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(Research Article)

Research work on an inevitable component to treat type 2 diabetes from the margin of *Colocasia esculenta*

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Abstract

Background: TARO (*Colocasia esculenta*) an herbal plant and used to treat type 2 diabetes in clinical practice, but the potential evidence needs to be provided.

Materials and Methods: plant material is collected and extraction completed. Then perform Phytochemical screening. Type 2 diabetic model rats were induced by feeding high fat diet (HFD) . The model rats were given for 4 weeks. Then treaded with herbal medicine

Results: After phytochemical study find out lots of active compound. Flavonoids and terpinoids are responsible for anti-diabetic activity. Extract significantly decreased fasting blood glucose at 750 mg/kg.

Conclusion: The results display that extract performs anti-diabetic functions in type 2 diabetic rats induced by feeding HFD.

Keywords: High fat diet; Anti diabetic; Type 2 diabetic

1. Introduction

Diabetes mellitus, often referred to simply as diabetes, is a chronic metabolic disorder characterized by high levels of blood sugar (glucose) resulting from defects in insulin production, insulin action, or both. Insulin, a hormone produced by the pancreas, plays a autoimmune destruction of the insulin-producing beta cells in the pancreas. As a result, the body fails to produce insulin, leading to high blood sugar levels.[1]

Symptoms of type 1 diabetes often develop rapidly and include excessive thirst, frequent urination, sudden weight loss, increased hunger, fatigue, and blurred vision. If left untreated, it can lead to serious complications such as diabetic ketoacidosis (DKA), a life-threatening condition characterized by the accumulation of ketones in the blood.[2]

Management of type 1 diabetes involves lifelong insulin therapy, usually through multiple daily injections or an insulin pump, along with regular monitoring of blood sugar levels, adherence to a balanced diet, and physical activity.[3]

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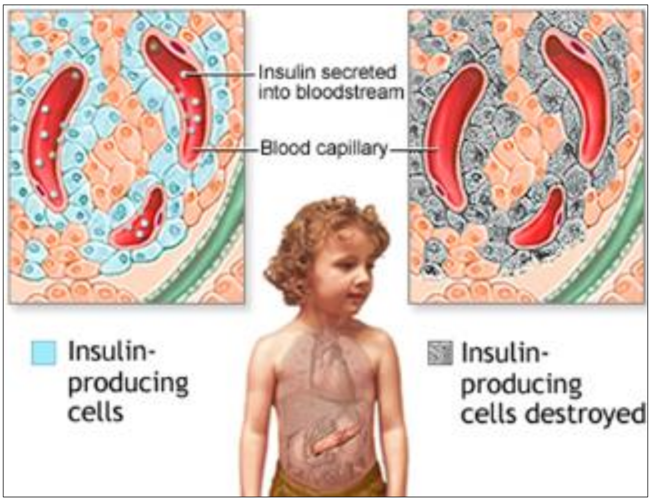

Figure 1 Before and After Effected by Diabetes

1.1. Type 2 Diabetes

Type 2 diabetes, formerly known as non-insulin-dependent or adult-onset diabetes, is the most common form of diabetes, accounting for the majority of cases worldwide. It typically develops gradually over time, often in adults, but is increasingly being diagnosed in children and adolescents due to rising obesity rates and sedentary lifestyles. [4]

Type 2 diabetes occurs when the body becomes resistant to the effects of insulin or when the pancreas fails to produce enough insulin to maintain normal blood sugar levels. Risk factors for type 2 diabetes include obesity, physical inactivity, genetics, and age. Symptoms of type 2 diabetes may be similar to those of type 1 but can be milder and may go unnoticed for years. They include increased thirst, frequent urination, fatigue, blurred vision, slow wound healing, and recurrent infections.

Treatment for type 2 diabetes typically begins with lifestyle modifications such as dietary changes, regular exercise, and weight management. In some cases, oral medications or injectable therapies may be prescribed to help improve insulin sensitivity or stimulate insulin production. As the disease progresses, insulin therapy may also be required.

1.2. Complications of Diabetes

Both type 1 and type 2 diabetes can lead to serious complications if not properly managed. These complications affect various organ systems and include:

- Cardiovascular complications: Diabetes significantly increases the risk of heart disease, stroke, and peripheral artery disease.
- Kidney disease (diabetic nephropathy): High blood sugar levels can damage the kidneys over time, leading to kidney failure.
- Eye damage (diabetic retinopathy): Diabetes can cause damage to the blood vessels in the retina, leading to vision problems and blindness if left untreated.
- Nerve damage (diabetic neuropathy): Diabetes can cause nerve damage, resulting in pain, numbness, tingling, or loss of sensation, particularly in the extremities.
- Foot problems: Nerve damage and poor circulation can increase the risk of foot ulcers, infections, and, in severe cases, amputation .[5]

1.3. Prevention and Management

Preventing and managing diabetes involves adopting a healthy lifestyle, including:

- Maintaining a balanced diet rich in fruits, vegetables, whole grains, lean proteins, and healthy fats.
- Engaging in regular physical activity, such as walking, cycling, or swimming, for at least 30 minutes most days of the week.
- Achieving and maintaining a healthy weight.
- Monitoring blood sugar levels regularly, as advised by a healthcare professional.

