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Research Article

Formulation And Evaluation of Polyherbal Nutraceutical Tablet

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ABSTRACT

The increasing demand for natural health products has led to the growing popularity of nutraceuticals, which offer health benefits beyond basic nutrition. This study focuses on the formulation and evaluation of a polyherbal nutraceutical tablet incorporating scientifically selected herbs known for their therapeutic and nutritional value. The herbal ingredients used—Curcumin, Ginger, Ashwagandha, Tulsi, and Moringa—were chosen based on their pharmacological activities including antioxidant, anti-inflammatory, immunomodulatory, and adaptogenic effects. The Tablet were prepared using conventional methods such as wet granulation and direct compression. Comprehensive evaluation of the formulated Tablet was conducted to assess their pre-compression and post-compression parameters, including hardness, friability, disintegration time, and drug content uniformity. The study also involved stability testing and assessment of bioactive content to ensure safety and efficacy. The results indicated that the optimized formulation exhibited satisfactory physicochemical characteristics within pharmacopeial limits, ensuring consistency, stability, and therapeutic relevance. This formulation holds potential as a dietary supplement to address nutritional deficiencies and promote general well-being. The findings support the role of polyherbal nutraceutical Tablet as a promising alternative in preventive healthcare and functional nutrition.

INTRODUCTION

In recent decades, there has been a significant shift in global health consciousness, with growing interest in natural and holistic approaches to disease prevention and wellness. Among these, nutraceuticals—a term combining “nutrition” and “pharmaceutical”—have emerged as a promising category of products that bridge the gap between food and medicine. Nutraceuticals are bioactive compounds derived from natural sources such as plants, herbs, fruits, and vegetables that provide medical or health benefits, including the prevention and treatment of disease [1,2,3]. Unlike synthetic pharmaceuticals, nutraceuticals offer the

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advantage of being perceived as safer, with fewer side effects due to their natural origin. They provide targeted health benefits such as antioxidant protection, immune modulation, improved metabolic function, and disease prevention. As modern lifestyles and dietary habits have led to nutrient deficiencies and increased susceptibility to chronic diseases, there is an urgent need for convenient and effective means of supplementation. Nutraceutical Tablet serve this purpose efficiently, offering a controlled dose of essential nutrients in an easy-to-administer form [4,5,6]. Polyherbal formulations, which combine multiple medicinal herbs, are known to produce synergistic therapeutic effects by targeting multiple physiological pathways. Traditional systems of medicine, such as Ayurveda, have long employed such combinations to enhance efficacy and reduce toxicity. In the current study, a polyherbal nutraceutical tablet was formulated using well-established herbs—Curcumin (Curcuma longa), Ginger (Zingiber officinale), Ashwagandha (Withania somnifera), Tulsi (Ocimum sanctum), and Moringa (Moringa oleifera)—each known for its unique pharmacological properties [7,8,9].

The formulation was developed through conventional pharmaceutical techniques, including wet granulation and direct compression. These techniques ensure consistent quality, ease of administration, and stability of the final product. The prepared Tablet were evaluated for various pre- and post-compression parameters to determine their suitability for therapeutic use. This research aims to develop a scientifically validated, effective, and consumer-friendly polyherbal nutraceutical tablet that supports health and well-being through natural means [10,11].

Potential Health Benefits [12,13,14]

Nutraceuticals have been studied for their potential to address various health concerns, including:

- Cardiovascular health: Omega-3 fatty acids, antioxidants, and phytosterols have¬ shown promise in reducing the risk of heart disease, stroke, and high blood pressure.
- Immune function: Vitamins C, D, and zinc, as well as probiotics, can support¬ immune system function and reduce the incidence of infections.
- Neurological health: Antioxidants, omega-3 fatty acids, and certain¬ phytochemicals have been linked to improved cognitive function and a reduced risk of neurodegenerative diseases.
- Metabolic health: Dietary fiber, prebiotics, and probiotics can play a role in weight¬ management, blood sugar control, and insulin sensitivity.
- Cancer prevention: Antioxidants, phytochemicals, and omega-3 fatty acids have¬ been investigated for their potential to reduce the risk of certain cancers.

