

Physicochemical and Pharmacognostical Standardization of Black carrot, Amla and Pippali

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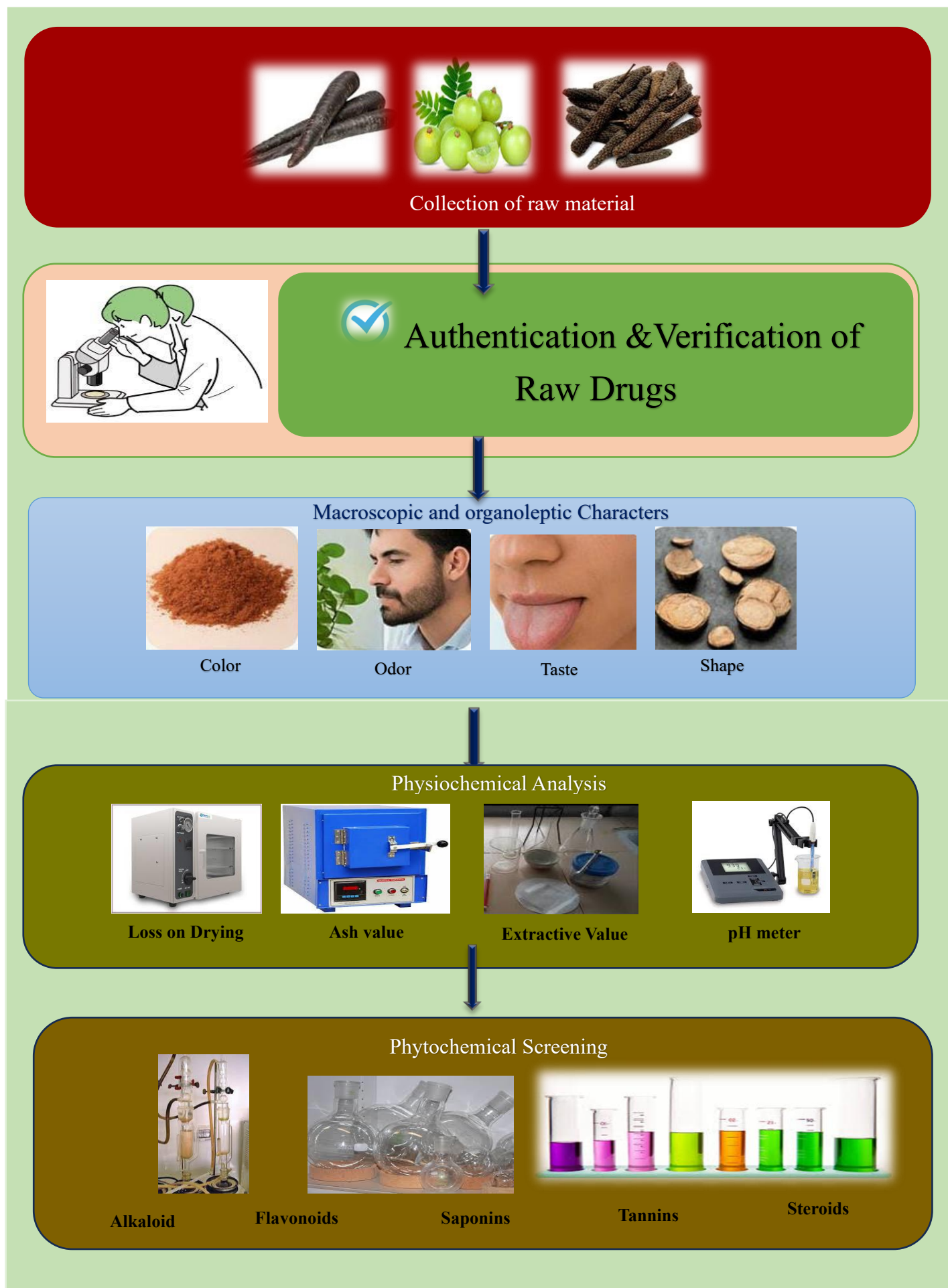
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ABSTRACT

