**Original Research Article**

# Antidiabetic effect of *Brassica oleraceae* var. *gongylodes* in Streptozotocin-induced diabetic rats

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**Abstract**

**Background:** Type 2 diabetes mellitus is a metabolic disorder which affects the metabolism of carbohydrates, proteins and fats. Amongst plant foods with health benefits, crops from the family *Brassicaceae* have been the focus of numerous epidemiological and clinical studies as they are a good source of a variety of nutrients and health promoting phytochemicals. Since the medicinal value of *Brassica oleracea* var. *gongylodes* or kohlrabi was not yet familiar in the society, we aimed to focus on its antidiabetic and antioxidant properties in Streptozotocin-induced diabetic rats. **Aim:** To study the antidiabetic effect of *Brassica oleracea* var. *gongylodes* in Streptozotocin-induced diabetic rats**. Materials and Methods:** Eighteen male Wistar rats (150-200g) were divided into 3 groups of 6 animals each, as Group I: Control group (citrate buffer), Group II: Streptozotocin-induced diabetes (47 mg/kg body weight) and Group III: Streptozotocin-induced diabetes treated with *Brassica oleracea* var. *gongylodes* (800 mg/kg body weight). **Results:** In Group III, the fasting blood glucose level was significantly reduced ($p<0.05$) to 91mg/dl in the first week of study, when compared to Group I and II and was maintained for the entire 28 days of the treatment. Antioxidant enzymes levels were found to be significantly increased ($p<0.05$) in Group II. **Conclusion:** This study revealed that the fasting blood glucose level of male Wistar rats with Streptozotocin-induced diabetes treated with *Brassica oleracea* var. *gongylodes* was significantly reduced when compared to the controls and the Streptozotocin-induced diabetic group. Further studies are required to confirm such effects in humans.

**Keywords:** *Brassica oleracea* var. *gongylodes*, diabetes mellitus, antidiabetic activity, Wistar rats

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## Introduction

Type 2 diabetes mellitus is a metabolic disorder that is found all over the world, and is a serious threat to health. Diabetes is a chronic disorder which affects the metabolism of carbohydrates, proteins and fats. According to World Health Organization projections, the prevalence of diabetes is likely to increase by 35% by the year 2025.[1] Diabetes also causes many complications

like neuropathy, nephropathy and delayed wound healing which are basically mainly due to accumulation of free radicals which causes generation of reactive oxygen species, reactive nitrogen species and induced oxidative stress and the provoked stress then causes insulin resistance and altered gene expression.[2]

Since studies have shown an inverse relationship between the intake of fruits and vegetables and diseases in which oxidative stress is implicated, many researchers have studied the role of dietary antioxidants like polyphenolic compounds, vitamin E, vitamin C and carotenoids in the prevention of these diseases.[3] Free radical chain reactions can be terminated by these polyphenolic compounds which act as nutraceuticals for oxidative stress implicated diseases like diabetes and cancer.[4]

*Brassica oleracea* var. *gongylodes* or 'kohlrabi' is a member of the *Brassicaceae* family and is a herbaceous vegetable that produces a swollen bulb-like stem at the base of the plant.[2] Amongst plant foods with health benefits, crops from the family *Brassicaceae* have been the focus of numerous epidemiological and clinical studies as they are a good source of a variety of nutrients and health promoting phytochemicals.[5]

In Tamil Nadu as well as in Kerala, 'kohlrabi' is widely consumed as a curried or pickled vegetable, but scientific investigations of this plant are limited in the literature.[2] Since *Brassica* vegetables were observed with various values of phytochemical activity, we aimed to focus on the antidiabetic activity of *Brassica oleracea* var. *gongylodes.*

## Materials and Methods

This study was conducted in the Department of Physiology, Meenakshi Medical College Hospital and Research Institute, Kanchipuram, Tamil Nadu, with the institutional animal ethical clearance.

Eighteen male Wistar rats (150 - 200 g) were used for the study. The animals were divided into three groups with 6 animals in each group, as follows:

Group I: Control group (citrate buffer)
Group II: Streptozotocin (STZ)- induced diabetes (47 mg/kg body weight)
Group III: Streptozotocin-induced diabetes treated with Brassica oleracea var. gongylodes (800 mg/kg bodyweight).

**Preparation of plant extract:** *Brassica oleracea* var. *gongylodes* was washed thoroughly and made into pieces and dried in a hot air oven at 45°C for 24 hours. The dried pieces were made into a powder by using an apex grinder. The powder was made into an extract by using solvents namely hexane, ethyl acetate and double distilled water at room temperature (25$^{o}$C) and this process of extract preparation was repeated until the solvent became colourless.[6] The extract was filtered using Whatman filter paper No.1 and was allowed to evaporate completely at room temperature after which it was stored until processed.[6]

**Induction of diabetes in rats:** All the animals were maintained in the institutional animal house of Meenakshi Medical College Hospital and Research Institute, Kanchipuram, Tamil Nadu. The animals were kept in plastic cages (34 cm × 47 cm × 18 cm) in an air conditioned environment with six animals in each cage and were maintained at a room temperature of 25 ± 2 °C. Twelve hours night and light cycle was maintained. Paddy husk was used as bedding material and was changed twice a week. The Group II and III animals were kept on overnight fasting before every experiment. Freshly prepared Streptozotocin (STZ) in citrate buffer was injected by intra peritoneal route (47 mg/kg body weight) to induce diabetes for Group II and III and after 96 hours, when the fasting blood glucose (FBS) was more than 250 mg/dl, the rats were confirmed as diabetic and then used for further analysis.[7] In group III after inducing diabetes by STZ, the rats were treated

by giving *Brassica oleracea* var. *gongylodes* orally (800 mg/kg body weight) for 28 days.[7]

**Blood sample collection:** Blood samples were collected from the tail vein on day 0, 7, 14, 21 and 28 correspondingly for the estimation of fasting blood glucose (FBS) levels and to identify the level of the antioxidant enzymes superoxide dismutase (SOD) and catalase (CAT).

