



Research Article

PHARMACEUTICAL AND ANALYTICAL STUDY OF VASA ARKA

Prakruthi T S^{1*}, Govinda Sharma K²

*¹PG Scholar, ²Professor, Department of Rasashastra and Bhaishajya Kalpana, Sri Dharmasthala Manjunatheshwara College of Ayurveda and Hospital, Hassan, Karnataka, India.

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ABSTRACT

Vasa (*Adhatoda vasica* Nees) is used in multiple Ayurvedic formulations. One such formulation is *Vasa Arka* which is said to be beneficial for treating conditions like *Jwara*, *Chardhi*, *Kushta*, *Meha* and *Kshaya*. Presently, *Arka* is gaining importance due to its sterility and shelf life. The present study focuses on the preparation and analysis of *Vasa Arka*. **Materials and method:** Fresh leaves of *Vasa* were collected and were authenticated from experts. To the measured quantity leaves 1/20th part of water (v/v) was added *Arka* was extracted in distillation apparatus. The prepared *Arka* was tested for its quality with help of Physico-chemical parameters and GCMS (Gas Chromatography Mass Spectrometry). **Results and discussion:** The percentage yield of *Vasa Arka* was 27.51%. The pH was 3.50, indicating acidic nature. Specific gravity (1) and viscosity (0.001kgcm⁻¹s⁻¹) were comparable to water, while the refractive index (1.346) suggested the presence of dissolved constituents. GC-MS analysis revealed alcohols, ketones, esters, phenols, and halogenated compounds. **Conclusion:** The preparation of *Vasa Arka* was pharmaceutically feasible; however, the yield was low. The quality control parameters established through this work can be considered as preliminary standards for *Vasa Arka*.

INTRODUCTION

Arka is a liquid preparation obtained by distillation of certain liquids or drugs soaked in water using *Arkayantra* or any convenient modern distillation apparatus [1]. The detailed references on pharmaceutical and therapeutic application of *Arka kalpana* are found in *Arka Prakasha* [2,3]. *Arka Kalpana* is said to be one among the *Pancha vidha kashaya kalpana* according to *Arka Prakasha* [4]. Presently, *Arka* is gaining importance due to its sterility and shelf life.

Vasa (*Adhatoda vasica* Nees) belonging to family Acanthaceae is a sub – herbaceous bush, found throughout the year in many regions of India, mainly from upper Gangetic plain to Bihar [5]. *Vasa* is said as *Bhishak-mata* as it takes care of diseased like a mother [6]. It is known for its effectiveness as a respiratory stimulant, expectorant, antibacterial, and uterine stimulant etc.

Vasa is used in multiple Ayurvedic formulations, including *Vasa swarasa*, *Vasavaleha*, *Vasakasava*, *Rasnadikwatha*, *Kumaryasava*, *Mahatiktakagritha*, *Panchatikta Kashaya*, and *Vasa chandanadi taila*. One such formulation is *Vasa Arka* which is said to be beneficial for treating conditions like *Jwara*, *Chardhi*, *Kushta*, *Meha* and *Kshaya* [7]. The present study focuses on the preparation and analysis of *Vasa Arka*.

MATERIALS AND METHOD: The materials and methods of this work can be classified into following section.

1. Pharmaceutical study
2. Analytical study

Pharmaceutical study

Collection of *Vasa*

Fresh leaves of *Vasa* were collected from herbal garden of an Ayurveda college and authenticated with help of Dravyaguna experts. The authentication was done based on morphology, organoleptic characters and comparison with standard herbarium specimens.

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Preparation of Vasa Arka

Vasa leaves were collected fresh, made into pieces and measured. It was added with 1/20th part of water (v/v) and kept in sunlight for 1 *Yama* (3hrs) [8]. Then, the leaves were hand macerated, transferred to distillation apparatus and placed on a heating mantle.

The energy regulator knob of heating mantle was set at 5 gradient. The continuous flow of water through the condenser was maintained. First few drops of distillate was discarded and then collection of arka was done. Distillation was continued for 3 hours and 27.51% of distillate was collected.

**Vasa patra****1/20th part water****Soaking in water****Exposing to Sunrays****Distillation****Vasa arka****Fig.1 Preparation of Vasa arka****Analytical study**

Vasa Arka was subjected for the following analytical study as per the references available in "Laboratory guide for the analysis of Ayurveda and Siddha formulations" published by CCRAS [9]. In the present work, the prepared *Arka* was subjected to physico-chemical analysis and GCMS (Gas Chromatography Mass Spectrometry).