Nutraceuticals and Their Role in Common Diseases [15,16,17]

- **Cardiovascular Diseases (CVD):**
  - CVD includes heart attack, stroke, heart failure, and high blood pressure.
  - Poor fruit and vegetable intake increases CVD risk.
  - Nutraceuticals like antioxidants, omega-3 fatty acids, polyphenols, and vitamins help prevent and manage CVD.

- **Hypertension (High Blood Pressure):**
  - Can be controlled with a healthy diet, exercise, and lifestyle changes.
  - Nutrients like lipoic acid, magnesium, vitamin B6, vitamin C, omega-3, celery, and Hawthorne act like natural blood pressure-lowering agents.

- **Obesity:**

  - A major risk factor for many diseases like heart issues, diabetes, joint pain, and infertility.
  - Caused mainly by junk food and lack of physical activity.
  - Nutraceuticals can help by boosting metabolism or reducing appetite.

- **Diabetes:**

  - Type 1 (autoimmune) and Type 2 (linked to obesity) are the most common.
  - Nutraceuticals help manage blood sugar levels and reduce complications.

- **Immune Boosting:**

  - Nutrients and phytoestrogens (like soy isoflavones) can strengthen immunity.
  - These also help balance hormones and may prevent infections, cancer, and inflammation.

- **Osteoarthritis:**

  - Affects joints and causes pain, limiting physical activity.
  - Nutraceuticals like glucosamine and chondroitin sulfate reduce inflammation and improve joint health.

Types of Nutraceutical Tablet [18,19]

- **Vitamin & Mineral Tablet**

Contain essential nutrients like vitamins A, C, D, B-complex, calcium, iron, and zinc for overall health.

- **Omega-3 Fatty Acid Tablet**

Provide EPA and DHA, which support heart, brain, and reduce inflammation.

- **Probiotic Tablet**
  Contain good bacteria to improve digestion, gut health, and immunity.

- **Antioxidant Tablet**
  Include vitamins like C, E, and beta-carotene to protect cells from damage.

- **Herbal Supplement Tablet**
  Made from herbs like ginseng, turmeric, and green tea for various health benefits.

Benefits of Nutraceutical Tablet [20,21,22,23]

- **Nutrient Supplementation**
  Provide essential nutrients like vitamins, minerals, antioxidants, and omega-3 fatty acids that may be missing from your diet.

- **Targeted Delivery**
  Can be designed to support specific health needs such as heart health, immunity, or digestion.

- **Antioxidant Protection**
  Help neutralize harmful free radicals, lowering the risk of chronic diseases like heart disease, cancer, and brain disorders.

- **Inflammation Reduction**
  Contain compounds that reduce inflammation, which is a root cause of many health issues.

- **Enhanced Immune Function**
  Boost immunity, making the body more resistant to infections and illnesses.

- **Improved Digestion**
  Probiotic and prebiotic Tablet support gut health and enhance digestive function.

- **Weight Management**
  Some formulations help in controlling weight by regulating metabolism and appetite.

- **Cognitive Support**
  Certain ingredients promote brain health, memory, and focus.

METHODS AND MATERIAL:

I. List of chemicals used

Sr. No.	Materials	Manufactures / Suppliers
1	Curcumin Powder	Yucca Chemical, Mumbai
2	Moringa Powder	Yucca Chemical, Mumbai
3	Ashwagandha Powder	Yucca Chemical, Mumbai
4	Tulsi Powder	Yucca Chemical, Mumbai
5	Ginger Powder	Yucca Chemical, Mumbai
4	Microcrystalline Cellulose	S. D. Fine Chemicals
5	Talc	S. D. Fine Chemicals
6	Magnesium Stearate	S. D. Fine Chemicals
7	PVP K 30	S. D. Fine Chemicals

Method

1. Preformulation Studies [24,25,26]

- Preformulation is the first step in drug development to study the drug's physical and chemical properties.
- Helps identify issues early and supports better formulation design.
- Ensures the final dosage form is safe, effective, and stable.

