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Antidiabetic Activity of Different Parts of the Plant *Lepidiumsativum Linn.*

M.S.Jency Malar[1], J.Shifa Vanmathi[2] and K.Chairman[3]

[1]*Annai Vellankanni College, Tholayavattam, Kanyakumari District, Tamilnadu, India.*
[2]*PG and Research Department of Zoology, St.John's College, Palayamkottai, Tamilnadu, India.*
[3]*Department of Microbiology, Kamarajar Government Arts College, Surandai, Tamilnadu, India.*

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ABSTRACT

Lepidiumsativum Linn.has been used in traditional and folklore medicine for the treatment of bronchial asthma, diabetes, local and rheumatic pain. An ethanolic extract of Cress (Lepidiumsativum L.) shoot, leaf, stem and seed has been studied for antidiebetic activity against alloxan induced diabetic rats both body weight an blood glucose level was estimated. Acute toxicity studies conducted revealed that no death was observed up to the dose of 1 g/kg body weight. The mice were physically active. Body weight was determined on the zero day then on 7, 14, 24 and 28th day respectively. Weight gain in normal control group during the study was increased. Standard drug metformin and L.sativum extracts treated groups showed decrease in body weight. Results shows that there was an elevation in blood glucose levels in alloxan treated diabetic rats when compared with normal rats. Among the administration of the extracts of various plant parts of L.sativum, only the seed and leaf extracts and metformin tends to bring the fasting blood glucose level towards the normal in the acute study. There is no significant level of reduction in fasting blood glucose level was noticed for the aqueous extracts of stem of L.sativum. The whole plant extract shows moderate effect in antidiabetic activity. The results of present data was shown that the ethanolic extract of Lepidiumsativum L. plant parts have contributed high potential antidiabetic activity

Keywords: Lepidiumsativum, antidiabetic activity, Acute toxicity test, Alloxan monohydrate, Blood glucose (BG) level, Metformin.

1. INTRODUCTION

Diabetes mellitus is a common and very prevalent disease affecting the citizens of both developed and developing countries. It is estimated that 25% of the world population is affected by this disease. Diabetes mellitus is caused by the abnormality of carbohydrate metabolism which is linked to low blood insulin level or insensitivity of target organs to insulin (Maiti*et al.*, 2004). Despite considerable progress in the treatment of diabetes by oral hypoglycemic agents, search for newer drugs continues because the existing synthetic drugs have several limitations. The herbal drugs with anti-diabetic activity are yet to be commercially formulated as modern medicines, even though they have been acclaimed for their therapeutic properties in the traditional systems of medicine (Wadkar*et al.*, 2008). Type 2 diabetes usually occurs in obese individuals and is associated with hypertension and dyslipidemia. Thus the treatment aims to reduce insulin resistance and to stimulate insulin secretion.

Diabetes is a metabolic disorder where in human body does not produce or properly us insulin, a hormone that is required to convert sugar, starches, and other food into energy. Diabetes mellitus is characterized by constant high levels of blood glucose (sugar). Human body has to maintain the blood glucose levels at a very narrow range which is done with insulin and glucagon. The function of glucagon is causing the liver to release glucose from its cells into the blood for the production of energy. Type 1 Diabetes leads to inability to release insulin results in low rates of glucose uptake into muscles and adipose tissue (Welihinda *et al.*, 1982).

Traditional medicine (herbal) is used for treatment of diabetes in developing countries where the cost of conventional medicines is a burden to the population (Hongxiang *et al.*, 2009). Despite the introduction of hypoglycemic agents from natural and synthetic sources, diabetes and its secondary complications continue to be a

major medical problem. Many indigenous Indian medicinal plants have been found to be useful to successfully manage diabetes. One of the great advantages of medicinal plants is that these are readily available and have very low side effects. Plants have always been an exemplary source of drugs and many of the currently available drugs have been derived directly or indirectly from them. The ethnobotanical information reports about 800 plants that may possess antidiabetic potential (Liu et al., 2007).

According to World Health Organization (W.H.O) report, number of diabetic patients is expected to increase from 171 million in year 2000 to 366 million or more by the year 2030. There are two main types of diabetes, namely type I diabetes, type II diabetes and gestational diabetes. In type I diabetes (juvenile), β-cell of pancreas does not produce insulin. These patients have absolute insulin deficiency and are dependent on insulin replacement for life. Type II diabetes is accounting for about 90-95%. The key components of type II diabetes are β-cell dysfunction causing impaired insulin secretion and increased need for insulin due to insulin resistance (Arif*et al.*, 2014). Preliminary phytochemical study of *Lepidiumsativum* following standard procedure showed presence of flavonoids, coumarins, sulphur containing glycosides, triterpenes, sterols, and various imidazole alkaloids (Patel *et al.*, 2009). The major secondary metabolites of this plant are glucosinolates. *Lepidiumsativum* contain rare imidazole alkaloids known as lepidine and semilepidine. From methanolic extract of defatted seed sinapic acid and sinapin were isolated (Nayak *et al.*, 2009). Despite the wide spread traditional and edible uses of *Lepidiumsativum*, very few pharmacological studies have been done so far. The present investigation was undertaken to screen the hypoglycemic effect of *Lepidiumsativum.*