For centuries, traditional medicinal systems have utilized botanical resources to maintain health and manage a wide spectrum of pathologies. The present study focuses on the preliminary pharmacognostic and physicochemical evaluation of three significant medicinal plants: Black Carrot (*Daucus carota* var. *sativus*), Pippali (*Piper longum*), and Amla (*Phyllanthus emblica*). The raw drugs were systematically assessed for their morphological traits and microscopic characteristics, which serve as primary diagnostic markers for authentication. Standard physicochemical parameters—including loss on drying (LOD), total ash, acid-insoluble ash, and water-soluble extractive values—were determined in accordance with official guidelines to ensure purity and consistency. Furthermore, this study bridges the gap between traditional knowledge and modern analytical validation, establishing critical baseline data for raw material quality control. These findings ensure the safety and efficacy of the studied botanicals, providing a foundation for future research, standardized herbal formulations, and industrial-level quality assurance.

Keywords: Pharmacognostic standardization, Physicochemical analysis, Botanical authentication, Quality control markers, *Phyllanthus emblica*, *Piper longum*, *Daucus carota*

GRAPHICAL ABSTRACT



I. INTRODUCTION

The traditional medicinal systems of India—namely Ayurveda, Siddha, and Unani—are globally recognized for their holistic approach to health. These healing practices find their origins in the ancient Vedas and other classical texts. Between 250 and 500 BC, the philosophy of Ayurveda emerged and gradually evolved into a comprehensive medical science.[1] Medicinal plants constitute the core foundation of these traditional healthcare practices, particularly in Ayurveda, where they are utilized as both single drugs and complex polyherbal formulations. The quality of botanical raw materials directly influences the safety, efficacy, and reproducibility of herbal medicines. Consequently, proper identification and standardization of crude drugs have become indispensable steps in pharmaceutical research and development.

Pharmacognostic evaluation, which encompasses the study of macroscopic traits, microscopic features, and diagnostic tissue structures, is vital for confirming the authenticity of plant materials and preventing substitution or adulteration. In addition to pharmacognosy, physicochemical analysis plays a critical role in establishing quality parameters. Metrics such as loss on drying (LOD), total ash, and extractive values (water and alcohol-soluble) provide essential data regarding moisture content, purity, inorganic matter, and the concentration of active constituents. These parameters serve as preliminary quality control standards and act as reference points for future batch-to-batch comparisons.

Among the prominent botanicals used in Ayurveda, the Black Carrot (*Daucus carota* var. *sativus*) is a visually distinctive, purple-hued vegetable.[2,3] Carrot varieties are generally classified into two main groups: carotene-rich Western types and anthocyanin-containing Eastern types.[4,5] Anthocyanins are water-soluble polyphenolic pigments that offer significant health benefits, including the management of coronary heart disease and cancer.[6,7] Furthermore, these compounds exhibit potent antioxidant, anti-inflammatory, and cardioprotective properties, while also acting as digestive stimulants, lipid-lowering agents, and anti-tumor agents.[8,9]

Phyllanthus emblica L., commonly known as Amla,[10] belongs to the family Phyllanthaceae.[11] Native to India, Amla (Indian gooseberry) bears edible fruits widely appreciated for their nutritional and therapeutic value. In traditional healing practices, Amla is regarded as a *Rasayana* (rejuvenating herb) that helps improve blood health and supports the male reproductive system.[12,13] It is also believed to promote *Deepana* (digestion),

strengthen liver function, calm anxiety, and act as a natural tonic for maintaining heart health and vitality.[14,15] Pharmacological research has revealed its antitussive, adaptogenic, cardioprotective, gastroprotective, and nephroprotective activities.[16,17] Fresh Amla also acts as a diuretic.[18] Additionally, it has demonstrated radioprotective, chemotherapeutic, immunomodulatory, and free radical neutralizing properties.[19,20]

Pippali (*Piper longum*), also known as Long Pepper, is a valuable medicinal plant belonging to the Piperaceae family.[21] It is extensively used in treating respiratory, digestive, and inflammatory disorders.[22] The fruits of Pippali possess significant therapeutic value in managing arthritic and gynecological ailments, exhibiting decongestant, antibiotic, and analgesic effects.[23,24] Traditionally, the fruits are used in Nepal for fever and bronchitis, in Thailand for diarrhea and postpartum care, and in China for gastric disorders.

