Formulation and Characterization of Edible Jelly for the Diabetic Patients

Mr. Shivprasad T. Bhambure[1], Mr.Shubham D. Borate[2], Mr.Suhas S. Deshmukh[3], Dr.Bhagyesh U. Janugade[4]

[1,2,3] *Student, K'Fs Jaywant Institute of pharmacy, wathar*

[4] *Principal, K'Fs Jaywant Institute of pharmacy, wathar*

Abstract- Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels, requiring controlled dietary intake of sugars and carbohydrates. Conventional jellies available in the market typically contain high amounts of sucrose, making them unsuitable for diabetic individuals. The present study focuses on the formulation and characterization of an edible, sugar-free jelly specifically designed for diabetic patients using suitable natural sweeteners and gelling agents. In this project, non-nutritive sweeteners such as stevia, sorbitol, or xylitol were incorporated to replace sucrose, while pectinor gelatin served as the primary gelling components. Additional functional ingredients such as Gokhru (Tribulus terrestris) extract were evaluated for potential antidiabetic and antioxidant benefits.

The formulated jelly batches were assessed for key physicochemical parameters, including pH, moisture content, gel strength, spreadability, syneresis, viscosity, and organoleptic properties. Stability studies were conducted under accelerated conditions to determine shelf life. Results indicated that the optimized formulation exhibited desirable jelly characteristics, acceptable sensory attributes, and maintained stability without phase separation. The incorporation of natural sweeteners and herbal extract demonstrated good compatibility and provided a healthier alternative for diabetic patients.

Keywords: Tribulus terrestris, Gokhru, antidiabetic, Jelly, alpha-glucosidase Steroidal saponins.

I. INTRODUCTION

Diabetes mellitus is one of the most prevalent metabolic disorders worldwide, characterized by chronic hyper glycemia resulting from defects in insulin secretion, insulin action, or both. Dietary management plays a crucial role in controlling blood glucose levels and preventing long-term complications in diabetic patients. As a result, the reisan increasing demand for food products that are not only nutritious but also safe for diabetic consumption, with reduced sugar content and a low glycemic index.

Edible jelly is a widely consumed confectionery product valued for its palatability, texture, and ease of formulation. Conventional jellies, however, contain high amounts of sucrose, making them unsuitable for diabetic individuals. Therefore, developing diabetic-friendly jelly formulations involves replacing sucrose with safe alternative sweeteners and incorporating functional ingredients that may provide additional health benefits, including antioxidant or antidiabetic properties.

Formulation of diabetic jelly requires careful selection of gelling agents (such as pectin, agar, or gelatin), non-nutritive sweeteners (like stevia, sucralose, or sugar alcohols), and natural extracts with therapeutic potential. This process ensures the product maintains desirable physicochemical characteristics including gel strength, texture, pH, flavor, and shelf stability. Characterization studies—such as organoleptic evaluation, viscosity measurement, moisture content analysis, pH, syneresis, and microbial load—are essential to ensure the formulated jelly meets quality, safety, and stability standards.

Additionally, the incorporation of medicinal plants with antidiabetic potential, such as Gokhru (Tribulus terrestris), offers added value by enhancing the functional properties of the jelly. Such herbal-based formulations may contribute to better glycemic control and promote overall health in diabetic populations.

Thus, the formulation and characterization of an edible jelly for diabetic patients aim to provide a health-oriented, palatable, and nutritionally acceptable alternative to conventional sugary jellies. This project seeks to optimize the jelly formulation, evaluate its

physicochemical properties, and ensure its suitability as dietary supplement for individuals with diabetes.

II. LITERATURE REVIEW

1. Sharma, H., &Agrawal,R. et al(2014): the demand for low-calorie, sugar-free foods driven by health awareness and the negative impacts of sugar. It discusses the health risks of high sugar intake, the interest in non-cariogenic alternatives, and explores natural sweeteners like Stevia for their health benefits and functional properties in food formulation.

2. Sanderson, G.R. et al (1988): "Gums and their use in food systems," various polysaccharides, commonly known as gums, play a crucial role as ingredients and additives within the food industry due to their functional properties. More details are available in the Food Technology journal.