RESULTS**Pharmaceutical study**

Color and texture of *Vasa* leaves were changed after exposure to sun rays. The first drop of *Arka* was collected after 15 min of heating. Smell of first few milliliters of *Arka* was like that of fresh leaf but changed to characteristic odor after sometime

Table 1: Pharmaceutical Results

S.No	Parameter	Quantity
1.	<i>Vasa patra</i>	900ml
2.	Water	45ml
3.	Yield	260ml
4.	Percentage of yield (in comparison to both <i>Jala</i> and <i>Patra</i>)	27.51%

Analytical study**Table 2: Analysis of *Vasa Arka***

S.No	Parameter	Results
1.	Colour	Colourless
2.	Odor	Bitter
3.	Appearance	Liquid
4.	pH	3.50
5.	Specific gravity	1
6.	Refractive index	1.346
7.	Viscosity	0.001 kg/cm·s

Table 3: The GCMS of *Vasa Arka* at RT = 2.6

Hit	Compound name	Formula	Match factor	CAS#	Prob%
1	3-Hexen-1-ol	C6H12O	922	544-12-7	68.6%
2	3-Hexen-1-ol, (E)	C6H12O	849	928-97-2	9.34%
3	3-Hexen-1-ol, (Z)	C6H12O	837	928-96-1	6.22%
4	3-Hexen-1-ol, formate, (Z)	C7H12O2	818	33467-73-1	3.02%
5	4-Hexen-1-ol, (E)	C6H12O	814	928-92-7	2.55%
6	4-Penten-1-ol, 3-methyl	C6H12O	806	51174-44-8	1.90%
7	4-Hexen-1-ol, (Z)	C6H12O	804	928-91-6	1.75%
8	4-Hexen-1-ol	C6H12O	790	6126-50-7	1.09%
9	4-Hexen-1-ol, acetate, (Z)	C8H14O2	778	42125-17-7	0.73%
10	Ethyl (Z)-hex-3-enyl carbonate	C9H16O3	768	-	0.51%

Table 4: The GCMS of *Vasa Arka* at RT= 3.7

Hit	Compound name	Formula	Match factor	CAS#	Prob%
1	Oxime-, methoxy-phenyl	C8H9NO2	762	-	76.8%
2	4-Ethylbenzoic acid, 2-methylbutyl ester	C14H20O2	696	-	12.1%
3	4-Ethylbenzoic acid, cyclohexyl ester	C15H20O2	665	-	3.30%
4	4-Ethylbenzoic acid, cyclopentyl ester	C14H18O2	652	-	2.13%
5	2-Amino-5-methylbenzoic acid	C8H9NO2	642	2941-78-8	1.50%
6	Benzoic acid, 2-amino-4-methyl	C8H9NO2	626	2305-36-4	0.86%
7	4-Ethylbenzoic acid, 2-pentyl ester	C14H20O2	618	-	0.64%
8	6-Chlorohexanoic acid, 3-methylbutyl ester	C11H21ClO2	618	-	0.64%
9	2-Amino-6-methylbenzoic acid	C8H9NO2	597	4389-50-8	0.27%
10	4-Ethylbenzoic acid, 2-butyl ester	C13H18O2	596	-	0.26%

Table 5: The GCMS of Vasa Arka at RT= 4.2

Hit	Compound name	Formula	Match factor	CAS#	Prob%
1	2-Propen-1-ol	C3H6O	909	107-18-6	38.1%
2	Neopentane	C5H12	889	463-82-1	17.4%
3	Aziridine, 1-methyl-	C3H7N	875	1072-44-2	10.9%
4	Formic acid, 2-propenyl ester	C4H6O2	872	1838-59-1	9.60%
5	Chloromethyl propanoate	C4H7ClO2	853	5402-53-9	4.66%
6	Diazene, bis(1,1-dimethylethyl)-	C8H18N2	848	927-83-3	3.75%
7	Propane, 2-methyl-2-nitro-	C4H9NO2	833	594-70-7	2.27%
8	Propanoic acid, anhydride	C6H10O3	833	123-62-6	2.27%
9	Propanoic acid, 2-propenyl ester	C6H10O2	824	2408-20-0	1.65%
10	di-tert-Butyl dicarbonate	C10H18O5	818	24424-99-5	1.29%

