INTRODUCTION

The term diabetes mellitus depicts a metabolic disorder of multiple etiology qualified by chronic hyperglycaemia with disruptions of carbohydrate, protein and fat metabolic process resulting from defects in insulin secretion, insulin action or both. Long term impairment, dysfunction and failure of several organs are the consequences of diabetes mellitus. The symptoms of diabetes mellitus include thirstiness, renal disorder, weight loss and blurred vision. In severe cases ketoacidosis or a non-ketotic hyperosmolar state might originated and lead to shock, coma and absence of effective treatment causes death. People with diabetes are to face the problems of cardio, peripheral and cerebro vascular disease.  

Aetiological types of Diabetes Mellitus

Type 1 Diabetes mellitus

It is formerly known as Insulin dependent diabetes mellitus (IDDM) or Juvenile onset diabetes mellitus (JODM). This type 1 is determined as complete insulin deficiency due to destruction of β cell and is of two types i.e. Autoimmune Diabetes mellitus and Idiopathic.

Auto immune diabetes mellitus

The rate of destruction of β cell is quite vary, being speedy in some people mainly observed in children and slow in adults and sometimes referred to as latent autoimmune diabetes in adults (LADA) and particulartiy in children and adolescents the first manifestation of the disease is ketoacidosis. Others have small fasting hyperglycaemia that can quickly convert to serious hyperglycaemia or ketoacidosis in front of contagion or other stress. Adults may hold remained β cell function, enough to forbid ketoacidosis for many years. People suffering with this type 1 diabetes often get dependant on insulin for living eventually and are at high risk for ketoacidosis. At this stage there is no chance of insulin secretion as evidenced by low levels of plasma C- peptide.

Idiopathic

Some of the patients with type 1 diabetic forms have permanent insulinopenia and have no evidence of auto immunity are prone to ketoacidosis and are commonly seen in people of Africa and Asia and they required insulin replacement therapy.

Key words: Diabetes mellitus, Momordica charantia, Insulin, ketoacidosis

ABSTRACT

Diabetes is dreadful lifestyle disorder of 21st century affecting more than 200 million people worldwide. In Diabetes mellitus patients have high blood level of glucose and this passess by urine. This is because the endocrine pancreas does not produce either or not enough insulin or the insulin effectively. Insulin is a metabolic hormone plays a main role in the stimulation of glucose intake into the body cells where it is utilized to provide energy. Prior to availability of insulin, dietary quantities admitting the traditional medicines derived from plants were the major form of treatment. A multitude of plants have on used for the treatment of diabetes mellitus all over the world. One such plant is Momordica charantia known as karela or bitter gourd which is grown in tropical countries has tremendous beneficial values in controlling and treating diabetes mellitus. Mixture of steroidal saponins such as charantins, insulin like peptides and alkaloids which are separated from Momordica charantia are the hypoglycaemic chemicals.
Type 2 Diabetes mellitus

It is formerly known as Non insulin dependent diabetes mellitus (NIDDM) or Adult onset diabetes mellitus (AODM). Grading from predominately insulin lacking to predominately insulin resistant. It is often unknown for many years and such patients are at high risk of developing microvascular and macrovascular complications because the hyperglycaemia is often not severe enough to elicit noticeable symptoms of diabetes. Majority of patients with type 2 diabetes are obese which itself causes insulin resistance and have normal or elevated levels of insulin, increase in blood glucose levels and results in even higher insulin values had their β cell function been normal.

Other specific type of diabetes causes due to genetic defects in β cell function, insulin action, diseases of the exocrine pancreas (pancreatic fibrosis) and drug or chemical induced (in treatment of HIV/AIDS) or after organ transplantation. Gestational diabetes diagnosed on pregnancy that is not clearly overt diabetes. The plant kingdom is a good potency for finding of new medicines to treat numerous diseases including diabetes mellitus. Presently around 400 plants contained more than 700 formulas and compounds which have been evaluated extensively for the treatment of diabetes mellitus which is considered to be a plant based medicine.

Medicinally the plant, whole fruit and its powder extracts have a long history of use in the treatment of various infections and diseases like viral, bacterial, microbial infections, skin diseases, HIV, quashed cholesterol and inflammation, detoxification of the body, exhausting worms from the body, hormonal balance, increases immunity, upgrades milk flow and indigestion. The active chemicals present in Momordica charantia are saponins, glycosides, alkaloids, fixed oils, triterpenes, proteins and steroids. The unripe fruits are a good source of vitamin C and also render vitamin A, phosphorus and iron.

Various phytochemicals such as momorcharins, momordenol, momordicins, momordol, charantin, charine, cryptoxanthin, cucurbitacins, cucurbitanes, cucurbitins, cycloartenols, diosgenin, erythrodial, galacturonic acids, gentisic acid, goyasaponins, multiflorenol, and goyaglycosides have been separated and described in all parts of plant.

Mode of hypoglycaemic action of Momordica charantia

The possible modes of hypoglycaemic actions are insulin secretagogue effect, stimulation of skeletal and peripheral muscle glucose utilisation, inhibition of glucose intake and hexokinase activity, suppression of key gluconeogenic enzymes, stimulation of key enzyme of HMP pathway, preservation of islet β cells and their functions.

