periods.

When the weight of the animals in each of the three groups was compared pairwise using the Post hoc Tukey test, the results showed that groups B and C had higher average values than group A (p-values <0.001

Table 1: Body weight measurements in groups (A, B and C) at three reading times after induction of diabetes

Groups	Baseline (day zero) Mean±SD	8th Week Mean±SD	12th Week Mean±SD	p-value*
Group A (n =15)	180 ± 19	18 1 ± 16	181 ± 16	0.393
Group B (n =15)	216 ± 18	203 ± 15	178 ± 18	<0.001
Group C (n =15)	201 ± 23	199 ± 24	198 ± 2	0.063

*p-value ≤0.05 was taken as statistically significant
Group A: control, healthy group
Group B: diabetic group
Group C: turmeric treated, diabetic group

and 0.018, respectively), and that the difference between the two groups was not statistically significant (p-value 0.090 at baseline). In comparison to group A, groups B and C had significantly higher averages in the eighth week (21.467 g and 17.67 g, respectively, with p-values 0.008 and 0.034), whereas the difference between the two groups [(B and C) (p-value 0.843)] was not statistically significant. Animals in group B had an average weight decrease that was comparable to those in group A (p-value 0.905) and significantly less than that of group C (p-value 0.019) by 20.0 g. With a p-value of 0.052, the difference between groups A and C was barely significant.

DISCUSSION

This study reveals a positive association between type I diabetes and weight loss. In the current study we determined the amelioration of weight-losing effects of diabetes with the administration of turmeric powder in rats with diabetes that was developed by injecting alloxan.

There are very few experiments regarding the pathophysiology of weight-reducing effects of type I diabetes. Our study revealed that untreated diabetic rats of group B had a significant reduction in their body weight in comparison to animals of groups A and C.[9] Our findings are consistent with different researchers who observed the same findings when they compared the body weight of their control group to that of the diabetic group and significant decrement in body weight of diabetic group was found.[21] The reduction in body weight of the diabetic group was associated with loss of tissue proteins which is the result of altered glucose metabolism in diabetics.[22]

The weight of diabetic animals of group C (treated with turmeric powder for 12 weeks) remained almost stable and showed a non-significant decline throughout the total duration of experiment, when compared with animals of normal control group A.[23,24] Our findings are in agreement with several studies which compared the body weight of diabetic group to that of rats treated with turmeric and weight loss was found to be prevented by the use of turmeric as a result of the positive effect of turmeric on glucose metabolism and its utilization.[25,26] The effect of turmeric powder to prevent weight loss of group C was maintained throughout the total duration of the experimental period, which could be due to the anti-inflammatory and antioxidant properties of turmeric to maintain blood glucose levels and thus prevent associated complications of type I diabetes.[25]

Limitations of this study worth mentioning were due to the low availability of animals we did not use an animal model of type-II diabetes as fourth (group D) to see the efficacy of turmeric powder in terms of quantitative analysis and comparison with type I diabetic animals.

Further safe clinical human trials using various doses of turmeric powder must be carried out to elaborate and ascertain the efficacy of this treatment in the human population of diabetic patients for stabilization of body weight.

CONCLUSION

Type I diabetes induces weight loss in diabetic animals when compared with the normal control group. Turmeric supplementation prevents weight loss in diabetic animals when compared with the diabetic control group.

REFERENCES

1. Michels Aw, Landry LG, McDaniel KA, Yu L, Campbell-Thompson M, Kwok WW, et al. Islet-derived CD4 T cells targeting proinsulin in human autoimmune diabetes. Diabetes. 2017; 66(3):722–734.
2. Inshaw JR, Walker NM, Wallace C, Bottolo L, Todd JA. The chromosome 6q22.33 region is associated with age at diagnosis of type 1 diabetes and disease risk in those diagnosed under 5 years of age. Diabetologia. 2018; 61(1):147–157.
3. Greenbaum CJ, Speake C, Krischer J, Buckner J, Gottlieb PA, Schatz DA, et al. Strength in numbers: Opportunities for enhancing the development of effective treatments for type 1 diabetes—The Trial Net Experience. Diabetes. 2018; 67(7):1216–1225.
4. Mayer-Davis EJ, Lawrence JM, Dabelea D, Divers J, Isom S, Dolan L, et al. Incidence trends of type 1 and type 2 diabetes

