

Formulation and Evaluation of Nutraceutical Tablet using Radish Leaves Powder

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Abstract

Nutraceuticals are bioactive chemicals that are found in everyday foods or botanical sources. They can be consumed as functional foods or dietary supplements and provide additional health benefits in addition to the important nutritional components. Antioxidants, phytochemicals, fatty acids, amino acids, and probiotics are just a few of the bioactive compounds gathered in dietary sources that make up nutritional supplements. Nutraceuticals are well-known for their role in illness treatment and prevention, anti-aging qualities, and cancer prevention, with either previously established effects or potential effects. Hence an attempt has been made to formulate a nutraceutical tablet using radish leaves.

Keywords: Radish leaves; Nutraceutical tablet; Formulation; Evaluation

1. Introduction

Radish, also known as *Raphanus sativus* or Mooli, is a vegetable that is grown annually and belongs to the Brassicaceae or the Cruciferae family. Medicine is made from almost all plant parts, including the leaves, seeds, and roots. [1]

An annual or biennial herb with a short condensed stem and a white or brightly coloured tuberous tap root; basal leaves that are long, lyrate-pinnate, and coarsely toothed; upper leaves that are shorter, petiolate, and uppermost simple, sublinear; flowers that are white or lilac-scented in loose racemes; petioles that are 3 to 5.5 cm long; leaf blades that are oblong, oblong- A vascular plant's leaf is a small, dorsiventral, flattened organ that is an extension of the stem and is used for photosynthesis. [2]

The edible, pendulous, globose, cotyledons conduplicate, endospermic, and occasionally utilised as a crispy, spicy radish seed has these characteristics. There are many different kinds of them, and they differ in size, flavour, colour, and how long it takes for them to mature. They sprout and grow swiftly, with smaller types becoming edible in about a month and larger daikon kinds needing many months. Fruits are upright, cylindric, inflated pods that are green at the beak and have 2 to 8 pendulous, ovoid, light brown seeds. [3]

Radishes are a family of root vegetables with a variety of skin colours, light, crisp meat, and an almost spicy, peppery flavour. They might be small and spherical or long and narrow, and the colour of their skin can range from red to black, white, pink, or purple. Everywhere in the world, radish is produced for its fleshy, tasty taproot. Depending on the grower, it may also be grown for its edible leaves, seeds, or seedpods. [4]

The powder made from radish leaves is high in vitamin C, calcium, iron, phosphorus, folic acid, ascorbic acid, and other phytonutrients that aid in the treatment of a number of illnesses, including hypertension, jaundice, piles, constipation, cardiovascular disease, cancer, kidney stone relief, gastrointestinal disorders, bacterial infections, and viral infections. It is also being investigated as a functional ingredient for use in a variety of food products. the idea of using food for purposes other than just sustenance to promote health. [5]

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Since the beginning of time, oral drug delivery has been recognised as the most often used route of administration among all those that have been investigated for the systemic distribution of medications via diverse pharmaceutical products of varied dose forms. It is regarded as the most organic, straightforward, practical, and secure path. Tablets are solid dosage forms that can include pharmaceuticals with or without the right diluents. They are the most frequently chosen type of medication among doctors, patients, and pharmaceutical companies. They offer high physicochemical stability compared to some other dosage forms, safe and practical methods of administering active pharmaceutical ingredients (API), as well as methods for precise dosing. [6]

Tablets can be characterized as the solid unit dosage form of a medication or medications containing the proper excipients and formed either by compression or moulding. It consists of a mix of excipients and active ingredients. [7]

The natural compounds in nutraceuticals have the potential to be beneficial to the body's health. A nutraceutical is a substance that has been separated or refined from food and is typically sold as medication with no apparent link to food. [8]

A nutraceutical is defined as "any non-toxic dietary ingredient with scientifically demonstrated health benefits, including the treatment or prevention of diseases." The idea underlying the mechanism of action of a nutraceutical dosage form is to give functional benefits by increasing the availability of natural building blocks, decreasing illness signs, and improving health. [9]

Raphanus sativus is therefore included in the current work's Nutraceutical tablet. Wet granulation was used to create L leaves powder, which can aid with health promotion and the treatment and prevention of the numerous ailments described above.

2. Materials and Method

Fresh leaves of white radish were collected from local cultivators in Tumakur, Karnataka. The collected leaves was washed with water, shade dried for 7days and further dried in a hot air oven at 60°C for 1 hour. Then the leaves were powdered by using blender and sieved in sieve no 22. The resulting powder was collected and used as active ingredient for formulation of Nutraceutical tablet. All other ingredients such as starch, magnesium stearate, lactose, talc used were of analytical grade.



