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Development Characterization Polyherbal Antidiabetic Liquisolid Tablet for Treatment of Type II Diabetes Mellitus

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Abstract:
The Liqui solid technique is an innovative and effective method for enhancing the solubility of poorly water-soluble drugs. Since bioavailability is highly dependent on a drug's solubility, improving this characteristic is a major focus in pharmaceutical development. With the growing complexity of modern drug formulations, low solubility remains a significant challenge for the industry, particularly in enhancing oral bioavailability. The Liqui solid or "powdered solution" technology offers a promising solution by converting water-insoluble drugs into fast-release solid dosage forms. This method is not only efficient and economical but also practical for large-scale industrial production. Additionally, it supports controlled drug delivery applications. Due to its reliability, cost-effectiveness, and adaptability, the Liqui solid technique stands out as a highly beneficial strategy for improving drug solubility and therapeutic performance.

The present study aimed to develop a polyherbal tablet formulation for the effective management of diabetes mellitus. Tablets were prepared using various herbal extracts combined with different disintegrant .The pre-compression parameters of all formulations were found to be within acceptable pharmacopoeial limits. Stability testing of 5 batches make confirmed its consistent performance, demonstrating favorable disintegration time and acceptable friability. These findings suggest that formulation is a stable and effective polyherbal tablet suitable for the treatment of diabetes mellitus.

I. Introduction:

Liquisolid tablets represent an advanced drug delivery system designed to enhance the solubility and dissolution rate of poorly water-soluble drugs[1]. his technology involves converting a liquid drug or drug solution into a free-flowing, non-adherent powder by incorporating it into a carrier material (such as microcrystalline cellulose) and coating material (such as silica)[2]. The resulting liquid solid formulation improves drug absorption and bioavailability, thereby enhancing therapeutic outcomes in T2DM treatment[3].

Recent studies have explored the application of liquisolid technology in formulating antidiabetic drugs like metformin and pioglitazone[4]. These formulations have shown promising results in improving drug release, reducing dosage frequency, and enhancing patient compliance[5]. By overcoming solubility challenges, liquid solid tablets could offer a more effective and reliable oral drug delivery system for managing T2DM[6].

essential determinant of a drug's remedial viability is bioavailability, and therefore relies on the solvency of the drug in the gastrointestinal fluid[7]. Dissolvability is one of the essential limits for achieving the ideal centralization of medicine for pharmacological reaction in basic dissemination[8]. Inadequately water dissolvable medications will be characteristically delivered at a moderate rate inferable from their restricted dissolvability inside the GI substance[9].The disintegration rate is regularly the rate deciding advance in the medication dissimilation. The test for inadequately water solvent medications is to improve the pace of disintegration. This thusly along these lines improves assimilation and bioavailability[10].

Different methods are employed to improve the dissolution characteristics of poorly water-soluble drugs, which include,
(a) solubilization in surfactants
(b) pH adjustment
(c) co-solvents
(d) micro emulsion
(e) self-emulsification
(f) polymeric modification

(g) drug complexation
(h) particle size reduction
(I) the pro-drug approach and
(j) solid solutions[11].

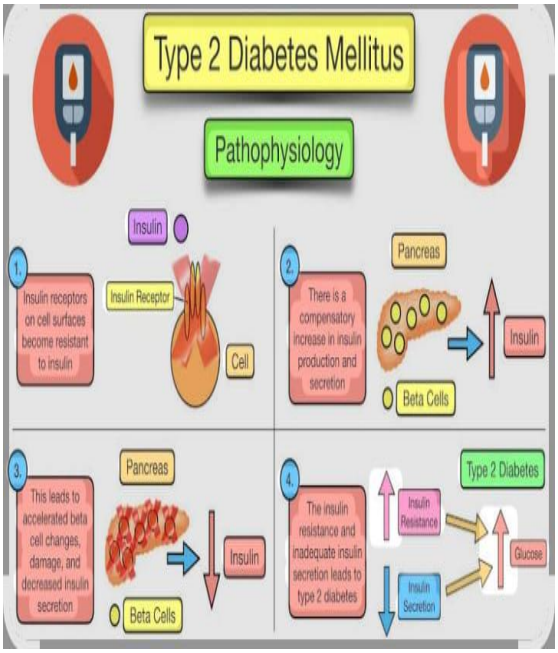


Fig : pathophysiology of Diabetic mellitus

The distinction between Type I and Type II diabetes was first recognized in 1936. Later, in 1988, metabolic syndrome was identified as being closely associated with Type II diabetes.

