GLOBAL JOURNAL OF INNOVATION AND RESEARCH
Vol -1, Issue-1, July - December 2025
Open Access peer-reviewed, multidisciplinary journal

Open Access Full Text Article

Research Article

Formulation development and In-vitro Evaluation of Effervescent Granules of Marketed *Avipattikar churna* Ayurvedic Formulation

Shubham Patel, Sunil Ahirwar*, Satkar Prassad, Shailesh Kumar Ghatuwary

RKDF School of Pharmaceutical Sciences, BHABHA Universisty, Madhya Pradesh, India

Cite this article as:

Patel S, Ahirwar S, Prasad S, Ghatuwary SK. Formulation development and In-vitro Evaluation of Effervescent Granules of Marketed Avipattikar churna Ayurvedic Formulation. Global Journal of Innovation and Research. 2025;1(1):82-92.

Correspondence to Author:

Sunil Ahirwar
RKDF School of Pharmaceutical Sciences, Bhabha University, Bhopal (M.P.).
Email: sunilahirwar687@gmail.com

Article Info:

Received 28 June 2025

Reviewed 29 July 2025

Accepted 30 July 2025

Published 25 August 2025

ABSTRACT

Avipattikar churna, a classical Ayurvedic formulation, is widely prescribed for the management of hyperacidity, indigestion, gastritis, and related gastrointestinal disorders. However, its traditional powder dosage form is often associated with poor palatability, reduced patient compliance, and variable dose accuracy. To overcome these drawbacks, effervescent granule formulations of *Avipattikar churna* were developed and evaluated. The formulation was prepared by non-aqueous wet granulation using citric acid, tartaric acid, and sodium bicarbonate as effervescent agents, along with suitable sweeteners and flavoring agents to improve taste masking and patient acceptability. Granules were evaluated for organoleptic properties, bulk and tapped density, angle of repose, Carr's index, moisture content, effervescence time, pH of solution, and drug content uniformity. The prepared granules showed good flow properties, low moisture content (<2%), rapid effervescence (<3 minutes), acceptable pH (5.5–6.5), and improved palatability compared to the crude powder. Stability studies indicated that the formulation remained stable under controlled storage when protected from moisture. Overall, effervescent granule formulation of *Avipattikar churna* proved to be a patient-friendly and convenient alternative dosage form with enhanced acceptability and potential for wider therapeutic use.

KEYWORDS: *Avipattikar churna*, effervescent granules, Ayurveda, formulation, patient compliance, gastrointestinal disorders.

INTRODUCTION

Herbal formulations have gained significant attention in recent years due to their safety, efficacy, and minimal side effects compared to synthetic drugs. Among the classical Ayurvedic preparations, *Avipattikar churna* is a well-established polyherbal formulation traditionally used for the management of hyperacidity, gastritis, indigestion, and related gastrointestinal disorders. It consists of multiple herbs such as Triphala, Trikatu, Musta, Vida Lavana, and Sugar, which collectively exert antacid, carminative, digestive, and mild laxative effects[1,2].

However, the conventional powder form of *Avipattikar churna* presents limitations such as bitter taste, poor palatability, hygroscopicity, and inconvenience of administration, especially in pediatric and geriatric populations. To overcome these challenges, novel dosage forms are being developed to enhance patient compliance, stability, and therapeutic efficacy[3].

Effervescent granules represent an innovative drug delivery approach where the active herbal ingredients are combined with effervescent agents like citric acid and sodium bicarbonate. Upon dissolution in water, they release carbon dioxide, producing a sparkling solution with improved taste masking, rapid onset of action, and enhanced gastric acceptability. This effervescent system not only improves the aesthetic appeal and patient acceptability of the formulation but also facilitates faster disintegration and absorption of the herbal actives[4,5].

Therefore, the formulation of effervescent granules of *Avipattikar churna* aims to modernize a classical Ayurvedic medicine into a more palatable, user-friendly, and effective dosage form, thereby bridging the gap between traditional knowledge and modern pharmaceutical technology.

