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Effect of Allicin on Pharmacodynamics and Pharmacokinetics of Gliclazide in Diabetic Animal Models

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Abstract

Background: Several factors contribute to the increased use of herbal products: namely, easy accessibility, perception of herbs as safe alternate treatment, desire for self-medication, and lesser cost. With expanding utilization of home-grown medications, there have been concerns with respect to the security of these items, specifically the potential communication of these medications with regular medications. Certain natural enhancements can cause conceivably perilous symptoms when taken with physician recommended drugs.

Objective: To inspect the pharmacodynamic interaction of allicin and gliclazide in animal models and to understand the safety and adequacy.

Methods: Single and multiple dose treatments in normal rats, diabetes triggered rats and rabbits to assess the impact of allicin on the gliclazide movement. Blood tests from the examination of animals were utilized for the estimation insulin and glucose levels by utilizing radioimmunoassay technique and science analyzer (computerized) separately. Homeostasis evaluation utilized for assurance of β-cell work.

Results: Gliclazide produces huge lessening in blood glucose levels in diabetic animals. In the combination, gliclazide in mix with allicin demonstrated more noticeable diminishment in blood glucose fixation in animals with diabetes.

Conclusion: Coadministration of allicin and gliclazide did enhance the antidiabetic activity compared with individual drugs.

Keywords: Allicin; Gliclazide; Diabetes mellitus; Pharmacodynamics; Interactions

Introduction

Numerous medication treatment is the concurrent use of various formulations. It can be identified with the arrangement and furthermore usage of unnecessary pharmaceuticals at estimations or frequencies higher than medicinally essential. These helpful mixes may be noxious [1] or perfect [2] at the given therapeutic measurement. Diabetes mellitus (DM) is a metabolic issue implies with glucose level is unusually high because of insulin deficiency and work or both [3]. Diabetic patient's shows reduce cancer prevention agent levels and expanded oxidative pressure [4]. Gliclazide (second line sulfonylureas) is the favored choice of pharmaceutical which is represented to need to have antioxidant properties [5] lessened tendency to provoke genuine hypoglycaemia and cell strengthening properties [6]. To be sure, phyto concoction separates from herbs either alone or as mix have been ensured to turn away diabetes intricacies [7]. Of these plants, mulberry (*Morus alba* L.) leaf, fenugreek (*Trigonella foenumgraecum*) seed [8], and American ginseng (*Panaxquinquefolius*) root [9] are a great part of the time declared as commendable. Allicin is sourced enzymatically from an unscented antecedent, alliin, when garlic cloves are mechanically disturbed [10]. Despite the fact that numerous clinical preliminaries demonstrated a constructive outcome of garlic on hyperlipidemia, atherosclerosis, thrombosis, hypertension and diabetes [11,12]. On oral organization to alloxan diabetic rabbits, allicin produces an expansion in its hypoglycemic activity with connection to measurement. A fleeting treatment with allicin, and also with tolbutamide, essentially lessened the glucose levels and glucose nitrogen proportion of the above animals [13]. Allicin indicates cardioprotective impact on myocardial damage of streptozotocin instigated diabetic rats with conceivable components were associated with diminishing blood glucose, redressing hemodynamic disability, lessening Fas articulation, actuating Bcl-2 articulation, diminishing intracellular calcium over-burden, repressing the declarations of TGF-β1 and CTGF, and further enhancing cardiovascular function [14]. Also, there is restricted data about allicin movement on blood glucose levels and communication with against diabetic medication gliclazide in creature models. Hence, this examination improves the hypoglycemic action of allicin on gliclazide in animals' model.

Methods

Drugs

Gift samples of gliclazide and allicin acquired from DRL, Hyderabad, India, and Inidamart, Delhi respectively. Alloxan (monohydrate) be procured from Loba Chemie, Mumbai, India. Analytical grade materials and reagents used for present study.

Allicin solution

allicin powder weighed and dissolved in distilled water and make to 4 mg/ml solution. A dose of 8mg/kg of body weight was administered by using clean and dry oral feeding needle for 21 days [14].

Gliclazide solution

Gliclazide in a small amount of 0.1 N sodium hydroxide used to prepare gliclazide solution and water used for final volume makeup [15].

Preparation of alloxan solution

A dose of 110 mg/Kg alloxan monohydrate in sterile saline prepared and injected by s.c. route instantly within few minutes to evade degradation [16].

Animals

Albino rats (8-9 weeks aged) & albino rabbits (3 months old) selected gender male aged having weight between 170 and 250g and between 1 and 1.5kg respectively were obtained from M/s Mahavir Enterprises, Hyderabad. They were maintained under controlled room temperature (24±2 ˚C; relative humidity 60-70%) in a 12h light - dark cycle. The animals were provided a standard laboratory diet and water *ad libitum.* Before performing the experiment, the animals were acclimatized. The experimental protocol was approved by the Institutional Animals Ethics Committee (IAEC). Reference # GBN/GQ/2014.