2. UV Spectroscopy

- A stock solution of curcumin was made using methanol.
- UV spectrum scanned between 200–400 nm using Shimadzu 1601 UV spectrophotometer.

3. Standard Curve of Curcumin [27,28]

- 100 mg curcumin was dissolved in methanol to make a 1000 µg/ml stock solution.
- Serial dilutions (2–10 µg/ml) were prepared.
- Absorbance was measured at 420 nm.
- A standard calibration curve was plotted with absorbance vs. concentration.

4. Drug-Excipient Compatibility Studies

- Done to check interactions between curcumin and excipients.
- FTIR (IR spectroscopy) was used for analysis.
- Samples were prepared with KBr in a 1:100 ratio and compressed into pellets.
- Spectra of mixed ingredients were compared with that of pure drug.

5. Formulation of Polyherbal Nutraceutical Tablet [29,30]

- Tablet were prepared using the wet granulation method.
- All powders were passed through sieve #40 for uniform size.
- Polyherbs were weighed, mixed, and combined with PVP K30 (binder).
- Microcrystalline cellulose (filler) was added and mixed well.

- A few drops of water were added to form a wet mass.
- Wet mass was passed through sieve #20 to form granules.
- Granules were dried at 70°C for 1 hour in a hot air oven.
- 1% magnesium stearate and 1% talc were mixed with dried granules.
- Final granules were compressed into Tablet using a rotary tablet machine (10 mm punch).

Table 1: Composition of Polyherbal Neutraceutical Tablet

Ingredients (mg)	F1	F2	F3	F4	F5	F6
Turmeric powder	200	200	200	**200**	200	200
Ginger powder	50	50	50	**50**	50	50
Ashwagandha powder	150	150	150	**150**	150	150
Moringa powder	100	100	100	**100**	100	100
Tulsi powder	100	100	100	**100**	100	100
PVP K 30	72	63	54	**45**	36	27
Talc	9	9	9	**9**	9	9
Mg. stearate	9	9	9	**9**	9	9
Microcrystalline Cellulose	210	219	228	**237**	246	255
Total Weight	900	900	900	**900**	900	900

6. Bulk Density (Db)

- Measures how much space the loose powder occupies.
- Calculated as: Db = M / Vb
  Where: M = mass of powder, Vb = bulk volume, Units: g/ml

7. Tapped Density (Dt)

- Measures powder density after tapping (settling).
- Calculated as: Dt = M / Vt
  Where: M = mass of powder, Vt = tapped volume, Tapping is done until volume change is < 2%, Units: g/ml

8. Angle of Repose (θ)

- Indicates flowability of powder.
- Formula: $\theta = \tan^{-1}(h / r)$
  Where: h = height of powder heap, r = radius of heap base, Powder is allowed to flow through a funnel to form a cone, Lower angle = better flow.

9. Carr's Index (% Compressibility)

- Measures powder compressibility and flow.
- Formula: Carr's Index = (Dt – Db) / Dt × 100
- Lower % = better flow.

Table 2: Relationship between % compressibility and flowability

% Compressibility	Flowability
5 – 12	Excellent
12 – 16	Good
18 – 21	Fair Passable
23 – 35	Poor
33 – 38	Very Poor
< 40	Very Very Poor

10. Hausner Ratio

- Assesses powder flow.
- Formula: Hausner Ratio = Dt / Db
- Dt = tapped density, Db = bulk density.
- A value <1.25 indicates good flow.

Evaluation of Tablet

11. Weight Variation

- 20 Tablet weighed individually to check uniformity.
- Acceptable deviation as per IP: ≤80 mg: ±10%, 80–250 mg: ±7.5%, ≥250 mg: ±5%

12. Hardness

- Measures tablet strength using Monsanto tester.
- Expressed in kg/cm².

13. Thickness

- Checked with vernier caliper.
- Ensures consistency in compression.
- Expressed in mm.

