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Critical Analysis of Formulation and Probable Mode of Action of *Avipattikara churna*: A Comprehensive Review



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HUMAN

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ABSTRACT

Background: The mode of action of a compound Ayurvedic formulation is a critical and essential issue to be concentrated in assuring the therapeutic efficacy and safety based on its composition. *Avipattikara Churna* is one of the commonly used formulations containing herbs-mineral drugs. **Objective:** To emphasize the rationality of *Avipattikara Churna* and its mode of action by classical and contemporary review. **Data Source:** Classical texts like Vangasena Samhita, Bhaishajya Ratnavali, Rasendra Sara sangraha, Rasendra Chintamani, and published research works. **Material and Methods:** In the present study a critical analysis based on ingredients and probable mode of action of *Avipattikara Churna* in different indicated clinical conditions like *agnimandya* (digestive impairment), *vibandha* (constipation), *amlapitta* (hyperacidity), *arsha* (piles), *mutraghata* (retention of urine) and *prameha* (diabetes mellitus) were done based on classical and contemporary research works. **Result:** Data from the critical review of classical and contemporary research works. **Conclusion:** *Avipattikara Churna* is a versatile formulation used in a wide range of gastrointestinal disorders. By this review, it can be emphasized that *Avipattikara Churna*, which is in clinical practice for *Amlapitta* (Hyperacidity) and *vibandha* (constipation) is a tailored formula by its ingredients. In-vivo studies not only justify the effectiveness of the formulation but provide more evidence of the safety and efficacy of the formulation. Clinical research works substantiate its significant gastro-protective activity.



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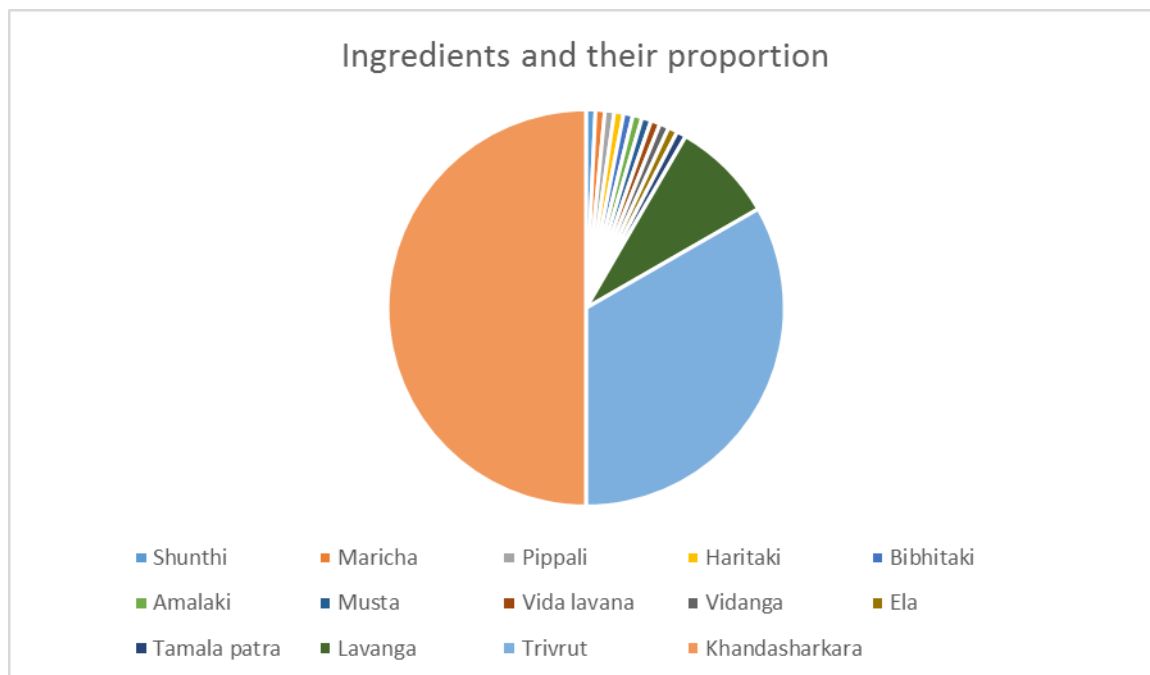
INTRODUCTION:

