

Micromorphological Studies of Capsule of *Linaria* Sect. *Linaria* and Sect. *Speciosae* in Iran

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Abstract: A total 16 species of sect. *Linaria* with disc shape seeds and 6 species of sect. *Speciosae* with terigonus and tetrahedral seeds have occurred in Iran. In different species, both the sections overlap on floral characters and therefore electron microscope scanning is used to distinguish their capsule surface. Being diverse in character, shape and size of capsule testa cells is one of the reliable and useful characters to separate these species.

Key words: Capsule surface • Iran • *Linaria* • Micromorphology

INTRODUCTION

The genus *Linaria* Mill. is widely distributed throughout the northern hemisphere with its center in Mediterranean basin, southwest and east Asia [1]. It contains annual or perennial herbs growing in a wide variety of habitats including dry and sandy soil and rocky slopes. Sutton [2] recognized some 150 species of which, 25 occur in Iran [3-9]. Of these: *Linaria elymatica* (Boiss.) Kuperian, *L. fastigiata* Chav., *L. kurdica* Boiss. & Hohen., *L. lineolata* Boiss., *L. michauxii* Chav., *L. nurensis* Boiss. & Hausskn. ex Boiss., *L. odora* (M. Bieb.) Fischer, *L. pyramidalis* (Vent.) F. Dietr., *L. remotiflora* Patzak in Rech., *L. striatella* Kuprian, *L. leptoceras* Kuprian., *L. bamianica* Patzak as well as recently found *L. karajensis* Hamdi & Assadi, *L. khorasanensis* Hamdi & Assadi, *Linaria azerbaijanensis* Hamdi & Assadi and *Linaria shahroudensis* Hamdi & Assadi [5, 6, 9], belong to section *Linaria*; whereas *Linaria genistifolia* (L.) Mill., *L. dalmatica* (L.) Mill., *L. grandiflora* Desf., *L. mazandaranensis* Hamdi & Assadi and *L. golestanensis* Hamdi & Assadi [7] belong to sect. *Speciosae* that is the most diversified in southwest Asia [1]. Genus of *Linaria* is 150 species in the world, that distribution in South Europe, W-South Asia, North Africa and E-Asia.

In the base, form and seed coat divided to section six that about 30 species in Iran. 15 species of *Linaria* are

section *Linaria* in Iran. In this section, species are linear leaves and discform seed. These species have complex and separation between of species are difficult that between species for management problem of scanning microscopy capsules micrograph to SEM provide.

During the course of preparing a revised genus for an ongoing project on *Flora of Iran* [12], many specimens were preserved in Iranian herbaria (TARI, IRAN, TUH, FUMH) and new collections of fresh material were examined. We collected some *Linaria* materials from mountainous region of Iran that was difficult to determine due to overlapping floral characters. However, capsule surface micromorphology is one of the reliable and useful characters to separate these species.

MATERIALS AND METHODS

Capsules of all 22 species of the genus *Linaria* sect. *Linaria* and sect. *Speciosae* occurring in Iran were studied using Scanning Electron Microscopy (SEM). The capsules samples were obtained mostly from freshly collected samples and herbaria vouchers deposited at FUMH, IRAN, TARI, TUH (acronym according to Holmgren & Holmgren [13]), see Appendix. 22 capsules were measured from each sampled population. Which dorsal part of capsules is selected for scanning. Measurements of polar axis (P) and equatorial diameter (E) were taken of 20 pollen grains per species under the

LM (¥ 400). Samples for SEM analyses were prepared according to Elisens [14] Sutton [2] with minor modifications. Therefore, to investigate capsule sculpturing, Moreover, to check stability of morphological characters and their putative taxonomical informative use, several specimens from different populations were examined thoroughly and which of samples mature fruits were mounted directly on 12.5mm diameter stubs and attached with sticky tape and then sputter-coated with approximately 25µm of Gold-Paladium. The capsules samples were examined and photographed using a LEO-440I Scanning Electron Microscope, set at an accelerating voltage of 10–15 kV. For each capsules shape, length, width of capsule testa cells and cell wall thickness were measured. The length and width of the testa cell of capsule surface of the smallest and longest on dorsal surface of capsules were measured from SEM preparations. Sutton [2] and Segarra & Mateu [15] were followed for terminology to describe seed coats and capsule features. The characters were measured with the aid of the Measurepro software.

RESULTS

The main features of the investigated capsule are summarized in Tables 1 & 2. Our studies show that the sculpturing and shape of capsule provides valuable characters for separating the species, sometimes even for closely related ones and delimitation of natural groups within the genus.

