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Review Article

Review On Anti-Diabetic Drug and Treatment

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ABSTRACT

Diabetes is the third leading cause of death in the United States, and is one of the world's major diseases. Diabetes is a metabolic disorder which is mainly characterized by hyperglycemia and arises from defects in insulin action or both. Approximately 2% of the population in India suffer from diabetes. Anti-diabetic drugs lower the levels of sugar in the blood. Most anti-diabetic drugs are administered by mouth. There are different types of anti-diabetic drugs and their selection depends on a number of factors. Treatments include the agents which increase the amount of insulin produced by the pancreas, or increase the sensitivity of target organs to insulin, and agents which decrease the rate at which glucose is absorbed from the gastrointestinal tract. There are a lot of people who are focused on controlling the blood sugar levels in diabetes. The drugs used in the treatment of diabetes are summarized in the present review. (4,2).

INTRODUCTION

The word "diabetes" means excessive excretion of sweet urine. Diabetes is a group of metabolic diseases characterized by hyperglycemia. Chronic hyperglycemia of diabetes can cause long term damage to various organs such as the eyes, kidneys, nerves, heart and blood vessels. Hyperglycemia occurs when there isn't enough insulin in sufficient amounts. When the blood glucose level is so high that it spills over in urine, it's hyperglycemia. Since entry into the cells is impaired, cells starve. Hyperglycemia is caused by excessive thirst and frequent urination. Damage to the eyes, kidneys, nerves, heart and blood vessels are caused by chronic hyperglycemia. 422 million people are affected by diabetes according to the World Health Organization. It causes 1.5 million deaths in 2012 and the majority of the population are affected by type-ll diabetes. Previously type-ll diabetes was diagnosed among adults but now it occurs in children as well. The development and progression of diabetes can be caused by increased free radical production and impaired antioxidant defenses due to the oxidative stress. We might be able to find new drugs which are therapeutically

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active and cheaper from the knowledge we have about the plants. There are some advantages to using herbs in a treatment. The review describes the antidiabetic plants which are said to have good therapeutic activity. (1.7)

Symptoms: -

General symptoms of unmanaged diabetes include: excessive thirst and hunger frequent urination drowsiness or fatigue dry, itchy skin blurry vision slow-healing wounds (9)

Types Of Diabetes Mellitus

Type 1 diabetes

Type 1 diabetes is believed to be an autoimmune condition. This means your immune system mistakenly attacks and destroys the beta cells in your pancreas that produce insulin. The damage is permanent.What prompts the attacks is not clear. There may be both genetic and environmental reasons. Lifestyle factors are not believed to play a role.

Type 2 diabetes

Type 2 diabetes starts out as insulin resistance. This means your body cannot use insulin efficiently, which causes your pancreas to produce more insulin until it cannot keep up with demand. Insulin production then decreases, which causes high blood sugar.The exact cause of type 2 diabetes is unknown. Contributing factors may include:

- Genetics A More Sedentary Lifestyle Higher Weight Or Obesity
- There May Also Be Other Health Factors And Environmental reasons.

Gestational diabetes

Gestational diabetes is caused by insulin-blocking hormones that are produced during pregnancy.

This type of diabetes only happens during pregnancy. It is often seen in people with preexisting prediabetes and a family history of diabetes. About 50 percentTrusted Source of people diagnosed with gestational diabetes go on to develop type 2 diabetes. (3,5,2)

