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Pitcher Plants (*Nepenthes*) Recorded From Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia

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Abstract: A dichotomous key and description of five pitcher plants taxa recorded from Universiti Kebangsaan Malaysia Campus is given. In this study, a new species is *Nepenthes sharifah-hapsahii* Adam and Hafiza is describe. Three other species and one hybrid found here are *Nepenthes gracilis* Korthals, *Nepenthes ampullaria* Jack, *Nepenthes mirabilis* (Loureiro) Druce and *Nepenthes* × *trichocarpa* Miquel. *Nepenthes sharifah-hapsahii* is closely related to *Nepenthes gracilis* but differ in having cylindrical upper stem, lamina base attenuate into petiole like region and not wing, lower lid surface densely covered with nectar glands, digestive glands on inner cavity covered by extended epidermal roof, peristome ribs distinct and pedicels commonly 2-flowered. On the other hand *Nepenthes gracilis* has angular upper stem, sessile leaves, lamina base decurrent, wings extends almost into one internode, lower lid surface sparsely covered with nectar glands, digestive glands exposed and epidermal roof poorly developed, persitome rib not distinct and pedicels all 1-flowered. *Nepenthes ampullaria* differs from the other taxa in having lower pitcher which is urceolate in shape, inner pitcher cavity wholly covered with digestive glands, lower lid surface not covered by nectar glands, paniculate inflorescence and pedicels commonly with 3-flowered and subtended by bract. *Nepenthes mirabilis* can be recognized and differentiated from the other species in having broad and flattened peristome and fimbriate leaves margin.

Key words: Biodiversity, dichotomous key, morphological description, *Nepenthes*, Peninsular Malaysia

INTRODUCTION

Peninsular Malaysia is one of the centre of distribution of tropical pitcher plants of the world. These pitchers belong to genus *Nepenthes* known locally in Malaysia as periuk kera (Malays, Peninsular Malaysia) entuyud (Iban) akah tuyud (Melanau, Matu and Daro) somboi-somboi (Brunei Malays) and kekuanga (Dusun, Sabah). Previous researchers recorded between 10-12 species of pitcher plants in Peninsular Malaysia (Som, 1988; Shivas, 1984). Shivas (1984) recorded 12 species and treated *Nepenthes hookeriana* and *Nepenthes trichocarpa* as two distinct species. Som (1988) listed 10 species but treated *Nepenthes* × *hookeriana* and *Nepenthes* × *trichocarpa* as natural hybrids; she also listed three other natural hybrids in her treatment. Both authors doubtfully listed the present of *Nepenthes alata* and *Nepenthes reinwardtiana* their treatments. Som (1988) and Shivas (1984) included *Nepenthes alata* in their treatments based on the specimen collected from Mt. Tahan by Ridley in 1911 which was deposited in Herbarium Singapore. However it has not been collected

by other botanists from the same mountain after Ridley. Som (1988) and Shivas (1984) too reported the occurrence of *Nepenthes reinwardtiana* in Peninsular Malaysia. There is no record of the herbarium specimen of the species collected from Peninsular Malaysia. The species of pitcher plants can be categorized into two group base on altitude distribution (Kurata, 1976; Shivas, 1984) name the lowland and highland species; the lowland and highland groups comprises of species which is distributed below 1000 m and above 1000 m altitude, respectively. The pitcher plants prefer to grow in open places and they failed to grow under heavy shaded of lowland dipterocarp forest (Holttum, 1940) and secondary vegetation. In low lying country of Malaysia species such as *Nepenthes gracilis* prefer to grow on road embankment covered with *Dicranopteris linearis* fern coastal plain of BRIS forest and heath forest of the east coast of Peninsular Malaysia (Adam, 2002; Adam *et al.*, 2005). In the highland of Peninsular Malaysia, the highland species often grow on open ridges, on mountain top and along the trail; in high canopy forest, the species grows as epiphyte on tree trunk or tree canopy.