Section Speciosae: In *L. genistifolia*, shape of capsule testa cells with regular and irregular penta & hexagonal, 22-30 µm length of capsule testa cells, 17-20 µm width of capsule testa cells and cell wall thickness 3-5µm (Fig. 1 d). In *L. dalmatica*, shape of capsule testa cell with irregular, 60-100 µm length of capsule testa cells, 25-33 µm width of capsule testa cells and cell wall thickness 2-3 µm (Fig. 1 a). In *L. grandiflora*, shape of capsule testa cells with irregular, 65-75 µm length of capsule testa cells, 25-30 µm width of capsule testa cells and cell wall thickness 3-4 µm (Fig. 1 e). In *L. mazandaranensis*, shape of capsule testa cells with elliptic-irregular, 30-35 µm length of capsule

Table 1: Comparison of the testa cells of capsule of *Linaria* sect. *Speciosae*

N	Species name	Shape of capsule testa cells	Length of capsule testa cells (µm)	Width of capsule testa cells (µm)	Cell wall thickness (µm)
1.	<i>L. genistifolia</i>	Regular and irregular Penta & hexagonal	22-30	17-20	3-5
2.	<i>L. dalmatica</i>	Irregular	60-100	25-33	2-3
3.	<i>L. grandiflora</i>	Irregular	65-75	25-30	3-4
4.	<i>L. mazandaranensis</i>	Elipetic-irregular	30-35	15-20	1-1.2
5.	<i>L. golestanensis</i>	Irregular	60-80	20-30	1-1.5
6.	<i>L. orientalis</i>	Irregular	75-90	25-35	3-5

Table 2: Comparison of the testa cells of capsule of *Linaria* sect. *Linaria*

N	Species name	Shape of capsule testa cells	Length of capsule testa cells (µm)	Width of capsule testa cells (µm)	Cell wall thickness
1.	<i>L. lineolata</i>	Regular & irregular penta & hexagonal	30-45	15-30	4-5
2.	<i>L. karajensis</i>	Irregular	60-90	10-40	1-1/2
3.	<i>L. elymatica</i>	Regular & irregular penta & hexagonal	25-30	10-15	5-7
4.	<i>L. striatella</i>	Irregular penta & hexagonal	18-25	15-20	3-4
5.	<i>L. michauxii</i>	Irregular hexagonal	30-45	27-35	8-10
6.	<i>L. kurdica</i>	Irregular penta & hexagonal	40-45	17-30	6-8
7.	<i>L. pyramidalis</i>	Irregular penta & hexagonal	30-32	20-25	4.5-5
8.	<i>L. fastigiata</i>	Regular & irregular penta & hexagonal	35-40	25-30	5-6
9.	<i>L. murensis</i>	Regular & irregular polygonal	50-100	35-40	5-10
10.	<i>L. odora</i>	Irregular	95-120	15-20	1-1.2
11.	<i>L. khorasanensis</i>	Irregular	50-60	35-40	12-17
12.	<i>L. leptoceras</i>	Irregular	75-120	20-40	2-4
13.	<i>L. remotiflora</i>	Irregular polygonal	50-90	22-40	7-10
14.	<i>L. bamianica</i>	Irregular	30-50	15-30	1-1.2
15.	<i>L. azerbaijanensis</i>	Irregular hexagonal	40-56	32-40	3-3.5
16.	<i>L. shahroudensis</i>	irregular polygonal	56-75	28-40	0.8-1

