

Taxonomic Studies on some species of genus *Huernia* R.Br. (*Asclepiadaceae*) growing in AL-Taif Province, Saudi Arabia

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Morphological characters of *Huernia* (*Asclepiadaceae*) play an important role in taxonomic identification. The present work is a revision of the taxonomic relationships based on morphological criteria of *Huernia* species growing in Wadi Thi-Ghazal or Al-Ghazal in the Al-Shafa region in Al-Taif province (SW Arabia). The objective was describing and scientifically authenticating the exotic species in the study area. The present revision revealed the presence of eight taxa belonging to *Huernia* from Asir area, three of these taxa were previously described, two are closely related to *H. khalidbinsultanii* Plowes & McCoy, and three are unresolved taxa.

Key words: *Huernia* spp., Taif Province, *Asclepiadaceae*.

Introduction

The genus *Huernia* R.Br. belongs to family *Asclepiadaceae* and includes about 70 species, distributed in the tropical part of the world (Court, 2000). The genus is characterized by large flowers (5-8 cm diam.), hairy to varying degrees, with color of mimics rotting meat and generate the odor of rotten

flesh which attracts scavenging flies, for pollination. It is believed that the putrid smell is created, at least to a certain degree, by amine compounds (putrescine and cadaverine), which are derived from the amino acids lysine and ornithine. (Armstrong, 1997). These amines stink and are produced when proteins rot and decompose.

Huernias are curious little plants, usually with short, fleshy, angular stems which are leafless and normally branched from the base; they are glabrous and either simply toothed or tipped with soft bristles. The campanulate flowers, which usually develop towards the base of the stem, have ten corolla lobes, consisting of five main lobes (outer corona) with sinuses extended to form five extra, inner lobes (inner corona). The inner surface of the flowers is variously and characteristically covered in papillae, presumably a modification for pollination providing obstacles to the approach or escape of certain insects.

Survey of the relevant literature Forsskål (1775), Brown (1895), Schwrtz (1939): Lavranos (1963): Field (1981), Collenette (1985, 1998; 1999), Heemstra & Minwer (1990), Miller and Cope (1996), Migahid (1996), Wood (1997),). Chaudhary and lawai (1999) showed that the genus *Huernia* is represented in the flora of the Kingdom of Saudi Arabia by eight species of which only three are named viz.: *H. arabica*, *H. laevis* and *H. saudi-arabica*. Collenette (1999) in her wild flowers of Saudi Arabia recorded another five un-named species of *Huernia* on the basis of her own collections. Al-Hemaid (2001) added a new species; *Huernia haddaica* to the genus *Huernia* from Saudi Arabia as an endemic species in the Al-Hada near Al-Taif which was proved to be an illegitimate and is now treated as synonym to *H. khalidbinsultanii* by Plowes & McCoy (2003) Based on the above citation we can say that flora Saudi Arabia currently has eight species of the genus *Huernia* viz.

Accordingly, eight species are known in the western and southwestern regions of Saudi Arabia viz.: *H. arabica* D.V.Field , *H. laevis* JRI Wood , *H. khalidbinsultanii* Plowes & D.C.H., *H. saudi arabica* N.E.Br. and two dubious defined taxa: *Huernia* sp. nov. aff. *boleana*, *H. sp.* aff. *lodarensis*. In addition to two unnamed *Huernia* sp 3610 and *Huernia* sp1176; the last six taxa are believed to be endemic to SW Arabia. However, Wadi Al-Gazal in Al-Shafa region (Al-Taif province) is the richest area with many species of the genus.

Materials and Materials

The study area of Wadi Thi-Ghazal in the Al-Shafa region (SW Arabia 2000 m (AMSL) Above Medium Sea Level) is the richest area with vegetation in Al-Taif province, including many species of genus *Huernia*. Plant specimens were collected from the study area during the flowering period between March and September 2010 and the flowers were kept in a conservation solution (2 ml formalin, 1 ml glycerol, 20 ml of distilled water), according to Leach (1995) to be examined in the laboratory. Herbarium specimens of all taxa are kept in the herbarium of King Abdul-Aziz University (Girls section) Jeddah, Saudi Arabia. The measurement, description, and photography of the vegetative and floral plant organs were examined by the aid of a binocular microscope; NOVEX AP-8. These include stem morphology (angles, width of tubercles) and the floral morphology (pedicel length, flower diameter, sepals and petals characters as well as corona characters). Quantitative morphological characters of recognized eight taxa are shown in tables 1 and 2. Qualitative characters include petal odor and color as well as outer and inner corona characters. All photos were taken by SONY Cyber-shot DSC-W350 camera. (Figs 2-9) Using a special program to create a dendrogram from a similarity matrix. The program calculates a similarity matrix transforms similarity coefficients into distances and makes a clustering using the Unweighted Pair Group Method with Arithmetic mean (UPGMA) algorithm.

Results and Discussion

Quantitative and qualitative morphological characters of the eight investigated species of *Huernia* genus are summarized in Tables 1 & 2 Based on 26 morphological characters studied, we recognized 15 major characters to categorize the eight *Huernia* species under investigation. From those characters, we identified pedicle length, corolla length, and diameter, corolla tube length and diameter, corolla lobe length and width, corolla papilla color, type and length. In addition, we studied outer corona diameter, inner corona lobe, type and length, as well as odor characteristics.

Table 1. Quantitative morphological characters of eight *Huernia* taxa under investigation.