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A key to the species of *Nepenthes*

- Pitcher shape urceolate; inflorescence a panicle.....*Nepenthes ampullaria*
- Pitcher shape other than urceolate; inflorescence a raceme 2
- Lid lower surface numerous covered with nectar glands; stem cylindrical in shape..... 3
- Lid lower surface scarcely covered with nectar glands; stem angular in shape 4
- Leaves base contracted into petiole winged; pedicels 1-flowered *Nepenthes mirabilis*
- eaves base contracted into petiole like region; pedicels 2-flowered....*Nepenthes sharifah-hapsahii*
- Leaves base of upper stem strongly winged, the wings extend up to half or almost the whole length of internodes*Nepenthes gracilis*
- Leaves base of upper stem slightly wing, the wings extend less than 1/3 length of one internodes.....*Nepenthes × trichocarpa*



Fig. 1: Upper pitcher of *Nepenthes sharifah-hapsahii* Adam and Hafiza

MORPHOLOGICAL DESCRIPTION

***Nepenthes sharifah-hapsahii* Adam and Hafiza species nova:** *Nepenthes sharifah-hapsahii* Adam and Hafiza differt a *Nepenthes gracilis* Korthals caulis superiore cylindricis, basi foliorum non-decurrente, pedicellis plerumque bifloris.

Nepenthes sharifah-hapsahii Adam and Hafiza differs from *Nepenthes gracilis* Korthals by its cylindrical upper stem, non decurrent lamina base, commonly 2-flowered pedicels (Fig. 1).

Type specimens: Jumaat H. Adam, JHA 8000, Malaysia, Selangor, Campus Universiti Kebangsaan Malaysia. 2nd August 2001. Holotype (UKMB), Isotype (UKMB).

Stem cylindrical, climbing up to 5 m high, glabrous, 3-9 mm thick, internodes 3-10 cm long. Leaves alternate, coriaceous, glabrous, *elliptic*, lanceolate or oblong, apex obtuse, base obtuse into a petiole like region, leaf attachment semi-amplexicaul and not decurrent, 9-20 cm long, 2.5-5 cm broad, longitudinal nerves 4-5 on each side, originating from leaf base, equally spaced out between midrib and margin, tendrils without pitchers 4-18 cm, tendrils with pitchers 15-20 cm. Upper pitchers infundibulate upper portion infundibulate, 2-3.5 cm wide, tubular towards the middle portion, 2-2.5 cm wide, basal portion infundibulate, 2-3.5 cm wide, 10-15 cm high, with 2 prominent ribs over the whole length; mouth ovate, oblique, peristome cylindrical, 1-2 mm thick, ribs distinct, inner peristome teeth distinct, inner wall cavity glandular on the lower infundibulate part, digestive glands

overarched; lids orbiculate, slightly cordate at base, 2-5 cm long, 3-4 cm broad, numerous nectar glands distributed all over on lower surface and without glandular crest. Spur cylindrical, simple, inserted on lid base. Male inflorescence a raceme, the axis 30-35 cm long, the peduncle 4-7 cm long, the rhachis 24-28 cm long, the pedicels 10-15 cm on the lower half, 3-5 mm towards the tips, 2-flowered on lower 2/3 and 1-flowered on upper 1/3, without bract. Female inflorescence unknown.

Distribution: Peninsular Malaysia

Altitude: Below 1000 m.

Derivation of Name: This species is name after Universiti Kebangsaan Malaysia Vice Chancellor, Prof. Dato' Dr. Sharifah Hapsah Syed Hasan Shahabudin.

This species resembles *N. gracilis* by its cylindrical peristome, orbiculate lid with subcordate base (Fig. 2 and 4) a raceme inflorescence, spur attach close to the lid base. *N. sharifah-hapsahii*, however can easily be distinguished from *N. gracilis* in having upper cylindrical upper stem, lamina base attenuate into petiole like region and not forming wings, lower lid surface covered with numerous honey or nectar glands (Fig. 2), inner pitcher wall cavity covered with glands with well developed epidermal roof concealing most part of the digestive glands and flower pedicels commonly 2-flowered (Table 1). *N. sharifah-hapsahii* have very close affinity with *N. tobaica* Danser recorded from Sumatra (Danser, 1928) by its cylindrical upper stem, sessile leaves, lamina

Table 1: Diagnostic characters of *Nepenthes sharifah-hapsahii* and *N. gracilis*