MATERIALS AND METHDS

Materials

All the chemicals used were of analytical grade. Ascorbic acid (HiMedia Laboratories Pvt., Ltd.), citric acid (Qualigens Fine Chemicals Pvt., Ltd.), 2,2-diphenyl-1-picrylhydrazyl (Wako Pure Chemical), ethanol (CS, India), sodium bicarbonate (Merck Pvt., Ltd.), and tartaric acid (Qualigens Fine Chemicals Pvt., Ltd.) were used for the study. A rotary evaporator (Buchi, Germany), UV spectrophotometer (UV-1800, Shimadzu, Japan), dissolution apparatus (Electrolab), and sonicator (PCi Analytics Pvt., Ltd.) were the major equipment used for the study.

Methods

Preformulation study of *Avipattikar churna*

a. Organoleptic properties

Avipattikar churna was studied for its physical appearance, color, characteristic odor and taste using a standardized panel and scoring system[6].

b. Determination of pH

The pH of different formulations in 1% w/v and 10% w/v of water soluble portions were determined using pH paper (range 3.5–6) and (6.5–1.4) with standard glass electrode at 24° C[7].

c. Determination of Ash value

This procedure involves preparing crucibles, accurately weighing the powdered sample, and charging it. The crucible is then placed in a muffle furnace and ignited at 500 ± 25 °C until white, light-gray ash is obtained. The weight of the crucible and ash is then calculated. The percentage of total ash is calculated by adding 25 mL of 1M HCl to the ash, filtering the mixture through an ashless filter paper, and washing thoroughly. The filter containing

residue is transferred to a weighed silica/porcelain crucible and ignited at 450-600 °C. The percentage of acid-insoluble ash indicates siliceous material[8,9].

d. Extractive values

The Cold Maceration Method is a method for extracting water and hydro-alcoholic extractives. It involves accurately weighing a powdered sample into a flask, adding a solvent, shaking intermittently for 6 hours, and then allowing it to stand for 18 hours. The filtrate is collected, filtered, and aliquot. The aliquot is evaporated, dried, and then weighed. The extractive value is calculated using a formula:

% w/w = W×A

R×V×100.

The calculation involves a step-by-step arithmetic, resulting in an extractive value of 10.0% for the solvent[10].

e. Angle of repose (Ø)

After precisely weighing 100 grams of the mixture, it was carefully poured through a funnel with the tip fastened 2.5 cm above the graph paper that was set out on a horizontal surface. The mixture was poured until the conical pile's apex barely touched the funnel's tip. Table 4.8 illustrates the relationship between the powder's flow characteristics and angle of repose. Equation 1 provides the following formula for calculating angle of repose.

$$Ø = Tan - 1\left(\frac{h}{r}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots ii$$

Where,Ø =angleofrepose, r=radiusof thepile, h=heightof the pile. The reference values for corresponding angle of repose and type of flow is excellent (25-30), good (31-35), fair (36-40), passable (41-45), poor (46-55), very poor (56-65) and extremely poor (> 66)[11,12].

f. Bulk density

Apparent bulk density (*b) was determined by pouring the blend into a graduated cylinder. The bulk volume (V*) and weight of the powder (M) was determined. The bulk densitywas calculated using the formula given in Equation iii[11,12].

$$* b = \frac{M}{V} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots iii$$

g. Tappeddensity

The measuring cylinder containing a known mass of blend was tapped for a fixed time (around 250). The minimum volume (V_t) occupied in the cylinder and the weight (M) of the blend was measured. The tapped density (*t) was calculated using the formula given in Equation iv[11,12].

$$* t = \frac{M}{Vt} \ldots\ldots\ldots\ldots\ldots\ldots iv$$

h. Carr'sindex

The simplest way for measurement of free flow of powder is compressibility, a indication of the ease with which a material can be induced to flow is given by compressibilityindex (C.I) which is calculated using the formula given in Equation v. The

correlation between the compressibility index and flow properties of powder are as excellent (< 10), good (11-15), fair (16-20s), passable (21-25), poor (26-31), very poor (32-37) and extremely poor (>38) [11,12].

$$C.I\ (\%) = \frac{(tapped\ density\ -Bulk\ density) \times 100}{Tapped\ density} \ldots\ldots v$$

i. Hausner'sratio

Hausner's ratio is an indirect index of ease of powder flow. It was calculated by the using the formula given in Equation vi.The correlation between the hausner's ratio and flow properties of powder are shown in the Table 4.10.

$$C.I\ (\%) = \frac{(tapped\ density\ -Bulk\ density) \times 100}{Tapped\ density}.v$$

Where*t=tappeddensityand *d=bulk density. Corresponding values for Hausner's ratio for different types of flow is excellent (1.00-1.11), good (1.12-1.18), fair (1.19-1.25), passable (1.26-1.34), poor (1.35-1.45), very poor (1.46-1.59) and extremely poor (> 1.60) [11,12].