Species	Number of stem cells	Number of stamens	Tubercles on stem		Flower			
			Number of tubercles	Number of tubercles	Pedicel length (cm)	Flower diameter (cm)	Sepals (mm)	
			Length (mm)	Width (mm)			L	W
<i>H.saudi arabica</i>	5	6-8	3-4	6-9	11.5-12	3.5-4	1-2.5	10-13
<i>H.khalidbinsultanii</i>	5	5-8	2-3	9-15	6.5-7.5	2.5-3.5	1.5-2	14-17
<i>Huernia .sp 1</i>	5	6-8	3-4	10-14	7-9.5	2.5-3	1-2	12-17
<i>Huernia .sp 2</i>	5	6-8	2-2.5	7-9	21-22	4.5-5	1.2-1.5	12-15
<i>Huernia sp. (Collenette 1176)</i>	5	5-6	1-1.5	5-6	15-16.5	3.5-5	1.75-2	12-14
<i>Huernia sp.3</i>	5	6-9.5	2-5	11-15	11.5-12	3-3.3	1.5-2	12-13
<i>Huernia sp.4</i>	5	5-6	2-2.2	6-7	12-12.5	4.5-5	1.75-2	11-12
<i>Huernia sp.5</i>	6-8	5.5-6	1.5-2	6-8	10-11	3.5-5	1.5-2	7-11

Species	Corolla-lobes		Outer corona Diameter (mm)	Inner corona		Nectar gland		Corolla-tube		Intermediate lobes
	Length	Width		Length	Width	Length	Width	Length	Width	
	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	
<i>H.saudi arabica</i>	7-15	17-22	8.5-9	4.8	1.1	1.2-1.3	2.4-2.7	12-18	8-15	2-3.5
<i>H.khalidbinsultanii</i>	7-9	14-18	4-5	3.7	0.9	0.2-0.4	1.1-1.4	9-12	12-13	2.2-2.5
<i>Huernia .sp 1</i>	9-10	15-16	5.5-6	3.6	1	0.3-0.4	1.4-1.5	11-12	11-12	1.5-1.75
<i>Huernia .sp. 2</i>	11-12	18-19	6.5-7	4.5	1.2	0.5-0.7	1.75-2	14.5-15	14-15	1.5-2
<i>Huernia sp. (Collenette 1176)</i>	11-14	21-25	8-10	4.7	1.3	0.8-1	1.7-2.3	11-16	9-15	3.5-4.5
<i>Huernia sp.3</i>	7-12	8-14	5.75-6	3.3	0.8	0.2-0.3	1.3-1.6	10-15	9-10	1-1.25

Table 2. Qualitative morphological characters of the eight *Huernia* species under investigation.

Characters	Flower odor	Corolla color	Corolla-lobes Groove	Corolla-lobes Groove spreading	ecccagm	Outer corona shape	Inner corona		
							Base shape		Tip shape
							From bottom	From dorsal side	
<i>H.saudi arabica</i>	Unpleasant smell	Yellowish creamy	Deep	Horizontal	aeccagm	εCk m e ur aC	hoed	aeC h a r e i cr ud a r r a m r cCa	Sub obtuse & Smooth
<i>H.khalidbinsultanii</i>	Very bad smell	Witch creamy	Superficial	Ascending	mor an h	εCk	Triangular	s n u g g e m aueC h a r e i cr ud a r r a m r cCa	Obtuse & Tuberculation
<i>H.khalidbinsultanii</i> 1	Very bad smell	Witch creamy	Absent	Ascending	mor an h	εCk	Straight	s n u g g e m aueC h a r e i cr ud a r r a m r cCa	Obtuse & Tuberculation
<i>H.khalidbinsultanii</i> 2	Very bad smell	Witch creamy	Deep	Ascending	mor an h	εCk	Triangular	Cnugae	Obtuse & Tuberculation
<i>Huernia</i> sp. (Collenette 1176)	Unpleasant smell	Yellowish creamy	Deep	Horizontal	aeccagm	e ur aC	s r h e d r r	Cnugae	Sub obtuse & Smooth
<i>Huernia</i> sp.3	Very bad smell	Yellowish creamy	Absent	Reflex	mor an h	εCk	Triangular	aeC h a r e i cr ud a r r a m r cCa	Sub obtuse & Tuberculation
<i>Huernia</i> sp.4	Unpleasant smell	Yellowish brown	Superficial	Reflex	aeccagm	e ur aC	s r h e d r r	convex	Obtuse & Smooth
<i>Huernia</i> sp.5	Very bad smell	Yellowish brown	Deep	Reflex	aeccagm	e ur aC	s r h e d r r	aeC h a r e i cr ud a r r a m r cCa	Sub obtuse & Smooth

From the results of all the morphological features of the studied material, the *Huernia* species can be separated into eight different taxa including identified species e.g.: *H. saudi-arabica*, *H. khalidbinsultanii*, *H. sp. 1*, *H. sp. 2*, *Huernia* sp. (collenette1176), *Huernia* sp.3, *Huernia* sp.4, and *Huernia* sp.5.

These examined characters divided the eight specimens into two groups: The first group is distinguished by the hairy-like papillae covering the corolla's inner surface. This group includes *H. khalidbinsultanii* (Figure 3), *H. sp. 1* (Figure 4), *H. sp. 2* (Figure 5), and *H. sp.5* (Figure 9). This group is

further divided into two subgroups based on the corolla base color and spreading lobes: the first subgroup includes only *Huernia* sp.5 (Figure 7b), which is characterized by a yellow creamy corolla color with reflexed lobes; the second subgroup has white creamy corolla color with steeply ascending lobes and this includes the three remaining species of the *H. khalidbinsultanii*, *H. sp. 2* (Figure 5b) which characterized by large flowers more than 3.5 cm in diameter and long pedicels (> 10 mm), whereas *H. khalidbinsultanii* (Figure 3b) and *H.sp. 1* (Figure 4b) with small flowers (less than 3.5 cm diameter) and short pedicels (< 10 mm). These two species can be differentiated by the triangular inner corona base in *H. khalidbinsultanii* (Figure 3c) and the straight base in *H. sp. 1* (Figure 4c).

