



## Effect of *Terminalia Arjuna* Bark Extract on Streptozotocin-Induced Diabetic Rats

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**ABSTRACT:** The present study was carried out to evaluate the antihyperglycemic property of *Terminalia arjuna* in streptozotocin-induced type 2 diabetic model rats. To evaluate the antihyperglycemic and antioxidant role of ethanol extract of *Terminalia arjuna* leaf in rats. Hyperglycemia was induced in rats by single intraperitoneal injection of streptozotocin (STZ, 120mg/kg body weight). Three days after STZ induction, the hyperglycemic rats were treated with a dilution of bark extract of *T. arjuna* orally at the dose of 1 ml and 2 ml daily for 15 days. The level of blood glucose before meals were measured on every fifth day during the 15-day treatment. Ethanol extract of *T. arjuna* dose-dependently reduced and normalized blood glucose levels. *T. arjuna* treatment also significantly increases protein levels. The present study shows that *T. arjuna* leaf shows remarkable reduction in blood glucose level in STZ-induced diabetic rats. The *T. arjuna* has an effect in physiological and biochemical processes in rats.

**KEYWORDS:** Antihyperglycemic, streptozotocin, *Terminalia arjuna* (Combretaceae).

### INTRODUCTION

Diabetes mellitus is a condition associated with high blood glucose levels and it is mainly linked with a low level of insulin in the blood or the inability of target organs to use insulin. It is the most prevalent disease in the world affecting 25% of the population and afflicts 150 million people and is predicted to rise to 300 million by 2025 (Vats et.al.2000). It causes numerous complications such as retinopathy, neuropathy, and peripheral vascular insufficiencies (Chehade & Mooradian, 2000). Diabetes is still not completely curable by the present antidiabetic therapy. Insulin therapy is the only satisfactory approach in diabetic Mellitus, even though it has several drawbacks like insulin resistance (Piedrola et al., 2001), anorexia, brain atrophy, and fatty liver in chronic treatment (Weidmann et al., 1993). There are many medications available To reduce blood glucose levels but certain adverse effects and weak effectiveness of them have led to the search for more effective agents.

*Terminalia arjuna* (Combretaceae), commonly known as Arjuna, is a large tree growing on the banks of rivers, streams, and dry watercourses and it is considered a versatile medicinal plant. In India, the plant has been traditionally used for several medicinal purposes. The fruits of the plant are used as a tonic. Externally, its leaf paste is used as a cover on sores and ulcers. The bark is antidiarrhetic, antipyretic, astringent, cardiotoxic, lithotripsy, and tonic; a powder of the bark acts as a diuretic in cirrhosis of the liver and gives relief in symptomatic hypertension (Chatterjee & Pakrashi, 1994). *T. arjuna* is a potent anti-diabetic and beneficial in the control of diabetes-related abnormalities in serum lipid profile renal markers and oxidative damage in liver and pancreas of streptozotocin-induced rat model (Parveen et al. 2011). The powder of the bark is also given with honey in fractures and contusions with ecchymosis. Besides this, the extract of the bark as an astringent is used for cleaning sores, ulcers, cancers, and so on (Dhiman, 2006). The stem bark of *Terminalia arjuna* is also used for the treatment of various cardiovascular diseases; (Parveen et al., 2012). No pharmacological investigation is still reported on *T. arjuna* leaf. Therefore the present study was performed to investigate the antidiabetic effect of extract of *T. arjuna* leaf against streptozotocin (STZ)-induced diabetic rat. Streptozotocin is a naturally occurring chemical that is particularly toxic to the insulin-producing beta cells of the pancreas in mammals. It is used in medicine for treating certain cancer cells of islets of Langerhans and used in medical research to induce an animal model with Type 1 diabetes in large doses as well as Type 2 diabetes with multiple low doses. ( Brentjens R, Saltz, 2001).