Morphological characters	<i>Nepenthes sharifah-hapsahii</i>	<i>Nepenthes gracilis</i>
Shape of upper stem	Cylindrical	Triangular or angular
Lamina base	Attenuate into petiole like region and the base not decurrent but clasping stem for about half of its circumference	Not attenuate into petiole like region and the base decurrent, wings extends almost up to one internodes
Distribution of nectar glands on lower lid surface	Numerous nectar glands distributed all over lower lid surface	Nectar glands scarcely distributed on lower lid surface
Type of digestive glands on inner wall cavity of pitcher	Overarched glands: prominently covered by extended epidermal roof conceal more than half of the glands	Exposed glands: Epidermal roof covering digestive glands poorly developed exposed almost all part of the glands
Peristome ribs	Distinct	Inconspicuous
Pedicels	2-flowered on lower 2/3 and 1-flowered on upper 1/3 part of male raceme	All 1-flowered



Fig. 2: Lower lid surface of *N. sharifah-hapsahii* densely covered with nectar glands



Fig. 4: Lower lid surface of *Nepenthes gracilis* sparsely covered with nectar glands



Fig. 3: Rosettes of pitchers of *Nepenthes ampullaria*

base not decurrent and clasping for half of stem circumference, with numerous nectar glands scattered all over the lower lid surface, lid orbiculate with subcordate base. *N. sharifah-hapsahii* can be distinguished from *N. tobaica* by its inner pitcher wall covered with overarched glands, pedicels of male inflorescence commonly 2-flowered and 1-flowered on the upper 1/3

region. *Nepenthes tobaica* have its inner pitcher wall cavity covered with non-overarched glands, pedicels of male inflorescence almost all of them 2-flowered, longitudinal nerves mostly absent sometimes 1 and rarely on each side (Danser, 1928).

***Nepenthes ampullaria* Jack, Comp. Bot. Mag., I: 271 (1835):** Lower stems cylindrical, 10 mm thick; internodes 3-4 cm long. Upper stems cylindrical, climbing up to 2 m tall, 5-10 mm thick, at the base of matured plants with numerous rosettes bearing pitchers; internodes 3-7 cm long. Rosette leaves sessile and compressed together with overlapping leaf bases, 2-5 cm long, 1-2 cm broad; every leaf bears urceolate pitcher; pitchers of rosettes the same as that of the pitchers of the lower stem; tendrils 3-4 cm long. Leaves of apex acute and obtuse, base attenuate into the petiole; longitudinal nerves 3 pairs, originating from the midribs of the leaf base; the petiole winged, 1-2 cm long, forming short sheath at the base clasping half of the stem; tendrils 6-8 cm long. Rosette pitchers 4-12 cm high, 3-8 cm broad, urceolate (Fig. 3), with 2 fringed wings, the wings 2-10 mm broad; mouth ovate, horizontal; peristome narrowly involved in the outer part, flat and almost vertical in the inner part, 3-15 mm broad, ribs distinct, inner marginal peristome

teeth almost none; inner wall cavity wholly covered with overarched digestive glands; lids narrowly cuneate, rounded at apex, 2-3 cm long, 1-1.5 cm broad, folded into 2 keels, no glandular crest on lower surface; spur simple, 3 mm long, inserted close to the lid. Leaves of lower stem as that of upper stem but some leaves may bear urceolate pitchers on the tendril tips. Pitchers of the lower stem urceolate, 4-6 cm high, 3-4 broad, with 2 fringed wings; mouth ovate, horizontal, 2-3 cm long, 2-2.5 cm broad; peristome narrowly involutes in the outer part and flat and almost vertical in the inner part, 10-15 mm thick, ribs distinct, inner peristome margin with short teeth; inner wall cavity wholly covered with minute overarched glands; lids oblong and ovate, 2-2.5 cm long, 7-10 mm broad, lower surface without glandular crest and nectar gland, covered with numerous black dots; spur simple, 5-6 mm long, inserted close to the lid base. Upper pitchers none. Female inflorescence a dense panicle, 21 cm long, peduncle 4-5 cm long, rhachis 11-16 cm long, pedicels commonly 3-flowered, rarely 2-flowered, 1-flowered towards the tips, with bracts.

