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# Herbal Formulation of Medicines in the Treatment of Patients with Type-2 Diabetes Mellitus

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**ABSTRACT**

Human history is providing the witness on significant and well esteemed herbal source of medicine for the control of diseases including, diabetes. The herbal medicines are widely used presently indicating that, the herbs are a growing part of modern high-tech medicine. In recent times, there has been a revived interest within the plant remedies. The year: 2021 marks the centenary of discovery of insulin secretion through the cells of "Islets of Langerhans" by Frederick Grant Banting. He became the first individual for isolation of the insulin secretion by the cells of the islets of Langerhans of pancreas and tout insulin as a potential and the most significant treatment for diabetic patients. The plan of Frederick Grant Banting was to tie up the duct of the pancreatic gland in laboratory dog, *Canis lupus familiaris* (L) until the cells of enzyme production degenerated, leaving only the sturdy cells of islets of Langerhans alive. Frederick Grant Banting would then extract the residues. The rapidly increasing rate of diabetes mellitus is a serious concern to human health all over the world. The medicines extracted from the plants with antidiabetic property are more efficient than conventional medicines. Utilization of medicinal plants for treating and the prevention of diabetes like diseases deserve the longest history in comparison with the conventional medicines. The extractive preparations from plants serve significant role in designing medicines and to utilize for treating the "Hyper-glycemic condition" in diabetes mellitus. The herbal formulation of the medicine is mainly utilized for treating the diabetes of the "Type-2" through consideration of its anti-inflammatory influence, anti-oxidative influence, blood lipid regulative influence, and anti-glucose characters. The herbal formulation of the medicine appears to be superior in its holistic quality. The herbal formulation of the medicine can treat the diabetes of the "Type-2" through targets of multiple nature. The herbal formulation of the medicine is a good complementary and alternative treatment for the diabetes of the "Type-2". There is a need of time to study further to fortify the herbal formulation for treating diabetes through accurate identification of active ingredients.

**Keywords**: Herbal formulation of medicine, Insulin, Insulin resistance, Active components, Diabetes mellitus

## INTRODUCTION

The most significant natural wealth for any country is the diversity of medicinal plants. The medicinal plants play a significant role for provision of primary health care services to the human population. The medicinal plants serve as therapeutic source. They constitute important raw material for the manufacture of medicines of traditional category. Higher sugar level in the blood for a prolonged tenure of time is the significant feature of diabetes, a metabolic disorder. Frequent and significant urination, increased level of the thirst and increased level of appetite are the diabetes. Ketoacidosis is exerted through the diabetes. Ketoacidosis is the state in metabolism. It is caused by production of bodies of ketones at uncontrolled rate. The state of hyperosmolar-hyperglycemic condition is another acute complication influenced by the diabetes. Cardiovascular disease; stroke; chronic diseases of kidney; ulcers of the feet; nerve damage; eyeball damage and cognitive impairments are the serious and long-term complications caused through the diabetes. The diabetes is caused through non-sufficient production of insulin by the pancreas or non-responding nature of the body cells to the available insulin or both. Type-1; Type-2 and Type-3 are the main categories of diabetes mellitus. The diabetes of the "Type-1" is the result of failure of the

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production of sufficient insulin through the reduction in number of beta cells in pancreas. Previously, the diabetes of the "Type-1" was referred to as insulin-dependent diabetes mellitus (IDDM) (or Juvenile Diabetes). The reduction in number of beta cells (or loss of beta cells) in pancreas is caused through autoimmune response. In the diabetes of "Type-2", the body cell fails in responding for the available insulin. This type of diabetes (Diabetes of "Type-2") begins through the insulin resistance. The "Gestational-Diabetes" is the third type of diabetes. The "Gestational-Diabetes" occurs in pregnant women without a previous history of diabetes develops high blood sugar levels [1].

The diabetes of "Type-1" should be managed through the injection of insulin. Maintaining the diet of healthy nature; participation in regular exercise; maintaining weight of the body at normal level and avoidance of tobacco chewing serve a lot to prevent and to control of diabetes of the "Type-2". The use of insulin sensitizers (example: Thiazolidinedione's) may also be followed for treating the diabetes of "Type-2". Care of foot, eye and blood pressure are the most significant practices in the control of the diabetes of "Type-2". The level of low blood sugar may occur using heavy titre of insulin and some oral medications. The surgery pertaining body weight loss in the diabetic (type 2) patient with obesity appears to be effective and significant measure. The diabetes of gestational type usually gets resolved soon after the baby birth [2].

