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FORMULATION AND EVALUTION OF POLYHERBAL TABLET AS A HEART SUPPLEMENT

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ABSTRACT

The present study focuses on the formulation and evaluation of polyherbal tablets intended for cardiovascular activity. The formulation consists of herbal ingredients such as Terminalia arjuna, Moringa oleifera, Triphala and Allium sativum, which are well known for their cardioprotective, antioxidant and antihyperlipidemic properties. The tablets were prepared using the wet granulation method and evaluated for various pre-compression and post-compression parameters including bulk density, angle of repose, weight variation, friability, disintegration and dissolution. The results indicated that all formulations showed acceptable pharmaceutical properties, while formulation F3 exhibited comparatively better drug release profile and overall performance. Thus, the study concludes that the developed polyherbal tablets can be considered as a promising approach for cardiovascular health management.

KEYWORDS: Allium sativam, cardiovascular activity, dissolution study, moringo oleifera, terminalia arjuna Polyherbal tablets.

INTRODUCTION

Cardiovascular diseases (CVDs) are among the leading causes of morbidity and mortality worldwide. These disorders mainly include hypertension, atherosclerosis, coronary artery disease and heart failure. The increasing prevalence of cardiovascular disorders is associated with lifestyle changes, unhealthy diet, stress and lack of physical activity. Although synthetic

drugs are available for the management of these conditions, their long-term use may lead to various side effects. Therefore, there is a growing interest in the use of herbal medicines due to their safety, efficacy and minimal adverse effects.

Herbal remedies have been used for centuries in traditional medical system such as Ayurveda, traditional chinese Medicine (TCM) and Unani. Many medicinal plant possess bioactive compounds which and build our heart profile strongly, and reduce chances of achieving heart disease. Some of that commonly studied herbs are Terminalia arjuna, Allivum Sativum (Garlic), Moringo Oliferia, triphala all these herbs exert their effect through various mechanisms such as reduce lipid level ,vasidilation ,diuresis ect.

INDIAN SURVEY FOR CARDIOVASCULAR DISEASES

Cardiovascular diseases (CVDs) are the leading cause of death in India, accounting for a significant proportion of total mortality. According to national health reports, CVDs contribute to nearly 28–30% of all deaths in India. The increasing burden is mainly due to rapid urbanization, sedentary lifestyle, unhealthy dietary habits, smoking and stress. The prevalence of hypertension, diabetes and obesity has also increased significantly, which are major risk factors for cardiovascular diseases. Studies indicate that Indians develop heart diseases at a younger age compared to Western populations. Rural areas are also showing a rising trend due to changing lifestyles. Therefore, there is a growing need for safe, effective and affordable therapies, including herbal formulations, for the management and prevention of cardiovascular diseases in India.

BENEFITS OF POLYHERBAL MEDICINE

Polyherbal formulations refer to the combination of two or more medicinal herbs in a single dosage form to achieve enhanced therapeutic efficacy. The major advantage of polyherbal medicine is the synergistic effect, where the combined action of different herbs produces a better therapeutic outcome compared to a single herb. This approach helps in improving the effectiveness of treatment while reducing the required dose of individual components. Polyherbal formulations act on multiple targets simultaneously, which is particularly beneficial in complex diseases such as cardiovascular disorders. They possess various pharmacological properties including antioxidant, anti-inflammatory, antihyperlipidemic and cardioprotective effects. Additionally, polyherbal medicines are generally safer, have fewer side effects and are suitable for long-term use.

Another important benefit is improved bioavailability, as certain herbs enhance the absorption of active constituents of others. Polyherbal formulations are also cost-effective, easily available and based on traditional knowledge systems like Ayurveda. Therefore, they offer a holistic and balanced approach in disease management and health promotion.

MARERIAL AND METHODS

Active Pharmaceutical Ingredients

1. GARLIC: GARLIC (ALLICIN)

The biological name of Garlic is:. Allium sativum

Garlic belongs to the family Amaryllidaceae (or Alliaceae in some classifications).

- Family: Amaryllidaceae
- Genus: Allium
- Species: A. sativum

API GARLIC

1. Allicin

-Standardized extracts: Garlic extracts can be standardized for allicin content.

- Potential health benefits: Allicin may support cardiovascular health and have antimicrobial properties.

mechanism of action

1) Cardiovascular Effects

- Vasodilation: Garlic may help relax blood vessels, improving blood flow.
- Lipid-lowering effects: Garlic may help reduce cholesterol and triglyceride levels.

2) Antimicrobial Effects

-Allicin's antimicrobial properties: Allicin may help combat bacterial, viral, and fungal infections.