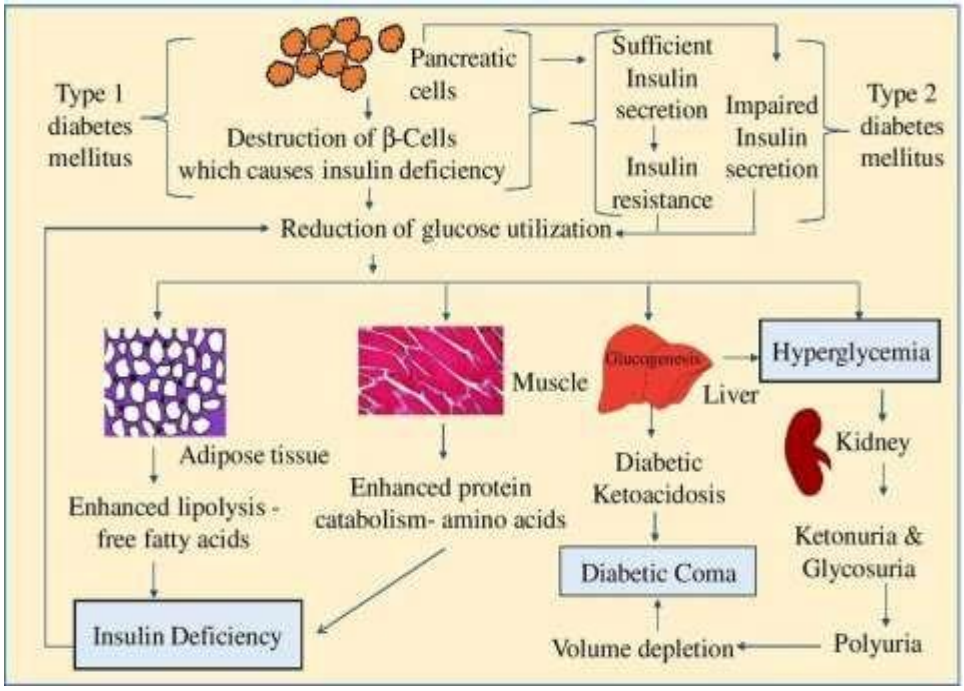
Causes Of Diabetes Mellitus

Main causes of diabetes mellitus are:

- Genetic defects of beta-cell function .
- Genetic defects in insulin action.
- Diseases of the exocrine pancreas.

Endocrinopathies, i.e., changes in hormonal secretion and, Drugs or chemical induced.(7)

Pathophysiology



Treatment: -

There are various methods to treat the diabetes mellitus, like non-pharmacological and pharmacological treatments.

1. Non-pharmacological Treatments: -

Medical nutrition therapy (MNT), weight management, physical activity, smoking cessation, diabetes self-management education and support, and psychosocial care are essential for achieving treatment goals and improving quality of life among patients with diabetes. (37)

Dietary Modification in Diabetes Treatment

Encouraging adherence to an appropriate diet can be one of the most challenging aspects of diabetes care. At the time of diagnosis, referral to a registered dietitian nutritionist (RD/RDN) can facilitate implementation of diabetes-specific MNT. According to the ADA, individuals with type 1 diabetes who received MNT delivered by an RD/RDN experienced HbA1c reductions ranging from 1.0% to 1.9%; patients with type 2 diabetes experienced HbA1c reductions ranging from 0.3% to 2%.(37)

Weight Management for Diabetes Control

A 500 to 700 kcal/d energy deficiency can lead to significant weight loss in patients with diabetes. If weight loss can be maintained for 5years, a more intense goal of 15% may be necessary for some individuals to achieve these benefits.(37)

Physical Activity as Treatment for Diabetes

Exercise improves blood glucose control, contributes to weight loss, decreases cardiovascular risk factors, and improves well-being. The benefits of physical activity for people with type 2 diabetes are well established; however, individuals with type 1 also stand to benefit from increasing their physical activity.(37)

Smoking Cessation

Smoking or exposure to secondhand smoke puts individuals with diabetes at greater risk of

microvascular complications, cardiovascular disease, poor glycemic control, and premature death.Although attendant weight gain is a concern among people who quit smoking, research has demonstrated that this weight gain does not detract from the cardiovascular benefits afforded by smoking cessation.(37)

2.Pharmacological Treatment

A. Natural Drugs:

1 Mustard (Brassica juncea)

Family: - Brassicaceae

Biological Source: - It is a fixed oil obtained from matured seeds of *Brassica nigra*

This plant is commonly known as brown mustard, Chinese mustard is widely found in Europe, Africa, North America and Asia. It contains several important chemical constituents such as triterpenes,Saponins,alkaloids,flavonoids etc.It is pharmacologically used as antiscorbutic, diuretic, stimulant, stomachic, antihelmintic, antidysentric, diaphoretic, antiarthritic. Thirumalai Tet al reported that the aqueous seed extract of the plant showed potent hypoglycemic activity at a dose level of 250, 350 and 450 mg/kg in streptozotocin induced diabetic male albino rat.

Chemical <u>Constituents</u>

Mustard oil contains glycerides of arachidic (0.5%), behenic (2–3%), eicosenoic (7– 8%), erusic (40–60%), lignoceric (1–2%), linoleic (14–18%), linolenic (6.5–7.0%), oleic (20–22%) and myristic (0.5–10%) acids.(20)

2.Coconut palm (Cocus nucifera)

Family: - Arecacear.