American Diabetes Association in its publication entitled, "Economic Costs of Diabetes in the U.S. in 2017" (2018) [3] opined, diabetes status for about eighty to ninety percent of adult population worldwide as of 2019. The postulated rate of diabetes in women and men are similar. There will be trend of the rate of increase in diabetic patients (type-2 diabetes). In future, the risk of early death through the diabetes is going to become double. Presently, diabetes is the seventh leading cause of death of human being at global level. International Diabetes Federation estimated the cost of about US$727 billion towards the global economic cost of expenditure towards the diabetes related health expenditure in 2017 was estimated at US$727 billion [4]. In 2017, in the United States, cost of diabetes was nearly US$327 billion in 2017. The International Diabetes Federation (IDF) carried out survey study on the prevalence of diabetes mellitus among adult population (age: 20-79) in 2017. In 2017, approximately 4 million adults died of diabetes, and 46.1% of patients died before reaching the age of 60 years. This study concluded that, nearly about 8.8% of the total population (of 425 million) was suffering from the diabetes. Further, International Diabetes Federation (IDF) postulated that, prevalence of the diabetes may reach six hundred twenty-nine million by the year: 2045. It has been estimated that, approximately half of total population of adult patients of diabetes worldwide appears to be non-diagnosed (as of the year: 2017). The results of the study of "International Diabetes Federation (IDF)" reveal that, the diabetic patients' number exhibits alarming rate of increase. It has to attain to represent a challenge for health of human being.

The diabetes of "Type-2" accounts for about approximately ninety five percent of the total diabetic-population. It leads to the most significant loss for human health, physical capabilities and economic status of the country. The diabetes of "Type-2" appears to be a chronic disease. The diabetes of "Type-2" can cause complications in a series and leads to death. It clearly indicates that, prevention or attempts towards the delaying the stage of the occurrence of complications is prime concern in treatments in controlling the diabetes of "Type-2". Maintenance of level of sugar (glucose) in blood stream in normal range is the key link for those suffering from diabetes is to maintain blood glucose levels within the normal range [5]. Presently, the nutrition and physical exercise are the two significant factors for the selection of way of treatment for the diabetes of "Type-2" [6]. The biguanides, sulfonylureas, and α-glucoside inhibitor like oral medication; attempts of injections of insulin and glucagon like peptides; undergoing through the surgical treatments are some of the methods of controlling the diabetes [7,8].

According to Shoback and Gardner [9], the Chinese ancient books on diabetes refer the diabetes of "Type-2" as a major disease of "Xiao-Ke". The Chinese ranks first among the countries utilizing the herbal medicines for the control of the diabetes mellitus. The Chinese are known from the last one thousand five hundred years in use of herbal medicines for the treatment of diabetes mellitus. Herbal medicines are safe for the animal health. They are not exerting any side effect. The present attempt is to review the therapeutic action of the herbal medicines used in treating the diabetes of "Type-2" through the anti-inflammatory features, anti-oxidative features, blood lipid metabolism regulating feature, anti-glucose influence and the other mechanisms concerned with use of herbal medicines in the treatment of diabetes mellitus of the "Type-2".

## THE ANTI-INFLAMMATORY INFLUENCE OF HERBAL MEDICINES IN THE DIABETES TREATMENT

In the diabetes of "Type-2", the body cell fails in responding for the available insulin. This type of diabetes (Diabetes of "Type-2") begins through the insulin resistance. The diabetes of "Type-2" exerts a state of inflammation of lower grade inflammation. The low-grade inflammation caused in the diabetes of "Type-2" is known to appear soon after the increased rate of production of cytokines. The cytokines exerting a low-grade inflammatory-effects include interleukin-1β (IL-1β), interleukin-6 (IL-6), and tumor necrosis factor-α (TNF-α) [10]. These cytokines exerting a low-grade inflammatory effect are not only damage the beta cells of the pancreatic gland, leading to decreased rate of secretion of the insulin, but also contribute for the resistance to the available titre of insulin in the body. There is a

