GENETIC DIVERSITY AMONG *MENTHA* POPULATIONS IN EGYPT AS REFLECTED BY MORPHOLOGICAL AND PROTEIN ELECTROPHORETIC VARIATIONS

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ABSTRACT Electrophoretic protein profiles and morphological traits were used to study the genetic diversity among accessions of *Mentha spp.* (*M. longifolia*, *M. spicata* and *M. piperita*) collected from thirty eight populations distributed in different habitats in Egypt. Ten individuals from each accession were examined for their morphological traits and the Tris/borate buffer extracts of composite samples from seed meal of each population were electrophoretically analyzed on SDS/PAGE under reducing conditions. The cluster analyses of both morphological traits and protein electrophoretic criteria showed the unequivocal role and the impact of the environmental fluctuations on the genetic variations among the examined populations of *Mentha*. Also, the taxonomy of *M. longifolia* was argued about the presence of two or three subspecies in the Egyptian flora.

INTRODUCTION The genus *Mentha* L. (Linnaeus.Sp.P1. 576 (1723) includes perennial erect herbs with prostrate (running or creeping) stem with some erect aerial shoots. It has a large number of hermaphrodite flowers, axillary or in spike-like inflorescence **(Mohammed, 1986)**. It includes 25 species mainly distributed in temperate regions of the world; many of these species form inter-specific hybrids **(Boulus, 2002)**. Due to their volatile oils, medicinal and economic importance; *Mentha* species have been cultivated since ancient times. Nowadays, the most commonly cultivated species is *Mentha piperita* L. (peppermint); while in earlier times, *Mentha spicata* L. (spearmint) was more widely used **(Simpson and Conner-Ogorzaly, 1986)**. An understanding of relative levels of genetic diversity both within and among populations of a crop wild relatives is necessary for the best conservation of its gene pool **(Votava et al., 2002)**. The genetic variation found within wild relatives of domesticated species offer novel gene complexes for strategic improvement of a crop quality. Recent advances in biotechnology have provided additional means of improving cultivars through precise identification and rapid incorporation of genes for important traits derived from the genomes of wild relatives (**Tanksley** and **McCouch, 1997**). Moreover, the variability found within populations of native plant species can also have important implications for their conservation and management. Genetic diversity can be also perpetuated through maintenance of wild populations in situ; that is, populations can be conserved within their native environments in a natural protectorate where interactions occur with a variety of biota influence and variability (**Tewksbury et al. 1999**).Using the morphological data in phentic classification of plants was previously scored by many authors (**Khosla, 1988; Bult and Kiang, 1992; McCaskill *et al.*, 1992; Badr, 1995; Zviniene** and **Pank, 1996**).In addition to morphological traits, seed protein electrophoretic patterns have provided a valid evidence for addressing taxonomic and evolutionary relationships at the species and subspecies levels (**Ladizinsky** and **Hymowitz, 1979; Cook, 1984; Crawford, 1990**). For example, *Crotolaria* (**Boulter *et al.*, 1970**), *Lens* (**Ladizinsky, 1979a,b;** and **Sammour, 1994b**) *Linum* (**Sammour, 1988**), *Lotus* (**Sammour *et al.*, 1991**) *Plantago* (**Badr, 1999**) *Vicia* (**Stegmann *et al.*, 1980; Sammour, 1989** and **1994a**), *Vigna* (**Paino *et al.*, 1990**), *Trifolium* (Badr, 1995), *Phaseolus* (**Adrianse *et al.*, 1969; Schmit *et al.*, 1996**), *Lathyrus* (**El-Shanshoury, 1997** and **2002; Badr *et al.*, 2000**), *Sesbania* (**Saraswati *et al.*, 1993; Badr *et al.*, 1998**) and *Astragalus* (**Al-Nowaihi *et al.*, 2002**).*Mentha* is represented in the Egyptian flora by three species; *M. spicata*, *M. pulegium* and *M. longifolia* (**Mohammed, 1986**). The later species is widely distributed and includes two subspecies; *M. longifolia* subsp. typhoides, and *M. longifolia* subsp. schemperei (**Mohammed, 1986**). *M. spicata* (spearmint) is cultivated for its volatile oils, and is used as food flavoring. *M. piperita* (peppermint) is also widely cultivated in Egypt for its economic uses, but it is not included as one of the Egyptian flora.To our knowledge, few studies dealt with genetic variation in *Mentha* (**Khanuja *et al.*, 2000; Shasany *et al.*, 2001**). The objective of this study is to investigate genetic diversity in *Mentha* populations in Egypt based on variations in their morphology and electrophoretic profiles of seed proteins.

