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Research Article



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DETAIL COMPARATIVE MACRO AND MICRO MORPHOLOGICAL STUDY OF *KARPAS* (*Gossypium herbaceum* Linn.) AND *RAKTA KARPAS* (*Gossypium arboreum* Linn.) LEAF AND STEM

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ABSTRACT

Gossypium herbaceum Linn. known as *Karpasa*. *Gossypium arboreum* Linn. Commonly known as *Rakta Karpasa*. both belongs to the family Malvaceae. *Karpasa* is widely used in *Ayurveda* for the treatment of diseases like post-puerperal haemorrhage, dysmenorrhoea, diarrhoea, hyperpiesia, dysentery etc. and for the processing of various formulations of *Rasashastra*. For the first time both varieties take into consideration and distinguish the morphologically, pharmacognostically including its powder microscopy and histochemical studies. In the present study, transverse section of fresh roots of *karpasa* showed, cortex with pericyclic fibres, prismatic crystals of calcium oxalate and starch grains. Vascular bundle shows the phloem above the xylem, xylem radially arranged with biseriate to multiseriate medullary rays. Transverse section of fresh leaf shows glandular trichomes, vascular bundles and rosette crystals, lignified parenchymatous cells. And the transverse section of fresh root of *Rakta karpas* shows parenchyma cells, starch grains, phloem, rosette crystals, calcium oxalate etc. transverse section of fresh leaf shows glandular trichomes, vascular bundles and rosette crystals, lignified parenchymatous cells.

Key words: *Karpas*, *Raktakarpas*, leaf, stem, pharmacognosy.

INTRODUCTION

Karpasa, *Gossypium herbaceum* Linn. is an annual or perennial shrub. It belongs to the family Malvaceae and possesses the following synonyms viz. Karpasaaki, Samudranta, Tundikeri, Cavya, Picu. 0.6-2.4 m. high, with thick and rigid stems; twigs and young leaves sparsely hairy, rarely glabrous; leaves flat, cleft up to half into 3-7 lobes; lobes ovate, rotund, only slightly constricted at the base; bracteoles with 6-8 serrated teeth on the margin, broadly triangular, flaring widely from the flower or capsule, usually broader than long; flowers medium sized, yellow with purple center, rarely white; capsules rounded, rarely with prominent shoulders, beaked with smooth surface and very few oil glands, 3-4 locular, opening slightly when ripe; seeds usually with two coats of hairs; lint hairs white, grey or red-brown in colour and fuzz hairs, distributed uniformly over the seed.ⁱ

Rakta Karpasa, Gossypium arboreum Linn., belonging to family Malvaceae, has synonyms *Karpasa, Tundikeri, Samudranta, Vanyakarpasa*, is a medium sized shrub comparatively smaller than karpasa, often with mucilaginous sap. native to South America, particularly its northwestern parts, it is also cultivated in India. The root is branched, with tap root system. The stem is erect, branched, somewhat reddish, young portion often covered with trichomes. Leaf is simple, alternate, often deeply palmately lobed, lobes 3 to 5 palmately veined, stipulated petiolated, entire margined, venation reticulate and multicosted divergent, veins purple in colour. The plant has inflorescence which is axillary, solitary in the leaf axis, flowers pinkish red in colour. In the present study an attempt has been made to establish the analytical and pharmacognostical standards for both the plant especially the roots and leaves.ⁱⁱ

MATERIAL AND METHODS

Plant material

Whole plant was collected from its natural habitat from Nagpur, Maharashtra, India during the month of April 2012. The botanical identity was confirmed by the pharmacognosist., IPGT&RA, Gujarat Ayurved University, Jamnagar

Macroscopical evaluation

The sample was cleaned and macroscopic evaluation of whole plant was carried out. The leaf and root were then separated and individual macroscopic characters were noted in detail.^{iii,iv,v}

Organoleptic evaluation: The colour, odour and taste of the root were recorded separately.^{vi}

Microscopical evaluation

Free hand sections of leaf and root were taken and washed with chloral hydrate solution. Sections were first observed in distilled water then stained with phloroglucinol and conc. HCl. Powder microscopy of shade-dried powder was also carried out. Photomicrographs were taken by Carl Zeiss trinocular microscope.^{vii}

Histochemical tests

Thick sections were treated with various reagents to locate chemical constituents i.e. Tannin, mucilage, lignin and calcium.^{viii}

RESULTS AND DISCUSSION

Karpas: Leaf

Macroscopical Characters

Simple, alternate, cordate, 3-5, lobed usually with a gland on the under surface of the midrib; stipules ovate, lanceolate, entire or slightly toothed, mucronate, the sinuses between the lobes are little open, the midrib and lateral veins are greenish. Leaves have a nectary on the major vein on either side of the midrib, and a pair is also developed on the major veins to the lateral lobe of a leaf.