- Taking medications or insulin therapy as prescribed.
- Quitting smoking and limiting alcohol consumption.

Regular medical check-ups and screenings are also essential for early detection and management of diabetes and its complications.[8]

Diabetes is a complex metabolic disorder characterized by high blood sugar levels, which can lead to serious health complications if left untreated. Type 1 diabetes results from the autoimmune destruction of insulin-producing cells, while type 2 diabetes is primarily due to insulin resistance and inadequate insulin production. Prevention and management strategies include lifestyle modifications, medications, insulin therapy, and regular medical care to minimize the risk of complications and improve quality of life for individuals living with diabetes. [6]

Herbal medicine, also known as botanical medicine or phytomedicine, refers to the use of plants or plant extracts for medicinal purposes. It is one of the oldest forms of healthcare practice, dating back thousands of years to various cultures around the world. Herbal remedies have been used traditionally for their therapeutic properties to prevent, alleviate, or treat various health conditions.

1.4. Components of Herbal Medicine:

- Plants and Plant Extracts: Herbal medicine utilizes various parts of plants, including leaves, flowers, roots, stems, and seeds, as well as their extracts and preparations. These plant-based substances contain a wide array of chemical compounds, such as alkaloids, flavonoids, terpenoids, and phenolic acids, which contribute to their medicinal properties.
- Herbal medicine, also known as phytotherapy, involves using plant-based substances for therapeutic purposes. Historically, plants have been the primary source of medicine, and even today, they play a crucial role in healthcare. The pharmaceutical approach to herbal medicine involves standardizing, researching, and integrating herbal remedies into modern medicine. This comprehensive overview explores the evolution, benefits, challenges, and future prospects of herbal medicine within the pharmaceutical industry.
- Benefits of Herbal Medicine: Herbal treatments that are effective analgesics, as well as anti-inflammatory and antispasmodic. Herbs and pharmaceutical medications, on the other hand, have a lot of functions in common. They are neither interchangeable or analogous in any way. Herbal formulations' medicinal efficacy is contingent on good diagnosis and cautious prescription.

The popularity of herbal medicine has soared in recent years all across the world. These items are not regulated by the Food and Drug Administration and are not subject to the same level of scrutiny as traditional pharmaceuticals. Herbal supplements are regularly used in conjunction with well-known pharmaceuticals by patients.[7]

Reduced Side Effects: Compared to synthetic drugs, herbal remedies typically have fewer and milder side effects. This is because they contain a complex mix of active compounds that work synergistically.

- Natural Composition: Many patients prefer natural products over synthetic ones, believing them to be safer and more in tune with the body's natural processes.
- Challenges in Herbal Medicine: Standardization: One of the primary challenges is the lack of standardization. The concentration of active compounds can vary significantly between batches, making consistent dosing difficult.
- Scientific Validation: Many herbal medicines lack rigorous scientific validation. While traditional use provides anecdotal evidence, modern clinical trials are necessary to confirm efficacy and safety.
- Regulatory Issues: The regulation of herbal medicines varies widely across countries. In some regions, they are classified as dietary supplements, which are subject to less stringent regulations than pharmaceuticals.
- Quality Control: Ensuring the quality and purity of herbal products is challenging. Contamination with heavy metals, pesticides, or other harmful substances can pose serious health risks.

1.5. Case Studies

1.5.1. Curcumin (Turmeric)

Curcumin, the active compound in turmeric, has been extensively studied for its anti-inflammatory and antioxidant properties. Clinical trials have shown its potential in managing conditions like arthritis, diabetes, and even cancer. Pharmaceutical companies have developed standardized curcumin extracts and enhanced formulations to improve bioavailability.

1.5.2. Echinacea

Echinacea is commonly used for its immune-boosting properties. Studies have indicated its effectiveness in reducing the duration and severity of colds. Standardized extracts of Echinacea purpurea are available in various forms, including tablets and liquid extracts.

1.5.3. St. John's Wort

St. John's Wort is used primarily for depression. Clinical studies have demonstrated its efficacy comparable to standard antidepressants, with fewer side effects. It acts by inhibiting the reuptake of neurotransmitters like serotonin. However, it can interact with several drugs, highlighting the need for careful regulation and patient education.