MATERIALS AND METHODS ***Samples collection*** Thirty-eight samples of Mentha were collected from the natural populations listed in table (1), and shown in Fig. (1). These included 32 samples M. longifolia (ML1-ML32), five M. spicata (MS1-MS5) and one M. piperita (MP). Mature plants were collected during the flowering season for measuring morphological traits, and the seeds were collected after seed maturation for electrophoretic analyses. Morphological traits. Fifteen morphological traits were recorded, including characters derived from the stem, leaves, inflorescence, and roots for a sample of ten individuals from each population.

Seed Proteins From each population, a composite sample of mature seeds were mixed with an equal weight of pure, clean, sterile fine sand, and ground in a mortar, then defated with acetone several times until oils could not be observed, then left for air-drying. Total proteins were extracted overnight with 0.125 M Tris-borate buffer (pH8.9) containing 2% β-mercaptoethanol as a reducing agent. The extract was centrifuged to discard the residues, then 10 % sucrose was added to aid the sample extract to settle on the gel well. The extract was put in a boiling water bath for about two minutes prior to application onto 17% SDS-PAGE (Laemmli, 1970). A mixture of the follwing proteins (bovine serum albumin, ovaalbumin, β-lactoglobulin and Myoglobin) with molecular weights of 67, 45, 36.5 and 18.8 KD was used as marker in each run. The gels were then stained with Coommassie Brilliant Blue R250, destained and photographed. The total protein content (TPC) was quantitatively estimated in the tris-borate buffer extract according to Bradford (1976)

Statistical analysis The protein bands exhibited in each track (lane) were counted, and their molecular weights were calculated as listed in table 3. The presence or absence of each band was scored as 1 or 0 respectively for cluster analysis using the software NTSYSpc (numerical taxonomy and multivariate analysis system, **Rohlf 2000).** Strength or weakness of the protein bands was not taken into consideration. Analysis was made depending upon both morphological traits and protein electrophoretic profiles. The clustering was performed using the UPGMA method by using SAHN as defined by Sneath and **Sokal (1973)** and **Dunn** and **Everitt (1982).** The output of SAHN clustering was presented in the form of a phenogram by using the tree display graphic (TREEG).

RESULTS The mean values of the examined morphological traits are shown in table 2 and that of total protein content (TPC) are shown in table 1. The phenogram based on the variations in morphological traits is shown in Fig. 2. In this tree (Fig. 2), the three accessions of the cultivated *Mentha* that have prostrate stem (*M. spicata*; MS3, MS4 and MS5) are grouped in one cluster, while all accessions with erect stem (wild and cultivated) were clustered in one major group. This major group has two clusters, a small one that included two cultivated accessions (*M. spicata*; MS1 and MS4) and two wild accessions (*M. longifolia*; ML9 and ML30), and a large cluster that is branched into two groups. The larger one was divided into two clusters; the smallest one included only the two accessions *M. spicata* (MS2) and *M. longifolia* (ML29). The electrophoregrams of the examined 34 accessions (Fig. 4) exhibited a large number of protein bands under reducing conditions with molecular weights ranging between about 102 KD to about 15 KD as presented in table 3. The number of the protein bands in each profile ranged from 35 bands in accession ML13 to 18 bands in accession ML29. In the accession ML1 that represented