The second group includes *H. saudi-arabica* (Figure 2), *Huernia* sp. (collenette1176) (Figure 6), *Huernia* sp.3 (Figure 7), and *Huernia* sp.4 (Figure 8), which were characterized by the conical papillae covering the corolla's inner surface. This group was further divided into two subgroups based on the multiplying of stem angles: The first subgroup can be distinguished by the five-angled stems, which multiply to 6–8 angles in the tip of *Huernia* sp.5 stems (Figure 9a), whereas the second subgroup includes *Huernia* sp. (collenette1176) (Figure 6a), *Huernia* sp.4 (Figure 8a) and *H. saudi-arabica* (Figure 2a), which are characterized by five-angled stems without multiplication. The second subgroup was divided into two subgroups based on the width of the papillae base: *H. saudi-arabica* was distinguished by broad base papillae (Figure 2c); both *Huernia* sp. (collenette1176) (Figure 6c) and *Huernia* sp.4 (Figure 8c) were characterized by narrow base papillae. Furthermore, *Huernia* sp.4 was distinguished by a broad corolla tube and short intermediate lobes (Figure 8f), whereas *Huernia* sp. (collenette1176) (Figure 6f) was distinguished by a narrow corolla tube and long intermediate lobes.

The study of similarity matrix based on morphological data (Table 3) showed that the closest relationship among the species under investigation was 65%, between the two species *H. khalidbinsultanii* and *H. sp. 1*, followed by the relationship (45%) between the two species *H. sp. 1* and *H. sp 2*; finally, the relationship (46%) between *H. khalidbinsultanii* and *H. sp 2*, a result that supports the proposal to treat *H. khalidbinsultanii* , *H. sp. 1* and *H. sp 2* as a different species in one complex.

The table also shows that the lowest value of the similarity among the species was between species *Huernia* sp.3 and *Huernia* sp.4 (3%), followed

by *H. khalidbinsultanii* and *Huernia* sp. (collenette1176) (7%) from the rest of the species.

Table 3. Similarity matrix based on 26 morphological characters for 8 *Huernia* species under investigation

Samples	1	2	3	4	5	6	7	8
1	1	0.23	0.26	0.26	0.50	0.23	0.34	0.38
2		1	0.65	0.46	0.07	0.50	0.19	0.19
3			1	0.45	0.11	0.50	0.11	0.23
4				1	0.19	0.30	0.34	0.15
5					1	0.23	0.42	0.42
6						1	0.03	0.23
7							1	0.30
8								1

(1: *H. saudi arabica*; 2: *H. khalidbinsultanii* ; 3: *H* .sp. 1; 4: *H* sp. 2 ; 5: *Huernia* sp.(collenette1176) ; 6:*Huernia* sp.3 ; 7: *Huernia* sp. 4 ; 8: *Huernia* sp. 5).

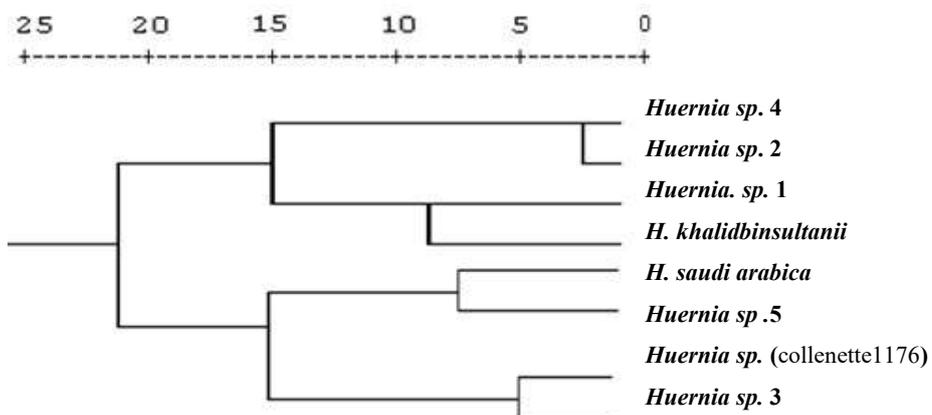


Fig. 1. Dendrogram showing the relationship between the eight *Huernia* sp. under investigation.

From the results of the similarity matrix, an UPGMA dendrogram (Figure 1) was constructed as part of investigations into dissimilarity

computed among *Huernia* species. The eight *Huernia* species were grouped into two main clusters: the first cluster included subsections with four species where *H. sp. 1* and *H. khalidbinsultanii* are closely allied, with *H. sp. 2*. The second cluster included subsection with the other four species allied to those species pair. *H. sp.3* and *H. sp.5* were different from all the others. From the above results, the delimitation of *Huernia* species needs more investigations

Morphological Key-

- 1.a.- Corolla yellowish brown 2
- 1.b. Corolla not yellowish brown 3
- 2.a. Five angled stem multiplying to 6-8 at tip *Huernia. sp.5*
- 2.b. Stem 5-angled without multiplication *Huernia.sp. 4*
- 3.a. Corolla white creamy 4
- 3.b. Corolla yellowish creamy 6
- 4.a. Diameter of outer corona 4-5 mm *H.khalidbinsultanii*
- 4.b. Diameter of outer corona 5.5- 7 mm 5
- 5.a. length of stem tubercles 10-14 mm *Huernia. sp.1*
- 5.b. Length of stem tubercles less than 10 mm long *Huernia. sp.2*
- 6.a. Base of inner corona swollen *Huernia sp.(collenette1176)*
- 6.b. Base of outer corona constructing above the base 7
- 7.a. Papillae of inner corona over 1 mm long*H. saudi arabica*
- 7.b. Papillae of inner corona less than 1 mm long *Huernia.sp.3*