resistance to the available titre of insulin in the body through the decrease in rate of extraction of the glucose and in the efficiency of utilization of the glucose by the peripheral tissues. According to Cash Jill [11] the most important step towards the treatment for the causing low-grade inflammatory effects is the inhibition of the cytokines. The most significant of diabetic pro-inflammatory category in pathogenesis in the diabetes of "Type-2" is the interleukin-6 (IL-6). According to Vos [12] the levels of interleukin-6 (IL-6) is directly reflecting on the level of inflammation in patients of diabetes "Type-2". The iron wood tree, *Memecylon umbellatum* (L) is a plant of family: melastomataceae. This plant is often utilized for treating the diabetes. The iron wood tree, *Memecylon umbellatum* (L) grows in the Western Peninsula and in most of the coastal areas. The study report of Amalraj and Ignacimuthu [13] reveals that, the extractives of *Memecylon umbellatum* (L) exerts the hypoglycemic influence in diabetic patients. In one of the attempts on treating the experimental animals of diabetes (insulin resistance in high-fat diet-induced obese mice) [14] used the extractives of the iron wood tree, *Memecylon umbellatum* (L) and reported the reduction in the level of interleukin-6 (IL-6) in serum. This attempt of Sunil [14] demonstrated utilization of the extractives of *Memecylon umbellatum* (L) for treatment to control the diabetes. There is participation of the "Nuclear Transcription Factor Kappa B" (NF-κB) in the response pertaining inflammation through the control of expression of gene for the promotion of the immunity. According to Baker [15] effective reduction in the production of the "Pro-inflammatory Cytokines" is possible through blocking the NF-κB-mediated signal pathway. *Lycii Radicis Cortex* is the root bark of *Lycium barbarum* (L) (also recognized as: *Lycium chinense* Miller) is called as "Lycii-Radicis" [16] used for the treatment for inflammations through diabetes and reported the effective inhibition of the activity of the "Nuclear Transcription Factor Kappa B" (NF-κB) for inhibition of inflammatory response. China is the country recognized for the use of the ginger as a spice and herbal medicine for treating many diseases. The pungent smell of the ginger is due to presence of chemical compound, "S-[6]-Gingerol". The "S-[6]-Gingerol" is expert in supressing the activity of expression of "Cyclo-oxygenase-2". The "S-[6]-Gingerol" is blocking the "NF-κB-mediated signalling pathway" and inhibits the expression of interleukin-6 (IL-6) and the expression of interleukin-8 (IL-8) in the HuH7 cells stimulated through the cytokines [17]. The "NF-κB (IκBα)" is the inhibitory protein of "NF-κB". According to Bai [18] the inactivation of the "IκBα-protein" is effective for the inhibition of the expression of the "NF-κB" and thus reduces the response of inflammation induced by the "NF-κB-mediated" signalling pathway. The bitter gourd (or bitter melon), *Momordica charantia* (L.) is known to grow in Asia. This bitter gourd (or bitter melon), *Momordica charantia* (L.) can be used as a functional food and as herbal medicine. The constituents of the bitter gourd (or bitter melon), *Momordica charantia* (L.) include water, dietary fibers, carbohydrates, proteins, and the micronutrients (calcium, phenolics, flavonoids, and saponins) [18]. According to Yeh [19,20] the "Hypoglycemic influence" of the bitter gourd (or bitter melon), *Momordica charantia* (L.) has been confirmed as early as 2003. According to Bai [18] the powder of the bitter gourd (or bitter melon), *Momordica charantia* (L.) is known for the inhibition of the activation of "NF-κB" through the inhibiting action and degradation of the "IκBα". Thus, the bitter gourd (or bitter melon), *Momordica charantia* (L.) deserve significant action of inhibition of inflammation in diabetes. The Chinese patent, entitled "Jin Qi-JiangTang tablets" is reported for anti-glucose properties. It contains refined extractives of *Astragalus membranaceus* (L) (Leguminosae), *Coptis chinensis* (L) (Ranunculaceae), and *Lonicera japonica* (L) (Caprifoliaceae). This tablet can reduce the degradation of the "IκBα" for the inhibition of the activity of "NF-κB". Many more attempts on the studies pertaining the diabetes (the diabetes of "Type-2") control through the herbal medicines have also confirmed the reduction of the activation of the "NF-κB" through the inhibiting IL-1β, TNF-α, and toll-like receptor-4 [21-25]