Specimens examined: Dayani Daiman, Jumaat H. Adam; Dayani 1, Taman Pendidikan Universiti Kebangsaan Malaysia, Bangi, Selangor Malaysia; Dayani Daiman, Jumaat H. Adam; Dayani 2, Taman Pendidikan Universiti Kebangsaan Malaysia, Bangi, Selangor.

Distribution: Peninsular Malaysia, Borneo, Singapore, Sumatra and New Guinea

Altitude: 0-900 m

It can easily be identified in the field by the urceolate pitcher shape, lid distinctly reduced in sized, flattened and almost vertical inner face of peristome, inflorescence a panicle, pedicels commonly from 3-flowered to 4-flowered, pedicels with bract. Although Danser (1928) indicated the species varies little, five varieties have been described namely *N. ampullaria* var *longicarpa* Beccari, *N. ampullaria* var *microsepala* Macfarlane, *N. ampullaria* var *geelvinkiana* Beccari, *N. ampullaria* var *vitata major* and *N. ampullaria* var *racemosa* Adam and Wilcock. It commonly grows below 100 m but can be found occasionally up to 900 m. It grows in open heath forest, secondary thickets and gaps of lowland dipterocarp forest, on the fringe of freshwater swamps or in areas of seasonal flooding by freshwater (Adam and Wilcock, 1990).

***Nepenthes gracilis* Korthals, Verh. Nat. Gesch. Bot. p. 22, t. I and t. IV, ic. 1-38 (1839):** Upper stem triangular with two wings, climbing up to 3 m tall, 3-5 mm thick;

internodes 3-9 cm long. Leaves sessile, linear-lanceolate, 6-12 cm long, 2.5-4 cm broad, apex acute, the base decurrent into 2 wings, extends almost over one internodes; longitudinal nerves 4-6 pairs, originating from the leaf base, tendrils without pitcher 6-10 cm long, tendrils with pitchers 15-16 cm long. Lower pitchers 4-5 cm high, 1 cm wide, cylindrical in the upper portion, ventricose in the lower portion, with 2 fringed wings; mouth orbiculate, oblique; peristome cylindrical, 1 mm broad, ribs indistinct, inner marginal peristome teeth very short; inner pitcher cavity wall covered with exposed round digestive glands on lower ventricose portion; lids orbiculate, cordate at the base, slightly vaulted, 2-2.5 cm long, 2-2.5 cm broad, without glandular crest on lower surface; spur simple, 3-4 mm long, inserted close on the lid base. Upper pitchers 9-11 cm high, infundibulate in the upper 1/3, 2.5-3 cm broad, tubular in the middle portion, 2-2.5 cm broad and ventricose in the lower 1/3 portion, 3 cm broad, with 2 prominent ribs over the whole length; mouth ovate, 2-3 cm long, 2 cm broad oblique, peristome cylindrical, about 1 mm broad, ribs inconspicuous, inner peristome teeth short; inner wall cavity covered with round exposed digestive glands on the lower ventricose portion; lids orbiculate, cordate at base, 2-2.5 cm long, 2.5 cm broad, lower surface sparsely covered with nectar glands, no glandular crest; spur cylindrical, 3-4 mm long, simple, attached close to the lid base. Male inflorescence a raceme, 22-24 cm long, peduncle 2 cm long, rhachis 20-22 cm long, pedicels 8-12 mm long in the lower half, 5-7 mm long in the upper half, 1-flowered, without bract.

Specimens examined: Dayani Daiman, Jumaat H. Adam; Dayani 3, Taman Pendidikan Universiti Kebangsaan Malaysia, Bangi, Selangor Malaysia. Dayani Daiman, Jumaat H. Adam; Dayani 4, Taman Pendidikan Universiti Kebangsaan Malaysia, Bangi, Selangor Malaysia.

Distribution: Borneo, Celebes, Peninsular Malaysia and Singapore.

Altitude: Below 1000 m.

