Recent Advances in Nano-formulation contain Anti-diabetic drug Therapy for type II Diabetes mellitus

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***Abstract*-Diabetes is a common form of endocrine disorder where the blood sugar levels are not properly managed. Pre-diabetes, Type 1, Type 2, gestational diabetes, neonatal diabetes and some other forms of diabetes. Despite the use of several treatment strategies, diabetes continues to exist and pose a danger. Many active plant chemicals, or phytocompounds, have low solubility, low permeability, or quick elimination, which makes them poorly bioavailable. Plant nanomedicines are being researched as a means of overcoming these obstacles and reducing the financial load on economically disadvantaged communities. Nano formulations with antidiabetic drug is compare with Nano formulations with phytocompounds or extracts from anti-diabetic plants have demonstrated promising outcomes. In this article, we wanted topresent an overview of the clinical use of antidiabetic medication loaded Nano formulations delivery systems for the treatment of diabetes.**

***Keywords*- diabetes; drug delivery; Nano formulations.**

1. INTRODUCTION

The spectrum of potential applications has been enlarged by recent developments in nanoscience and nanotechnology. The medical and health sciences are increasingly using applications of nanotechnology. Nanosized formulations in the realm of medical research offer an unparalleled success in drug deliverysystems over traditional formulations by improving the clinical efficacy of therapeutic agents by strengtheningtheir biopharmaceutical properties, pharmacokinetic profiles, and target specificity.[1] In terms of efficiency, stability, bioavailability, bio-distribution, and drug release, the development of nanocarrier drug nanoparticles such as liposomes, polymeric nanoparticles, dendrimers, niosomes, nanomicelles, metallic nanoparticles, nano lipid carriers, and nanofabricated devices has outperformed conventional drug delivery systems. Combining ligands with nanocarriers makes them more targeted, which has the benefit of protecting the medicine that is entrapped.[2]

2. GENERAL INFORMATION ABOUT DIABETES MELLITUS

A dangerous and widespread metabolic syndrome known as diabetes mellitus is characterised by elevated blood glucose levels. Type 1 and type 2 diabetes mellitus are the two main categories. Diabetes has been more and more common during the last few decades.[3] A total of 422 million people were diagnosed with diabetes in 2014, making up 8.5% of the world's population.[4] Among them, type 2 diabetes patients made up 7% of the total diabetes population. By 2040, it is expected that 642 million people worldwide would have diabetes mellitus. Nephropathy, retinopathy, neuropathy, cardiomyopathy, peripheral arterial disease, coronary artery disease, and stroke are just a few of the slowly or quickly progressing pathologies thatdiabetes can cause.[5]

It has long been believed that the main therapy strategy for diabetes mellitus is glycemic control. However, numerous diabetes risk factors, fatal consequences, and the emergence of vasculopathy prior to diagnosis for the development of novel treatment approaches for the efficient management of diabetes. Insulincontrols how glucose will absorbed and utilized by organs to produce energy. It is secreted by islets of Langerhans cells in the pancreas. Patients with type I diabetes get single dose injections of fast-acting insulin at suppertime along with prolong acting insulin injections to maintain a lowermost level of insulin.[6]

Clinically, a number of anti diabetic medications, either alone combines with insulin, for the treatment type II diabetes mellitus. Although the unfavourable side effects of the presently available antidiabeticmedications depress both doctors and patients, which has directed attention more and more toward thedevelopment of new antidiabetic medications.[7] Otherwise, many naturally occurring phyto-constituents have showed vast potential against diabetes under the preclinical testing.[8]

2.A Modern Promise: Nanocarrier-Based Drug Delivery

The prefix "nano" comes from the Latin word "nanus," which implies midget. Nanoscience is concerned with things that are 109–107 m in size. The use of nanotechnology in medical science for both diagnosis and treatment has skyrocketed in recent years. It has been demonstrated that materials on the nanoscale develop

unique physical, chemical, and biological characteristics that make them desirable for biomedicalapplications.[9] Therapeutic effects

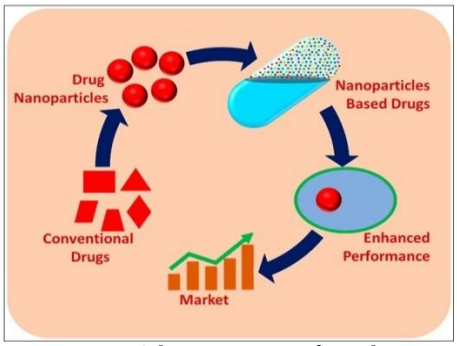

Figure 1. Recent Advances in Nanoformulation

and pharmacological ineptitude have been found to be separated by curative substances at the nanoscale dimension.[10]