Biological source:-Coconut oil is the oil expressed from the dried solid part of endosperm of coconut, *Cocos nucifera* L. It is commonly known as coconut widely available in the coastal regions of India. It is used pharmacologically as an analgesic, anti-inflammatory, anti-bacterial, antifungal, antioxidant, antiparasitic, antimalarial, cardioprotective etc. S. Saranya et al found that the significant antidiabetic activity was showed by the flowers extract of the plant in the streptozotocin induced diabetic rats at the dose of 300 mg/kg. Nidhi Tyagi et al reported that ethanolic extract of this plant showed potent antidiabetic activity at the doses of 200 mg/kg and 400 mg/kg in the streptozotocin induced diabetic rats.

Chemical constituents:- . It contains several important chemical constituents such as phenols, tannins, leucoanthocyanidins, flavonoids, triterpenes, steroids, and alkaloids.(12)

3.Castor bean(Ricinus communis)

Family:- Euphorbiaceae.

Biological source:- Castor oil is the fixed oil obtained by cold expression of the seeds of *Ricinus communis*Linn.

Chemical constituents:-This plant is a species of perennial flowering plant and widely available in India. It contains several chemical constituents such as steroids, Saponins, alkaloids, flavonoids and glycosides etc.The seeds and fruits contain 45% of fixed oil which contains glycosides of ricinoleic, isoricinoleic, stearic, dihydroxystearic acids.

Uses:- Pharmacologically it is used as an anticancer, antioxidant, antiulcer, antimicrobial, antidiabetic, hepatoprotective, central analgesic, antiasthmatic etc. reported that the root, stem and leaves of the plant showed hypoglycemic activity in the albino rats at the dose of 250 mg/kg in the initial screening studies. Poonam Shokeen et al reported that the ethanolic extract of the roots of the plant showed potent blood glucose lowering activity in alloxan induced diabetic rats at a dose of 500 mg/kg.(13)

4. Mango(Mangifera indica)

Biological source:- Mangifera indica (MI), also known as mango, aam, it has been an important herb in the Ayurvedic and indigenous medical systems for over 4000 years. Mangoes belong to genus Mangifera which consists of about 30 species of tropical fruiting trees in the flowering plant.

Chemical constituents:-This plant is commonly known as mango which is native to indian subcontinent. It contains numerous chemical constituents among them polyphenolics, flavonoids and triterpenoids are specific.The main bioactive constituent is mangiferin, which is a xanthone glycoside. The other active constituents present in this plant are isomangiferin, tannins etc.

Uses:-It has several pharmacological uses such as antioxidant, antidiabetic, antiviral,anthelmintic,antiallergenic, antiparasitic, antidiarrhoeal etc. reported that the aqueous extract of the leaves of the plant showed significant hypoglycemic activity in normoglycaemic and glycose-induced hyperglycaemic mice.(14)

5.Garlic (Allium sativum)

Family:- Amaryllidaceae

Biological source:-Garlic is the ripe bulb of *Allium sativum* Linn.,

This plant commonly known as garlic is native to Central Asia and northeastern Iran and widely found in India.

Chemical constituents:-It mainly contains essential oil which consists of sulpher compounds such as trisulfides and disulfides. It is pharmacologically beneficial as an antibacterial, antifungal, antiparasitic, antiviral, antihypertensive, antithrombotic etc. The future studies on diabetes mellitus the plant should be considered. Because at the doses of 0.1, 0.25 and 0.5 g/kg in streptozotocin-induced diabetic rats.(16)

6.Amla (Emblica officinalis)

Family:- Euphorbiaceae

Biological source:-This consists of dried, as well as fresh fruits of the plant *Emblica officinalis* Gaerth (*Phyllanthus emblica* Linn.),Commonly known as amla, this plant is widely available in India.

Chemical constituents:-It contains vitamin C, tannins, gallic acid, ellagic acid, chebullagic acid etc.

Uses:- It is used as an antiaging, anti-amnesiac,anti-inflammatory, anti-bacterial, anticancer, anti-fungal, anti-viral, anti-venom, anti-ulcerogenic, astringent etc. The aqueous extract of the seeds of the plant showed definite hypoglycaemic activity in streptozotocin induced type-Il diabetic rats at the dose of 300 mg/kg.(15)

7.Babul (Acacia arabica)

Family:- Fabaceae

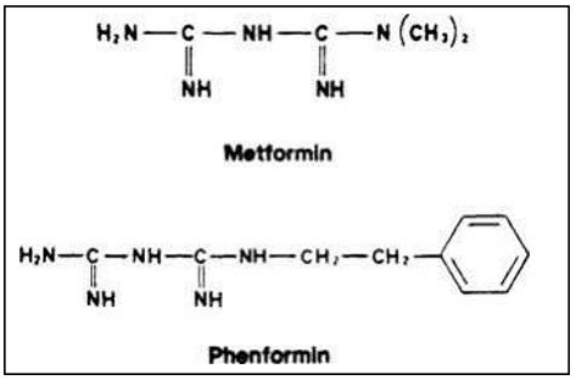
Biological source:-Acacia nilotica Linn.is an ayurvedic herb used in the treatment of skin diseases, dhat syndrome, bleeding disorders and to treat intestinal worms.It is cultivated throughout the India.