Experimental study design

Five groups of male albino rats/rabbits were made and each consisting of six animals. Based on the gliclazide doses of 2 and 4mg/kg per body from dose-effect association learning in normal rats and rabbits, the weight considered for oral administration. Study designed as follows:

Group I: Normal control

Group II: Diabetic control

Group III: Gliclazide (2mg/kg for rats/ ;4mg/kg for rabbits) body weight, *po*.

Group IV: 4mg/kg, *po* of Allicin on body weight.

Group V: Allicin (8mg/kg) + Gliclazide (2mg/kg for rats/4mg/kg for rabbits) body weight, *po*.

Diabetic rats - Pharmacodynamic interactions

Male albino rats weighing (170-250g) were fasted for overnight prior to administration of freshly prepared alloxan monohydrate solution and injected within 5 min of preparation to avoid solution degradation at a dose of 110mg/kg. Immediately, 5% glucose solution was orally administered for 72 h to prevent any chances of hypoglycemia shock. Animals had provided with continuous with water and feed. Animals were confirmed for development of hyperglycaemia by analysis of fasting serum glucose levels after 72 h of alloxan monohydrate solution injection where animals were fasted for a second time of 14 h and blood samples collected from retro orbital plexus.

The rats having a fasting blood glucose level of 200mg/dl or above at 72h were included in the study as diabetic subjects. Gliclazide (2mg/kg, *po*.) was administered after 30 min of allicin administration (8mg/kg, *po*.). Blood glucose levels were estimated on initial, 1st day, 3rd day, 7th day, 14th day, and 21st day of the treatment.

Normal rats - pharmacodynamic interactions

Six rats were chosen for the investigation. Gliclazide (2mg/kg of animal body weight) was given orally to Group III rats and withdrawn blood at programmed time points. A similar procedure was followed with either allicin 8mg/kg, *po*. (Group IV) alone or combination of allicin and gliclazide (Group V) as per the designed doses. Consequently, the treatment was sustained for 20 days with standard feeding. The animals were dosed with gliclazide (2mg/kg) after 30 minutes of each allicin treatment. Samples withdrawn at programmed time points for each treatment [17].

Diabetic rabbits - Pharmacodynamic interactions

Each group has six rabbits. Alloxan (100mg/kg) in normal saline used to induce diabetes on single intravenous *iv* injection [18]. Gliclazide (4mg/kg) was given orally to Group III rabbits and their samples withdrawn at planned time points. A similar procedure was followed with either allicin only (Group IV) or combination of allicin and gliclazide (Group V) at the specified doses.

After this single-dose interaction study, the same animals received daily treatments with allicin for the next 20 days with regular feeding. Before 30minutes of gliclazide treatment the animals were dosed with allicin for each treatment. Samples withdrawn at scheduled time intervals for each treatment of drugs gliclazide, allicin, or combination [19].

Collection of serum samples

Under light ether anesthesia, marginal ear vein and retro orbital plexus punctured and the blood withdrawnfor14h fasted rats and rabbits respectively on different occasions i.e., day 0, 1st day, 3rd day, 7th day 14th day and 21st day. On day 0 (SDT) and day 21st (MDT) blood samples collected to estimate insulin levels and glucose concentration by using radioimmunoassay and chemistry analyzer (automated), respectively. Homeostasis model assessment was used to determine β-cell function.

Determination of β-cell function

β-cell function was assessed by the homeostatic model assessment protocol and calculated [15,20,21]. β-cell function = (FSI x 20) / (FSG – 3.5) ×100

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$$\beta - \text{cell function} = \frac{(\text{FSI X } 20)}{(\text{FSG} - 3.5)} \text{X}100$$

Where FSI=fasting serum insulin (μIU/ml) and

FSG= fasting serum glucose(mg/dL).

Statistical analysis

The data were analysed using one-way analysis of variance (ANOVA), followed by Dunnett's test (Sigma Plot version 11) and $p<0.05$ was considered as statistically significant. The data were expressed as mean ± Standard deviation (SD).

Results

Pharmacodynamic interaction between allicin and gliclazide

Table 1: Mean percent blood glucose reduction of gliclazide in presence and absence of Allicin in single and multi-dose study for normal rats (n=6).

Treatment	Mean Percent Blood Glucose Reduction					
	Day 0	Day 1	Day 3	Day 7	Day 14	Day 21
Gliclazide (2mg/kg)	39.8**	40.2**	41.3**	42.5**	45.1**	46.3**
Allicin (8mg/kg)	1.6	1.6	1.7	1.7	1.6	1.7
Allicin (8mg/kg) + Gliclazide (2mg/kg)	40.7**	41.0**	42.1**	43.3**	45.9**	47.1**

**(*p<0.01)* Statistically significant when compared with normal control.

Table 2: Mean percent blood glucose reduction of gliclazide in presence and absence of Allicin in single and multi-dose study for diabetic rats (n=6).