Given their widespread use in powders, health supplements, and dietary preparations, ensuring the quality of these raw materials is essential. The present study focuses on the systematic evaluation of the raw plant materials of Black Carrot, Pippali, and Amla. By documenting their morphological features, microscopic characteristics, and key physicochemical parameters, this work aims to provide fundamental reference data for quality assurance, botanical authentication, and further scientific exploration.

II. MATERIAL AND METHODS

1. COLLECTION OF PLANT MATERIAL :The raw materials, including Black Carrot (*Daucus carota* var. *sativus*), Amla (*Phyllanthus emblica* L.), and Pippali (*Piper longum* L.), were procured from the local market of Kharwar, Hamirpur (Himachal Pradesh). The specimens were cleaned and prepared for subsequent analytical procedures to ensure they were free from any external contaminants.

2. AUTHENTICATION OF RAW HERBAL :DRUGS The identity of the herbal materials was authenticated by the Herbal Health Research Consortium (HHRC) Pvt. Ltd., Amritsar, a Government of India sponsored and Punjab Government assisted AYUSH Cluster Project. Verification was conducted through comprehensive microscopic, organoleptic, and pharmacognostic evaluations. The identification was further cross-referenced with standard literature, specifically the Quality Standards of Indian Medicinal Plants.

III. STANDARDIZATION OF RAW DRUGS

1. Pharmacognostic Study : The pharmacognostic investigation involved a systematic assessment of the plant materials through both macroscopic and microscopic analyses to establish their identity and anatomical profile.

A) Macroscopic and Organoleptic Study (*Panchabhautika Parikshana*) : The macroscopic study focused on determining the morphological characters of the drugs. Organoleptic evaluation, referred to in Ayurveda as *Panchabhautika Parikshana*, was utilized to document parameters such as color, odor, taste, appearance, and texture for precise morphological description.

B) Microscopic Characterization: This method facilitated a qualitative histological evaluation of the organized crude drugs based on their specific cellular features. Transverse sections and powder microscopy were performed to identify diagnostic tissue markers.

2. Physicochemical Analysis: Physicochemical Analysis The physicochemical parameters were determined in accordance with the protocols mentioned in the **Ayurvedic Pharmacopoeia of India (API)** and relevant official guidelines.[16] The evaluation included:

- **Loss on Drying (LOD):** To determine the moisture content.
- **Ash Values:** Including Total Ash and Acid-Insoluble Ash to detect inorganic impurities.
- **Extractive Values:** Water-soluble and Alcohol-soluble extractives to estimate the active constituents.
- **pH Determination:** To assess the acidic or alkaline nature of the drug.

3. Preliminary Phytochemical Screening : The crude drug samples were subjected to qualitative phytochemical tests to detect the presence of essential secondary metabolites, including glycosides, alkaloids, tannins, and flavonoids.[25]