**Estimation of fasting blood glucose:** Fasting blood glucose was measured by using a commercial Glucomonitor kit.

**Estimation of Antioxidant enzymes:** Antioxidant enzymes were estimated by liver and kidney homogenate (10% homogenate), prepared in chilled phosphate buffer solution of pH 7.0 through standard protocols.[6] Superoxide dismutase was assayed by auto-oxidation of pyrogallol while catalase was assayed by decomposition of hydrogen peroxide. The activities were expressed as unit/mg of protein (a unit is defined as the amount which will catalyse the transformation of 1 micromole of substrate (or product) per minute, under defined assay conditions.[6]

## Results

It was found that the fasting blood glucose level was significantly reduced ($p<0.05$) in the Streptozotocin (STZ)-induced diabetes treated with *Brassica oleracea* var. *gongylodes* group i.e., Group III (91 ± 4.3 mg/dl), in the 1st week, when compared with Group II which was the STZ induced diabetes group (310 ± 2.3 mg/dl), and Group I, which was the control group (99 ± 1.4 mg/dl). This was maintained for the entire 28 days of the treatment.

Antioxidant enzyme (SOD and catalase) levels were significantly higher ($p<0.05$) in Group II (Streptozotocin-induced diabetes) when compared with Group III (Streptozotocin-induced diabetes treated with *Brassica oleracea* var. *gongylodes*), and controls, as shown in Table 1.

**Table 1: Comparison of fasting blood glucose and antioxidant enzyme levels among groups**

| Group | FBS mg/dl | SOD U/mg of protein | CAT U/mg of protein |
|---|---|---|---|
| I | 99±1.4 | 42.35±2.3 | 42.05±1.3 |
| II | 310±2.3* | 93.89±4.9* | 79.20 ±3.3* |
| III | 91±4.3* | 41.26 ±3.7 | 43.70±1.9 |

Group I: Control group, Group II: Streptozotocin induced Diabetes, Group III: Streptozotocin induced Diabetes treated with *Brassica oleracea* var. *gongylodes*; n= 6 for each group; FBS = Fasting blood glucose, SOD = superoxide dismutase, CAT = catalase; values expressed as mean ± SD; *$p < 0.05$ was considered as significant

## Discussion

Antioxidants naturally suppress and prevent the oxidative damage in food by inhibiting the oxidative process of reactive oxygen species which improves the shelf life of the food and protects the internal environment of the body and its activity.[8] Nowadays medicinal plants are widely being used as sources of drugs in the medicinal field.[3] Various studies have shown that plants belonging to the *Brassicacea* family have anti-hyperglycemic property without causing any toxic effects.[7]

Ethanol leaf extracts of *Brassica oleracea* var. *italica* have been shown to possesses definite hypoglycemic properties in STZ induced diabetic rats after 28 days of treatment, which is also similar to our study in that the *Brassica* family was studied.[7] In the present study, on treating diabetic rats with *Brassica oleracea* var. *gongylodes* extracts, the fasting blood glucose levels normalized within one week and it was maintained for 4 weeks. This could be due to the activation of molecular pathways by the enriched bioactive components. Our study also revealed a restoration of the anti-oxidant activity in the *Brassica oleracea* var. *gongylodes* treated group which could be due to the presence of polyphenols like chlorogenic acid,

sinapic acid & rutin in *Brassica* vegetables which also stimulates glucose transport in skeletal muscles.[9] These phenolic components might also have the ability to regulate oxidative stress genes (PPAR-α) which is also considered as an important functional feature of *Brassica* vegetables.[10] Our findings are further supported by previous reports which state that polyphenols isolated from plants exhibit hypoglycemic effects against type 2 diabetes which are equal to or better than some known oral hypoglycemic agents and that there is a role for dietary constituents that can regulate blood glucose levels or induce insulin production by pancreatic beta cells.[4]

This study involved determining the antidiabetic effect of *Brassica oleracea* var. *gongylodes* (*kohlrabi*) in Streptozotocin-induced diabetic rats and showed that fasting blood glucose levels were reduced during the period of the study. If similar results are proven in humans and if its role in preventing and treating human disease induced by free radicals is clearly proven and if consistent long term effects are seen, then it can be an important part of the meal planning for diabetic patients. Moreover, in the longer run, compounds identified in kohlrabi have the potential to be developed as natural anti-diabetic drugs.

## Conclusion

In this study the fasting blood glucose level of male Wistar rats with Streptozotocin-induced diabetes treated with *Brassica oleracea* var. *gongylodes* was found to be significantly reduced when compared to the controls and the Streptozotocin-induced diabetic group. Further studies are required to confirm the beneficial effects in humans.

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**Conflicts of interest:** Nil

## References

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