IJBPAS, September, 2025, 14(9): 4783-4793

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

PHARMACEUTICO-ANALYTICAL STUDY OF *VIDANGADI KSHARA* WITH SPECIAL REFERENCE TO ITS ANTICANCER ACTIVITY

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Received 15th March 2024; Revised 20th April 2024; Accepted 11th Aug. 2024; Available online 1st Sept. 2025

https://doi.org/10.31032/IJBPAS/2025/14.9.8809

ABSTRACT

Ayurveda offers a broad range of formulations that show promise in treating a number of illnesses. Vidangadi Kshara, a polyherbal remedy, can be an ideal preparation for patients with splenic and tumorous illnesses when prescribed correctly. The traditional indications for *Vidangadi kshara* are *Gulma* and *Pliha Vyadhi*, while cow's milk is the recommended *anupana*. *Vidangadi Kshara* does not have a clearly explained methodology. This attempt is made to definite method and understand the action of medicine through analytical parameters. In the pilot study, *Vidangadi kshara* was prepared by two different methods. One by burning drugs over an open pan, the other in a closed container. Both *ksharas* were accessed on pH, colour and particle fineness. Among these, the closed method showed better results, so it was selected for further analysis. Individual drugs of *Vidangadi kshara* are assessed using parameters like physico-chemical analysis, extractive values, TLC, and preliminary phytochemicals. *Kshara* is checked for analytical parameters like organoleptic tests, pH, Na and K assays, qualitative & quantitative phytochemical screening and FTIR. Consequently, it concludes that the phytochemicals found in *Vidangadi kshara* are tannins and carbohydrates. In *Vidangadi Kshara*, functional groups for isothiocyanates and alkanes are present. Also, the *Kshara* assay contains potassium and sodium content. It had an alkaline pH. This analytical evaluation suggests that *Vidangadi kshara* has anticancer properties.

Keywords: ***Kshara kalpana, Mashi kalpana, Dagdhva, Antardhuma, Vidangadi kshara, Anticancer activity***

INTRODUCTION

Vidangadi Kshara (*Ayurvedic* medicine with alkali property) is a polyherbal formulation explained by *Acharyas* (experts of *ayurveda*) in *Ayurvedic* classics. In total seven references are by the name of *Vidangadi kshara* (*Ayurvedic* medicine with alkali property), another reference with similar drugs has been named as *Vidangadi yoga* (formulation of similar drugs). This *yoga* (formulation) has been used by *vaidyas* (physician) for several years and has had a positive impact on the society. Drugs included in the formulations commonly by all *Acharyas* (experts of *Ayurveda*) are *Vidanga* (*Embelia ribes*), *Chitraka* (*Plumbago zeylanica*), *Ghrita* (*cow ghee*), *Saindhav* (*Rock salt*) and *Vacha* (*Acorus calamus*). Other few ingradients like *Shunthi* (*zingiber officinale*), *Saktu* (barley meal), *Arka* (*Calotropis gigantea*) and *Trivrut* (*Operculina turpethum*) differ from text to text. The *rogaghnata* (indication) mentioned for *Vidangadi kshara* (*Ayurvedic* medicine with alkali property) is almost same as per all *Acharyas* (experts of *Ayurveda*) i.e. *Udara* (ascites) and *Gulma* (Abdominal mass). Even though *Vidangadi Kshara* (*Ayurvedic* medicine with alkali property) is called *kshara* (substance with alkali property), *Acharyas* (experts of *Ayurveda*) have used word "*DAGDHVA"* (burning) **[1]** to explain it, which does not directly relate to the *Kshara kalpana* (alkali preparation of medicine) method. Some *vruddha vaidyas* (senior physician) have suggested to prepare *Kshara* (substance with alkali property) by *antardhuma* (closed type preparation) method **[2]**. There have been no pharmaceutical studies on *Vidangadi kshara* (*Ayurvedic* medicine with alkali property). Hence pharmaceutical and analytical studies are undertaken. *Vidangadi kshara* (*Ayurvedic* medicine with alkali property) has been prepared by two methods in a pilot study i.e. by open pan burning and by *samputa* (set of two clay plates which are kept over each other) method. The reference selected here to follow the procedure is from *Charaka Samhita Chikitsasthana Udara Chikitsa Adhyay* (chapter in *Charaka samhita* on ascites) **[1]**.