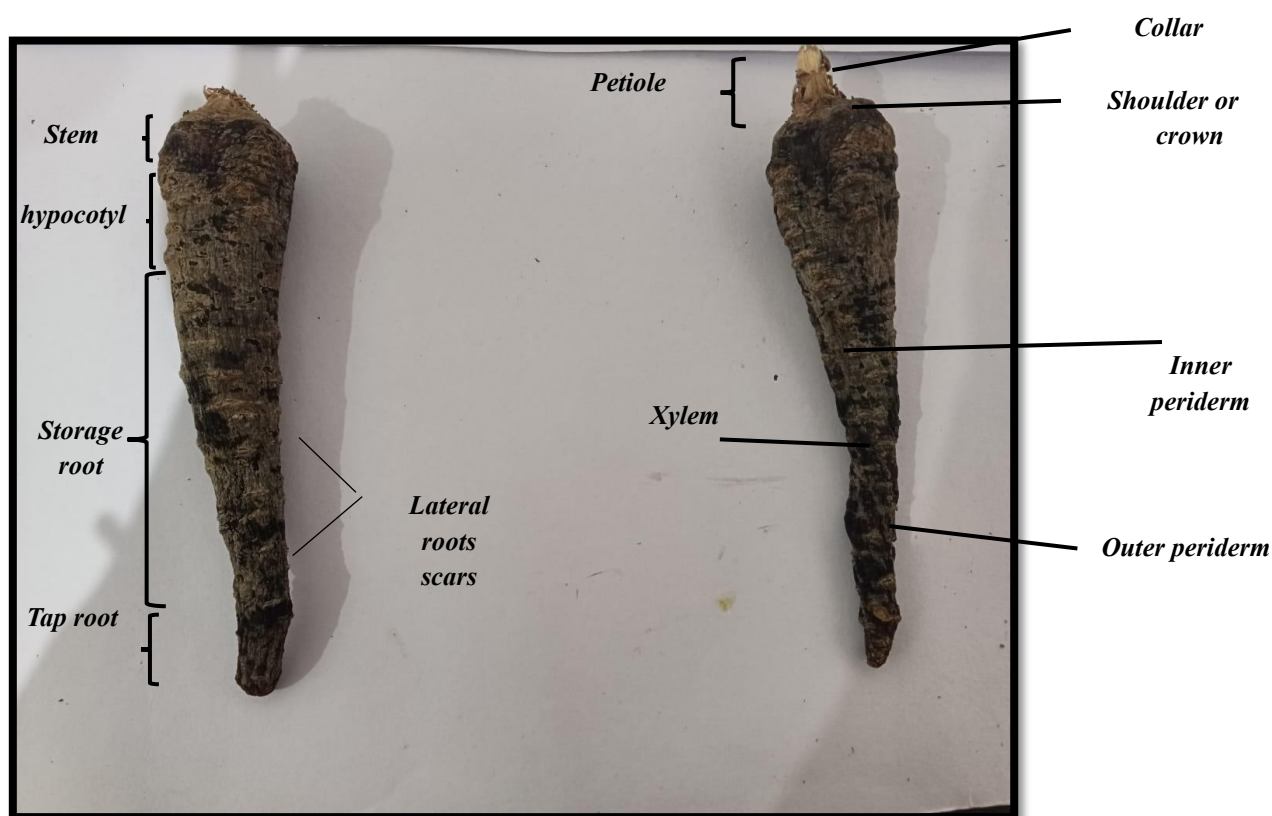
IV. RESULTS AND DISCUSSION

1.1 MACROSCOPIC CHARACTERISTICS

A) BLACK CARROT MACROSCOPIC STUDY :

Sr. No.	Characteristic	Description
1	Shabda (Fracture)	Crisp, breaks with a moist sound; fibrous texture
2	Sparsa (Touch)	Smooth outer surface; firm and juicy texture inside

3	Roopa (Appearance)	
	Color	Dark purple to black externally; deep violet to reddish-purple internally
	Shape	Conical or cylindrical root with tapering end
	Size	15–30 cm long 2–4 cm in diameter
4	Rasa (Taste)	Madhura (sweet), slight Kashaya (astringent)
5	Gandha (Odour)	Mild, earthy smell typical of root vegetables

*Fig1.1 Black Carrot**Fig 1.2 Size of Black Carrot**Fig 1.3 Structure of black carrot*

2. AMLA

MACROSCOPIC STUDY :

Sr. No.	Characteristic	Description
1.	Shabda (Fracture)	Hard, produces sound when broken; smooth fracture; not fibrous
2.	Sparsha (Touch)	Smooth, hard outer surface; inner part firm and slightly succulent
3.	Roopa (Appearance)	
	Color	Fresh fruit: glossy green to yellowish-green; dried fruit: dark brown to blackish
	Shape	Nearly spherical, slightly flattened, with 6 vertical grooves
	Size	Diameter 2–3.5 cm (fresh); variable in dried form (segments or whole)
4.	Rasa (Taste)	Predominantly Amla (sour), with other Rasas: Madhura (sweet), Tikta (bitter), Kashaya (astringent), and slight Katu (pungent) – known for all tastes except Lavana (salty)
5.	Gandha (Odour)	Slight, characteristic odour; more prominent in dried fruit