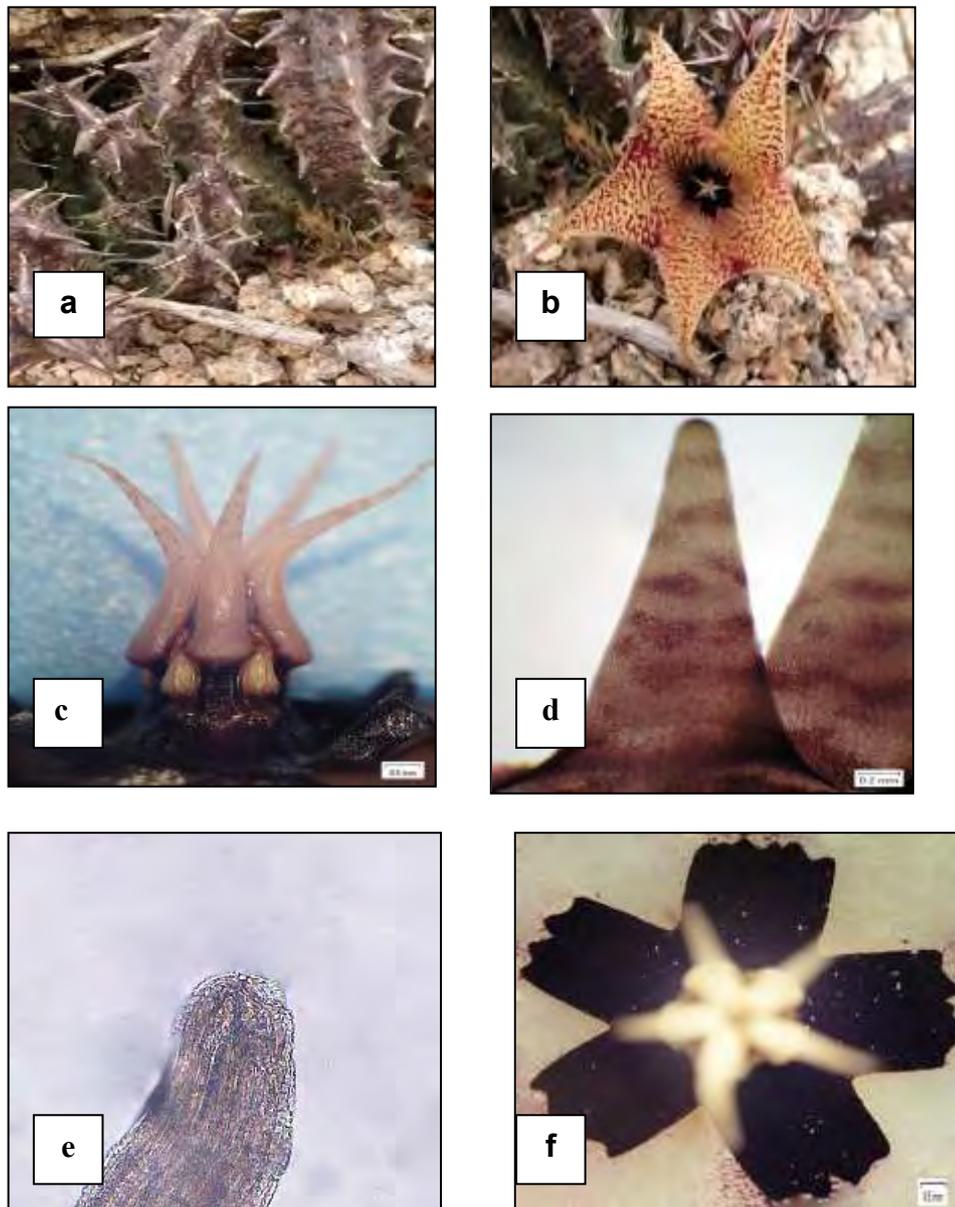


Fig. 2. *Huernia saudi arabica* a) 5 angled stem b) Yellowish creamy flower deep corolla lobes groove, c) Gynostegium and round base eeealmm corona d) Conical Papillae e) Sub obtuse tip of inner corona f) Outer corona disk and lobes shape.