Compound classical Ayurvedic formulation analysis to understand the rationality of combination and its mode of action based on pharmacological activities of drugs supported by recent research works is the need of an hour. Many polyherbal formulations are described in the diseases of Gastrointestinal tract. *Amlapitta* is a most commonly encountered disease in the clinical practice. The digestive process is the transformation of ingested macromolecules such as proteins, fats, and complex carbohydrates into definite items like amino acids, fatty acids, and glucose by different enzymes. Our digestive system must secrete powerful enzymes to digest food into absorbable small molecules. This physiology of digestion is coordinated by four basic processes namely digestion, absorption, motility, and secretion.^[1] For this, proper nutrition, appropriate secretion of the digestive juices and enzymes and in addition motility of the gastrointestinal tract is prerequisite. Any disturbance in the physiology of digestion gives rise to stasis and poor assimilation, which may lead to fermentation (*Vidagdhatta*) by the activity of intestinal microorganisms.^[2] Acharya Sushruta has mentioned that *amla rasa* is the quality of *vidagdhatta pitta*.^[3] *Amlapitta* may be correlated with various presentations of gastroesophageal and gastrointestinal diseases like gastritis, hyperacidity, heartburn, dyspepsia, and gastric ulcer.^[4] Ayurveda also highlights the role of digestive enzymes (*agni*) in the genesis of almost all diseases. *Agnimandya* (Low fire) is the prime cause of all diseases.^[5] *Avipattikara churna* is *Churna* is a rational composition of herbs formulated to strengthen *jataragni* (digestion power) with subsidiary effect on *pitta* and also expels excessive *pitta* by its mild laxative action. *Avipattikara Churna* comprises *shunthi, maricha, pippali, haritaki, bibhitaki, amalaki, musta, vida lavana, vidanga, tamala patra, ela, lavanga, trivrut, and khandasharkara*. It is indicated in *agnimandya* (digestive impairment), *vibandha* (constipation), *amlapitta* (hyperacidity), *arsha* (piles), *mutraghata* (retention of urine), and *prameha* (diabetes mellitus).^[6] In the present paper an attempt is made to address, rationality of formulation composition and its mode of action based on critical analysis of each ingredient with contemporary research works.

MATERIAL AND METHODS

The formulation was critically reviewed from different reference books, like Bhaishajya Ratnavali,^[6] Vangasena Samhita,^[7] Rasendra Sara sangraha^[8], and Rasendra Chintamani^[9] and published research works. All the references have the same ingredients with the same

proportion. These individual ingredients were analyzed for their percentage in the combination (Fig. 01) and their pharmacological properties (Table 01).



Sl. No	Ingredient	Part used	Ayurvedic pharmacological properties	Percentage
1.	<i>Shunthi</i> ^[10] <i>Zingiber officinale</i> Roxb.	Rhizome	<i>Rasa – Katu</i> <i>Guna – Laghu, Snigdha</i> <i>Veerya – Ushna</i> <i>Vipaka – Madhura</i> <i>Doshagnata – Vatakaphashamaka</i> <i>Karma – Shothahara, Vedanasthapana, Rochana, Deepana, Pachana, Triptigna, Vatanulomana, Shoolaprashamana, Arshogna, Grahi</i>	0.76
2.	<i>Maricha</i> ^[11] <i>Piper nigrum</i> Linn.	Fruit	<i>Rasa – Katu</i> <i>Guna – Laghu, Tikshna, Ruksha</i> <i>Veerya – Ushna</i> <i>Vipaka - Katu</i> <i>Doshagnata – Kaphavatashamaka</i> <i>Karma – Lalasravajanaka, Deepana, PachanaVatanulomana, Krimigna,</i>	0.76

