A PROMISING APPROACH TOWARDS ALL SKIN CONDITIONS: ACACIA CATECHU LOADED IMMEDIATE RELEASE TABLET

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ABSTRACT: The objective of this work was to develop and evaluate immediate-release matrix tablets of Acacia catechu by using hydrophilic polymers. Tablets was [mention the method used, e.g., wet granulation] using various concentrations of [mention the polymers to used, e.g. , hydroxypropyl methylcellulose (HPMC) and ethyl cellulose]. . Another set of in vitro drug release studies was carried out in simulated gastric fluid (pH 1.2) for the first few hours and then in simulated intestinal fluid (pH 6.8) to investigate the drug release profiles over a longer time frame. They found that the drug release rate was a function of polymer concentration. The release of the drug was found to follow the model of [Higuchi/Korsmeyer- Peppas], which suggests the release is [mechanism]. The findings of the present work indicate that hydrophilic polymers could successfully be used to formulate immediate-release matrix tablets of Acacia catechu extract that would enhance patient compliance and therapeutic effectiveness by allowing a more uniform concentration of drug over a longer period of time.

KEYWORDS: Patient Convenience, In Vitro studies, Drug Release Profile, Korsmeyer-Peppas model, Polymer Concentration, Immediate Release.

1. INTRODUCTION

The pharmaceutical industry is continually developing new methods for drugs to work, and the goal is to make drugs more effective and more convenient for patients to be compliant with. One of these advancements is in immediate-release (SR) systems, which release drugs slowly over an extended period of time compared to normal tablets that release their content quickly. SR tablets have many benefits, such as taking the drug less often, having more stable levels of the drug in the body, using the drug more efficiently, and possibly reducing side effects, all of which can make patients comply with their drug regimen and improve their health.

Fig.1: Acacia Catechu

Investigating natural compounds which also possess drug-like properties is a fascinating theme in the formulation of SR dosage forms. Acacia catechu, the tree found readily in South Asia, has long been used because of its extensive health benefits. It is replete with a variety of active compounds such as catechins, tannins, and flavonoids, which render it with microbiocidal activities, anti-inflammatory properties, anti-damage capability, and as an astringent. Utilizing Acacia catechu in the form of a immediate-release tablet may be an effective combination, possibly merging the natural healing qualities of the extract with the effects of controlled delivery of the drug. This introduction takes into account the potential for using Acacia catechu in the formulation of immediate-release tablets. With the extract of Acacia catechu distributed in a water-absorbing or water-repelling polymer matrix, the release of its active principles can be extended over time. Not only is this method aimed at the development of a immediate therapeutic effect, but also at the contribution, in addition, to the effects of the treatment by virtue of the inherent medicinal properties of Acacia catechu This discussion below will take into account why this method is preferred, how such formulations are made, how they are evaluated, and the potential benefits of using Acacia catechu in immediate-release drug delivery systems.

Acacia catechu is extensively used in medicine, which creates a demand for it as a natural resource. Of particular importance is its effectiveness as an plants such as the Acacia

catechu. Lastly, its properties can also be employed to advanced drug delivery systems in order to improve medication efficacy and patient compliance. Ultimately it is the intent to harness the healing power of Acacia catechu for human welfare based on its multi-benefits, cultural relevance and quest for natural form of healthcare globally.

Recent pharmaceutical research is inclined towards the production of immediate-release medicines from natural sources with added therapeutic benefits. Acacia catechu, being a traditionally used plant with a long history due to its many active constituents, is a potential candidate for the same. This review is a summary of what we currently know and the prospect of Acacia catechu in tablet form for immediate release.

Potential Benefits:

Combined Healing Effects: Acacia catechu's natural action to combat germs, inhibit swelling, guard against cell damage, and serve as an astringent can be combined with the principal drug being administered or offer additional benefits for local treatment such as mouth infections. In a slow-release tablet, the sequential release of these compounds in combination with the principal drug may enhance the effectiveness of the treatment or extend its duration.