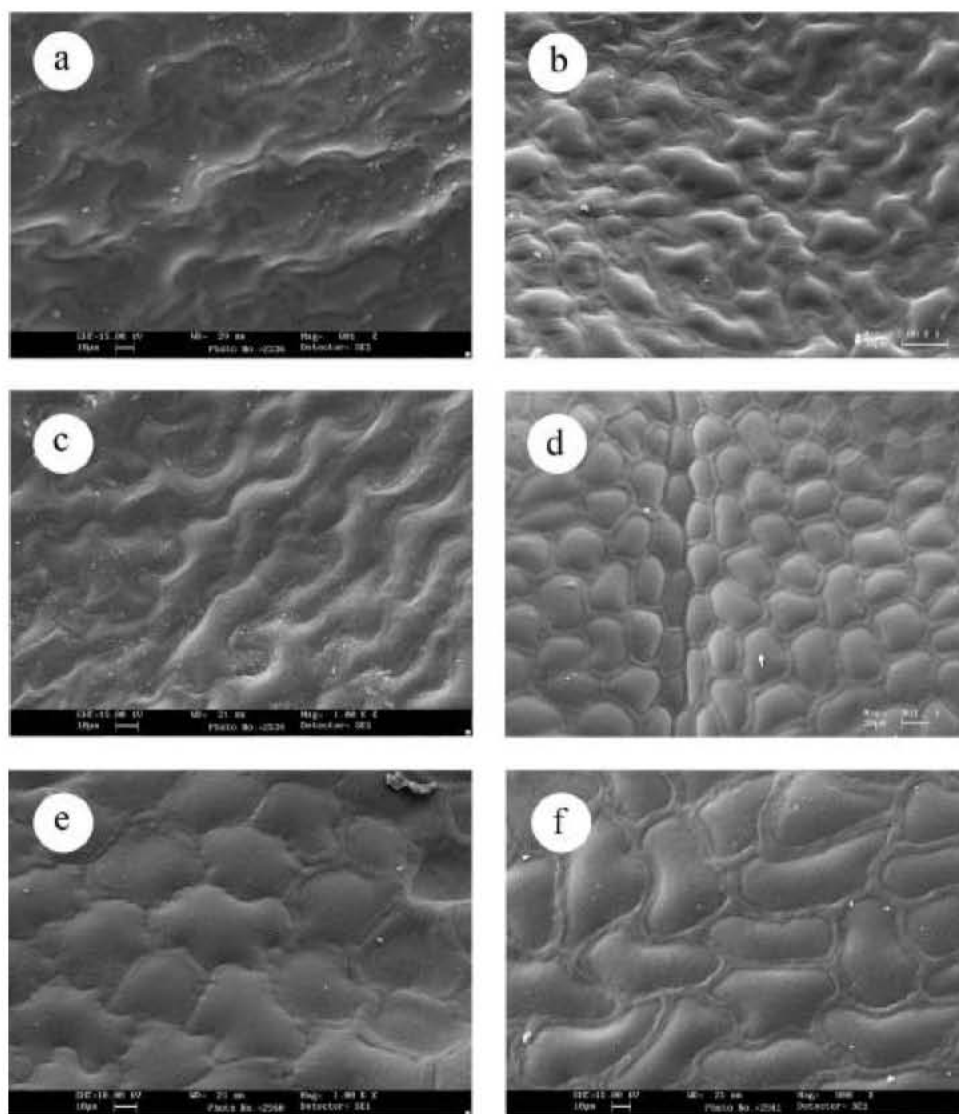


Fig. 1: Surface of inside wall at the base of value of dehiscenced capsules of *Sect. Speciosae* (*Linaria*) - a: *L. Dalmatica*; b: *L. Mazandaranensis*; c: *L. Golestanensis*; d: *L. Genistifolia*; e: *L. grandiflora*; f: *L. Orientalis*. Scal bars a = 10 μ m; b = 30 μ m; c = 10 μ m; d = 20 μ m; e = 10 μ m; f = 10 μ m.

testa cells, 15-20 μ m width of capsule testa cells and cell wall thickness 1-2 μ m (Fig. b). In *L. golestanensis*, shape of capsule testa cells with irregular, 60-80 μ m length of capsule testa cells, 20-30 μ m width of capsule testa cells and cell wall thickness 1-1.5 μ m (Fig.1 c). In *L. orientalis*, shape of capsule testa cells with irregular, 75-90 μ m length of capsule testa cells, 25-35 μ m width of capsule testa cells and cell wall thickness 3-5 μ m (Fig. 1 f).

Section *Linaria*: In *L. lineolata* shape of capsule testa cells with regular and irregular penta and hexagonal, 30-45 μ m length of capsule testa cells, 15-30 μ m width of

capsule testa cells and cell wall thickness 4-5 μ m (Fig. 3 n). In *L. karajensis* shape of capsule testa cells with irregular, 60-90 μ m length of capsule testa cells, 10-40 μ m width of capsule testa cells and cell wall thickness 1-1.2 μ m (Fig. 3m). In *L. elymatica* shape of capsule testa cells with regular and irregular penta and hexagonal, 25-30 μ m length of capsule testa cells, 10-15 μ m width of capsule testa cells and cell wall thickness 5-7 μ m (Fig. 3 o). In *L. striatella* shape of capsule testa cells with irregular penta and hexagonal, 18-25 μ m length of capsule testa cells, 15-20 μ m width of capsule testa cells and cell wall thickness 3-4 μ m (Fig. 3 t). In *L. michauxii* shape of