Traditional healers claim that the stem bark of the plant possesses anti-diabetic properties. Some scientific studies also show the hypoglycemic property of this plant. However, no published report supports both the acute and chronic hypoglycemic effect of *T. arjuna* on streptozotocin-induced diabetic model rats. As the majority of the diabetic population suffers from diabetes, we undertook the present study to evaluate the anti-diabetic effect of *T. Arjuna* on diabetic model rats and to analyze the possible hypoglycemic /

antihyperglycemic and activity of the extract as well as to investigate the possible chemical constituents responsible for the activity and the target tissue involved in this action.



## MATERIALS & METHODS

### Plant Extract:-

The experimental animals were administered intramuscularly with active principles of plants extract *T. arjuna*. Dilution of drugs. *T. Arjuna* was made with 100 ml distilled water. From the above stock, 1 ml and 2 ml quantities were administered intramuscularly to the high region of the experimental rat using a 2 ml disposable syringe and 24G disposable needle daily once for up to 15 days.

### Experimental Setup:-

Experiments were carried out by dividing the rat of both sexes into various groups.

Group I:- Served as a normal healthy control rat.,

Group II:- Served as experimental rat (EXPT. A. Diabetic induce control rat given 1 ml. bark extract 500 mg/kg PO. )

Group III; - served as experimental rat (EXPT. B. Diabetic induced control rat given 2 ml. *T. arjuna* extract 250 mg/kg PO.)

Group IV: - Served as untreated diabetic induced control rat. (EXPT. C) Induction of diabetes in rat: -120 mg/kg of STZ in sterile saline was induced by a single IP injection. The duration of treatment was 15 days.

### Collection of blood, kidney, and liver from the rat:-

After the experimental regimen, the animals were sacrificed by cervical dislocation under mild chloroform anesthesia. Blood was collected on decapitation and serum was separated by centrifugation (for 20 min at 2000 rpm). The liver and kidney were excised immediately and thoroughly washed in ice-cold saline. The serum and tissues were collected and used for biochemical experiments.

**Estimation of serum glucose** was estimated by GOD/POD method (Trinder, P. 1969).

### Determination of total protein in tissue:-

Liver protein analysis can diagnose the liver disorder, nutritional deficiencies of protein, renal failure, and lymphoproliferative disorder. 100 mg(0.10g) of tissue was taken and dried by folding between the folding of filter paper and drop in a beaker kept on ice. It was transferred to a homogenizer tube and homogenized by taking 10 ml of distilled water. It was centrifuged and the supernatants were used for protein estimation. Protein is estimated by different methods as described by the de Lowry method. No method is 100% sensitive. Hydrolyzing the protein and estimating the amino acid alone will give the exact quantification. Specimens used are Liver, Kidney & Pancreas.

### Determination of glycogen in tissue

“Glycogen, the branched-chain homopolysaccharide, is present both in liver & muscle. Glycogen can be effectively extracted from the liver by treatment with alkali followed by separation of glycogen by alcoholic precipitation.

Liver tissue was collected from a well-fed rat .10 g of liver tissue was weighed or transferred into a 100ml conical flask & added 20ml of 30% KOH and kept in a boiling water bath for 30 minutes Content was centrifuged at 4000 rpm for 30 min. The supernatant was discarded and the ppt was collected. The glycogen ppt is recovered by centrifugation of the above content with d/w and ethanol at 4000 rpm for 15 min. Discarded supernatant was dried for a glycogen sample in a desiccator containing calcium chloride as a desiccant and the % yield of glycogen was calculated.



