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Research Article

Formulation of Arrowroot Edible Powder- Useful for UTI

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ABSTRACT

Recent studies on prevalence of urinary tract infection indicate that approximately one third population of the world has been suffering from this disease. Urinary tract infections (UTIs) are among the most common infection with an incidence rate of 25-80% of females. The present study aimed at Prevention of Urinary Tract Infection (UTI) Using Arrowroot as API. It acts as anti-inflammatory The cause of the infection is a wide range of microorganism, and the toxicities producing the difficulties during the act of micturition which results in pain and burning sensation along with passage of urine with obstruction. The main ingredient in the study is. Arrowroot (Maranta arundinaceae L.) belongs to Marantaceae family and is a large perennial herb found in tropical forest. D- mannose reduced UTI symptoms in women with an active infection, it was also more effective than the antibiotic for preventing additional infections. Amla act as anti-oxidant, Shatavari shows Anti-bacterial property in UTI prevention, Jaggery powder is used as flavoring agent.

INTRODUCTION

Urinary tract is the most prone part of the body for infectious diseases as it is directly intact with external environment via pathway for liquid waste disposal. The urinary tract infection (UTI) is one of the most common infections which can involve upper and or lower urinary tract causing pyelonephritis (renal pelvis), urethritis (urethra), cystitis (urinary bladder) and prostatitis (prostate gland) respectively. Urinary tract infection is a second most important infection which encompasses the asymptomatic presence of bacteria in urine to severe infection of kidney. Arrowroot (Maranta arundinaceae L.) belongs to Marantaceae family and is a large perennial herb found in tropical forest. D-mannose reduced UTI symptoms in women with an active infection, It is obtained from orange or citric fruits. Amla (Indian Gooseberry) belongs to Phyllanthaceae family. Amla's antimicrobial, antibacterial, and diuretic properties help to soothe the inflamed mucosa of the urinary tract, through which relief is ensured to

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the patient with UTL Shatavari (Asparagus racemosus) belongs to Asparagaceae family help to reduce urine cloudiness and eliminate the bad smell of the urine that may due to infection or pus cell to act as anti-bacterial. Arrowroot is a low perennial herb found in rain forest habitats which is often cultivated for starch obtained from its rhizome. Arrowroot is indigenous in tropical America but has spread to other countries such as Brazil, India, Ceylon, Indonesia, and the Philippines. Arrowroot was first introduced in the Philippines in 1918. The arrowroot powder is a healthier alternative, Arrowroot powder is twice the thickening power of wheat flour and because it contains no protein, arrowroot is gluten free. Unlike corn starch, arrowroot powder creates a perfectly clear gel und does not break down when combined with acidic ingredients, like fruit juice Arrowroot abo stands up to freezing, whereas mixtures thickened with corn starch tend to break down after freezing and thawing.

Classification

Urinary Tract Infection Classified into Two Types:

1. **Lower UTI:**

1) Urethritis (Inflammation of ureter)

2) Cystitis (Inflammation of bladder)

3) Uretheritis (Inflammation of urethra)

2. **Upper UTI:**

Pyelonephritis (Inflammation of kidney)