Type II diabetes significantly increases the risk of developing a range of health complications, many of which can lead to premature death. This is especially concerning in developing

T2DM is a multisystem disease, often associated with cardiovascular complications. It can affect both small and large blood vessels, increasing the risk of conditions such as peripheral vascular disease (PVD), heart attacks, and strokes. In fact, diabetes can double or even quadruple the risk of heart disease and stroke-related deaths due to its links with inflammation, oxidative stress, and hypertension.

Maintaining a healthy diet is essential for heart health. Type II diabetes is also linked to atherosclerosis, macrophage accumulation, and impaired vascular function, all of which raise the risk of atherosclerotic cardiovascular disease (ASCVD). Managing blood pressure, taking statins, exercising regularly, and quitting smoking can help lower these risks.

In the U.S., individuals with Type II diabetes have approximately a 15% higher risk of premature death, though this can vary. Diabetic retinopathy, which affects vision, impacts around 44% of adults with diabetes, while end-stage renal disease occurs in about 1% of cases. Current treatments, including pharmacotherapy, play a crucial role in managing the disease and its complications.

Controlling blood sugar levels and lowering low-density lipoprotein (LDL) cholesterol can significantly reduce the risk of disease-related deaths. Effective management of vascular complications, including the use of salicylates for additional protection, can be beneficial. Furthermore, various antihypertensive medications and timely interventions for blood pressure control play a crucial role in improving patient outcomes.

INTRODUCTION OF LIQUISOLID TABLET:

1. Background and Importance of Liqui solid Technology
Oral drug delivery is widely regarded as the most convenient and preferred route for medication due to its simplicity, safety, and patient compliance[12].However, a significant challenge in this method arises from the poor water solubility of many new pharmaceutical compounds[13].According to the Biopharmaceutical Classification System (BCS), a large proportion of drugs belong to Class II, characterized by low solubility but high permeability. For such drugs, dissolution is the limiting step in their absorption process[4].

To enhance the solubility and dissolution rate of poorly soluble drugs, various formulation techniques have been explored—these include solid dispersions, micro ionization, lipid-based carriers, and inclusion complexes with cyclodextrins[15]. Among these methods, liquid solid technology stands out as a simple, efficient, and cost-effective technique for improving drug solubility and bioavailability[16].

Liquisolid systems are an innovative approach in which a liquid drug—or a drug solution/suspension in a non-volatile solvent—is transformed into a dry, flowable, and compressible powder. This powder can then be used to manufacture tablets or filled into capsules[17].

In this process, the drug is first dissolved or suspended in a hydrophilic liquid vehicle, such as polyethylene glycol (PEG), propylene glycol, or glycerin[18]. This liquid medication is then absorbed onto carrier materials and coated with fine excipients to maintain its flow and compressibility[19]. As a result, the drug remains in a solubilized or

molecularly dispersed state, improving its dissolution and absorption[20].

2. Key Components of Liqui solid Formulations

Liquisolid tablets are composed of several essential components:

Liquid Medication: The active pharmaceutical ingredient (API) is dissolved or suspended in a suitable non-volatile solvent to form the liquid phase of the formulation.

Carrier Materials: These are porous powders—such as microcrystalline cellulose, lactose, or starch—that absorb the liquid and form the bulk of the powder mixture.

Additional Excipients: Disintegrants and lubricants are included to assist in tablet formation and disintegration, much like in conventional tablet formulations.

4. Mechanism and Benefits of Liqui solid Systems

The principle behind liquid solid systems is centered on improving the dissolution rate of the drug. By dissolving the drug in a non-volatile solvent, its surface area for dissolution increases significantly compared to its crystalline form.