among youths, 2002–2012. N Engl J Med. 2017; 376(15):1419–1429.
5. Shepherd M, Shields B, Hammersley S, Hudson M, McDonald TJ, Colclough K, et al. Systematic population screening, using biomarkers and genetic testing, identifies 2.5% of the UK pediatric diabetes population with monogenic diabetes. Diabetes Care. 2016; 39(11):1879–1888.
6. International Diabetes Federation (IDF) IDF Diabetes Atlas. 10th ed. International Diabetes Federation; Brussels, Belgium: 2021. Available from: https://diabetesatlas.org/idfawp/resource files/2021/07/IDF_Atlas_10th_Edition_2021.pdf (accessed 20 February 2024).
7. Thomas NJ, Jones SE, Weedon MN, Shields BM, Oram RA, Hattersley AT. Frequency and phenotype of type 1 diabetes in the first six decades of life: a cross-sectional, genetically stratified survival analysis from UK Biobank. Lancet Diabetes Endocrinol. 2018; 6(2):122–129.
8. Oram RA, Patel K, Hill A, Shields B, McDonald TJ, Jones A, et al. A Type 1 diabetes genetic risk score can aid discrimination between Type 1 and Type 2 diabetes in young adults. Diabetes Care. 2016; 39(3):337–344. Available from: doi:10.2337/dc15-1111
9. Insel RA, Dunne JL, Atkinson MA, Chiang JL, Dabelea D, Gottlieb PA, et al. Staging presymptomatic type 1 diabetes: A scientific statement of JDRF, the Endocrine Society and the American Diabetes Association. Diabetes Care. 2015; 38(10):1964–1974.
10. Ferrara CT, Geyer SM, Liu Y, Evans-Molina C, M. Libman I, Besser R, et al. Excess BMI in childhood: A modifiable risk factor for type 1 diabetes development? Diabetes Care. 2017; 40(5):698–701. Available from:
11. Markova E, Goldina I, Savkin I, Knyazheva M, Smyk A. Efficiency of the original flavonoids composition based on curcumin in chronic alcohol intoxication. Eur Psychiatry. 2022; 65(Suppl. 1): S825-S826.
12. El-Saadony MT, Yang T, Korma SA, Sitohy M, Abd El-Mageed TA, Selim S, et al. Impacts of turmeric and its principal bioactive curcumin on human health: Pharmaceutical, medicinal and food applications: A comprehensive review. Front. Nutr. 2023; 9:1040259.
13. Uchio R, Higashi Y, Kohama Y, Kawasaki K, Hirao T, Muroyama K, et al. A hot water extract of turmeric (*Curcuma longa*) suppresses acute ethanol-induced liver injury in mice by inhibiting hepatic oxidative stress and inflammatory cytokine production. J Nutr Sci. 2017; 6(3):1-9. Available from: doi:10.1017/jns.2016.43
14. Salgintas H, Donmez N, Ozsan M. The effect of Curcumin on the antioxidant system in diabetic rats. J Hellenic Vet Med Soc. 2021. 72(4),3279–3284.
15. Rahimi HR, Mohammadpour AH, Dastani M, Jaafari MR, Abnous K, Mobarhan MG, et al. The effect of nano-curcumin on HbA1c, fasting blood glucose, and lipid profile in diabetic subjects: a randomized clinical trial. Avicenna J Phytomed. 2016; 6(5): 567-577.
16. Hodaei H, Adibian M, Nikpayam O, Hedayati M, Sohrab G. The effect of curcumin supplementation on anthropometric indices, insulin resistance and oxidative stress in patients with type 2 diabetes: a randomized, double-blind clinical trial. Diabetol Metab Syndr. 2019; 11(41):1-8.
17. Banaszak, M, Górna, I, Wo´zniak, D, Przysławski, J, Drzymała-Czyz S. The impact of Curcumin, resveratrol, and cinnamon on modulating oxidative stress and antioxidant activity in type 2 diabetes: moving beyond an anti-hyperglycaemic evaluation. Antioxidants. 2024; 13(5): 510.
18. Bagheri Y, Barati A, Nouraei S, Namini NJ, Bakhshi M, Fathi E, et al. Comparative study of gavage and intraperitoneal administration of gamma-oryzanol in alleviation/attenuation in a rat animal model of renal ischemia/reperfusion-induced injury. Iran J Basic Med Sci. 2021; 24(2):175-183.
19. Ghasemi A, Jeddi S, Kashfi K. The laboratory rat: Age and body weight matter. Excli J. 2021; 20 (1): 1431-1445.
20. Shirani F, Teimoori A, Rashno M, Latifi SM, Karandish M. Using rats as a research model to investigate the effect of human adenovirus 36 on weight gain. ARYA Atheroscler. 2017; 13(4): 167-171.
21. DiMeglio LA, Evans-Molina C, Oram RA. Type 1 diabetes. Lancet. 2018; 391(10138): 2449–2462.
22. Hope SV, Weinand-Barnett S, Shepherd M, King SM, Fox c, Khunti K, et al. Practical classification guidelines for diabetes in patients treated with insulin: A cross-sectional study of the accuracy of diabetes diagnosis. Br J Gen Pract. 2016; 66(646):e315 322.
23. Chuengsamarn S, Rattanamongkolgul S, Luechapudiporn R, Phisalaphong C, Jirawatnotai S. Curcumin extract for prevention of type 2 diabetes. Diabetes Care. 2012; 35(11):2121–2127.
24. Madkor HR, Mansour SW, Ramadan G. Modulatory effects of garlic, ginger, turmeric and their mixture on hyperglycemia, dyslipidemia and oxidative stress in streptozocin-nicotinamide diabetic rats. Br J Nutr. 2011; 105(8):1210-1217.
25. Nair RV, Varma K, Paul B, Kuttappan S. Evaluation of the anti-hyperglycemic and antioxidant activities of a novel phytochemical formulation. Phytomedicine Plus. 2021; 1(3):1-7.
26. Júnior AS, Aidar FJ, Dos Santos JL, Estevam CD, Santos JD, Silva AM, et al. Effects of resistance training and turmeric supplementation on reactive species marker stress in diabetic rats. BMC Sports Sci Med Rehabil. 2020; 12(45):1-12.