International Journal of Medicine and Pharmaceutical Research

Journal Home Page: www.pharmaresearchlibrary.com/ijmpr

Research Article **Open Access**

Antidiabetic Potential of Insulin Plant (*Costus igneus*) Leaf Extracts in Streptozotocin-Induced Diabetic Rats

Choudhary Urmila*[1], Soni N.D[1], Rajnee[1],Purohit A.K[2], Choudhary Sunita[1], Maheshwari R. K[3]

[1]*Department of Physiology, Dr. SN. Medical College, Jodhpur, Rajasthan, India.*
[2]*Director of Rajasthan Knowledge Center, Jodhpur, Rajasthan, India.*
[3]*Department of Chemistry, SBRM Govt. PG College, Nagur, Rajasthan, India*

A B S T R A C T

Costus igneus, Insulin plant is a medicinal plant and capable of having magic cure for Diabetes. Leaf of this herbal plant helps to build up insulin by strengthening β–cells of pancreas in the human body thus popularly known as "Insulin plant" in India. Objective: The present research study was carried out to investigate the antidiabetic potential of aqueous and methanolic extracts of different doses of *Costus igneus* plant leaves. Healthy male albino rats weighing about (150-220) g were selected for the present investigation. Diabetes was induced in rats by intraperitoneal injection of streptozotocin given at a dose of (45mg/kg, body weight). Normal Control, Diabetic Control, Diabetic rats treated with Glibenclamide (0.5mg/Kg body weight) and Diabetic rats treated with aqueous extract of *Costus igneus* (AEC) of different doses AEC50, AEC100 and AEC200 (mg/Kg BW) and methanolic extract of *Costus igneus* (MEC) of different doses MEC50, MEC100 and MEC200 (mg/Kg BW) in one month study. Induction of diabetes with STZ (45mg/Kg BW) significantly increased the blood glucose ($p<0.001$) of the animals in the diabetic control group. The diabetic rats that were treated with glibenclamide and different doses of aqueous and methanolic extract of *Costus igneus* leaves, showed a significant decrease in the blood glucose level. Aqueous and methanolic extracts of *Costus igneus* leaves exhibited antidiabetic potential. The methanolic extract was more effective than aqueous extract.

Keywords: Costus igneus, hyperglycemia, insulin plant, STZ

A R T I C L E I N F O

CONTENTS

Article History: Received 25 December 2014, **Accepted** 9 March 2015, **Published Online** 10 April 2015

***Corresponding Author**
Choudhary Urmila
Department of Physiology,
Dr. S.N Medical College,
Jodhpur, Rajasthan, India.
Manuscript ID: IJMPR2495

PAPER-QR CODE

Citation: Choudhary Urmila, et al. Antidiabetic Potential of Insulin Plant (Costus igneus) Leaf Extracts in Streptozotocin-Induced Diabetic Rats. *Int. J. Med. Pharm, Res.*, 2015, 3(2): 989-995.

1. Introduction

Diabetes is a chronic disease characterized by high level of blood glucose. It is a metabolic group of disorders, which is responsible for mortality and morbidity throughout the world. Long-term diabetes can lead to many life threatening complications. Considering the complications, mortality, morbidity and various socioeconomic aspects it is very important to develop a proper management strategy for the control of glycaemia in diabetes mellitus.

Various drugs have been used in the treatment of diabetes mellitus, but with the side effects and other complications they accompany, the researchers are forced to search in for a better options suited for diabetes management. Medicinal plants constitute an effective source of both traditional and modern medicines and about 80 percent of rural populations depend on it for their primary health care. ***Costus igneus***, Insulin plant is a medicinal plant and capable of having cure for Diabetes. Leaf of this herbal plant helps to build up insulin by strengthening β–cells of pancreas in the human body thus popularly known as "Insulin plant" in India. This plant has large and ample leaves which are spirally disposed around the stem. The plant can grow about 2 feet tall and it requires a lot of sun (1). However, it can also sprout quickly in shady areas. *Costus igneus* has attractive orange flowers that are about 1.5 inch in diameter. These flowers have a sweet aroma and are considered to be highly nutritious. Moreover, they seem to look like cone heads at the extremities of the branches and flowering takes place during the warm season. In southern India, it usually grows as an ornamental plant and its leaves are used as a dietary supplement in the treatment of diabetes mellitus.