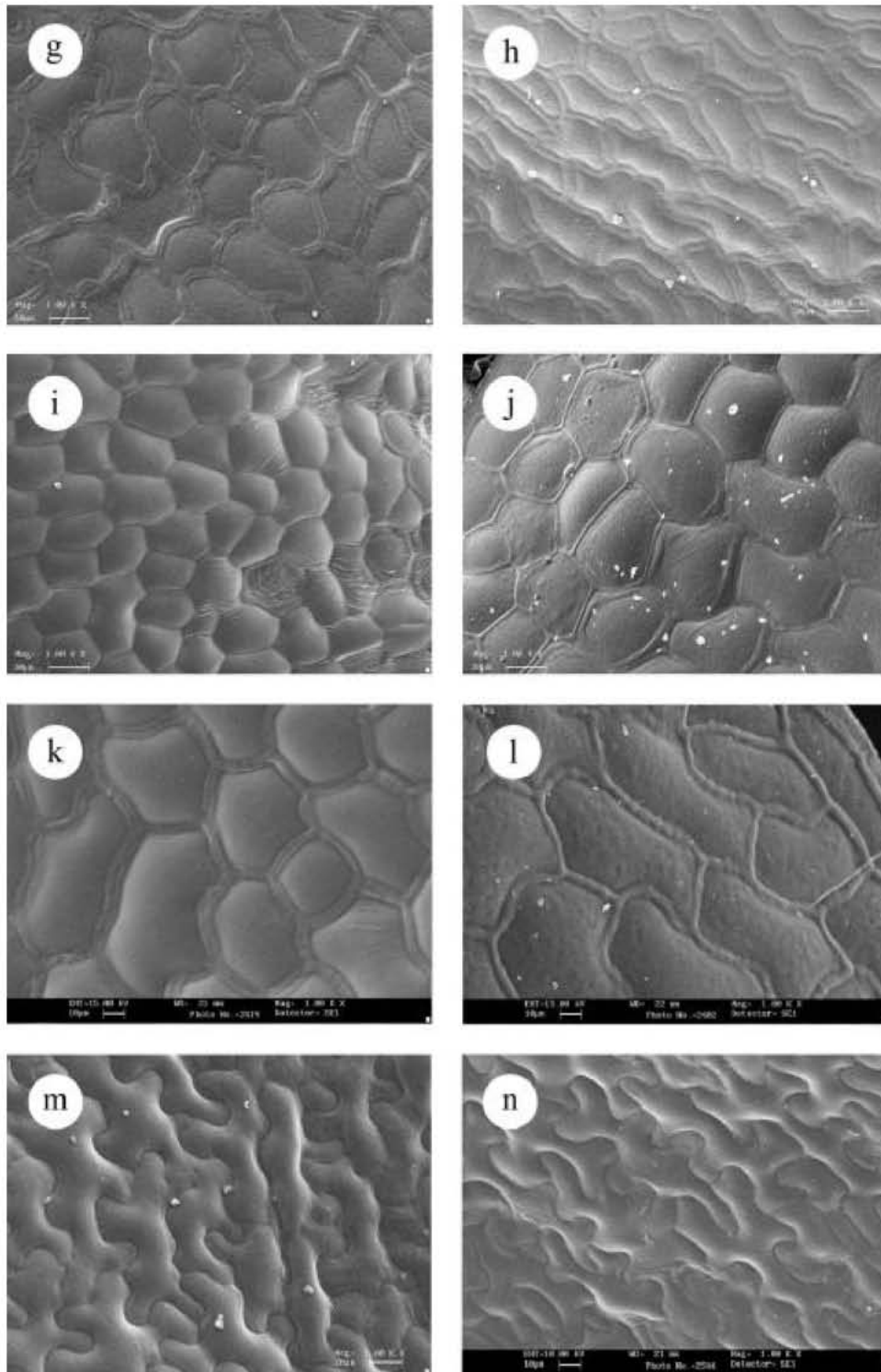


Fig. 2: Surface of inside wall at the base of valve of dehiscence of *Sect. Linaria* (*Linaria*) - g: *L. Michauxii*; h: *L. Kurdica*; i: *L. Pyramidalis*; j: *L. Fastigiata*; k: *L. Remotiflora*; l: *L. Nurensis*; m: *L. Shahroudensis*; n: *L. Azerbaijensis*.

- Scale bars g = 30 μ m; h = 30 μ m; i = 30 μ m; j = 30 μ m; k = 10 μ m; l = 10 μ m; m = 20 μ m; n = 10 μ m.