Microscopical Characters

Detailed TS shows upper and lower epidermis covered with thin cuticle bears simple multicellular multibranching and glandular trichome. Mesophyll composed of palisade tissue underlying the upper epidermis and spongy parenchyma underlying the lower epidermis. The upper epidermis of a leaf is thicker than the lower epidermis. Palisade cells are longer in the upper layer of palisade parenchyma than in the lower layer. 2-3 rows of spongy parenchyma which is often more compact traversed with obliquely cut vascular bundles and rosette crystals of calcium oxalate. Stellate hairs, were present on the leaves which are commonly more abundant on the lower than on the upper surface, and frequently more abundant along the major veins than elsewhere on the lamina. Oblate or spherical cavities commonly with brownish contents occur in the mesophyll. Parenchyma which extends to a collenchymatic layer of variable thickness underlying the epidermis, the Meristele composed of vessels, tracheids

and narrow phloem band almost completely encircling the xylem tissue. Detailed TS passing through the petiole circular in outline with irregular margins shows outer layer epidermis with thin cuticle and trichomes loaded with pigment, underneath the epidermis lie in a continuous colenchymatous band of hypodermis embedded with rosette crystals of calcium oxalate and pigment. Centrally located wide pith with lignified parenchymatous cells encircled by ring of wedge shaped vascular bundles. The diagnostic characters of powdered leaves showed that prismatic and rosette crystals, single and multibrached trichomes, Stomata, simple fibres from cortical region, yellow coloured pigment (tannin) content cell.

ROOT

Macroscopical features:

The root system consists of a long woody cylindrical tap root and a few lateral roots with their branches. The lateral roots are often as long as the tap root and fairly thick. They may attain half to one meter or more in length and about one cm. in diameter. The outer surface of the root when fresh is light reddish yellow to yellowish brown in colour and shows the presence of lenticels, many root-lets and scars of fallen rootlets. The lenticels are many in number prominent, protruding fairly long, tangentially elongated. Those towards the upper or basal part of the root are often arranged closer together. The surface skin is very thin. It can be easily scraped off exposing a smooth cream white tissue. In transverse section of mature root about one cm in diameter the entire bark which appears whitish and the wood which forms the bulk part of the root. It appears dull or yellowish white, minutely diffusely porous, slightly hard and with several whitish radial lines or streaks. The root has no particular odour or taste.

Microscopical characters

The outermost tissue namely the cork or phellem and is composed of 12 – 18 rows of thin walled rectangular tangentially elongated cells. Phelloderm composed of a few two to three of more rows of thin walled rectangular cells, similar to those of inner rows of the cork. Considerable number of these cells contain fairly large sized rosette crystals of calcium oxalate and simple and compound starch grains.

Phloem occupies the major part of the bark, wedge shaped strips or patches of varying width with the apices towards the periphery and radially alternating with or separated by the widened distal ends of the vascular (phloem) rays. The majority of phloem ray cells contain abundance of starch grains. The same cells may contain small as well as large and simple as well as compound grains. In some of the wider rays lysigenous secretory cavities with brownish contents occur. This is a special or noteworthy feature of this root.

Xylem composed of both lignified and unlignified xylem elements which as seen in T.S. occurs in narrowly wedge shaped radial strips extending from the centre of the root. The walls appear pitted. The centre of the root is occupied by the primary xylem surrounded by a small amount of secondary xylem. The primary xylem is tetrarch. The medullary rays are generally two to four seriate. Many of the rays start from very near the center of the root, contain starch grains which may be simple or compound or occasionally aggregated. Some of the ray cells contain rhomboidal crystals of calcium oxalate. The diagnostic characters of powdered root showed that rosette and prismatic crystals, simple and compound starch grains, fibres from cortical region, brown pigment (tannin) content cell from cortex zone, fragment of cork in surface view, fragment of pitted vessels from stealer region.

RAKTA KARPASA: LEAF

Macroscopical

Simple, alternate, stipulate Stipules linear about 0.5cm, long acute with a prominent nerve long petiole, broad ovate-cordate acute firm or thick, nearly glabrous deeply palmately five to seven or 3 to 7 lobed; lobes linear – oblong to oblong – lanceolate, mucronate contracted at the base often with a small extra or supplementary lobe or tooth in the left side sinus on both sides of the lateral lobe; the sinuses between the lobes open; the midrib and lateral veins pinkish purple, the midrib provided with a gland. Under surface punctate with black dots.