			<i>Mutrala</i>	
3.	<i>Pippali</i> ^[12] <i>Piper longum</i> Linn.	Fruit	<i>Rasa – Katu</i> <i>Guna – Laghu, Snigdha, Tikshna</i> <i>Veerya – Anushnasheeta</i> <i>Vipaka – Madhura</i> <i>Doshagnata – Kaphavata shamaka</i> <i>Karma – Deepana, Vatanulomana,</i> <i>Shoolaprashamana, Mridurechana,</i> <i>Krimigna, Mutrala</i>	0.76
4.	<i>Haritaki</i> ^[13] <i>Terminalia</i> <i>Chebula</i> Retz.	Fruit Pulp	<i>Rasa – Kashaya, Tikta, Madhura, Katu,</i> <i>Amla</i> <i>Guna – Laghu, Ruksha</i> <i>Veerya – Ushna</i> <i>Vipaka – Madhura</i> <i>Doshagnata – Tridoshashamaka</i> <i>Karma – Deepana, Pachana, Shothahara,</i> <i>Vedanasthapana, Anulomana,</i> <i>Mridurechana, Mutrala</i>	0.76
5.	<i>Bibhitaki</i> ^[14] <i>Terminalia</i> <i>bellirica</i> Roxb.	Fruit Pulp	<i>Rasa – Kashaya</i> <i>Guna – Ruksha, Laghu</i> <i>Veerya – Ushna</i> <i>Vipaka – Madhura</i> <i>Doshagnata – Tridoshashamaka,</i> <i>especially Kaphashamaka</i> <i>Karma – Deepana, Bhedana, Shothahara,</i> <i>Vedanasthapana, Anulomana,</i> <i>Mridurechana, Madakari, Grahi</i>	0.76
6.	<i>Amalaki</i> ^[15] <i>Emblica</i> <i>officinalis</i> Gaertn.	Fruit Pulp	<i>Rasa – Amla, Madhura, Kashaya, Tikta,</i> <i>Katu</i> <i>Guna – Guru, Ruksha, Sheeta</i> <i>Veerya – Sheeta</i> <i>Vipaka – Madhura</i> <i>Doshagnata – Tridoshashamaka</i>	0.76

			<i>especially pittashamaka</i> <i>Karma – Dahaprashamana, Rochana,</i> <i>Deepana, Anulomana, Amlatanashaka,</i> <i>Sramsana, Mutrala, Pramehagna</i>	
7.	<i>Musta</i> ^[16] <i>Cyperus</i> <i>rotundus</i> Linn.	Tuber	<i>Rasa – Tikta, Katu, Kashaya</i> <i>Guna – Laghu, Ruksha</i> <i>Veerya – Sheeta</i> <i>Vipaka – Katu</i> <i>Doshagnata – Kaphapittashamaka</i> <i>Karma – Deepana, Pachana, Grahi,</i> <i>Shothahara, Mutrala</i>	0.76
8.	<i>Vida lavana</i> ^[17] Black salt	-	<i>Rasa – Kshara</i> <i>Guna – Laghu, Ruksha, Teekshna, Ushna,</i> <i>Vyavayi</i> <i>Veerya – Ushna</i> <i>Vipaka – Katu</i> <i>Doshagnata – Kaphavatashamaka</i> <i>Karma – Deepana, Rochana,</i> <i>Vatanulomana, Shulahara</i>	0.76
9.	<i>Vidanga</i> ^[18] <i>Embelia ribes</i> Burm. f.	Fruit	<i>Rasa – Tikta, Katu</i> <i>Guna – Laghu, Ruksha, Teekshna</i> <i>Veerya – Ushna</i> <i>Vipaka – Katu</i> <i>Doshagnata – Kaphavatashamaka</i> <i>Karma – Deepana, Pachana, Anulomana,</i> <i>Mutrajanana, Krimigna</i>	0.76
10.	<i>Ela</i> ^[19] <i>Elettaria</i> <i>cardamomum</i> (Linn.)Maton.	Seed	<i>Rasa – Katu, Madhura</i> <i>Guna – Laghu</i> <i>Veerya – Sheeta</i> <i>Vipaka – Madhura</i> <i>Doshagnata – Tridoshashamaka</i> <i>Karma – Deepana, Pachana, Rochana,</i> <i>Anulomana, Hridya, Mootrajanana,</i>	0.76