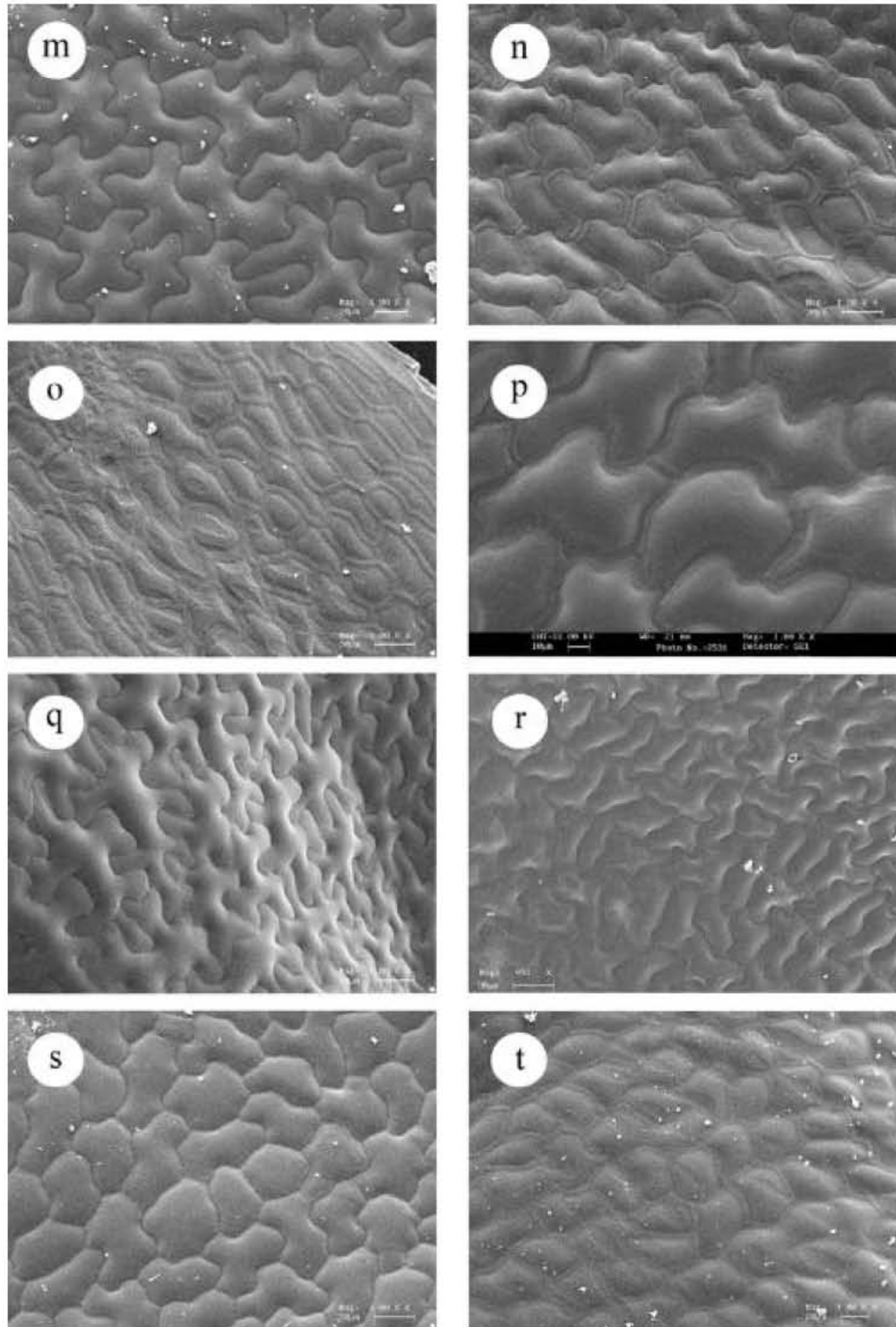


Fig. 3: Surface of inside wall at the base of value of dehisced capsules of Sect. *Linaria* (*Linaria*) - m: *L. Karajensis*; n: *L. Lineolata*; o: *L. elymatica*; p: *L. Leptoceras*; q: *L. Odora*; r: *L. Khorasanensis*; s: *L. bamanica*; t: *L. Striatella*. - Scal bars g = 30 μ m; h = 30 μ m; i = 30 μ m; j = 30 μ m; k = 10 μ m; l = 10 μ m; m = 20 μ m; n = 10 μ m.

capsule testa cells with irregular hexagonal, 30-45 μm length of capsule testa cells, 27-35 μm width of capsule testa cells and cell wall thickness 8-10 μm (Fig. 2 g). In *L. kurdica* shape of capsule testa cells with regular and irregular penta and hexagonal, 40-45 μm length of capsule testa cells, 17-30 μm width of capsule testa cells and cell wall thickness 6-8 μm (Fig. 2 h). In *L. pyramidalis* shape of capsule testa cells with irregular penta and hexagonal, 30-32 μm length of capsule testa cells, 20-25 μm width of capsule testa cells and cell wall thickness 4.5-5 μm (Fig. 2 i). In *L. fastigiata* shape of capsule testa cells with regular and irregular penta and hexagonal, 50-100 μm length of capsule testa cells, 35-40 μm width of capsule testa cells and cell wall thickness 5-10 μm (Fig. 2 j). In *L. nurensis* shape of capsule testa cells with regular and irregular polygonal, 50-100 μm length of capsule testa cells, 35-40 μm width of capsule testa cells and cell wall thickness 5-10 μm (Fig. 2 i). In *L. odora* shape of capsule testa cells with irregular, 95-120 μm length of capsule testa cells, 15-20 μm width of capsule testa cells and cell wall thickness 1-1.2 μm (Fig. 3 q). In *L. khorasanensis* shape of capsule testa cells with irregular, 50-60 μm length of capsule testa cells, 35-40 μm width of capsule testa cells and cell wall thickness 12-17 μm (Fig. 3 r). In *L. leptoceras* shape of capsule testa cells with irregular, 75-120 μm length of capsule testa cells, 20-40 μm width of capsule testa cells and cell wall thickness 2-4 μm (Fig. 3 p). In *L. remotiflora* shape of capsule testa cells with regular and irregular polygonal/penta, 50-90 μm length of capsule testa cells, 22-40 μm width of capsule testa cells and cell wall thickness 7-10 μm (Fig. 2 k). In *L. bamianica* shape of capsule testa cells with regular and irregular, 30-50 μm length of capsule testa cells, 15-30 μm width of capsule testa cells and cell wall thickness 1-1.2 μm . (Fig. 3 s). In *L. azerbaijanensis* shape of capsule testa cells with regular and irregular penta and hexagonal, 40-60 μm length of capsule testa cells, 32-40 μm width of capsule testa cells and cell wall thickness 3-3.5 μm (Fig. 2 n). In *L. shahroudensis* shape of capsule testa cells with regular and irregular polygonal, 56-75 μm length of capsule testa cells, 28-40 μm width of capsule testa cells and cell wall thickness 0.8-1 μm (Fig. 2 m).