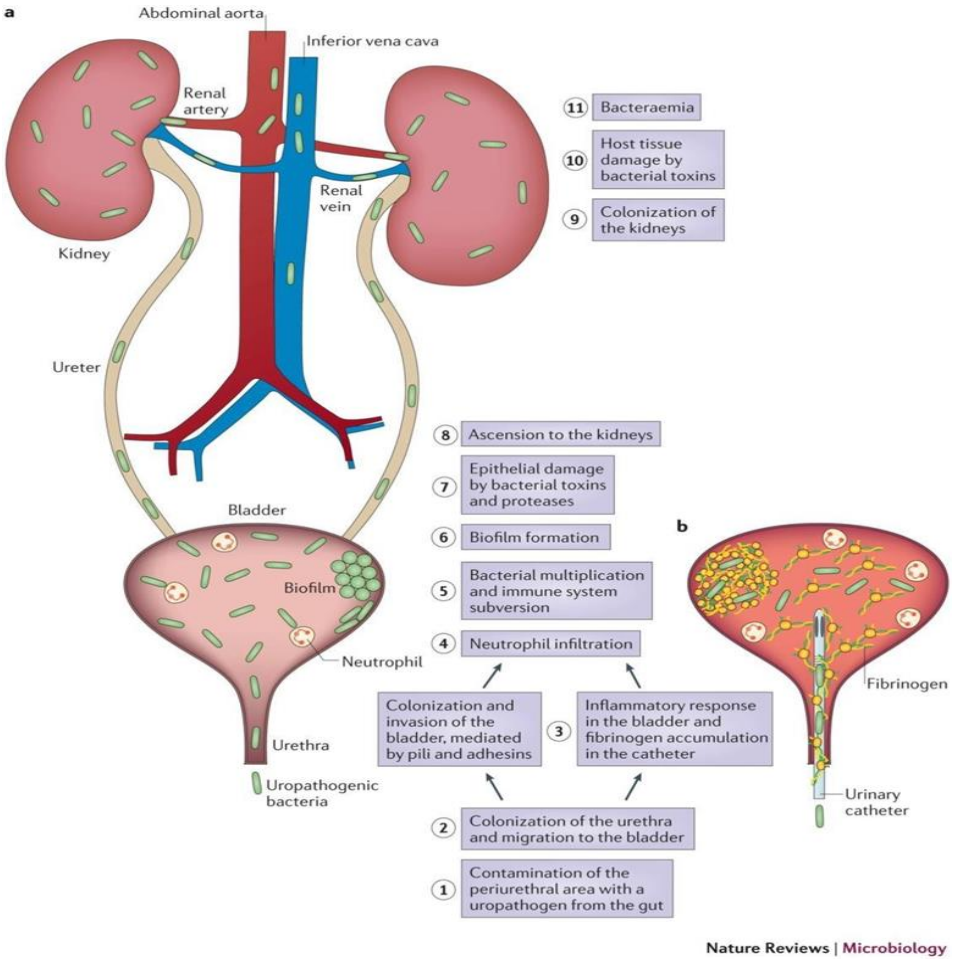


Fig.no.1- Pathogenesis of UTI

Epidemiology: -

- UTI is the 2nd most common infections present in community practices.
- Worldwide, about 150 million people are diagnosed with UTI each year.
- Prevalence 35% of healthy women suffer symptoms of UTI at some time in their life.

Etiology: -

- The causative organism causing UTI are: -E. coli, Pseudomonas aeruginosa, Streptococcus faecalis, Staphylococcus epidermis and Proteus mirabilis.
- Waiting for long to urinate.
- Sexual transmitted diseases [STD] like gonorrhea causes urethritis.
- Presence of tumor/stones/ foreign bodies in urinary tract.

UTI Effects of…?

- Women are more than of men in UTI
- Pregnancy
- Diabetes mellitus (D. M)
- Previous UTI
- Age
- Kidney stone

Prevention of UTI…

- Drink enough water on regular basis and a daily output of bacteria and wash the urethra.
- urinate immediately if feeling the need to urinate
- refrain from drinking alcohol.
- Go to the bathroom and get rid of the urine before going to bed sleep.
- Avoid eating spicy foods many spices, and avoid drinking tea, coffee, fruit juice because they cause heartburn in the urine.
- Avoid using scented soaps and vaginal odor removers, and chemicals in the bath
- Do not use contraceptives such as topical pregnancy female condom to avoid urinary tract infections.

Known and possible age-related risk factors for recurrent urinary tract infection (UTI) in women are: -

In Young and premenopausal women-

- Sexual intercourse
- Use of spermicide
- A new sexual partner
- A mother with a history of UTI
- History of UTI during childhood

Postmenopausal and elderly women-

- History of UTI before menopause
- Urinary incontinence
- Atrophic vaginitis due to estrogen deficiency
- Cystocele
- Increased post-void urine volume
- Blood group antigen urine secretory status
- Urine catheterization and functional status deterioration in elderly institutionalized women
- UTIs have different names depending on where they occur. For example:
  - A bladder infection is called cystitis,
  - A urethra infection is known as urethritis.
  - A kidney infection is called pyelonephritis.

According to 2022 research trusted Source, groups at a higher risk of complicated UTIs include:

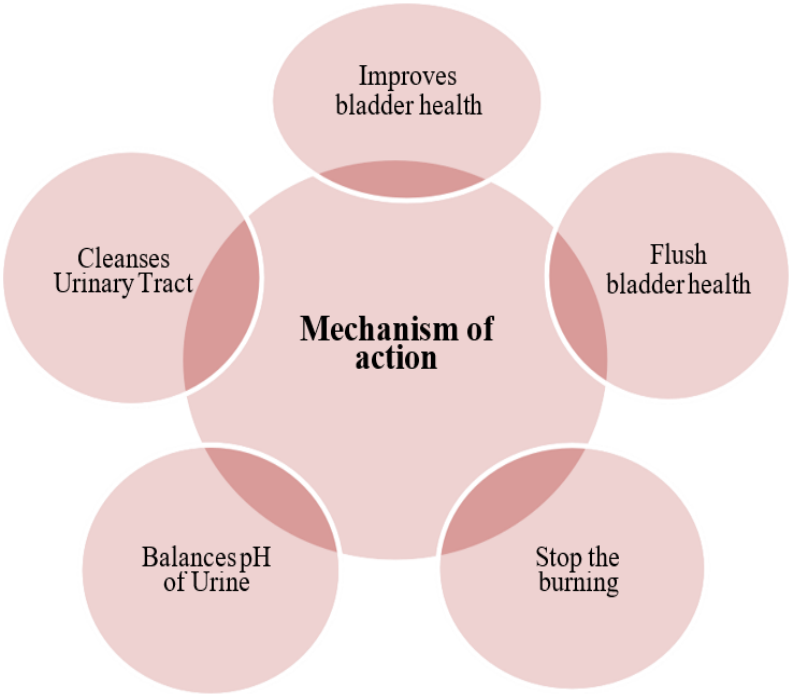
- Males
- Pregnant people Immunocompromised people older people
- Those using catheters

- Those having radiotherapy treatment.

Importance of edible powder: - Benefits:

- Convenience: Powdered food is easy to prepare and can be consumed quickly, making it a convenient option for busy people or those who don't have access to a full kitchen.
- Portion control: Powered food is typically pre-portioned, which can help with portion control and calorie management.

Mechanism of action of edible powder for UTI



Ingredients

Arrowroot Powder:

Fig.No.2- Arrowroot Powder

Biological Name: Maranta arundinacea

Family: Marantaceae

Properties:

- It has anti-inflammatory property.
- It might act as antioxidant
- It has antibacterial activity
- It may have anti-viral activity.

Preparation of arrowroot powder:

- Arrowroot tubers were washed and peeled.
- Instantly, they were ground with stingray skin to obtain the fine pulps and then they were soaked by the water in the receptacle at the same time.
- Then the fine pulps were mixed and filtered through fine basket.
- After that they were soaked in the water overnight and then they precipitated from the swill.
- Afterwards, the supernatant was removed and filled the water again.
- The process was repeated for 10 times (10 days) or until to obtain the clear water.
- Finally, the powders were air dried in the sun and crushed to a smaller size.

D-Mannose Powder:

Fig.No.3- D Mannose Powder

- D-Mannose is obtained from orange fruit.
- D-Mannose is a C-2 epimer of d-glucose, which is a natural monosaccharide.
- It can be obtained from both plants and microorganisms.
- Chemical synthesis and biotransformation of d-mannose from d-fructose or d- glucose by using d-mannose isomerases, d-xylose isomerases, and cellobiose 2- epimerase were intensively studied.

Preparation Of D-mannose: -

- It can be obtained from the orange fruit.
- The skins need to be totally dried out, nice and crispy hard. The orange zest is dry when it crushed under pressure. Stored in a glass jar until you have collected a larger amount that can be put into a small food processor to grind them into powder.

Amla Powder:

Fig.No.4- Amla Powder

Synonym: - Indian Gooseberry, Amalek, amla

Biological Source: Amla consists of the fresh or dried fruits of Emblica officinalis Gaertn. (syn, Phyllanthus emblica Linn).

Family: - Euphobiaceae

Properties: -

- It shows anti-oxidant activity
- Rich in vitamin C
- It also has antimicrobial Property.

Preparation of amla powder: -

- Some Fresh amlas were Sun-dried for a week. Then grinded into a fine powder.
- The extraction was conducted for 30 and 120 minutes at extraction temperature 60°C.
- The mixture of extraction product was filtered using filter paper to separate the amla seed powder that has been removed from the fat and miscella.

Shatavari Powder:

Fig.No.5- Shatavari Powder

Synonym: Shatmuli

Biological Source: It consists of dried roots and leaves of plant Asparagus Racemosus.

Family: Liliaceae

Properties:

- It shows antibacterial property.
- It aids our immune system.
- Battling inflammation.

Preparation of Shata Vari powder:

Shatavari powder was made at home by cleaning the Shata Vari root, drying it, then grinding it and finally sifting and storing it.

Jaggery Powder:

Fig.No.6- Jaggery Powder

Biological Name: Saccharum officinarum

Biological Source: It is made from the sap of sugarcane that consists high amounts of sucrose.