Fig 1.4 Amla Fruit

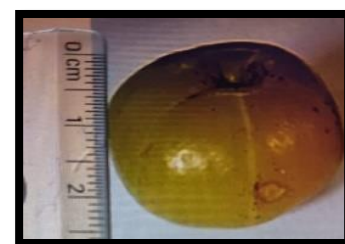


Fig 1.5 Size of Amla

3. PIPPALI

MACROSCOPIC STUDY

Sr. No.	Characteristic	Description
1.	Shabda (Fracture)	Hard and brittle; breaks with a sharp sound
2.	Sparsha (Touch)	Rough and dry to touch; surface has a bumpy texture
3.	Roopa (Appearance)	
	Color	Blackish-brown to dark brown
	Shape	Small cylindrical spike, tapering; resembles a tiny "catkin"
	Size	Length 2–5 cm; diameter ~0.5 cm
4	Rasa (Taste)	Katu (pungent), slightly Tikta (bitter)
5	Gandha (Odour)	Aromatic, pungent odour typical of Piper species



Fig 1.6 Pippali



Fig 1.7 Size of Pippali

1.2 MICROSCOPICAL CHARACTERISTICS

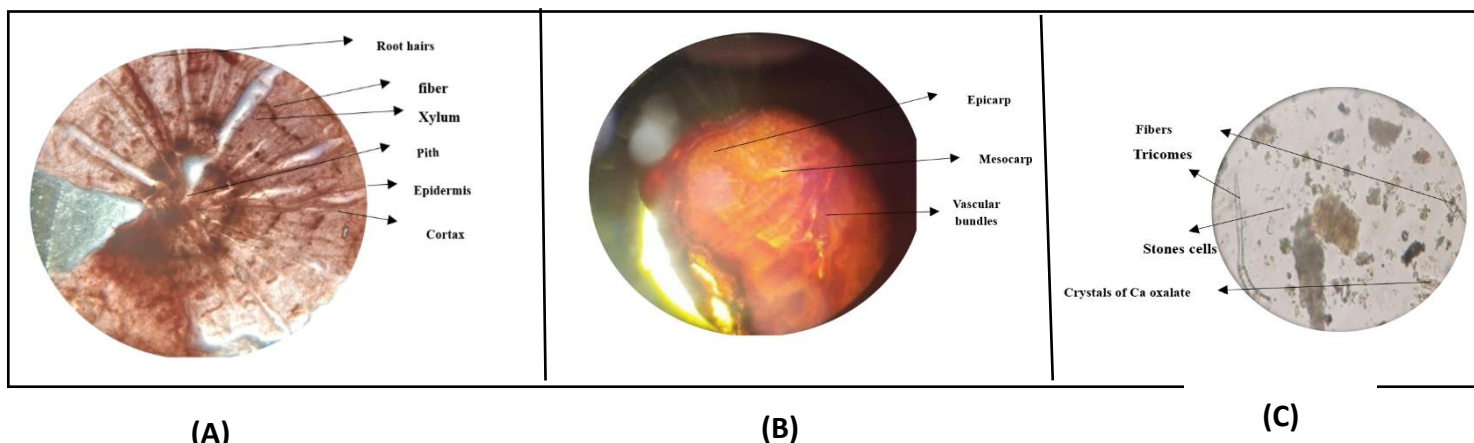


Fig 1.8 Microscopical characteristics A) Black Carrot B) Beetroot C) Amla

2.1 ORGANOLEPTIC CHARACTERS

Color ,odour ,taste etc. of powders were recorded

• ORGANOLEPTIC CHARACTERS OF POWDERED DRUG

Name	Organoleptic Characters	
1.Black Carrot  <i>Fig 2.1 Black Carrot</i>	Color	Deep purplish-brown
	Odor	Mild, earthy
	Taste	Slightly sweet, earthy
	Touch	Fine, smooth
2.Amla  <i>Fig 2.2 Amla</i>	Organoleptic Characters	
	Color	Yellowish-green
	Odor	Faint, characteristic sour
	Taste	Sour, astringent
	Touch	Fibrous, slightly coarse
3. Pippali  <i>Fig 2.3 Pippali</i>	Organoleptic Characters	
	Color	Brownish-black
	Odor	Strongly aromatic, spicy
	Taste	Pungent, spicy
	Touch	Coarse, gritty

Table2.1 organoleptic Characteristics of Powdered drug

• FOREIGN MATTER

All the raw materials were checked for the presence of foreign matter.