1.6. Future Prospects

- Advancements in Biotechnology: Biotechnology can aid in the discovery of new herbal medicines. Techniques like genetic engineering can enhance the production of active compounds in plants.
- Personalized Medicine: The future may see the integration of herbal medicine into personalized treatment plans, considering genetic, environmental, and lifestyle factors.
- Global Collaboration: International collaboration can harmonize regulations, ensuring the safety, efficacy, and quality of herbal medicines worldwide.
- Education and Awareness: Increasing awareness among healthcare professionals and the public about the benefits and risks of herbal medicine is crucial. This includes incorporating phytotherapy into medical curricula.
- Traditional Knowledge: Herbal medicine often draws upon traditional knowledge passed down through generations within specific cultural or indigenous communities. This knowledge encompasses the identification, preparation, and administration of herbal remedies for different ailments based on empirical observations and experiences.

1.6.1. Uses and Benefits of Herbal Medicine

- Treatment of Health Conditions: Herbal medicine is used to treat a wide range of health conditions, including digestive disorders, respiratory ailments, skin problems, hormonal imbalances, musculoskeletal issues, and mental health disorders. Certain herbs have demonstrated pharmacological effects that can help alleviate symptoms and promote healing.
- Supportive Care: Herbal remedies are often used as complementary or alternative therapies alongside conventional medical treatments to provide supportive care and enhance overall well-being. They may help reduce side effects of medications, boost the immune system, improve energy levels, and promote relaxation and stress relief..

Taro leaves, derived from the taro plant (*Colocasia esculenta*), have been utilized for their medicinal properties for centuries in traditional medicine systems across Asia, Africa, and the Pacific Islands. While taro roots are more commonly consumed as a staple food, taro leaves also offer numerous health benefits due to their rich nutritional content and bioactive compounds.

1.6.2. Nutritional Profile

Taro leaves are a rich source of vitamins, minerals, and dietary fiber, making them a valuable addition to a balanced diet. They contain significant amounts of vitamin A, vitamin C, vitamin E, vitamin K, and several B vitamins, as well as minerals such as potassium, magnesium, calcium, and iron. Additionally, taro leaves are low in calories and fat but provide a good amount of protein and carbohydrates. [8]

Figure 2 Taro Leaves

1.6.3. Medicinal Properties

- Anti-inflammatory: Taro leaves contain phytochemicals such as flavonoids and polyphenols with anti-inflammatory properties. These compounds help reduce inflammation in the body, making taro leaves potentially beneficial for managing conditions like arthritis, gout, and inflammatory bowel disease .
- Antioxidant: The high antioxidant content of taro leaves helps neutralize harmful free radicals in the body, which can contribute to oxidative stress and damage to cells and tissues. Regular consumption of taro leaves may help protect against chronic diseases such as cardiovascular disease, cancer, and neurodegenerative disorders .
- Antimicrobial: Studies have shown that taro leaves possess antimicrobial properties against various bacteria, fungi, and viruses. Compounds found in taro leaves may help inhibit the growth of pathogens and prevent infections, promoting overall immune health.
- Hypoglycaemic: Taro leaves have been investigated for their potential to lower blood sugar levels and improve insulin sensitivity, making them beneficial for individuals with diabetes or those at risk of developing the condition. Certain bioactive compounds in taro leaves may help regulate glucose metabolism and reduce the risk of diabetic complications [9].
- Digestive Health: The dietary fiber content of taro leaves supports digestive health by promoting regular bowel movements, preventing constipation, and supporting the growth of beneficial gut bacteria. Additionally, taro leaves may help soothe gastrointestinal inflammation and alleviate symptoms of digestive disorders like gastritis and colitis.

1.7. Traditional Uses

In traditional medicine systems, taro leaves are often used to prepare herbal remedies for various ailments. They may be consumed fresh, cooked, or as an ingredient in soups, stews, salads, or herbal teas. Taro leaf extracts or poultices may also be applied topically to treat skin conditions such as wounds, burns, and insect bites.

1.7.1. Safety Considerations

While taro leaves offer numerous health benefits, it's important to note that certain varieties of taro plants contain oxalates, which can cause irritation or discomfort in some individuals, particularly those with kidney problems or oxalate sensitivity. Cooking or boiling taro leaves can help reduce oxalate levels and minimize potential adverse effects

Taro leaves are valued not only for their culinary versatility but also for their medicinal properties. Rich in nutrients and bioactive compounds, taro leaves offer a range of health benefits, including anti-inflammatory, antioxidant, antimicrobial, and hypoglycaemic effects. Incorporating taro leaves into a balanced diet may contribute to overall well-being and support various aspects of health, although individuals should be mindful of potential oxalate content and consult healthcare professionals for personalized advice .

Recent research on taro leaves (*Colocasia esculenta*) indicates potential benefits for diabetes management, primarily due to their rich phytochemical composition. Taro leaves contain significant amounts of flavonoids, which have been shown to possess strong antioxidant properties. These antioxidants can help reduce oxidative stress, a key factor in the development of diabetes complications. Additionally, the high fiber content in taro leaves aids in regulating blood sugar levels by slowing down the absorption of glucose in the bloodstream .