3) Antioxidant Effects

- Antioxidant activity: Garlic's sulfur compounds may help protect against oxidative stress.

4) Other Potential Effects

- Anti-inflammatory effects: Garlic may help reduce inflammation. antimicrobial properties may help preserve food.

2. ARJUNA API: ARJUNA)

- **Biological Name –** *Terminalia arjuna.*
- **Kingdom -** *plantae*
- **Family –** Combretaceae
- **Genus –** *Terminalia*
- **Species –** *arju*

1. Active Constituents

Tannins (arjunic acid, arjunolic acid) Flavonoids Glycosides

Standardized extracts: Arjuna extracts can be standardized for tannin content.

Potential health benefits: Cardioprotective, antioxidant

Mechanism of Action

1) Cardiovascular Effects: Cardiotonic effect: Strengthens heart muscles Improves coronary circulation: Enhances blood flow to heart
2) Antioxidant Effects: Free radical scavenging: Protects against oxidative stress
3) Lipid-lowering Effects: Helps reduce cholesterol levels
4) Anti-inflammatory Effects: Reduces inflammation in cardiovascular system.

Uses

Management of cardiovascular disorders

Hypertension control

Hyperlipidemia

Heart tonic in Ayurveda

General health supplement

3. Moringa oleifera (API: MORINGA)

Biological Name – Moringo Oleifera

Kingdom – plantae.

Family – Moringaaceae

Genus – Moringa

Species – Oleifera

1. Active Constituents

Flavonoids

Alkaloids

Vitamins (A, C, E)

Polyphenols

Standardized extracts: Based on polyphenol content

Potential health benefits: Antioxidant, anti-inflammatory

Mechanism of Action

- 1) Antioxidant Effects: Neutralizes free radicals
- 2) Anti-inflammatory Effects: Reduces inflammatory mediators
- 3) Cardiovascular Effects: Helps reduce blood pressure, Improves lipid profile
- 4) Nutritional Support: Provides essential nutrients

Uses

- ✓ Nutritional supplement
- ✓ Antioxidant therapy
- ✓ Blood pressure control
- ✓ Immune booster
- ✓ General wellness

4. Triphala (API: TRIPHALA)

The triphala is a mixture of 3 different herbs that includes Haritaki, Bibhitaki and Amalaki. Biological profile.

1. Haritaki

Biological name – Terminalia chebula

Kingdom – Plantae

Family – Combretaceae

Genus – Terminalia

Species – chebula.

2. Bibhitaki

Biological name – Terminalia bellirica

Kingdom – plantae

Family – Combretaceae

Genus – Terminalia

Species – bellirica.

3. Amalaki

Biological name – Emblica officinalis

Kingdom – Plantae

Family – Phyllanthaceae

Genus - Emblica

Species – officinlis.

4. Active Constituents

- Tannins
- Gallic acid
- Ellagic acid
- Vitamin C

Standardized extracts: Based on tannins and phenolics

Potential health benefits: Antioxidant, detoxifying

Mechanism of Action

1) Antioxidant Effects: Strong free radical scavenging activity

2) Digestive Effects: Improves digestion and metabolism

3) Detoxification: Eliminates toxins from body

4) Anti-inflammatory Effects: Reduces inflammation.

Uses

- ✓ Digestive health
- ✓ Detoxification
- ✓ Antioxidant therapy
- ✓ Ayurvedic medicine

- ✓ General health tonic

Excipients

1. Starch

Starch is a natural polymer widely used as a pharmaceutical excipient in tablet formulations. It is obtained from plant sources such as maize, potato and rice, and consists mainly of two components, amylose and amylopectin. In the present study, starch was used primarily as a binder to provide cohesiveness to the granules, ensuring proper tablet formation during compression. Starch also exhibits disintegrant properties due to its ability to absorb water and swell, which facilitates the breakup of tablets after administration. This dual functionality makes starch a versatile excipient in tablet formulation. It is non-toxic, biodegradable, cost-effective and readily available, making it suitable for use in herbal formulations. The presence of starch improves the mechanical strength of tablets while also aiding in their disintegration and drug release.

2. Microcrysalline cellulose

Microcrystalline cellulose (MCC) was used as a diluent and dry binder due to its excellent compressibility and ability to enhance tablet hardness. Starch was employed as a binder to provide cohesiveness to the granules and ensure proper tablet formation during compression. It also acts as a disintegrant by facilitating water uptake and swelling, thereby promoting tablet breakup. Talc was used as a glidant to improve the flow of granules and reduce friction during tablet compression.