Table 6: The GCMS of Vasa Arka at RT= 5.6

Hit	Compound name	Formula	Match factor	CAS#	Prob%
1	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3	814	541-05-9	34.4%
2	1,2,4-Benzenetricarboxylic acid, 1,2-dimethyl ester	C11H10O6	811	54699-35-3	30.4%
3	4-tert-Octylphenol, TMS derivative	C17H30OSi	794	78721-87-6	16.6%
4	4-Methyl-2,4-bis(p-hydroxyphenyl) pent-1-ene, 2TMS derivative	C24H36O2Si2	769	-	5.06%
5	1,2-Benzisothiazol-3-amine, TBDMS derivative	C13H20N2SSi	751	-	2.61%
6	Tris (tert-butyldimethylsilyloxy)arsane	C18H45AsO3Si3	750	-	2.51%
7	2'-Hydroxy-5'-methylacetophenone, TMS derivative	C12H18O2Si	744	97389-69-0	1.97%
8	4,4'-Bi-4H-pyran, 2,2',6,6'-tetrakis(1,1-dimethylethyl)-4,4'-dimethyl-	C28H46O2	744	-	1.97%
9	Arsenous acid, tris(trimethylsilyl) ester	C9H27AsO3Si3	739	55429-29-3	1.59%
10	4-Methyl-2-trimethylsilyloxy-acetophenone	C12H18O2Si	721	97389-70-3	0.82%

Table 7: The GCMS of Vasa Arka at RT=8.6

Hit	Compound name	Formula	Match factor	CAS#	Prob%
1	2-Norbornanone, 3-bromo-	C7H9BrO	799	89856-55-3	90.0%
2	Cyclohexene, 4-(2-bromoethyl)-	C8H13Br	624	63540-01-2	1.80%
3	p-Mesyloxyphenol	C7H8O4S	614	-	1.27%
4	1-Propanone, 1-(1-cyclohexen-1-yl)-	C9H14O	599	1655-03-4	0.77%
5	Bicyclo[2.2.2]octane, 1-bromo-	C8H13Br	584	7697-09-8	0.46%
6	Ethanone, 1-(1-cyclohexen-1-yl)-	C8H12O	579	932-66-1	0.37%
7	Bicyclo[2.1.0]pentane-5-carboxylic acid, 1-methyl-, ethyl ester	C9H14O2	579	74810-55-2	0.37%
8	3,5-Heptadien-2-one, 6-methyl-, (E)-	C8H12O	578	16647-04-4	0.36%
9	6-Methyl-3,5-heptadiene-2-one	C8H12O	578	1604-28-0	0.36%
10	2-Cyclohexen-1-one, 3-bromo-2-methyl-	C7H9BrO	576	56671-83-1	0.33%

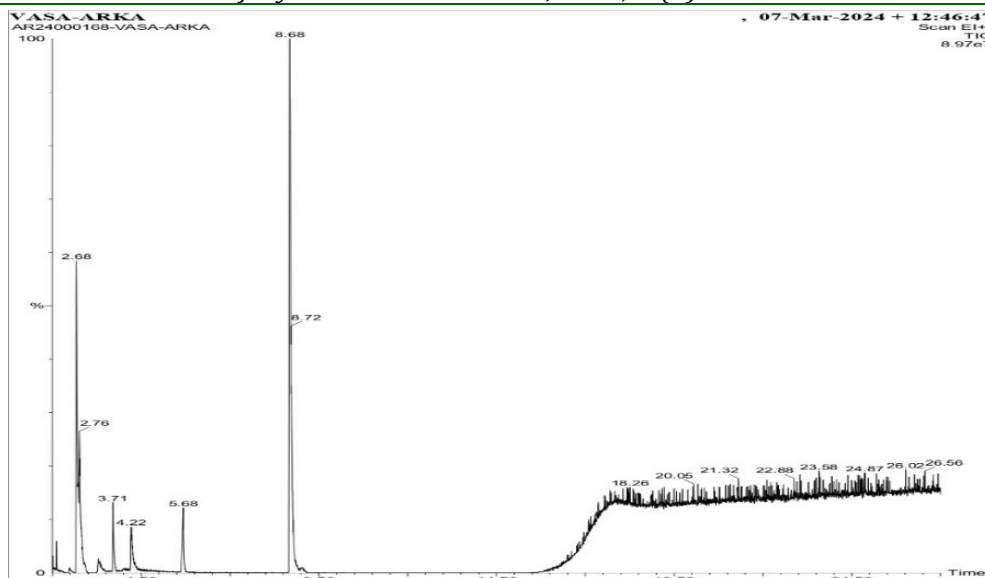


Fig. 2 TIC (Total Ion Chromatogram) of *Vasa Arka*

DISCUSSION

The preparation of *Vasa Arka* involves soaking the leaves in water under sunlight for 3 hours, which can be considered as *Toya sannikarsha* and *Kala prakasarsha* samskara. It helps in changing qualities of drugs. 1/20th part of water was added to the quantity of *Vasa* was based on the references *Arka prakasha* considering it as a *Nirasadravya* [8]. Soaking leaves in water and keeping under sunlight may help in swelling up of cells and easy release of active compounds, which can then be further extracted more efficiently. The leaves were macerated so that heat applied will be evenly distributed. To avoid charring of *Vasa*, the energy regulator knob of heating mantle was set at 5 gradient. The distillate started to collect after 15 min of heating and the duration to complete was less than three hours, may be because the water added was less.