Figure 1 Radish leaves powder

Nutraceutical tablets containing radish leaves powder were prepared by wet granulation method. Other ingredients like Starch paste was used as granulating medium, Magnesium stearate and talc as Glidant and Lubricant, Dry starch powder as Disintegrating agent, and Lactose as Diluents. All ingredients were mixed following geometric mixing excluding Glidant and Lubricant. The granules were prepared by wet granulation method by using required quantity of starch paste to form a damp mass. The damp mass was passed through sieve no 10 to form a granules and the granules were dried at 50-60°C for 15-20mins in the hot air oven. Then the dried granules was passed through sieve no 22/44. The fines obtained were within 1%, hence the fines were added to the granules. Then the Talc and Magnesium stearate thoroughly mixed with granules and compressed into 400mg tablet using Rotary Mini Tablet press Machine. (Shakthi Engineering Manufacturing of Pharmaceutical Machine.)

Table 1 Formulation of Nutraceutical Tablet (400mg)

Sl. NO	Ingredients	Quantity for one tablet (mg)	Quantity for 80 tablets (gm)
1	Radish Leaves Powder	200	16
2	Starch Paste (10%)	35	2.8
3	Magnesium Stearate	10	0.8
4	Lactose	85	6.8
5	Dry Starch Powder	25	2.0
6	Talc	45	3.6

2.1. Composition

Each tablet containing 200mg of Radish leaves Powder.

**Figure 2** Radish Nutraceutical tablet

2.2. Evaluation of Radish Leaves Powder

2.2.1. Phyto-chemical Screening. [10]

Preparation of aqueous extract

The aqueous extraction is done by taking 5gm of Radish leaf powder with 100ml of distilled water in a beaker. Heat at 30⁰-40⁰ with continuous stirring for twenty minutes. Filter the mixture by using Whatman filter paper. Filter and the clear filtrate obtained is used for phytochemical analysis.

2.2.2. Detection of Alkaloids

Dragendorff's test

Take 2ml of aqueous extract in a clean test tube, add Dragendorff's reagent. Orange brown color precipitate indicates presence of Alkaloids.

Hager's test

Take 2ml of aqueous extract in a clean test tube, add Hager's reagent. Yellow color precipitate indicates the presence of Alkaloids.

Wagner's test

Take 2ml of aqueous extract in a clean test tube, add Wagner's reagent. Red color precipitate indicates the presence of Alkaloids.

Mayer's test

Add Mayer's reagent to 2 ml of clean test tubes worth of aqueous extract. Alkaloids are absent if there is no cream-colored precipitate.

2.2.3. Test for Steroids

Take 2ml of aqueous extract in a clean test tube, add few drops of chloroform and equal amount of conc. sulphuric acid. Appearance of blue colour indicates the presence of Steroids.

2.2.4. Tannins and Phenolic compounds

- Take 2ml of aqueous extract in a clean test tubes, add Ferric chloride. Appearance of bluish black colour indicates the presence of Tannins and Phenolic compounds.
- Take 2ml of aqueous extract in a clean test tube, add lead acetate. No appearance of bluish yellow precipitate indicates the absence of Tannins and Phenolic compounds.
- Take 2ml of aqueous extract in a clean test tube, add potassium chromate solution. Appearance of orange yellow precipitate indicates the presence of Tannins and Phenolic compounds.

2.2.5. Flavonoids

Take 1ml of aqueous extract in a clean test tube add 5% FeCl_3 (Ferric chloride) solution. Green or purple precipitate indicates the presence of Flavonoids.

2.2.6. Protein and Aminoacids

Millon's test

Take 1ml of aqueous extract in a clean test tube; add 5 drops of Millon's reagent, heat for 30seconds. Appearance of yellowish to red precipitate indicates the presence of Proteins and Amino acids.

Xanthoproteic test

Take 1ml of aqueous extract in a clean test tube, add Ethanol and Concentrated Nitric acid. Appearance of yellow colour indicates the presence of Proteins and Aminoacids.

2.2.7. Carbohydrates test

Molisch's Test

Take 4ml of aqueous extract in a clean test tube, add 2-3 drops of Molisch's reagent and add 1ml of Sulphuric acid. Appearance of violet colour ring at the junction of the test tube indicates the presence of Carbohydrates.

