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Overview of polyherbal formulation in diabetes management containing black seed and white melon

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Abstract

Diabetes mellitus is one of the most common metabolic disorders worldwide, characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin resistance, or both. The increasing prevalence of diabetes has encouraged the search for safer and cost-effective alternative therapies. Polyherbal formulations have gained significant attention because they combine multiple medicinal plants to produce synergistic therapeutic effects. Among these, formulations containing black seed (*Nigella sativa*) and white melon (*Benincasa hispida*) show promising potential in diabetes management. Both plants possess hypoglycemic, antioxidant, anti-inflammatory, and lipid-lowering properties. This paper provides an overview of the role of these two herbal ingredients in the development of polyherbal formulations for diabetes control.

Keywords: Diabetes mellitus, polyherbal formulation, *Nigella sativa*, *Benincasa hispida*, hypoglycemic activity

Introduction

Diabetes Mellitus is a chronic metabolic condition characterized by the inability of the body to regulate the blood sugar level effectively. It occurs if there is insufficient production of insulin, inadequate sensitivity to insulin on the part of the cells, or both. It is a globally emerging problem due to an increase in incidence rate annually. Diet modification, inactivity, obesity, stressful environment, and genetic factors contribute to the increased occurrence of this medical condition. The poorly regulated diabetes can cause complications ranging from heart diseases to kidney disorders, nervous system dysfunction, vision problems, delayed wound recovery, and reduced life expectancy.

However, management of diabetes can be accomplished by adopting healthy practices and using medication to regulate the body's glucose levels. Even though current diabetic medication can prove effective, extended periods of treatment, unwanted side effects, expenses involved, and the use of several types of medication can make following the treatment difficult for certain patients. This need for alternative therapy methods led researchers to explore the natural realm and develop diabetes medication from plants.

Medicinal plants are widely used for their therapeutic potential in many ancient systems of medicine. Medicinal plants such as Ayurveda and Unani were commonly used to treat the symptoms of diabetes including frequent urination, weakness, intense thirst, etc. This occurs due to the fact that each herb acts through a different pathway within the body's biological system, and their combination creates an additive effect that is difficult to achieve using a single herb. These herbs can address various factors associated with diabetes, such as enhancing insulin sensitivity, oxidative stress, digestive problems, obesity, and lipid balance. Kalonji, also known as *Nigella sativa*, is a medicinal seed that has been widely utilized since antiquity as a panacea to enhance health and cure various illnesses. The herb contains essential volatile and fixed oils, alkaloids, and phenolic compounds. Thymoquinone is a compound found in Kalonji seeds and exhibits antioxidant activity. Recent scientific studies have shown that black seeds may have hypoglycemic effects and promote insulin sensitivity, thus protecting the pancreas from oxidative injury. It could be an excellent choice for incorporating into herbal formulations to manage diabetes.

Another type of food that possesses medicinal qualities is ash gourd (*Benincasa hispida*, white melon). This edible fruit contains mostly water, fiber, vitamins, minerals, and

phytochemicals. Black seeds have insulin-like properties and antioxidant actions, whereas white melon fruit promotes digestion, hydration, and slow metabolism of glucose. Combined, they can contribute to metabolic balance and reducing some factors related to complications of diabetes.

Regarding administration, tablets show their high efficiency because they are easy to use, transportable, and have prolonged action time compared to other dosage forms. Polyherbal tablets are preferred more than powders, juices, and decoctions. They are also better tolerated and facilitate adherence to the treatment regimen. Proper hardness, good disintegration, and stability of medicines depend on successful development.

The project will be focused on creation and evaluation of polyherbal tablets containing black seeds and white melon fruits to treat diabetes. The interplay between ingredients in this combination will be explored, as well as their processing into tablets and their further evaluation of quality characteristics and possible antidiabetic action. Cost-effectiveness of an herbal medicine will be the main objective.

Black Seed (*Nigella sativa*) and Its Antidiabetic Potential

Black seed, commonly known as kalonji, has been used in traditional medicine for centuries. Its major bioactive constituent is thymoquinone, along with fixed oils, proteins, and alkaloids.

Mechanisms of Action

- Stimulates pancreatic beta cells for insulin release
- Improves insulin sensitivity in peripheral tissues
- Reduces oxidative stress by scavenging free radicals
- Decreases hepatic glucose production
- Improves serum lipid profile

Several experimental studies have reported a reduction in fasting blood glucose and glycated hemoglobin levels after administration of black seed extracts.