The Catchphrase of this plant is "A *leaf a day keeps diabetes away"*. Recently, a number of researches have been carried out to evaluate the anti–diabetic potential of this plant. Besides, it has been proven to possess various pharmacological activities like hypolipidemic, diuretic, antioxidant, anti–microbial, anti–cancerous. Further, various phytochemical investigations reveal the presence of carbohydrates, triterpenoids, proteins, alkaloids, tannins, saponins, flavonoids, steroid, and appreciable amounts of trace elements. Diabetic patients are advised to chew down a leaf in the morning and one in the evening for a month. It is also possible to consume the leave by drying and grinding powder of the leaves.

2. Materials and Methods

Plant material

The fresh leaves of plant *Costus igneus* was collected from central arid zone research institute (CAZARI), Jodhpur, Rajasthan. Authenticated fresh leaves were dried under shade and used for the preparation of extract. Extraction and preparation of crude extracts was carried out by percolation method at room temperature and by solvent evaporation. This helps in protection of any heat labile metabolite present.

Plant Extract Preparation

Aqueous Extract of *Costus igneus* (AEC) and methanolic extract (MEC) i.e. leaves of different doses AEC50, AEC100 and AEC200 and MEC50, MEC100 and MEC200 were prepared and administered orally to albino rats.

Experimental Animals

Healthy male albino rats weighing about (150-220) g were selected for the present investigation. Diabetes can be induced in various experimental animals for the purpose of research investigations. Institutional ethical clearance was obtained before commencement of the study from the ethical committee of Dr. S.N Medical College, Jodhpur, Rajasthan. Various techniques have been used but the most common method of diabetes induction is the use of chemical diabetogens. Streptozotocin was used for the induction of diabetes in the present study. Diabetes was induced in rats that had been fasted for 24 hours by intraperitoneal injection of streptozotocin, freshly dissolved in citrate buffer (pH 4.5) immediately before use. Streptozotocin was given at a dose of (45mg/kg, body weight) to induce diabetes (3). The animals were administrated 5 percent glucose solution for 24 hours after the streptozotocin injection.

Experimental Design:

For evaluating the hypoglycemic activities of the most potent extract of the most effective dose among AEC and MEC all the animals were randomly divided in the 10 groups with 6 rats in each group.

Group I: Normal Control: The group consisted of healthy non-diabetic rats without any streptozotocin induced diabetes induction.

Group II: Diabetic Control: The group contained streptozotocin induced Diabetic rats. This group was non treated group or without any antidiabetic drug or any plant extracts administration.

Group III: Diabetic + Glibenclamide (0.5 mg/Kg BW): The group consisted of streptozotocin induced diabetic rats which were given standard allopathic antidiabetic drug glibenclamide for 30 days.

Group IV: Diabetic + AEC at a dose of 50 mg/Kg BW (AEC50): The group consisted of streptozotocin induced diabetic rats which were given aqueous extract of *Costus igneus* leaves of dose 50 mg/Kg body weight for duration of 30 days.

Group V: Diabetic + AEC at a dose of 100 mg/Kg BW (AEC100): The group consisted of streptozotocin induced diabetic rats which were given aqueous extract of *Costus igneus* leaves of dose 100 mg/Kg body weight for duration of 30 days.

Group VI: Diabetic + AEC at a dose of 200 mg/Kg BW (AEC200):

The group consisted of streptozotocin induced diabetic rats which were given aqueous extract of *costus igneus* leaves of dose 200 mg/Kg body weight for duration of 30 days.