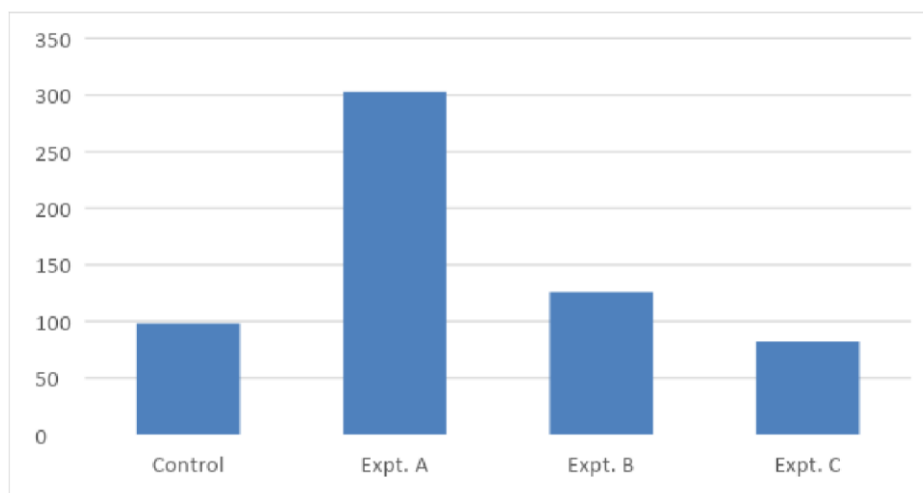
**RESULT & DISCUSSION**

**Table 1.** Effect of *T. arjuna* stem bark on serum glucose, of control and experimental rats.

Parameters	Group 1	Group II	Group III	Group IV
	Control	Expt. A	Expt. B	Expt. C
Serum Glucose (mg/dl)	98.33 ± 02.66	* 302.67±22.35	* 125.60 ± 24.73	* 82.50 ± 04.72

Values are mean ± SD of five observations, \*p<0.05, \*\*p<0.01, and NS =Not significant.

**Fig.:- 1**



**Table 2.** Effect of *T. arjuna* plant extract on glycogen% in some organs of the rat.

Tissue\Group	Control	Expt. A	Expt. B	Expt. C
Liver	3.47 ± 0.34	** 1.02 ± 1.44	NS 0.7 ± 1.84	** 0.5 ± 0.37
Kidney	3.58 ± 0.39	** 0.78 ± 0.26	** 0.98 ± 0.57	** 7.52 ± 0.40
Pancreas	2.07 ± 0.27	** 1.71 ± 0.15	** 0.57 ± 0.36	* 1.19 ± 0.63
Muscles	2.25 ± 1.57	NS 0.37 ± 0.3	** 0.28 ± 1.65	NS 13.4 ± 11.14

Values are mean ± SD of five observations, \*p<0.05, \*\*p<0.01, and NS =Not significant.

Fig:- 2

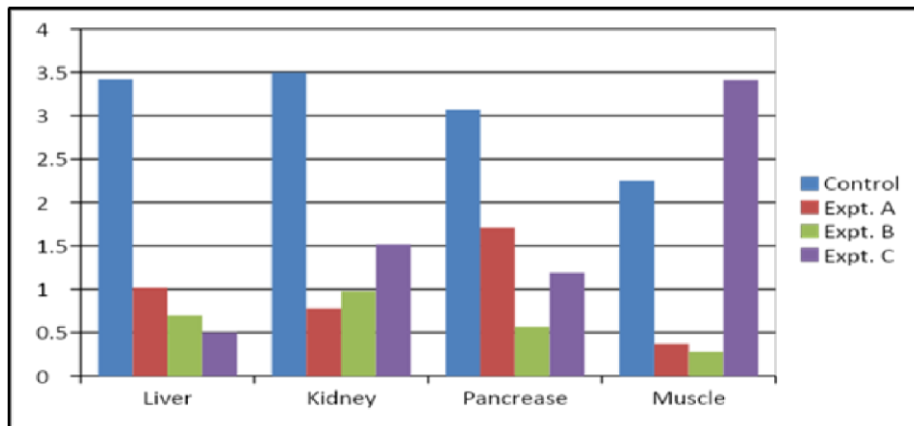
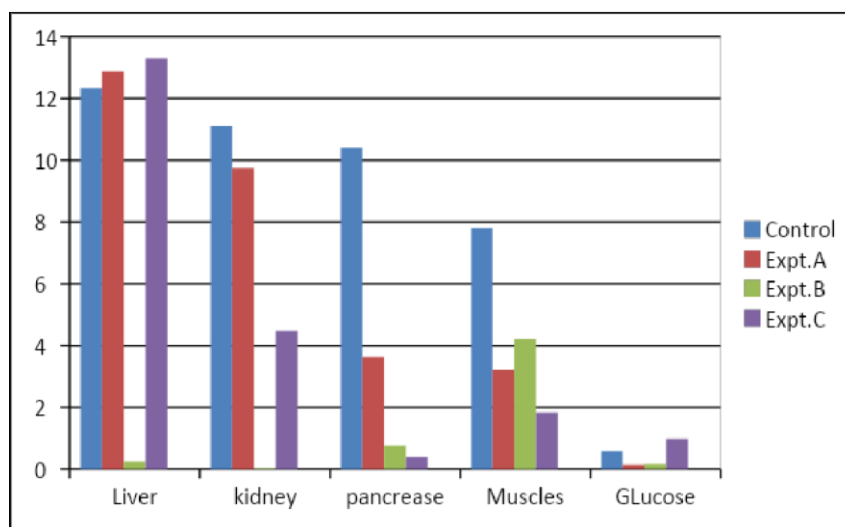