2. MATERIALS AND METHODS

2.1 Preparation of plant extracts

Lepidiumsativum leaf, stem, seed and whole plant were collected. The collected plant parts were cleaned and washed well with water. Then 50 g of selected plant parts were dried under shade at 258C for 5 days in the absence of sunlight and grounded well to fine powder. The powdered plant parts (nearly 30 g) were successfully extracted with boiling water using soxhlet extractor are then cooled and filtered using Whatman No. 1 filter paper. The filtrate was centrifuged at 10,000 rpm at room temperature (258C) and the sediment was discarded. The supernatant was concentrated up to 100 mL on rotavapor under reduced pressure. The concentrated crude extract was lyophilized into powder (5 g) and used for the study.

2.2 Experimental animal

Healthy rats were selected to test the antidiabetic property. The animals were housed in standard environmental conditions. During experimental time, rats were given standard pellet diet and water.

2.3 Acute toxicity test

Seven main groups of rats were selected to study the acute toxicity of all plant extracts under investigation. All groups received one oral dose of 100, 250, 500, 650, 800, 950, and 1100 mg of plant extract/kg body weight. Animals were kept under close observation for 24 h after administering the extract, and then they were observed

daily for 3 days for any change in general behavior and/or other physical activities. After 24 h, there were no died animals representing the safety action of all extracts.

2.4 Experimental design

The rats were segregated into 7 groups with minimum of 4 rats in each group.

Group I: Normal control rats

Group II: Diabetic control rats

Group III: Diabetic rats treated with leaf extract of *L. sativum*

Group IV: Diabetic rats treated with stem extract of *L. sativum*

Group V: Diabetic rats treated with seed extract of *L. sativum*

Group VI: Diabetic rats treated with whole plant extract of *L. sativum*

Group VII: Diabetic rats administered with metformin (150 mg/kg) in aqueous solution orally for 28 days.

2.5 Anti-diabetic activity

Induction of diabetes in rats:

Diabetes was induced on overnight fasted rats by a single dose of freshly prepared alloxan monohydrate (150 mg/kg b.w) in normal saline (Etuk and muhammed, 2010). Blood glucose (BG) level was measured by using one-touch glucometer and diabetes was confirmed after 72 h of alloxanisation. Rats with fasting BG level more than 150 mg dL^{-1} were considered to be diabetic and were selected for studies.

Study protocol

Test extracts (250 mg/kg b.w), standard drug metformin (150 mg/kg b.w), and control (2 mL saline) were administered orally, every 24 h for a period of 28 days. The experimental rats were carefully monitored every day; no sign of toxicity was noticed on the behaviors and general health of the rats when exposed to the plant extract. Animals described as festered were deprived of food for at least 12 h but allowed free access to drinking water. During the study period body weight and BG level was recorded at the end of 7, 14, 21, and 28 days (prolonged study). On the 28^{th} day animals were sacrificed organs were isolated for the histopathological study.

3. RESULT & DISCUSSION

Herbal medicines are great body balancers that help regulate body functions, can be used to support balance process of our body and offer the nutrients that the body fails to receive due to poor diet or environmental deficiencies in the soil and air. They can be used to treat many diseases such as diabetes, asthma, eczema, premenstrual syndrome, rheumatoid arthritis, migraine, menopausal symptoms, chronic fatigue, and irritable bowel syndrome, etc., and can be used for maintaining general health. Herbal preparations are best when taken under the guidance of a trained professional. When used correctly, herbal medicines are considered safer than conventional medications. People are greatly concerned about the efficacy and side effects of many synthetic drugs, and hence choose herbal

medicines for providing a safe and natural alternative treatment for many health problems. The use is widespread and growing, In fact, herbs are always the alternative medicine and primary source.

Diabetes mellitus is a syndrome, initially characterized by loss of glucose homeostasis resulting from defects in insulin secretion, insulin action both resulting in impaired metabolism of glucose and other energy-yielding fuels such as lipids and proteins (Sivajothia *et al.,* 2008). Currently, many countries face large increases in the number of people suffering from diabetes. The World Health Organization estimated that about 30 million people suffered from diabetes in 1985 and the number increased to more than 171 million in 2000. It is estimated that the number will increase to over 366 million by 2030 and that large increases will occur in developing countries, especially in people aged between 45 and 64 years (Wild *et al.,* 2004).