Fehling's Test

Take 2ml of aqueous extract in a clean test tube, add Fehling's reagent. Appearance of green colour indicates the presence of Carbohydrates.

2.2.8. Glycoside test

Borntrager's test

Take 2ml of aqueous extract in a clean test tube and dissolve in 1ml of Benzene and add dil. Ammonia to the sample add Hydrochloric acid heat and filter. Rose pink to red colour is not obtained indicates the absence of Glycosides.

Keller Kiliani test

The test consists of boiling about 1gm of finely powdered radish leaf powder with 10ml of 70% alcohol for 2-3min. The extract is filtered. To the filtrate add 5ml of water and treat with 0.5ml of strong solution of lead acetate. Shake well and

separate the filtrate. The clear filtrate is treated with equal volume of chloroform and it is evaporated to yield the residue. The residue is dissolved in Glacial acetic acid shake well, add a trace amount of Ferric chloride solution and Conc. Sulfuric acid, Presence of blue colour in acetic acid layer and presence of red colour at junction of 2 liquids indicates the presence of Glycosides.

Legal test

Take 2ml of aqueous extract in a clean test tube and water make it alkaline add few drops of Sodium nitroprusside, no blue colour indicates the absence of Glycosides.

2.3. Determination of $\lambda_{\max}$ for radish leaves powder. [11]

- 50 mg of radish leaves powder was added to 50ml volumetric flask and the volume was made up to 50ml mark using distilled water.
- 5ml from the above solution was taken in 50ml volumetric flask and the volume was made up to 50ml mark using distilled water.
- The resulted solution was used to determine the $\lambda_{\max}$ using Shimadzu UV-1800 UV/Visible spectrophotometer in the range 200 to 400 nm.
- The $\lambda_{\max}$ was found to be 264 nm.

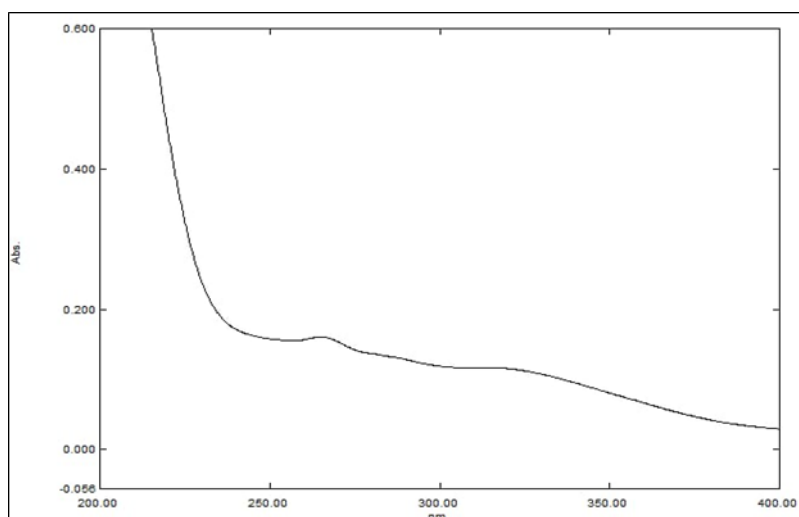


Figure 3 $\lambda_{\max}$ of *Raphanus sativus*.L leaves powder

2.4. Evaluation Of Nutraceutical Tablet

2.4.1. Preformulation Studies of Powdered Blend: - [12],[13].

Angle of repose

Angle of repose was determined by using funnel method. The weighed blend was taken in a funnel and height was adjusted in such a way that tip of the funnel almost touches the apex of the heap. Blend was allowed to flow through the funnel and height of the heap of blend was measured. A circle around the heap was drawn to measure the radius of the cone. The angle of repose was calculated using the equation.

$$\tan \theta = h/r$$

Where

h=height of the pile (cm).

r=radius of the pile base (cm).

Rate of flow

Weighed quantity of blend was taken in a clean and dry funnel placing a cotton plug at neck of funnel. The cotton was removed and time required for the blend to flow out of the funnel was recorded.

Loose bulk density

Loose bulk density was determined by placing weighed quantity of blend into graduated measuring cylinder. Volume and weight were measured.

$$\text{LBD} = \text{Weight of the powder} / \text{volume of the packing.}$$

Tapped bulk density

The measuring cylinder contain weighed amount of blend was allowed to fall under its own weight on to a hard surface from the height of 5cm at two second intervals. The tapping was continued until no further change in volume was noted.

$$\text{TBD} = \text{weight of the powder} / \text{tapped volume.}$$

Compressibility Index

It was determined using following formula.

$$\text{Compressibility Index (\%)} = (\text{TBD} - \text{LBD}) \times 100 / \text{TBD.}$$

Hausner ratio

It was determined by using formula.

$$\text{Hausner ratio} = \text{TBD} / \text{LBD.}$$

2.4.2. Evaluation of Nutraceutical Tablets (Post Compression) :- [14]

Colour and Appearance

The compressed tablets were examined for their colour and appearance.