Detailed T.S. shows upper and lower epidermis covered with thin cuticle bears simple multicellular multibrached and glandular trichome. Lamina shows single layer of palisade underneath the upper epidermis and 2-3 of rows of spongy parenchyma traversed with obliquely cut vascular bundles and rosette crystals of calcium oxalate. Section passing through the midrib shows collenchymatous tissue is located underneath both the epidermis, the Meristele composed of vessels, tracheids and narrow phloem band almost completely encircling the xylem tissue being

parenchymatous. The parenchyma tissue containing pigment rosette crystals of calcium oxalate were seen. Detailed TS passing through the petiole circular in outline with irregular margine shows outer single layer epidermis with thin cuticle and trichomes loaded with pigment, underneath the epidermis lie in a continuous colenchymatous band of hypodermis embedded with rosette crystals of calcium oxalate and colouring pigments. Centrally located wide pith with lignified parenchymatous cells encircled by ring of wedge shaped vascular bundles. The diagnostic characters of powdered leaves showed that prismatic and rosette crystals, single and multibranched trichomes, Stomata, simple and lignifiedfibres, yellow coloured pigment tannin content cell.

ROOT:

Macroscopical Features:

The root system consists of a long woody cylindrical tap root and a few lateral roots with their branches. The lateral roots are often as long as the tap root and fairly thick. They may attain half to one meter or more in length and about one cm. in diameter .The outer surface of the root when fresh is light reddish yellow to yellowish brown in colour and shows the presence of lenticels. The surface skin is very thin. It can be easily scraped off exposing a smooth cream white tissue. In transverse section of mature root about one cm in diameter the entire bark which appears whitish and the wood which forms the bulk part of the root. It appears dull or yellowish white, minutely diffusely porous, slightly hard and with several whitish radial lines or streaks. The root has no particular odour or taste.

Microscopical characters

Outermost cork composed of 12 – 18 rows of thin walled rectangular tangentially elongated cells somewhat wavy are light yellow to yellowish brown in colour. Inner to the cork, zone of pericyclic parenchyma extends inside as far as the phloem. The parenchyma cells are thin walled and larger being somewhat broader and more tangentially elongated. Most of the cells are abundantly packed with starch grains both simple and compound and rosette crystals of calcium oxalate.

Phloem occupies the major part of the bark. As seen in T.S it occurs in the form of wedge shaped strips or patches of varying width with the apices towards the periphery and radially alternating with or separated by the widened distal ends of the vascular (phloem) rays. The phloem consist parenchyma and sieve elements. A few phloem elements situated at the distal ends are compressed and collapsed and appear as very narrow streaks. In some of the some of the parenchyma cells are large in size and are lysigenous secretory cavities with brownish contents occur.

Xylem composed of xylem elements ie. xylem parenchyma and its fibres. Xylem is occurs tetrarch. The medullary rays are biseeriate, radially elongated. Rays contain starch grains which may be simple or compound, some of the ray cells contain rhomboidal crystals of calcium oxalate. The diagnostic characters of powdered root showed that rosette crystals, simple and compound starch grains, fibres from cortical region, brown pigment (tannin) content cell from cortex zone, fragment of cork in surface view, fragment of pitted vessels from stealer region.

Discussion:

Detailed morphological and pharmacognostical study regarding to differentiate the *Karpas* and *Raktakarpas* reveals that the leaves size of the *karpas* comparatively larger than *Raktakarpas* and also lobes are more, Trichomes distributed more in *Raktakarpas* than *Karpas*, more colouring pigments observed in *Raktakapas*, vascular system well developed in *Karpas* as compared to *Raktakarpas*. *Karpas* stem shows more cork cells as compared to *Raktakarapas*, tannin content, rosette and prismatic crystals of calcium oxalate, starch grains and vascular system characters are consistence developed in *Karpas* as compared with the *Raktakarpas*. But the Histochemical studies revels that the presences of the tannin, calcium, tannin and starch.

Conclusion:

Morphological and anatomical character varies from species to species and play important row in specific species identification. Morphological and Anatomical and Histochemical test are very necessary aspect to standardize the raw drug further study required regarding its clinical aspects.

TABLES

Powder microscopy

Colour, odour, taste, texture Organoleptic character are recorded and result are depicted in the **table 1**

Table No. 1: Organoleptic characters

Powder microscopy	<i>Rakta Karpasa</i>		<i>Karpasa</i>	
	Leaf	Root	Leaf	Root
Colour	greenish gray	Pale Yellowish brown	greenish gray	Pale Yellowish brown
Odour	Pungent	Pungent	Pungent	Pungent
Taste	pungent Bitter Astringent	Bitter Astringent	pungent Bitter Astringent	Bitter Astringent
Texture	rough	---	rough	Smooth

Table no. 2: Histochemical tests for *Rakta Karpas* Linn.