3. Magnesium Stearate

Magnesium stearate was incorporated as a lubricant to prevent sticking of granules to the punches and dies, ensuring smooth tablet production. These excipients collectively contributed to the successful formulation of tablets with acceptable pharmaceutical characteristics.

4. Talc

Talc was used as a glidant to improve the flow of granules and reduce friction during tablet compression.

METHOD

The present study was carried out for the formulation and evaluation of polyherbal tablets intended for cardiovascular activity. The formulation was developed using selected herbal ingredients, namely Terminalia arjuna, Moringa oleifera, Triphala and Allium sativum. The tablets were prepared by wet granulation method and evaluated for various pharmaceutical parameters**.** In the tablet pressing process, the appropriate amount of active ingredient must be in each tablet. Hence, all the ingredients should be well-mixed. If a sufficiently homogenous mix of the components cannot be obtained with simple blending processes, the ingredients must be granulated prior to compression to assure an even distribution oof active compound in the final tablet. Two basic techniques are used to granulate powders for compression into a tablet: wet granulation and dry granulation.

WET GRANULATION

Wet granulation is a widely used method for the preparation of tablets, in which powder particles are agglomerated using a liquid binder to form granules with improved flow and compressibility. In the present study, polyherbal tablets were prepared using the wet granulation technique. Accurately weighed quantities of herbal powders were passed through a suitable sieve to ensure uniform particle size and then mixed thoroughly to obtain a homogeneous blend. A binder solution was prepared using starch and added gradually to the powder mixture with continuous mixing to form a coherent damp mass. The wet mass was then passed through a sieve to produce granules of uniform size. These granules were dried at a controlled temperature to remove moisture. The dried granules were again sieved to break lumps and obtain uniform granule size. Lubricants such as talc and magnesium stearate were added to the dried granules and mixed properly. Finally, the prepared granules were compressed into tablets using a rotary tablet press with suitable punch size. This method improves flow properties, compressibility and uniformity of the final tablets.

Compression of Herbal Tablets

The dried granules obtained after wet granulation were subjected to compression for tablet formation. The granules were first passed through a sieve to obtain uniform size and then blended with lubricants such as talc and magnesium stearate to improve flow and reduce friction during compression. The lubricated granules were then compressed into tablets using a rotary tablet press fitted with appropriate punch and die set. The compression process was carried out under controlled conditions to obtain tablets with uniform weight, hardness and

thickness. The use of wet granulation prior to compression ensured better flow properties, improved compressibility and uniformity of the final tablets.

Formulation Table

The formulation table shows the quantity of 500mg weight of 20 tablets.

Sr.no	Ingredients		Quantities	
		F1	F2 (Standard)	F3
1.	Conc. Powder of arjuna	2.50 g	2.50 g	2.50 g
2.	Conc. Powder of moringa	1.50 g	1.50 g	1.50 g
3.	Extract of garlic	1.00 g	1.00 g	1.00 g
4.	Conc. Powder of Triphala	1.00 g	1.00 g	1.00 g
5.	MCC	2.80 g	2.40 g	2.00 g
6.	Starch	0.80 g	1.20 g	1.60 g
7.	Talc	0.20 g	0.20 g	0.20 g
8.	M. Stearate	0.20 g	0.20	0.20

Evaluation of Polyherbal tablets

1. Precompression Test

Evaluation of Granules The angle of repose was determined by allowing the granules to flow through a funnel and form a cone. The height and radius of the heap were measured and the angle of repose was calculated using the formula: $\tan \theta = h/r$

This test indicates the flow property of granules. The prepared granules were evaluated for pre-compression parameters to assess their flow properties and suitability for tablet compression.

A. Angle of Repose

The angle of repose was determined by allowing the granules to flow through a funnel and form a cone. The height and radius of the heap were measured and the angle of repose was calculated using the formula: $\tan \theta = h/r$

This test indicates the flow property of granules

B. Bulk Density

Bulk density was determined by pouring a known quantity of granules into a graduated cylinder and measuring the volume. It is expressed as: Bulk density = Weight / Bulk volume.

C. Tapped Density

Tapped density was determined by tapping the graduated cylinder containing granules until a constant volume was obtained. It is expressed as: Tapped density = Weight / Tapped volume.

D. Carr's Index

Carr's index was calculated using bulk and tapped density: Carr's index = [(Tapped density – Bulk density) / Tapped density] × 100 It indicates compressibility of granules.

E. Hausner Ratio

Hausner ratio was calculated as: Hausner ratio = Tapped density / Bulk density It indicates flowability of granules.

Results of precompression Parameters

Table No. 2.