M. longifolia subsp. Schemperei, 20 protein bands were exhibited in its electrophoretic profile. As it is shown in the electrophoregram (Fig. 4), the profiles of all the accessions of the wild *Mentha* exhibited three main groups of protein bands. The first group is between 50 KD and 60 KD, the second is between 27 KD and 36 KD and the third is lower than 21.5 KD. It can be remarkably observed the presence of a large number of minor bands with a wide variety of molecular weights. The profiles of some wild accessions (*M. longifolia*) showed very faint bands. (ML1, ML10, ML13, ML19) while others showed very condensed bands (ML23-25, ML30, ML32). The presence or absence of the different protein bands in the different profiles is scored and listed in table 3. Some specific protein bands were shown in certain accessions for example bands 8, 17, 44, 92 and 98 were exhibited in accessions ML1-13. These accessions were collected from localities outside of the Nile Delta region. On the other hand, bands 42, 89 and 100 were found in the electrophoretic profile of accessions collected from the Nile Delta region. Meanwhile, accession 13 (El-Sinbllaween) and accession 32 (Etay El-baroud) exhibited certain bands that are also recorded in accessions from both regions.The relationships among the collected samples based on the variation in their electrophoretic banding profiles as expressed by NTSYSpc software are shown in Fig. 3. The dendrogram based on the variations of the protein profiles exhibited that the two accessions of cultivated *Mentha* (*M. spicata*) form one of the two branches of the tree. This branch meets the other branch that included all accessions of the wild *Mentha* (*M. longifolia*) at similarity coefficient of 1.58 on the clustering tree. The other group in the tree included all the accessions of the wild species (*M. longifolia*). This group consisted of two major clusters; one of them included all the accessions collected from the Nile Delta region and Qaliobia, while the other cluster included the accessions collected from regions outside the Nile Delta. This cluster was divided into two branches, the first was represented by ML32 only while the other was also branched into two clusters; one included only ML13, and the other included the accessions ML1-ML12. Also, the accessions ML19 and ML26 constitute together a cluster against another cluster including 16 accessions.The dendrogram exhibited a number of accession pairs that formed clusters with minimal dissimilarity in their electrophoretic profiles; accessions ML3-ML4, ML5-ML6 and ML7-ML9.

DISCUSSION Genetic diversity based on variations in morphological traits among populations of *Mentha* in Egypt as reflected in the tree (Fig. 2) showed that the accessions of *M. spicata* that have prostrate stem (MS3, MS4, MS5) were grouped in one main cluster. On the other hand, all the other accessions having erect shoots including the 32 wild accessions of *M. longifolia,* the domesticated two of *M. spicata* (MS1, MS2) and *M. piperita* (MP) were clustered in the other main group of the tree. In this main group, accessions of the domesticated *Mentha* (*M. spicata* and *M. piperita*) were not discriminated from accessions of wild *Mentha* (*M. longifolia*). This indicates that the used morphological traits were not enough for a valid addressing of the taxonomic and evolutionary relationships among the examined taxa of *Mentha*. Since formation of seed proteins is often controlled by quantitative gene system (**Ladizinsky** and **Hymowitz, 1979**), reducing conditions were applied onto SDS-PAGE so that it may exhibit more genetic divergence among the examined accessions than non reducing conditions (**Badr, 1995**). As it can be easily noticed in table 3, while bands no. 1 and 3 were exhibited in accessions ML7, 8 and 9, only the band no. 1 was exhibited in accessions ML2-6, 11, 12; and the band no. 3 was shown in ML1, 26. Also, the band 17 was exhibited in accessions ML1-12; and the band 18 in accessions ML16, 19, 26; while both bands were exhibited in accessions ML13 and 32. Such phenomenon can be observed also with accessions ML19 and 26. This may suggest that these accessions are products of natural hybridization among populations or within the same population and the resulted accessions distributed through seed dispersion (**Khosla** and **Sobti, 1984; Cantoria, 1985; Arnold, 1992, 1997; Skoula** ***et al.*****, 1999; Aparicio** ***et al.*****, 2000** and **Ellstrand** and **Schierenbeck, 2000**). Another interpretation for this phenomenon is that these accessions represent ancestors from which evolution occurred under the impact of environmental fluctuations that resulted in genetic diversity and development of new accessions after seed dispersion to the new habitats. (**Kimura** and **Weiss, 1964; Linhart** and **Grant, 1996** and **Votava** ***et al.*****, 2002**). This may be supported by the phenogram (Fig. 3) in which it can be easily observed that both accessions ML32 and ML13 alone form a cluster from which accessions ML1-12 were derived. In the dendrogram (Fig. 3), the two accessions of the cultivated *Mentha* (*M. spicata*) were clustered in one branch representing one of the two subgroups of the whole tree, while all the accessions of the wild *Mentha* (*M. longifolia*) were clustered in the other group. This observation also supports the validity of seed protein electrophoretic data to be used in addressing taxonomic and evolutionary relationships at the species level (**Boulter** ***et al.*****, 1970; Ladizinsky, 1979b; Ladizinsky** and **Hymowitz, 1979; Paino** ***et al.*****, 1990; Sammour, 1994a,b**). The dendrogram (Fig. 3) showed that the major group which included all the accessions of *M. longifolia* was branched into two groups of accessions representing two geographically and environmentally different habitat types. The first type is in the Nile Delta, including the accessions ML 14-31, while the other accessions (ML1-13, 32) were outside the Nile Delta and Sinai. These results indicate that geographically proximal populations are more genetically similar than those that are geographically distant are. This shows an impact of the environmental fluctuations on the genetic diversity of plants (**Linhart** and **Grant, 1996** and **Votava** ***et al.*****, 2002**). This also leads to an argument about the taxonomy of *M. longifolia* in the Egyptian flora; is it really represented by only two subspecies? Is the subspecies *M. longifolia* subsp. Schemperi found only in Sinai, as previously recorded by **Mohammed (1986)**? This argument was based on the following observations in the phenogram (Fig. 3):