Preparation of effervescent granules

Avipattikar churna was was prepared using the Non-Aqueous Wet Granulation method. The acid mix was made by weighing citric acid, tartaric acid, sweetener, and flavoring agent. The base mix was made by weighing sodium bicarbonate and glidant. The granules were then passed through a sieve and dried at 40-45°C. The dehydrated granules were then mixed with the remaining flavor, glidant, or sweetener in Blend B. The granules were then filled into HDPE containers and sealed to prevent moisture intrusion[13-15].

2.2.3 Evaluation of *Avipattikar churna* effervescent granules

a. Micrometrical evaluation

Bulk density, tapped density, angle of repose, hausner's ratio and carr's index were determined for the prepared effervescent granules of *Avipattikar churna* in the similar manner as described under preformulation section[16,17].

b. Particle size Distribution analysis: Evaluation of the granules particle size distribution was carried out with a standard sieve set. The sieves and collection pans were orderly arranged from top to bottom as follows, 20, 30, 50, 60, 80, 100, and collection pans. Furthermore, the sample used was 100 grams of effervescent granules. At the initial stage, each sieve and collection pan were weighed, and the arrangement was placed on the "Retsch Vibrator. Subsequently, the granules were placed on the top sieve, closed, and tightened. A set of sieves was vibrated at a frequency of 60 Hz for 20 mins and weighed. Based on the data obtained, the weight of the granules contained in each sieve and the collection pan was determined[18].

c. Granules Moisture Content: Moisture content evaluation was carried out by weighing 5 grams of the granules and placing them on the moisture content analyzer. The instrument was run for 15 min with an annealing temperature of 100°C. The previous

validation exhibited that for these granules 15 min had been reached a constant weight. The moisture content was indicated on the instrument in percentage[19].

d. Effervescent Cessation Time

A volume of 200 mL of distilled water was taken in a beaker, one dose of effervescent granules (3 g) was poured into the beaker, and effervescent cessation time and effervescent production were observed[19].

e. Stability Studies

For stability study of the formulation, effervescent cessation time was carried out after the 1st month, 2nd month, and 3rd month of formulation at normal room temperature, i.e., at 27 ± 2°, and accelerated temperature, i.e., at 40 ± 2°, and also the granules were examined visually for any changes in color, odor, and texture[20,21].

RESULTS

Preformulation study

Preformulation study was performed to investigate for the selected *Avipattikar churna* formulation to avoid any problems during formulation step. It included oganoleptic properties determination, ash value, extractive value and acid values. Physical properties such as bulk density, tapped density, angle of repose, hausner's ratio and carr's index were also determined.

a. Organoleptic properties

Organoleptic properties such as appearance, color, taste and odor were determined the results are tabulated in Table 1

Table 1: Organoleptic properties of different *Avipattikar churna* formulations

Parameters	Appearance	Colour	Taste	Odour
In-house	Powder	Light brown	Sweet	Characteristic
Baidyanath	Powder	Light brown	Sweet	Characteristic

b. Determination of Ash value

Ash values for all the ingredients of *Avipattikar churna* was determined and tabulated in Table 2.

c. Extractive values

Both alcohol soluble and water soluble extractive values were determined and the results are tabulated in Table 3.

