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Allium cepa Protects Renal Functions in Diabetic Rabbit

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ABSTRACT [ENGLISH/ANGLAIS]

About 90% of all diabetes is type 2, wherein the body can produce the insulin needed, but cells do not respond to it. In this study we investigated the possibility that *Allium cepa* (a very cheap and readily available species of the genus *Allium*) has healing/beneficial effects on type 2 diabetics. Twenty acclimatized adult rabbits were randomly divided into four groups of five rabbits each. Three of the groups were made diabetic (with single intraperitoneal injection of alloxan), and two of the three groups were administered graded doses of Allium cepa extract. The results reveal that *Allium cepa* has renal protective effects in diabetic rabbits. This study concludes that *Allium cepa* contains some bioactive substances (mostly antioxidants) which could prevent renal organ damage from hyperglycemia in diabetes mellitus. Directions for further studies are also suggested

Keywords: Diabetes, kidney, renal, creatinine, urea, Allium cepa, oxidant, anti-oxidants

RÉSUMÉ [FRANÇAIS/FRENCH]

Environ 90% de tous les diabètes de type 2, dans lequel le corps peut produire l'insuline nécessaire, mais les cellules ne répondent pas à elle. Dans cette étude, nous avons étudié la possibilité que Allium cepa cepa (une espèce très bon marché et facilement disponible du genre Allium) a des propriétés curatives / des effets bénéfiques surdiabétiques de type 2. Vingt lapins adultes acclimatés ont été divisés au hasard enquatre groupes de cinq lapins chacun. Trois des groupes ont été rendus diabétiques(avec injection intrapéritonéale unique de l'alloxane), et deux des trois groupes ont reçu des doses progressives de la LCPE extrait Allium. Les résultats révèlent que Allium cepa a rénales effets protecteurs chez les lapins diabétiques. Cette étude conclut queAllium cepa contient certaines substances bioactives (la plupart du temps antioxydants) qui pourraient empêcher des dommages aux organes rénale de l'hyperglycémie dans le diabète sucré. Itinéraire pour d'autres études sont également suggéré

Mots-clés: Le diabète, les reins, rénale, la créatinine, urée, Allium cepa, oxydants, anti-oxydants

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INTRODUCTION

Diabetes mellitus is a disorder of glucose (blood sugar) metabolism, whereby the body is not properly making use of glucose in the blood stream, therefore compromising a necessary function for cell nutrition and function. The less common Type 1 Diabetes is caused by the body's inability to produce insulin. However, about 90% of all diabetes is Type 2, wherein the body can produce the insulin needed, but cells do not respond to it, making it ineffectual, while type 1 Diabetes accounts for the remaining 10% of all diabetes cases.

Allium cepa is one of the oldest vegetables known to mankind, and are found in a bewildering array of recipes and preparations, spanning almost the totality of the world's cultures, although native to South Asia [1]. Active contents of Onion include Flavonoids which is documented to be very helpful in taken care of atherosclerosis [2]. Intake of quercetin in the diet, primarily from onion, tea, and apples, has been linked to a decreased risk of having a heart attack [3].Although onion and onion oil constituents have been repeatedly shown to kill various microbes in the test tube, studies have not been conducted in humans to determine whether onion is a useful antimicrobial agent.

In this study we investigated the possibility that onion has healing/beneficial effects on type 2 diabetics.

MATERIALS AND METHODS

Preparation of *Allium cepa* (onion) Extract

Allium cepa extract was prepared as described by Nelson et al. [4]. Fresh clean *Allium cepa* of 200g was blended and left to stand for 24 hrs so as to release the active contents. Its Juice was then squeezed out using clothing mesh and stored at a temperature of 4°C.

Animals and Experimental Design

Twenty acclimatized adult rabbits were randomly divided into four groups (A, B, C, D), n = 5. The animals in group A served as the control and were not made diabetic. Groups B, C and D animals were made diabetic using intraperitoneal injection of 200 mg of alloxan/Kg BW [5]. The animals were, after 24 hours, tested for diabetes by taking their blood glucose level. The research continued after groups B, C, D animals were confirmed diabetic. Both group A and group B animals were given 5.0 ml of normal saline daily. Group C animals were treated daily with low dose (2.5ml) of Allium cepa extract and 2.5ml of normal saline orally, while group D animals were treated daily with high dose (5.0ml) of *Allium cepa* extract and 5.0 ml of normal saline orally. The experiment continued for eight weeks.