DISCUSSION

Sect. *Speciosae*, with terigonus and tetrahedral seeds, is generally scattered in northern, northeastern, northwestern and central parts of Iran. In this section, species contain lanceolate leaves, usually with 25 to 47 mm yellow corolla. These species are perennial with

lax inflorescence. With regard to their morphological character, the species show an overlapping position. *Linaria orientalis* Hamdi & Assadi [16] found that in central Iran is very much similar to *L. grandiflora*, though morphologically, both differ in length of their pedicle, corolla, calyx lobes and size of capsule. In other words, these two species differ in size and shape of their capsule testa cells. Like wise, *L. mazandaranensis* and *L. genistifolia* are also similar, but are different in morphological character such as, size, corolla, spur and pedicel, cell wall and even the shape of capsule testa cells. The other two species i.e. *L. dalmatica* and *L. golestanensis* are quite similar in their morphological character, however, size of their capsule testa cells differ.

So far as sect. *Linaria* with disc shape seeds is concerned, 16 species are found in Iran in which, four species i.e. *L. lineolata*, *L. kurdica*, *L. karajensis*, *L. azerbaijanensis*, *L. shahroudensis* and *L. elymatica* have linear leaves and dense inflorescence with 8 to 17 mm corolla but, they differ in the form and size of their capsule surface cells. Other two species, *L. odora* and *L. khorasanensis* have linear leaves, lax inflorescence, similar size corolla, however, size of their capsule testa cells are different. *Linaria michauxii* and *L. farsensis* Hamdi & Assadi [8] are closed but shape and cell wall of capsule testa cells differs. Similarly, *L. fastigiata* and *L. kurdica* species are closed but differ in capsule testa cells shape. Moreover, *L. nurensis* with lanceolate leaves and 40 mm corolla is similar to *L. michauxii*, *L. farsensis*, even shape of cells is same but they differ in the size of cells. *L. lineolata* and *L. elymatica* differ both in size and shape of capsule testa cells. *L. leptoceras*, *L. striatella* and *L. odora* species are also closed and differ in size and shape of testa cells of capsule. The two species *L. leptoceras* and *L. odora* are also very close together, having linear leaves, lax inflorescence and corolla 13-17 mm but they differ in the size and shape of testa cells capsule. The *L. pyramidalis* that has dense and long inflorescence with yellow corolla resembles more the species of sect. *Specioseae*, however, it is also diverse in shape and size of capsule cells. In sum, one of the most reliable and useful characters to separate these species is the size and shape of capsule testa cells (Tables 1 & 2).

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APPENDIX

Additional Specimens Revised

Linaria Lineolata:

Representative material. Iran: Prov. Tehran, Firouzkouh, Kariz, 2500 m, 14.viii.1985, *Mozaffarian 54161*(TARI); Darbandsar, 2700-3400 m, 18.iv.1984, *Mozaffarian & Mohammadi 49179*(TARI); Firouzkouh, near of Rostamabad village, 2550 m, 27.vi.1972, *Deini & Azarm 21407*(TARI); 41km Shemshak to Emamzadeh, 1000 m, 19.vi.1973, *Amin 21401*(TARI); Gardaneh Ghoochak, 1950 m, 3.vi.1972, *Deini & Azarm 21428*(TARI); 21 km to Jajroud, Kamarkouh, 1700 m, 15.v.1973, *Azarm & Bazargan 21389*(TARI); Lashkarak to Teloo, 1780 m, 25.v.1974, *Deini 8970*(TARI); near of Karaj, Kalak, 2200 m, 3.v.1972, *Foroughian 21405*(TARI); Tehran to Shemshak, 30 km, 1930 m, 12.vi.1973, *Amin & Babakhanloo 21379*(TARI); West of Latian mountains, 2000 m, 30.v.1972, *Bazargan & Azarm 21433*(TARI); 4 km Roudehen to Eskej, 2020 m, 10.vi.1972, *Deini & Azarm 21398*(TARI); Karaj to Chaloos, 10 km of Karaj, 1750 m, 23.v.1973, *Babakhanloo & Amin 21402*(TARI); Tehran, Road Firouzkouh to Aliabad, 2000 m, 26.vi.1972, *Dieni & Azarm 21388*(TARI); North of Latian, 1800 m, 16.v.1973, *Azarm & Bazargan 21403*(TARI); Protected area o Teloo, 1800 m, 4.vi.1972, *Deini & Azarm 21417*(TARI); Damavand, 14 km to Akhorbedin, 1650-1850 m, 22.vi.1985, *Mozaffarian 53818*(TARI); Karaj, 2km of South Kalak, 1750 m, 18.vii.1976, Ronemark & Rezaeian 21711 (TARI); Gazvin; 16 km of South Gazvin, Esfahan mountains, 2350 m, 2.vi.1972, *Hariri & Foroughian 21381*(TARI); Taleghan, Joestan, 1950 m, 11.9.1970 *Termeh 14099*(IRAN); Jajroud, mountains of Latian, 1800-2200 m, 9.v.1975, *Termeh & Matin 200*(IRAN); Damavand, Lar mountains, 2680-3000 m, 12.vii.1982, *Termeh, Mousavi & Tehrani s. n.*(IRAN); Abali road, Sarpolak, 1700-1800, 8.vii.1974, *Mobaien 10577*(TUH); Road of Parkvay, 10.iv.1991, *Attar 28258*(TUH); Road Heraz, Peloor, Lar lake near, 1850 m, 29.v.1994, *Vaezi 19268*(TUH).