Treatment	Mean Percent Blood Glucose Reduction					
	Day 0	Day 1	Day 3	Day 7	Day 14	Day 21
Gliclazide (2mg/kg)	43.9**	45.5**	47.3**	50.4**	53.9**	57.9**
Allicin (8mg/kg)	44.2**	46.4**	48.5**	51.3**	55.3**	60.5**
Allicin (8mg/kg) + Gliclazide (2mg/kg)	48.7**	51.7**	54.7**	58.5**	63.3**	68.5**

**(p<0.01) Statistically significant against diabetic control.

Table 3: Mean percent blood glucose reduction of gliclazide in presence and absence of Allicin in single and multi-dose study for diabetic rabbits (n=6).

Treatment	Mean Percent Blood Glucose Reduction					
	Day 0	Day 1	Day 3	Day 7	Day 14	Day 21
Gliclazide (4mg/kg)	36.2**	40.7**	43.5**	47.6**	52.0**	56.3**
Allicin (8mg/kg)	37.9**	42.0**	44.9**	49.2**	53.8**	57.5**
Allicin (8mg/kg) + Gliclazide (4mg/kg)	42.4**	46.1**	51.2**	55.9**	61.6**	66.8**

**(p<0.01) Statistically significant when compared with diabetic control.

Table 4: Effect of Allicin on β-cell function in diabetic rats (n=6)

Treatment	β-cell function					
	Day 0	Day 1	Day 3	Day 7	Day 14	Day 21
Gliclazide (2mg/kg)	130.90±1.85	143.07±2.30	152.76±3.45	183.93±3.73	218.71±3.82	258.02±8.98
Allicin (8mg/kg)	142.35±3.75	158.00±4.26	169.66±4.64	192.75±2.27	234.12±5.45	285.63±4.22
Allicin (8 mg/kg) + Gliclazide (2mg/kg)	199.98±3.54	218.99±3.65	237.39±3.74	278.80±4.95	400.21±4.87	538.43±5.52

Notes: Data expressed as mean ± standard deviation. Calculated by homeostasis model assessment

Table 5: Effect of Allicin on insulin levels in diabetic rats (n=6)

Treatment	Insulin (μIU/mL)					
	Day 0	Day 1	Day 3	Day 7	Day 14	Day 21
Gliclazide (2mg/kg)	11.23±0.16	12.27±0.20	13.33±0.30	15.59±0.32	17.77±0.31	19.93±0.69
Allicin (8mg/kg)	12.14±0.32	13.31±0.36	14.46±0.40	16.05±0.19	18.44±0.43	20.64±0.31
Allicin (8mg/kg) + Gliclazide (2mg/kg)	15.65±0.28	16.59±0.28	17.75±0.28	19.73±0.35	25.71±0.31	30.83±0.32

Notes: Data expressed as mean ± standard deviation.

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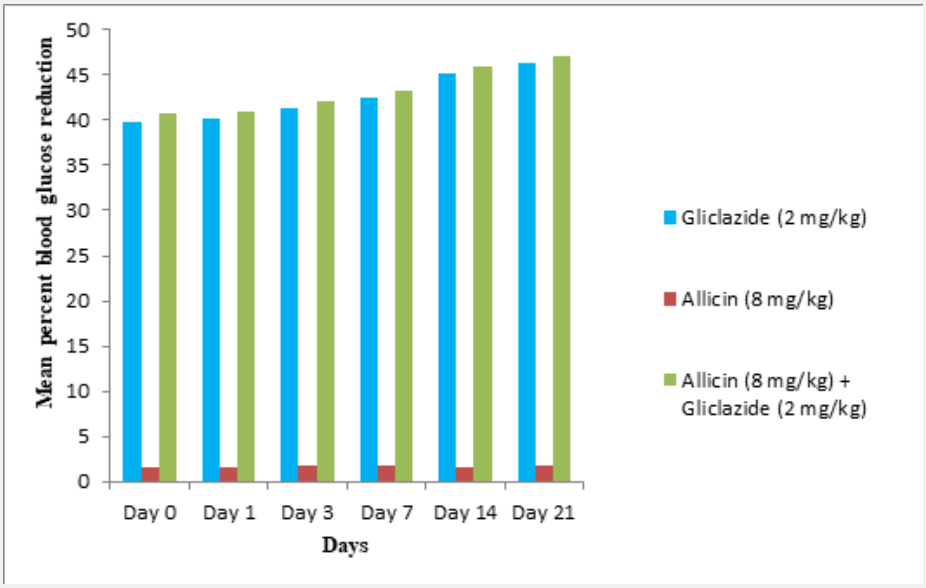

Figure 1: Mean percent blood glucose reduction of gliclazide in presence and absence of Allicin in single and multi-dose study for normal rats (n=6).