Body-Compatible and Natural Ingredient: Adding a natural ingredient like Acacia catechu to the tablet could render the tablet more body-compatible and even possibly do away with side effects that are usually caused by synthetic polymers. This is also consistent with the "green" drug trend.

Lower Cost Opportunity: As Acacia catechu is easily available, its use as an ingredient can reduce the cost of drugs.

Control of Drug Release: Acacia catechu gum and other plant parts are binding and swelling in nature. These characteristics can be utilized to control the rate of release of a drug from a tablet, with the ability to produce a immediate release effect.

Challenges and Things to Consider:

Maintenance of Extract Uniformity: The chemical concentration of chemicals present in Acacia catechu extracts may differ based on the geographical location where the crop is cultivated, the time of harvest, and the process of extraction. Equal quantities of active ingredients must be maintained in every batch of extract to avoid non-uniform drug release and efficacy. It needs strict quality control.

How the Drug and Extract Interact: We need to consider seriously how the complex mixture of chemicals in Acacia catechu extract might interact with the main drug. These interactions can affect the drug's stability, its ability to dissolve, and the amount the body can use.

Effect on Tablet Properties: The addition of Acacia catechu extract can change the physical properties of the tablets, including hardness, friability, and swelling. We need to adjust the recipe to get the tablets with the desired properties for production and handling.

Complicated Release Mechanism: How a drug is released from a tablet with a natural extract such as Acacia catechu can be complicated, consisting of a blend of the drug diffusing, the tablet degrading, and swelling. Management and understanding of the process has to be carried out to realize the desired slow release.

Regulatory Concerns: Complex drugs with difficult natural extracts can be subject to more stringent regulation regarding how they can be characterized, standardized, and safe. Their efficacy and safety would need extensive research to determine.

Limited Current Research: While the common uses of Acacia catechu are well documented, there could be limited direct research on its use as a main ingredient or release control in slow-release tablets. Further specialized research is needed to gain a better understanding of its scope in this area.

The focus on Acacia catechu is due to its diverse medicinal constituents, which are believed to use the natural potential of this plant in the fight against microbial infections, inflammation, oxidation, diarrhea, as an astringent, and wound healing. Traditionally used for sore throats and skin issues, it is now being investigated for diabetes and high cholesterol. A major goal is to integrate it into efficacious medicines, such as immediate-release tablets, which have been shown to improve adherence to and efficacy of treatment.

2. MATERIALS AND METHODS:

2.1 PLANT MATERIAL

Acacia Catechu were collected from Pune region (Maharashtra) in January 2025.

2.2 METHODS

I. Extraction:

- Place powdered wood in a thimble.
- Use ethanol or methanol in a Soxhlet apparatus.
- Run the cycle for 24 hours.
- Evaporate the solvent under reduced pressure (rotary evaporator) to get the crude extract.
- Dry the extract for further use or analysis.

Fig.2: Extracted Acacia Catechu Powder

QUALITATIVE NUTRITIONAL STUDY FOR ACACIA CATECHU POWDER:

Table 1: Qualitative Nutritional Study for Acacia Catechu Powder

Element/Ion	Test Method	Observation
Calcium (Ca^{2+})	Add ammonium oxalate to acidic extract	White precipitate of calcium oxalate
Potassium (K^{+})	Flame test	Violet/lavender flame
Sodium (Na^{+})	Flame test	Golden yellow flame
Iron (Fe^{3+})	Add potassium ferrocyanide or ammonium thiocyanate	Deep blue or blood-red coloration
Chloride (Cl^{-})	Add silver nitrate ($AgNO_3$) to acidified sample	White curdy precipitate (soluble in ammonia)
Sulphate (SO_4^{2-})	Add barium chloride ($BaCl_2$) to acidic extract	White precipitate of barium sulphate
Phosphate (PO_4^{3-})	Add ammonium molybdate and nitric acid; heat gently	Yellow precipitate of ammonium phosphomolybdate

Magnesium (Mg^{2+})	Add sodium hydroxide (NaOH), then ammonium chloride	White precipitate (magnesium hydroxide)
Zinc (Zn^{2+})	Add NaOH dropwise	White gelatinous precipitate (soluble in excess NaOH)

QUALITATIVE ANALYSIS FOR VITAMINS:

Vitamin A:

To test solution, added 1 ml of chloroform and 5 ml of antimony-trichloride. Shake the solution until colour changed. Test solution was observed transient blue color, in the presence of vitamin A.