Table 2: % Ash values of individual ingredients present in *Avipattikar churna* (w/w)

Samples	Total ash Mean (n=3)± SD	Acid insoluble ash Mean (n=3)± SD
Zingiber Officinale	5.69 ± 0.07	0.64 ± 0.03
Piper nigrum	4.70 ± 0.60	0.33 ± 0.07
Piper longum	4.84 ± 0.40	0.47 ± 0.08
Terminalia chebula	2.78 ± 0.41	0.12 ± 0.03
Terminalia bellirica	4.22 ± 0.45	0.29 ± 0.10
Embelica officinalis	4.18 ± 0.64	0.38 ± 0.33
Cyperus rotundus	3.64 ± 0.22	3.60 ± 0.14
Embeliaribes	4.74 ± 0.70	0.19 ± 0.05
Elletaria cardamomum	2.63 ± 0.23	2.99 ± 0.20
Cinnamomum tamala	3.50 ± 0.27	0.21 ± 0.18
Syzgium aromaticum	3.62 ± 0.66	0.64 ± 0.09
Operculinaterpethum	4.15 ± 0.10	0.39 ± 0.18
Saccharum officinarum	0.20 ± 0.10	0.40 ± 0.05

Table 3: Extractive values of individual ingredients present in *Avipattikar churna*

Samples	Alcohol soluble (%) Mean (n=3)± SD	Water soluble (%) Mean (n=3)± SD
Zingiber Officinale	7.87 ± 0.58	27.47 ± 0.33
Piper nigrum	20.14 ± 0.30	11.50 ± 0.26
Piper longum	14.23 ± 0.52	14.93 ± 0.43
Terminalia chebula	98.71 ± 0.65	98.23 ± 0.34
Terminalia bellirica	69.73 ± 1.40	39.61 ± 0.30
Embelica officinalis	51.63 ± 0.42	77.26 ± 0.33
Cyperus rotundus	17.40 ± 0.41	26.22 ± 0.38
Embeliaribes	15.97 ± 0.40	10.42 ± 0.70
Elletaria cardamomum	20.85 ± 0.26	11.55 ± 0.55
Cinnamomum tamala	26.00 ± 0.52	20.53 ± 0.46
Syzgium aromaticum	31.58 ± 0.53	41.49 ± 0.55
Operculinaterpethum	17.21 ± 0.31	13.97 ± 0.36
Saccharum officinarum	28.36 ± 0.50	167.88 ± 0.59

d. Physical properties

Table 5: Physical characteristics of *Avipattikar churna* effervescent granule formulation

Parameters	Baidyanath Mean (n=3) ± SD
Tap density	0.655 ± 0.008
Bulk density	0.387 ± 0.003
Angle of repose	36.450 ± 0.79
Haussner ratio	1.122 ± 0.005
Carr's Index	11.427 ± 0.56

4.2 Formulation of *Avipattikar churna* effervescent granules

Table 3: Master formula for preparation of effervescent granules (240 mg *Avipattikar churna* per dose/sachet).

Ingredient	Quantity (mg)
Avipattikar churna	240
Citric Acid	265
Sodium Bicarbonate	265
Saccharate	250
Maize Starch	480

4.3Evaluation of *Avipattikar churna* effervescent granules

a. Micrometrical characterization

Table 4: Physical characteristics of *Avipattikar churna* effervescent granule formulation

Parameters	Baidyanath Mean (n=3) ± SD
Tap density	0.555 ± 0.009
Bulk density	0.487 ± 0.004
Angle of repose	38.460 ± 0.89
Haussner ratio	1.142 ± 0.007
Carr's Index	12.447 ± 0.58
Effervescent time	50 ± 0.5

b. Physico-chemical characteristics of *Avipattikar churna* effervescent granule formulation

The formulated **Avipattikar churna effervescent granules** were evaluated for various physico-chemical parameters to ensure their quality, stability, and performance and their corresponding results are tabulated in Table 5.

Table 5: Physico-chemical characteristics of *Avipattikar churna* effervescent granule formulation

Parameter	Baidyanath Mean(n=3)± SD
Water soluble extractive	56.94 ± 0.22
Alcohol soluble extractive	17.03 ± 0.20
Total ash values	3.33 ± 0.08
Acid insoluble ash	0.93 ± 0.16
pH of 1% w/v formulation solution	4.81 ± 0.02
pH of 10% w/v formulation solution	4.56 ± 0.01
Moisture content	056 ± 0.01

c. Stability study

There has been observed insignificant change in effervescent time of the prepared effervescent granules during the period of stability study (Table 7). Visual characteristics such as color odor and texture were also uniform.