Som (1988) indicated that *Nepenthes gracilis* is the most widespread in the Malay Peninsula and exhibited a wide range of variation. She reported that this species has a number of varieties namely *Nepenthes gracilis* var *elongata* Blume, *Nepenthes gracilis* var *longinodis* Beck and *Nepenthes gracilis* var *arenaria* Ridley. *N. gracilis* has been often confused with *N. reinwardtiana* by its angular or triangular stem, sessile leaves, decurrent lamina base with wings extended almost in to one

internodes, very narrow and cylindrical peristome, inconspicuous peristome ribs and pitcher shape (Adam and Wilcock, 1993). This species can be differentiated from *Nepenthes reinwardtiana* by inner pitcher wall covered with exposed digestive glands, lower lid surface scarcely covered with honey glands, all pedicels 1-flowered and the absent of two spots on the inner pitcher wall cavity below the mouth.

***Nepenthes mirabilis* (Loureiro) Druce, Rep. Exch. Cl. Br.**

Isl., 637 (1917) Stems cylindrical, climbing up to 3 m tall, 5-10 mm thick; internodes 2-12 cm long. Leaves of climbing stem petiolate, elliptic, oblong and lanceolate, 8-16 cm long, 4-7 cm broad, apex obtuse, the base gradually contracted into the petiole; longitudinal nerves 5-6 pairs, originating from the base of the leaves; the petiole winged, 4-7 cm long, semi-amplexicaul, tendrils without 7-13 cm long, tendrils with pitchers 14-20 cm long. Leaves of lower stem petiolate, oblong and elliptic, 18-22 cm long, 6-8 cm broad, apex obtuse, base gradually and abruptly contracted into winged petiole semi-amplexicaul, margin fimbriate or denticulate, longitudinal nerves 6-7 pairs, originating from the leaves base; the petiole winged, 5-8 cm long; tendrils without pitchers 10-15 cm long, tendrils with pitchers 10-15 cm long. Lower pitchers 5-12 cm high, cylindrical in the upper 2/3, 1-3.5 cm wide, ventricose or infundibulate on the lower 1/3, 1.5-3.5 cm wide, with 2 ribs or fringed wings; mouth ovate, oblique, peristome flattened, 2-3 mm broad, with distinct inner peristome teeth distinct, inner wall cavity covered with overarched digestive on lower ventricose part; lid orbiculate, 2.5-3 cm long, 2-2.5 cm broad, lower surface with midrib extend almost to the apex and densely covered with nectar glands; spur simple, cylindrical 8 mm long, inserted on the lid base. Upper pitchers tubular on upper half, 2.5-3 cm wide, infundibulate on lower half, 2.5 cm wide, 12-15 cm high, with 2 prominent ribs; mouth orbicular, 2.5-3 cm long, 2-2.5 cm wide, oblique; peristome flattened, 2-6 mm broad, ribs distinct, inner peristome teeth conspicuous; inner wall covered with overarched digestive glands on the lower infundibulate portion; lids orbiculate, 2.5-3 cm long, 2-2.5 cm broad, without glandular crest and densely covered with nectar glands on lower surface; spur cylindrical, simple, 5 mm long, attached onto lid base. Male inflorescence raceme, 21-38 cm long, pedicels 1-flowered, ebracteolate.

Specimens examined: Dayani Daiman, Jumaat H. Adam, Dayani 5, Taman Pendidikan Universiti Kebangsaan Malaysia (UKM), Bangi, Selangor. Dayani Daiman, Jumaat H. Adam, Dayani 6, Taman Pendidikan UKM, Bangi.; Jumaat H. Adam, JHA8001, Selangor, UKM, Behind Green House, Alt. 30 m; 2nd August 2001.

Distribution: Australia, Borneo, Celebes, Moluccas, Palau, Peninsula Malaysia, Philippines, Indo-China, Southern China, Sumatra and New Guinea.

Altitude: Low altitudes up to 1000 m.

The distinct characters of *N. mirabilis* is fimbriate the leaf margins of lower stem and rosettes (Fig. 6); peristome of upper and lower pitchers are flattened (Fig. 7); flowers are borne singly and without bract. Varieties of the species described by previous researchers includes *N. phyllamphora* var *platyphylla* Blume, *N. fimbriata* var *leptostachya*, *N. mirabilis* var *macrantha* Hook, *N. mirabilis* var *pediculata* Lecomte and *N. mirabilis* var *biflora* Adam and Wilcock. It is geographically the most widespread species (Adam and Wilcock, 1992). It grows in open and damp habitats (Fig. 5), swampy areas, secondary vegetation and are commonly found occurring at low altitude, below 100 m. Phillipps and Lamb (1988) reported the species failed to grow in Borneo Peat-swamp forest which could be due to acidic water condition. According to them, it prefers to grow in alkaline conditions and has been recorded from brackish-water tidal.