Animal Sacrifice, Sample Collection, and Data Analyses

Blood glucose level was measured before inducing diabetes, after inducing diabetes, and after each week of treatment. Twenty four hour urine sample were collected at the end of the eight weeks of treatment. Animals were then sacrificed and blood samples were collected and kidneys harvested. Data on blood glucose level, renal (creatinine and urea) clearance, urine glucose concentration, histology of the kidney were collected and analysed. Results are presented as point estimates (and with a measure of variations included). Independent samples t-test was used to analyse data. Differences at the level of $p < 0.05$ are considered significant.

RESULTS

Body weight increase and kidney weight were significantly ($p< 0.01$, and $p< 0.05$ respectively) lower in the diabetic untreated group (table 1). The mean values of weight increase in the control and the treated group (low and high doses) showed no significant differences. Table 1 shows that at the initial stage, there is no significant difference in the blood glucose level between the control group and the diabetic group. At the fourth week a significant increase ($p< 0.05$) in blood glucose level was observed in the diabetic untreated group while there was a reduction in blood glucose level in the treated groups. A recovery trend towards the value of the control was confirmed at the eighth week. Similar trends were also obtained for other characteristics (such as packed cell volume, etc.) that were studied (see Table 1 and Table 2). This may mean that the treatment has the potential of providing complete recovery given a longer period of administration. For example blood glucose level was lowered significantly in the *Allium cepa* treated groups; packed cell volume was more conserved in the *Allium cepa* treated groups; the 24-hour urine volume for the *Allium cepa* treated groups did not significantly deviate from that of the control; and unlike the diabetic non-treated groups, the diabetic *Allium cepa* treated groups had urine urea concentration, plasma urea concentration, urine creatinine concentration, plasma creatinine concentration, and urea and creatinine clearances that are comparable to those obtained in the control group (see Table 1 and Table 2).

Table 1 : This table shows effect of *Allium cepa* on body weight, kidney weight and blood parameters

	Group A	Group B	Group C	Group D
Body weight change (Kg)	0.19 ± 0.10	0.008 ± 0.10**	0.15 ± 0.057	0.15 ± 0.04
Kidney weight (g)	1.40 ± 0.34	1.29 ± 0.154*	1.41 ± 0.110	1.38 ± 0.104
PCV				
Initial	38.0 ± 1.58	37.6±1.81	38.2±1.92	37.8±3.89
Fourth week	38.6±2.30	32.2±1.48**	35.6±2.70*	35.0±2.91*
6th week	37.6±2.07	31.8±1.92*	36.6±2.70	37.0±3.24
Blood glucose level				
Initial	118.6 ±6.10	115.8±5.89	115±7.91	118.8±6.87
Fourth week	119.6±2.30	157.2±9.52**	142±10.44**	138.6±6.27*
Eight week	119.4±2.07	156.0±8.66**	125.4±5.17	123.8±7.38

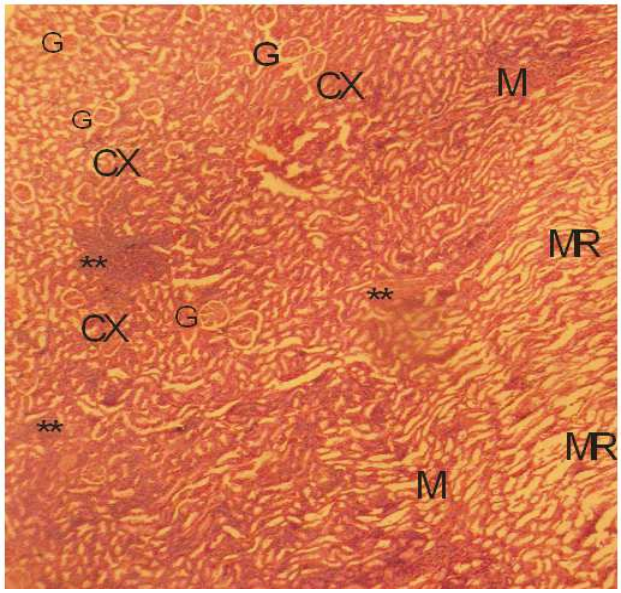
** = "p < 0.05"; ** = "p < 0.01"*

Table 2 : This table shows effects of *Allium cepa* on urine volume, plasma and urine creatinine and urea concentrations, and urea and creatinine clearances

