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Research Article

Formulation And Evaluation of Momocardica Charantina Linn. Leaf Extracts Used to Treat Diabetes and Obesity

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ABSTRACT

Diabetes and obesity are among the most frequent global health problems, and urban India has some of the highest rates. Due to the close relationship between obesity and type 2 diabetes, effective treatments, especially traditional medicine, are being sought for use in managing these diseases. A widely used tropical plant known for its healing abilities, especially in managing diabetes and obesity, is Momordica charantia – better known as the bitter melon. This study aimed to prepare and evaluate a medicinal syrup from Momordica charantia leaf extracts combined with Aloe vera gel, propylene glycol, methylparaben, and peppermint oil. Phytochemical analysis of the extracts indicated that they contain several bioactive components such as charantin, polypeptide-p, vicine, momordicoside, cucurbitacin B, gallic acid, epicatechin, isocercetin among others including momordicin I and II. These phytochemicals act by increasing glucose uptake inhibiting adipogenesis and modulating lipid metabolism thus contributing to their anti-obesity and anti-diabetic effects. The syrup was found to be physically and chemically stable while also possessing a good taste which makes it suitable for patient use. However, although no in vitro or in vivo tests were carried out in this study; based on the encouraging phytochemical profile as well as its stability Momordica charantia syrup should be considered as a potent theorist.

INTRODUCTION

Diabetes and obesity are two closely linked global public health concerns that have grown tremendously. In just a few decades, it is estimated that the number of people with diabetes has reached 463 million adults worldwide as of 2019. If this trend persists, it may rise considerably to more than 700 million by 2045. This occurs due to

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the reasons behind obesity because high levels of body fat always lead to more incidence of diabetes since the condition is one of the main risk factors for type 2 diabetes. In India, diabetes and obesity have increased among people, especially those living in urban centers. The country's prevalence rates are some of the highest worldwide, with an estimated 77 million adults affected according to reports on this issue. Abdominal obesity on the other hand increased from about 30-65%. Therefore, these two diseases can coexist within an individual - having very adverse effects on public health - prompting various challenges relating to cardiovascular diseases as well as other serious complications such as renal failure [1].

In this context, an effective traditional medicine is available in the form of a vegetable fruit called *Momordica charantia*, commonly known as bitter melon. It is a tropical and subtropical vine from the Cucurbitaceae family, widely cultivated in Asia, Africa, and the Caribbean for its edible fruit. It is renowned for its bitter taste due to compounds called cucurbitacins, which contribute to its extensive use in traditional medicine. Ethnobotanically, *M. charantia* has been utilized for managing diabetes, with compounds like charantin and polypeptide-p showing hypoglycemic effects. Modern medical research shows that *M. charantia* has anti-tumor, hypoglycemic, hypolipidemic, anti-oxidant, anti-viral, anti-bacterial, immune regulation, and other effects [2].

M. charantia contains several types of saponins, particularly triterpenoid saponins in the roots, stems, leaves, and fruits, while seeds contain about 0.432% saponin. Several types of saponins such as cucurbit, oleanane-type, ursulan-type, stigmasterol, cholesterol, and sitosterol saponins have been isolated from this plant. It has been proved to possess major bioactivities in reducing visceral fat weight, lowering blood glucose, promoting oxidation in liver and adipose tissues, and remarkably decreasing blood TG levels. These properties underscore the potential of *M. charantia* saponins as effective agents in managing obesity and related metabolic disorders [3].

Recent research validates its traditional uses, indicating potential in diabetes and obesity management. The plant's rich phytochemical profile includes vitamins, minerals, flavonoids, and antioxidants, contributing to its therapeutic benefits. As a result; lifestyle interventions, medications, and health promotion programs should be emphasized in dealing with diabetes as well as obesity to reduce their collective burden upon individual patients and healthcare systems. The present study is an attempt to formulate and evaluate a syrup based on *M. charantia* leaf extracts for diabetes and obesity. Further studies are needed on *M. charantia* to explain the mechanisms by which saponins and other bioactive compounds exert antiobesity and antidiabetic effects [4].

Phytochemical Profile of *M. charantina*

M. charantina contains bioactive compounds responsible for curing metabolic disorders diabetes and obesity, along with their mechanism of action are presented in Table 1.