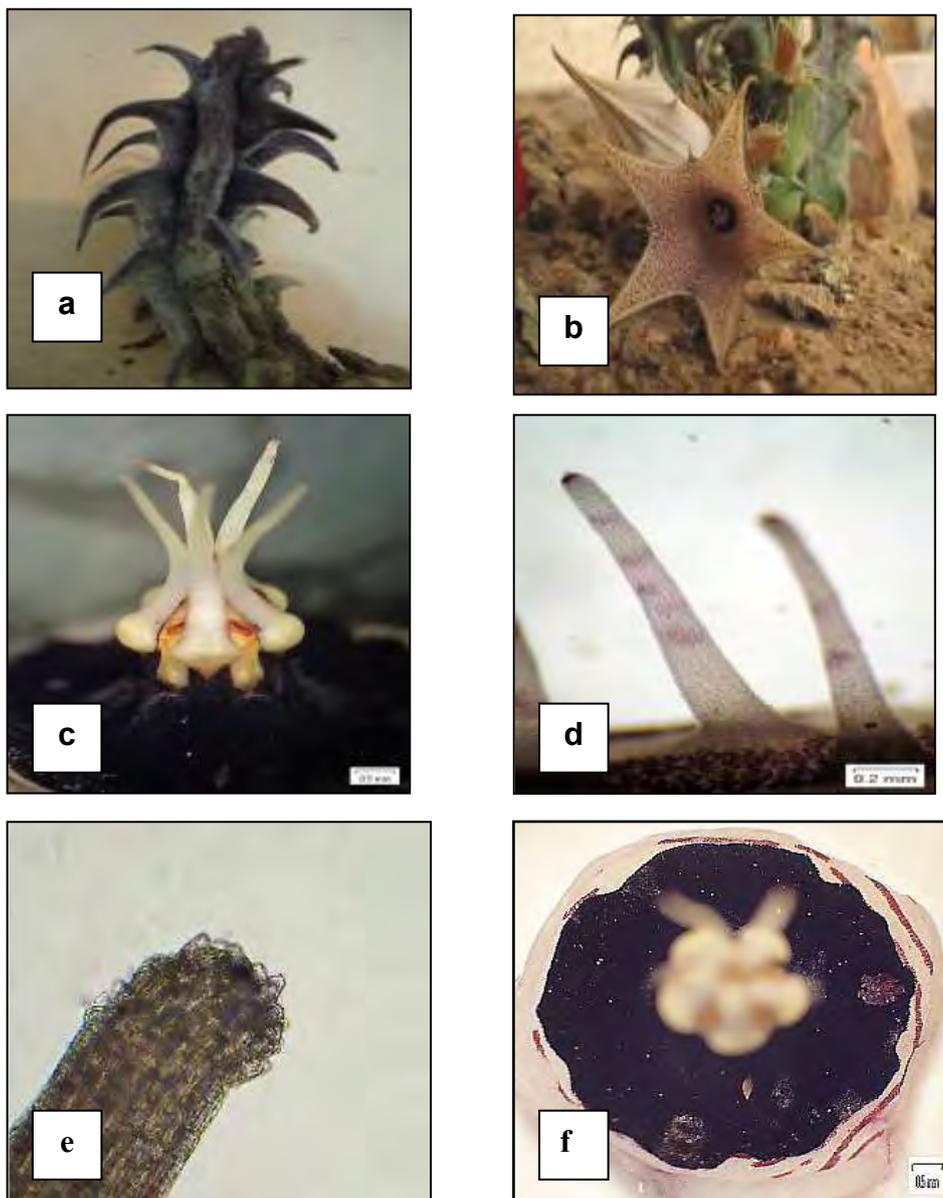


Fig. 3. *Huernia khalidbinsultanii* a) 5 angled stem b) Witch creamy flower superficial corolla lobes groove c) Gynostegium and triangular mm ~~meelcoronard~~ d) Tube form papillae e) Obtuse tuberculation tip of inner corona f) Outer corona disk shape.

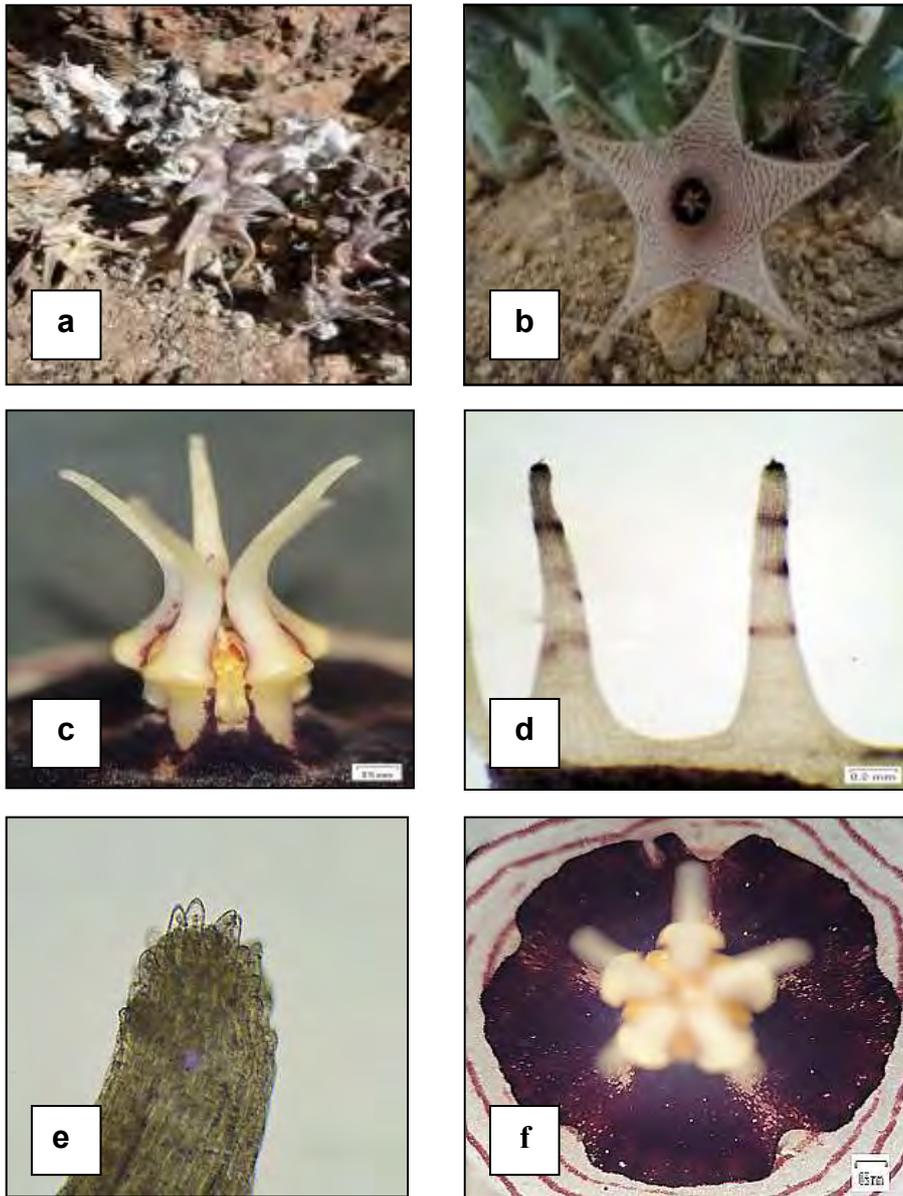


Fig. 4. *Huernia khalidbinsultanii* 1 a) 5angled stem b) witch creamy flower no corolla lobes groove, c) Gynostegium and straight corona d) Tube form papillae e) Obtuse tuberculation tip of inner corona f) Outer corona disk shape.