Chemical Constituents:- It contains phenolics, tannins, gallic acid, protocatechuic acid pyrocatechol, catechin, epigallocatechin-7-gallate, quercetin, isoquercetin etc.

Uses:-It is pharmacologically used as an antibacterial, antifungal, antiviral, antimalarial,antidiarrhoeal,immunomodulatory,anti-inflammatory, antioxidant, antiabortifacient, antiulcer etc. A study reported by clearly indicates that this plant extract showed significant hypoglycaemic activity in albino rats at the doses of 100 mg/kg and 200 mg/kg. found that cold aqueous extract of the plant gives higher antihyperglycaemic activity in diabetic and normal rats at the dose of 400 mg/kg.(17)

2. Synthetic drugs/Anti-diabetic drug:-

1. BIGUANIDES



In obese patients who fail diet and exercise therapy, biguanides are used as an alternative to treat their diabetes. Biguanides have a mechanism of action that enhances peripheral muscle. It is possible to make muscle and fat cells more sensitive to available insulin, and it is possible to prevent the liver from making excessive glucose. Biguanides are usually associated with a low risk of low blood sugar due to the fact that they don't promote the production of insulin.Biguanides are known as insulin sensitizers.It's not clear what the complete mechanism of action of biguanides is, but it acts in the liver by decreasing excessive glucose production through reduced gluconeogenesis. The main action of biguanide drugs can be seen in the liver mitochondria. The release of hormones,such as glucagon, is not stimulated by the presence of metformin. The secretion of adiponectin is suppressed by metformine.The excretion of Metformin is unchanged in the urine and it is not metabolized.Metformin has a low risk of causing hypoglycaemia and lactic acidosis. However, metformin is contraindicated in people with any condition that could increase the risk of lactic acidosis, including kidney disorders, lung disease and liver disease. Metformin is often used in combination with other oral antidiabetic drugs.(31) The most popular combination of metformin is used with rosiglitazone. Metformin is also used in combination with pioglitazone, glipizide, glibenclamide or glyburide, dipeptidyl peptidase (DPP)-4 inhibitors sitagliptin, saxagliptin, meglitinide repaglinide and Novo Nordisk.Furthermore, the Food and Drug Administration (FDA) also approved the combination of metformin and alogliptin under the trade name Kazano in 2013.(19,33)

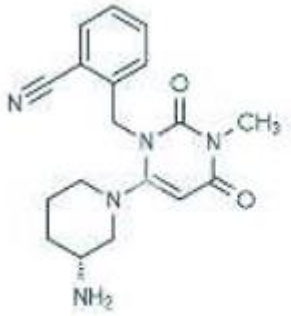
2. Bile Acid Seuestrants

Cholestyramine and colestipol are first-generation bile acid sequestrants and antihyperlipidaemic agents that currently have a limited use due to their weak effect on lowering low-density lipoprotein cholesterol (LDL-C) and poor tolerability . The second-generation bile acid sequestrants, such as colesevelam and colestimide (also called colestilan) have a glucose-lowering effect and improved tolerance, which has led to re-evaluation of their application as oral antidiabetic agents. Colesevelam is a bile acid-binding resin sequestrant, it is indicated as an adjunct to diet and exercise to reduce elevated LDL-C in patients with primary hyperlipidaemia as monotherapy and to improve glycaemic control in T2DM, including in combination with a statin . The mechanism by which colesevelam improves glycaemia has not been fully understood but may involve enhanced

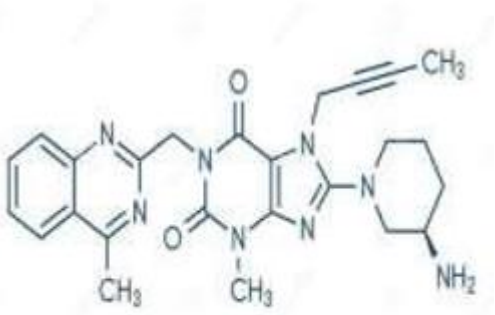
meal-induced incretin secretion and altered farnesoid X receptor (FXR) signaling.(21,34)