Family: Poaceae.

Properties:

- It has diuretic properties and stimulates urine production
- It also acts as flavoring agent
- It can reduce inflammation in the bladder.
- It aids in the smooth flow of urine

Preparation of Jaggery powder: -

- Crushing of sugarcane for juice extraction, filtration and boiling of juice for concentration

and then cooling and solidifying to give jaggery blocks. The juice is extracted in conventional crusher; this is then filtered and boiled in shallow iron pans.

- During cooling jiggery blocks are rubbed till it become dry and crushed for making it a powder.

Objectives

1) Prevention of Urinary Tract Infection
2) The research aims to determine the antimicrobial effect of arrowroot.
3) To reduce the inflammation in urinary tract.
4) To reduce the inflammation in urinary track.
5) To relieve symptoms, get rid of the infection.
6) Minimize urinary catheter use and duration use in all patients.
7) To Minimize douching, sprays, or powders in the genital area.
8) Vitamin C prevents bacteria from growing by making urine more acidic.
9) To Re-balances Urinary Tract pH.
10) To assess the patient's compliance.

Experimental Work

Table 1:

Apparatus	Ingredients
Beaker	Arrowroot Powder
Mortar and Pestle	D-Mannose Sugar
Sieves no.44	Amla Powder
Spatula	Shatavari Powder
Glass rod	Jaggery Powder
Petri Dish	
Electronic Balance	
Funnel	
Tripod Stand	
pH meter	

Method Of Preparation

- **Collection of Sample: -**

1) Arrowroot Powder
2) D-Mannose Powder
3) Shatavari Powder
4) Amla Powder
5) Jaggery Powder

- **Preparation Procedure: -**

1) All glassware were cleaned and dried.
2) The required quantity of the ingredients was weighed accurately obtained from the extraction procedure.
3) These dried powders were triturated with the help of mortar-pestle.
4) All the triturated powders were passed through sieve no.44.
5) Further these powders were mixed in ascending order as per the prepared formulation table.
6) Then the mixture was triturated and passed through sieve no.44.
7) Then the prepared formulation was stored in glass container.
8) According to dosage form the packing was done and labeled.
9) Evaluation was performed. calculated and reported.

Formulation table: -

Table 2:

Ingredients	F1	F2	F3	F4	F5
Arrowroot Powder	4gm	4gm	4gm	4gm	4gm
D-Mannose	4gm	3gm	4gm	5gm	5gm
Amla Powder	1.5gm	1gm	1gm	1gm	1gm
Shatavari Powder	2.5gm	3gm	3gm	3gm	5gm
Jaggery Powder	3gm	4gm	3gm	2gm	-

9. Evaluation Parameter

Organoleptic Evaluation:

All the organoleptic properties viz. color, odor, taste, and texture of the drug to touch were performed as per standard procedure and noted down.

Fig.No.7- Organoleptic Evaluation

Pharmaceutical Evaluation:

Pharmaceutical parameters like Bulk density, tapped density, Carr's Index, Hausner's Ratio and Angle of repose were determined as per standard protocols.

Determination Of Bulk Density and Tapped Density:

Bulk density is defined as the mass of many particles of the material divided by the total volume they occupy. The total volume includes particle volume, inter-particle void volume and internal pore volume. Tapped density is the term used to describe the bulk density of a powder (or granular solid) after consolidation/compression prescribed in terms of "tapping" the container of powder a measured number of times, usually from a predetermined height. The term bulk density refers to a measure used to describe a packing of particles or granules and the term Tapped density refers to the true density of the particles or granules. Formula for calculation:

$$\text{Bulk Density} = \frac{Weight\ of\ powder\ taken}{Bulk\ volume\ of\ powder}$$

$$\text{Tapped Density} = \frac{Weight\ of\ powder\ taken}{Tapped\ volume\ of\ powder}$$

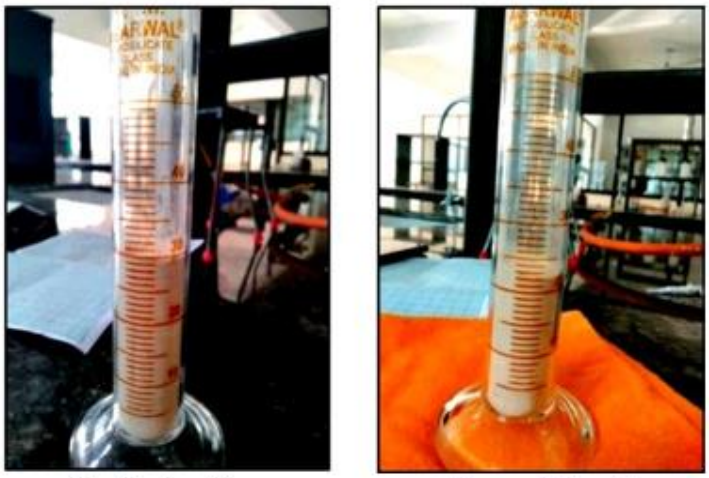


Fig.no.8- Bulk and Tapped density

Determination of Carr's Compressibility Index:

The Carr index is an indication of the compressibility of a powder. It is another indirect

method of measuring the powder flow from bulk and tapped density.

Formula For Calculation:

$$\text{Carr's Index} = \frac{Tapped\ density - Bulk\ density}{Tapped\ density} \times 100$$

Determination of Hausner's Ratio:

Hausner's ratio is related to inter-particle friction and as such can be used to predict the powder flow properties. Formula for calculation:

$$\text{Hausner's Ratio} = \frac{Tapped\ density}{Bulk\ density}$$

Determination of Angle of Repose:

The angle of repose is a parameter used to estimate the flowability of a powder. It is defined as the maximum angle possible between the surface of the pile of powder and the horizontal plane. Powders with low angles of repose will flow freely and powders with high angles of repose will flow poorly.

Formula for calculation:

where,

$\theta = \text{Angle of repose}$

$\text{h} = \text{Height of pile}$

$\text{r} = \text{Radius of the base of the pile}$

Fig.no.9- Angle of repose

Physio-Chemical Evaluation:

Physicochemical parameters like foreign matter, moisture content (Loss on Drying), pH, total ash, water- solubility of all five formulae were determined as per standard protocols. All the procedures are described as follows:

Foreign matter: Sort the foreign matter into groups either by visual inspection, using a magnifying lens (5-10 x), or with the help of a suitable sieve.

Moisture Content/loss on Drying: Clean the dish and dry in oven. Allow the dish to cool in desiccator and weigh. Weigh the sample in dry and pre weight aluminum dish with lid. Transfer again the dish in the oven for drying. Remove the dish. Allow the dish to cool in the desiccator for cooling, Weigh the dish. Repeat the process for two successive readings. Record the lowest weight. Calculate the result.

Formula for calculation:

$$\%\text{LOD} = \frac{W2 - W3}{W3 - W1}$$

Where,

W1=weight of container(g)
W2= weight of container wet sample (g) W3=weight of container dried sample(g) W2-W3=weight of moisture
W3-W1= weight of dried sample

Determination of pH value:

20 or the powder will be dissolved in 100 ml of distilled or deionized water and be sure that all the powder is dissolved in the water, then measure the pH using any pH meter.

Determination of Total Ash:

Weigh and ignite flat, thin, porcelain dish or a tared silica crucible. Weigh about 2 g of the powdered drug into the dish/crucible. Support the dish on a pipe-clay triangle placed on a ring of retort stand. Heat with a burner, using a flame about 2 cm high and supporting the dish about 7 cm above the flame, heat till vapors almost cease to be evolved, then lower the dish and heat more strongly until all the carbon is burnt off. Cool in a desiccator. Weigh the ash and calculate the percentage of total ash with reference to the air-dried sample of the crude drug.

Formula for calculation:

$$\%\text{Total Ash} = \frac{Weight\ of\ Ash}{Weight\ of\ sample\ taken} \times 100$$

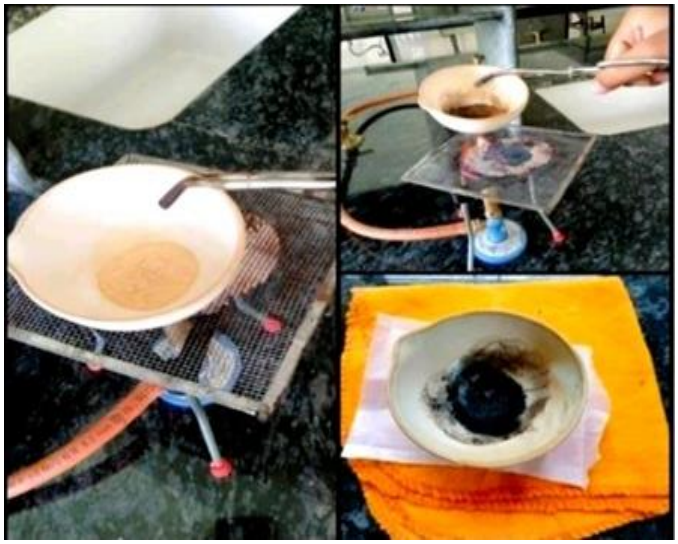


Fig.No.10- Ash Value

Determination of Water Solubility:

Place 0.05 mL or 25 mg of compound in a small test tube, and add 0.75 mL of water in small portions. Shake test tube vigorously after the addition of each portion of solvent.