Name	Standard (AIC to API)	Sample (a)	Sample (b)	Sample (c)
Black carrot	-	Nil	Nil	Nil
amla	Not more than 3%	Nil	Nil	Nil
Pippali	Not more than 2%	Nil	Nil	Nil

Table 2.2 Foreign Matter

2.2 PHYSICO-CHEMICAL TEST Standard physicochemical parameters of all drugs were evaluated.

A)ASH VALUES OF RAW MATERIALS

Total ash value

Raw material	Units	Standard According to API(%)	Sample		Average	Standard deviation	Standard error	RSD (RELATIVE STANDARD DEVIATION)
Black carrot	(%w/w)	--	a.	8.6	8.2	0.29	0.16	2.072
			b.	8.1				
			c.	7.9				
Amla	(%w/w)	Not more than 7%	a.	6.74	6.39	0.248	0.143	2.243
			b.	6.19				
			c.	6.24				
Pippali	(%w/w)	Not more than 5.5%	a.	5.34	5.29	0.12	0.073	1.383
			b.	5.12				
			c.	5.42				

Table 2.3 Total ash value

water soluble ash values:

Raw material	Units	Standard According to API(%)	Sample		Average	Standard deviation	Standard error	RSD (RELATIVE STANDARD DEVIATION)
Black carrot	(%w/w)	--	a.	2.93	3.03	0.086	0.049	1.639
			b.	3.02				
			c.	3.14				
Amla	(%w/w)	Not more than 7%	a.	3.2	3.76	0.543	0.313	8.333
			b.	3.6				
			c.	4.5				
Pippali	(%w/w)	Not more than 5.5%	a.	5	5.20	0.16	0.094	1.813
			b.	5.20				

			c.	5.4				
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Table 2.4 Water soluble ash values

Acid insoluble ash values:

Raw material	Units	Standard According to API(%)	Sample		Average	Standard deviation	Standard error	RSD (RELATIVE STANDARD DEVIATION)
Black carrot	(%w/w)	--	a.	0.13	0.15	0.016	0.0094	6.28
			b.	0.17				
			c.	0.15				
Amla	(%w/w)	Not more than 2%	a.	0.45	0.54	0.069	0.040	7.45
			b.	0.55				
			c.	0.62				
Pippali	(%w/w)	Not more than 0.5%	a.	0.21	0.22	0.012	0.0072	3.22
			b.	0.22				
			c.	0.24				

Table 2.5 Acid insoluble ash values

B) EXTRACTIVE VALUES OF RAW MATERIALS*Water soluble extractive values :*

Raw material	Units	Standard According to API(%)	Sample		average (Mean)	Standard deviation	Standard error	RSD (RELATIVE STANDARD DEVIATION)
Black carrot	(%w/w)	--	a.	91.04	90.96	0.55	0.32	0.354
			b.	91.6				
			c.	90.24				
Amla	(%w/w)	Not less than 50%	a.	65.6%	66.23	0.531	0.306	0.463
			b.	66.2				
			c.	66.9				
Pippali	(%w/w)	Not less than 12%	a.	59.92	58.296	0.91	0.529	0.892
			b.	58.0				
			c.	59.968				

Table 2.6 Water soluble Extractive values

Alcohol soluble extractive values :

Raw material	Units	Standard According to API (%)	Sample	average (Mean)	Standard deviation	Standard error	RSD (RELATIVE STANDARD DEVIATION)
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Black carrot	(%w/w)	-	A	22.92	22.48	0.081	0.047	0.20
			B	22.72				
			c	22.82				
Amla	(%w/w)	Not less than 40%	a	49.12	49.38	0.367	0.212	0.429
			b	49.12				
			c	49.9.				
Pippali	(%w/w)	Not less than 4%	a	21.96	22.06	0.36	0.21	0.96
			b	22.56				
			c	21.68				

Table 2.7 Determination of alcohol soluble extractive value

C) DETERMINATION OF PH(5% AQUEOUS SOLUTION)

Raw material	Standard According to API(%)	Sample		average (Mean)	Standard deviation	standard error	RSD(RELATIVE STANDARD DEVIATION)
Black carrot	-	A	6.31	6.31	0.0081	0.0047	0.074
		B	6.3				
		C	6.30				
Amla	-	A	5.74	5.76	0.016	0.0098	0.170
		B	5.77				
		C	5.78				
Pippali	-	A	7.03	7.05	0.016	0.0068	0.097
		B	7.06				
		C	7.07				