The most popular plant used for treating diabetes mellitus is the bitter melon, *Momordica charantia* (L). It is also known as karela, balsam pear, or bitter gourd. It is a popular plant used for the treating of diabetes-related conditions amongst the populations of India, Asia, and South America, Caribbean indigenous populations of Asia, South America, India, the Caribbean and East Africa [26,27]. The fruits of *Momordica charantia* (L) deserve distinguishing bitter taste. The fruit taste of *Momordica charantia* (L) is more pronounced as it ripens. This may be reason for its name: bitter melon or bitter gourd. The experiments on the biochemical assays and animal models have produced abundant data and hypotheses accounting for the anti-diabetic influence of *Momordica charantia* (L). The bitter melon, *Momordica charantia* (L) has significant antidiabetic as well as hypolipidemic activity. Therefore, it can be used as an adjuvant along with allopathic treatment of medicine to treat diabetes **(Figures 1 & 2)**.

**Figure 1**. *Momordica charantia* (L), the most popular herb used for the control of diabetes mellitus.

**Figure 2**. The Juice and slices of fruits of *Momordica charantia* (L), used in the control of diabetes mellitus.

## THE ANTI-OXIDATIVE INFLUENCE OF HERBAL MEDICINES IN THE DIABETES TREATMENT

The chemical reaction of the "oxidation-reduction" (or "REDOX" reaction) is significant process in the human body. It is closely related to the metabolism and efficient working of the tissues in the body. In a normal state of physiology, animal body is expected the "Redox-Homeostatic State". Soon after the receipt of the stimulus (any type), the animal body lose the "Redox-Homeostatic State" and leads to cause the oxidative stress. The body of patient of diabetes of the "Type-2" has been confirmed for the oxidative stress [28,29]. There is a damage of the parts of individual cell with oxidative stress [30] the cells of Islets of Langerhans (insulin secretory cells) in pancreas are naturally weak with reference to the activity of anti-oxidation. Therefore, the enzymes pertaining the activity of anti-oxidation in the cells of Islets of Langerhans (insulin secretory cells) in pancreas are lower in concentration in comparison with than of the other cells of body tissues. It leads to conclude that, the oxidative stress is the most harmful for the cells of Islets of Langerhans (insulin secretory cells) in pancreas [31,32] and reported the induction of resistance of insulin in human body. Therefore, it is more evident that oxidative stress appears to be the most significant parameter for the onset (or exacerbation) the diabetes of the "Type-2". The therapy pertaining "anti-oxidative" significance is going to help for treating the diabetes of the "Type-2". The enzymes like super-oxide-dismutase (SOD), glutathione-peroxidase (GSH-px), and catalase (CAT) are the most significant for the free radicals in the body of human being [33,34] carried out the studies on attenuation of the oxidative stress and distorted metabolism of carbohydrates in rats with induced diabetes of the "Type-2" through the extractives of *Tinospora cordifolia* (Hook and Thomson) (family: Menispermaceae). This attempt of Sangeetha [34] reported increase in the velocity of biochemical reaction controlled by the superoxide dismutase (SOD) as well as the velocity of biochemical reaction controlled by catalase (CAT) using extractives of *Tinospora cordifolia* (Hook and Thomson) (family: Menispermaceae) experimentally induced diabetes of the "Type-2" in rats. The titre of two hundred milli grams of extractives of the *Tinospora cordifolia* (Hook and Thomson) (family: Menispermaceae) per kilogram weight of experimental animals (rats) was reported for the better performance in this attempt by Sangeetha [34]. In China, the herbal formula entitled, "Jiao-Tai-Wan" is consisting of the extractives of *Rhizoma coptidis* (L) and *Cinnamomum cassia* (L) [35] reported significantly increasing activities of Superoxide dismutase (SOD), glutathione-peroxidase (GSH-px and catalase (CAT) in diabetic mice treated with this Chinese herbal formula, "Jiao-Tai-Wan" [36] carried out the study on use "JTXK" (The Chinese patent herbal medicine) in combination of the metformin for treating the diabetic mice and reported as effective in the improvement of the capacity of antioxidation through the activation of expression of the enzyme: superoxide dismutase (SOD). "JTXK" (The Chinese patent herbal medicine) is containing extractives of the herbs like: *Radix Salviae Miltiorrhizae* (Dan Shen), *Radix Rehmanniae* (Di Huang), *Panax ginseng* (Ren Shen), *R. coptidis* (Huang Lian), and *Fructus corni* (Shan Yu Rou). The long form of "JTXK" is Jiang Tang Xiao Ke. The bioactive product famous for the exacerbation of the oxidative stress in the body of human being is nitric oxide (NO). According to Soskic [37] the enzyme: "Inducible Nitric Oxide Synthase" (iNOS) is promoting the formation of nitric oxide (NO) an important bioactive product in the human body that can exacerbate oxidative stress. Therefore, inhibition of the activity of enzyme: "Inducible Nitric Oxide Synthase" (iNOS) is going to prevent oxidative stress. The malondialdehyde (MDA) is the product formed in the peroxidation of the lipids. It is well known that malondialdehyde (MDA) is a product of lipids. The malondialdehyde (MDA) is mostly used for the reflection of the oxidative stress level. Aqueous extractives of stevia (Kapur Tulas) are reported by Assaei [38] for effective decrease the concentration of malondialdehyde (MDA).