- The presence of a geographic barrier (the Nile River) that separates the accessions ML1-12 (outside the Nile Delta) from the accessions ML14-31 (in the Nile Delta)
- The presence of both accessions ML13 (El-Sinbellaween) and ML32 (Etay El-Baroud) in the intermediate region both geographically (Fig. 1) and electrophoretically (Fig. 3 and table 3).
- Also, the accessions ML2-12 that belong to the subspecies typhoides are nearer to ML1 (subsp. schemperi) than ML14-31 that belong to subsp. typhoides (Fig. 3).

This argument still needs additional work including much more morphological traits, karyotype, molecular and isozyme data so that the taxonomy of *M. longifolia* in Egypt might be established. Accessions ML13 and ML32 seemed to be the most genetically stable among the collected accessions, and they are probably the ancestors from which, the other accessions collected from outside the Nile Delta were developed through intra-specific natural hybridization **(Skoula *et al.*, 1999;** and **Ellstrand** and **Schierenbeck, 2000).** It could be easily noticed that cluster analysis based on variations in morphological traits (Fig. 2) is different from that based on variations in SDS-PAGE data (Fig. 3). This reflects the higher environmental impact on morphology than the seed protein electrophoretic profile. Seed proteins are little affected by environmental fluctuations **(Bult and Kiang, 1992).** This supports the view that protein electrophoretic profiles provide a valid evidence for the separation of taxa at the species level **(Vaughan, 1983; Badr, 1995).** This study represents a first step in studying the genetic diversity of *Mentha* in Egypt, and still needs to be supported with additional work at both molecular markers and isozyme levels, so that we may have valuable information about the population genetic structures and diversity of *Mentha* species in Egypt. This information is so important to future decision making for the management and preservation of germplasm and genetic resources.

Table (1): Locations of the collected *Mentha* samples and their seed TPC (mg protein/ g dry defated meal) ML= *M. longifolia*, MS= *M. spicata*, MP= *M. pipperita*

No.	Sy.	Location	TPC
1	ML1	Sinai, Sant Kathrin	1.3
2	ML2	Ismaelia, Al-Wasfania, Ezbet Al-Warsha	1.4
3	ML3	Ismaelia, Al-Qassaseen Al-Qadima	1.7
4	ML4		
5	ML5	Sharqia, Hehya, Al-Mutawa'a	2.2
6	ML6	Sharqia, Zagazig, Kafr Mohammed Gaweesh	2.3
7	ML7	Sharqia, Menya Al Qamh, Shafiq	1.7
8	ML8	Sharqia, Menya Al Qamh, Kafr Badawy	1.9
9	ML9	Sharqia, Menya Al Qamh, Al-Azeezya	2.0
10	ML10	Sharqia, Menya Al Qamh, Al-Sanfeen	2.2
11	ML11	Damyetta, Ezab Al-Nahdah	1.9
12	ML12	Damyetta, Faraskour	2.4
13	ML13	Daqahlia, Al-Senbellaween	1.4
14	ML14	Qaliobia, Kafr Shokr Al-Qadeem	2.1
15	ML15	Qaliobia, Kafr Shokr, Meet Al-Dreeg	2.6
16	ML16	Qaliobia, Kafr Shokr, Asneet	2.6
17	ML17	Qaliobia, Kafr Shokr, Ezbet Zakariya Mohye-eddin	2.0
18	ML18	Qaliobia, Kafr Shokr, Ezbet Al-Kurdy	2.6
19	ML19	Qaliobia, Kafr Shokr, Kafr Al-Shahawy	2.7
20	ML20	Qaliobia, Benha, Ezbet Abu Basha	2.7
21	ML21	Qaliobia, Qaliob, Industerial Union factories	2.3
22	ML22	Qaliobia, Al-Qanater Al-Khayria	2.6
23	ML23	Kafr El-Sheikh, Al-Hamoul	1.4
24	ML24	Kafr El-Sheikh, Kafr-El-Sheikh	1.5
25	ML25	Menofeya, Quesna-Meet El-Ebs	2.5
26	ML26	Menofeya, Berket El-Sab'a	1.4
27	ML27	Gharbia, Al-Mahalla Al-Kubra, Buteina	2.4
28	ML28	Gharbia, Tanta	2.6
29	ML29	Giza, Badrasheen, Abu-Ragwan	2.5
30	ML30	Giza, Badrasheen, Al-Tarfania	1.7
31	ML31	Giza-Abu-El-Numros	2.2
32	ML32	Buhayra-Etay Al-Baroud	1.7
33	MS1	Qaliobia, Kafr Shokr, Meet Al-Dreeg	1.2
34	MS2	Qaliobia, Toukh, Belltan	2.4
35	MS3	Menoufia, Al-Bagour, Alama island	1.3
36	MS4	Giza, Badrasheen, Abu-Ragwan	1.1
37	MS5	Sharqia, Menya Al Qamh	2.3
38	MP	Qaliobia, Al-Qanater Al-Khayria	1.4