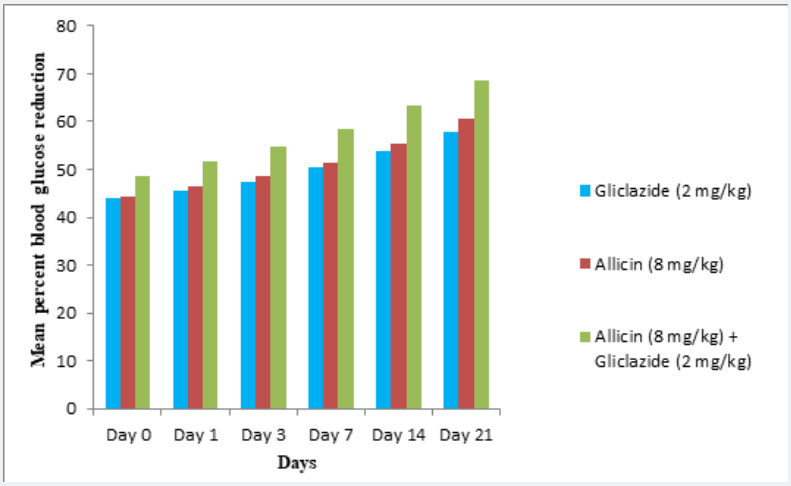

Figure 2: Mean percent blood glucose reduction of gliclazide in presence and absence of Allicin in single and multi-dose study for diabetic rats (n=6).

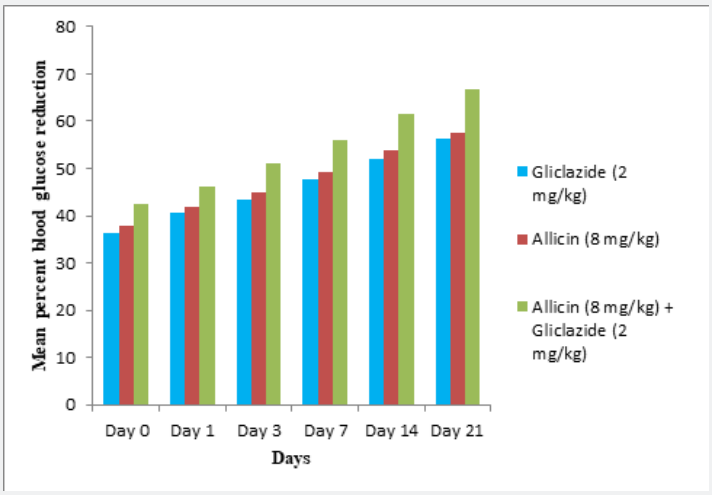

Figure 3: Mean percent blood glucose reduction of gliclazide in presence and absence of Allicin in single and multi-dose study for diabetic rabbits (n=6).

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Gliclazide Results: Gliclazide created the hypoglycemic effect in normal rats. The observations from Table 1 & Figure 1 of lowering of blood glucose levels by improvement in mean percent blood glucose reduction from initial day 39.8% to 46.3% for the day 21 treatment. The results from Table 2 & Figure 2 in diabetic rats the activity is more extreme as per record mean percentage blood glucose reduction from initial day 43.9 to 57.9% on day 21 treatment. In diabetic rabbits the anti-hyperglycemias action was shown in Table 3 & Figure 3 with maximum percent blood glucose reduction of 36.2 to 56.3% from the initial day to 21st day respectively. The anti-hyperglycaemic activity evidenced by improvement in β-cell function and insulin levels as recorded in Table 4&5 and Figure 4&5 for the initial dose in the 21st day study are 130.90±1.85 to 258.02±8.98 and 11.23±0.16 to 19.93±0.69 respectively in diabetic rats.

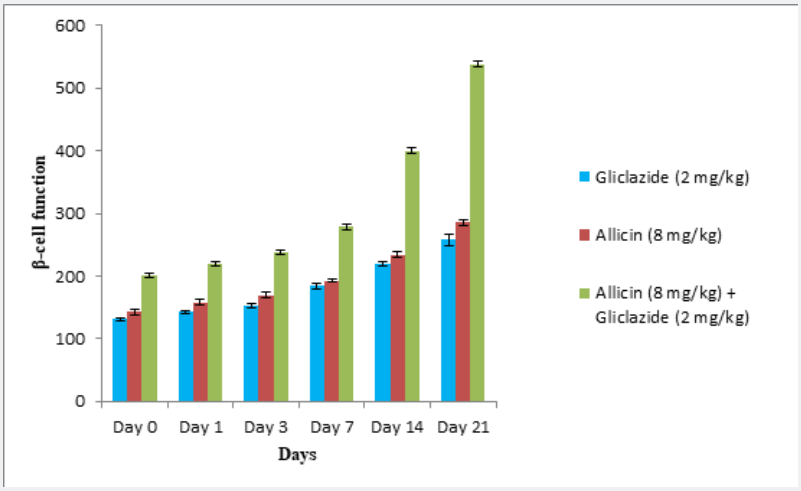

Figure 4: Effect of Allicin on β-cell function in diabetic rats (n=6).