AIM & OBJECTIVES- To develop the procedure of *Vidangadi kshara* (*Ayurvedic* medicine with alkali property) explained in *Ayurvedic* classics. To critically analyse *Vidangadi kshara* (*Ayurvedic* medicine with alkali property)

MATERIALS-

Ingredients of *Vidangadi kshara, Vidanga (Embelia ribes), Chitraka (Plumbago zeylanica), Shunthi (Zingiber officinale), Vacha (Acorus calamus), Goghrita (*Cow ghee*)* and *Saindhava lavana* (Rock salt) were collected from GMP certified KLE's Ayurveda Pharmacy, Khasbag, Belagavi.

Preparation of *Vidangadi kshara* (*Ayurvedic* medicine with alkali property) was carried out at the Department of RSBK, KAHER Shri. B.M.K. Ayurveda Mahavidyalaya and Research Centre, Belagavi.

Analysis of *Vidangadi kshara* (*Ayurvedic* medicine with alkali property) was carried out at ASU approved drug testing laboratory, KAHER Shri. B.M. K. Ayurveda Mahavidyalaya and Research Center, Belagavi.

METHOD-

Vidangadi kshara preparation is instructed to be performed by burning of drugs **[1]**. To finalise the procedure of *Vidangadi kshara*, pilot study was conducted wherein procedure is performed by two different methods. One by burning of drugs on open pan, while another was burning of drugs in closed vessel i.e. using *antardhuma* method. As name suggests, final product (*Vidangadi kshara*) will be of alkaline nature. Hence pH was considered here as main factor to finalize procedure of *Vidangadi kshara.*

Pilot Study

Purvakarma-

All ingredients were taken in fine powdered form and weighed upto 5gms. All ingredients apart from *Ghrita* (ghee) were taken in a porcelain *khalva* (mortar) and homogenously mixed together. The mixture was divided into two parts, one for each of the following methods.

Pradhanakarma-

Method I-

The mixture was taken into a pan. A pan was kept on the gas stove, and *Madhyamagni* (medium flame) was given. 2.5 grams of *Ghrita* (Ghee) was taken and added drop by drop. The whole content was fried with *Ghrita* (Ghee), and later burned completely. The time taken for the entire process was 40 minutes. The temperature was maintained at 300 °C. Later, *Kshara* (substance with alkali) was collected and stored.

Method II-

The mixture was taken in a porcelain *Khalva* (mortar). 2.5 grams of *Ghrita* (ghee) was then added drop by drop. The whole mixture was well triturated until *Ghrita* (ghee) completely got mixed. Later, *chakrikas* were prepared of *Kupilu* (Strychnos nux-vomica) size and kept for drying. After this, *chakrikas* (round pellets) were kept in a *sharava* (clay plate). Another *sharava* (clay plate) was placed over it, and *sandhibandhan* (sealing of a joint) was done by 7 layers of mud-smeared cloth. Later, *sharava* (clay plate) was kept in an electrical muffle furnace. The temperature was set to 500 °C. After the self-cooling of the furnace, the *sharava* (clay plate) was removed. *Kshara* (a substance with alkali property) was collected and stored.

Pashchatkarma: The collected *Ksharas* (a substance with alkali property) of both methods were then analyzed.

OBSERVATION:

Observation of kshara prepared for pilot study

By observing these parameters, closed method was selected for analysis. *Vidangadi kshara* preparation was repeated according to closed method. Each ingredient was weighed upto 50gms. Rest all procedure is adopted same of method II of pilot study **(Table 1)**.