One study highlighted the effectiveness of flavonoid-rich taro leaf extracts in improving superoxide dismutase (SOD) levels and reducing serum C-reactive protein (CRP) levels in diabetic rats induced by streptozotocin. These changes suggest a reduction in inflammation and oxidative damage, which are critical in managing diabetes. Moreover, the leaves are a good source of essential nutrients such as vitamins A and C, which support overall metabolic health and enhance the body's ability to manage blood sugar levels .

In traditional medicine, taro leaves have been used to treat various ailments, and their incorporation into a diabetic diet can offer a natural and holistic approach to managing the condition. The high fiber content also contributes to better digestion and prolonged satiety, helping with weight management, which is crucial for individuals with diabetes.

Despite these promising findings, it is essential to consider the preparation of taro leaves, as they contain oxalates, which can cause irritation if not cooked properly. Therefore, it is recommended to boil the leaves thoroughly before consumption to reduce oxalate content and enhance their safety and nutritional value.

While taro leaves show potential in diabetes management due to their antioxidant and anti-inflammatory properties, further clinical studies in humans are needed to confirm these benefits and establish standardized guidelines for their use in diabetic diets. Integrating taro leaves into a balanced diet, under professional guidance, could provide a complementary approach to conventional diabetes treatments.

1.8. Reported Mechanism of Actions to Exert Antidiabetic Potentials

1.8.1. Inhibition of α-glucosidase secreted from the brush border of the small intestine

Mammalian α-glucosidase is a membrane-bound hydrolytic enzyme, located in the epithelia of the small intestine's mucosal brush border, which facilitates carbohydrate digestion. Inhibitors of this enzyme prevent carbs from being cleaved, resulting in less glucose absorption and a lower postprandial glycemic level [10].

1.8.2. Inhibition of DPP-4 enzyme

Incretin hormones include glucagon-like peptide-1 (GLP-1) and glucose-dependent insulinotropic polypeptide (GIP), which facilitate the secretion of insulin. A serine peptidase enzyme called dipeptidyl peptidase-4 (DPP-4) breaks down these hormones quickly. Hence, inhibitors of the DPP-4 enzyme have anti-diabetic properties by stimulating insulin secretion and inhibiting glucagon secretion [10].

1.8.3. Inhibition of α-amylase secreted from the salivary gland

Inhibition of the enzyme, α-amylase, which is found mainly in saliva and pancreatic juice, can lead to lower postprandial blood glucose levels. As it breaks down starch and glycogen and increases the blood sugar level. Hence, this enzyme's inhibition helps to control diabetes[10].

1.8.4. Increased secretion of insulin

An increase in intracellular calcium ion [Ca2+]i stimulates pancreatic β cells and facilitates insulin secretion. Some phytochemicals, e.g., p-methoxy cinnamic acid acting on the L-type Ca2+ channels have been demonstrated to boost insulin release by increasing cAMP via the inhibition of phosphodiesterase [10].

1.8.5. Increased insulin sensitivity and improved glucose uptake by muscle cells and adipose tissue

The sensitivity of non-pancreatic cells to insulin is enhanced by certain phytochemicals, resulting in better glycemic management. Glucose uptake is increased in skeletal muscle and adipose tissue due to the activation of a sequence of processes that occur in response to a rise in insulin levels. Insulin promotes the phosphorylation of protein substrates and increases the uptake of circulating glucose by adipose tissue and muscle cells when it interacts with insulin receptors [10].

1.8.6. Nourishment of Pancreatic β-Cells

Insulin-secreting pancreatic β cells can be impaired by autoimmune processes mediated via macrophages, cytokines, and T cells weaken them in type 1 diabetes and by oxidative stress, elevated lipid or glucose levels, and inflammatory mediators in type 2 diabetes. They can be strengthened against reactive oxygen species accumulation and lipid peroxidation-mediated cell death by increasing antioxidants, such as reduced glutathione (non-enzymatic) and catalase, superoxide dismutase, glutathione peroxidase, glutathione S transferase (enzymatic)

1.8.7. Reduction of HbA1c and glycated plasma protein levels

In diabetes mellitus, blood glucose content is increased and monosaccharides react non-enzymatically with blood proteins (mostly hemoglobin A and albumin) in a process known as glycation. Glycation inhibitors obstruct this process by a variety of methods, including competitive interaction with the protein's amino group, cleaving the open chain of monosaccharides, binding at the glycation site, and attaching with the intermediates of glycation reaction. As a result, HbA1c and glycated plasma protein concentrations are reduced, and the consequences of glycation and diabetes problems can be avoided.

2. Material and method

2.1. Plant material

Leaves of *Colocasia esculenta*were collected from Dubrajpur ,Birbhum India.

- The collected plant parts is dried for one week in shed dry.
- Grind into a coarse powder with the help of a suitable grinder.
- Then the grinded fine power was shieving by 24 mess.
- The powder was kept in an airtight container and kept in a sun shed and dry place.

