

Role of Biotechnology in Diabetic Treatment: A Review

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Abstract

According to the World Health Organization (WHO) in 2021, about 422 million people have diabetes globally, most of them in low-income and medium-income nations, and 1.6 million fatalities annually. In Malaysia, DM is ranked at 9th place as the leading causes of deaths. DM is categorized into 3 types, namely Type 1 or Insulin Dependent Diabetes Mellitus (IDDM), Type 2 or Non- insulin Dependent Diabetes Mellitus (NIDDM) and Gestational Diabetes Mellitus (GDM). Typically, lifestyle change, diet and exercise are the recommended treatment for DM patients. Nevertheless, oral antidiabetic drugs and insulin (injection) which are produced using biotechnology applications are also available. Currently, biotechnology industries have been endeavored to develop new diabetes treatments such as real-time continuous interstitial glucose monitoring, continuous subcutaneous insulin infusion (CSII), electronic tools for monitoring therapeutic approaches, automated bolus calculators for insulin, and electronic tools for patient education and information as well as hormone therapy and new designing oral diabetes drugs. Optimistically, the future therapies will be accessible to limit the growing trend of DM disease.

Keyword: Diabetes mellitus; diabetes treatment; biosynthetic human insulin; insulin infusion; hormone therapy

INTRODUCTION

Diabetes mellitus (DM) is a chronic disease that cause high blood sugar or hyperglycemia because pancreas does not produce enough insulin or problem in insulin action or maybe both. The absence of insulin in diabetes patients will lead to high glucose level in blood. Hyperglycemia, or high blood sugar, is a typical side effect of untreated diabetes, and it may cause significant injury to many of the body's systems, particularly the neurons and blood vessels over time [1]. Diabetes affects about 463 million people worldwide, while in Malaysia, it is projected that 3.9 million or 18.3% of the adult population had high blood sugar in 2019. Regrettably, these figures are anticipated to rise [2]. Therefore, access to affordable medicine, particularly insulin, is critical for those living with diabetes.

This study overviews the basic understanding about diabetes including the types, risk factors, symptoms, and complication were studied. The current and future diabetic treatment using biotechnologies techniques are also acknowledged and compared. Apart from insulin production, there are more applications and technologies been discussed in related of treating diabetes that use biotechnologies techniques.

METHODOLOGY

This study is a review article basis that was carried out during COVID 19 pandemic (April 2021 – July 2021). Only online sources been used to find journals and reading materials. Online platforms such as Google Scholar, Mendeley, NCBI, PubMed and ResearchGate as well as Government and Non-government websites such as MOH and WHO were utilized to complete this study. The online sources which were published from 2017-2021 were scrutinized and summarize before writing were made.

RESULTS AND DISCUSSION

Overview of Diabetes Mellitus

Diabetes is a worrying trend in Malaysia. It is one of the primary noncommunicable illnesses in Malaysia, affecting up to 3.9 million people aged 18 years and above. It is estimated that 1 in 5 adults in Malaysia have diabetes [3]. Generally, diabetes is categorized as Type 1 or Insulin Dependent Diabetes Mellitus (IDDM), Type 2 or Non-Insulin Dependent Diabetes Mellitus (NIDDM) and Gestational Diabetes Mellitus (GDM) or pregnancy diabetes [4]. Body weight, sedentary lifestyle, genetics, ethnicity, and age are the common risk factors for diabetes. Nevertheless, IDDM can occur at any age, although it most commonly manifests during childhood or adolescence. NIDDM is the most prevalent type, can occur at any age, although it is more frequent in persons over the age of 40.

While diabetes symptoms include increased thirst, frequent urination, extreme hunger, unexplained weight loss, fatigue, blurred vision, slow-healing sores and infections, these symptoms are significant to specific types of diabetes. While IDDM symptoms can appear fast, in a couple of weeks, NIDDM symptoms may appear gradually over several years and might be so mild that you may not even notice them.

Diabetes can be easily treated if detected early. However, if left untreated, it can lead to problems such as blindness, renal failure, heart attacks, stroke and lower limb amputation are the main effect of diabetes. [5].

Current Diabetes Treatment using Biotechnological Techniques

General treatment for diabetes requires lifestyle change, diet, and exercise, however some patients require to take regular medication. For IDDM, insulin is the main treatment whereas metformin and other oral medication is generally medication prescribed for NIDDM. GDM treatment conversely requires diet planning and regular physical activity, regular blood glucose monitoring and insulin injections.

Insulin is a pancreatic hormone that regulates glucose in blood circulation by allow cells to use glucose as energy. Due to advancement in biotechnology, genetic engineering is currently used to manufacture human insulin. Biosynthetic human insulin (BHI) is produced by *in vitro* technique using recombinant DNA technology by introducing a gene that codes for the insulin protein into either a bacterium, most frequently *Escherichia coli*, or a yeast [6].

Differently from insulin, the synthesis of oral drug nowadays was done chemically. Nevertheless, most of these drugs were originally developed from natural compounds found in the plant. The development process involves screening genes, peptides, proteins, or other compounds for discovery of its therapeutic prospect and mechanisms. In fact, these processes involve biotechnology applications such as immunochemistry, genetic modelling, cell culture, animal model research, clinical trials, and many more [7, 8].

Future Promising Biotechnological Technique for Diabetic Treatment

At present, biotech companies were competing to develop advance alternatives medications and treatments for diabetes. New diabetes treatments, such as real-time continuous interstitial glucose monitoring, continuous subcutaneous insulin infusion (CSII), electronic tools for monitoring therapeutic approaches, automated bolus calculators for insulin, and electronic tools for patient education and information as well as hormone therapy and new designing oral diabetes drugs are the latest advancement in diabetes treatments using biotechnology application [9, 10].

Comparison of Current and Future Biotechnological Technique for Diabetic Treatment

New diabetes treatments using biotechnological application have been created for the last 30 years which indicates that biotechnology have a significant influence on the treatment of DM. Clinical advances in treatment of the disease have been made, although no report claim a 100% successful rate. The extensive study that led to the discovery of the pathway genes involved in the development of the illness, as well as the sequencing of entire genomes, has transformed diabetes research. Application of biotechnological methods like as PCRs, DNA microarrays, and gene knockouts has opened a new field in the detection of mutated genes. Additionally, the treatments trends are now focusing on the inter-relation application in biotechnology, bioinformatics and engineering that aims for disease self and optimal management.

CONCLUSION

This study contributes to the comprehensive understanding of DM as well as review of various DM treatments that use biotechnology applications. Publications have shown that newly design diabetes treatments enhance human health and quality of life. This report also provides a preview of biotechnology's accomplishments and prospects in diabetes treatments. The advancement in genetic research along with inter-field application in biotechnology, bioinformatics, and engineering field, have found mechanism that explain the cause and effect of diabetes and its treatments.

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