Observation of *Kshara* (substance with alkali property) used for analysis (Table 2)

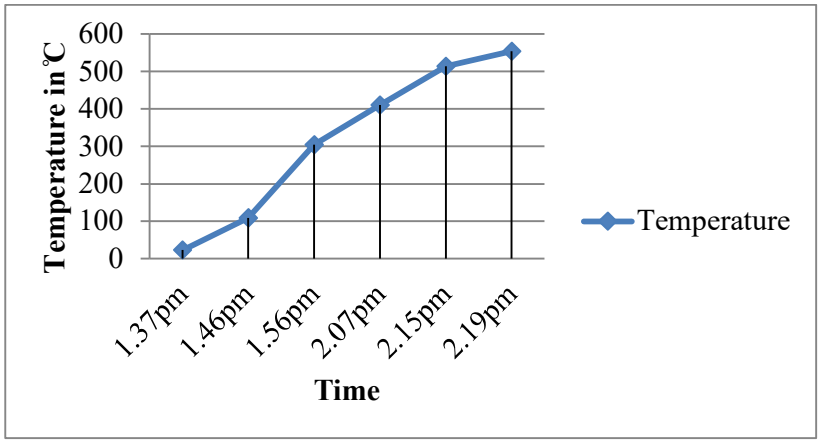
Table 1: Observation of *Vidangadi kshara* prepared for pilot study

Parameters	Method I	Method II
Colour	Black	Greyish black
Odour	Not specific	Not specific
pH	10.2	12.2
Reduction in weight	3gms	7gms

Table 2: Observation of *Vidangadi kshara* (substance with alkali property)

Parameters		Results
Weight	Initial quantity	300gms
	Final product (*Kshara*)	98gms
	One *Chakrika* (round pellet)	3.2gms
	One *Sharava* (clay plates)	214.2gms
Total no. of chakrika		101
Time required for drying of sandhibandhana		18 hrs
Total time required		42min
Temperature		540 ˚C

Temperature Pattern-



Graph 1: Temperature pattern of *Vidangadi kshara* preparation by closed method

RESULTS:

Analysis of raw drugs i.e. *Vidanga phala, Chitraka moola, Shunthi kanda, Goghrita* (cow ghee), *Saindhav, Vacha moola,* was done as per API standards.

Raw Drug Analysis as per API standards

1. *Vidanga phala* **[3]**
2. *Chitraka moola* **[4]**
3. *Shunthi kanda* **[5]**
4. *Vacha moola* **[6]**

Table 3: Physico chemical analysis raw drugs of *Vidangadi kshara*

Parameters	*Vidanga*	*Chitrak*	*Shunthi*	*Vacha*
Colour	Brownish black	Reddish to deep brown	Buff Colored	Light brown to pinkish externally, buff coloured internally
Odour	Slightly Aromatic	Disagreeable	Agreeable & Aromatic	Aromatic
Taste	Astringent	Acrid	Agreeable & Pungent	Pungent & bitter
Part	Fruit	Root	Rhizome	Rhizome
Total Ash	4.227% (N- <6%)	2.988% (N- <3%)	4.302% (N- <6%)	6.231% (N- <7%)
Acid Insoluble Ash	0.578% (N- < 1.5%)	0.048% (N- <1%)	1.040% (N- <1.5%)	0.939% (N- <1%)
Water Soluble Extract	10.222% (N- >9%)	13.834% (N- >12%)	13.64% (N- >10%)	18.570% (N- >16%)
Alcohol Soluble Extract	11.399% (N- >10%)	31.113% (N- >12%)	4.586% (N- >3%)	10.191% (N- >9%)

Analysis of *Choornas* (powders) of raw drugs

Standard analytical parameters for *Vidanga choorna, Chitrak Choorna, Shunthi choorna* and *Vacha choorna* are not available in API. Hence we have followed methods of analysis similar to that of raw drugs. For TLC, toluene & ethyl acetate solvents were used in the ratio of 7:3.

1. *Vidanga Choorna*
2. *Chitraka Choorna*
3. *Shunthi Choorna*
4. *Vacha Choorna*