Extraction methods for Momordica charantia

There are many types of extraction have been done to Momordica charantia in order to extract the active compounds. This includes the following methods:

1. Pressurized Boiler Set Up
2. Soxhlet extraction and boiling
3. Aqueous extract

Pressurized Boiler Set Up

It was performed by using a pressurized boiler system consisting of boiler, condenser, pressure relief valve, pressure gauge and thermocouple (shown in fig 1). The sample of 10g was placed in the boiler and mixed with 550ml water at a given time (30, 60, 90, 120 min), solid to liquid ratio (1:15, 1:25, 1:35, 1:45, 1:55, 1:65) and pressure (0.5, 1.0, 2.0, 2.5 bar). Then all the screws were tightened in order to prevent leakage at the system, deliberately check the system was in pressurized condition or not. Hot plate was used to heat the water and when the temperature reaches to 100°C, the steam gets pressurized in the boiler and gives reading at the pressure gauge. The analysis was made in the pressure range between 0.5±0.5 bar to 2.5±0.5 bar. Then the sample was shifted to rotary evaporator to separate and clear the water from the extract under reduced pressure in vacuum.
The yield was weighted and the extract would be treated with n-hexane to extract the compounds.

**Effect of Momordica charantia in hypoglycaemic condition**

Various low quality human studies have suggested that *Momordica charantia* lowers serum glucose levels\(^{39-42}\). The extracted elements appears to have similar structures related to animal insulin, as evaluated by electrophoresis and infrared spectroscopic analysis and also have insulin like properties\(^{43-45}\). Other manifest suggests that *Momordica charantia* may decrease hepatic gluconeogenesis, enhance hepatic glycogen synthesis and increase peripheral glucose oxidation in erythrocytes and adipocytes\(^{46}\). The polypeptide isolated from the seeds called “polypeptide p” and a mixture of two steroid glycosides referred as “charantin”\(^{47-48}\).

**Applications of Momordica charantia in diabetes**

The fresh juice of *Momordica charantia* can lower blood glucose levels and hold insulin under control. It is mainly due to presence of phytoconstituents i.e. charantin, insulin like peptides and alkaloids which pretend together and improves glucose allowance without enhancing insulin levels. These elements trigger a protein named AMPK, which governs fuel metabolic process and alters glucose uptake processes which are afflicted in diabetes. It also noticed, that increase in number of insulin releasing β cells in the pancreas. Multiple clinical examines have authenticated the efficacy of *Momordica charantia* and respective pharmaceutical companies have started and let them in their preparations.

**Applications of Momordica charantia in other diseases**

**Antibacterial activity**

The extract of entire *Momordica charantia* plant has antiprotozoal activity against *Entamoeba histolytica*, *E.coli*, *Salmonella paratyphi*, *Streptomyces griseus*, *Shigella dysenteriae*\(^{49-50}\).

**Antiviral activity**

The extract of *Momordica charantia* contain α and β momorcharin, lecithin and MAP 30 have been documented to have *in-vitro* antiviral activity against *Epstein barr*, herpes, HIV, *Coxsackievirus* B3 and polio viruses.
Anti HIV activity
Isolated protein known as MAP 30 having anti HIV activity.\(^{1,51-53}\)

Anti herpes activity
Two in-vitro studies have shown antiherpes activity of *Momordica charantia* ribosome deactivating proteins and MAP 30 against HSV-1 and HSV-2. This effect is probably mediated through inhibition of protein synthesis.\(^{54-55}\)

Anti polio virus activity
*Momordica charantia* ribosome deactivating proteins inhibited polio virus replication by inhibiting protein synthesis suggested its use against sexually transmitted diseases, as it had no effect on the motility or vitality of spermatozoa.\(^{56}\)

Anti cancer activity
*Momordica charantia* crude extract containing MAP30 shown activity against lymphoid leukemia, lymphoma, choriocarcinoma, melanoma, breast cancer, skin tumour, prostatic cancer, squamous carcinoma of tongue and larynx, human bladder, carcinomas and Hodgkin’s disease.\(^{57-60}\)

Anti ulcer activity
Momordin Ic potentially inhibited ethanol induced gastric mucosal lesions and also have anti H.pylori activity which would also be beneficially contribute to antiulcer activity.\(^{61-63}\)

Anti helmintic activity
Preparations from *Momordica charantia* exhibited in-vitro activity against *Ascardia galli* worms shown to be effective than piperazine hexahydrate.\(^{64}\)

Anti malarial activity
Observe weak in-vitro antiplasmodial activity for *Momordica charantia* and moderate in-vivo activity against rodent protozoal infection P.vinckeipetteri.\(^{65-66}\)

Immunomodulatory activity
\(\alpha\) and \(\beta\) momorcharin showed immunosuppressive activity via lymphocyte toxicity or to a shift in the kinetic parameters of the immune response.\(^{67}\)

Miscellaneous
Antipsoriasis
Granylate cyclase enzyme inhibitory property i.e. reported in treatment of psoriasis.\(^{68-70}\).

Anti infective and Analgesic activity
Momordin Ic and its aglycone, oleanolic acid are active principles with anti rheumatoid activity.\(^{71}\).

Hypotension and antiprothrombin activity
Observed mild hypotensive with momordin. In another study, *Momordica charantia* prolonged prothrombin time by inhibiting activation of factor X by factor VII a tissue factor complex or factor IXa.\(^{72}\)

Hypocholesterolemic and anti oxidant potential
Feeding of conjugated octadecatrienoic fattyacid isolated from *Momordica charantia* seed for 4 weeks significantly lowered the plasma lipid and erythrocyte membrane lipid peroxidation as well as non- enzymatic liver tissue lipid peroxidation in sunflower oil fed rats.\(^{73-75}\)

CONCLUSION
The herbal plants find out application in pharmaceutical, agriculture, cosmetic and food industry and have negligible side effects than the synthetic drugs. It was concluded that *Momordica charantia* contains the active constituents known as steroidal saponins (charantin, insulin like peptide and alkaloids) which are responsible for the lowering of blood glucose levels. Separation and recognition of active ingredients from plants, formulation of standardized dose and dosage form can act as a substantial part in improving the hypoglycaemic action.

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