9.1.2. ***Pistacia khinjuk*** Stocks, Hooker's J. Bot. Kew Gard. Misc. 4: 143 (1852); Boulos, Fl. Egypt 2: 75 (2000).

var. ***glabra*** Schweinf. ex Engl. in DC., Monog. Phan. 4: 291 (1883).

Syn. *Pistacia khinjuk* Stocks var. *glaberrima* Schweinf. ex Boiss., Fl. Orient. Suppl. 154 (1888).

var. ***microphylla*** Boiss., Fl. Orient. Suppl. 154 (1888).

Botom (Ar) بطم

Proximate Composition and Lipids

The fruits of *Pistacia khinjuk*, growing in Turkey contain an average of water 4.6, fat 57.6, protein 20.3, N-free extract 10.0, crude fiber 4.7 and ash 2.8%. The oil contained saturated acids 14.7, oleic acid 56.4, and linoleic acid 28.9% (Yazicioglu, 1950). The percentage of lignin and ash in the bark are 35.14 and 209.25 respecively. Tannins of 3 plants, including *Pistacia khinjuk*, ranged from 8.65 - 18.24% (Al-Dawoody *et al*., 1980). The proximate composition and amino acids of *Pistacia khinjuk* are shown in Tables 2-6.

The lipids of the plant, growing in Pakistan, were classified by TLC into hydrocarbons (0.9%), wax esters (1.3%), triglycerides (62.3%), free fatty acids (4.9%), 1:3 diglycerides (15.6%), 1:2-diglycerides (7.7%), 2-monoglycerides (4.0%) and 1-monoglycerides (3.3%). The fatty acid composition of the nreutral lipids as well as the whole oil was determined (Waheed *et al*., 1994). The fatty acids identified in kernels and pericarp of the seeds of *Pistacia khinjuk*, growing in Turkey are mentioned above (9.1.1) (Agar *et al*., 1995). The fatty acids of *Pistacia khinjuk* are shown in Tables 13 and 14. The major fatty acid components characterized in the oils were as follows: oleic (51.46-52.12%), linoleic (17.44-38.85%), palmitic (8.5-17.82%), palmitoleic (1.23-5.73%), stearic ((1.48-2.61%), and linolenic (0.95-1.5%) acids. Margaric (0.4%), margaroleic (0.43%), gadoleic (0.76%) and erucic (0.88%) were only identified in the fatty acid composition of *Pistacia khinjuk.* The oil of this species was characterized by its higher palmitic and palmitoleic acids in comparison with the two other species (Tavakoli and Pazhouhanmehr, 2010).

Essential Oils

The essential oils of the leaves of *Pistacia chinensis*, *Pistacia khinjuk* and *Pistacia lentiscus*, (collected from Zoological and El-Orman gardens, Giza, Egypt) showed qualitative and quantitative differences (Table 21). All three species were found to be rich in monoterpene hydrocarbons. In *Pistacia lentiscus* oil (0.2-0.3%), 4% sesquiterepene alcohols were found, and no monoterpene alcohols, whereas in *Pistacia khinjuk* and *Pistacia chinensis* 16.3% and 8% monoterpene alcohols respectively were detected and no sesquiterpene alcohols (Aboutabl *et al*., 1990; De Pooter *et al*., 1991).

Thirty-six compounds were identified from the leaf essential oil of *Pistacia khinjuk*, growing in Iran (Table 22) (Taran *et al*., 2010c). Ninty-five compounds were identified from the fruits; the two main ones are β-phellandrene and α-pinene (Table 23). Other 80 components were present in amounts less than 6% (Pirbalouti and Aghaee, 2011).