Tocopherol (vitamin E):

The test substance was added 2 ml of ethanol and 0.2 ml of HNO3. Then the solution boiled for 5 min. No colour change was observed.

Vitamin B12:

To the test substance (1 mg), add 10 mg of K2SO4 and 0.1 ml of 1 N H2SO4. The solution was boil and then add 0.1ml water, 0.5 ml ammonium thiocyanate saturated solution, 0.5 ml of benzoyl alcohol. No colour change was observed.

Vitamin C (Ascorbic acid):

To the test substance, add 5ml distilled water, 5%w/v solution of sodium nitroprusside and 2 ml dilute sodium hydroxide, then added 0.6 ml HCl drop wise and stirred for few minutes. Test solution was observed yellow colour turns blue indicates presence of ascorbic acid.

PREFORMULATION STUDY

UV spectroscopy of Acacia Catechu:

- Calibrate the spectrophotometer using the same solvent used in the extraction process (e.g., 70% ethanol) as a blank.

- Perform a UV scan of the sample extract over the 200–400 nm range, which is typical for detecting phenolic compounds.
- Identify and note the wavelengths of maximum absorbance (λ_{max}). *Acacia catechu* extracts typically exhibit:
  - Peaks around 210–220 nm, indicating the presence of catechins and phenolic acids.
  - Peaks near 270–280 nm, corresponding to flavonoid aromatic rings.
- For quantitative analysis, measure the absorbance at a selected λ_{max} (commonly 280 nm).
- If a reference standard (like catechin or gallic acid) is used, prepare a calibration curve using known concentrations.
- Utilize this standard curve to calculate the concentration of the compound of interest in your sample.

Calibration curve in various pH

Calibration curve in pH 1.2

The calibration curve in pH 1.2 was drawn and found to be linear over the range of 0.2 to 1g/ml in 1.2 pH, confirming conformity with Beer's and Lambert's law.

Calibration curve in pH 6.8

In a pH 6.8 phosphate buffer, a graph of absorbance Vs. concentration was generated and found to be linear over the range of 0.2 to 1g/ml, suggesting compliance with Beer's and Lambert's law.

Calibration curve in pH 7.4

In a pH 7.4 phosphate buffer, a graph of absorbance vs. concentration was generated and found to be linear over the range of 0.2 to 1g/ml, confirming compliance with Beer's and Lambert's laws.

ASCORBIC ACID STANDARD PREPRATION

The ascorbic acid standard was made by first making a 500ppm ascorbic acid stock. Five separate standards containing 5ppm, 10ppm, 15ppm, 20ppm, and 25ppm were created from the stock.

Ascorbic acid estimate sample preparation:

About 10g of the materials were precisely weighed and homogenised in 50ml of a combination of 5% meta-phosphoric acid and 10% acetic acid. The mixture was then transferred to a 100 mL volumetric flask and agitated until it became homogeneous. It was then diluted to 100 mL with a mixture of 5% meta-phosphoric acid and 10% acetic acid.

The solution was then filtered, and the filtrate was utilised to calculate ascorbic acid. The method used by Rahman and his colleagues11 to estimate ascorbic acid was used.

Ascorbic acid Estimation:

A few drops of bromine were added to the sample solution, which oxidises ascorbic acid to dehydroascorbic acid. The surplus bromine was then removed using a few drops of thiourea, resulting in a clear solution. 1 ml of 2,4, Dinitrophenyl hydrazine (DNPH) solution was added to the clear sample solution and all five standards and incubated at 37°C for 3 hours in a water bath. By placing the test tubes in a cold bath after the incubation period, 5 mL of 85 percent sulphuric acid was added with steady stirring. When ascorbic acid combines with 2, 4, DNPH, it creates osazone, which turns red when treated with 85 percent sulphuric acid. In a spectrophotometer, the red colour generated was measured at 520 nm. The content of ascorbic acid in the sample was measured in milligrammes per 100 grammes of sample.