Weight variation test

Weight variation was determined by weighing 20 tablet individually. Average weight was calculated from the total weight of all tablets. The individual weights are compared with the average weight then percentage deviation was calculated using the formula,

$$\text{Percentage deviation} = \text{individual weight} - \text{average weight} \times 100 / \text{average weight.}$$

Hardness test

The hardness of the tablet was tested using Monsanto hardness tester. The tablet was placed across the diameter in between the spindle and the anvil. The knob was adjusted to hold the tablet in position. The pressure was increased slowly to break the tablet.

Friability test

It was tested by using Roche friabilator (4 minute at 25 rpm). 10 tablets were weighed collectively and placed in the chamber of friabilator after 100 rotations (4 minute), the tablets are taken out from the friabilator and intact tablets are again weighed collectively. Percentage friability was determined.

$$\text{Percentage Friability} = \frac{W_1 - W_2}{W_1} \times 100.$$

Where,

W_1 = Weight of the tablets before test.

W_2 = Weight of the tablets after test.

Thickness and Diameter

Thickness and Diameter of the tablets were evaluated by using Vernier Calipers.

Disintegration test

The Disintegration test apparatus consist of a basket rack assembly containing six open ended glass tubes, A tablet was placed in each of six tubes in the basket. They are held vertically and bottom of the tube was covered with 10mesh screen. By the use of the motor the basket raises and lowers in the immersion fluid at a frequency of 28-32 cycles per minute. The wire screen was always maintained below the level of the fluid. The fluid temperature was maintained at $37\pm 2^\circ\text{C}$ throughout the test. The disintegration time was noted when all the tablets pass through the sieve. This time should comply with the time stated in the monograph for that tablet.

Disintegration for uncoated tablets is 15mins.

Dissolution Test. [15]

In vitro testing of drug release from tablet is common step of quality control as well as an initial phase of the product development process. In vitro dissolution testing of oral dosage forms measures the dissolution rate of drug substance going from the solid state into solution per unit time under standardized conditions of temperature, pH, and composition.

The procedure involving *in-vitro* dissolution:-

Preparation of standard sub-stock solution.

50mg of radish leaves powder was weighed accurately and dissolved it in 50ml of volumetric flask. In that above solution withdrawn 5ml of solution dissolved in 50ml volumetric flask. Concentration of sub stock solution is $100\mu\text{g/ml}$.

Preparation of standard calibration curve

From the above standard sub-stock solution 1, 2, 4, 6, 8, 10ml were withdrawn and transferred to 10ml volumetric flask and make up the volume up to 10ml to get a concentration of 10, 20, 40, 60, 80, $100\mu\text{g/ml}$ respectively. The absorbance of each solution was measured by UV-Visible spectrophotometer at 264nm. The curve of concentration (x-axis) v/s absorbance (y-axis) was plotted.

In-vitro drug release

- Dissolution studies of nutraceutical tablet of radish leaves powder were conducted in USP Apparatus 2 i.e., Paddle Apparatus (Electro lab TDT-08L). The dissolution medium was distilled water 900ml. The paddle rotation speed was kept at 50 rpm for 60 minutes. Samples were analyzed by UV-Visible Spectrophotometer at 264nm. (Shimadzu UV-1800). Percentage of drug dissolved from tablet was calculated.
- The Nutraceutical tablet was placed in dissolution basket containing 900ml of distilled water temperature is maintained at $37\pm 0.50^\circ\text{C}$, paddle is rotated at 50rpm.
- 5ml of samples are withdrawn at different time period of 2.5min, 5min, 7.5min, 10min. Samples are filtered on whatman filter paper, samples are analyzed at 264nm using UV-Visible Spectrophotometer

3. Results and discussion

3.1. Phytochemical screening of radish leaves powder

The radish leaves powder was subjected to qualitative chemical analysis for identification of various plant constituents like Alkaloids, Steroids, Tannins and Phenolic compounds, Flavonoids, Proteins and Aminoacids, Carbohydrates, Glycosides. The results are tabulated in Table No-02.