## THE REGULATION OF THE LIPID EFFECT USING HERBAL MEDICINES IN THE DIABETES TREATMENT

The aggravate resistance to the insulin and loss of normal functioning of cells of Islets of Langerhans (insulin secretory cells) in pancreas may be caused through the lipotoxicity. The lipotoxicity is the disorder in metabolism of the lipids. The lipotoxicity is responsible to cause the aggravates insulin resistance and pancreatic cell dysfunction [39]. The fundamental cause of biochemical changes of the diabetes of "Type-2" appears to be in the disorder in the metabolism of lipids [40]. The lipid metabolism, therefore, serves to play an imperative role in the pathogenesis of diabetes of "Type-2". Cai [41] and Duan [42] reported significant role of herbal medicines in the reduction of levels of triglycerides (TG), total cholesterol (TC), the lipo-proteins of low-density (LDL) and increase in the level of high-density lipoprotein

(HDL) in the blood stream. The extractives of the leaves of mulberry, *Morus alba* (L) is famous in China for treating the diabetic complications. The extractives of the leaves of mulberry, *Morus alba* (L) was found significantly effective in reduction of levels of triglycerides (TG), total cholesterol (TC), the lipo-proteins of low-density (LDL) in serum in the diabetes of "Type-2" in rat [41]. Ahmed [43] reported reduction in the levels of triglycerides (TG), total cholesterol (TC) in diabetic rats with polyherbal formulation entitled, "Qurs-Tabasheer", containing the extractives of *Lactuca sativa* (L); *Portulaca oleracea* (L); *Rosa damascene* (L) *Punica granatum* (L) and *Bambusa arundinacea* (L). Duan [42] reported Tibetan herbal formulation entitled, "Tang-kang-fu-san" for hypoglycaemic influence. The major active ingredients of "Tang-kang-fu-san" include: gallic acid and curcumin. "Tang-kang-fu-san" can effectively work for the reduction in the level of triglycerides (TG) and lipo-proteins of low density (LDL). "Tang-kang-fu-san" can also effectively work for the increase in the levels of high density lipo-proteins (HDL) in serum in diabetic mice. Zhang [44] reported effective reduction in the level of triglycerides (TG) and lipo-proteins of low density (LDL) and increase in the levels of high density lipo-proteins (HDL) with "Damming capsule" (Chinese patent medicine developed under the guidance of traditional Chinese theory) in diabetic mice. According to Yang [45] increase in the levels of free fatty acids (FAA) exert the influence in the form of increase in the levels of triglycerides (TG) in the blood. The free fatty acids (FAA) are the most important components in the process of in the synthesis of triglycerides (TG). Yeo [23] reported the use of multiherbal extractives (aqueous extractives of *Pueraria lobata* L; *Panax ginseng* L; C.A. *Rehmannia glutinosa* L; *Poncirus fructu* L; *Dioscorea batatas* L; *Evodia officinalis* L and *Amomum cadamomum* L) decrease in the levels of plasma free fatty acids (FFA). According to Chen [46] the enzyme: "Acetyl-coenzyme A carboxylase" (ACC) is the most significant factor involved in the fatty acid metabolism. In addition, the inhibition of enzyme: "Acetyl-coenzyme A carboxylase" (ACC) is going to reduce the free fatty acid (FAA) level in the blood. It means the inhibitors of the enzyme: "Acetyl-coenzyme A carboxylase" (ACC) deserve significant potentials in treating the diabetic patients Chen [46] reported effective inhibition of the enzyme: "Acetyl-coenzyme A carboxylase" (ACC) with C57BL/6J (herbal formulation) in mice of the group received diet with high-fat content. The enzyme: Acetyl-coenzyme-A-(CoA)-acetyltransferase-2-(ACAT2)" is the most significant enzyme participating in the process of synthesis of triglycerides (TC); in the process of inhibition of ACAT2 and leading to reduce TC levels in the blood [47,48]. Banz [49] reported significant reduction in the levels of triglycerides (TG) with extractives of the ginseng in male Zucker diabetic fatty rats. Additionally, Saba [50] reported amelioration of the hypercholesterolemia through attenuation of the enzyme: Acetyl-coenzyme-A-(CoA)-acetyltransferase-2-(ACAT2)" using extractives of the ginseng. Utilization of herbal formulation is not only controlling the diabetes but also minimize the lipotoxicity.