			<i>Dahaprashamana</i>	
11.	<i>Patra</i> ^[20] <i>Cinnamomum</i> <i>tamala</i> Nees and Eberm.	Leaf	<i>Rasa – Katu, Madhura</i> <i>Guna – Laghu, Pichhila, Tikshna</i> <i>Veerya – Ushna</i> <i>Vipaka – Katu</i> <i>Doshagnata – Kaphavatashamaka</i> <i>Karma – Vishagna, Mukhashodhana,</i> <i>Bastidoshagna, deepana, Mootrajanana</i>	0.76
12.	<i>Lavanga</i> ^[21] <i>Syzygium</i> <i>aromaticum</i> Linn.	Floral bud	<i>Rasa – Katu, Tikta</i> <i>Guna – Laghu, Tikshna</i> <i>Veerya – Sheeta</i> <i>Vipaka - Katu</i> <i>Doshagnata – Kaphapittashamaka</i> <i>Karma –Deepana, Pachana, Ruchya,</i> <i>Vatanulomana,</i> <i>Krimigna,Shoolaprashamana, Mutrala,</i> <i>Amapachana, Vranaropana</i>	8.33
13.	<i>Trivrut</i> ^[22] <i>Operculina</i> <i>terpethum</i> Linn.	Root	<i>Rasa – Katu, Tikta, Madhura, Kashaya</i> <i>Guna – Laghu, Ruksha, Teekshna</i> <i>Veerya –Ushna</i> <i>Vipaka – Katu</i> <i>Doshagnata – Pittakapha samshodhana</i> <i>Karma – Sukhavirechaka, Bhedana,</i> <i>Rechana, Shothahara</i>	33.33
14.	<i>Khanda</i> <i>sharkara</i> ^[23] <i>Saccharum</i> <i>officinarum</i> Linn.	-	<i>Rasa – Madhura</i> <i>Guna – Snigdha</i> <i>Veerya – Sheeta</i> <i>Vipaka – Madhura</i> <i>Doshagnata – Vatapittashamaka</i> <i>Karma – Balya, Brumhana, Chakshushya,</i> <i>Vrushya, Vantihara</i>	50

DISCUSSION

Critical analysis on ingredients and their quantity in *Avipattikara Churna*

The ingredient which contributes major quantity in *Avipattikara Churna* is *Khanda sharkara* (50%) which is having *madhura rasa*, *snigdha guna*, *sheeta virya*, and *madhura vipaka*, and simultaneously helps to take care of *vidagdha pittajanya daha* i.e *hrutkantadaha*, *tiktaamlodgara*, *hrillasa*, *praseka*, and *chhardi* as it is described in *Bhavaprakasha* as “*Vantiharamparam*”.^[23] *Khandasharkara* properties compensate the *laghu*, *ruksha*, *ushna*, and *teekshna guna* of other drugs mainly *lavanga*, which contributes about 8.3% of the formulation. Second major quantity is contributed by *trivrit (nishotha)* it has mainly *katu rasa*, *laghu*, *ruksha*, *tikshna guna*, *ushna virya* and *katu vipaka*. It has *rechana* and *shothahara* property leading to excess *pitta virechana (sukhavirechaka-mild laxative)* thus helpful in *samprapti vighatana* of *amlapitta* and *arsha (durnama)*. *Lavanga* being the third high quantity ingredient has *katu*, *tikta rasa*, *laghu*, *tikshna guna*, *sheeta virya* and *katu vipaka*. It has *deepana*, *amapachana*, *vatanulomana*, *shulaprashamana* activity which helps to tackle *agnimandyajanya vikara* and associated *shula*. Rest 11 ingredients are in minimal quantity i.e each 1/11th part of *lavanga*. All these possess *katu*, *tikta*, *madhura rasa*, *laghu*, *ruksha*, *teekshna*, *snigdha guna*, *ushna virya*, *katu* and *madhura vipaka* having *deepana*, *pachana*, *vatanulomana* activity ideal in all *agnimandyajanya* and *amaja vikaras*.