A preliminary toxicity study was designed to demonstrate the appropriate safe dose range that could be used for subsequent experiments rather than to provide complete toxicity data on the extract. Acute toxicity studies conducted revealed that the administration of graded doses of stem, leaf, root, and flower crude extracts (up to a dose of 1100 mg/kg) of *L.sativum* did not produce significant changes in behaviors such as alertness, motor activity, breathing, restlessness, diarrhea, convulsions, coma, and appearance of the animals. No death was observed up to the dose of 1 g/kg body weight. The mice were physically active. These effects were observed during the experimental period (72 h). The result showed that in single dose; the plant extracts had no adverse effect, indicating that the LD_{50} could be greater than 1 g/kg body weight in mice (Matthews *et al*., 1985).

Body weight was determined on the zero day then on 7, 14, 24 and 28^{th} day respectively. Weight gain in normal control group during the study was increased but in diabetic control group diabetes prevents the weight gain on 14, 24 and 28^{th} day (Table 1). Standard drug metformin and *L.sativum* extracts treated groups showed decrease in body weight.

The mean fasting glucose levels for Group I–VII are indicated in Table 2 (for prolonged study). Results shows that there was an elevation in blood glucose levels in alloxan treated diabetic rats when compared with normal rats. The intraperitoneal injection of alloxan in rats produced hyperglycemial impaired glucose tolerance and insulin resistance (Cazarolli *et al*., 2008). Among the administration of the extracts of various plant parts of *L.sativum*, only the seed and leaf extracts and metformin tends to bring the fasting blood glucose level towards the normal in the acute study. There is no significant level of reduction in fasting blood glucose level was noticed for the aqueous extracts of stem of *L.sativum*. The whole plant extract shows moderate effect in antidiabetic activity.

The fall was evident even in the 1^{st} week and goes on progressively increasing till at the end of 4 weeks and the fall in the fasting blood sugar was nearly equal to that of reference drug metformin. The antidiabetic activity of stem is not significant in prolonged study. These findings clearly established that the antidiabetic efficacy of the seed and leaf extract of *L.sativum* are almost equal and both exhibited more potent antidiabetic activity by reducing the blood glucose level significantly than all other whole plant and stem extracts. However, further studies were warranted, to

observe their effects on diabetic model and to find out the exact mechanism of such action and to isolate bioactive compounds responsible for observed activities.

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Figure.1. Effect of ethanolic extract of *Lepidiumsativum* on bodyweight of alloxan induced diabetic rats