3. Gliptins (DDP-4 Inhibitors)

Dipeptidyl peptidase-4 (also known as adenosine deaminase complexing protein 2 or CD26) cleaves the two N-terminal amino acids from peptides with a proline or alanine in the second position, and inactivating both glucagon-like peptide-1 (GLP-1) and gastric inhibitory polypeptide (GIP) . Endogenously released GLP-1 has a short biological half-life around 1.5-5 min, whereas the serum half-life of GIP is approximately 7 min . Upon secretion of GLP-1 and GIP both are rapidly degraded and inactivated by DPP-4. Therefore, DPP-4 inhibitors have been developed and to prevent degradation of endogenously released GLP-1 and GIP. Consequently, it enhanced plasma concentrations of active incretin, prolonging the actions of the incretin and leading to increased insulin levels.



alogliptin



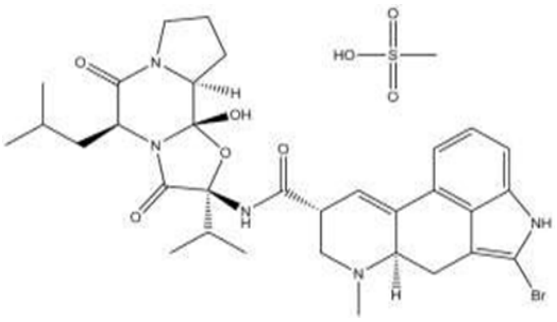
linagliptin

The insulin-releasing effects of incretins are glucose dependent and the incretins have no insulinotropic activity at lower glucose concentrations (< 4 mmol/L), thus it reduces the chance of hypoglycaemia, which is one of the major concerns with other antidiabetic drug classes.Furthermore, DPP-4 inhibitors are the first substances that have a glucose-dependent dual action on &- and B-cell functions, stimulating insulin secretion and suppressing glucagon secretion under hyperglycaemic conditions.This dual action of incretin leads to an improved time-course of islet hormone secretion after a meal as well as in hyperglycaemia. The discovery of incretin therapy may help overcome the limitations of the classical treatment options for T2DM.(18,32)

Dopamine D2 Receptor Agonists (Bromocriptine)

Bromocriptine a central-acting dopamine D2 receptor agonist used for the treatment of TDM in 2009. This drug has been previously widely used in treatment of hyperprolactinaemia and galactorrhoea caused by pituitary tumours, Parkinson's disease, hyperprolactinaemia and neuroleptic malignant syndrome. The mechanism of action underlying how bromocriptine regulates glycaemic control is not clear, but data indicate that bromocriptine improves insulin sensitivity and other metabolic abnormalities . Bromocriptine is a potent agonist at dopamine D2 receptors, serotonin (5-HT1, 5-HT2 and 5-HT6) receptors and al- and a2-adrenoceptors. In addition, it is also a moderate agonist for dopamine D1 receptors and 1-and 2-adrenoceptors . Bromocriptine inhibits

glucose-stimulated insulin secretion by direct activation of a2adrenoceptors on ß-cells . Clinical studies have shown that quick release (QR) bromocriptine. (24)



Bromicriptine

CONCLUSION AND FUTURE DIRECTION

In India several medicinal plants are used traditionally in many forms in the treatment of diabetes. Current research of the antidiabetic activity of the herbs helps to develop effective herbal therapies for such purpose. For the discovery of new potential antidiabetic compounds suitable information about medicinal plants are needed. This article is prepared for providing proper information regarding the medicinal plants having antidiabetic property. The informations which are discussed here regarding the medicinal plants might be helpful for further research on diabetes.(26,27,28) Although many antidiabetic drugs are currently available to treat T2DM patients, the current treatment of diabetes is still inadequate, and the search for an effective treatment continues. In addition to side effects such as weight gain and hypoglycemia, current diabetes treatments do not address the underlying cause of the condition, which is B cell dysfunction, and the nature of the defect in insulin secretion is irreversible. Furthermore, the pathophysiology of the disease is only partially understood, and there are no anti-inflammatory drugs that are effective in reducing the cardiovascular risk associated with T2DM. Therefore, the development of new antidiabetic drugs should not only target blood sugar, but also prevent infection, restore B cell function, and reduce complications associated with T2DM, such as cardiovascular risk in the long term (29).The examples mentioned in this review, on the one hand, reveal the inadequacy of diabetes treatment, while at the same time, highlight the need for antidiabetic drugs. Honey is truly beneficial and better. (30)

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