This leads to a faster and more complete dissolution of the drug in the gastrointestinal tract.

Significantly improved bioavailability for poorly soluble drugs.

A simplified manufacturing process using standard mixing and compression equipment.

The elimination of complex processing methods like micro ionization or nanotechnology.

Additionally, the technology can be adapted for sustained or controlled drug release by using suitable excipients or polymer matrices.

5. Applications of Liqui solid Technology

Liquisolid systems offer diverse applications in pharmaceutical development:

Enhancing the oral bioavailability of drugs from BCS Class II and IV.

Facilitating the formulation of lipophilic drugs into solid oral dosage forms.

Providing effective taste masking for bitter drugs.

Enabling the development of modified-release formulations, depending on the formulation strategy.

Several drugs, such as carbamazepine, hydrocortisone, and furosemide, have been successfully formulated using liquisolid systems to overcome their solubility challenges.

6. Limitations and Formulation Challenges

Despite their advantages, liquisolid systems have certain limitations:

Low drug loading capacity may require large amounts of excipients, which can increase tablet size.

Some formulations may be sensitive to moisture, affecting stability.

Improper optimization of excipient ratios can lead to poor flow properties and reduced compressibility.

For drugs classified under BCS Class II, low solubility and slow dissolution in the gastrointestinal tract often limit their bioavailability. To address this, several formulation techniques have been developed. One of the most commonly used methods is micro ionization, which increases the surface area of the drug particles. However, micronized hydrophobic drugs often tend to aggregate, reducing the effectiveness of this method, especially when incorporated into tablets or capsules.

Liquisolid formulations enable rapid drug release, making them particularly useful for water-insoluble solid drugs, lipophilic liquid drugs, or solid drugs dissolved in non-volatile solvents. These liquid medications are converted into dry, free-flowing, non-sticky powders that are suitable for tablet compression. Because the drug exists in a solubilized or molecularly dispersed form, the system enhances wetting and provides a greater surface area for dissolution. As a result, Liqui solid tablets significantly improve the dissolution rate and bioavailability of poorly water-soluble drugs.

Based on the formulation technique used, Liqui solid systems may be classified into two categories:

1. Liqui solid compacts
2. Liqui solid microsystems.

The liquisolid technique is an innovative method used to enhance the dissolution rate of poorly water-soluble drugs. Also referred to as "powdered solution technology," it enables the conversion of such drugs into fast-releasing solid dosage forms. In this process, a liquid drug, solution, or suspension is combined with specific carrier and coating materials through simple physical mixing to create a dry, free-flowing, and easily compressible powder. The drug is first dissolved or suspended in a non-volatile liquid, then absorbed into a porous carrier. A liquid layer forms on the carrier particles, which is quickly adsorbed by a fine, highly adsorptive silica-based coating material. This coating not only ensures uniform surface coverage but also preserves the flowability of the final powder blend.

Liquisolid technology has gained widespread attention because of its simplicity and cost-efficiency. It is especially beneficial for enhancing the dissolution of poorly water-soluble drugs and enables the development of solid dosage forms from liquid medications.

Earlier liquid-based self-emulsifying drug delivery systems (S-EDDS) had several limitations, such as poor stability, low drug loading capacity, limited administration options, and a tendency for the drug or excipients to precipitate, which could not be reversed. To address these issues, solid-state S-EDDS were introduced. These solid formulations offer enhanced stability, improved patient compliance, better handling and transport, and increased drug effectiveness after oral administration.