14. Friability

- Assesses tablet resistance to breaking.
- Tested using Roche friabilator at 25 rpm for 100 rotations.
- Formula: F = [(Winitial – Wfinal) / Winitial] × 100

15. In-Vitro Disintegration Time

- Time taken for Tablet to break down in fluid.
- Tested using USP disintegration apparatus.

16. Content Uniformity

- Drug content in 10 random Tablet checked by UV spectrophotometer at 240 nm.

17. In-Vitro Dissolution Study

- Carried out using USP Dissolution Apparatus (Type II – Paddle).
- Medium: Phosphate buffer (pH 6.8), 900 ml, 50 rpm, 37±0.5°C.
- Samples taken at intervals and drug release measured at 240 nm.

18. Stability Study

- Conducted to check shelf-life and storage conditions.
- Followed ICH guidelines.
- Tablet stored at 40°C and 75% RH for 3 months in aluminum foil.
- Parameters evaluated before and after: Appearance, Hardness, Disintegration Time, Drug Content, and Drug Release.

RESULT AND DISCUSSION:

Preformulation Studies:

The melting point of Curcumin was found to be 180–183°C, confirming its purity. It was insoluble in water, but soluble in ethanol, chloroform, and acetone, with better solubility in basic pH. Using UV spectroscopy, Curcumin showed a maximum absorbance (λmax) at 425 nm, matching reported values.

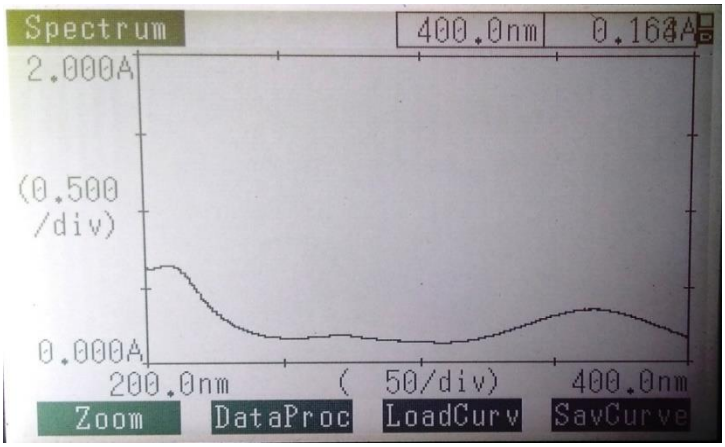

Figure 1: UV Absorption Maxima (λ max) of Curcumin at 425 nm

Standard Calibration Curve:

Curcumin solutions (5–35 µg/ml) were tested, and a straight-line graph was obtained, confirming it follows Beer-Lambert's Law. This curve was used to measure drug content in later tests.

Table 3: Standard Calibration Curve of Curcumin in in PBS pH 6.8

Sr. No.	Concentration (ug/ml)	Absorbance
1	0	0
2	5	0.146
3	10	0.283
4	15	0.38
5	20	0.502
6	25	0.627
7	30	0.714
8	35	0.832

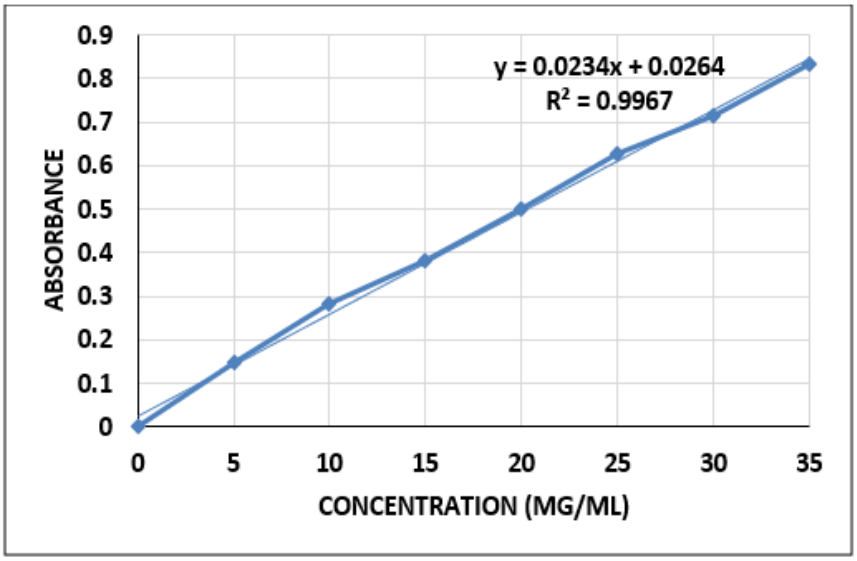

Figure 2: Standard Calibration Curve of Curcumin in Phosphate Buffer pH 6.8

FTIR Compatibility Study:

FTIR analysis showed that there was no chemical interaction between Curcumin and the excipients. All major characteristic peaks of Curcumin remained unchanged, confirming good compatibility.

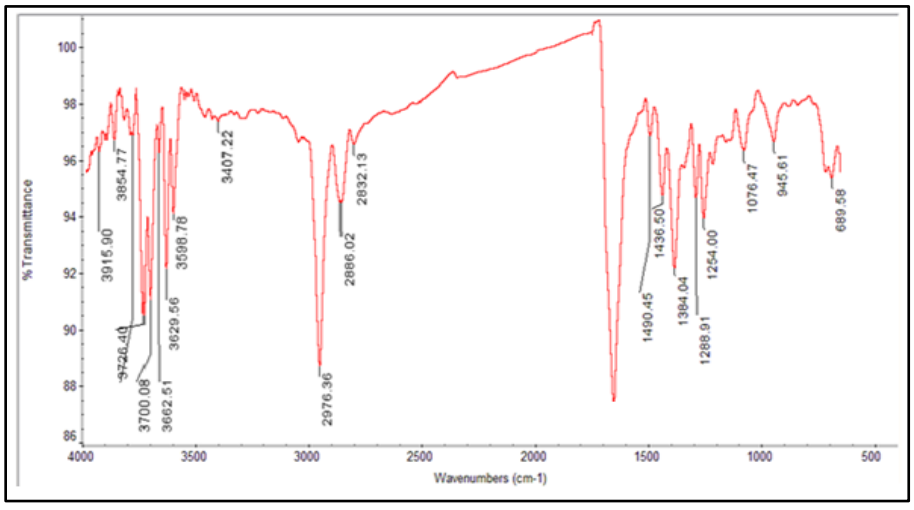

Figure 3: IR spectra of Pure Drug Curcumin

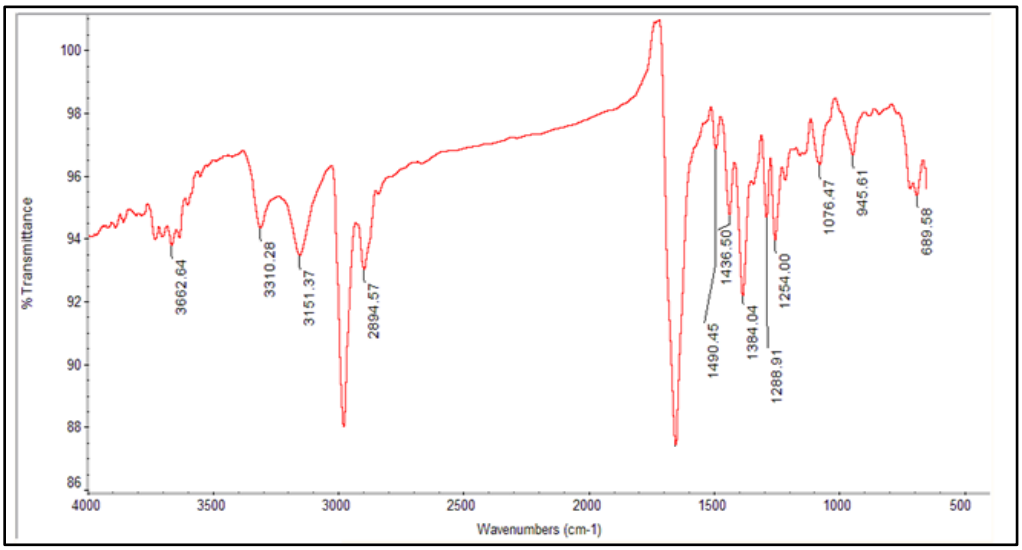

Figure 4: IR Spectra of Curcumin with excipients

Pre-compression Evaluation:

Powder blends of six formulations (F1 to F6) were tested for flow properties. All showed good to excellent flow with Hausner ratios <1.25 and Carr's Index <16%. F4 and F6 had the best flow properties, suitable for tablet making.