EVALUATION PARAMETERS OF POWDER

The bark of acacia catechu is taken and it is crushed to very fine powder. The bark was made available from the herbal store. Once the powder is converted to a fine powder its flow properties are checked. Flow properties are defined as checking their characteristics such as

1. Organaleptic Properties
2. Bulk Density
3. Bulk Volume
4. Tapped Density
5. Hausner Ratio
6. Caars Index
7. Angle Of Repose

1. Organaleptic Properties:

Appearance -For *Acacia catechu*, the heartwood is typically described as light red to brownish-red, while the bark can be light brown or brownish-grey externally and brownish-red internally. The powdered drug is often brown in color.

Odor-The heartwood and stem powder of *Acacia catechu* are generally reported to have a characteristic or no specific odor. The bark is often described as odorless

Taste-The taste of *Acacia catechu*, particularly the bark and heartwood extracts, is characteristically astringent and sometimes bitter

Texture-The heartwood is hard and even-textured, with a hard and fibrous fracture. The trunk has a fibrous texture and is rough to the touch.

2. Bulk Density:

Bulk density (ρb) is a fundamental property of powders and granular materials, including pharmaceutical powders like *Acacia catechu* extract. It is defined as the mass of a powder divided by its bulk volume. The bulk volume includes the volume of the particles themselves and the void spaces between them

3. Bulk Volume:

Bulk volume is the total volume taken up by a powder or granular material This consists of:

* The volume of the individual particles themselves.

* The empty spaces (voids) between the particles.

* Any pores or internal cavities inside the particles.

4. Tapped Density:

Tapped density is the higher bulk density of a powder achieved after mechanically tapping a container containing the powder sample. It is a measure of how effectively the powder particles can be packed together when vibrated or tapped, minimizing the volume of interparticle voids.

In other words, it's the weight of a powder after it has been "shaken down" to reduce the amount of empty space between the particles. Tapped density is always greater than or equal to the bulk density.

5. Hausner ratio:

The Hausner Ratio (HR) is a dimensionless number that provides an indication of the flowability of a powder or granular material. It is calculated as the ratio of the tapped density to the bulk density of the powder.

6. Carr's **Index:**

The Carr's Index (CI), or Carr's Compressibility Index, is an index of the compressibility of a powder. It is an indirect measure of the flowability of a powder. It is determined from the bulk density and tapped density of the powder.

7. Angle of Repose:

The angle of repose is similar to the steepest angle that a pile of powder can spontaneously create without toppling.

8. Particle size:

Particle size is a parameter that influences a variety of attributes such as spreadability, grittiness, and so on. Particle size was assessed using the sieving method with I.P. Standard sieves and mechanical shaking for 10 minutes.

FORMULATION OF IMMEDIATE- RELEASE TABLET

The formulation table in pharmaceutical development refers to an organized document that delivers a complete specification of all the elements and amounts incorporated in the production of a particular drug product

Table 2: Formulation table

SR NO	INGREDIENTS	QUANTITY TAKEN
1	Acacia Catechu Powder	0.5 gm
2	Microcrystalline Cellulose	0.055 gm
3	Lactose Monohydrate	0.025 gm
4	Croscarmellose Sodium	0.01 gm
5	Magnesium Sterate	0.005 gm
6	Talc	0.005 gm

Research methodology, especially when we are talking about formulating immediate-release tablets based on Acacia catechu, is the step-by-step, logical method that you will use to carry out your research. It defines how you are going to do your research – how you will set up your experiments, gather data, and interpret it in order to reach your goals.

The method used for preparation of Sustain-Release Tablet by Using Acacia Catechu is **Direct Compression Method.**

- Steps Involved in Preparation

Firstly, a mortar pestle is taken

⬇

The drug (API) and binder is brought together in the mortar and mixed with the pestle

⬇

The mortar pestle can be rotated clockwise or anti-clockwise for fluent and effective mixing

⬇

By continuous mixing other ingredients like diluent, lubricant, disintegrant, anti-adherant are added

After proper mixing of all ingredients, a fine powder is produced as a result

The fine powder is now allowed to go for punching tablet in a punching machine

A weight of 0.6gm is placed in the tablet punching machine for punching a single tablet

Finally, as a result a sustain release tablet by using acacia catechu is formed.