3. Patel, J.,& Patel,N. et al (2016): The literature review by Patel and Patel (2016) explores natural sweeteners as safer and healthier alternatives to sugar and artificial sweeteners, which are linked to health issues such as obesity and diabetes. The paper indicates that non- saccharide natural sweeteners are low in calories, non-toxic, and significantly sweeter than sugar. You can read the review in the Journal of Pharmacognosy and Phytochemistry.

4. Kumar, S., & Mittal,A. et al (2020):According to a literature review by Kumar and Mittal (2020), herbal plants are presented as promising, cost-effective complementary options for diabetes management, potentially having fewer side effects than conventional drugs. For more details, consult the original article by Kumar and Mittal.

5. Myers, N.W. et al (1982): Myers's 1982 article in the Journal of Chemical Education likely details the fundamental concepts and benefits of employing a rotary evaporator in an academic laboratory environment. The text aims to instruct teachers and learners on the proper and secure methods for operating the equipment for solvent extraction. You can find more information about this publication in the Journal of Chemical Education.

6. Harborne, J. B. et al (1998): J.B. Harborne's Phytochemical Methods (1998, 3rd Ed.) is a foundational practical guide for plant analysis, detailing techniques to isolate and identify plant compounds (phenolics, terpenoids, sugars, lipids, nitrogen compounds) using modern methods like HPLC, NMR, and GC/MS, covering everything from extraction to structural elucidation, essential for researchers in plant science, pharmacology, and ecology for discovering new drugs and understanding plant biochemistry.

7. Nussinovitch, A. et al (2009): Amos Nussinovitch's book, Plant Gum Exudates of the World, provides a detailed reference by systematically categorizing plant gum exudates based on their botanical taxonomy. The literature review within the book covers the sources, distribution, properties, and various applications of these natural polymers, particularly as hydrocolloids in food and other industries.

III.AIM

To formulate and evaluate an edible jelly suitable for diabetic patients using low- glycemic sweeteners and medicinal plant ingredients, ensuring acceptable taste, stability, and therapeutic potential.

3.1 Objectives:

1) To select suitable ingredients

Identify low-calorie and low-glycemic sweeteners (e.g.stevia,sucralose,sorbitol).

Choose gelling agents(pectin/agar/gelatin) and therapeutic plant extracts (e.g.,Tribulus terrestris / Gokhru if used).

2) To develop a safe and palatable jelly formulation

Optimize the concentration of sweetener, gelling agent, flavoring, and plant extract. Ensure the jelly has desirable texture, appearance, and mouth feel.

3) To perform physicochemical evaluation of the formulated jelly pH, viscosity, spreadability, moisture content, syneresis, and gel strength.

4) To evaluate the nutritional and stability profile

Caloric value, sugar content, and compatibility of ingredients. Conduct short- term or accelerated stability studies.

5) To assess the anti-diabetic potential (if included)

Evaluate in-vitro antioxidant activity or α-amylase/α-glucosidase inhibition (optional, based on project scope).

6) To compare the developed jelly with marketed

sugar-free jellies Assess differences in texture, acceptability, and overall quality.

IV. MATERIALS AND THEIR SOURCES:

5.1 Materials

As this is are view-based project, the materials listed are those commonly reported in research studies related to diabetic-friendly jelly formulations.

❖ Raw Materials Used in Jelly Formulation

❖ Gelling Agents
- Pectin (High-methoxyl or low-methoxyl depending on sugar level)
- Agar-agar
- Carrageenan
- Gelatin (optional, depending on product type)

❖ Sweeteners (Low-Calorie/Non-Nutritive/Suitable for Diabetics)
- Stevia (Stevioside or RebaudiosideA)
- Sucralose
- Acesulfame-K
- Sorbitol or xylitol (limited used ueto laxative effect)

❖ Fruit Base
- Fresh fruit pulps/Juices (e.g.,lemon, orange, strawberry, apple)
- Herbal extracts for antidiabetic benefits (example: Tribulusterrestris–Gokhru extract)

❖ Acidulants
- Citric acid
- Ascorbic acid(also works as antioxidant)

❖ Preservatives
- Potassium sorbate
- Sodium benzoate (used minimally)

❖ Colorants & Flavoring Agents
- Natural colors (beet root extract, turmeric, chlorophyll)
- Fruit essences(optional)

❖ Chemicals for Characterization
- Distilled water
- Buffer solutions
- Reagents for pH, viscosity, and microbial evaluation.