	Group A	Group B	Group C	Group D
Urine volume (ml)	11.68± 1.23	15.38 ± 1.32**	13.24 ± 0.89*	11.64±1.06
Urine urea concentration	31.98± 2.26	17.44± 4.76**	24.70 ± 6.71**	26.62 ± 2.92
Plasma urea concentration	18.92±2.08	24.72 ±3.71	21.72 ± 2.09	18.56 ± 1.52
Urine creatinine concentration	1088.8±112.7	477.8±85.15**	917.0 ± 46.91	1011.6±88.06
Plasma creatinine concentration	604.8±46.31	681.6±50.18*	644.0±29.46	603.4±45.51
Urea clearance	19.92±3.28	10.66±1.69**	15.30±5.30	16.45±2.96
Creatinine clearance	21.07±2.98	10.73±0.57**	18.88±1.80	19.55±2.41

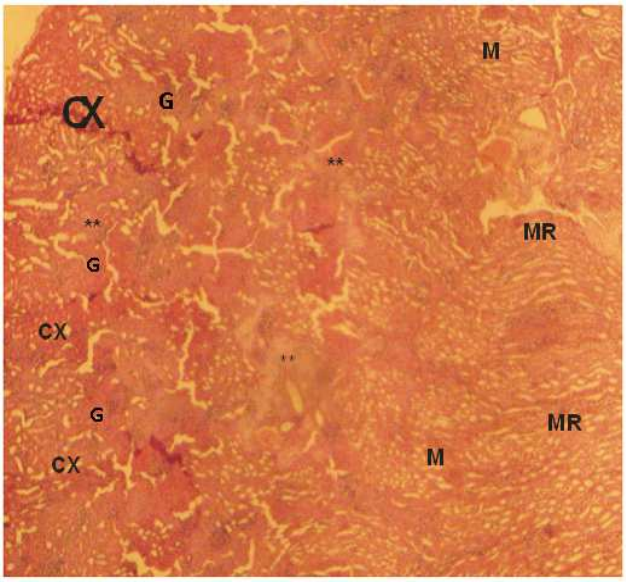
** = "p < 0.05"; ** = "p < 0.01"*

Figure 1 : This figure shows the photomicrograph of the kidney of rabbit for normal control group



*G = Glomerulus; CX = Cortex; MR = Medullary Rays; M = Medulla; ** = Potential Artifact; staining method: H & E; Magnification level: X400*

Figure 2 : This figure shows the photomicrograph of the kidney of rabbit for diabetes control group



*G = Glomerulus; CX = Cortex; MR = Medullary Rays; M = Medulla; ** = Potential Artifact; staining method: H & E; Magnification level: X400*

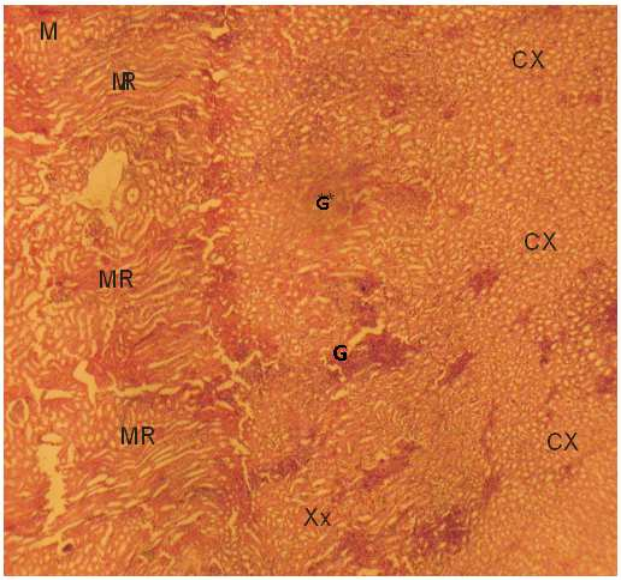
The normal control group (group A) shows normal cortico-medullary differentiation with normal renal parenchyma. It also show normal glomerullus with it bowman capsule, the medullary region showing at the upper part of the micrograph with the normal cell lining the epithelium (figure 1). The Diabetes Control Group had (artifact around the cortex which spread toward the medulla, and) infiltration of glomerulli tissue within the cortex with distortion of the epithelia lining the cortex and glomerullus. Degenerative changes are observed with the destruction of the glomerullus which twins the tissue to become fibrous to become fibrous and the epithelia lining becomes simple squamous (figure 2). Diabetes group treated with low dose of *Allium Cepa* (group C) shows (a reduce artifact around the cortex and glomerulus, with) distortion of the epithelia lining the cortex and glomerulus. The cortico-medullary differentiation is not in good form. Medullary rays and cortex are affected (figure 3). Diabetes group treated with high dose of *Allium Cepa* (group D) shows greater enhancement and preservation of in the (micro-)structures of the kidney. The glomeruli with their bowman's capsules and the medullary rays are within normal limits (figure 4).