Table No 3. Effect of *T. arjuna* plant extract on protein concentration mg /g in some organs of the wild rat.

Tissues/ groups	Control	Expt. A	Expt. B	Expt. C
Liver	12.33 ± 1.0	* 12.87 ± 0.3	** 0.24 ± 1.97	NS 13.3 ± 0.26
Kidney	11.12 ± 0.39	NS 9.74 ± 2.8	** 0.032 ± 0.08	NS 4.47 ± 2.8
Pancreas	10.4 ± 0.13	** 13.62 ± 0.26	** 0.75 ± 2.28	** 0.4 ± 0.15
Muscles	7.80 ± 0.86	* 3.22 ± 0.72	* 4.21 ± 0.31	* 1.83 ± 0.27

Values are mean ± SD of five observations, \*p<0.05, \*\*p<0.01, and NS =Not significant.

Fig:- 3



In our study, administration of *T.arjuna* bark extract resulted in a significant reduction in blood glucose level, when compared with diabetic control animals. The extract containing 500 mg/kg body weight showed a better glucose level reduction than 250 mg/kg body weight. The mechanism may be through the stimulation of b cells for elevated secretion of insulin, thereby increasing the utilization of glucose in various tissues (Prakasam et al., 2002.).



In the present study, the STZ induced diabetic rats were chosen as an experimental model. An experimental rat that was administered with 2 ml Terminalia arjuna bark extract for 15 days showed a significant fall in tissue protein whereas control rats were shown there were small changes in tissue protein i.e the protein level in tissue is moderately decreasing. It might be due to the antihyperglycemic property of *T. arjuna*.

Experimental wild rats administered *T. arjuna* (2ml) showed that the liver protein gradually decreased as compared with the control rat as well as bark extract of 1 ml showed that the liver protein moderately increased as compared to control and again those diabetic induced rats showed liver protein significantly increase. The decrease in total protein content and other diabetic complications such as increased gluconeogenesis and ketogenesis in STZ induced mice may be due to elevated transaminase activities (Ghosh & Suryawanshi, 2001).

The glycogen of liver and glycogen of muscles is decreased given 2 ml dose experimental rat as compared to another rat. Diabetic induced rats showed that the glycogen of muscles moderately increases.

Mythili P. et. al., 2012 have found phytosterols, flavonoids (arjunone, arjunolone, and luteolin, arjunic acid, arjunolic acid, arjungenin, arjun glycosides) in *Terminalia arjuna* bark triterpenoids extract. Flavonoids (Arjunic acid, arjunolic acid, arjungenin acid, and arjunglycosides) being powerful antioxidants are reported to play a role in antihyperglycemic and analgesic activity by targeting pancreas and prostaglandins since the stem bark of *T. arjuna* plant contain flavonoids and glycosides.

## CONCLUSION

It can be concluded that the medicinal plant *T. arjuna* has a promising antihyperglycemic effect in streptozotocin-induced model rats and it can be considered a potent source of the antidiabetic agent. The antihyperglycemic activity can be possible due to its antioxidant properties. It also shows that *T. arjuna* decreases the protein level in the tissue of rats.

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