The yield of *Vasa Arka* (27%) in this study appears lower compared to *Yavani Arka* (39%) [10] and *Tulasi Arka* (60%) [11] reported in previous studies. In another study, different drug-water ratios (1:2 and 1:16) were used, and the proportion influenced the yield, indicating that both the nature of the drug and the preparation method affect distillate recovery [12]. The comparatively lower yield of *Vasa* may be due to its thick and fibrous leaves, which can restrict easy release of contents during distillation. The mention of *Putapakwa Swarasa* for *Vasa* may reflect an approach to soften fibrous tissue and thereby improve extraction [13].

The analysis of *Vasa Arka* shows a pH of 3.50, indicating its acidic nature. Its specific gravity (1) and viscosity (0.001kg/cm·s) are similar to water, suggesting comparable density and flow characteristics. However, its refractive index (1.346) is slightly higher than water, reflecting the presence of dissolved constituents. Thus, while *Vasa Arka* resembles water in physical properties, it differs in

acidity and optical characteristics due to its solute content.

The GCMS analysis of *Vasa Arka* found a range of compounds such as alcohol, ketone, ester, halogenated compounds, and phenols. Among these, those detected around retention time 2.6 minutes are primarily leaf alcohols, known for their aromatic characteristics. Specifically, 3-Hexen-1-ol, (E)/Trans-3-Hexen-1-ol, is an oxygenated monoterpene said to possess calming and anti-anxiety effects [14].

At retention time 3.7, the compounds predominantly include esters and amino-substituted derivatives of benzoic acid. Oxime-, methoxy-phenyl [15] is noted to possess antioxidant, antimicrobial and anti-inflammatory properties. 2-amino-4-methylbenzoic acid is known for its antimicrobial activity mainly antifungal [16]. 4-Ethylbenzoic acid, 2-methylbutyl ester may contribute to the secondary aroma [17]. Both 2-amino-5-methylbenzoic acid [18] and 4-ethylbenzoic acid, cyclopentyl ester [19] are recognized for their antibacterial activity. 4-ethylbenzoic acid, cyclohexyl ester belong to phenolic esters used as food additives and known for their bactericidal, fungicidal, insecticidal, and antimicrobial properties [20].

At retention time 4.2, 2-Propen-1-ol (Allyl alcohol) [21], Formic acid, 2-Propenyl ester [22] and Chloromethyl propanoate [23] are said to possess antimicrobial properties, while Diazene, bis (1,1-dimethylethyl), is noted for its anti-phytopathogenic activity. Aziridine, 1-methyl-, is suggested to have antibacterial effect due to the presence of its aziridine ring [24].

At retention time 5.6, predominantly phenolic compounds were detected. Cyclotrisiloxane, hexamethyl-, a cyclic siloxane, is recognized for its antioxidant, antidiabetic and antimicrobial

properties^[25]. 1,2-Benzisothiazol-3-amine, TBDMS derivative, a derivative of sugar, is identified to have antimicrobial effects^[26]. Tris(tert-butyl)dimethylsilyloxy) arsane, a phenol, said to possess a broad spectrum of activities including antineoplastic, anti-ulcerative, antifungal, anti-inflammatory and antimicrobial effects^[27]. 4-methyl-2-trimethylsilyloxy acetophenone is an aromatic ketone known for its activity against *Listeria* bacteria^[28].

At retention time 8.6, ketones are predominantly observed. Among them, only 3,5-Heptadien-2-one, 6-methyl-, (E) is recognized for its ability to influence immune response by inhibiting neutrophil migration^[29]. No other compounds at this retention time show notable activity.

CONCLUSION

The preparation of *Vasa Arka* is pharmaceutically feasible; however, the yield obtained is low. The quality control parameters established can serve as preliminary standards for *Vasa Arka*. The analysis shows an acidic pH, a density comparable to water, and distinct optical characteristics. GCMS analysis identifies several bioactive compounds, including alcohols, esters, phenols, and antimicrobial agents, all of which may offer significant therapeutic benefits.

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***Address for correspondence**

Dr. Prakruthi T S

PG Scholar,

Department of Rasashastra and

Bhaishajya Kalpana,

Sri Dharmasthala Manjunatheshwara

College of Ayurveda and Hospital,

Hassan, Karnataka.

Email: pakkuts@gmail.com

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