Table 4: Micromeritics Properties of Powder Blend (F1 to F6)

Batch	Angle of Repose (θ)	Bulk Density (g/cc)	Tapped Density (g/cc)	Compressibility Index (%)	Hausner's Ratio
F1	26.18	0.159	0.182	12.64	1.14
F2	28.04	0.165	0.195	15.38	1.18
F3	26.12	0.169	0.2	15.50	1.18
F4	**26.07**	**0.18**	**0.201**	**10.45**	**1.12**
F5	27.25	0.171	0.203	15.76	1.19
F6	26.55	0.178	0.198	10.10	1.11

Post-compression Evaluation:

Tablet were evaluated for weight, hardness, thickness, friability, drug content, and disintegration time:

- Weight variation was minimal, all within limits.
- Hardness decreased from F1 (7.6 kg/cm²) to F6 (5.5 kg/cm²) as binder concentration reduced.
- Thickness remained consistent (5.0–5.2 mm).
- Friability was below 1% in all batches, meaning Tablet were strong and not crumbly.
- Drug content was between 96.82% and 98.44%, indicating good uniformity.
- Disintegration time reduced significantly from F1 (8.34 min) to F6 (2.44 min) as binder concentration decreased. This shows that lower binder helps Tablet break faster.

Table 5: Post Compression parameters of Nutraceutical Tablet Formulation (F1 to F6)

Batch	Weight Variation (mg)	Thickness (mm)	Hardness (Kg/Cm^2)	Friability (%)	Drug Content Uniformity (%)	Disintegration Time (min)
F1	905±0.32	5.1±0.05	7.6±0.40	0.94±0.30	97.21±0.67	8.34±0.28
F2	904±0.23	5.2±0.07	7.4±0.25	0.86±0.19	96.82±0.24	7.24±0.18
F3	903±0.26	5.1±0.07	6.5±0.31	0.69±0.14	97.24±0.45	5.11±0.52
F4	**901±0.18**	**5.0±0.08**	**6.5±0.18**	**0.68±0.18**	**98.44±0.56**	**3.12±0.31**
F5	902±0.32	5.2±0.05	6.0±0.51	0.61±0.20	97.27±0.37	3.10±0.30
F6	902±0.22	5.1±0.9	5.5±0.46	0.54±0.18	97.19±0.56	2.44±0.22

In-Vitro Dissolution Study:

The drug release from Tablet was tested over 45 minutes. Results showed that:

- Lower binder concentration = faster drug release
- F4 (45 mg binder) had the highest drug release at 99.54% in 45 minutes.
- F5 and F6 also released >97%.
- F1 and F2 (higher binder) showed slower and incomplete drug release.

Table 6: Invitro Dissolution Profile of Curcumin

Time (min)	% Drug Release					
	F1	**F2**	**F3**	**F4**	**F5**	**F6**
0	0	0	0	**0**	0	
5	12.34 ±0.67	15.06 ±0.66	19.14 ±0.67	**33.19 ±0.55**	28.17 ±0.61	31.84 ±0.45
10	20.14 ±1.18	25.65 ±1.06	32.26 ±1.78	**42.23 ±1.20**	36.22 ±1.22	40.6 ±1.25
15	28.45 ±1.23	35.47 ±0.91	45.66 ±1.56	**55.61 ±1.34**	47.56 ±1.78	51.73 ±1.24
20	35.2 ±2.10	45.3 ±1.27	57.17 ±0.89	**74.67 ±1.60**	61.14 ±1.03	70.53 ±1.39
25	42.31 ±1.56	53.45 ±1.18	66.67 ±0.52	**86.33 ±1.56**	76.73 ±1.56	80.07 ±1.43
30	49.89 ±1.21	60.74 ±0.78	74.81 ±1.83	**90.44 ±1.25**	84.46 ±0.94	88.92 ±1.77
35	55.19 ±0.87	66.51 ±1.35	80.26 ±1.23	**94.54 ±1.93**	90.59 ±1.62	93.44 ±1.08
40	61.22 ±0.77	71.84 ±1.29	84.18 ±0.76	**96.71 ±1.44**	94.75 ±0.56	96.31 ±1.88
45	67.35 ±1.22	74.27 ±1.15	87.51 ±1.66	**99.54 ±1.28**	97.12 ±1.52	98.21 ±1.42