2.2. Preparation of *Colocasia esculenta*Ethanolicextract

Taro leaves margine were washed by distilled water then leaves and their edible portions were carefully separated. The leaves were air dried in shade at 40°C for 48 h and ground to a fine powder and passed through a 24-mesh sieve. 50g powdered sample was extracted with either 400ml ethanol at room temperature by Soxhlet extraction method for 24 h. The mixture filtered through filter paper for removal of peel particles. The extracts were filtered and evaporated to dryness under reduced pressure at 60°C by a rotary evaporator.[11]

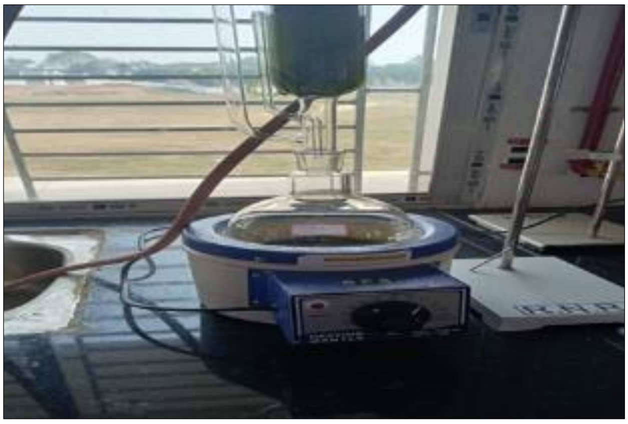

Figure 3 Preparationof Taro leaves(*Colocasia esculenta)*margin EthanolicExtract

2.3. Preliminary Phytochemical Studies

2.3.1. Test for Alkaloids [12]

- Dragendorff 's test: By adding 1 mL of Dragendorff"s reagent to 2 mL of extract, an orange red precipitate was formed, indicating the presence of alkaloids.
- Mayer's test: Few drops of Mayer's reagent were added to 1 mL of extract. A yellowish or white precipitate was formed, indicating the presence of alkaloids.
- Hager's test: Two milliliters of extract were treated with few drops of Hager's reagent. A yellow precipitate was formed, indicating the presence of alkaloids.

2.3.2. Tests for glycosides [12]

- Keller Killiani test: A solution of 0.5 mL, containing glacial acetic acid and 2-3 drops of ferric chloride, was mixed with 2 mL of extract. Later, 1 mL of concentrated H2SO4, was added along the walls of the test tube. The appearance of deep blue colour at the junction of two liquids indicated the presence of cardiac glycosides.

2.3.3. Test for carbohydrates [12]

- Molish test: Few drops of alcoholic a-naphthol solution were added to 2 mL of extract. Later, few drops of concentrated H2SO4 were added along the walls of test tube. At the junction of two liquids, a violet colour ring appeared, indicating that carbohydrates were present.
- Benedict's test: To 5 mL of Benedict's reagent, 8-10 drops extract were added, then heated for five minutes; the resulting dark red precipitate indicated the presence of carbohydrates.
- Fehling's test: To 2 mL of extract, an equal volume of Fehling's (A & B) solution was added and heated for five minutes, the resulting red/dark red precipitate indicating the presence of carbohydrates.

2.3.4. Test for Flavonoids [12]

- Alkaline reagent test: Two to three drops of sodium hydroxide were added to 2 mL ofextract. Initially, a deep yellow colour appeared but it gradually became colourless by addingfew drops of dilute HCL, indicating that flavonoids were present.

- Shinod's test:Ten drops of dilute HCL and a piece of magnesium were added to 1 mL of extract, the resulting deep pink colour indicating the presence of flavonoids.

2.3.5. Test for Terpenes/Terpenoids[12]

To 2 ml of extract, 5ml of chloroform and 2 ml of Conc. H_2SO_4 was added. Reddish brown colourations of interface visualize the presence of terpenes.

2.3.6. Test for Saponins [12]

To 2ml of extract add water and shaken vigorously for frothing presence visualize saponins.

2.3.7. Test for Tannins[12]

To 1ml of extract, 1ml of 5% $FeCl_3$ was added which visualize by the presence of greenish black precipitate.

2.3.8. Test for Steroids[12]

To 2ml of extract, 1ml of chloroform and drop of glacial acetic acid was added, followed by heating and add Conc. H_2SO_4 which visualises by the presence of orange colour.