Fig.3: Compression of Acacia Catechu Tablets

3. RESULT AND DISCUSSION:

QUALITATIVE NUTRITIONAL STUDY FOR ACACIA CATECHU POWDER:

Table 3: Qualitative Nutritional Analysis for Acacia Catechu Powder

Element/Ion	Result
Calcium (Ca^{2+})	++
Potassium (K^{+})	++
Sodium (Na^{+})	++
Iron (Fe^{3+})	++
Chloride (Cl^{-})	+
Sulphate (SO_4^{2-})	+

Phosphate (PO_4^{3-})	++
Magnesium (Mg^{2+})	++
Zinc (Zn^{2+})	++

QUALITATIVE ANALYSIS FOR VITAMINS:

Table 4: Qualitative analysis for vitamins

Vitamins	Result
Vitamin A	++
Vitamin E	++
Vitamin B12	++
Vitamin C	++

UV spectroscopy of Acacia Catechu:

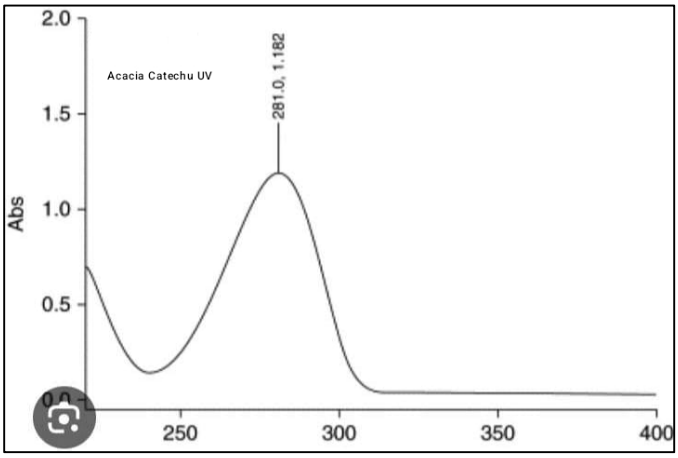

Fig.4: UV spectroscopy of Acacia Catechu

Calibration curve in various pH

Calibration curve in pH 1.2

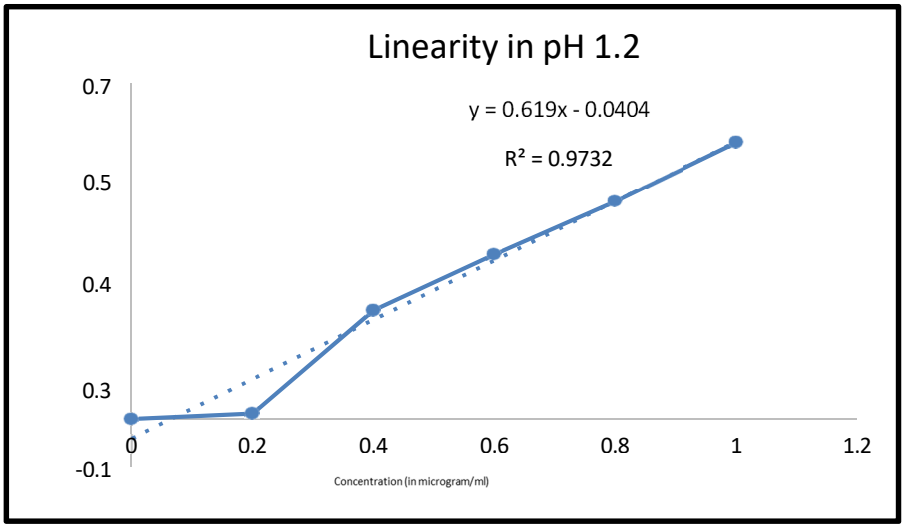

Fig.5: Calibration curve in pH 1.2