Linaria Azerbaijanensis: Representative material. Iran: Prov. Azerbaijan, Tabriz, Lighvan, Sahand, 1900-2900 m, 27.vi.1970, *Termeh s. n.* (IRAN). Ardebil, 9 km of Kivi to Miresht village, 2000 m, 18.vi.1980, *Mozaffarian & Nouroozi 34387* (TARI); Mianeh, 10 km of Gharah Chaman to Mianeh, 1600 m, 30.vi.2003, *Assadi 85356* (TARI); Ghareh Chaman, 10 km to Mianeh, 1600 m, 130. vi.2003, *Assadi, 85356* (TARI); Ahar, Siodil Kuh, 13.viii, 1968, *Termeh* (IRAN *s. n.*).

Linaria Shahroudensis: Representative material. Iran: Prov. Semnan, Shahroud, 15 km of Tash to Gorgan, 2800 m, 16.vii, 2003, *Assadi & Hamdi 85676* (TARI); Shahroud to Nekraman, Shahvar mountains, 3000-3700 m, 1.viii.1982, *Assadi & Mozaffarian 40843* (TARI); Shahroud, 25 km of Tash to Gorgan, 2300, *Assadi & Hamdi 85440* (TARI); Shahroud 65 km to Azadshahr, Bastam, Tashe-Olia, Shahvar mounts, 2400-3000 m, 13.viii,88, *Moosavi, Delghandi & Tehrani s. n.* (IRAN).

Linaria Elymatica: Representative material, Iran, Kerman province, Kerman, lalehzar mountain, 3200 m, 3.4.1994, Froughi & Assadi (TARI 16360).

Linaria Remotiflora: Representative material, Iran, Mazandaran province; Ghaemshahr, Rineh, Khamseh, 10 km of western of Rineh, 2900 m, Mousavi, Habibi and Tehrani (IRAN *s.n.*); Kerman, Zardar, Lalehzar mountain, 3200 m, Froughi and Assadi (TARI 16360). Kogiloueh and Bouyerahmad province; between Yasouj and Dehdasht, Dilgoon, Saverz mountain, 2200-3200 m, Assadi and Abouhamzeh, (TARI 46411).

Linaria Bamianica: Representative material, Iran, Khorasan province; Torbate-Jam, 10 km of south westrn of Torbate-Jam, Feritag, 1050 m, Jouharchi (TARI 30649).

Linaria Leptoceras: Representative material, Iran, Khorasan province; Shirvan, Kouseh, Alkhas mountain, 1900-2100 m, Termeh, Mousavi and Tehrani (IRAN *s.n.*); Ghochan, east of Ghochan, Kakanloo mountain, 1650 m, Faghiniha and Zangouee (TARI 27499).

Linaria Odora: Representative material, Iran, Esfahan province; Esfahan, Kouseh, Tangdouzan mountain, 2700-3000 m, Eatemadi (TARI 981). Khorasan province, Neyshabour, Dizbade-Olia, 1800 m, Pariab and Abassi (TARI 8610); Neyshabour, Dizbad-Olia, 2000 m, Mousavi and Pariab (TARI 8825). Tehran province, East of Tehran, Azineh protected area, Arazm and Dini (TARI 21426).

Linaria Striatella: Representative material, Iran, Esfahan province; Esfahan, Sarcheshmeh village, 1700 m, Mozaffarian (TARI 48405); Feridoonshahr, Shahghaleh village, 2650 m, (TARI 7479); Feridoonshahr, near of Seek village, 2800 m, Assadi and Khatam saz (TARI 76520); Khorasan province; Shirvan, 45 km to Gelool protected area, 1500 m, Assadi and Massoumi (TARI 50563); Torbat-Heidarieh, 1700 m, Iranshahr (TARI 39065).

Linaria Khorasanensis: Iran, Khorasan prov.; Mashad, S. W. of Moghan mountain, 2300 m, Jouharchi 33665 (holo. FUH); Mashad, Cheshmeh Parishan, 2550 m, Amirabadi & Abassi 3338; Shirvan, to Verk, 1850 m, Zangouei & Hoseinzadeh 24286.

Linaria Karajensis: Representative material, Iran, Tehran prov.; Tehran, Shahrestanac, Kuh-Touchal, 3150 m, 8470 M. Riazi (holo. TARI). Karaj, Gach-sar, mountain Gach-sar, 1700-2400 m, Termeh (IRAN *sn.*).

Linaria Farsensis: Representative material, Iran, Fars province, Abadeh, Soghad, Dashte Ayon, 2100-2270m, June.4.1975, P. Wendelbo & H. Froughi (TARI 17870).