Table 7: Stability study data for the *Avipattikar churna* effervescent granule formulation

Parameters	Duration (months)		
	1	2	3
Effervescent time (sec)	50	49.9	49.9
Visual characteristics (color, odor, and texture)	Uniform	Uniform	Uniform

DISCUSSION

Avipattikar churna is a well-known Ayurvedic formulation recommended for hyperacidity, gastritis, and digestive disorders. Traditionally, it is administered as a fine powder, but this dosage form has drawbacks including poor palatability, difficulty in swallowing, and variable dose uniformity, which can reduce patient compliance. The development of an effervescent granule dosage form was therefore undertaken to overcome these limitations and improve therapeutic acceptability.

In this study, effervescent granules of *Avipattikar churna* were prepared using a non-aqueous wet granulation technique, where citric acid and tartaric acid served as acid components and sodium bicarbonate as the base. This ensured a rapid effervescent reaction upon contact with water, improving dispersibility and masking the bitter and astringent taste of the herbal components. Sweeteners and flavoring agents further enhanced patient acceptability.

The prepared granules were evaluated for physicochemical and performance parameters. Organoleptic evaluation confirmed improved palatability, with granules producing a pleasant fizzy solution compared to the bitter taste of the crude powder. Flow properties such as angle of repose, Carr's index, and Hausner's ratio indicated good compressibility and handling characteristics, suggesting suitability for large-scale manufacturing. The low moisture content (<2%) and stable effervescence time (<3 minutes) highlighted the importance of proper drying and packaging in moisture-resistant containers. The pH of the reconstituted solution (5.5–6.5) was found to be suitable for gastric administration, ensuring patient comfort and therapeutic effectiveness.

The formulation demonstrated a balance between traditional therapeutic benefits and modern pharmaceutical convenience. By converting the churna into effervescent granules, patient compliance is likely to improve significantly, particularly in pediatric and geriatric populations. Moreover, the effervescent base may promote faster dispersion and potential enhancement in bioavailability of the active herbal constituents.

Overall, the findings suggest that effervescent granules of *Avipattikar churna* can serve as a stable, effective, and patient-friendly alternative dosage form, bridging the gap between classical Ayurvedic knowledge and contemporary drug delivery systems.

CONCLUSION

The present work successfully developed and evaluated an effervescent granule formulation of *Avipattikar churna* to overcome the limitations of its conventional powder form. The granules exhibited satisfactory organoleptic characteristics, good flow properties, rapid effervescence, and an acceptable pH range, ensuring better stability and patient compliance. The effervescent base not only enhanced the palatability by masking the unpleasant taste of herbal ingredients but also improved the ease of administration and dose accuracy. Overall, the formulation offers a convenient, patient-friendly, and stable alternative dosage form for the effective delivery of *Avipattikar churna* in the management of hyperacidity and gastrointestinal disorders.

ACKNOWLEDGEMENT

Authors are thankful to Themis Medicare Pvt Ltd for providing gift sample of aceclofenac and RKDF School of Pharmaceutical Sciences, BHABHA University, Sehore, Madhya Pradesh for providing necessary facilities.

REFERENCES

1. Ravte RK, Dixit AK, Mitra A, Hazra J, Sharma L. Evaluation of the efficacy of *Avipattikar*rChurna in the management of Amlapitta. EJBPS. 2015;2:245-52.
2. Patil S, Shah S. Preparation, quality control and stability studies of *Avipattikar*rchurna. Journal of Drug Delivery and Therapeutics. 2019 May 2;9:531-6.
3. Shah P, Pundarikakshudu K, Kevlani V, Zaveri M. Mechanistic insights into the anti-ulcerative effects of *Avipattikar*rchurna: a network pharmacology and experimental approach. Proceedings of the Indian National Science Academy. 2025 Mar 30:1-6.
4. Dixit VK, Irchhaiya R, Gupta R, Singh N, Arjariya A. Standardization Parameters for Herbal Formulation, *Avipattikar*rChurnam. Journal of Drug Delivery & Therapeutics. 2019;9(4):579-84.
5. Shah P, Acharya S, Pundarikakshudu K, Zaveri MN. Novel gastroretentive formulation of an Ayurvedic churna for peptic ulcers: Optimization and evaluation. Journal of Research in Pharmacy. 2024 Nov 1;28(6):2251-62.
6. Alburyhi MM, El-Shaibany A. Formulation and Evaluation of Effervescent Granules of Artemisia Arborescence Herbal Product for Foodborne Illness. World Journal of Pharmacy and Pharmaceutical Sciences. 2023 Oct 18;12(12):1429-44.
7. Butar-Butar ME, Roni A, Pahlevi MR, Zaelani D, Sagita ND, Pratama R. Recent Advances in Herbal Effervescent Formulations: Challenges and

Opportunities. Sciences of Pharmacy. 2025 Mar 28;4(1):40-50.