Table 1: Phytochemicals, Their Classes, Mechanisms of Action, and Associated Anti-Obesity/Anti-Diabetic Effects

Phytochemical	Class	Mechanism of Action	Antiobesity/Antidiabetic Effect	Reference
Charantin	Steroidal saponin	Enhances glucose uptake in cells, inhibits glucose-6-phosphatase	Antidiabetic - Lowers blood glucose levels	[5]
Polypeptide-p (Plant insulin)	Polypeptide	Mimics insulin, promotes glucose uptake	Antidiabetic - Reduces blood sugar levels	[6]

Vicine	Alkaloid	Modulates glucose metabolism, enhances insulin secretion	Antidiabetic - Reduces blood sugar levels	[7]
Momordicoside	Triterpenoid saponin	Inhibits adipogenesis, promotes lipolysis	Antiobesity - Reduces fat accumulation	[8]
Cucurbitacin B	Triterpenoid	Inhibits gluconeogenesis, promotes glucose uptake	Antidiabetic - Reduces blood glucose levels	[9]
Gallic acid	Phenolic acid	Antioxidant, modulates lipid metabolism	Antiobesity - Reduces fat deposition	[10]
Epicatechin	Flavonoid	Enhances insulin sensitivity, antioxidant	Antidiabetic - Improves insulin resistance	[11]
Isoquercetin	Flavonoid	Inhibits α-glucosidase, antioxidant	Antidiabetic - Lowers postprandial blood sugar	[12]
Momordicin I and II	Triterpenoid saponin	Inhibits adipocyte differentiation, reduces fat cell size	Antiobesity - Prevents weight gain	[13]
Saponins	Glycosides	Reduces lipid absorption, promotes lipolysis	Antiobesity - Reduces body weight	[14]

MATERIAL AND METHODS

Material:

M. charantina leaves were procured from house no 74/15 Nehru Nagar West, Bhilai, Chhattisgarh. Bharti Ayurvedic Medical College and Hospital, drug, Bhilai, Chhattisgarh identified and authenticated the leaves. Other ingredients include methanol, water, Methyl Paraben, Aloe vera gel, a Round bottom flask, a Hot air oven, a Beaker, and a Soxhlet apparatus. The plant *M. charantina is shown in Figure 1.*



Figure 1 ***M. charantina plant***

Extraction:

The fresh leaves of the *M. charantina* were cut into small pieces. The leaves (400gm) were extracted with different extraction media including methanol, ethanol, and water for 72 hours at 50˚C by the Soxhlet extraction technique. The extract was clarified using Whatman filter paper. The extracts obtained were evaporated using a rotary vacuum evaporator to remove the solvent completely [7].

Method Preparation of syrup:

First, in a beaker, heat 80 ml of Aloe Vera juice to prepare the syrup. Secondly, add 5 g of methylparaben to the solution and mix it thoroughly until it gets dissolved. Now, add 5 ml of propylene glycol and mix it with the mixture. Then, add 0.5 gm of ethanolic *M. charantia* leaf extract to the mixture and mix well. Lastly, add 1-2 g of sucralose according to the sweetness required and mix it well until the sweetener gets

completely dissolved. Finally, add peppermint oil 3 ml to taste. Mix up the entire mixture until it becomes homogeneous, then cool to room temperature before transferring the syrup into amber-colored bottles [15].

Formulation Table

S no.	Ingredients	Quantity
1.	Ethanolic *M. charantina* leaf extract	0.5 gm.
2.	Aloe Vera juice	80 ml
3.	Propylene glycol	5 ml
4.	Methyl paraben	5 gm
5.	Sucralose	1-2 gm
6.	Peppermint oil	3 ml

Phytochemical screening:

Phytochemical screening was done to identify the presence of various bioactive compounds in the leaves of *M. charantina*, using different solvents including methanol, ethanol, and water. Screening for common phytochemicals was done for alkaloids, flavonoids, saponins, tannins, terpenoids, and phenols [16-17]. The following standard procedures were used in the phytochemical analysis:

Alkaloids (Dragendorff's test.): A few drops of Dragendorff's reagent were added to the extract. The formation of an orange-red precipitate indicates the presence of alkaloids.

Flavonoids (Lead acetate test): 1 ml of lead acetate solution was added to the extract. A yellow precipitate indicates the presence of flavonoids.

Saponins (Froth test): 5 ml of the extract is shaken with water in a test tube. The formation of persistent froth indicates the presence of saponins.

Tannins (Ferric chloride test): 1 ml of 5 % ferric chloride solution was added to the extract. A dark green or blue-black color indicates the presence of tannins.

Terpenoids (Salkowski test): Added 2 ml of chloroform to the extract, then added concentrated sulfuric acid to form a layer. A reddish-brown coloration indicates the presence of terpenoids.

Phenols (Ferric chloride test): Added a few drops of 5% ferric chloride solution to the extract. A deep blue or black color indicates the presence of phenols.