Group VII: Diabetic + MEC at a dose of 50 mg/Kg BW (MEC50):

The group consisted of streptozotocin induced diabetic rats which were given aqueous extract of *Costus igneus* leaves of dose 50 mg/Kg body weight for duration of 30 days.

Group VIII: Diabetic + MEC at a dose of 100 mg/Kg BW (MEC100):

The group consisted of streptozotocin induced diabetic rats which were given aqueous extract of *Costus igneus* leaves of dose 100 mg/Kg body weight for duration of 30 days.

Group IX: Diabetic + MEC at a dose of 200 mg/Kg BW (MEC200): The group consisted of streptozotocin induced diabetic rats which were given aqueous extract of *Costus igneus* leaves of dose 200 mg/Kg body weight for duration of 30 days.

Group X: Diabetic + MEC at a dose of 100 mg/Kg BW + Glibenclamide (0.5 mg/Kg BW): The group consisted of streptozotocin induced diabetic rats which were treated with MEC 100 mg/Kg BW/day and reference standard drug glibenclamide (0.5 mg/Kg BW/day) for the duration of 30 days. Different extracts of *Costus igneus* were given orally with the help of feeding needle. Blood samples were collected by cardiac puncture under all aseptic precautions for estimation of biochemical parameters on various time periods of 0 day (before diabetes induction), after diabetes induction, 15th day and 30th day of experimental study. In whole experimental study body weight measurement were performed by digital weighing machine.

Statistical analysis

The data were analyzed on Graph Pad Prism software and expressed as mean ± S.D (n=6).The statistical difference between the normal and diseased was analyzed by Un-paired t-test. Statistical analysis was performed by ANOVA followed by Post Hoc Student - Newman- Keuls Comparison Test to compare the diseased and treated groups. The results were considered statistically significant, if $p<0.05$.

3. Results and Discussion

In the present investigation in diabetic group the increased level of glucose or induced hyperglycemia was obtained by using STZ (45 mg/kg BW). It is experimentally established that STZ induces artificial diabetes in rats successfully (4). Table No. 1 showed the mean and SD values of blood glucose parameter in control and streptozotocin induced diabetic rats. In diabetic rats, the blood glucose level was significantly high 284.83±17.38 mg/dl just after the 72 hours of the injection of STZ (45 mg/kg BW). Increased level of blood sugar shows that the use of STZ was highly effective in inducing diabetes in rats (Fig.No.1).

Table 1: Blood Glucose Level in Control and Streptozotocin Induced Diabetic Albino Rats (0 Day)

Groups No.	Groups	No. of Observation	**GLUCOSE** mg/dl of the serum			
			Mean±SD	**SE**	**t value**	**p Value**
I	Normal Control	6	91.5±4.41	1.80	26.40	0.001
II	Diabetic Control	6	284.83±17.38	7.09		

Table 2: Blood Glucose Level in Control and Streptozotocin Induced Diabetic Albino Rats (After 15 Days)

Groups No.	Groups	No. of Observation	**GLUCOSE** mg/dl of the serum			
			Mean±SD	**SE**	**t value**	**p Value**
I	Normal Control	6	89.66±4.54	1.85	19.08	0.01
II	Diabetic Control	6	334.16±31.04	12.67		

Table 2 represented the mean and SD values of blood glucose parameter in control and streptozotocin induced diabetic groups on 15th day. Mean blood glucose of rats in the normal control group was 89.66±4.54 mg/dl. In diabetic rats, the blood glucose level was 334.16±31.04 significantly high. It is observed that the induction of diabetes with the help of STZ (45mg/kg BW) was persistent even after 15 & 30 days and the level of blood glucose was more than 3-4

times higher in diabetic rats, over control and results were highly significant (Fig. No. 1).