***Nepenthes x trichocarpa* Miquel, Fl. I, 1, p 1072 (1858):**

Stems, glabrous, angular in shape, 3-5 mm thick, internodes 2.5-4 cm long, rosettes at the base of older stems. Leaves of lower stem sessile coriaceous, elliptic, 7-19 cm long, 1.5-4 cm broad, apex acute, base attenuate into petiole like region and extended into 1/2 or the whole length of internodes to form into two wings; pennate nerves almost horizontal originating from the midribs distinct, longitudinal nerves 3 pairs originating from the leaf base; tendrils without pitchers 4-9 cm long, with pitchers 4-12 cm long. Upper stem, glabrous, angular, 4-5 mm thick, internodes 5-7 cm long. Leaves of upper stem sessile as that of lower stem; tendrils without pitchers 8-11 cm long, tendrils with pitchers 15 cm long. Lower pitchers 4-7 cm high, tubular on the upper 1/3, 1.5-3.5 cm wide, ventricose on the lower 2/3, 3-4 cm wide, with 2 fringed wings; mouth orbicular, oblique, 1-3.5 cm long, 1-3 cm broad, peristome cylindrical, 1-2 mm thick, ribs distinct, inner peristome teeth distinct; inner wall cavity covered by overarched digestive glands on lower ventricose part; lids orbicular, 1-2 cm long, 1-1.5 cm broad, without glandular crest below, lower surface very sparsely covered with nectar glands and numerous black dots; spur flattened, variable from simple and bifid to 5-fid, 5-6 mm long, attached to the lid base. Upper pitchers infundibulate or tubular upper 1/3 and infundibulate upper 2/3, 8-9 cm high, 4-4.5 cm wide, with two prominent ribs



Fig. 5: *Nepenthes mirabilis* growing on exposed habitat on wet ground



Fig. 8: *Nepenthes x trichocarpa* growing together with *N. ampullaria*



Fig. 6: Leaf of lower stem of *Nepenthes mirabilis* showing fimbriate margin



Fig. 7: Upper pitcher of *Nepenthes mirabilis* showing flattened peristome

or rudiment of fringed wings; mouth orbicular, oblique, 2-2.5 cm long, 2-2.5 cm broad, peristome

cylindrical, 2 mm thick, ribs distinct, inner peristome teeth distinct; inner wall cavity covered with overarched digestive glands on lower 2/3 part; lid orbicular, 2-2.5 cm long and 2 cm broad, without glandular crest on lower surface, scarcely covered with nectar glands but with numerous black dots; spur cylindrical, 5-8 mm long, attached close to the lid base.

Specimens examined: Dayani Daiman, Jumaat H. Adam; Dayani 7, Taman Pendidikan Universiti Kebangsaan Malaysia, Bangi, Selangor Malaysia.; Dayani Daiman, Jumaat H. Adam; Dayani 8, Taman Pendidikan UKM, Bangi, Selangor Malaysia.

Distribution: Borneo, Peninsular Malaysia Singapore, Sumatra

Altitude: Low altitude *Nepenthes x trichocarpa* grows together with both of its parental species that is *N. gracilis* and *N. ampullaria*. Our field observation showed that the rare occurrence in term of density of the hybrid population from the study compared to its parental species population (Fig. 8). Som (1988) recorded the occurrence of the hybrid from Sepang, Bukit Takun, Serdang, Rawang and Batu Arang in Selangor and Mersing in Johore.

CONCLUSIONS

One new species, *Nepenthes sharifah-hapsahii* Adam and Hafiza is describe. Three other lowland species found in the study are *N. ampullaria*, *N. gracilis* and *N. mirabilis*. One hybrid, *N. x trichocarpa* (*N. gracilis* x *N. ampullaria*) is also recorded. These taxa

differs in their morphological characters. These characters can easily be used to identify them in the field and in the herbarium.

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