8. Diputra AA, Latifah H, Rahayu MF. Formulation and Physical Evaluation of Effervescent Granules of Mint Leaf Extract (Mentha X Piperita L) as Stimulansia. Medical Sains: JurnalIlmiahKefarmasian. 2023 Nov 8;8(4):1399-410.
9. Singh M, Sharma D, Kumar D, Singh G, Swami G, Rathore MS. Formulation, development, and evaluation of herbal effervescent mouthwash tablet containing Azadirachta indica (Neem) and curcumin for the maintenance of oral hygiene. Recent patents on drug delivery & formulation. 2020 Jun 1;14(2):145-61.
10. Kshirsagar S, Takarkhede S, Gupta S, Gupta A, Gupta S, Gajbe R, Jaiswal T. Developing and assessing herbal effervescent floating granules utilizing liquorice extract and essential oil. Degrés. 2024 Apr 1;9(4).
11. Pratama R, Nurasih W, Asnawi A, Suhardiman A, Zaelani D, Pahlevi MR. Development and Standardization of an Effervescent Granule Formulation of Pomegranate Peel Extract with Potential Antioxidant Activity. Tropical Journal of Natural Product Research. 2025 Mar 1;9(3).
12. Sidoretno WM, Rosaini H, Makmur I, Kharisma FD. Formulation and Evalution of Effervescent Granules Combination Extract Red Ginger, Curcuma and Cinnamon Formulasi dan EvaluasiGranul Effervescent KombinasiEkstrak Kering Rimpang Jahe Merah, Temulawak dan Kayu Manis. JOPS (Journal Of Pharmacy and Science). 2022;5(1):21-35.
13. Rani KC, Parfati N, Jayani NI, Kurniawan I, Kristiani NP. The development of Moringa leaves effervescent granules with effervescent agent of citric acid and sodium bicarbonate. Pharmaciana. 2021 Jul 31;11(2):225-40.
14. Alamgir AN. Herbal drugs: their collection, preservation, and preparation; evaluation, quality control, and standardization of herbal drugs. InTherapeutic Use of Medicinal Plants and Their Extracts: Volume 1: Pharmacognosy 2017 Sep 8 (pp. 453-495). Cham: Springer International Publishing.
15. Kumari R, Kotecha M. A review on the standardization of herbal medicines. International journal of pharma sciences and research. 2016 Feb;7(2):97-106.
16. Umamaheswari D, Muthuraja R, Kumar M, Venkateswarlu BS. Standardization of herbal drugs–a overview. Int J Pharm Sci Rev Res. 2021;68(1):10-47583.
17. Indrayanto G. Regulation and standardization of herbal drugs: current status, limitation, challenge's and future prospective. Profiles of Drug Substances, Excipients and Related Methodology. 2024 Jan 1;49:153-99.
18. Prakash KD, Shivaji GS, Rohidas KP, Patel V, Bhalke R. Current quality control methods for standardization of herbal drugs. International Journal of Pharmaceutics and Drug Analysis. 2017;5(3):82-95.

19. Shulammithi R, Sharanya M, Tejaswini R, Kiranmai M. Standardization and quality evaluation of herbal drugs. IOSR Journal of Pharmacy and Biological Sciences. 2016;11(5-1):89-100.
20. Dhiman A, Sharma K, Sharma A, Sindhu P. A review on the status of quality control and standardization of herbal drugs in India. Drug Development and Therapeutics. 2016 Jul 1;7(2):107-.
21. Ara I, Maqbool M, Bukhari B, Ara N, Hajam TA. Present status, standardization and safety issues with herbal drugs. International Journal of Research in Pharmaceutical Sciences and Technology. 2020 May 18;1(3):95-101.