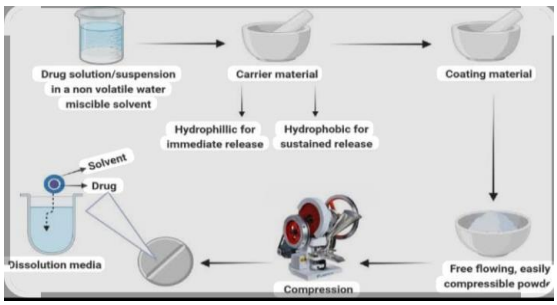


Fig : liqui solid tablets formulation

Lipid-based liquid formulations, such as self-emulsifying drug delivery systems (S-EDDS), are composed of oils, surfactants (both hydrophilic and lipophilic), and co-surfactants. These ingredients work synergistically to dissolve drugs effectively and streamline the formulation process. S-EDDS offer several benefits, including enhanced drug solubility, better intestinal absorption, and reduced variability in drug uptake related to food intake, particularly for lipophilic drugs. As a result, they greatly improve the oral bioavailability and overall therapeutic performance of these medications.

SEDDS operate by forming fine oil-in-water emulsions or microemulsions when exposed to gastrointestinal fluids. This leads to the generation of tiny droplets, increasing the surface area of the drug and promoting faster dissolution and absorption. Moreover, these systems help shield the drug from enzymatic breakdown and reduce first-pass liver metabolism by enhancing absorption through the lymphatic system.

II. Literature Review

1.Suryawanshi S. S. et al. (2022) developed liquisolid tablets of glibenclamide, a poorly water-soluble antidiabetic agent, to improve its solubility and bioavailability. The formulation utilized polyethylene glycol 400 as the solvent, with Avicel PH 102 and Aerosil 200 serving as the carrier and coating materials, respectively. A central composite design guided the optimization process, resulting in significantly enhanced dissolution rates. Analytical techniques such as FTIR and DSC confirmed no chemical interactions between the drug and excipients.

2.Fahmy R. H. et al. (2020) formulated a liquisolid compact system for pioglitazone hydrochloride to address its limited solubility in water. Transcutol HP was used as the non-volatile solvent, while microcrystalline cellulose and silica acted as the carrier and coating agents. The optimized formulation exhibited a 2.5-fold improvement in dissolution compared to the pure drug and physical mixtures, demonstrating the effectiveness of the liquisolid technique for enhancing pioglitazone delivery.

3.Sharma D. et al. (2019) utilized the liquisolid technique to improve the release profile of metformin hydrochloride and reduce its gastrointestinal side effects. Although metformin is highly soluble, the liqui solid approach allowed better dispersion and facilitated potential modified-release characteristics. Polyethylene glycol 400 was used as the solvent, and a factorial design evaluated the impact of excipient ratios on flowability and compressibility.

4.Ahmed M. O. et al. (2018) designed a liquisolid formulation of repaglinide, a fast-acting antidiabetic drug, to enhance its dissolution and bioavailability. Capryol 90 was chosen as the non-volatile solvent. The optimized tablets demonstrated improved release characteristics and remained stable over a three-month period, indicating their effectiveness in controlling post-meal blood glucose levels.

5.Patel M. R. et al. (2017) improved the solubility of rosiglitazone maleate using a liquidsolid system with Tween 80 as the solvent. The formulation significantly enhanced the dissolution rate—over three times greater than that of conventional tablets—showcasing the efficiency of liquisolid technology in optimizing drug release.

6.Kaur G. et al. (2016) formulated liquisolid tablets containing sitagliptin phosphate to enable faster drug release. The use of PEG 400 and microcrystalline cellulose resulted in rapid in vitro dissolution within 15 minutes, suggesting the formulation could offer a quicker onset of action for better glycemic control.

7.Pandya K. et al. (2015) applied a design of experiments (DoE) methodology to develop liquisolid tablets of gliclazide, a drug with limited solubility. The optimized formulation showed enhanced dissolution, uniform drug content, and strong mechanical properties, reinforcing the applicability of liquisolid systems for improving antidiabetic drug performance.