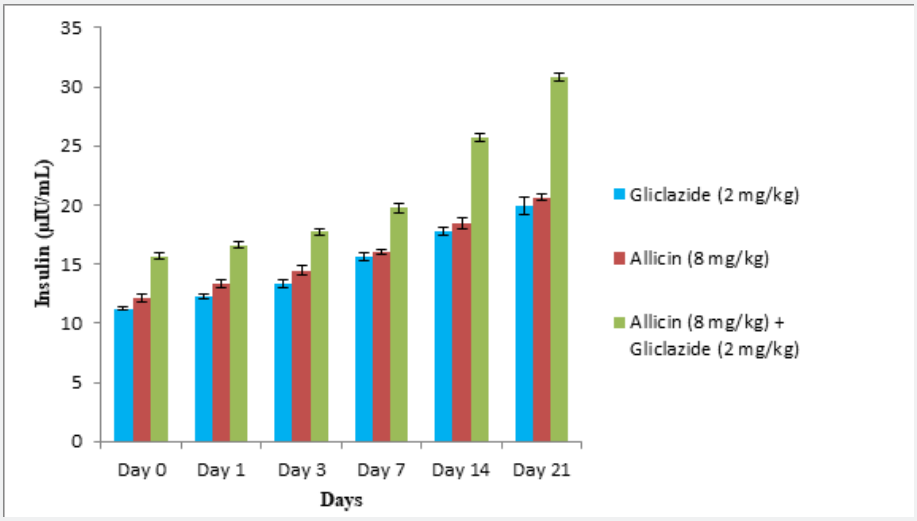

Figure 5: Effect of Allicin on insulin levels in diabetic rats (n=6).

Allicin Results: The blood glucose levels from Table 1 & Figure 1 in normal rats doesn't alter by allicin treatment alone, but significant mean percentage blood glucose reduction observed in diabetic rabbits as 44.2 to 60.5% from day initially to 21st day treatment from Table 2 & Figure 2. This is the similar fashion as with gliclaizde the anti-hyperglycaemic activity probably with improvement in β-cell function and insulin levels as recorded in Table 4&5 and Figure 4&5 for the initial dose to 21st day study are 142.35±3.75 to 285.63±4.22 and 12.14±0.32 to 20.64±0.31 respectively.

Combination treatment results: Single and multiple dosed allicin along with gliclazide proved to significant percent blood glucose improvement as 40.7% of initial dose to 47.1% of 21st day treatment in normal animal models (Table 1 & Figure 1). Further, numerous measurement combination of allicin with gliclazide created fundamentally more prominent decreasing in blood glucose levels after treatment in diabetic rats and rabbits when contrasted and diabetic control. The values recorded from an initial dose to 21st day treatment of mean percentage blood glucose reduction is 48.7 to 68.5% and 42.4 to 66.8% of diabetic rats from Table 2 & Figure 2 and rabbits Table 3 & Figure 3 respectively.

Allicin exhibited supportive effect by escalating the activity of gliclazide and also significant changes in β-cell function 199.98±3.54 to 538.43±5.52 and insulin levels 15.65±0.28 to

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30.83±0.32μIU/mL in diabetic rats (Table 4&5 and Figure 4&5). Whereas the results validated from diabetic rabbit study the significant changes in β-cell function 248.09±2.10 to 503.99±2.49 and insulin levels 20.28±0.17 to 28.85±0.14μIU/mL from initial dose of single dose study to 21st day dose of multiple dosed study represented in Table 6 &7 & Figure 6&7.

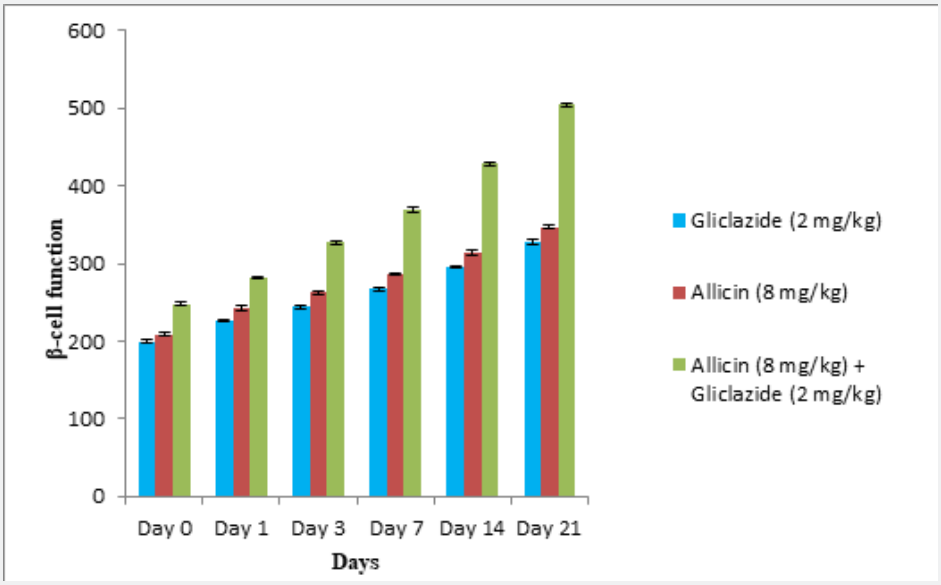

Figure 6: Effect of Allicin on β-cell function in diabetic rabbits (n=6).