Table 4: Physicochemical, Phytochemical and TLC of Choorna

Parameters	*Vidanga*		*Chitraka*		*Shunthi*		*Vacha*	
Colour	Brownish lack		Reddish brown		Buff coloured		Light Brown	
Taste	Astringent		Acrid		Agreeable & Pungent		Bitter	
Odour	Slightly aromatic		Disagreeable		Agreeable & Aromatic		Aromatic	
LOD	11.547%		5.289%		6.401%		6.939%	
Ash Value	4.096%		3.970%		4.216%		7.477%	
Acid insoluble ash	1.135%		1.029%		0.663%		0.997%	
Water soluble extract	7.855%		8.667%		13.708%		37.717%	
Alcohol soluble extract	11.948%		12.697%		3.205%		6.499%	
Phytochemical screening								
	WSE	ASE	WSE	ASE	WSE	ASE	WSE	ASE
Carbohydrates	+ve	+ve	+ve	+ve	+ve	-ve	+ve	+ve
Reducing sugar	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve
Monosaccharides	+ve	+ve	+ve	-ve	-ve	-ve	-ve	-ve
Pentose sugar	-ve	-ve	-ve	+ve	-ve	+ve	-ve	-ve
Non reducing sugar	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Hexose sugar	-ve	-ve	-ve	+ve	-ve	-ve	-ve	-ve
Proteins	-ve	+ve	-ve	+ve	-ve	-ve	-ve	-ve
Amino acids	-ve	-ve	-ve	-ve	-ve	-ve	+ve	-ve
Steroids	+ve	-ve	-ve	-ve	-ve	-ve	+ve	-ve
Flavonoids	+ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Alkaloids	-ve	+ve	-ve	-ve	-ve	-ve	-ve	-ve
Tannins	+ve	-ve	-ve	-ve	+ve	+ve	+ve	+ve
Cardiac glycoside	-ve	-ve	-ve	-ve	-ve	+ve	-ve	-ve
Anthraquinone glycosides	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Saponin glycosides	+ve	+ve	-ve	+ve	-ve	+ve	-ve	+ve
TLC								
Long Wave	0.506, 0.545		0.18, 0.4, 0.49, 0.57, 0.77, 0.91		0.18, 0.23, 0.33, 0.48, 0.81, 0.86, 0.95		0.07, 0.18, 0.23, 0.32, 0.42, 0.51, 0.57, 0.73, 0.81, 0.90	
Short Wave	0.480, 0.532		0.05, 0.18, 0.49, 0.52, 0.59, 0.66, 0.71, 0.86, 0.89		0.25, 0.5, 0.65, 0.85, 0.88, 0.95		0.20, 0.34, 0.42, 0.54, 0.65	

Table 5: Microbial analysis

Parameters	*Vidanga*	*Chitraka*	*Shunthi*	*Vacha*
Test for specified micro-organism				
E coli	**Absent**	**Absent**	**Absent**	**Absent**
S aureus	**Absent**	**Absent**	**Absent**	**Absent**
P aeruginosa	**Absent**	**Absent**	**Absent**	**Absent**
S abony	**Absent**	**Absent**	**Absent**	**Absent**
Microbial limit test				
Total Bacterial Count	**38 cfu/ml (N- 30-300cfu/ml)**	**43 cfu/ml (N- 30-300cfu/ml)**	**41 cfu/ml (N- 30-300cfu/ml)**	**49 cfu/ml (N- 30-300cfu/ml)**
Total Fungal Count	**06 cfu/ml (N- 10-100cfu/ml)**	**07 cfu/ml (N- 10-100cfu/ml)**	**04 cfu/ml (N- 10-100cfu/ml)**	**06 cfu/ml (N- 10-100cfu/ml)**

Table 6: Physico chemical analysis of *Saindhav*

Parameters	*Saindhav*
Colour	**Whitish**
Odour	**Not Specific**
Taste	**Salty**
Form	**Irregular shaped hard masses**
pH	**5.96**
Test for Na+	**Present**
Test for K+	**Present**

Table 7: Physicochemical analysis of *Goghrita* [7] (cow ghee)

Parameters	*Goghrita* (cow ghee)
Colour	**White to Yellow**
Odour	**Rich & Characteristic**
Taste	**Pleasant**
Form	**Semisolid with granular texture**
Saponification Value	**216.25%**
Iodine Value	**(N- <225)**
Acid Value	**27.05%**
Moisture Content	**(N- <35)**

Table 8: *Vidangadi Kshara* (*Ayurvedic* medicine with alkali property) Analysis

Parameters	Observation
Colour	**Black**
Odour	**Odourless**
Taste	**Salty**
pH	**9**
Loss on drying	**1.447%**
Acid insoluble ash	**4.041%**
Assay for Na	**13,902 ppm**
Assay for K	**2,660 ppm**

