Experimental Models for Evaluation of Antidiabetic Drugs: A Review

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***Abstract*—Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It is one of the major global health challenges due to its increasing prevalence and long-term complications. Preclinical experimental models play a crucial role in understanding the pathophysiology of diabetes and in the development and screening of new antidiabetic drugs before clinical use. This review focuses on commonly used experimental models for evaluating antidiabetic activity, including chemical-induced models, genetic models, and functional tests. Emphasis is given to their methodology, advantages, limitations, and relevance to human diabetes. The review is intended to provide a clear and practical understanding of antidiabetic experimental models suitable for postgraduate students and researchers.**

***Index Terms*—Diabetes mellitus, Antidiabetic drugs, Experimental models, Streptozotocin, Alloxan.**

I. INTRODUCTION

Diabetes mellitus is a metabolic disorder marked by chronic elevation of blood glucose levels due to insufficient insulin production or impaired insulin action [1]. The global incidence of diabetes has increased rapidly, making it a serious public health concern [2]. Long-standing hyperglycemia leads to complications such as nephropathy, neuropathy, retinopathy, and cardiovascular diseases, which significantly affect patient morbidity and mortality [5]. Experimental models are essential tools in diabetes research as they help in understanding disease mechanisms and evaluating the efficacy and safety of antidiabetic drugs [6]. Since diabetes is a complex and heterogeneous disease, no single experimental model can completely represent the human condition [7]. Therefore, different models are used depending on the research objective.

II. EXPERIMENTAL MODELS FOR ANTIDIABETIC ACTIVITY

A. Chemical-Induced Models

Chemical-induced models are widely used in antidiabetic research because they are simple, economical, and reproducible [8]. These models mainly induce diabetes by selective destruction of pancreatic beta cells.

Alloxan-Induced Diabetes: Alloxan produces diabetes by generating reactive oxygen species that damage pancreatic beta cells, resulting in insulin deficiency [8,9]. It is commonly administered in rodents via intraperitoneal or intravenous routes. Hyperglycemia is confirmed within 48–72 hours. This model is easy to perform and suitable for screening insulin secretagogues and insulin-mimetic drugs. However, variability in response and potential toxicity are its limitations [9].

Streptozotocin-Induced Diabetes: Streptozotocin causes beta-cell damage through DNA alkylation and oxidative stress [8]. Depending on the dose and administration protocol, it can be used to model both type 1 and type 2 diabetes [10]. This model is highly reliable and commonly employed in antidiabetic drug screening [11]. Limitations include strain sensitivity and possible mortality at high doses [10].

B. Genetic Models

Genetic models develop diabetes spontaneously due to inherited mutations. Common examples include db/db mice, ob/ob mice, and Zucker diabetic fatty rats [14]. These models closely resemble type 2 diabetes and are

useful for long-term studies of disease progression and complications [15]. However, their use is limited by high cost and limited availability [18].

C. Oral Glucose Tolerance Test (OGTT)

The oral glucose tolerance test is a functional method used to assess glucose handling and insulin sensitivity [16]. After overnight fasting, glucose is administered orally, and blood glucose levels are measured at specific intervals. OGTT is commonly used along with other models to evaluate the antihyperglycemic effect of drugs [17].

III. DISCUSSION

Each experimental model offers specific advantages and limitations. Chemical-induced models are suitable for routine screening due to their simplicity and reproducibility [8]. Genetic models provide insight into chronic disease mechanisms and complications [15]. OGTT serves as a supportive functional test for assessing glucose tolerance [16]. Selection of an appropriate model depends on study objectives, available resources, and ethical considerations [6].

IV. CONCLUSION

Experimental models are indispensable in the evaluation of antidiabetic drugs. Proper selection and application of these models enhance the reliability of preclinical findings and support the development of effective antidiabetic therapies. Emphasis on methodological clarity and critical interpretation ensures meaningful translation of experimental results to clinical practice [6,15].

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