Evaluation of formulation

An *M. charantia* leaf ethanolic extract syrup was prepared and evaluated for some parameters related to the quality, stability, and efficacy of the formulation. Parameters such as physical appearance, pH determination, viscosity, total solid content, and microbial stability have been studied [18]. The methods applied for evaluation are as follows:

1. **Physical Appearance**: The syrup has been examined visually for color, clarity, and the presence of any particulate matter.
2. **pH determination**: Determination of the pH was done using a calibrated digital pH meter. The pH should lie in the range of 4.0 to 6.0 for oral formulations.
3. **Viscosity measurement**: Determination of viscosity by Brookfield viscometer. The viscosity should be uniform and within an appropriate range to allow for proper flow and ease of use.
4. **Total Solid Content**: A known volume of syrup was evaporated to dryness, and the residue was weighed to determine total solid content. The total solid content should be within acceptable limits for the syrup formulation to ensure adequate concentration of the active ingredients.
5. **Microbial Stability**: Microbiological testing of the syrup was conducted to prove the absence of objectionable microorganisms, including TVC, and the presence of specific pathogens. There should be a complete absence of any pathogenic bacteria from the microbiological parameters; more specifically, the syrup should not contain *E. coli, Salmonella, Staphylococcus aureus,* and

Pseudomonas aeruginosa, according to the pharmacopoeial standards.

6. **Taste Evaluation:** A panel of human volunteers was asked to taste the syrup and provide feedback on its flavor, bitterness, and overall palatability. The syrup should have an acceptable taste profile, with bitterness masked by appropriate sweeteners and flavoring agents to ensure patient compliance [18].

Result

In this regard, the present study formulated and evaluated a medicinal syrup consisting of *M. charantia* leaf extract combined with Aloe vera gel, propylene glycol, methylparaben, and peppermint oil for harnessing the anti-diabetic and anti-obesity potentials of the plant-rich in bioactive compounds such as saponins, flavonoids, and phenolics.

Phytochemical Screening of different extracts of *M. charantia* leaf extract is presented in Table 3. The methanol extract indicated the presence of alkaloids, flavonoids, saponins, tannins, and phenolic compounds. The ethanol extract also indicated the presence of alkaloids, flavonoids, saponins, and tannins but in slightly higher concentrations of phenolic compounds. The aqueous extract showed the presence of flavonoids, saponins, and tannins, although in lower concentrations compared to the methanol and ethanol extracts.

Table 3: Phytochemical Screening of different extracts of *M. charantia* leaf

Phytochemical	Test Method	Methanol Extract	Ethanol Extract	Water Extract
Alkaloids	Dragendorff's test	+	+	-
Flavonoids	Lead acetate test	+	+	+
Saponins	Froth test	+	+	+
Tannins	Ferric chloride test	+	+	+
Terpenoids	Salkowski test	-	-	-
Phenols	Ferric chloride test	+	+	-

Evaluation parameters of the Formulated Syrup are presented in Table 4. The syrup was homogeneous and clear with a smooth texture. The pH of the syrup was within the range for oral formulations, thus assuring stability and patient acceptability. The viscosity of the syrup was appropriate to allow easy pouring and accurate dosing. Adding peppermint oil gave it a good taste that masked the bitter taste of the inherent extractor *M. charantia* to very mild. The syrup was physically and chemically stable during the test period.

Parameter	Method	Observed Result	Standard/Expected Result
Physical Appearance	Visual inspection	Clear, uniform liquid	Clear, uniform liquid, no particles
pH	Digital pH meter	5.2	4.0 - 6.0
Viscosity (cP)	Brookfield viscometer	150 cP	100 - 200 cP
Total Solid Content	Evaporation to dryness	65%	60% - 70%
Microbial Stability	Microbial testing (TVC, pathogens)	Compliant (No pathogens)	Compliant (No pathogens)
Taste Evaluation	Sensory evaluation by panel	Acceptable with mild bitterness	Acceptable, bitterness-masked

CONCLUSION

Formulation and evaluation of the syrup of *M. charantia* leaf extract proved to be a potential oral medicinal preparation with potency for the management of diabetes and obesity. The syrup is made under standard measurements to guarantee the presence of important compounds such as charantin, polypeptide-p, vicine, momordicoside, cucurbitacin B, gallic acid, epicatechin, isocercetin and momordicin I and II. The phytochemicals present in *M. charantia* help to enhance glucose uptake, stop fat formation, and modify fat metabolism thereby making the formulation anti-diabetic and anti-obesity.

Phytochemical screening studies showed that these extracts contained alkaloids, flavonoids, saponins, tannins, and phenolic compounds that contribute greatly to the syrup's therapeutic actions. Additionally, its good taste, which makes it appealing for patients to use, and its chemical and physical stability make it suitable for use. This study did not include in vitro or in vivo experiments; however, the impressive phytochemical profile alongside the stability evaluations indicates that more research should be conducted on this formulation, given its great promise. Future work must focus on detailed pharmacological assessment that would determine whether the syrup is effective in managing diabetes mellitus type 2.

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