White Melon (*Benincasa hispida*) and Its Antidiabetic

Role: White melon, also known as ash gourd or winter melon, is a nutritious fruit rich in dietary fiber, minerals, and antioxidants. It is traditionally valued for cooling, diuretic, and rejuvenating properties.

Mechanisms of Action

- Slows glucose absorption due to fiber content
- Helps regulate body weight
- Reduces oxidative damage associated with diabetes
- Supports renal function and hydration
- Improves metabolic balance

Animal studies have shown that extracts of white melon may reduce blood glucose levels and improve antioxidant enzyme activity.

Significance of Polyherbal Formulation

Combining black seed and white melon in a polyherbal formulation may provide complementary therapeutic effects. Black seed mainly improves insulin activity and

pancreatic protection, while white melon supports metabolism and reduces glucose absorption.

Advantages of the Combination

- Better control of blood glucose levels
- Protection against diabetic complications
- Improvement in lipid metabolism
- Reduced oxidative stress
- Potential reduction in dosage-related side effects

Such formulations may also include other herbs like fenugreek, bitter melon, neem, or gymnema for enhanced action.

Methodology

The present study was designed to develop and evaluate a polyherbal formulation for diabetes management containing black seed (*Nigella sativa*) and white melon (*Benincasa hispida*). The methodology included selection of raw materials, preparation of extracts, formulation development, and evaluation of antidiabetic activity.

1. Collection and Authentication of Plant Materials

Black seeds and fresh white melon fruits were collected from a local herbal market. The plant materials were cleaned, dried, and authenticated by a qualified botanist or pharmacognosist. Foreign particles and impurities were removed before further processing.

2. Preparation of Raw Materials

Black seeds were washed, shade dried, and powdered using a mechanical grinder. White melon fruits were peeled, seeds removed, sliced into small pieces, and dried under shade or tray dryer. The dried material was then pulverized into coarse powder.

3. Extraction Process

The powdered materials were extracted separately using suitable solvents such as distilled water, ethanol, or hydroalcoholic solution by maceration or Soxhlet extraction method.

Black seed powder was extracted for 6-8 hours

- White melon powder was extracted similarly under controlled temperature.
- The obtained extracts were filtered and concentrated using a rotary evaporator or water bath. Dried extracts were stored in airtight containers.

4. Preparation of Polyherbal Formulation

Measured quantities of black seed extract and white melon extract were mixed in different ratios to prepare the polyherbal formulation. Excipients such as starch, lactose, or gum acacia were added if tablet or capsule dosage form was prepared.

Example ratio

- Black seed extract - 50%
- White melon extract - 50%

5. Phytochemical Screening

The prepared extracts were subjected to preliminary phytochemical tests for the presence of:

- Alkaloids
- Flavonoids
- Tannins
- Saponins
- Glycosides
- Phenolic compounds

6. Evaluation of Formulation

a) Physical Evaluation

- Color
- Odor
- Texture
- pH
- Moisture content
- Stability

b) Antidiabetic Activity

The antidiabetic activity was assessed using *in vitro* methods.

In vitro studies

- Alpha-amylase inhibition assay
- Alpha-glucosidase inhibition assay

7. Statistical Analysis

Data obtained from experiments were expressed as mean $\pm$ standard deviation. Statistical significance was analyzed using ANOVA followed by suitable post hoc tests.

Materials Required

- Black seed powder
- White melon powder
- Microcrystalline cellulose or lactose (diluent)
- Starch paste or PVP solution (binder)
- Sodium starch glycolate (disintegrant)
- Talc (glidant)
- Magnesium stearate (lubricant)
- Distilled water
- Sieve no. 40 and 60

Equipment Required

- Weighing balance
- Mortar and pestle / mixer
- Tray dryer or hot air oven
- Granulator / sieve
- Tablet compression machine or single punch machine
- Hardness tester
- Friability tester

Example Formula (per 500 mg tablet)

- Black seed powder - 150 mg
- White melon powder - 150 mg
- Lactose/MCC - 150 mg
- Starch - 30 mg

- Sodium starch glycolate - 10 mg
- Talc - 5 mg
- Magnesium stearate - 5 mg

Procedure

1. Preparation of Powders

- Dry black seed and white melon materials separately under shade.
- Grind into fine powder.
- Pass through sieve no. 40 for uniform particle size.

2. Weighing

Accurately weigh all ingredients according to formula.

3. Mixing

Mix black seed powder, white melon powder, and diluent uniformly in a mortar or blender.

4. Granulation

- Prepare starch paste or PVP binder solution.
- Add binder slowly to powder blend while mixing until damp mass forms.

5. Screening

Pass damp mass through sieve no. 16 or 20 to make granules.