Table 2.8 Determination of pH(5% aqueous solution)

D) DETERMINATION OF LOSS ON DRYING

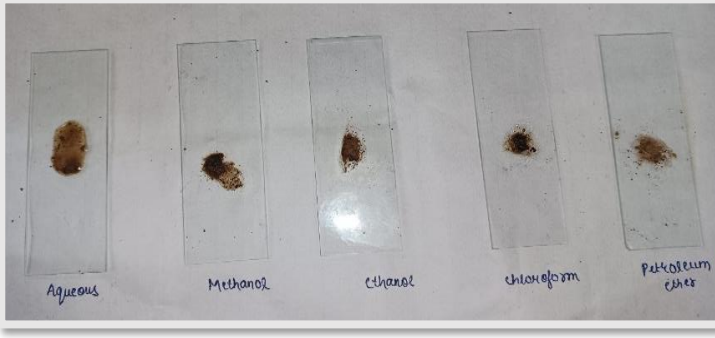
Raw material	Units	Sample		average (Mean)	Standard deviation	standard error	RSD(RELATIVE STANDARD DEVIATION)
Black carrot	(%w/w)	A	7.2	7.44	0.17	0.103	1.388
		B	7.62				
		C	7.52				
Amla	(%w/w)	A	7.6	6.7	0.82	0.47	7.14
		B	6.9				
		C	6.7				

Pippali	(%w/w)	A	6.56	6.24	0.234	0.135	2.16
		B	6				
		C	6.17				

Table2.9 determination of loss on drying of Pippali

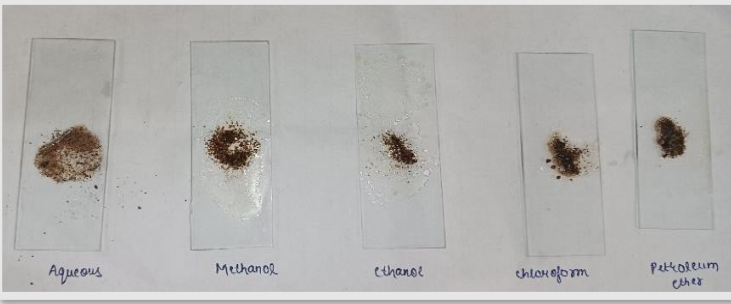
E. SUCCESSIVE SOLVENT EXTRACTION OF DRIED POWDER WITH VARIOUS EXTRACTS

1.Amla

Solvent	Color Observed	Figure
Aqueous	Light brown	
Methanol	Dark brown	
Ethanol	Brown	
Chloroform	Dark brown	
Petroleum Ether	Brownish	

*Fig.2.4 Successive solvent extraction of Amla powder**Table 2.10 Successive solvent extraction of Amla powder*

2. Pippali

Solvent	Color Observed	Figure
Aqueous	Light brown	
Methanol	Brown	
Ethanol	Brown	
Chloroform	Dark brown	
Petroleum Ether	Light brown powder	

*Fig. 2.5 Successive solvent extraction of Pippali powder**Table2.11 Successive solvent extraction of Pippali powder*

3. Black Carrot

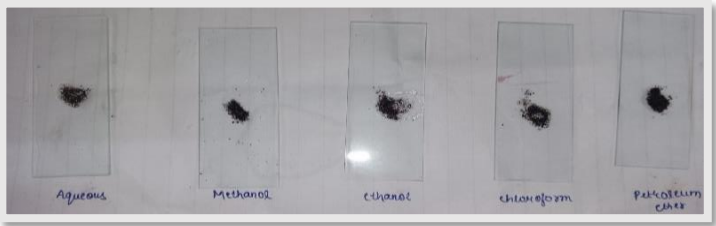
Solvent	Color Observed	Figure
Aqueous	Dark purple	
Methanol	Purple-black	
Ethanol	Dark violet	
Chloroform	Black	
Petroleum Ether	Black	

Fig.2.6 Successive solvent extraction of Black Carrot powder

Table2.12 Successive solvent extraction of Black Carrot powder

3.1 Phytochemical stuuues

A) Phytochemical Screening of Black Carrot (Aqueous & Alcoholic Extracts)