Linaria Pyramidalis: Representative material, Iran, Kourdestan Prov ; Sanandaj, 25 km south-east of Naran village, 2200-2600 m, Assadi (TARI 60498). Azerbaijan; Urmieh, between Urmieh and Salmas, 1900-2600 m, Assadi (TARI 78924); Marand, Mishodagh, south west Payam, 1700-2200 m, Ghahreman and Agustin (TUH 10587).

Linaria Nurensis: Representative material, Iran, Esfahan Prov; Esfahan, Nouristan and Tangdoudan, 2600-2900 m, Reihani and Nekouee 1810. Lorestan province; Khoramabad, Dour, Oshtourankouh, 1750-2250 m, Riazi (TARI 9665); Doroud, Gohar Leak, 2250-2900 m, Mozaffarian and Sardabi (TARI 42246). Fars province; Nourabad, 44 km next Fahelian, toward Reshk, 1800m, Mozaffarian(TARI 45932).

Linaria Michauxii: Representative material, Iran, Esfahan Prov; Esfahan, Shahrab, East-north Ardestan, 900 m, Amin and Rejamand (TARI 32978); Esfahan, Ghameshloo, Riya protected area, Binazir toward Mahvar, 1800 m, Yousefi 646; Esfahan, Ghameshloo, Arya protected area, 2000-2200 m, Yousefi 1146-1. Balouchestan province; Zahedan, 5 km to Zaboul, 1450 m, Mozaffarian (TARI 52676). Fars province; Abadeh, Eghlid, Bel maintain, 2700-3600 m, Termeh (IRAN s.n.).

Linaria Kurdica: Representative material, Iran, Kourdestan Prov ; Ghorveh, Asefabad, Kanibarezeh maintain, 2400-3100 m, Assadi (TARI 75334); Sanadaj, Nashour village, between Sanandaj and Kamiaran, 1700-2200 m, (TARI 75179); Marivan, 15 km to Sanandaj, old road, Gardaneh Garan, 1400-1500, Mozaffarian (TARI 74666); Sanadaj, 36 km to Kamiaran, Nashour village, 2000 m, Assadi (TARI 60633).

Linaria Fastigata: Representative material, Iran, Kourdestan Prov; Noursod, to Marivan, between Noursod and Gardaneh Tat, near Dezaveh and Hanigermal, 2000 m, Mozaffarian 74814; Sanandaj, next of Nashour village, Avalan village, slope of southern, 2100 m, Hamzee and Khaledian (TARI 895). Hamedan province; Ghahavand, Biukabad, to Shahbodagh, Aghdash maintain, slope of western, 1800-2350 m, Mozaffaria (TARI 64470). Kermanshah province; Paveh, Shahoo maintain, 1300-2000 m, Tavakoli and Miabdali (TARI 2904). Fars; Nourabad, next of Fahelian, 44 km to Reshk, 1800 m, (TARI 45932).

Linaria Orientalis: Representative material, Iran, Semnan prov; Shahroud, to Azadshahr, Khosh Yielagh, 6.26.1972, 2000 m, M. Riazi (holo. TARI 8496).

Linaria Mazandaranensis: Representative material, Iran, Mazandaran prov; Ghaem-shahr, toward Firouz-Kuh and Ghaem-shahr, 8km west-south of Pole-Sefid, 1720 m, Moosavi 33702(holo. IRAN).

Linaria Golestanensis: Representative material, Iran, Golestan Prov; East-south Maraveh-Tapeh, Shalmi mountain 1200 m, Faghih-Nia & Zangouii 32889. (holo.TARI).

Linaria Genistifolia: Representative material, Iran, Mazandaran province, Ramsar, Javaherdeh, western-south, 2500-2750 m, Wendelbo & Maassoumi 20889. Azerbaijan, Ardebil, Germe < Germe toward Ani, 6 km, 900-1200 m, Mozafarian & Nouroozi 34922; Germe toward Ani, 1000-1380 m, Mohammadi & Mozafarian 37733; Khalkhal toward Asalem, above of Sefid Poshteh, 1900-2100 m, Wendelbo & Assadi 18547. Lorestan, Kouhrang, 2150 m, Pabou 29753. Tehran, toward Firouz-Kouh, before of Gadouk, margin of road, 2100-2400 m Assadi & Hamdi 85667.

Linaria Grandiflora: Representative material, Iran, Golestan Prov; East-south Maraveh-Tapeh, Shalmi mountain 1200 m, Faghih-Nia & Zangouii 32889. (holo.TARI).

Linaria Dalmatica: Representative material, Iran, Azerbaijan Prov; Sarab, Saraban Kouh, Termeh, (39071 IRAN); Soudeh, to Uromieh, Dareh Ghasemloo, 1990 m, Matin & Daneshpajoo (IRAN 38499); Oushnavieh, to Ghesloo, near of Dourahi, Attar & Mehdigholi. Kourdestan; Sannandaj, to Divandareh, next of Sannandaj, 1640 m, Attar & Darjoo, (TUH 16886).