Excipient profile

1. Black Seed Oil :

Biological source: Black seed oil is an herbal ingredient derived from the tiny black seeds of a flowering plant called Nigella sativa (N. sativa)

Family: Buttercupus

Constituents

1. volatile oil (0.4-0.45 %)
2. thymohydroquinone (THQ)
3. dithymoquinone
   carvacrol
6. α and β-pinene
7. d-limonene
8. d-citronellol

Uses : Research suggests that black seed oil may help in Diabetes Mellitus

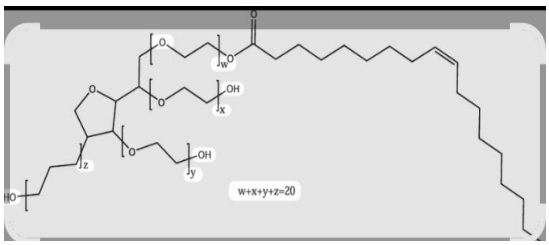
2. Tween 80

Synonyms: Polysorbate 80 (polyoxyethylene-80-sorbitan monooleate

Molecular weight: 1,310 g/mol

IUPAC name : Polyoxyethylene (20) sorbitan monooleate

Molecular formula :C64H124O26



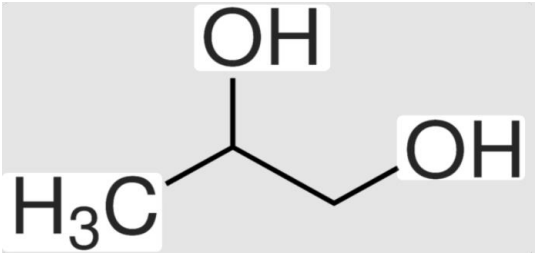
3. Propylene glycol1) Synonyms: 1,2-dihydroxypropane, 1,2-propanediol, methyl glycol, and trimethyl glycol.

2) IUPAC Name : Propane-1,2-diol

3) Molecular Formula : C3H8O2

4) Molecular Weight : 76.1 g/mol

5) Chemical structure:



6. Talc

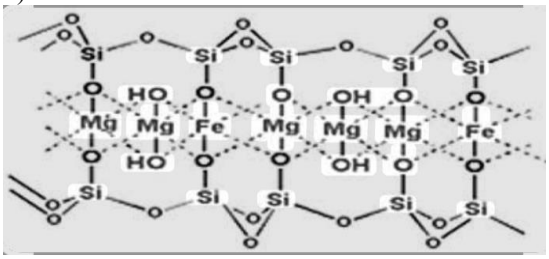
1)Synonyms : Talc, Talcum powder, Atlac

2) IUPAC Name: tris(oxomagnesium) tetrakis(silanedione) hydrate

3) Mol.W. : 379.27 g/mol

4) Molecular formula: Mg3Si4O10(OH)2

5) Chemical structure:



7. Magnesium stearate

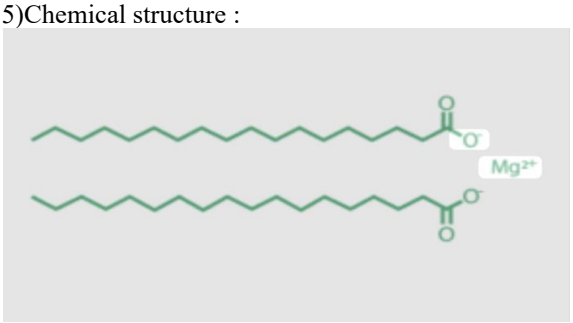
1) IUPAC Name : Magnesium octadecanoate

2) Mol. Formula:Mg(C18H35O2)2

3) Mol. W. : 591.34 g/mol

4) Odour : slight

5)Chemical structure :



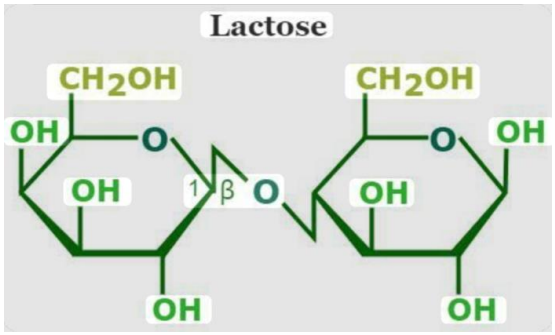
5. Lactose

1) IUPAC Name : β-D-Galactopyranosyl-(1→4)-D-glucose

2) Mol. Formula : C12H22O11

3) Mol. Weight : 342.3 g/mol

4) Chemical structure:



6) Micro crystalline cellulose
Synonym: Cellulose gel
Chemical names: Cellulose
Chemical formula (C6H10O5)n
Assay : Not less than 97% of carbohydrate calculated as cellulose on the dried basis
Chemical structure :

III. Material And Methods

Extraction and Preparation of Polyherbal Extract :Soxhlet extraction:
The Soxhlet extractor, created in 1879 by German agricultural chemist Franz von Soxhlet, was originally designed to extract fats from substances like milk and plant material. Before its invention, extracting compounds from solids involved labor-intensive methods such as repeated soaking and filtration. The Soxhlet apparatus introduced a more efficient, automated process that reused and condensed solvents, greatly improving the extraction technique used in fields like analytical chemistry and food science.

Principle of Soxhlet Extraction:
Soxhlet extraction is based on the concept of continuous washing or percolation. A solvent repeatedly passes through the solid sample, dissolving the target compound. After several cycles, the extract accumulates in a flask, while the undissolved material remains behind.
Soxhlet Extraction Procedure:
Materials Needed:
Soxhlet extractor
Condenser
Round-bottom flask
Heating mantle or water/oil bath
Solvent (e.g., ethanol, hexane)
Solid sample (e.g., plant material)
Thimble (typically cellulose)
Boiling chips

Procedure:
1. Sample Preparation:
Dry and grind the solid sample to increase the surface area for extraction.
Place the sample into a cellulose thimble.

2. Assembly of Apparatus:
Place the thimble into the Soxhlet extractor body.
Attach the Soxhlet extractor to the round-bottom flask containing the solvent.
Connect a condenser to the top of the extractor.
Add boiling chips to the flask to ensure smooth boiling.

3. Extraction Process:
Heat the solvent in the round-bottom flask.
The solvent vaporizes, rises through the extractor tube, and condenses in the condenser.
The condensed solvent drips into the thimble containing the sample.
Once the extractor fills to the siphon point, the solvent containing dissolved compounds is siphoned back into the boiling flask.
This cycle repeats multiple times (usually 6–24 hours).

4. Post-Extraction:
After sufficient extraction, stop heating and allow the apparatus to cool.
Remove the solvent (now containing extracted compounds) from the flask.
Evaporate the solvent to isolate the extract, typically using a rotary evaporator.

5. Cleanup:
Disassemble and clean all glassware properly for future use.

Phytochemical Screening of Better melon and cinnamon powder :

1) Molish test:
When a extract is treated with Molisch reagent (a solution of α-naphthol in ethanol) and then with concentrated sulfuric acid, a purple or violet ring forms at the interface of the two layers carbohydrates is present

2) test for tannin
Give the extract few drops of 10 % ferric chloride solution.apperance green to blue colour indicates that tannin is present

3) test for terpenoids (salkowashi test)
5 ml extract were mixed with 2 ml chloroform and 3 ml conc H2SO4 solution . A reddish brown colour indicates the presence of terpenoids

4) test for steroids
Leaf extract where mixed with 1 ml of chloroform and 2-3 drops Conc H2SO4 were added.appearances pink to red colour indicates the steroids

5) test for alkaloids (Mayers test)
Extract is treated with Mayers reagents (potassium mercuric chloride) formation of yellow colour precipitate indicate that the presence of alkaloids

6) test for flavonoids
Extract is treated with conc H2SO4 solution and formation of yellowish orange colour
Indicates tthe presence of flavonoids

7) Killer Killani Test (Keller-Kiliani Test)
Add 2 mL of plant extract Add 1 mL of glacial acetic acid containing a trace amount of ferric chloride ($FeCl_3$).Carefully add 1 mL of concentrated sulfuric acid (H_2SO_4) down the side of the test tube.A blue-green color appears in the acetic acid layer.and a reddish-brown ring appears **at** the interface between the acid layers.