Thus, the ingredients of *Avipattikara Churna* can be attributed different pharmacological activities in different clinical conditions explained in *phalashruti* (indications) of *Avipattikara Churna* formulation as below.

Probable mode of action of *Avipattikara Churna*

Avipattikara Churna, is a herbo mineral compound formulation having clinical significance in the treatment of *amlapitta* (hyperacidity and dyspepsia). Majority of drugs in *Avipattikara Churna* are possessing *katu*, *tikta*, *madhura rasa*, *laghu*, *ruksha*, *tikshna*, *snigdha guna*, *ushna sheeta virya*, *madhura* and *katu vipaka*. Apart from *khandasharkara* the main ingredient is *trivrut (nishoth)*. It has *katu*, *tikta rasa*, *laghu*, *tikshna*, *ruksha guna*, *ushna virya* and *katu vipaka*. It has *bhedana*, *rechana* and *shothahara* properties leading to *pitta virechana* useful in *samprapti vighatana* of *amlapitta*. This action of *trivrut* is also contributed by *mridu rechana/anulomana* action of *triphala*. Both *trivrut* and *triphala* help in relieving *vibandha*.^{[24], [25]} *Deepana*, *pachana karma* of all the drugs maintains *agni* and

prevent *aama* formation. *Lavanga* by its *katu*, *tikta rasa*, *tikshna guna*, *katu vipaka* helps in *vatanulomana* and *shula prashamanaa*. *Khanda sharkara* being maximum in quantity (66 part) helps in *daha* and *vanti shamana*.

These therapeutic actions of *Avipattikara Churna* are supported by recent research works on its ingredients like, *haritaki*, which exhibit antiulcer properties.^{[26], [27]} Cytoprotective effect of *Maricha* and *pippali* are investigated and proven on the gastric mucosa.^{[28], [29]} Decreased secretion from stomach, increased resistance of mucosa by *shunthi* is been evaluated.^[30] *Trivrut* is known to reduce hyperacidity, gastric ulcers ^[31] *Lavanga* aids to sustain gastric mucosal blood circulation which helps to increase mucus secretion.^[32]

It is evident from the study that, *Avipattikara churna*, which was experimentally investigated for its efficacy in gastric ulcers in the pyloric ligated model, has exhibited anti-secretory and anti-ulcerogenic effects. These results of the drug were equivalent to standard control drug ranitidine. The significant pharmacological effect was statistically seen at 500 mg/kg dose of *Avipattikara churna*.^[33]

Avipattikara churna also increases gastric motility and enhances gastric secretion thereby improving the digestion process. Drugs like *trivrut*, *triphala*, *shunthi*, *lavanga*, etc are *ushna*, *laghu* which help to increase *Agni*. *Katu rasa dravya* increase gastric secretion and enhance digestion process. *Trikatu* contain piperine which has been reported in recent researches that, it has enhanced stimulation over the digestive enzymes of pancreas. It also enhances the digestion process and effectively decreases the gastro intestinal food transit.^[34]

Ela, *Lavanga*, *Tamala Patra* being spices and aromatic plants, contain essential oil and possess carminative and antispasmodic effect, thereby reduce colicky pain.^[35] Drugs like *trivrut*, *triphala* improve gastric motility and cause *anulomana* (*mild laxative*) and eases *vibandha* (Constipation).^[36] *Vibandha* will be a cause and aggravating factor for *arsha*, by easing *vibandha* it is also helpful in *arsha*. By Virtue of *Vatanulomana* property it is having role in the management of *mutraghata* and even in *mutashmari*.