Table 3: Relationship of Angle of Repose, Carr's Index and Hausner's Ratio with flow properties of powder

Angle of Repose	Carr's Index	Hausner's Ratio	Flow Properties
25-30	<10	1.00-1.11	Excellent
31-35	11-15	1.12-1.18	Good
36-40	16-20	1.19-1.25	Fair
41-45	21-25	1.26-1.34	Passable

46-55	26-31	1.35-1.45	Poor
56-65	32-37	1.46-1.59	Very Poor
>66	>38	>1.60	V. very Poor

10. RESULT AND DISCUSSION

Organoleptic Evaluation: -

The observations for the organoleptic evaluation of UTI Prevention edible powder are reported in Table 4.

Table 4: Results for Organoleptic Evaluation

Sr. No.	Properties	F1	F2	F3	F4	F5
1.	Appearance	Powder	Powder	Powder	Powder	Powder
2.	Color	Yellowish Brown	Light Brown	Light Brown	Yellowish Brown	Light Brown
3.	Odor	Characteristic	Characteristic	Characteristic	Characteristic	Characteristic
4.	Taste	Bitter	Bitter	Sweet and Bitter	Sweet and Slightly Bitter	Bitter
5.	Texture	Moderately Fine Powder	Moderately Fine Powder	Moderately Fine Powder	Moderately Fine Powder	Moderately Fine Powder

Pharmaceutical Evaluation: -

The observations for the pharmaceutical evaluation of UTI prevention edible powder are reported in Table 5.

Table 5: Results for Pharmaceutical Evaluation

Sr. No.	Properties	F1	F2	F3	F4	F5
1.	Bulk Density	0.64	0.6	0.58	0.61	0.872
2.	Tapped Density	0.769	0.652	0.833	0.738	0.58
3.	Hausner's Ratio	1.20	1.086	1.436	1.209	1.503
4.	Carr's Index	16.77%	7.97%	30.37%	17.34%	33.56%
5.	Angle of Repose	36.86□	28.786□	47.35□	38.48□	57.333□
6.	Flow Property	Fair	Excellent	Poor	Fair	Very Poor

Physico-Chemical Evaluation: -

The observations for the physico-chemical evaluation of UTI prevention edible powder are reported in Table 6.

Table 6: Results for Physico-chemical Evaluation

Sr. No.	Properties	F1	F2	F3	F4	F5	Standard (IP)
1.	Foreign Matter	Nil	Nil	Nil	Nil	Nil	NMT 3.0%
2.	pH	7.02	7.05	6.8	7.03	6.9	-
3.	Loss on Drying/ Moisture	11.86%	11.73%	10.07%	11.07%	10.69%	NMT 12.0%

	Content						
4.	Water solubility	49.6%	40.8%	39.5%	48.7%	37.3%	NLT 35.05%
5.	Total Ash Value	3.52%	4.44%	3.36%	6.0%	7.3%	NMT 8.0%

- From evaluation table it was concluded that F1 and F4 batches showed Fair results,
- whereas F2 batch showed excellent result,
- And F3 & F5 showed Poor and very Poor result respectively.

CONCLUSION

- Powder dosage forms are versatile, flexible in dosage strengths, relatively stable and convenient to manufacture, handle, store, and use.
- Due to increasing antibiotic resistance among UTI pathogens, the burden caused by UTIs is expected to increase creating a high demand for alternative options.
- D-mannose appears to have great potential with minimal side effects.
- Arrowroot abounds with an impressive profile of essential nutrients and bioactive compounds that are beneficial not only for growth and development but also boosts immunity, promotes digestion and control diabetes
- Being a gluten-free starch, arrowroot is a perfect cereal to combat celiac disease, gluten intolerance and enhances overall health.
- Add this healthy gluten-free starch to your regular meal plan.
- So, from our performed experiment we formulated and evaluated an edible powder for the prevention and re-occurrence of Urinary Tract Infection which contains an Arrowroot as API with other powerful blends of powder.

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