Table 3: Blood Glucose Level in Control and Streptozotocin Induced Diabetic Albino Rats (After 30 Days)

Groups No.	Groups	No. of Observation	**GLUCOSE** mg/dl of the serum			
			Mean±SD	**SE**	**t Value**	**p Value**
I	Normal Control	6	90.33±4.36	1.78	40.72	0.001
II	Diabetic Control	6	387.33±13.32	3.59		

Table 3 depicts that in group II diabetic rats, blood glucose level was significantly high 387.33±13.32 mg/dl throughout the study period ($p<0.001$). Mean blood glucose of rats in the normal control group was 90.33±4.36 mg/dl of the serum on day 30th (Fig. No. 1).

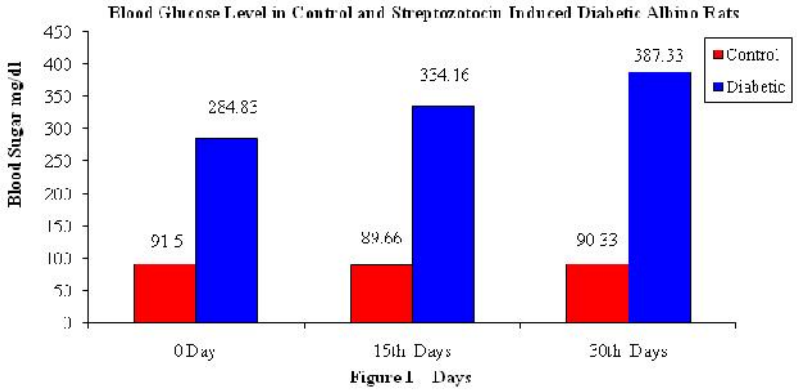

Figure 1

Table 4: Effect of Aqueous and Methanolic Extracts of Leaves of *Costus igneus* on Blood Glucose Level (mg/dl) in Albino Rats

Groups No.	Groups	15th day	30th day	% Change Over Diabetic Control ↓↑
I	Normal control	89.66±4.54	90.33±4.36	–
II	Diabetic control	334.17±31.04	387.33±13.32	–
III	Diabetic+Glibenclamide (0.5mg/Kg)	138.67±14.33	102.50±14.37	73.50 ↓
IV	Diabetic + AEC (50mg/Kg)	219.17±19.99	186.17±19.99	51.90 ↓
V	Diabetic + AEC (100mg/kg)	182.83±13.65	163.00±12.19	57.91 ↓
VI	Diabetic + AEC (200mg/kg)	177.17±15.34	142.00±15.23	63.33 ↓
VII	Diabetic + MEC (50mg/kg)	198.00±21.01	132.00±14.98	65.92 ↓
VIII	Diabetic + MEC (100mg/kg)	143.83±13.74	111.46±14.37	71.22 ↓
IX	Diabetic + MEC (200mg/kg)	128.00±18.24	97.16±16.51	74.91 ↓
X	Diabetic+MEC100+ Glibenclamide (0.5mg/Kg)	113.67±17.55	93.16±16.51	75.94 ↓