Trivrut is *tikta rasa*, *ushna virya* and *virechaka*, thereby removes *kleda* from the body, so it is helpful in *Prameha*. Its hypoglycemic effect was because of enhanced insulin secretion which was proven in a diabetic rat model.^[37] *Trikatu* contains Piperine which was proved by the research work to enhance hepatic oxidized glutathione and decreases renal glutathione

concentration and renal glutathione reductase (GR) activity (by 25%) in streptozotocin-induced diabetic rats when compared to healthy controls.^[38]

CONCLUSION

Avipattikara Churna is an effectively used formulation in a wide range of gastrointestinal disorders. By this review, it can be emphasized that *Avipattikara Churna* is a tailored formula for *Amlapitta* (Hyperacidity). In-vivo studies not only justify the effectiveness of the formulation but provide more evidence of the safety and efficacy of the formulation. Clinical research works substantiate its significant gastro-protective activity.

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Author contributions

Dr Geeta Gadad has conceptualized and drafted the manuscript. Dr. K. S. Gudaganatti has reviewed and revised the manuscript critically.

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REFERENCES:

1. Silverthorn DU. Human Physiology: An Integrated Approach, 6th edition, Pearson India Education Services Pvt. Ltd. 2016:737.
2. Dash MK, Joshi N, Dwivedi L, Sharma K. Probable mode of action of Hingwashtaka Churna: A Critical review. Int. J. Res. Ayurveda Pharm. 2016;7:1-8.
3. Acharya J. T. Vaidya, Acharya N. R. Susuruta Samhita Sutrashana with Commentaries of Dalhana and Gayadas. Reprint 2012, Varanasi, Chaukhambha Surabharati Prakashan, 2012, Pg.No.101.
4. Rathiya K, Nayak NR. an Ayurvedic Approach on Amlapitta: European J. of Pharmaceutical and Med. Research. 2018: 154-156.
5. Kunte AM, Navare KR. Ashtang Hrudayam of Vagbhata, Nidana Sthana, With Commentaries of Arundatta and Hemadri, Edition 9th, Chaukhambha Surabharati Prakashan, Varanasi 2011, chapter 12 verse 1st Pg.no.513.
6. Govind Das, Bhaishajya Ratnavali, Edition Reprint 3rd, Chaukhambha Prakashan, Varanasi 2013, chapter 56 verse 25-29 Pg. no. 922.
7. Pandit Hariprasad Tripathi, Vangasena Samhita, Reprint Edition 1st, Chowkhambha Sanskrit Series office, Varanasi 2009, chapter 27, verse 78-83, Pg no.362.