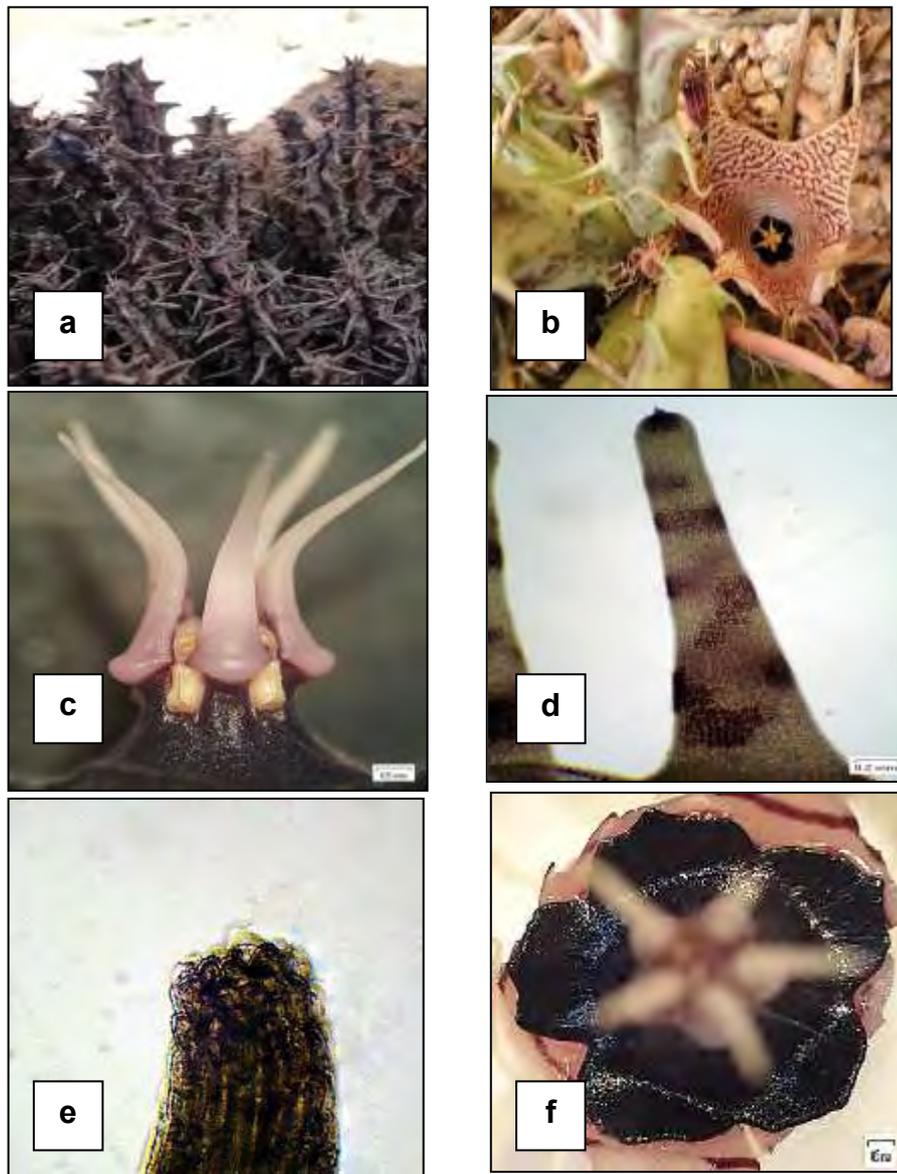


Fig. 5. *Huernia khalidbinsultanii* 2 a) 5angled stem b) Witch creamy flower superficial corolla lobes groove, c) Gynostegium and triangular papillae d) Tube form papillae e) Obtuse tuberculation tip of inner corona f) Outer corona disk shape.

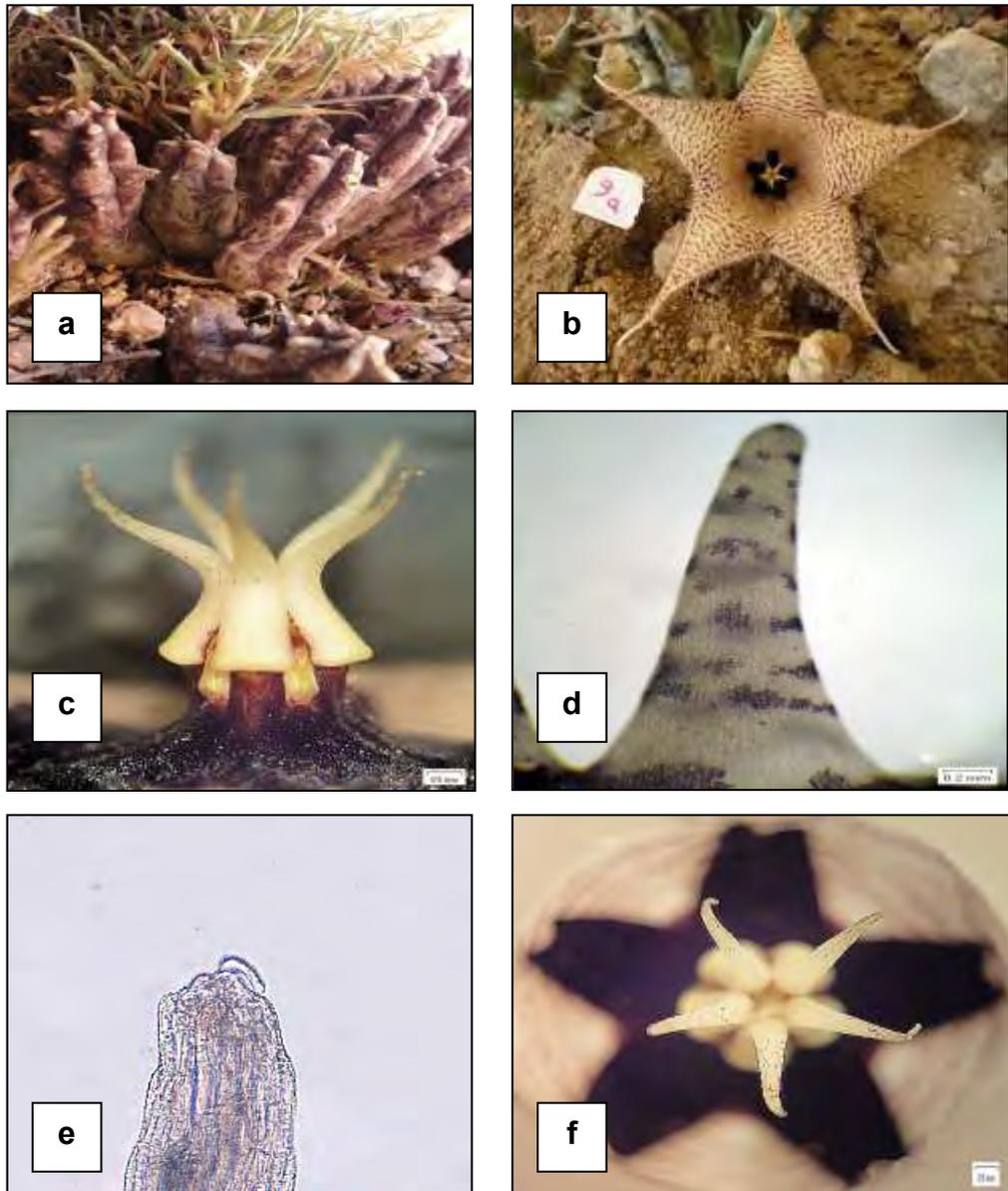


Fig. 6. *Huernia* sp. (collenette 1176) a) 5 angled stem, b) Yellowish creamy flower deep corolla lobes groove, c) Gynostegium and straight papillae d) Conical papillae e) Sub obtuse smooth tip of inner corona f) Outer corona Lobes shape.