Note: All values expressed as Mean ± SD, ↑ - Increase ↓- Decrease

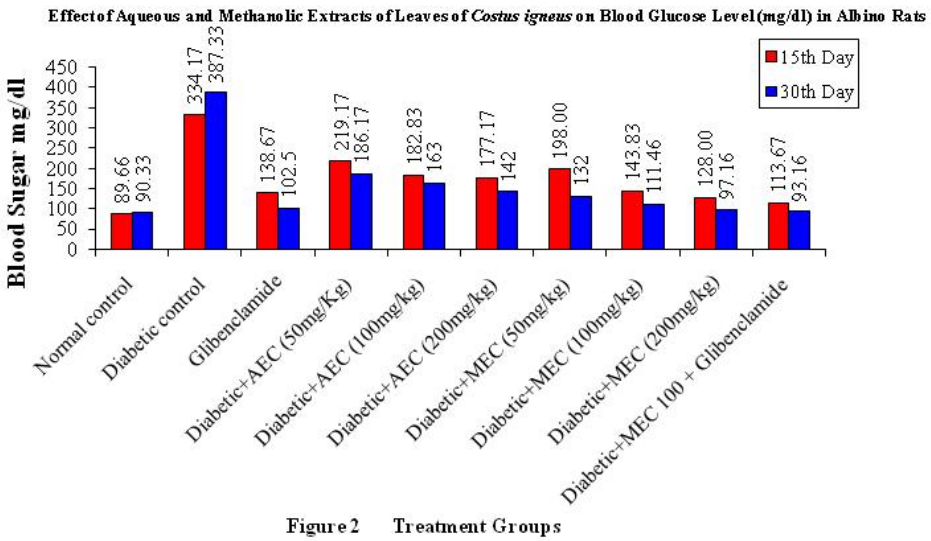

Figure 2 Treatment Groups

Table No. 4 showed the comparison of the blood glucose levels of the rats from 10 groups: Normal Control, Diabetic Control, Diabetic rats treated with Glibenclamide (0.5mg/Kg body weight) and Diabetic rats treated with aqueous extract of *Costus igneus* (AEC) of different doses AEC50, AEC100 and AEC200 (mg/Kg BW) and methanolic extract of *Costus igneus* (MEC) of different doses MEC50, MEC100 and MEC200 (mg/Kg BW) in one month study. Values represent mean±SD. Normal Control rats showed a slight increase in the blood glucose level throughout the study period. But induction of diabetes with STZ (45mg/Kg BW) significantly increased the blood glucose ($p<0.001$) of the animals in the diabetic control group. The diabetic rats that were treated with glibenclamide and different doses of aqueous and methanolic extract of *Costus igneus* leaves, showed a significant decrease in the blood glucose level. The percentage change in the blood glucose level of the rats in all treatment groups in end of the study over diabetic control is shown in this table. Standard glibenclamide drug decreased blood glucose level up to 73.57% when compared with diabetic control group. Significant hypoglycemic activities were observed in the aqueous extract of doses AEC50, AEC100 and AEC200 in STZ induced diabetic rats. The observed decrease was 51.9%, 57.91% and 63.33% respectively when compared with untreated diabetic rats or with Group II. While methanolic extract of *Costus igneus* of different doses MEC50, MEC100 and MEC200 comparatively decreased more blood glucose level in STZ induced diabetic rats like 65.92%, 71.22% and 74.91% respectively. Group X which include both standard glibenclamide and methanolic extract of 100mg dose decreased maximally blood glucose level up to 75.94% when compared with diabetic control group. The results (Table No. 4 & Fig. No. 2) indicated that *Costus igneus* methanolic leaf extract shows a more potent anti diabetic activity.

Discussion

In the present study, the antidiabetic activity of methanolic and aqueous extract of *Costus igneus* leaves was determined. Diabetes mellitus has emerged as a major health problem in the cotemporary world with the number of people with diabetes increasing day by day at an alarming rate. It ranks high among the top ten disorders causing morbidity and mortality throughout the world. This increase can be attributed to the population growth, aging, urbanization and increasing prevalence of obesity and physical inactivity (5). Diabetes mellitus is a chronic condition, which is characterized by high blood glucose levels, a condition known as hyperglycemia, due to an absolute or relative lack of insulin. Prolonged diabetic condition can lead to various complications such as heart disease, stroke, leg ulcers, gangrene, loss of vision, kidney failure and nerve damage. To maintain the well-being and avoid all the chronic complications of diabetes, the hyperglycemia must be controlled. However, the most important part of the diabetes management is the maintenance of the glucose levels within the normal range as the main metabolic currency of human body is glucose (6). Glucose is a fundamental part of all carbohydrates where it forms glucose chains of varying length. If the glucose transaction of the body is impaired due to age, genetic malfunctioning or infection, energy sources become lacking and a person may experience lethargy, irritability and drowsy spells etc., reduced energy supply to muscles and nerve cells impede their efficiency (7). Effective metabolism of glucose is coordinated by insulin produced in the pancreas in proportion to the energy requirement of the body. For the corrections of the defects in the glucose-insulin cycle, various methods have been used in order to maintain the normal levels of glucose. In the present management of diabetes mellitus the standard line of treatment is allopathic yet there are several other therapeutic approaches are in practice namely: Ayuervedic, herbal and ethnic remedies, homeopathic, nutritional supplements and life style approaches including diet & exercise etc. In the present investigation the plant selected for research i.e *Costus igneus*, known as insulin plant represents a case of Ayurveda, herbal and ethnic remedy where the use is popular but systematic and scientific data are lacking (8,9). The present research study was carried