Calibration curve in pH 6.8

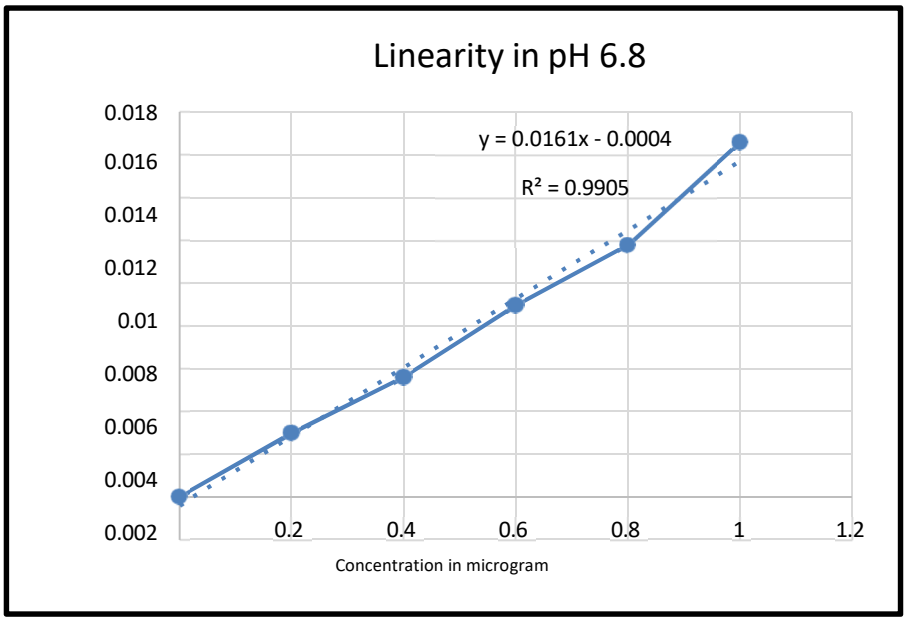

Fig.6: Calibration curve in pH 6.8

Calibration Curve in pH 7.4

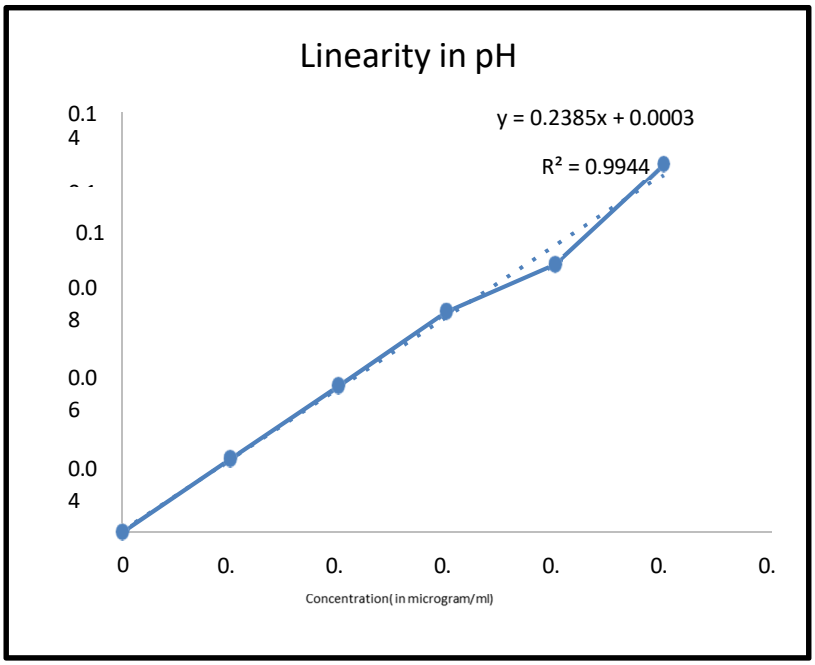

Fig.7: Calibration Curve in pH 7.4

PREDICTION OF GOOD QUALITY ACACIA CATECHU POWDER

Standard calibration curve of Ascorbic acid

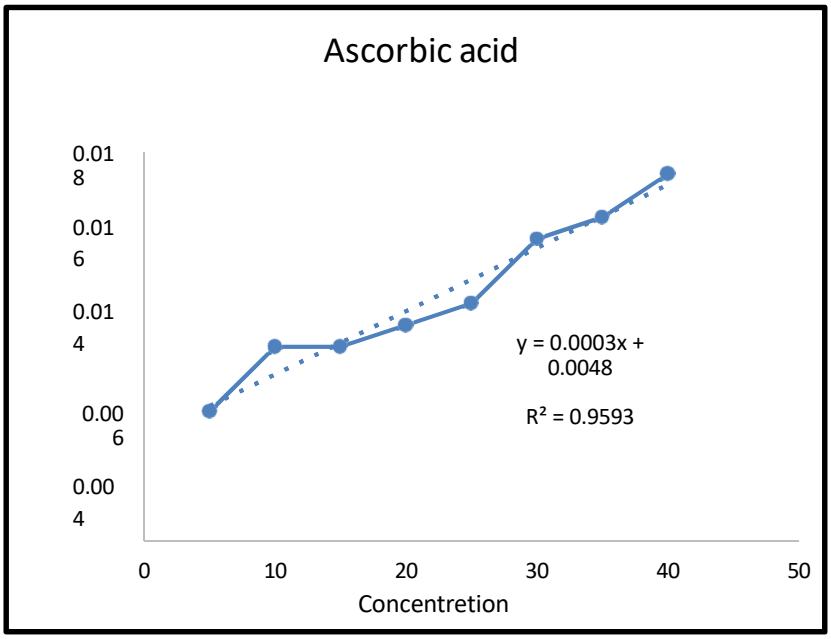

Fig.8: Standard calibration curve of Ascorbic acid

Table 5: Calculated concentration Ascorbic acid

Powders	Extracted (mg)
Concentration of Ascorbic acid	53.4

EVALUATION PARAMETERS OF POWDER

Table 6: Powder Flow Properties Results

FLOW PROPERTIES	RESULT
Bulk Density	0.5g/ml
Bulk Volume	10
Tapped Density	0.58g/ml
Hausner Ratio	1.16
Caars Index	10%
Angle Of Repose	33°58'

FORMULATED TABLETS

The preparation of immediate-release tablet by using acacia catechu is prepared successfully.