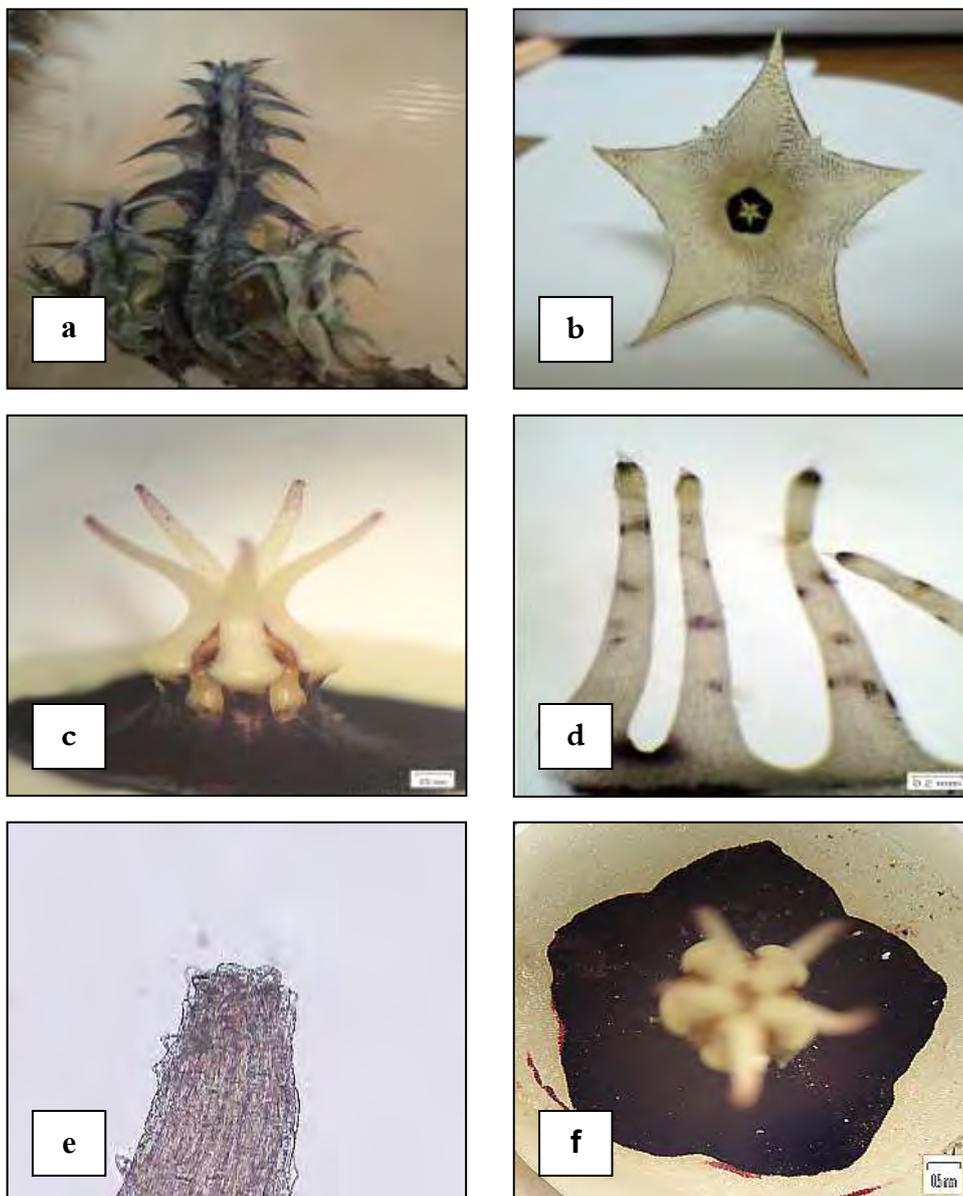


Fig. 7. *Huernia* sp. 3 a) 5angled stem , b) Yellowish creamy flower absent of corolla lobes groove, c) Gynostegium and triangular empicorona, d) Tube form papillae e) Sub obtuse tuberculation tip of inner corona f) Outer corona disk shape