A good smelling volatile oil (0.87%) was obtained from the mastiche gum of *Pistacia khinjuk*. α-Pinene (61.13%) was the predominant terpene of the oil followed by myrcene (8.28%), β-pinene (2.51%) *p*-cymene (2.50%), Δ^3-carene (1.36%), nonaldehyde plus linalool (2.76%), and β-caryophyllene (1.95%). The minor identified terpenes were α-thujene, camphene, α-fenchene, sabinene, α-phallendrene, β-phallendrene, limonene, cineol, fenchone, borneol, and α-terpineol (Mahmud *et al*., 1994). The essential oil obtained from the

Table 21. Composition (%) of the essential oils of *Pistacia* specis*, growing in Egypt**

Compounds	*Pistacia khinjuk*	*Pistacia chinensis*	*Pistacia lentiscus*
1. Tricyclene	0.7	-	tr
2. α-Thujene	1.3	-	-
3. α-Pinene	18.4	0.7	1.0
4. Camphene	2.7	Tr	0.6
5. Sabinene	13.5	0.3	-
6. β-Pinene	9.4	0.1	0.5
7. Myrcene	0.9	1.0	1.3
8. α-Phellandrene	0.1	0.1	-
9. Car-3-ene	-	-	65.3
10. α-Terpinene	0.6	-	-
11. *p*-Cymene	6.4	0.1	0.6
12. 1,8-Cineole			
13. β-Phellanderne	2.2	-	-
14. Limonene		26.5	4.6
15. *cis*-β-Ocimene	0.1	4.9	-
16. *trans*-β-Ocimene	0.2	38.8	0.2
17. γ-Terpinene	2.7	0.2	-
18. *trans*-Sabinene hydrate	0.1	-	-
19. Terpinolene	0.1	-	0.7
20. Linalool	0.9	0.1	-
21. α-Pinene oxide	0.1	0.9	-
22. *cis*-Sabinene hydrate	0.5	-	-
23. 2-Phenylethanol	-	0.1	-
24. *trans*-Pinocarveol	0.4	-	-
25. *trans*-Pinene hydrate (?)	0.2	-	-
26. Verbenol (?)			
27. Pinocarvone	0.3	-	-
28. δ-Terpineol	-	0.2	-
29. Borneol	0.1	-	-
30. Terpinen-4-ol	12.1	-	-
31. (*Z*)-Hex 3-enyl butanoate	0.1	0.7	-
32. *p*-Cymen-8-ol (?)	0.2	-	-
33. α-Terpineol	1.6	0.5	-
34. *trans*-Piperitol (?)	0.2	-	-
35. Verbenone	Tr	-	-
36. *cis*-Piperitol (?)	0.2	-	-
37. Geraniol	0.3	-	-
38. Bornyl acetate	0.1	-	-
39. α-Copaene	-	0.4	0.2
40. *β*-Bourbonene	0.1	-	2.6
41. Longifolene (?)	0.3	-	-
42. 3-Methylbutyl benzoate	-	-	0.4
43. *β*-Caryophyllene	3.3	10.2	-

Table 21. Composition (%) of the essential oils of *Pistacia* species*, growing in Egypt** (cont.)

Compound	*Pistacia khinjuk*	*Pistacia chinensis*	*Pistacia lentiscus*
44. *β*-Gurjunene (?)	Tr	-	0.4
45. Aromadendrene	0.1	-	-
46. α-Humulene	1.2	1.0	0.3
47. β-Farnesene	0.1	-	0.1
48. *allo*-Aromadendrene	0.1	-	-
49. γ-Muurolene (?)	Tr	-	-
50. α-Farnesene	0.7	-	-
51. β-Bisabolene	-	-	3.4
52. γ-Cadinene	-	-	tr
53. δ-Cadinene	0.1	-	0.5
54. Nerolidol	0.1	-	-
55. (*Z*)-Hex-3-enyl benzoate	2.0	-	0.5
56. Hexyl benzoate	Tr	-	-
57. Spathulenol	-	-	0.6
58. Caryophyllene oxide	4.0	-	4.1
59. *T*-Cadinol	-	-	1.6
60. α-Cadinol	-	-	1.8

tr = < 0.1%; - = < 0.05%; (?) = identified by comparison of the MS and retention times
* Collected from Zoological and El-Orman gardens
** De Pooter *et al*. (1991)