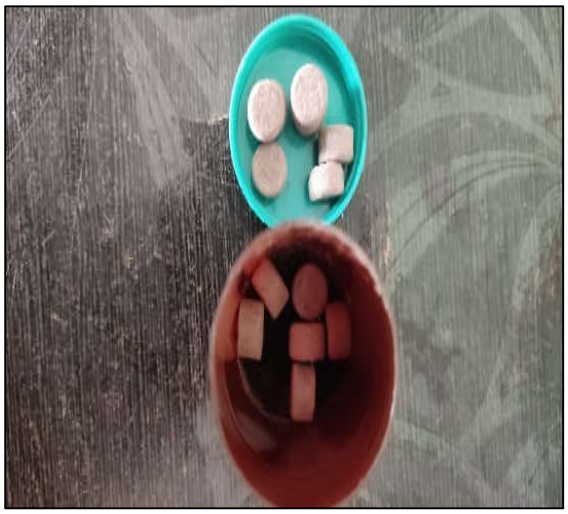

Fig.9: Formulated Tablets

POST COMPRESSION STUDIES OF ACACIA CATECHU TABLETS

Table 7: Post Compression Parameters of Acacia Catechu

Formulations	Weight Variation (mg)	Hardness (N)	Thickness (Mm)	Disintegration Time (min)	Friability (%)	Drug content (%)
F1	600.12	11	3.05	6.00	1.66	76.42
F2	599.04	10	3.04	4.15	1.69	84.78
F3	600.07	11	3.05	6.50	1.69	78.52
F4	600.10	11	3.03	5.30	1.66	67.37
F5	**600.03**	**11**	**3.06**	**3.20**	**1.66**	**92.07**

Comparative Release Profile of Acacia Catechu in Various Formulations with Innovator

We found that, the following order of the formula F5> F4 > F3> F1 > F2, the highest percent of release over 30 min. The release percent was decreased when the concentration of the tablet increased.