Table 2 Observed Phytochemical screening reports of *Raphanus sativus.L* leaves powder

SL. No.	Phytoconstituents	<i>Raphanus sativus.L</i> leaves powder.
1	Alkaloids	+ve
2	Steroids	+ve
3	Tannins and Phenolic compounds	+ve
4	Flavonoids	+ve
5	Proteins and Aminoacids	+ve
6	Carbohydrates	+ve
7	Glycosides	+ve

+ve= PRESENT and –ve=ABSENT.

3.2. Evaluation Of Nutraceutical Tablet

3.2.1. Preformulation Studies of powdered blend

The powdered blend was evaluated for various parameters and their results are shown in Table No-03. Evaluation parameters such as Angle of repose, Rate of flow, Loose bulk density, Tapped bulk density, Compressibility index, Hausner ratio were found to be 34.55°, 1.030gm/sec, 0.496gm/cc, 0.554gm/cc, 10.469%, 1.116 respectively. After study of flow rate is conclude that powder blend exist good flow property which does not cause affect the process of tablet punching.

Table 3 Observed Preformulation studies of the powdered blend

SL. No.	Preformulation tests	Results
1	Angle of repose	34.550
2	Rate of flow	1.030 gm/sec
3	Loose bulk density	0.496 gm/cc
4	Tapped bulk density	0.554 gm/cc
5	Compressibility index	10.469%
6	Hausner Ratio	1.116

3.2.2. Evaluation of Nutraceutical Tablet (Post compression)

Nutraceutical tablet was evaluated for various parameters and their results are shown in Table No-04. Evaluation parameters such as Colour and odour, Percentage weight variation, Hardness , Friability , Thickness, Diameter, Disintegration time were found to be Light green colour and round shape, 1.51%, 4.2kg/cm², 0.503%, 0.4mm, 1.43mm, 6minutes respectively.

After evaluation studies conclude that Nutraceutical tablets were prepared by wet granulation method gave satisfactory and acceptable result.

Table 4 Observed evaluation of Nutraceutical tablet

SL. No.	Evaluation test	Results
1	Colour and appearance	Light green and Round shape.
2	Percent weight variation	1.51%
3	Hardness test	4.2 kg/cm ²
4	Friability test	0.503%
5	Thickness	0.4 mm
6	Diameter	1.43 mm
7	Disintegration Time	6 minutes

Table 5 Relationship between flow and Angle of repose, Carr's index, Hausner ratio

Flow	Angle of repose	Carr's index (%)	Hausner ratio
Excellent	<25	5-15	1.00-1.11
Good	25-30	12-16	1.12-1.18
Fair to passable	30-40	18-21	1.19-1.34
Poor	>40	23-35	1.35-1.45
Very poor		33-38	1.46-1.59
Extremely poor		>40	>1.60

Table 6 The percentage difference in the weight variation should be within the permissible limit

Average weight (mg)	Percentage deviation allowed (%)
80 or less	10.0
More than 80 and less than 250	7.5
250 or more	5.0

3.2.3. In-vitro Dissolution test

In pharmaceutical industry, drug dissolution testing is routinely used to provide critical in vitro drug release information for both quality control purposes, to assess batch-to-batch consistency of tablets.

3.3. Calibration curve

Table 7 Reading of different concentration of radish leaves powder at 264nm

Concentration (µg/ml)	Absorbance
10	0.036
20	0.072
30	0.096
40	0.146
50	0.180
60	0.191