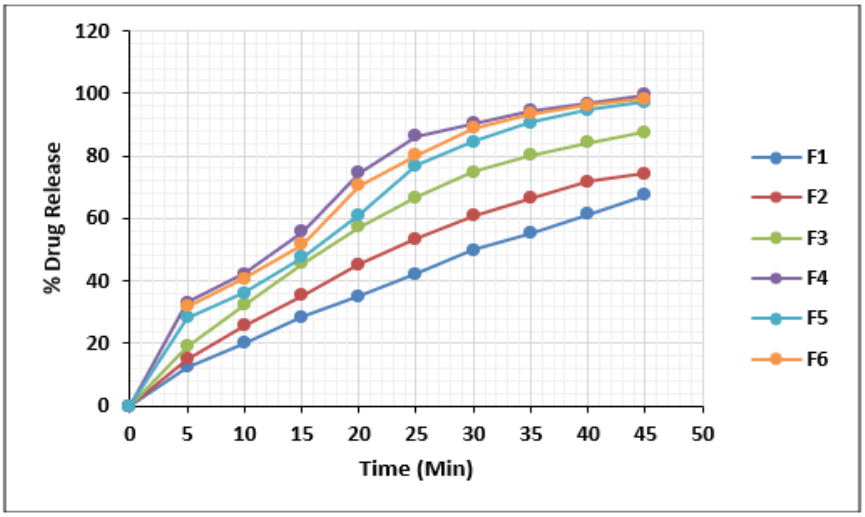

Figure 5: Comparative In vitro Dissolution Profile of Formulation F1 to F6

Conclusion from Dissolution Study:

Formulation F4 was considered best, offering quick and complete drug release without compromising strength.

Stability Study:

Formulation F4 was stored for 3 months at 40°C and 75% RH. No major changes were observed in:

- Hardness
- Drug content
- Disintegration time
- Drug release

This confirms that F4 was stable and suitable for long-term use.

Table 7: Stability data of Optimized formulation F4

Formulation Code	Parameter	Before storage (0 month)	After storage (3 month)
F4	Hardness (kg/cm2)	6.5±0.18	5.5±0.12
	Drug Content (%)	98.44±0.56	98.64±0.72
	Disintegration Time (sec)	3.12±0.31	27.21±0.18
	% Drug Release	99.54±1.28	99.82±1.31

CONCLUSIONS:

The results of this study provide a strong foundation for the successful development of nutraceutical Tablet using PVP K30 as a binder, so as to provide nutritional support to body and to overcome the nutrients deficiency of diet through formulation d.0evelopments of nutraceutical Tablet formulations. PVP K30 concentration significantly influences nutraceutical tablet mechanical strength, disintegration time, and dissolution profile. Formulation F4, containing 45 mg of PVP K30, showed an ideal balance of physical integrity and rapid drug release. Stability studies confirmed that F4 remained stable under accelerated conditions, making it a viable product for commercialization. In conclusion, moderate binder concentration (45 mg PVP K30) offers the most effective approach for formulating stable, fast-releasing, curcumin nutraceutical Tablet. These Tablet hold potential for improving the

therapeutic efficacy and patient compliance of nutraceutical supplements in the health and wellness industry. Future research may focus on long term stability study and incorporation of additional nutraceuticals agents for more health benefits.

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