8) test for saponin (foam test)
2 ml Extract were diluted with 20 ml distilled water and observe the stable persistent foam

9) test for amino acid (Ninhydrin test)
2 drops of Ninhydrin solution (10 ml Ninhydrin with 200 ml acetone) where added a 2 ml aqueous filtrate. A purple colour indicates the presence of amino acid

10) test for phenolic compound
2 ml diluted extract where treated with dil Fecl3 solution. Apperance of the violet colour indicates the presence of phenolic compound

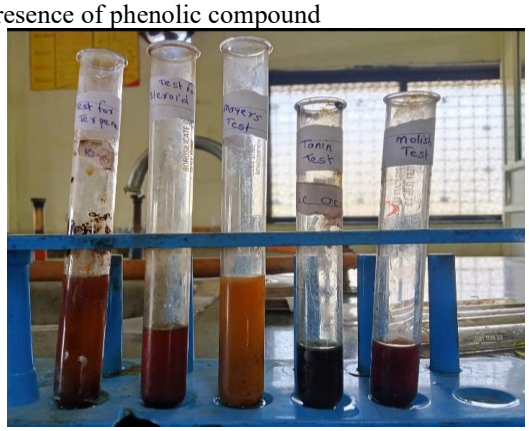


Fig: phytochemical screening of better melon and cinnamon powder

Fig : phytochemical screening of better melon and cinnamon powder

Evaluation of powder
Tap density
Tap density (or tapped density) refers to the bulk density of a powder after it has been compacted or "tapped" down, typically by mechanical vibration or tapping. It's a measure of how tightly the particles can pack together and is expressed in units like g/cm^3 or kg/m^3.

Formula:
Tapped Density = Mass of powder ÷ Tapped Volume of Powder
= 22.87 ÷ 38
= 0.60 g/cm^3

Bulk density:
Bulk density is the mass of a powder divided by the volume it occupies, including the space between particles (voids). It reflects how loosely or densely a material is packed under minimal compaction.

Formula:
Bulk Density = Mass of powder ÷ Bulk Volume of powder
= 22.87 ÷ 55
= 0.41 g/cm^3

Angle of Repose :
Angle of repose is the steepest angle at which a pile of unconsolidated granular material (like sand or powder) remains stable without sliding.

Formula:
$\theta = \tan^{-1} h/r$
$= 25\text{-}^{1}\ 5.5/26.7$
$= \tan^{-1}\ 0.20$
=25.8

Indicates flowability of powders:
< 30° = good flow
30–40°= acceptable flow
> 40° = poor flow

Angle of repose	Nature of flow
< 25	Excellent
25 to 25	Good
30 to 40	Passable
>40	Very poor

Characterization of Liquisolid Tablet :
Evaluation of Tablets
All the formulated tablets were subjected to following evaluation parameters:

1.Color and Appearance

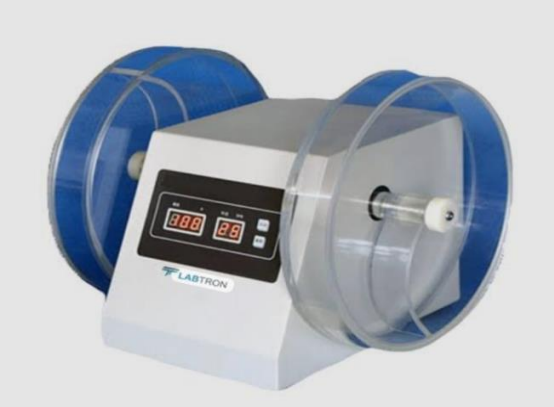
The compressed tablets were examined for their color and appearance.

2. Tablet Hardness

Tablet hardness refers to the force required to break a tablet by compression. It is evaluated using devices like the Monsanto or Pfizer hardness testers. A typical acceptable range is between 4 to 10 kg/cm², depending on the formulation. Adequate hardness ensures that tablets can endure handling during production and distribution while still being able to dissolve efficiently in the body.

3. Friability Test

Friability measures a tablet's resistance to abrasion and breakage. This test involves rotating the tablets in a friabilator, usually for 4 minutes at 100 rotations, and checking for weight loss. Tablets should not lose more than 1% of their original weight. This test ensures the tablets remain intact during packaging, transportation, and use.