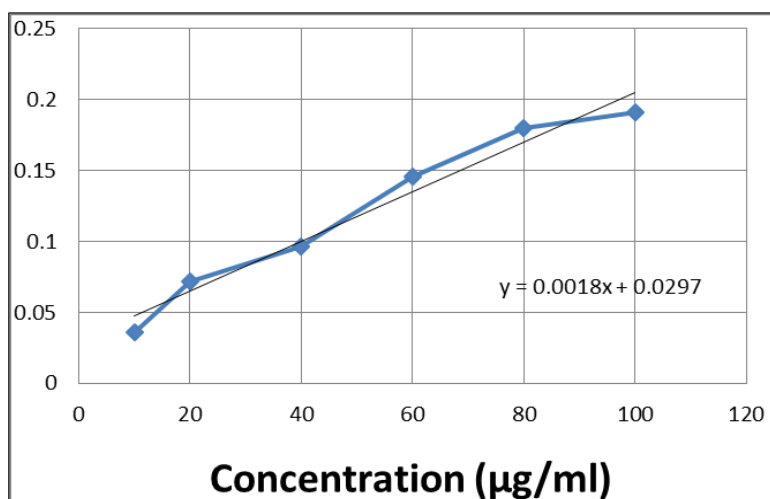


Figure 4 Calibration Curve for radish leaves powder at 264nm

3.4. Percentage of Drug release

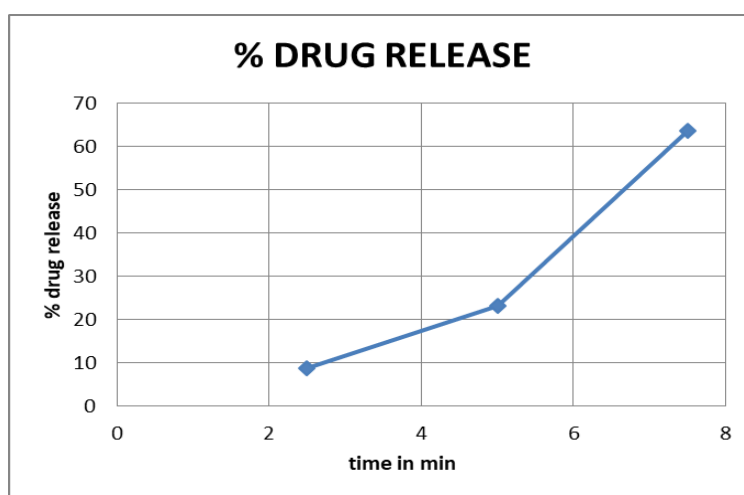


Figure 5 Percentage of drug release from the Nutraceutical Tablets

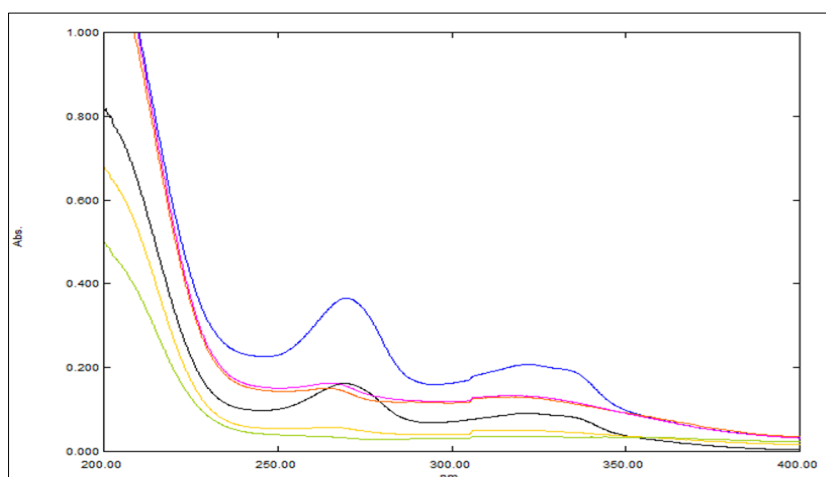


Figure 6 UV Spectra for Dissolution of Nutraceutical Tablet

The average percentage of drug release within 10mins as determined by the proposed Spectrophotometric method after in vitro dissolution of tablets is depicted in figure 15.

Dissolution studies of Nutraceutical tablets were preformed and the percentage of drug release was found to be 63.75% within 7.5 mins.

4. Conclusion

This research area is particularly interesting to the academic community as well as the food and pharmaceutical industries. Of nutraceutical products for clients of different ages. Because of the major preventative function that these products have been shown to play, additional in-depth research on their effectiveness and safety in the academic and pharmaceutical fields is needed. With regard to the implications for the economy and health, utilising cutting-edge and high-throughput technologies can also help us better understand the underlying mechanisms of action and advance this fascinating field of study.

Delivering the active ingredient to the target organ at therapeutically relevant levels with minimal side effects is essential for a newly developed Nutraceuticals to be successful. In the current study, the Nutraceutical tablet made from powdered radish leaf was analysed using the dissolving method. In addition, the percentage of medication released vs time was analysed using the UV-Spectrophotometric method, and a graph illustrating this was produced. A statistical closeness of the results was ensured through the analysis of the data. Whereas at 7.5 minutes, the percentage of drug release was significant (65.75%).

Compliance with ethical standards

Acknowledgment

Every stage of the research project involved equal participation from all of the authors. They have extended their consent for the publication of present manuscript your prestigious journal.

Disclosure of conflict of interest

We are here by declaring that there is no conflict of interest.

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Author's short biography



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