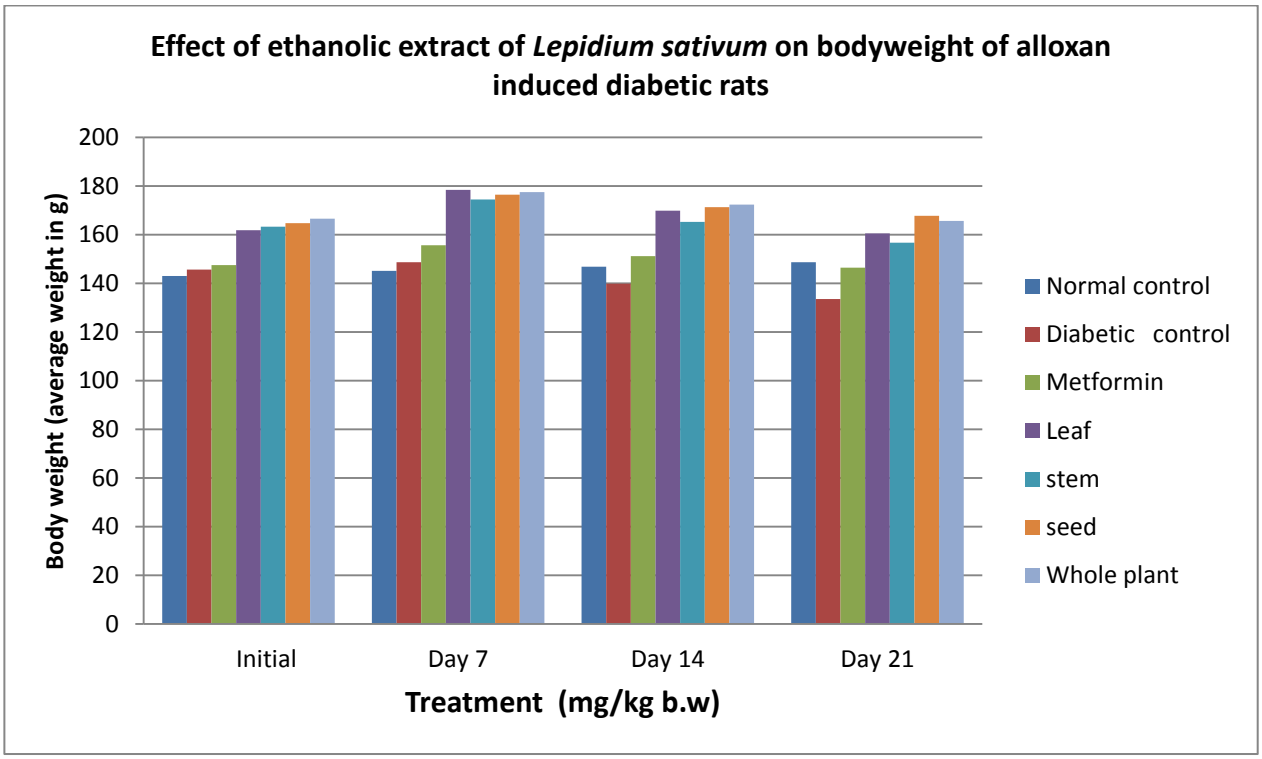

Figure.2. Effect of ethanolic extract of *Lepidiumsativum* on blood glucose level of alloxan induced diabetic rats

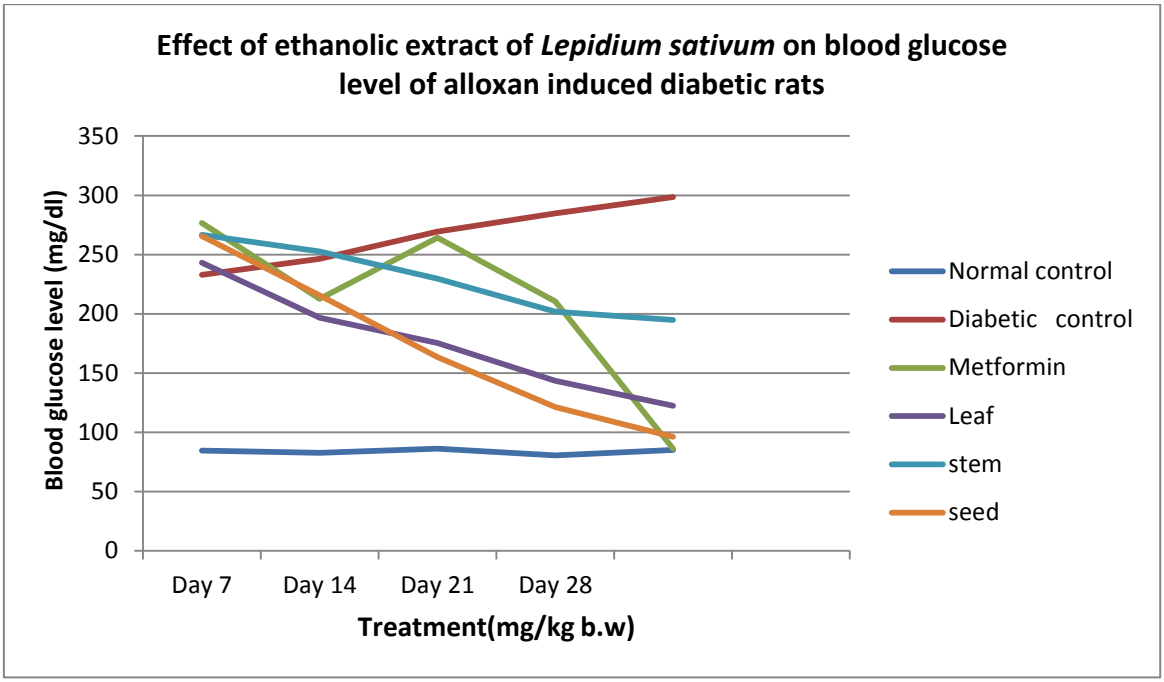

Table.1. Effect of ethanolic extract of *Lepidiumsativum* on bodyweight of alloxan induced diabetic rats

Treatment (mg/kg b.w)	**Body weight (average weight in g)**				
	Initial	**Day 7**	**Day 14**	**Day 21**	**Day 28**
Normal Control	143.07±22.32	145.14±13.32	146.87±21.51	148.74±11.47	150.68±20.54
Diabetic control	145.66±19.71	148.77±16.78	139.93±18.46	133.67±15.43	130.57±19.58
Metformin (150)	147.59±06.55	155.74±17.39	151.25±19.78	146.56±16.48	134.76±20.81
Leaf (250)	161.87±16.11	178.43±13.54	169.87±12.39	160.57±23.55	152.95±17.73
Stem (250)	163.24±14.36	174.45±14.88	165.39±22.94	156.73±11.57	144.62±16.42
Seed (250)	164.72±0.12	176.52±17.61	171.34±19.16	167.84±24.36	161.79±15.65
Whole plant (250)	166.61±11.98	177.58±21.68	172.38±20.85	165.64±11.43	157.95±16.72