By functionalizing surface of nanocarrier-based formulations with synthetic polymers or combining them with the suitable molecules as depicted Fig.1; it is possible to achieve excellent active target selectivity. Alarge variety of medications with flexible physicochemical features can be delivered by nanocarriers.[11] Contrarily; there are certain difficulties with drug delivery using nanocarriers, such as low drug loading capacity, inadequate cellular uptake, noxious, and obscure biodegradability and ligand-labeling capabilities. However, a number of strategies to overcome these restrictions and use nanocarrier-based medication delivery in practical settings.[12] According to a recent estimate, the global market for medicinal nanoformulations is steadily expanding at a rate of 22%each year.[13]

3. NANOFORMULATIONS FOR THE TREATMENT OF DIABETES

Approaches based on nanotechnology provide better therapeutic management of diabetes mellitus with reducedrisk of acute and long-term consequences. Drugs are effectively delivered to the target site with the correct release pattern thanks to nanocarrier-based formulations. Additionally, nanoformulations provide a variety of drug delivery methods. Therefore, appropriately created nanoformulations of hypoglycaemic drugs may soon provide better therapeutic control of diabetes. The progress and efficacy of nano-based formulations of

antidiabetic drugs were highlighted in the following section of this review.[14]

4. DIFFERENT ANTIDIABETIC DRUG NANFORMULATION

Table 1. Antidiabetic drug nanoformalation and their properties

Sl.no.	Anti-diabeticdrugs	Nanoformulation andmethod	Summary
1.	Glimepiride	**Nanoemulsion (NE)** Clove oil, Tween 80, PEG-400	Synergistic combination of GMP withclove oil improved the overall drug permeation across the skin membraneand the hypoglycemic activity of GMP.
2.	Acarbose	**Encapsulation method** PEG 4000 and 6000 polymers	10% *Channa striata* protein hydrolyzate formulation and chitosan-PEG 6000 nanoparticles were more effective than acarbose in lowering blood glucose, cholesterol, triglycerides, HDL, and LDL levels.
3.	Glycyrrhizic acid	Nanoparticles	Enhance lipid profiles and lower blood glucose levels
4.	Metformin	**High shear hot homogenization** MH,Beeswax , Phospholipid, Sorbitol , Tween 80,distilled water	Metformin-loaded PEGylated solid lipid nanoparticles could be employed as a potential approach to improve the delivery of metformin hydrochloride in oral diabetic treatment
5.	Pioglitazone	**Nanoemulsion** PGZ, NSO, Surfactant and co-surfactant , Pluronic F127	PGZ-loaded NE formulation showed asignificant reduction in blood glucose level, which appeared to be enhanced by the presence of NSO-NE could be a promising nanocarrier for enhancing the hypoglycemic effect of PGZ.
6.	Repaglinide	Nanoparticles	Repaglinide improves bioavailability, permeability, compatibility, efficacy of treatment, and lowers side effects.
7.	Tolbutamide	**Nanosponges** Solvent evaporation method-Hydrophilic, Lipophilic material	-
8.	Rosiglitazone	**Nanoemulsion** Rosiglitazone, Black cuminoil	The activity of rosiglitazone to a nanoemulsion (NE) formulation by the organic phase black cumin oil were increased.

5. FUTURE PERSPECTIVE

In recent years, the use of nanotechnology in medicine has significantly increased. When long-term or ongoing treatment is necessary for the management of diabetes, patient compliance has been viewed as a crucial factor. By providing a variety of administration routes, controlling release, enhancing biologicalstability, increasing target specificity, and lowering toxicity, nanoformulations have been demonstrated to increase patient compliance.[34] Thus, as shown by the published papers during the past years, there has been a sharp rise in interest in creating nanoformulations to treat diabetes. Given this, it might be asserted that crude herbal products or naturally occurring antidiabetic compounds could be used to create acceptable nanoformulations to lessen diabetes and its related consequences.[35]

6. CONCLUSION

Long-term treatment is necessary for chronic metabolic syndrome conditions like diabetes. Patient compliance is therefore the most important factor to consider when formulating pharmacotherapeutic drugs forthe treatment of diabetes. Nano formulation is primarily chosen in this aspect. Antidiabetic compoundsprovide great potential for reducing diabetes and its consequences. Polymeric nanoparticles, nano-emulsions, nanocarrier-assembled nanoparticles, nanoliposomes, solid lipid nanoparticles, nanostructured lipid carriers, nanomicelles, solid dispersions, and nanocrystals are just a few of the many types of nanoparticles that have been created over time. In conclusion, it has been discovered that the pharmacokinetic and biopharmaceutical barriers associated with antidiabetic medication formulations can be overcome to improve compliance and clinical efficacy. So, it is possible to focus on the emerging nanotechnology as a expected medication to reachout the highest clinical output of anti-diabetic therapy. To effectively control diabetes and its consequences, clinically effective therapeutic nanoformulations of antidiabetic drugs are still needed.

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