out in order to investigate the antidiabetic potential of aqueous and methanolic extracts of different doses of *Costus igneus* plant leaves. The various doses of aqueous and methanolic extracts of *Costus igneus* leaves were subjected to experimentation for their evaluation. The results obtained were indicative of the fact that both of these extracts contain glucose lowering potential. In the present investigation in diabetic group the increased level of glucose or induced hyperglycemia was obtained by using STZ (45 mg/kg BW). It is experimentally established that STZ induces artificial diabetes in rats successfully (10).

The blood glucose level was significantly high just after the 72 hours of the injection of STZ. The level of blood glucose was more than 3-4 times higher in diabetic rats, over control and results were highly significant. The researches on *Costus igneus* and other related species were unequivocal to demonstrate the hypoglycemic effect of this plant. Similar results have been obtained in the earlier studies on alloxane diabetic rats and streptozotocin induced diabetic rats. The publications related to the antidiabetic property of *Costus* spieces is summarized in our review in tabular form in detail which include works of all scientists from 2007 to 2012 related to antidiabetic activity of *Costus igneus.* Our result coincided with the earlier finding that the supplementation of extracts of *Costus igneus* resulted in decrease blood glucose in diabetic rats. The hypoglycemic action can be due to release of insulin, insulin-sensitizing action or a combination of both. Extract of *Costus pictus* leaves does not significantly stimulate glucose uptake by L6 skeletal muscle cells. It appears that *Costus pictus* had no direct peripheral action (11). Previous studies (12,13) says that diosgenin posses hypoglycemic property. Regeneration of the islets of langerhans by quercetin is in agreement with one study who specifically demonstrated the regeneration and functional activity of regenerated beta cells by flavonoids (14). Ultrastructure of the islet can be affected by various glucose and oxygen concentration (15). Firstly, hyperglycemia (in diabetic rats) with high oxygen induced hypertrophy of endoplasmic reticulum and golgi complex, an abundance of free ribosomes, and degranulation and the margination of secretory granules in the beta cells. It was speculated that these changes represented the effort to increase the insulin secretion. Secondly, hyperglycemia with hypoxia induced dilatation of endoplasmic reticulum cisternae and dominance of golgi vesicles in addition to the above-mentioned changes. Because the transfer of proinsulin from the granular endoplasmic reticulum to the golgi complexes and the intra-golgi transfer of the prohormone are energy dependent processes. In his study, abundant immature secretory granules lacking a dense central core, hypertrophied and partially dilated endoplasmic reticulum and golgi complexes and increased mitochondria were observed at the 30th day of diabetic rat treated with *Costus igneus* extracts. With the above findings, it can be speculated that the compensatory changes in pancreatic beta-cells of *Costus igneus* treated STZ induced diabetic rats may induce increase of insulin production. It was revealed in studies that methanolic extract was found to contain the highest number of phytochemicals such as carbohydrates, triterpenoids, proteins, alkaloids, tannins, saponins, and flavonoids. Sequential screening for phytochemicals of *Costus igneus* leaves revealed that it is rich in protein, iron, and antioxidant components such as ascorbic acid, α-tocopherol, β-carotene, terpinoids, steroids, and flavonoids (16).