S. No.	Phytoconstituents	Tests	Aqueous Extract	Alcoholic Extract
1	Alkaloids	Mayer's Test	—	+
		Dragendorff's Test	—	+
		Hager's Test	+	+
		Wagner's Test	+	+
2	Carbohydrates	Benedict's Test	+	+
3	Tannins / Phenols	FeCl ₃ Test	—	+
		Lead acetate Test	+	+
4	Flavonoids	NaOH Test	—	+
		Lead acetate Test	+	+
5	Anthocyanins	HCl Test	—	—
6	Cardiac Glycosides	Keller–Killiani Test	—	—
7	Saponins	Froth formation Test	—	—
8	Triterpenoids	Salkowski's Test	+	+

Fig 3.1 Phytochemical screening of Black Carrot

B. Phytochemical Screening of Amla (Aqueous & Alcoholic Extracts)

S. No.	Phytoconstituents	Tests	Aqueous Extract	Alcoholic Extract
1	Alkaloids	Mayer's Test	+	+
		Dragendorff's Test	—	+
		Hager's Test	+	+
		Wagner's Test	+	+
2	Carbohydrates	Benedict's Test	—	+
3	Tannins / Phenols	FeCl ₃ Test	+	+
		Lead acetate Test	+	+
4	Flavonoids	NaOH Test	+	+
		Lead acetate Test	—	+
5	Anthocyanins	HCl Test	—	—
6	Cardiac Glycosides	Keller–Killiani Test	—	—
7	Saponins	Froth formation Test	+	+
8	Triterpenoids	Salkowski's Test	+	

*Fig 3.2 Phytochemical screening of Amla***D. Phytochemical Screening of Pippali (Aqueous & Alcoholic Extracts)**

S. No.	Phytoconstituents	Tests	Aqueous Extract	Alcoholic Extract
1	Alkaloids	Mayer's Test	+	+
		Dragendorff's Test	—	+
		Wagner's Test	+	+
		Hager's Test	+	+
2	Carbohydrates / Reducing sugars	Benedict's Test	+	+
3	Tannins / Phenols	FeCl Test	+	+
		Lead acetate Test	+	+
4	Flavonoids	NaOH Test	+	+

		Lead acetate Test	+	+
5	Anthocyanins	HCl Test	—	—
6	Cardiac glycosides	Keller–Killiani Test	—	—
7	Saponins	Froth formation Test	—	+
8	Triterpenoids / Sterols	Salkowski’s Test / Liebermann–Burchard	+	+

Fig 3.3 Phytochemical screening of Pippali

V. DISCUSSION

The standardization of Black Carrot, Amla, and Pippali through systematic pharmacognostic and physicochemical evaluations confirms their high quality and botanical authenticity. The physicochemical parameters, including ash values and extractive values, were found to be within the permissible limits defined by official pharmacopoeial standards. The low moisture content, observed through the Loss on Drying (LOD) values, indicates a high degree of stability and resistance to microbial degradation, which is essential for maintaining the shelf-life of raw herbal materials.

The preliminary phytochemical screening revealed a rich diversity of secondary metabolites, such as alkaloids, flavonoids, tannins, and phenolic compounds. The presence of these bioactive constituents validates the traditional therapeutic claims associated with these plants. For instance, the high phenolic and flavonoid content highlights the potent antioxidant potential of the samples, while the presence of alkaloids in Pippali supports its role as a bio-enhancer. These findings establish a strong scientific correlation between traditional knowledge and modern analytical data, reinforcing the safety and efficacy of these botanical raw materials for pharmaceutical use.

VI. CONCLUSION

The present study successfully establishes comprehensive pharmacognostic and physicochemical profiles for Black Carrot, Amla, and Pippali. The macroscopic and microscopic characterizations provide definitive diagnostic markers to prevent adulteration and ensure the botanical identity of the raw drugs. Furthermore, the standardized physicochemical datasets generated in this study serve as essential reference benchmarks for quality control and batch-to-batch consistency in the herbal pharmaceutical industry. These results support the traditional medicinal applications of these plants and provide a robust foundation for future quantitative research, bio-activity profiling, and the development of standardized polyherbal formulations.

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