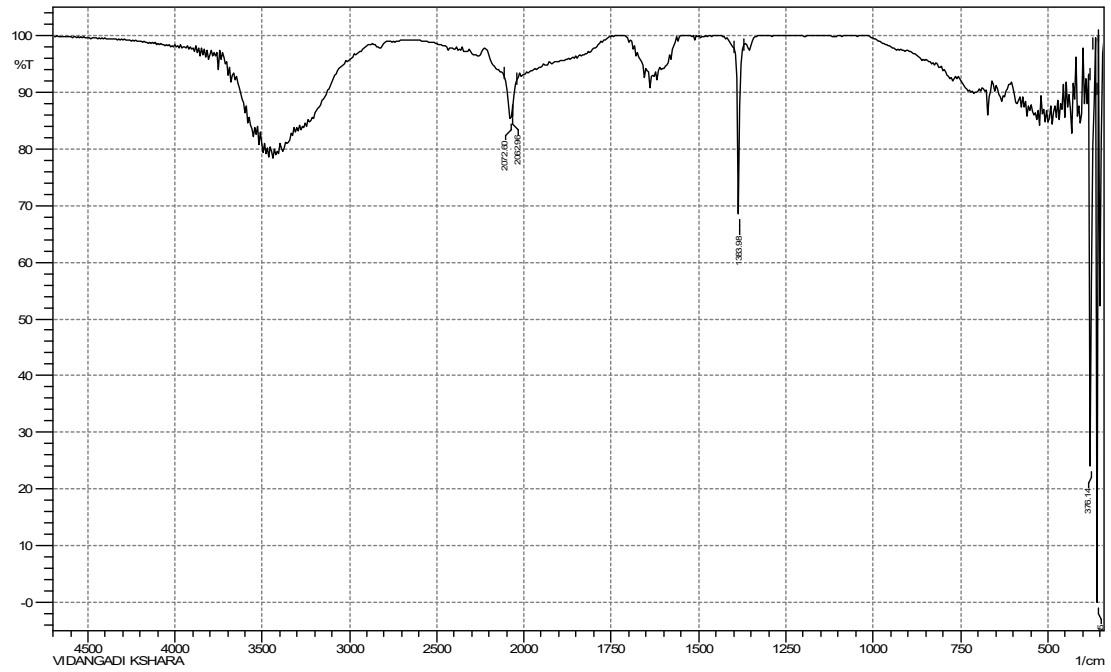
Table 9: Inorganic Phytochemicals of *Vidangadi kshara*

Phytochemical	Result
Calcium	**-ve**
Magnesium	**-ve**
Sodium	**+ve**
Potassium	**-ve**
Sulphate	**-ve**
Phosphate	**-ve**
Carbonate	**-ve**
Nitrate	**-ve**
Iron	**-ve**
Chloride	**-ve**

Table 10: Organic Phytochemicals of *Vidangadi kshara*

	Alcohol soluble drug	Water Soluble drug
Phytochemicals	**Result**	**Result**
Carbohydrate	**+ve**	**+ve**
Reducing Sugar	**-ve**	**-ve**
Tanin	**+ve**	**-ve**
Saponin	**-ve**	**-ve**

FTIR Result of *Vidangadi kshara* –



Graph 2: FTIR peaks of drug *Vidangadi kshara*

Table 11: Details of FTIR of *Vidangadi kshara*

Absorbance	Range	Appearance	Group	Compound class
2072.60	2140-1990	strong	N=C=S stretching	isothiocyanate
2062.96	2140-1990	strong	N=C=S stretching	isothiocyanate
1383.98	1385-1380	medium	C-H bending	alkane

DISCUSSION-

As the name implies, *Vidangadi kshara* (*ayurvedic* medicine with alkali property) is classified under the *Kshara kalpana* (alkali preparation of medicine), yet its preparation is comparable to that of *Mashi kalpana* (ash preparation). Drugs are thought to be burned into ash, dissolved in water, filtered, and evaporated in *Kshara kalpana* (alkali medicine preparation); however, in *Mashi kalpana*, drug burning is explained solely. In terms of preparation, *Acharyas* (*Ayurveda* experts) have directly mentioned to the term *DAGDHVA* (burning) **[1]**. In light of this, it is recommended that all drugs be burned, as stated clearly. The *Antardhuma* (closed type preparation) method for producing *Vidangadi kshara* (*Ayurvedic* medication with alkali properties) is mentioned in Bhaishajya Ratnavali's Hindi version **[2]** and the English translation of Sahasrayogam **[8]**. In order to choose between two approaches, the *Vidangadi kshara* (*Ayurvedic* medicine with alkali property) preparation process was finalised. *Chakrikas* (round pellet) of *Kupilu beeja* (*Strychnos nux-vomica* seed) size were made for the *sharava samputa* (set