8. Indradeva Tripathi, Rasendra Sara sangraha, Edition 3rd, Chaukhambha Orientalia, Varanasi 2003, chapter 2, verse 32-38, Pg no. 468.
9. Acharya Dundukanatha, Rasendra Chintamani, Siddhiprada Hindi translation by Prof. Siddhinandan Mishra, Reprint Edition 1st, Chowkambha Orientalia, Varanasi 2006, chapter 9, verse 34-40, Pg no. 273-274.
10. Sharma PC, Yelne MB, Dennis TJ, Joshi A, Prabhune YS, Khade K, et al, Database on Medicinal Plants used in Ayurveda and Siddha, Central Council for Research in Ayurveda and Siddha, Vol 5, Documentation and Publication Division CCRAS, New Dehli, Reprint 2008, Pg no.315.
11. Sharma PC, Yelne MB, Dennis TJ, Joshi A, Prabhune YS, Khade K, et al, Database on Medicinal Plants used in Ayurveda and Siddha, Central Council for Research in Ayurveda and Siddha, Vol 5, Documentation and Publication Division CCRAS, New Dehli, Reprint 2008, Pg no.187.
12. Sharma PC, Yelne MB, Dennis TJ, Joshi A, Prabhune YS, Khade K, et al, Database on Medicinal Plants used in Ayurveda and Siddha, Central Council for Research in Ayurveda and Siddha, Vol 3, Documentation and Publication Division CCRAS, New Dehli, Reprint 2008, Pg no.472.
13. Sharma PC, Yelne MB, Dennis TJ, Joshi A, Prabhune YS, Khade K, et al, Database on Medicinal Plants used in Ayurveda and Siddha, Central Council for Research in Ayurveda and Siddha, Vol 3, Documentation and Publication Division CCRAS, New Dehli, Reprint 2008, Pg no.282.
14. Sharma PC, Yelne MB, Dennis TJ, Joshi A, Prabhune YS, Khade K, et al, Database on Medicinal Plants used in Ayurveda and Siddha, Central Council for Research in Ayurveda and Siddha, Vol 3, Documentation and Publication Division CCRAS, New Dehli, Reprint 2008, Pg no.158.
15. Sharma PC, Yelne MB, Dennis TJ, Joshi A, Prabhune YS, Khade K, et al, Database on Medicinal Plants used in Ayurveda and Siddha, Central Council for Research in Ayurveda and Siddha, Vol 3, Documentation and Publication Division CCRAS, New Dehli, Reprint 2008, Pg no.11.
16. Sharma PC, Yelne MB, Dennis TJ, Joshi A, Prabhune YS, Khade K, et al, Database on Medicinal Plants used in Ayurveda and Siddha, Central Council for Research in Ayurveda and Siddha, Vol 3, Documentation and Publication Division CCRAS, New Dehli, Reprint 2008, Pg no.404.
17. Sri Bhavamishra, Bhavaprakash Nighantu, Commentary by K C Chuneekar, edited by G S Pandey, Choukamba Bharati Academy, Varanasi: Revised & Enlarged ed. 2010; p. 214-215.
18. Sharma PC, Yelne MB, Dennis TJ, Joshi A, Prabhune YS, Khade K, et al, Database on Medicinal Plants used in Ayurveda and Siddha, Central Council for Research in Ayurveda and Siddha, Vol 5, Documentation and Publication Division CCRAS, New Dehli, Reprint 2008, Pg. no. 478.
19. Sharma PC, Yelne MB, Dennis TJ, Joshi A, Prabhune YS, Khade K, et al, Database on Medicinal Plants used in Ayurveda and Siddha, Central Council for Research in Ayurveda and Siddha, Vol 5, Documentation and Publication Division CCRAS, New Dehli, Reprint 2008, Pg no.391.
20. Sharma PC, Yelne MB, Dennis TJ, Joshi A, Prabhune YS, Khade K, et al, Database on Medicinal Plants used in Ayurveda and Siddha, Central Council for Research in Ayurveda and Siddha, Vol 6, Documentation and Publication Division CCRAS, New Dehli, Reprint 2008, Pg no.401.
21. Sharma PC, Yelne MB, Dennis TJ, Joshi A, Prabhune YS, Khade K, et al, Database on Medicinal Plants used in Ayurveda and Siddha, Central Council for Research in Ayurveda and Siddha, Vol 4, Documentation and Publication Division CCRAS, New Dehli, Reprint 2008, Pg no.358.
22. Sharma PC, Yelne MB, Dennis TJ, Joshi A, Prabhune YS, Khade K, et al, Database on Medicinal Plants used in Ayurveda and Siddha, Central Council for Research in Ayurveda and Siddha, Vol 1, Documentation and Publication Division CCRAS, New Dehli, Reprint 2008, Pg no.462
23. Sri Bhavamishra, Bhavaprakash Nighantu, Commentary by K C Chuneekar, edited by G S Pandey, Choukamba Bharati Academy, Varanasi: Revised & Enlarged ed. 2010; p.776-780.
24. Sri Bhavamishra, Bhavaprakash Nighantu, Commentary by K C Chuneekar, edited by G S Pandey, Choukamba Bharati Academy, Varanasi: Revised & Enlarged ed. 2010; p. 39-40.
25. Sri Bhavamishra, Bhavaprakash Nighantu, Commentary by K C Chuneekar, edited by G S Pandey, Choukamba Bharati Academy, Varanasi: Revised & Enlarged ed. 2010; p. 166.
26. Tamhane MD, Thorate SP, Rege NN, Dahanukar SA. Effect of oral administration of Terminalia chebula on gastric emptying: An experimental study. J. Postgrad. Med., 43 (1) : 12-13 (1997).
27. Chattopadhyay RR, Bhattacharyya SK. (2007). Plant review *Terminalia chebula*: An update. *Pharmacog Rev* 1:151–156.