Table 22. Chemical composition of the leaf oil of *Pistacia khinjuk**

Components	%	Components	%
1. Tricyclene	0.64	19. β-Caryophyllene	3.67
2. α-Pinene	2.11	20. α -Guaiene	2.24
3. Camphene	1.52	21. Aromadendrone<dehydro>	8.80
4. Sabinene	0.67	22. Germacrene B	9.53
5. β-Pinene	1.49	23. Luparene	1.38
6. Myrcene	2.85	24. Occidentalol cadinene <delta>	3.77
7. α -3-Carene	0.29	25. Thusopsanone	3.84
8. β-Cymene	0.58	26. Eudesmol	2.29
9. Limonene	0.58	27. Spathulenol	20.87
10. γ-Terpinene	1.15	28. α -Eudesmol	6.78
11. Nonanol	1.13	29. Occidentalol acetate	3.68
12. Camphenol	0.63	30. Zizanol	6.51
13. *trans*-Pinocarveol	0.35	31. Khusimol	1.48
14. Verbenol	0.41	32. Aristolone	0.55
15. *p*- Mentha-1,5-dien8-ol	0.75	33. Muurolene <14-hydroxy-α >	0.28
16. α -terpineol	0.58	34. Dibutyl phthalate	0.33
17. Bornyl acetate	2.77	35. Pentacosane	0.54
18. δ-Elemene	1.52	36. Heptacosane	0.35

* Taran *et al.* (2010c)

Table 23. Some major constituents of the essential oil of *Pistacia khinjuk* fruits from Bakhtiari mountains, Central Zagross, lran (Pirbalouti and Aghaee, 2011)

Components	(%) (w/w)	Components	(%) (w/w)
1. α-Pinene	15.28	9. Linalool	1.69
2. Sabinene	0.90	10. Thujopsene	1.47
3. Phellandrene	52.33	11. Caryophyllene oxide	1.65
4. Δ-Limonene	4.08	12. Hexadecanoic acid	1.08
5. 1,3,6-Octatriene	1.30	13. Octadecanoic acid	6.26
6. γ-Terpinene	1.54	14. 9-Octadecanoic acid	1.21
7. α -Terpinolene	0.58	15. Ethyl oleate	1.37
8. (*Z*)-4,8-dimethyl-1,3,7-nonatriene	1.01		

fruits (whole seeds, kernel and the green hull of the seeds) of *Pistachia khinjuk* tree growing wild in Iran, amounted to 4.0% (v/w). Thirty-four compounds consisting *ca*. 99% of the total components were identified in the oil. Among them, *cis*-ocimene (24%), α-pinene (17.9%), myrcene (14%) and *trans*-ocimene (8%) were the major components (Naseri *et al*., 2006b).

Flavonoids and other Phenolics

The flavonoids identified in the plant growing in Egypt are shown in Table 19 (Kawashty *et al*., 2000). Later, Esmat *et al*.(2012) identified the following seven phenolic compounds from the plant: gallic acid, methyl gallate, quercetin-3-*O*-β-D-4*C*1-galactopyranoside (hyperin), myricetin-3-*O*-α-L-1*C*4-rhamnopyranoside (myricitrin), 1,6-digalloyl-β-D-glucose, 1,4-digalloyl-β-D-glucopyranoside, and 2,3-di-*O*-galloyl-(α/β)-4*C*1-glucopyranose (nilocitin).

As the only evergreen member of the genus *Pistacia*, this species stands unique in its flavonoid composition as compared to the other three species investigated by Kawashty *et al*. (2000), in having three myricetin glycosides as its major glycosides. The other three species contained quercetin 3-glucoside as their major glycoside.