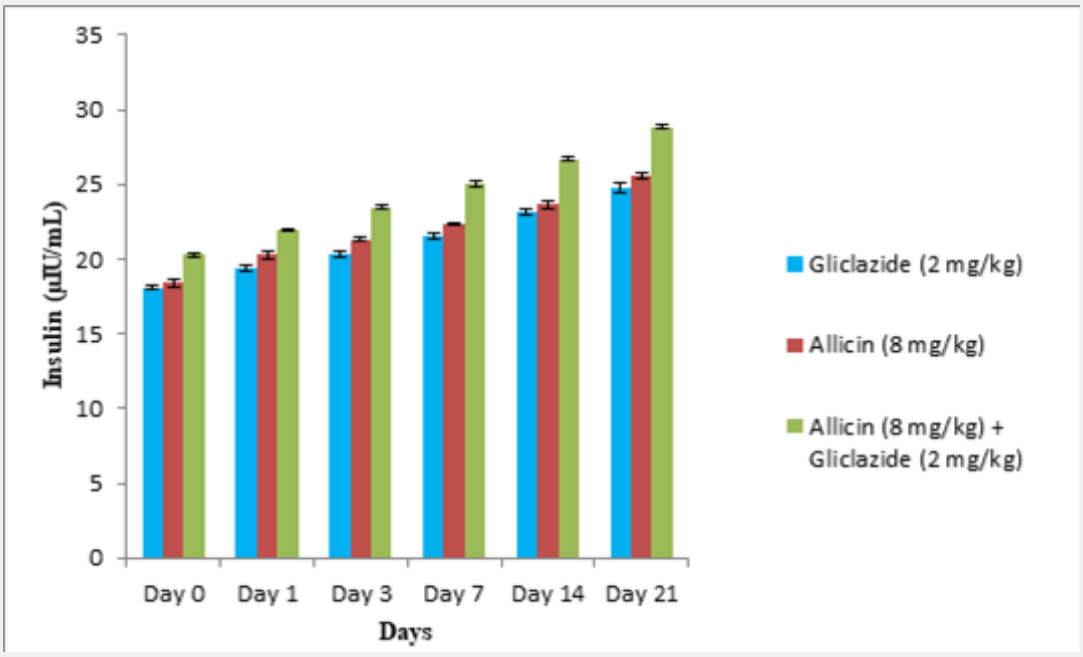

Figure 7: Effect of Allicin on insulin levels in diabetic rabbits (n=6).

Table 6: Effect of Allicin on β-cell function in diabetic rabbits (n=6).

Treatment	β-cell function					
	Day 0	Day 1	Day 3	Day 7	Day 14	Day 21
Gliclazide (4mg/kg)	199.43±2.05	226.22±1.79	243.86±2.17	267.10±2.25	295.59±2.08	326.91±3.73
Allicin (8mg/kg)	208.42±2.60	242.21±3.34	262.42±1.89	285.58±1.57	314.02±3.95	346.55±2.02
Allicin (8mg/kg) + Gliclazide (4mg/kg)	248.09±2.10	282.51±1.24	327.13±2.34	369.05±3.32	428.57±2.81	503.99±2.49

Notes: Data expressed as mean ± standard deviation. Calculated by homeostasis model assessment

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Table 7: Effect of Allicin on insulin levels in diabetic rabbits (n=6).

Treatment	Insulin (μIU/mL)					
	Day 0	Day 1	Day 3	Day 7	Day 14	Day 21
Gliclazide (4mg/kg)	18.10±0.19	19.40±0.15	20.30±0.18	21.57±0.18	23.13±0.16	24.76±0.28
Allicin (8mg/kg)	18.39±0.23	20.29±0.28	21.32±0.15	22.35±0.12	23.63±0.30	25.56±0.15
Allicin (8mg/kg) + Gliclazide (4mg/kg)	20.28±0.17	21.97±0.10	23.47±0.17	25.00±0.23	26.68±0.17	28.85±0.14