2.4. Induction of type 2 diabetes

Rats were fed high-fat diet containing cholesterol 3%, cholic acid 1%, coconut oil 30% and standard rat feed 66% along with this 30% sucrose through drinking water for the period of 60 days. On the 60th day of feeding, after overnight fasting, blood glucose was checked and the rats which have blood glucose above 120 mg/dl will be chosen as type 2 diabetic rats. Treatment would be started on the next day after confirmation of type 2 diabetes and this would be considered as 1st day of treatment and it will be continued for 30 days. The rat were fed with high fat diet during this period. [13]

Sucrose is a disaccharide composed of the monosaccharides glucose and fructose. In humans and other mammals, sucrose is broken down into its constituent monosaccharides by sucrose or isomaltase, glycoside hydrolases, which are located in the membrane of the microvilli lining the duodenum. The resulting glucose and fructose molecules are then rapidly absorbed into the bloodstream. Excessive glucose will be stored as glycogen. Fructose is more lipogenic than glucose or starches. It induces moderate obesity and several adverse metabolic effects, including hypertriglyceridemia, hyperinsulinemia and hypertension in rodents.

Fructose bypasses the phosphofructokinase regulatory step and enters the pathway of glycolysis or gluconeogenesis at the triose phosphate level, resulting in increased hepatic triglyceride production. Excess storage of saturated fat in white adipose tissue causes hypertrophy and hyperplasia of adipocytes, which exhibit attenuated insulin signaling due to their production and release of saturated fatty acids. These adipocytes recruit macrophages to white adipose tissue and together with them, initiate proinflammatory response. Proinflammatory factors and saturated fatty acids secreted into the blood stream from white adipose tissue impair insulin signaling in non-adipose tissues, which causes whole body insulin resistance.[19].Then, the rats were treated according to the following regimens: the formulation group(750 mg /kg) by oral administration; the standard formulation(500 mg/kg) by oral gavage; the control and model groups, receiving an equal volume of water by oral gavage. The treatment course lasted for 4 weeks.

2.5. Animals

Healthy adult male albino rats of Wistar strain (150-180 days old weighing 180-200g) were used in this study and maintained in clean polypropylene cages at the Central Animal House.

Institute under specific humidity (65 ± 5 %) and temperature (21 ± 2°C) with constant 12 h light and 12 h dark schedule. The standard rat pelleted diet (Lipton India, Mumbai, India) were provided with clean drinking water.[14]

Figure 4 Animals

2.6. Dose fixation study

The optimal dose of herbal drug was fixed on the basis of following dose fixation study.

Rats were randomly divided into 3 groups each consisting of 2 rats each.

- Group I: Control,
- Group II: Diabetic rats,
- Group III: Diabetic rat treated with herbal drug 750 mg/kg b.wt/day orally for 30 days. and Diabetic rat treated with Metformin 500 mg/kg b.wt/day orally for 30 days.

2.7. Biochemical estimation:

- Fasting blood glucose (FBG): Blood glucose will be estimated using glucose test strips after overnight fasting. Blood will be collected by nicking the tip of the rat tail.[15]

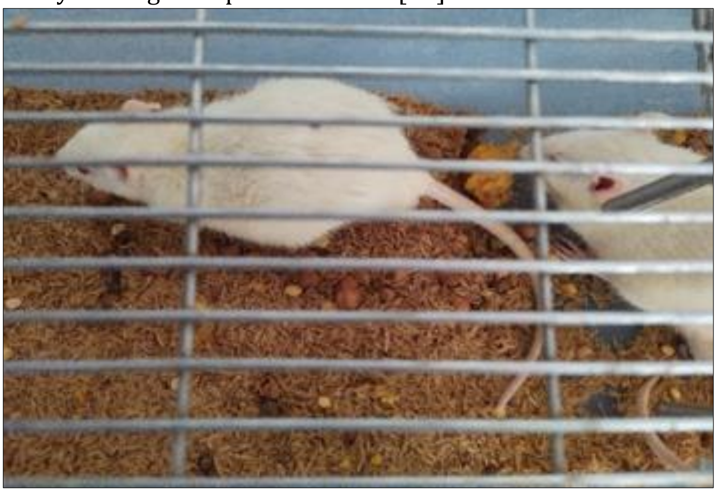

Figure 5 Fasting blood glucose

- Oral Glucose Tolerance Test (OGTT): For oral glucose tolerance test, animals will be fasted overnight and blood glucose will be estimated using blood glucose test strips at various time periods (60, 120 and 180 min) after giving the oral glucose load (10 ml/kg; 50% w/v). Blood glucose value before giving glucose load will be considered as 0 minute value. [16]

Figure 6 Oral glucose tolerance test

3. Results

Table1 Phytochemical constituents of dried tubers of *Colocasia esculenta*

Test Name	Abbreviation	Colour Change
Dragendorff 's Test	Positive	Orange Red Precipitate
Mayer's test	Positive	Yellowish or White Precipitate
Hager's test	Positive	A yellow Precipitate
Keller Killiani test	Positive	Deep Blue at the junction of two Liquids
Molish Test	Positive	A violet Colour Ring Appeared
Benedict Test	Positive	Dark Red precipitate
Fehling Test	Positive	Red/Black precipitate
Alkaline reagent test	Positive	Deep yellow then gradually become colorless
Shinod'stes	Positive	Deep Pik Colour