of two clay plates which are kept over each other) method in order to provide even heating from all sides. To avoid any contamination from outside & also to seal both the *sharava* (clay plate) from all the sides *sandhibandhan* (sealing of a joint) is done. *Sandhibandhan* (sealing of a joint) is done in seven layers so that cloth can sustain heat of higher temperature. Classically temperature specification is not available. 450 °C to 500 °C is required temperature for herbal drug to burn into ash form **[9]**. As such, the muffle furnace's temperature was set to 540°C. The *sharava samputa* (set of two clay plates which are kept over each other) method is used to prepare *Vidangadi kshara* (*Ayurvedic* medicine with alkali property) because the pH of the closed method was greater than that of the open method. Temperature fluctuations cause color variances. As the temperature decreases, the colour of the ash becomes darker due to the presence of more carbon particles. The second method produced softer ash compared to the first. Extreme heat reduces particle size, leading to softer ash.

Organic phytochemicals present in *Vidangadi kshara* (*Ayurvedic* medicine with alkali property) include carbohydrates and tannins; while inorganic phytochemicals found are sodium & potassium. Energy is provided by carbohydrates **[10]**, when carb is a medical component, it will lessen constipation like symptoms in cancer patients because it maintains regular bowel movements **[11]**. Because they can be generated from natural sources in a repeatable manner, can go through a variety of chemical and enzymatic reactions, are biocompatible and biodegradable, and have little immunogenic characteristics, polysaccharides represent very appealing molecules. In order to transport their anti-cancer medications to cancer cells via polysaccharides, a number of anti-cancer medications, including doxorubicin (DOX), paclitaxel, docetaxel, cisplatin, and 5-fluorouracil, have been conjugated to these molecules **[12]**. Certain tannins suppress the growth of cancer by producing tumour necrosis factor alpha, and they also demonstrate the actions of inducing apoptosis, inhibiting DNA oxidative damage, and stimulating bacterial growth to promote advantageous colonic digestion **[13]**. Tannins have antioxidant, anti-inflammatory, anti-cancerous, anti-carcinogenesis, anti-fungal, and antibacterial pharmacological effects **[14]**. Patients with cancer frequently experience sodium imbalances **[15]**. Patients with lymphoma have a significant incidence of hyponatremia **[16]**. Malignancies and severe illnesses both have hyponatraemia as a poor prognostic factor **[17]**. High potassium levels during T cell development maintain the "stemness" of the T cells. Although such

T cells are capable of self-replication, they are unable to develop into killer immune cells. Tumours continue to spread and avoid attack as a result. Such T cells develop into killer T cells and are able to assault a cancer when they are generated in-vitro and given back to the patient. However, these T cells can develop inside tumours and engage in tumor-attacking activity when they are kept under high potassium concentrations **[18]**. Isothiocyanate (ITC) **[19]** is a functional group present in *Vidangadi kshara. ITC*, phytochemicals with potential for preventing cancer, can have positive and negative effects on cellular oxidative stress. ITC immediately alkylate and reduce thiol cellular groups, harm mitochondria, and boost ROS, causing cellular stress. However, they also directly alkylate and reduce numerous antioxidant enzymes and non-enzymatic proteins, resulting in higher protection against oxidative stress. The activation of apoptosis, suppression of cell cycle progression, and blockage of angiogenesis are some of the mechanisms by which *ITC* has cytotoxic and cytostatic effects.

There is no previous analysis of *Vidangadi Kshara*. This analytical information and operational technique will be used for future evaluations of *Vidangadi Kshara*. Analytical results indicate that *Vidangadi kshara's* components are commonly used to treat cancer.

CONCLUSION-

Analytical evidence indicates that *Vidangadi kshara*, an *Ayurvedic* medicine with alkali properties, is better prepared using the *antardhuma* (closed-type preparation) method. Based on analytical data, *Vidangadi kshara* is expected to exhibit anticancer effects.