## THE "ANTI-GLUCOSE" INFLUENCE USING HERBAL MEDICINES IN THE DIABETES TREATMENT

### Anti-glucose effects

In the diabetes of "Type-2", the body cell fails in responding for the available insulin. This type of diabetes (Diabetes of "Type-2") begins through the insulin resistance. The "Gestational-Diabetes" is the third type of diabetes. The "Gestational-Diabetes" occurs in pregnant women without a previous history of diabetes develops high blood sugar levels [1].

According to Bensellam [51] the most significant parameter to diagnose the diabetes of the "Type-2" is the fasting glucose in the blood plasma. The reading of "fasting plasma glucose ≥7.0 mmol/L and 2-h post-prandial plasma glucose ≥ 11.1 mmol/L" is confirmed state of diabetes of the "Type-2". The hyperglycemia of "Chronic Nature" is going to destroy the beta cells in the islets of Langerhans in pancreas. The injury to the beta cells in the islets of Langerhans in pancreas is responsible to lead to decrease the rate of production of imperative titre of insulin. This condition may also be called as, the "Pancreatic β-cell glucotoxicity". This condition further leads to aggravate the hyperglycemia. It is prime need of the body to stabilize the level of glucose in the blood stream in the patients of diabetes of the "Type-2". The aim of the attempts of treatment in the patients of diabetes of the "Type-2" is to bring the levels of glucose level in a reasonable range. Chang [52] reported reduction in the levels of glucose in the blood in "db/db" mouse model through the use of Korean herbal formulation entitled, "Okchun-san". Morimoto [53] reported "Bofu-tsusho-san", herbal formulation for the significantly effective against the condition of hyperglycemia in KKAy mice. It is interesting to mention the fact about the adjustment of the human body for the secretion of the insulin by beta cells of Islets of Langerhans of pancreas to fight the problem of hyperglycemia caused through the absorption of the digested food under normal physiological conditions. In the diabetes of "Type-2", there is impairment of working of the beta cells of Islets of Langerhans of pancreas. It is difficult to have enough volume of insulin secretion to face the condition of hyperglycemia in the diabetes of "Type-2". Therefore, the "Post-Prandial-Plasma-Glucose" in human individuals with diabetes of "Type-2" appears to be higher in comparison with the normal healthy human individuals. Attempt of studies in the last century reported significant role of the enzymes: α-amylase and α-glucosidase in the process of absorption of glucose in the body [54]. Taslimi [55] and Olennikov [56] opined the reduction of the "post-prandial" hyperglycemia through significantly effective inhibition of activity of the enzymes: α-amylase and α-glucosidase is going to achieve the treatment for the diabetes of "Type-2".