4.2 Gokharu

Biological Source-
Pedalium murex (P. muno) Linn (Family: Pedaliaceae) is annual herb, which grows abundantly on the sea costs in South India, Shrilanka, Ceylon, Mexico and tropical Africa. In and around Visakhapatnam the plant is very prolific afler summer rains. The plant has medicinal attributes. Dinatoinglycoside and diosmeting lucuronides are isolated from the leaves of P. murex. An infusion from leaves and stems was reported to be used in the treatment of gonorrhea and dysurea. In the past several flavonoids have been solated from the leaves and flowers.

Family of Gokhru- Pedahaceae Kingdom-Plantae. Plant Phylum/Division:-Magnoliophyta, Class-Magnoliopsida (Dicotyledonac)
Genus Pedalium.

Species-P.MurexL

Botanical plant description-
it is a creeper that is about 2 to 3 feet long having branches spread all over, leaves are in pairs of 5 to 8 and is of irregular stupe. Flowers are small and yellow coloured, Fruits are round and possess 5 to 12 compartments and cacti compartinent contains a seed. The seeds contain aromatic oil. Roots are 4 to 5 inch long, town in colour and bear aysocet aroma.

Fig No.1 Gokharu

Chemical constituents-Fruit: Alkaloids 3.5%-5%, stable oil, aromatic oil, resins
glycosides, carbohydrates, saponin and triterpenoids

Stem: Saponin, Herman, phytosterols, tannins and carbohydrates.

Root: Reducing sugars, phenolic compounds, sapo nin, xanthoproteins, alkaloids, triterpenoids and flavonoids.

Leaves: Flavonoids, alkaloids, steroids, resins, saponin and proteinsmecha

4.3 Mechanism of action-

Saponin used in hyperglycemia which leads to increases ovidative stress which causes damage DNA, protein and lipid. When the saponin lower the glucose level by activation of glycogen synthesis, modulate insulin signalling by action of stimulates secretion of insulin

Which is decreases gluconeogenesis via inhibition the two key enzymes glucose 6 phosphate and fructose 6 bisphosphate and improve glucose activating glucose 6 phosphate dehydrogenase and also upgrades insulin release from beta cells pancreatic islates and promote a new growth of insulin secreting B cells. The ability of saponin to decrease blood glucose level makes saponin an excellent efficient antioxidant in the remediation of diabetes mellitus.

V.MATERIAL USED

Sr. No.	Name of Material	Source
1.	Gokhru	General store
2.	Gelatin	Blossom gelatin
3.	Pectin	Loba Chem
4.	Saccharin	Padmavati distributer
5.	Methanol	Saccosolv Ltd
6.	Ethanol	Ecochem Ltd
7.	Flavours and colours	Gift Sample

JELLY

Oral medicated jellies are palatable solid dosage forms administered in the oral cavity, meant to be dissolved in mouth or pharynx for its localor systemic effect.

Advantages
1. It can be administer casily i.e. anywhere, anytime as it is easy to handle & doesn't require water.

2. Therapeutic action of drug can be terminated by spitting it before complete ingestion of medicated jelly.

3. It can also be used for systemic delivery of drugs, which are prone to metabolism in the gut wall or liver.

4. Moreover the drugs that are liberated & swallowed from medicated jelly, will reach the gastrointestinal tract either in dissolved or suspended form in saliva and hence it will be easily available.

5. Delivery of therapeutic agent to systemic circulation through the oral mucosa can help to overcome the problems related to difference in drug release and retention times.

6. It serves as ideal method of drug delivery for dysphasia patients as it reduces the risk of aspiration.

❖ Extraction of saponin

➤Soxhlet Extraction

The Soxhlet apparatus is the best and highly accurate extraction method mainly for the alcoholic extraction. For the ethanolic/ methanolic extraction soxhlet apparatus is used.8 gm of Gokhru powder is weighed and poured in a soxhlet apparatus and 250 ml ethanol is measured and taken in round bottom flask. The extraction is performed for 6-8 hrs. and the sample is then collected. Depending on the optimized conditions the extracted sample is then collected and stored in air tight container.

Fig.no.2 Soxhlel Extraction

Evaporation of solvent-

➤Rota evaporator-

Evaporation of solvent from extract was done by using rotary evaporator. Temperature was kept lower than the boiling point of ethanol (78.37°c). After complete evaporation of the solvent the concentrated extract was collected and further evaluation of extract was done.