FURTHER SCOPE OF STUDY-

Anticancer activity can be verified through preclinical or clinical investigations. The action of alkane needs to be evaluated.

REFERENCES-

[1] Acharya Y. T., editor. Charaka Samhita of Agnivesha (Reprint 2015). Chikitsa Sthana, Udara Chikitsa: Chapter 13, Verse 80. New Delhi: Chaukhamba publication; 2017; p 495.

[2] Prof. Siddhi Nandan Mishra, Commentator. Bhaishajya Ratnavali of Acharya Shri Govinda Das Sen. Plihyyakruta Adhyay: Chapter 41, Verse 20. Varanasi: Chaukhamba Prakashan; pg 748.

[3] Anonymous, The Ayurvedic Pharmacopoeia of India. 1st edition. Reprinted 2001. Part 1, Volume 1;123pg

[4] Anonymous, The Ayurvedic Pharmacopoeia of India. 1st edition. Reprinted 2001. Part 1 Volume 1: 29pg

[5] Anonymous, The Ayurvedic Pharmacopoeia of India. 1st edition.

Reprinted 2001. Part 1 Volume 2: 103 pg

[6] Anonymous, The Ayurvedic Pharmacopoeia of India. 1st edition. Reprinted 2001. Part 1 Volume 2: pg 168

[7] Anonymous, The Ayurvedic Pharmacopoeia of India. 1st edition. Reprinted 2001. Part 1 Volume 6: pg204

[8] Dr. K.Nishteswar and Dr. R. Vidyanath; Sahasrayoga (2nd edition); Bhasmaksharadi yoga: 100. Varanasi: Chaukhamba samskrit series office; 2008; pg 222.

[9] Anonymous, The Ayurvedic Pharmacopoeia of India. 1st edition. Reprinted 2001. Part 1 Volume 2; Appendix 2: pg143

[10] *Carbohydrate | Definition, Classification, & Examples*. (n.d.). Encyclopedia Britannica. https://www.britannica.com/science/carbohydrate

[11] *Lymphoma Action | Diet and nutrition*. (2000, January 1). Lymphoma Action. https://lymphoma-action.org.uk/about-lymphoma-living-and-beyond-lymphoma/diet-and-nutrition

[12] Posocco B, Dreussi E, De Santa J, Toffoli G, Abrami M, Musiani F, Grassi M, Farra R, Tonon F, Grassi G, Dapas B. Polysaccharides for the Delivery of Antitumor Drugs. *Materials*. 2015; 8(5):2569-2615. https://doi.org/10.3390/ma8052569

[13] Matin, Md. (2021). A Review Study On The Pharmacological Effects And Mechanism Of Action Of Tannins. European Journal Of Pharmaceutical And Medical Research. 8. 05-10.

[14] M. Narmadha, M. Surendar, S. Sathesh Kumar. Tannin Loaded Nanoparticles and its Therapeutic Applications – A Comprehensive Review. Asian Journal of Pharmaceutics. 2021 September 17; Vol 15(3): 325.

[15] Krishnamurthy A, Bhattacharya S, Lathia T, Kantroo V, Kalra S, Dutta D. Anticancer Medications and Sodium Dysmetabolism. *Eur Endocrinol*. 2020;16(2):122-130. doi:10.17925/EE.2020.16.2.122

[16] Castillo JJ, Glezerman IG, Boklage SH, et al. The occurrence of hyponatremia and its importance as a prognostic factor in a cross-section of cancer patients. *BMC Cancer*. 2016;16:564. Published 2016 Jul 29. doi:10.1186/s12885-016-2610-9

[17] https://assets.researchsquare.com/files/rs-386327/v2_covered.pdf?c=1643907598 Dated on 15/05/2023

[18] *Harnessing T-cell "stemness" for immunotherapy*. (2019, March 28). National Cancer Institute. https://www.cancer.gov/news-

events/press-releases/2019/stemness-potassium-immunotherapy

[19] Molina-Vargas, Luis Federico. (2013). Mechanism of action of isothiocyanates. A review. *Agronomía Colombiana*, *31*(1), 68-75.