28. Selvendiran K, Singh JP, Krishnan KB, Sakthisekaran D. Cytoprotective effect 2003 Feb; 74:109-15. doi: 10.1016/s0367-326x(02)00304-0. PMID: 12628402.
29. Vijayakumar RS, Surya D, Nalini N. "Antioxidant efficacy of black pepper (*Piper nigrum* L.) and piperine in rats with high fat diet induced oxidative stress, Redox Report. 2004; 9: 105–110,.
30. Al-Yahya MA, Rafatullah S, Mossa JS, Ageel AM, Parmar NS, Tariq M. Gastroprotective activity of ginger *Zingiber officinale* Rosc., in albino rats. *American Journal of Chinese Medicine*. 1989;17(1-2):51–56.
31. Bhande RM, Laakshmayya Kumar P, Mahurkar NK, Ramachandra Setty S. Pharmacological screening of root of *Operculina turpethum* and its formulations. *Acta Pharm Sci*. 2006; 48:11–7.
32. Ramirez RO, Roa CC Jr. The gastroprotective effect of tannins extracted from duhat (*Syzygium cumini* Skeels) bark on HCl/ethanol induced gastric mucosal injury in Sprague-Dawley rats. *Clin Hemorheol Microcirc*. 2003;29:253-61. PMID: 14724349.
33. Gyawali S, Khan GM, Lamichane S, Gautam J, Ghimire S, Adhikari R. et. al. Evaluation of anti-secretory and anti-ulcerogenic activities of avipattikar churna on the peptic ulcers in experimental rats. *J Clin Diagn Res*. 2013;7(6):1135-1139. doi:10.7860/JCDR/2013/5309.3058
34. Srinivasan K. Black pepper and its pungent principle-piperine: a review of diverse physiological effects. *Crit Rev Food Sci Nutr*. 2007;47(8):735-48. doi: 10.1080/10408390601062054. PMID: 17987447.
35. Heghes SC, Vostinaru O, Rus LM, Mogosan C, Iuga CA, Filip L. Antispasmodic Effect of Essential Oils and Their Constituents: A Review. *Molecules*. 2019 Apr 29;24(9):1675. doi: 10.3390/molecules24091675. PMID: 31035694; PMCID: PMC6539827.
36. Onoja SO, Madubuike GK, Maxwell E, Chukwu CJ. Investigation of the Laxative Activity of *Operculina turpethum* Extract in Mice. *Int. J of Pharmaceutical and Clinical Res*. 2015; 7:275-279.
37. Pulipaka S, Challa S, & Pingili R. Comparative antidiabetic activity of methanolic extract of *Operculina turpethum* stem and root against healthy and streptozotocin induced diabetic rats. *Int Curr Pharma J*. 2012; 1:272–8.
38. Rauscher FM, Sanders RA, Watkins JB 3rd. Effects of piperine on antioxidant pathways in tissues from normal and streptozotocin-induced diabetic rats. *J Biochem Mol Toxicol*. 2000;14:329-34. doi:10.1002/1099-0461(2000)14:6<329:AID-JBT5>3.0.CO;2-G. PMID: 11083086.