Fig.no.3 Rota evaporator

FORMULATION PREPARATION			
Sr.no	Ingredient	Quantity	Uses
1.	Drug (Saponin)	500mg	Antidiabetic activity
2.	Gelatin	5gm	Gelling agent
3.	Peptin	2.5gm	Gelling agent
4.	Methyl paraffin(MLF)	0.01gm	Preservatives
5.	Citric acid	0.5gm	Flavoring agent preservatives
6.	Propylene glycol	0.1gm	Maintain moisture
7.	Stavia leaf	0.3gm	As sweetening agent
8.	Colour	Q.S.	Colouring agent
9.	Essence	Q.S.	Fragrance
10.	Water	Upto50ml	

Procedure:-
All the required ingredients of the formulation were weighed accurately.

1step-Dry gelatine powder and pectin were dispersed in 50 ml of distilled water maintained at 95°C.

The dispersion was stirred at 95°C for 20 min using a magnetic stirrer.to facilitate hydration of gelatine.

2 step-extract was added with stirring. Then remaining ingredients were added and stirred properly for homogenous mixture

3 step-Finally, required amount of sodium citrate and sodium citrate was dissolved in 10 ml of distilled water and added to the mixture.

4thstep-At last flavor was added. The weight of the gel was monitored continuously during manufacturing and finally it was adjusted to the 50 ml with distilled water.

5thstep-The jelly was packed in polyethylene mould with airtight seal. The mixture was allowed to cool up to room temperature to form jelly.

Evaluation test for saponin-
5.0 ml of distilled water was mixed with aqueous crude plant (extract of Gokhru) in a test tube and it was mixed vigorously

Evaluation of formulation of jelly Organoleptic properties-
In this test we observed colour, odour, texture & taste for the good appearance and for complies the patient.

pH of the soft jelly
The pH of the jelly solution before the moulding was determine using Electro quip Digital pH meter at room temperature.

Drug content-
Take10 jellies from jelly mould in a beaker and there average weight was determined. They were breaked into gel consistency. Then gel equivalent 250 mg of extract was taken in 100 ml. volumetric flask and dissolved in 70 ml of methanol with vigorous shaking for 5-10 min.
Finally the volume was made up to the mark with methanol. Finally it was analyzed by UV after proper dilution and filtration.

In vitro drug release-
In vitro drug release studies was carried out using USP dissolution apparatus 2 using paddle at a speed of 50 rpm using 900 ml of 0.IN HCI as dissolution media containing 0.1% sodium lauryl sulphate at 37±2°C.The ready to use soft jelly (3.5 gm) containing 25 mg of extract was used in the dissolution test. 5 ml of sample was withdrawn at the interval of every 5 min and the drug solution was replaced with the same volume of 0.1NHCI (pH1.2) maintained at 37±2°C. 1mlofthe filtered sample was diluted upto50 ml with methanol and absorbance was measured at 253 nm using UV spectroscopy.

VI.Result and Discussion

calibration curve

In the calibration curve the highest absorbance Amax 253mm can be found.

Test for saponin

The foam appearance showed the presence of saponin

Organoleptic properties

Colour green

Odour-Guava flavoured Taste-Sweet and sour
Texture-Glossy and Plain Surface

pH-
The pH of the jelly preparation in the form of solution just before gelation is adjusted preferably to 4.0 or more upto 7.0. This is because when pH is below 4 jelly preparation hable to cause syneresis and stability of the preparation deteriorates in some cases. When the pH is 6 or more (close to neutrality), the jelly preparation is far more excellent in stability. Therefore, the pH of the formulated gel a were adjusted and maintained in between 4 and 7 with the help of buffering agents such as citric acid.

Fig.no.4 ph meter

Drug content

The drug content of prepared jelly was in between20.5±1.0 per jelly for which is well within acceptable limits.

Dissolution test

The results shown that jelly exhibited acceptable consistency and viscosity. Thus, it was subjected to dissolution study to draw any conclusion and their percentage drug releaseat different time intervals has been shown in Fig, it was observed that after 2 hrs. it 91.29% drug release.

VII.CONCLUSION

The outcomes demonstrate that a therapeutic, low-glycemic, stable, and sensory-acceptable edible jelly can be successfully formulated and characterized for diabetic individuals. The addition of plant extracts like Gokhru further enhances the health benefits, making it a promising functional food product.

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