TEST	RESULTS		
	F1	F2	F3
Angle of Repose	26	27	29
Bulk density (g/ml)	0.52	0.55	0.49
Tapped denisy (g/ml)	0.58	0.60	0.55
Carr's index (%)	14.30	14.40	14.42
Haunsner ratio	1.16	1.15	1.19

OBSERVATION "The granules showed good flow properties with acceptable angle of repose, Carr's index and Haunser ratio, Indicating suitable for compression."

Post Compression Tests

The prepared tablets were evaluated for various post-compression parameters to assess their quality, uniformity and performance. These tests are essential to ensure that the tablets meet pharmacopoeial standards and are suitable for therapeutic use. The evaluation includes parameters such as weight variation, hardness, friability, disintegration time and dissolution study.

1. Weight Variation Test

Twenty tablets were randomly selected and weighed individually using a digital balance. The average weight was calculated, and individual weights were compared with the average weight. The tablets comply with the test if the weight variation is within the pharmacopoeial limits. Calculate the percentage deviation of each tablet's weight using formula

Percentage deviation = Individual tablet weight – Average weight / average weight *100.

2. Hardness Test

The hardness of tablets was determined using a hardness tester. It measures the force required to break the tablet and indicates the mechanical strength of tablets.

3. Thickness of tablet

Measuring thickness of Tablet use a Vernier caliper or a calibrated micrometer. Place the tablet between the jaws of the caliper and gently close the jaws until they touch the tablet surface without compressing it. Read the measurement on the scale to get the tabet thickness, usually expressed in millimeters.(mm).

4. Friability Test

Friability was evaluated using a friabilator. A pre-weighed sample of tablets was subjected to 100 revolutions at 25 rpm. The tablets were then dedusted and reweighed. The percentage friability was calculated, and values less than 1% are considered acceptable.

5. Disintegration Test

Results of Postcompression Test

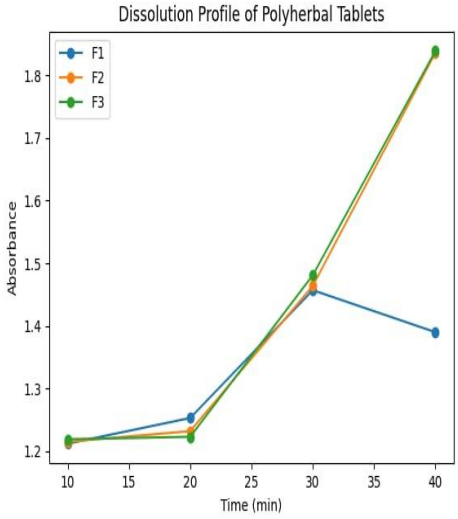
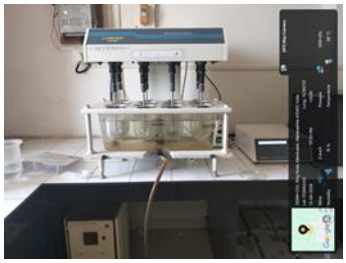


Table No. 3.

TEST	RESULTS		
	F1	F2	F3
Weight Variation	239.5 mg	237 mg	242.8 mg
Hardness test	2 kg/cm	3.5 kg/cm	4 kg/cm
Thickness of tablet	3.9 mm	4.1 mm	4.3 mm
Friability	1.48	0.9	0.6
Disintegration	8 min	9.5 min	13 min

The disintegration test was performed using a disintegration test apparatus. Tablets were placed in the basket assembly containing suitable medium, and the time taken for complete disintegration was recorded.

5. Dissolution Test



The dissolution study was carried out using a dissolution apparatus in a suitable dissolution medium. Samples were withdrawn at predetermined time intervals and analyzed using a UV spectrophotometer to determine the amount of drug released.

DISSOLUTION TEST RESULTS

Table No. 4.

TIME (Min)		% Drug Release	
	F1	F2	F3
10	66	66	66
20	68	67	67
30	79	80	81
40	76	98	94

OBSERVATION

dissolution study was carried out and percentage drug release was calculated from the absorbance values. The results showed that drug release increased with time for all formulations. Among all batches, formulation F3 exhibited the highest drug release, followed by F2 and F1. At 40 minutes, F2 showed maximum drug release indicating better dissolution profile. The optimized concentration of binder and MCC in F3 may have contributed to improved drug release. Minor variations observed in intermediate readings may be due to experimental conditions. “The dissolution profile indicates that the formulation is suitable for effective deug Release.