Notes: Data expressed as mean ± standard deviation

Discussion

Prescription mixes accept about being a basic piece of pharmacology inquire about, and such correspondences are ordinarily surveyed in animal models [22]. Despite the fact that animal models can never swap the necessity for broad contemplates in human subjects, they help in understanding the frameworks of medicine joint efforts. The present examination is expected to evaluate the effect of allicin on the activity of gliclazide in animal models. animal demonstrate utilizing typical rats was utilized to distinguish the connection where as that of diabetic rats was utilized to approve the association. The investigation additionally approved by utilizing unique species, rabbit show [19]. The hypoglycemic activity of gliclazide in rats is intervened by blocking K+channels in β-cells of pancreas [23], thusly engaging insulin outflow and in addition change in β-cell work by the way growing tissue take-up of glucose [24]. Insulin levels were evaluated at time interims, where more prominent change in mean percent blood glucose levels were watched both in rats and in rabbits under diabetes upon gliclazide treatment. Any drug or home-grown dynamic segment may change the pharmacodynamic development of the substrate when it is a potential inducer or inhibitor of that particular medicine using proteins, for example, using chemicals. Allicin can possibly cause herb–tranquilize cooperation when regulated with different medications. This investigation uncovered the impact of allicin on the pharmacodynamic movement of gliclazide alone and in mix utilizing single and various measurements medications in rats and rabbits. The end judgments were surveyed the extent that glucose level (% mean glucose lessening), insulin level and β-cell work using homeostatic model evaluation of gliclazide in rabbits. In the present examination, single and numerous measurement treatment of allicin acquired about noteworthy change by means of change with percent blood glucose decrease in diabetic rats and diabetic rabbits when differentiated and ordinary and diabetic controls exclusively. Here allicin demonstrates a strong impact when joined with gliclazide. Liver has been gave off an impression of being an insulin subordinate tissue, and is evidently drawn in with glucose and lipid homeostasis, which is typically to a great degree affected in the midst of diabetes [25]. The metabolic activity of Allicor was examined in the 4-week twofold blinded fake treatment-controlled investigation in 60 type 2 diabetic patients. Fasting blood glucose was estimated day by day, and serum fructosamine and in addition cholesterol and triglyceride levels were resolved at the gauge, after 1, 2, 3 and a month. It has been shown that treatment with Allicor brought about better metabolic control because of the bringing down of fasting blood glucose, serum fructosamine and serum triglyceride levels. The consequences of this examination may permit suggesting garlic powder tablets Allicor for the treatment of sort 2 diabetes mellitus alongside dietary treatment and additionally sulfonylurea subordinates to accomplish better metabolic control [26]. Insulin impacts the intracellular utilization of glucose in different ways. Glucokinase catalyzes the difference in glucose to glucose - 6-phosphate and expect a central part in the protection of glucose homeostasis. In the liver, this compound is a basic controller of glucose accumulating and exchange [27]. Allicin may apply its hypoglycemia movement by means of expanded hepatic glucokinase action and most likely by animating insulin discharge from pancreatic β-cells as prove by raised serum insulin level [28].

Conclusion

The examination affirms that the interaction of allicin with gliclazide is pharmacodynamic in nature as the glucose levels in animal models. Since the interaction is grasped in two different species, it is likewise liable to happen in people. Hence, this combination needs observing of glucose levels occasionally when managed for their clinical advantages in diabetic patients.

References

1. Zhao ZL, Kim SC, Liu HF, Wu YY, Li LB et al. (2017) Blockade of nicotine sensitization by methanol extracts of Glycyrrhizae radix mediated via antagonism of accumbal oxidative stress. BMC Complement Altern Med 17(1): 493.
2. Soudeiha MAH, Dahdouh EA, Azar E, Sarkis DK, Daoud Z (2017) *In vitro* Evaluation of the Colistin-Carbapenem Combination in Clinical Isolates of *A. baumannii* Using the Checkerboard, Etest, and Time-Kill Curve Techniques. Front Cell Infect Microbiol 7(209).
3. Ozougwu JC, Obimba KC, Belonwu CD, Unakalamba CB (2013) The pathogenesis and pathophysiology of type 1 and type 2 diabetes mellitus. J PhysiolPathophysiol 24: 46-57.
4. Ganjifrockwala FA, Joseph JT, George G (2017) Decreased total antioxidant levels and increased oxidative stress in South African type 2 diabetes mellitus patients. Journal of Endocrinology, Metabolism and Diabetes of South Africa 22(2): 21-5.
5. Brien RC, Luo M, Balaza N (2000) In vitro and in vivo antioxidant properties of gliclazide. J Diabetes Complications 14(4): 201-206.
6. Kimoto K, Suzuki K, Kizaki T, Hitomi Y, Ishida H, et al. (2003) Gliclazide protects pancreatic beta-cells from damage by hydrogen peroxide. Biochem Biophys Res Commun 303(1): 112-119.
7. Chang CL, Lin Y, Bartolome AP, Chen YC, Chiu SC, et al. (2013) Herbal therapies for type 2 diabetes mellitus: chemistry, biology, and potential application of selected plants and compounds. Evid Based Complement Alternat Med 2013: 378657.