4. Content Uniformity

Content uniformity ensures that each tablet contains a consistent amount of the active pharmaceutical ingredient (API). This is verified by analyzing individual tablets using methods such as HPLC or UV spectroscopy. The content of each tablet should typically fall within 85% to 115% of the labeled claim, with minimal variation. This guarantees dosage accuracy and product safety.

5. Disintegration Time test

Disintegration testing determines how quickly a tablet breaks down into smaller particles when exposed to a liquid

6.weight variation

A weight variation test is a critical quality control method used in the pharmaceutical industry to confirm that tablets or capsules within a batch have uniform weight. This ensures each unit delivers a consistent dosage and maintains product integrity.

Procedure for Tablets or Capsules:

1. Selection of Units: A random sample of 20 tablets or capsules is taken from a production batch.
2. Individual Weighing: Each unit in the sample is weighed separately.
3. Average Weight Calculation: The mean weight of all 20 units is determined.
4. Deviation Assessment: The percentage difference between each unit's weight and the average weight is calculated.
5. Compliance Check: The sample is evaluated against pharmacopeial

7.Thickness

The thicknesses of the tablets were evaluated by Vernier calipers

Fig : vernier caliper

Formulation table for liquisolid tablets:

Sr.no	Excipients	Role	Quantity taken
1	Black seed oil	Oil	3 ml
2	Tween 80	Surfactant	3 ml
3	Polyethylene Glycol	Co - surfactant	1 ml
4	Microcrystalline cellulose	disintegrant , absorbent, filler or diluents, lubricant, and anti-adherent.	1.9 gm
5	Lactose	Compressibility	1.9 gm
6	Talc	Glidant	200 mg
7	Magnesium sterate	Lubricants	150 mg
8	Starch	Binder	5 %

IV. Result:

1) Extraction and Preparation of Polyherbal Extract :

In a Soxhlet extraction system, a finely ground sample is placed inside a porous container known as a thimble, usually made of cellulose or sturdy filter paper. This thimble is inserted into the main chamber of the Soxhlet extractor. A suitable solvent, capable of dissolving the target compounds, is poured into a round-bottom flask located beneath the extractor. The solvent is then heated, typically using a heating mantle, to initiate the extraction process.

2) Phytochemical Screening of Polyherbal Powder :

Sr no	Phytochemical test for chemical constituents	Result (Present / absent)
1	Molish test	Present
2	tannin test	Present
3	test for terpenoids (salkowashi test)	Present
4	test for steroids	Absent
5	test for alkaloids (Mayers test)	Present
6	test for flavonoids	Present
7	test for phenolic compound	Present
8	Killer killani test	Absent
9	test for saponin	Present
10	Test for amino acid (Ninhydrin test)	Present

3) Stability :

Each of the four batches of the extract-loaded formulation was stored in sealed containers at ambient conditions for a 24-hour period. Throughout this time, the formulations were visually inspected at hourly intervals to monitor for any signs of phase separation. No phase separation was observed during the entire observation period.

4) Physical Characterization of Powder :

Flow Properties of Powder

1. Bulk Density
2. Tap density
3. Angle of Repose

Sr no .	Bulk density (g/ ml)	Tap density (g/ml)	Angle of Repose (θ)
1	0.41	0.60	25.8

Evaluation parameter

Sr . no	Evaiuation parameter	Range
1	Appearance	Brownish colour, round shape
2	Weight variation (mg)	623.3
3	Thickness(mm)	4.27
4	Friability(g)	0.184
5	Hardness(kg/cm)	5.27

V. Conclusion

The research presented in this thesis highlights the significant potential of liquisolid technology in enhancing the solubility, dissolution rate, and bioavailability of poorly water-soluble drugs, particularly those used in the management of Type 2 Diabetes Mellitus (T2DM). Through a detailed exploration of liquisolid systems and a comprehensive review of existing formulations for antidiabetic agents like metformin, glibenclamide, pioglitazone, and others, it is evident that this approach can substantially improve therapeutic outcomes and patient compliance.

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