Development of new anti-diabetic drug from medicinal plant-genomic research.

Prasanta Chakraborty*

Kalpana Chawla Center for Space and Nano Science, Indian Institute of Chemical Biology, India

Abstract

Diabetes mellitus is considered as one of the five leading causes of death in the world. The global prevalence of diabetes was 3-4% in 2000, and expected to increase to 4.5-5.5% by 2030, and WHO has predicted that the major burden will go to developing countries. Nearly 60-80% of the world's population uses traditional medicines derived from medicinal plants for various diseases including diabetes. Since time immemorial traditional plants have played a very crucial role in treatment, prevention, mitigation and cure of the different diseases. There are huge numbers of plants that are having anti-diabetic properties. Some plants like O sanctum possess anti-diabetic, anti-cancer, anti-fertility, analgesic properties. Many pre-clinical studies have been documented that shows anti-diabetic and hypoglycemic effects of O sanctum through various postulated mechanisms. A huge number of medicinal plants with potential antidiabetic activity have been listed which may include: Azadirachta indica its leaves, stem bark and seeds possess hypoglycemic activity via increasing insulin secretion from pancreatic beta-cells similarly, Grewia asiatica has antioxidant and radical scavenging activity. But in spite of having huge number of medicinal plants worldwide, there are not many biologically active antidiabetic molecules/drugs in our hand. There should be some general mechanism of searching among hundreds of active ingredients like important classes of terpenoids, alkaloids, flavonoids and phenolic compounds as plant metabolic products presents in herbs.

Keywords: Hyperglycemia, diabetes, insulin.

Accepted on March 03, 2018

Short Commentary

Around 60-80% of the world's population uses traditional medicines derived from medicinal plants for various diseases including diabetes. We all know, diabetes is an important human ailment affects millions of people worldwide. Both type I (insulin dependent) and type II (insulin independent) diabetes, a metabolic disease, in which high levels of sugars in the blood lead to blurred vision, heart damage, stroke and kidney failure. The global prevalence of diabetes was 3-4% in 2000, and expected to increase to 4.5-5.5% by 2030, and WHO has predicted that the major burden will go to developing countries [1]. Till date, there are various approaches to control the disease, however, herbal formulations are preferred due to low cost and minimum side effects. A huge number of medicinal plants with potential antidiabetic activity have been listed which may include: Azadirachta indica its leaves, stem bark and seeds possess hypoglycemic activity via increasing insulin secretion from pancreatic beta-cells, Grewia asiatica its antioxidant and radical scavenging activity, Eugenia jambolana its seed kernel extracts inhibits alpha-glucosidase activity, Cinamomum zeylanicum its chief active constituent cinnamaldehyde increases serum insulin level, Allium sativum its active compound allicin shows significant hypoglycemic activity, Allium cepa its active constituent S-methyl cysteine sulphoxide significantly controls blood glucose levels and many more like Aegle mermelos, Aralia elata, Phyllanthus amarus, Tinospora cordifolia [1].

Now, in spite of having huge number of medicinal plants worldwide, there are not many biologically active antidiabetic molecules/drugs in our hand. There should be some general mechanism of searching among hundreds of active ingredients like important classes of terpenoids, alkaloids, flavonoids and phenolic compounds as plant metabolic products presents in herbs. As vast majority of chemical potential of unexplored medicinal plants awaits discovery and is hidden away in plant genomes, emerging genomics research/genome sequencing may be the right choice for searching [2,3]. Identification of genes mined in the genome will definitely help in finding out the unknown enzymes and specific pathway of secondary metabolite production. Genome knowledge for medicinal plants is therefore necessary not only to understand their metabolic potential/source of new molecules but also to understand their diversity, regulations and evolutionary implications. Although whole- genome sequencing of medicinal plants hampers due to large genome size, poly ploidy, heterozygosity, duplication events and large number of repetitive sequences, now, breakthroughs in sequencing technology and with inexpensive next-generation sequencing technologies(NGS) [4] along with advancement of computational methods has allowed researchers to access even the transcriptomes of recalcitrant medicinal plant genomes. Despite having highly repetitive sequences, many medicinal plant genomes have now been sequenced successfully [2]. All these sequencing data through advance sequencing technologies has enabled/accelerated genome-wide prediction of metabolic enzymes, pathways and gene-clusters in diverse plants including medicinal plants [5]. Genomic information, together with other omics data therefore plays an important role in enhancing the success rate of general drug discovery including anti-diabetic drug from medicinal plants. In

this context, it should be mentioned that recently, whole nuclear and chloroplast genomes of *Ocimum sanctum* L, "Holy basil" in India and genome of bitter gourd, Momordica charantia,a vegetable and medicinal plant in tropical and subtropical regions were sequenced. *O. sanctum* has been suggested to possess anti-cancer, anti-fertility, analgesic, cardioprotective including anti-diabetic activities. The genome sequence of this plant shows highest similarity to that of *S. miltiorrhiza*, an important medicinal plant of traditional Chinese medicine. Both the plants are rich in phenylpropanoids and their derivatives, and many of these are implicated for different therapeutic activities. The presence of large number of homologs of copalyl diphosphate synthases in O. sanctum genome indicates the possibility of finding newer diterpenes having potential bioactivity not implicated so far. Genome sequences of *M. charantia* shows some unique gene in bitter gourd genome and this finding is interesting as we already know that bitter gourd contains some insulin like molecules. These plant-based insulin (Polypeptide-p or p-insulin) has been shown to control both type I and type II diabetes naturally. Therefore, it is hoped, that in future more and more unexplored medicinal plant genome projects will give us the right molecules to identify new anti-diabetic drug.

References

1. Modak M, Dixit P, Londhe J, et al. Indians herbs and herbal drugs used for the treatment of diabetes. J Clin Biochem Nutr. 2007;40:163-73.
2. Chakraborty P. Herbal genomics as tools for dissecting new metabolic pathways for unexplored medicinal plants and drug discovery. Biochemie Open. 2018;6:9-16.
3. Chakraborty P. Search for new molecules/prospects of drug discovery from herbal medicines. J Complement Med Alt Healthcare. 2018;5:1-3.
4. Metzker ML. Sequebcing Technologies- the next generation. Nat Rev Genet. 2010;11:31-34.
5. Schlapfer P, Zhang, Wang C, et al. Genome-wide prediction of metabolic enzymes, pathway's and gene cluster's in plants. Plant Physiol. 2017;176:2041-59.

***Correspondence to:**

Prasanta Chakraborty
Dept of Chemical Biology
Indian Institute of Chemical Biology
Kalpana Chawla Center for Space and Nano Science
Kolkata
India
Tel: +91 9876565678
E-mail: prasanta3274@yahoo.in