Figure 7 Phytochemical screening

Table 2 Dose dependent effect ofherbal drug in body weight, food intake

Group	0 Weeks	2 Weeks	4 Weeks
Negative Control gr-I	150.7±4.2	153.6±6.8	156.9±7.3
Positive Control gr-II(HFD)	150.1±3.9	170.5±6.3	191.6±2.7
HFD+Extract (750mg/kg)	153.±2.3	159.6±5.2	174.1±4.8
HFD +Metformin (500mg/kg)	151.1±3.8	156.1±4.9	160.4±5.3

Table 3 Effect of Taro extract on weight gain/Food intke

Group	Initial	Final	Weight Gain (g/4 wk)	Food Intake (g/4 wk)
N.Control	150.7±4.2	156.9±7.3	6.2	956
P.Control	150.1±4.2	191.6±2.7	41.5	1098
HFD+E.	153.2±2.3	174.1±4.8	20.9	998
HFD+M	151.1±3.8	160.4±5.3	9.3	858

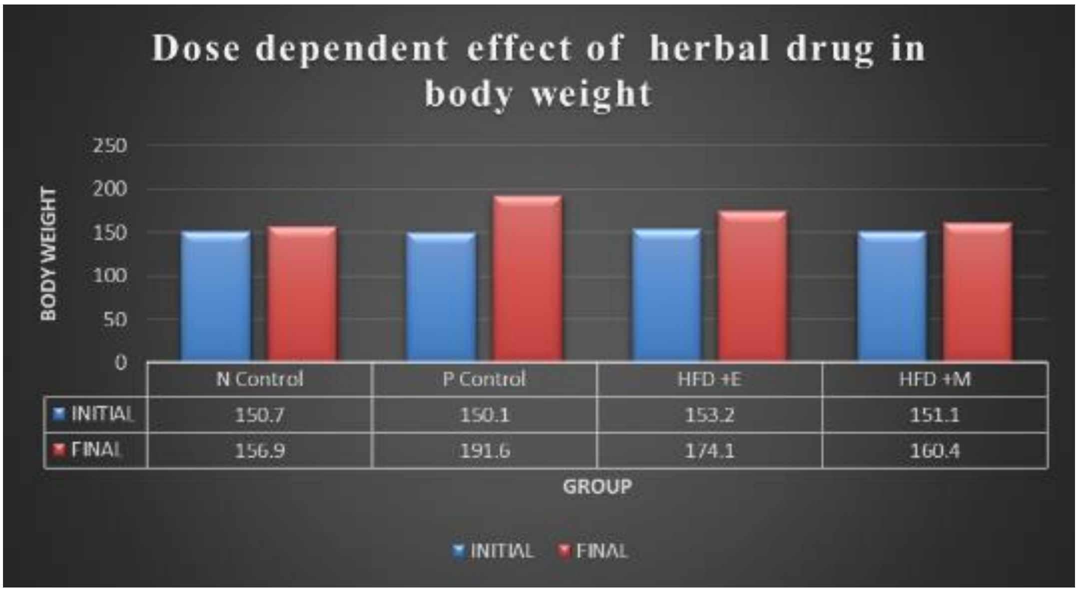

Figure 8 Dose dependent effect of herbal drug in body weight

Table 4 Effects of Poly herbal drug on blood glucose in High Fat Diet induced type 2 diabetic rats.

Group	0 weeks	2 weeks	4 weeks
NC	3.88±0.81	4.05±0.16	4.10±1.79
PC	5.36±3.18	5.36±3.18	6.23±1.23
HFD+E.(750mg/kg)	5.87±2.90	5.87±2.90	4.68±3.15
HFD+Mct	6.37±2.36	4.01±3.80	3.98±1.17

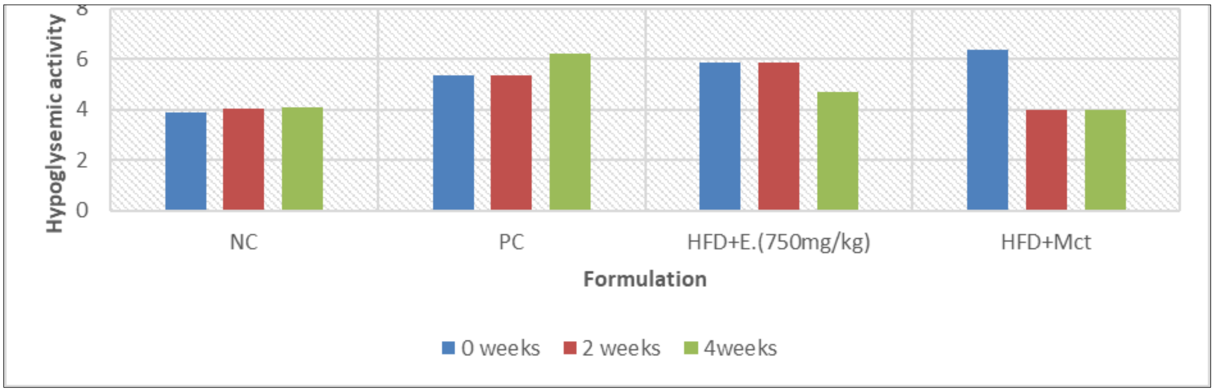

Figure 9 Effects of herbal drug on blood glucose in High Fat Diet induced type 2 diabetic