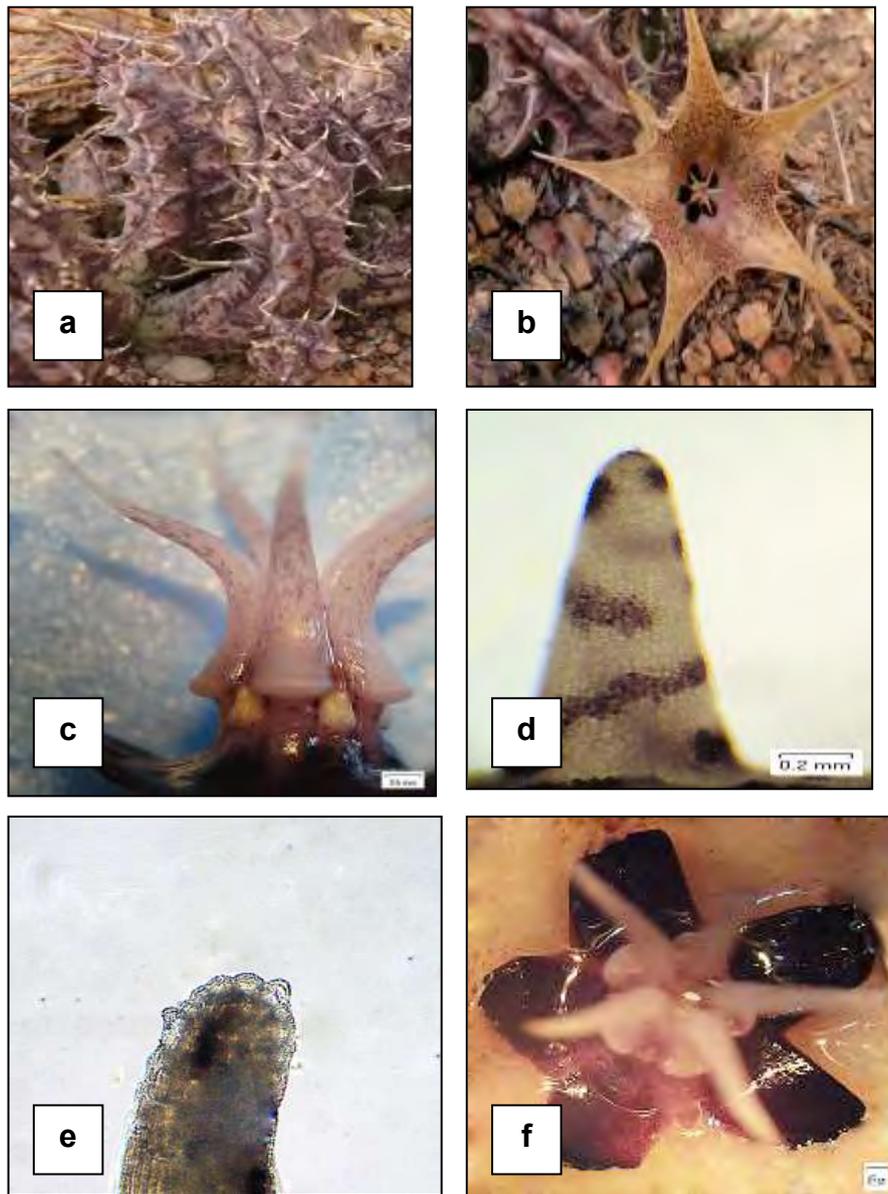


Fig. 8. *Huernia* sp. 4 a) 5 angled stem b) Yellowish brown flower with superficial corolla lobes groove , c) Gynostegium and straight coronad) Conical papillae e) Obtuse and smooth tip of inner corona f) Outer corona lobes shape.

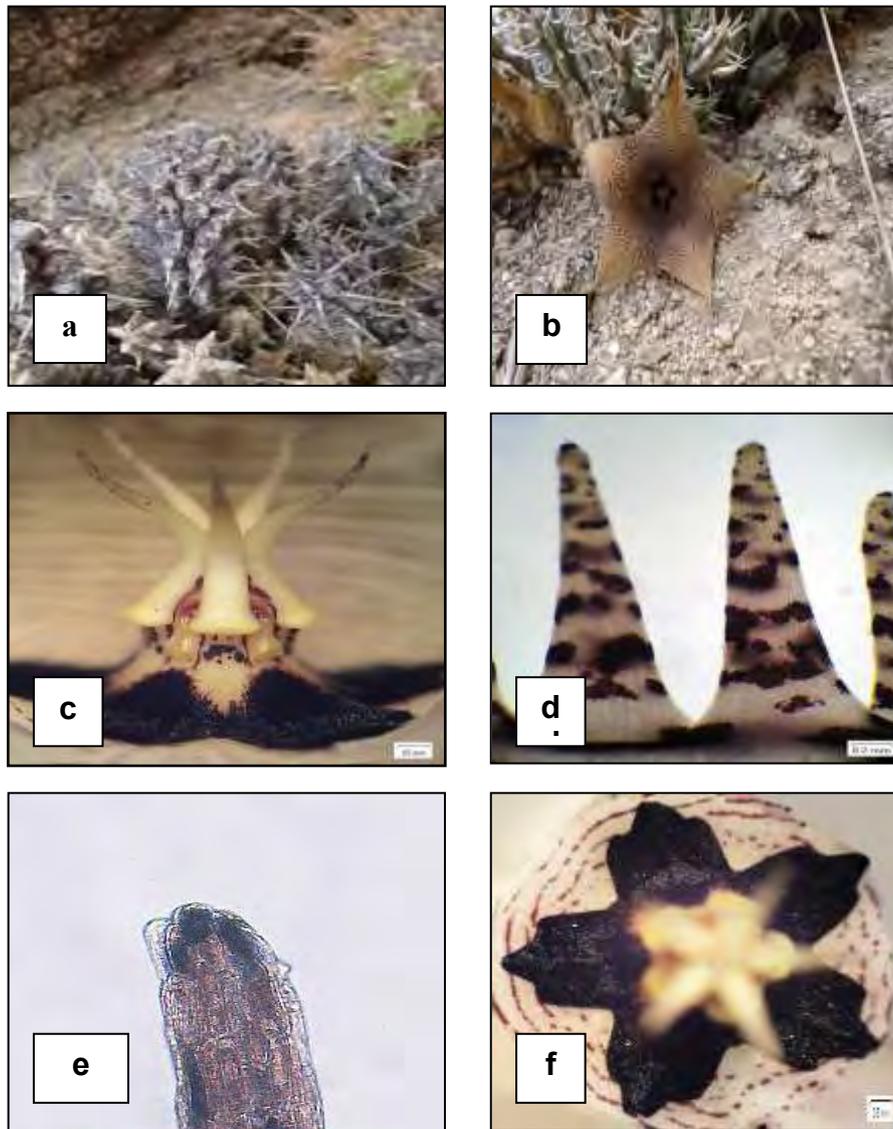


Fig. 9. *Huernia* sp. 5 a) 6-8 angled stem, b) Yellowish brown flower with deep corolla lobes groove, c) Gynostegium and straight coronam, d) Conical papillae, e) Sub obtuse smooth tip of inner corona, f) Outer corona lobes shape

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