4. Conclusion

Aqueous and methanolic extracts of *Costus igneus* leaves exhibited antidiabetic potential. The methanolic extract was more effective than aqueous extract. *Costus igneus* leaf extract exhibited other beneficial effects like antidiabetic activity, hypolipidemic activity, antioxidant activity, diuretic effect, ameliorative effect, antimicrobial, anticancer and putative activities. No adverse side effects were observed up to the dose of 200 mg./kg/BW. Hence, the present study finds insulin like activity in *Costus igneus* leaf extracts without adverse effects and with a complimentary to standard allopathic medicine.

5. References

1. Gilman E.F., Florida: University of Florida, Inc (**2012**): *Costus igneus*. Fact sheet. *FPS-151. EDIS-Electronic Data Information Source-UF/IFAS Extension*.
2. Szkudeliski T. (**2001**): The mechanism of Alloxane and streptozotocin action in β cell of the rat's pancreas. *Physiology Res.* 50: 536-546.
3. Katsumata K., Katsumata Y., and Ozawa T. (**1993**): Potentiating effects of combined usage of three sulfonylurea drugs on the occurrence of alloxan diabetes in rats. *Horm. Metab. Res.* 25: 125-126.
4. Wild S., Roglic G., Green A., Sicree R. and King H. (2004): Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. *Diabetes Care.* 27: 1047-1053.
5. Cheng J.T. (**2003**): Herbs used to treat diabetes mellitus in chinease traditional medicine. in: Recent progress in medicinal plants. *Phytochemistry and pharmacology*. 2: 175-184.
6. Kpooria R.G. (**2003**): A growing modern problem and its botanical management. In: recent progress in medicinal plants. *Ethnomedicine and pharmacology.* 7:105-115.
7. Samidha A. Kaleker, Renuka P. (2013): Insulin sensitizing effect of Indian medicinal plants: An invitro study. *Indian J. of pharmacology.* 45: issue 1.

8. Hegde K. Prakash, Harini A. Rao and Prasanna N. Rao (**2014**): A review on insulin plant (*Costus igneus Nak*). *Pharmacogn Rev.* 8: 67-72.
9. Sharma Vivek Kumar. (2010): Streptozotocin: an experimental tool in diabetes and alzheimer's disease (A- Review) *International J. of pharma. research. www.ijprd.com.*
10. Pareek Anil, Manish Suthar, Ashok Godavarthi, Manoj Goyal, Vijay Bansal (**2010**): Negative regulation of glucose uptake by Costus pictus in L6 myotube cell line. *J. of Pharaceutical Negative Results.* 1: 24-26.
11. Undie A.S. and Akubue P. I. (**1986**): Pharmacological Evalution of Dioscorea dumentorum tuber used in traditional antidiabetic theraphy. *J .Ethanopharmacol.* 86: 133-134.
12. Presenna (**2000**): Hypoglycemic effect of fenugreak: A clinical study, *Indian J. Pharmacolo*. 32: 34-36.
13. Chakravarthy B.K. Gupta S. Gambhir S.S. and Gode K.D. (**1981**): Pancreatic beta-cell regeneration in rats. *Lancet*. 2: 759-760.
14. Hamaguchi K. Nakamura M. Yamaguchi K. and Takaki R. (**1986**): Combined effects of glucose and oxygen concentrations upon the ultrastructure of cultured islet cells and insulin accumulation in culture media. *Acta Anat.*, 127: 265-270.
15. Devi V.D. and Urooj A. (**2008**): Hypoglycemic potential of *Morus indica*. L and *Costus igneus*. Nak. A preliminary study. *Indian J. Exp.biol.* 46: 614-616.
16. Choudhary U., Soni N.D., Rajnee, Maheshwari R.K. (**2014**). Awesome Insulin Plant (*Costus igneus*): An Ecstasy of Natural Remedy for Diabetes Melitus. *Int. J. Med. Pharm. Res.* 2(3): 669-674.