4. Discussion

Plants are important sources of potentially bioactive constituents for the developments of new chemotherapeutic agents. The first step towards this goal is the nutritional profile and phytochemical screening. Phytochemicals are nonnutritive plant chemicals that have protective or disease preventive properties; they are found generally in plants. Phytochemicals can have complementary and overlapping action including antioxidants, modulation of detoxification enzymes and reduction of inflammation, modulation of steroid metabolism, antibacterial and antiviral effects in humans.[17]

In my findings tubers of *Colocasia esculenta* contain various chemical components such as alkaloids, glycosides, terpenoids, flavonoids, saponins and phenols in ethanolic extract. The plant species could use alkaloids to protect themselves against herbivores. Because of the life style plants are unable to avoid their predators. They could also be used as a natural source of insecticides and fungicides. Researchers also revealed that alkaloids help biologically in storage of waste nitrogen, cationic balancing and protection against parasites . **Alkaloids** are also used in medicine for reducing headache and fever. These are attributed for antibacterial and analgesic properties .**Terpenoids** represent a diverse class of molecules that are related to therapeutic properties including anti-cancer, antiparasitic, anti-microbial, anti-allergic, anti-spasmodic, antihyperglycemic, anti-inflammatory and immunomodulatory properties. **Phenolic compound** with strong antioxidant activity have been identified in edible members of Araceae family and are of interest to food manufactures as consumers moves toward functional foods with specific health effects. Phenolic compounds are considered to be the most important antioxidants of plant materials. They constitute one of the major groups of compounds acting as primary antioxidants or few radical terminators [18]. **Glycosides** are naturally cardioactive drugs used in the treatment of congestive heart failure and cardiac arrhythmia . The presence of glycosides indicates that they may be potent in curing cardiac insufficiency, coughs and circulatory problems. Also, they may act as good sedatives and have antispasmodic properties [19] .**Flavonoids** are group of polyphenolic compounds which influence the radical scavenging, inhibition, of hydrolytic and oxidative enzymes and also act as anti-inflammatory agent[39]. The biological functions of flavonoids apart from its antioxidant properties include protection against aggregation, microbes, ulcers, hepatoxins, viruses and tumors [20] . **Saponins** were found in *Colocasia esculenta* tubers shows natural tendency to ward off microbes makes them good candidates for treating fungal and yeast infections.

Diabetes mellitus is a critical warning to society health and one of the high-rise prime concerns in medicine worldwide, Since 3.7 million deaths were occurred due to diabetes and higher optimal blood glucose level, many of that could be prevented.In the modern lifestyle high dietary fat is one of the core and central environmental risk factor and also it is connected with metabolic-related diseases such as type-2 diabetes mellitus (T2DM), hypertension, stroke and coronary artery disease. This type food habits also causes the weight gain and adiposity in both animals and humans. Wistar rats are susceptible to high fat diet (HFD) induced insulin resistance (IR). Hence, we selected high fat diet and sucrose-induced type-2 diabetic animal model which are suitable for the present study.

Results of our study showed that Herbal drug (750 mg /kg) revealed the positive effects through decreasing the plasma glucose levels.

4.1. Dose dependent effect of Poly herbal drug in body weight, food intake

The body weight and food intake of the animals was significantly reduced due to diabetes. Treatment experimental groups 750 mg/kg b.wt doses treatment significantly normalized and improved the body weight and food intake which altered by diabetes induction. [21]

4.2. Effects of Poly herbal drug on blood glucose in High Fat Diet induced type 2 diabetic rats.

Diabetes induced rats showed elevated levels of glucose, were significantly increased, whereas the levels of Metformin and herbal extract significantly decreased in the diabetic rats when compared with control rats. Treatment with herbal drug 750 mg/kg b.wt and metformin reversed these values to near normal in diabetic rats. Oral administration of herbal drug to normoglycemic rats.[22]

5. Conclusion

Type 1 Diabetes: Overall, the results indicated that the active principles present in the herbal extract may possess diverse biological action and can be developed as a therapeutical based on its hypoglycemic. The polyherbal extract has shown to afford significant protection against high fat diet. Further studies are aimed at understanding the possible mechanism of action of the herbal drug.

Using parameters ethanolic extract of *Colocasia esculenta*which at dosages of 500 mg/kg body weight, exhibited a significant anti diabetic effect. These findings demonstrated that the extractwas a mixture of flavonoid and Terpenoids could result in an active for diabetics. The acute toxicity research found no deaths, indicating that the herb is safe to use.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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