Antioxidant Activity (DPPH Assay)

The antioxidant activity of the formulated polyherbal tablets was evaluated using the DPPH assay method. DPPH (2,2-diphenyl-1-picrylhydrazyl) is a stable free radical which shows a deep violet color. When an antioxidant is present, it donates hydrogen and reduces DPPH, resulting in a decrease in absorbance. In this method, a fixed concentration of DPPH solution was prepared in methanol. Different concentrations of the sample solution were prepared and mixed with DPPH solution. The mixture was incubated in dark for 30 minutes. The absorbance was measured at 517 nm using a UV spectrophotometer. The antioxidant activity

of the formulated tablets was evaluated by DPPH assay using a standard 96-well plate method. The analysis was carried out at an external certified laboratory, and the obtained results were used for further interpretation.

The percentage inhibition of DPPH radical was calculated using the formula

% Inhibition = $[(A_0 – A_1) / A_0] \times 100$

Where,

A_0 = Absorbance of control

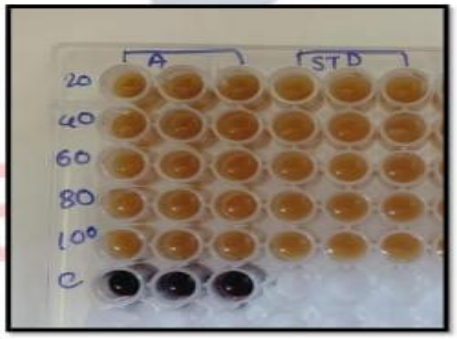
A_1 = Absorbance of sample

Antioxidant Activity of Sample by DPPH Method (96-Well Plate)

Sr. no	Sample code	Conc. µg/ml	OD			Mean	Percent inhibition
1	Control	-	1.456	1.564	1.485	1.502	
2	Standard (Ascorbic Acid)	200	0.369	0.345	0.355	0.356	76.27
		400	0.345	0.341	0.336	0.341	77.31
		600	0.326	0.342	0.343	0.337	77.56
		800	0.256	0.245	0.255	0.252	83.22
		1000	0.123	0.122	0.121	0.122	**91.88**
3	Sample- A (Tablet)	200	0.586	0.595	0.585	0.589	60.80
		400	0.445	0.542	0.439	0.475	68.35
		600	0.425	0.421	0.458	0.435	71.05
		800	0.385	0.399	0.378	0.387	74.21
		1000	0.349	0.352	0.354	0.352	**76.58**

Calculation:

Inhibition (%) = (OD Control – OD Sample) / OD Control ×100



The above data is obtained from the certified analytical report of antioxidant activity (DPPH Assay) performed by an external laboratory for the development of polyherbal tablet.

RESULT

The antioxidant activity of the formulated polyherbal tablets was evaluated using the DPPH assay method. The results showed a concentration-dependent increase in percentage inhibition, indicating significant free radical scavenging activity. At a concentration of 200 µg/ml, the formulation showed 60.80% inhibition, which increased progressively to 76.58%

at 1000 µg/ml. This indicates that the antioxidant activity of the formulation improves with increase in concentration. The results suggest that the polyherbal formulation possesses considerable antioxidant potential, which may be attributed to the presence of phytoconstituents such as phenolics and flavonoids present in the herbal ingredients. eport of antioxidant activity (DPPH Assay) performed by an external laboratory for the development of polyherbal tablet formulation.

OBSERVATIONS

The polyherbal tablets were successfully prepared using wet granulation method. The prepared granules showed good flow properties with acceptable values of angle of repose, Carr's index and Hausner ratio, indicating suitability for compression.

The compressed tablets were evaluated for post-compression parameters. The weight variation of all batches was found within acceptable limits. The hardness of tablets indicated adequate mechanical strength. The friability of formulation F1 was slightly above the acceptable limit, while F2 and F3 were within limits.

The disintegration time of all formulations was within the prescribed limit, with F1 showing faster disintegration compared to F2 and F3. The dissolution study indicated that drug release The antioxidant activity evaluated by DPPH assay demonstrated a concentration-dependent increase in percentage inhibition, confirming significant free radical scavenging activity of the formulation.

CONCLUSION

The present study concludes that polyherbal tablets containing Terminalia arjuna, Moringa oleifera, Triphala and Allium sativum can be successfully formulated using wet granulation method. The prepared tablets exhibited satisfactory pre-compression and post-compression parameters. The dissolution study indicated effective drug release, and antioxidant activity confirmed significant free radical scavenging potential of the formulation. Among all batches, formulation F3 was found to be the optimized formulation due to its better mechanical strength, faster disintegration and higher drug release. Thus, the developed polyherbal tablet formulation can be considered as a promising candidate for cardiovascular activity and may provide therapeutic benefits.

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