DISCUSSION

Allium cepa is said to contain antioxidants [6]. In this study (where we examined the possible protective effects of *Allium cepa*'s antioxidants on diabetic rabbits administered *Allium cepa*) the noted significant decrease in blood glucose level in the *Allium cepa* treated groups C and D

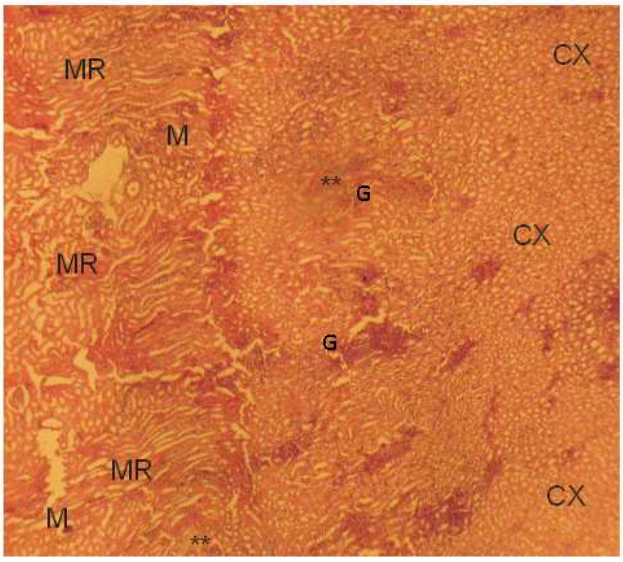
(table 1) suggests that long-term administration/intake of *Allium cepa* may truly have hypoglycemic effect. The noted reduction in the blood glucose level may be due to the presence of certain bioactive components and the protective effects that the antioxidant components of *Allium cepa* may have on pancreatic β-cells which may enhance their production of insulin [7], and, more importantly, the possibility that *Allium cepa* may enhance cellular response to insulin (making target cells more responsive to insulin).

Figure 3 : This figure shows the photomicrograph of the kidney of rabbit for diabetes treated low dose *Allium Cepa* treated group



*G = Glomerulus; CX = Cortex; MR = Medullary Rays; M = Medulla; ** = Potential Artifact; staining method: H & E; Magnification level: X400*

Figure 4 : This figure shows the photo micrograph of the kidney of rabbit for diabetes treated high dose *Allium Cepa* treated group



*G = Glomerulus; CX = Cortex; MR = Medullary Rays; M = Medulla; ** = Potential Artifact; staining method: H & E; Magnification level: X400*

The finding of normal (although, dose-dependent) plasma urea and creatinine levels in the diabetes groups treated with *Allium cepa* (groups C and D) (which were not significantly different from those of the control) suggest that *Allium cepa* might have some positive effects on renal functions even in diabetic state. This was not the case in the diabetic group that was not treated with *Allium cepa* (table 2). The results from renal urea and renal creatinine clearance (table 2) are also consistent with these. These put together further supports our claim that *Allium cepa* may have protective effects against nephropathy [8] that hyperglycemia causes. For example, plasma urea and creatinine levels in group B remained high and this could be due to the destructive effects that hyperglycemia has on glomeruli, leading to low glomerular filtration, consequently the accumulation of urea and creatinine in blood. But in *Allium cepa* treated groups (C and D), despite the initial hyperglycemia, (hopefully) the antioxidants present in *Allium cepa* were able to prevent oxidative stress effect of hyperglycemia on the glomeruli [9].

Further convincing evidences are provided by kidney photomicrographs obtained from the histological aspects of this study. There was almost complete distortion of the cortico-medullary differentiation in the diabetic untreated rabbits (figure 2), while the histology of the kidneys of diabetic rabbit treated with *Allium cepa* showed that the renal cortex and the medulla were improved, especially in the structure and counts of normal glomeruli.

CONCLUSION

This study conclude that *Allium cepa* (a very cheap and readily available species of the genus *Allium*) contains some bioactive substances mostly antioxidants which

could prevent renal organ damage from hyperglycemia in diabetes mellitus. Further studies would, however, be required to have a comprehensive understanding of the molecular mechanism of the noted effects, and, perhaps, to answer the question as to whether or not some components of *Allium cepa* may affect (in this case, enhance) cell receptors for insulin.

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Nil

CONFLICT OF INTEREST

No conflict of interests was declared by authors