Honma [57] reported lowered levels of hyperglycemia via inhibition of activity of enzyme: α-amylase with extractives of *Acer pycnanthum* (L). According to Butala [58] there are nineteen herbal components in the ayurvedic anti-diabetic formulation entitled; "Lodhrasavam". Butala [58] reported the action of "Lodhrasavam" against the activity of the enzymes: α-amylase and α-glucosidase for simulation of digestion in gastro-intestinal tract. According to Nadkarni [59] promotion of insulin synthesis as well as secretion and thereby reducing the levels of glucose in the blood stream by the efficient action of: "GLP-1". The "GLP-1" is a protein belongs to the secretion of the "L-Cells" in the mucosa of gastrointestinal tract. There is a positive correlation between the promotion of insulin synthesis as well as secretion through the "GLP-1" and action pertaining lowering the levels of glucose in blood stream. According to Li [60] the higher the blood glucose is, the stronger the effect is the lower the blood glucose is, the weaker the effect is. Thus, the "GLP-1" serves to play significant role in the regulation of homeostasis with reference to blood glucose. According to Samad [61] demonstrated increased influence on the secretion of insulin through strengthening the capabilities of "GLP-1" with compound: [6]-Gingerol.

## OTHER INFLUENCES THROUGH THE USE OF HERBAL MEDICINES IN THE DIABETES TREATMENT

The microbiome is the significant and largest system in the body of human being. Eckburg [62] there are more than thousand types of microbiomes in the alimentary of human being. The microbiome in the alimentary of human being is more than hundred times the number of genes. Kootte [63] and Wang [64] confirmed the fact about close relationship between the disorder pertaining microbiome of the gut; resistance of insulin and the onset of diabetes of the "Type-2". Wang [64] reported the effective reduction in the levels of the fasting glucose through changes in the composition of the "Gut Microbiota" through the use of the extractives of *Ephedra sinica* (L). Gao [65] used to recommend the herbal mixture entitled, "Qijian mixture" for the purpose of treatment for the diabetes of "Type-1". The contents of "Qijian mixture" include the extractives of *Ramulus euonymi* (L) *P. lobata* (L), *A. membranaceus* (L) and *C. chinensis* (L). Gao [65] reported richness of the "Qijian mixture" in the Bacteroidetes. Long [66] carried out the attempt of studies on the influence of "Recombinant-Adeno-Associated-Virus-Adiponectin" (rAAV2/1-Acrp30) on irregular metabolism and the morphology of the in rats induced with diabetes. The "Recombinant-Adeno-Associated-Virus-Adiponectin" (rAAV2/1-Acrp30) is a cytokine belongs to the adipocytes. The "Recombinant-Adeno-Associated-Virus-Adiponectin" (rAAV2/1-Acrp30) is known to improve the resistance of insulin. Lim [67] mentioned the "Recombinant-Adeno-Associated-Virus-Adiponectin" as the significantly recognized strategy of treatment for the diabetes of the "Type-2". The non-availability of the "Recombinant-Adeno-Associated-Virus-Adiponectin" (rAAV2/1-Acrp30) (the adiponectin: biologic agents) in medical practice is the existing fact. However, the herbal medicines had been reported for the improvement of the expression of adiponectin in treating diabetes.

## CONCLUSION

The diabetes of the "Type-2" appears to be the worldwide problem for the human health. It is causing distress of most significant nature in diabetic patients. Although many synthetic medicines have been developed to treat the diabetes of the "Type-2", attention of the treatments towards the herbal form of medicines in has been attaining the peak. The herbal formulation of the medicine is mainly utilized for treating the diabetes of the "Type-2" through consideration of its anti-inflammatory influence, anti-oxidative influence, blood lipid regulative influence, and anti-glucose characters. The herbal formulation of the medicine appears to be superior in its holistic quality. The herbal formulation of the medicine can treat the diabetes of the "Type-2" through targets of multiple nature. The herbal formulation of the medicine is a good complementary and alternative treatment for the diabetes of the "Type-2". There is a need of time to study further to fortify the herbal formulation for treating diabetes through accurate identification of active ingredients.

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