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8. Hamden K, Keskes H, Elgomdi O, Feki A, Alouche N (2017) Modulatory Effect of an Isolated Triglyceride from Fenugreek Seed Oil on of α-Amylase, Lipase and ACE Activities, Liver-Kidney Functions and Metabolic Disorders of Diabetic Rats. J Oleo Sci 66(6): 633-45.

9. Xie JT, Wang CZ, Ni M, Wu JA, Mehendale SR, et al. (2007) American Ginseng Berry Juice Intake Reduces Blood Glucose and Body Weight in ob/ob Mice. J Food Sci 72(8): S590- S594.

10. Freeman F, Yukihiro Kodera (1995) Garlic Chemistry: Stability of S-(2-Propenyl)-2-Propene-1-sulfinothioate (Allicin) in Blood, Solvents, and Simulated Physiological Fluids. J Agric Food Chem 43(9): 2332-2338.

11. Steiner M, Li W (2001) Aged Garlic Extract, a modulator of cardiovascular risk factors. A dose finding study on the effects of AGE on platelet functions. J Nutr 131(3s): 980S-984S.

12. Stevinson C, Pittler MH, Ernst E (2000) Garlic for treating hypercholesterolemia. A meta-analysis of randomized clinical trials. Ann Intern Med 133(6): 420-429.

13. Augusti KT (1975) Studies on the effect of allicin (diallyl disulphide-oxide) on alloxan diabetes. Experientia 31(11): 1263-1265.

14. Liu Y, Qi H, Wang Y, Wu M, Cao Y, et al. (2012) Allicin protects against myocardial apoptosis and fibrosis in streptozotocin-induced diabetic rats. Phytomedicine 19(8-9): 693-698.

15. Mastan SK, Kumar KE (2010) Effect of antiretroviral drugs on the pharmacodynamics of gliclazide with respect to glucose-insulin homeostasis in animal models. J ExpPharmacol 2: 1-11.

16. Haribabu T, Divakar K, Goli D (2013) Evaluation of anti-diabetic activity of Allicin and its synergistic effect with Metformin hydrochloride and Glipizide in Alloxan induced diabetes in rats. SchAcad J Pharm 2(2): 119-24.

17. Satyanarayana S, Kilari EK (2006) Influence of nicorandil on the pharmacodynamics and pharmacokinetics of gliclazide in rats and rabbits. Mol Cell Biochem 291(1-2): 101-105.

18. Anna Gumieniczek, Hanna Hopkala, Zbigniew Wójtowicz, Justyna Nikolajuk (2002) Changes in antioxidant status of heart muscle tissue in experimental diabetes in rabbits. Acta Biochim Pol 49(2): 529-35.

19. Kumar KE, Mastan SK (2011) Influence of efavirenz and nevirapine on the pharmacodynamics and pharmacokinetics of gliclazide in rabbits. J Endocrinol Metab 1(3): 113-24.

20. Bonora E, Targher G, Alberiche M, Bonadonna RC, Saggiani F, et al. (2000) Homeostasis model assessment closely mirrors the glucode clamp technique in the assessment of insulin sensitivity: studies in subject with various degrees of glucose tolerance and insulin sensitivity. Diabetes Care 23(1): 57-63.

21. Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, et al. (1985) Homeostasis model assessment: insulin resistance and β-cell function from fasting plasma glucose and insulin concentrations in man. Diabetologia 28(7): 412-419.

22. Gupta RC, Atul BV (2000) Drug metabolism studies in animal models. Ind J Pharmacol 32(4): 562-6.

23. Ma A, Kamp M, Bird B (1989) The effects of long term gliclazide administration on insulin secretion and insulin sensitivity. Aus N Z J Med 19(1): 14-49.

24. Vanhaeften TW, Vaneman TF, Gerich JE (1991) Influence of gliclazide on glucose stimulated insulin release in man. Metabolism 40(7): 751-5.

25. Shetti AA, Sanakal RD, Kaliwal BB (2012) Anti diabetic effect of ethanolic leaf extract of Phyllanthusamarus in alloxan induced diabetic mice. Asian J Plant SciRes 2(1): 11-5.

26. Sobenin IA, Nedosugova LV, Filatova LV, Balabolkin MI, Gorchakova TV, et al. (2008) Metabolic effects of time-released garlic powder tablets in type 2 diabetes mellitus: the results of double-blinded placebo-controlled study. Acta Diabetol 45(1): 1-6.

27. Roger R Gomis, Cristia´n Favre, Mar Garcı´a-Rocha, Josep M Ferna´ndez-Novell, Juan C Ferrer, et al. (2003) Glucose 6-Phosphate Produced by Gluconeogenesis and by Glucokinase Is Equally Effective in Activating Hepatic Glycogen Synthase. J Biol Chem 278:9740-6.

28. Daniel EE, Mohammed A, Yusuf T, Ahmed A, Mohammed KR (2015) Hypoglycemia effect of Allicin in Streptozotocin-Induced Diabetic Wistar Rats. Br J Med Med Res 7(9): 762-770.

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