Sr. No.	Reagents	Observation	Characteristics	Leaf	Root
1.	Phloroglucinol+Conc. Hcl	Red	Lignified cells	++	++
2.	Phloroglucinol+Conc. Hcl	Dissolved	Calcium oxalate crystals	++	++
3.	Fecl3 solution	Blue to black	Tannin	++	++
4.	Ruthenium red	Red	Mucilage	++	++
5.	Starch grains	Iodine	Blue	--	++

Table no.3: Histochemical tests for *Karpas* Linn.

Sr. No.	Reagents	Observation	Characteristics	Leaf	Root
1.	Phloroglucinol+Conc. Hcl	Red	Lignified cells	++	++
2.	Phloroglucinol+Conc. Hcl	Dissolved	Calcium oxalate crystals	++	++
3.	Fecl3 solution	Blue to black	Tannin	++	++
4.	Ruthenium red	Red	Mucilage	++	++
5.	Starch grains	Iodine	Blue	--	++

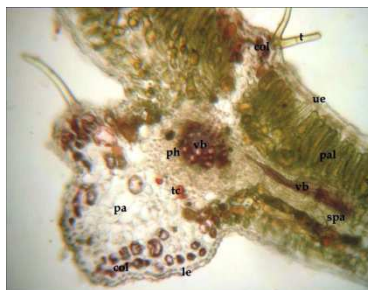
Transverse section of *Karpas* and *Rakta karpas*

Natural habitat

Leaf

Root

Rakta karpasa



Karpasa

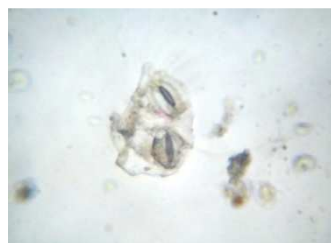


Powder microscopy of *Karpas* and *Rakta karpas*

K.
Leaf



Powder



Stomata



Multibranched Trichome



Tannin content

K.
Root



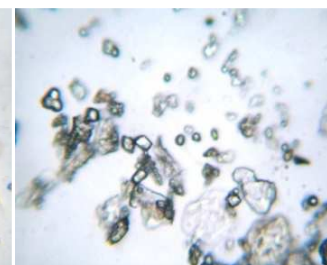
Powder



annular vessel

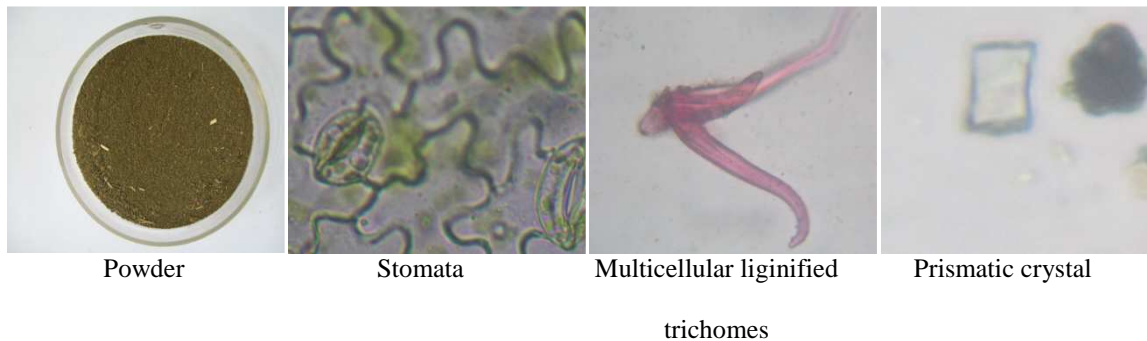


pitted vessel

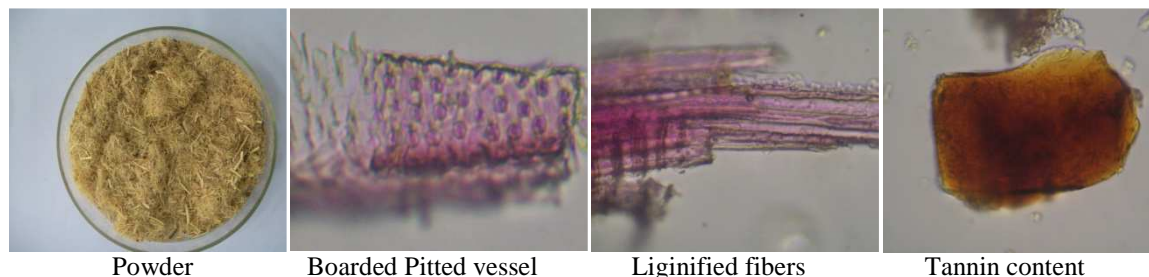


Starch grains and prismatic crystals

R.K.
Leaf



R.K.
Root



K – Karpas, R.K.- Rakta karpas

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