Table No.8: Comparative Release Profile of Acacia Catechu in Various Formulations with Innovator

Time (Min)	F1 (%)	F2 (%)	F3 (%)	F4 (%)	F5 (%)
0	**0**	**0**	**0**	**0**	**0**
05	45.78 ± 0.76	62.31 ± 0.57	21.21± 0.69	46.98± 0.93	**42.73 ± 0.56**
10	64.37 ± 0.70	71.35 ± 0.41	38.18 ± 0.55	58.60 ±0.55	**63.34 ± 0.44**
15	73.29 ± 0.61	80.93 ± 0.72	47.25 ± 0.51	64.37 ± .70	**66.34 ± 0.67**
20	90.30 ± 0.47	90.41 ± 0.56	64.18 ± 0.54	70.29 ±0.61	**71.25 ± 0.51**
25	93.22 ± 0.51	94.30 ± 0.34	86.20 ± 0.46	81.88 ± .90	**91.43 ± 0.92**
30	97.10 ± 0.58	96.30 ± 0.17	97.28 ± 0.70	98.48 ±0.66	**99.37 ± 0.11**

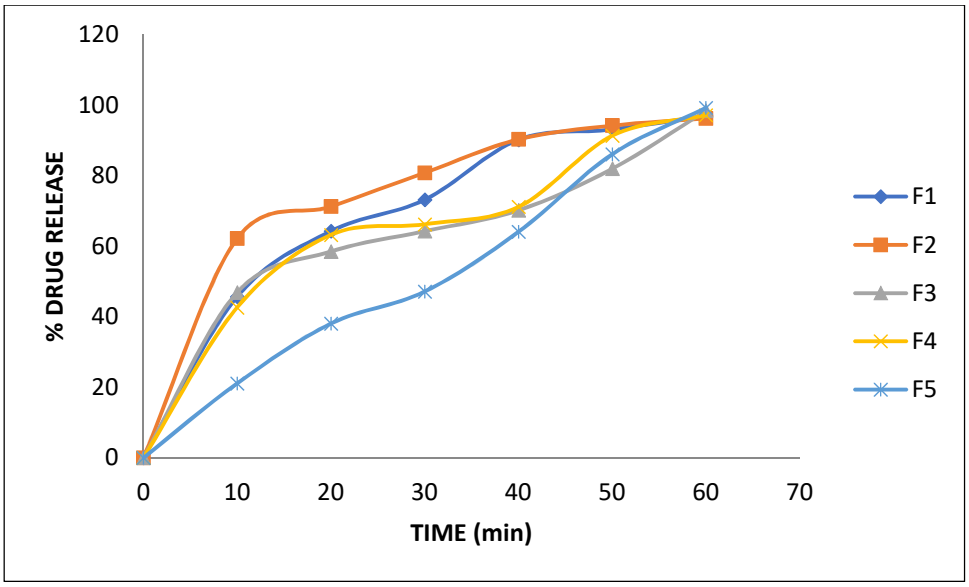

Fig.10: Comparative Study of %Drug Release

STABILITY STUDY

Table 9: Drug release of Acacia Catechu at 25^0C & 60% RH

DRUG	Drug content (%)	Drug release (%)
Initial	**92.07**	99.88

30 days	92.02	99.88
45 days	91.99	99.87

4. CONCLUSION:

The formulated tablets had appropriate physicochemical attributes, such as weight and drug content uniformity, sufficient hardness for handling, and acceptable friability. These aspects suggest the possibility of producing stable and durable immediate-release dosage forms employing Acacia catechu extract and the chosen polymeric matrices. The possibility of exerting extended therapeutic effect and better patient compliance using this immediate-release mechanism justifies further research. Future research will need to centre on in vivo testing to link the in vitro release profiles to pharmacokinetic parameters and determine the overall safety and efficacy of these formulations.

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