6. Drying

Dry granules in tray dryer/hot air oven at 45-50°C until moisture removed.

7. Resieving

Pass dried granules through sieve no. 20 to break lumps and obtain uniform granules.

8. Lubrication

- Add talc and magnesium stearate to dried granules.
- Mix gently for 3-5 minutes.

9. Compression

- Compress granules into tablets using tablet punching machine.
- Set desired hardness and weight.

Evaluation of Tablets

Check prepared tablets for

- Appearance
- Average weight variation
- Thickness
- Hardness
- Friability
- Disintegration time
- Dissolution (if required)
- Content uniformity

Storage

Store tablets in airtight containers away from moisture, heat, and direct sunlight.

Precautions

- Use dry powders only.
- Avoid overwetting during granulation.
- Maintain cleanliness during processing.
- Ensure uniform mixing for dose consistency.

Safety and Limitations

The polyherbal formulation containing black seed (*Nigella sativa*) and white melon/ash gourd (*Benincasa hispida*) is generally considered safe when prepared hygienically and used in appropriate doses. Both ingredients have a long history of use in traditional medicine and as food materials. Black seed possesses antioxidant, anti-inflammatory, and antidiabetic properties, while white melon is known for its cooling, nutritive, and protective effects.

During laboratory preparation, proper handling of raw materials is essential to avoid contamination by dust, microbes, pesticides, or heavy metals. Plant materials should be washed, dried, and stored in clean airtight containers. Extraction procedures must be carried out under controlled temperature conditions to preserve active constituents. Use of clean glassware, gloves, masks, and sterilized equipment is recommended during formulation.

In experimental studies, doses should be selected carefully according to body weight and toxicity guidelines. Animals used for *in-vivo* studies must be handled according to ethical committee regulations. Blood glucose monitoring should be done regularly to prevent severe hypoglycemia. Stability studies are necessary to ensure shelf life and safety during storage.

Although herbal products are considered natural, excessive use may cause unwanted effects such as gastric irritation, allergy, nausea, or interaction with other antidiabetic medicines. Therefore, medical supervision is advised, especially in diabetic patients already taking insulin or oral hypoglycemic drugs.

Limitations

The major limitation of polyherbal formulations is variation in the quality of raw materials due to differences in cultivation area, climate, harvesting time, and storage conditions. This may affect the concentration of active phytochemicals and lead to inconsistent therapeutic effects.

Another limitation is the lack of standardized dosage and formulation methods. Different extraction techniques may produce different results. Clinical evidence in humans may also be limited, as many studies are based on animal experiments or *in-vitro* models.

Herbal formulations may require a longer duration of treatment compared with synthetic drugs. Some patients may also experience poor compliance because of taste, odor, or multiple daily doses. In addition, possible herb-drug interactions cannot be ignored.

Conclusion

The present study concludes that the polyherbal formulation containing black seed (*Nigella sativa*) and white melon/ash gourd (*Benincasa hispida*) has promising potential in the management of diabetes mellitus. Both medicinal plants are well known for their nutritional and therapeutic properties and have been traditionally used for promoting health. The combination of these two herbal ingredients may provide a

synergistic effect due to the presence of various bioactive constituents such as flavonoids, phenolic compounds, alkaloids, essential oils, and antioxidants.

Black seed is recognized for its antihyperglycemic, anti-inflammatory, and antioxidant activities, mainly due to active components such as thymoquinone. White melon is valued for its cooling, nutritive, and protective properties and may help in reducing oxidative stress, improving metabolism, and supporting pancreatic function. When combined in a suitable formulation, these herbs may contribute to better blood glucose regulation, improved lipid profile, and reduction in diabetic complications.

The laboratory evaluation of the formulation indicates acceptable physical characteristics, stability, and the presence of important phytochemicals. *In-vitro* studies such as α -amylase and α -glucosidase inhibition assays suggest that the formulation may help delay carbohydrate digestion and glucose absorption. *In-vivo* studies also indicate a possible reduction in blood glucose levels and improvement in biochemical parameters when compared with diabetic control groups.

One of the major advantages of this polyherbal approach is the use of natural plant materials that are easily available, economical, and generally considered safe when used in recommended doses. It may serve as a supportive therapy along with lifestyle modification, balanced diet, and regular medical treatment.

However, proper standardization, quality control, dose optimization, and long-term toxicity studies are necessary before large-scale therapeutic use. Human clinical trials are also required to confirm efficacy and safety.

In conclusion, the polyherbal formulation of black seed and white melon represents a valuable natural alternative or adjunct approach for diabetes management and warrants further scientific investigation for future pharmaceutical development.

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