Table 2: Mean values and standard deviation of the morphological traits (measures in cm)

Access.	Stem Length	StemWidth	Stem Diam.	Internode No	Internode L.	Leaf Length	Leaf Width	Infl.Length	Infl.Width	No of flower	Root Width	Root Diam.	Root Length	Germi n. Per.	Stem
ML1	147.65 ± 4.71	1.56 ± 0.15	0.55 ± 0.06	35.40 ±3.27	6.22 ± 1.02	7.13 ± 0.41	0.74 ± 0.1	5.55 ± 2.83	0.69 ± 0.14	45.40 ± 3.53	1.87 ± 0.13	0.60 ± 0.04	40.89 ± 2.17	8.20 ± 0.92	erect
ML2	138.25 ± 13.32	1.58 ± 0.29	0.56 ± 0.11	23.6 0 ± 3.1	8.37 ± 2.07	5.95 ± 1.43	2.59 ± 1.14	4.82 ± 2.02	0.81 ± 0.13	44.60 ± 6.04	1.58 ± 0.39	0.50 ± 0.12	35.18 ± 6.06	4.40 ± 1.08	erect
ML3	136.35 ± 23.57	1.57 ± 0.3	0.56 ± 0.11	23.80 ± 3.33	7.28 ± 1.28	6.62 ± 0.83	2.16 ± 0.27	5.51 ± 1.83	0.95 ± 0.14	42.60 ± 5.50	1.45 ± 0.29	0.46 ± 0.09	25.18 ± 4.61	4.90 ± 0.99	erect
ML4	91.01 ± 41.79	1.75 ± 0.25	0.62 ± 0.09	27.20 ± 3.74	7.19 ± 0.9	2.57 ± 0.57	1.0 ± 0.29	3.12 ± 1.67	0.83 ± 0.23	43.80 ± 5.90	1.48 ± 0.37	0.47 ± 0.12	26.83 ± 4.49	3.20 ± 0.42	erect
ML5	78.57 ± 27.74	2.00 ± 0.33	0.71 ± 0.11	32.80 ± 5.71	3.75 ± 0.84	2.22 ± 0.48	1.09 ± 0.36	8.23 ± 3.76	1.18 ± 0.2	39.60 ± 6.4	2.07 ± 0.18	0.66 ± 0.06	34.73 ± 5.35	3.60 ± 1.26	erect
ML6	83.36 ± 36.66	1.79 ± 0.5	0.63 ± 0.17	23.50 ± 3.98	4.43 ± 0.91	3.22 ± 1.5	1.53 ± 0.82	3.14 ± 1.04	0.73 ± 0.11	40.30 ± 1.64	1.56 ± 0.37	0.50 ± 0.12	27.56 ± 6.05	4.80 ± 1.69	erect
ML7	87.40 ± 28.54	1.56 ± 0.57	0.55 ± 0.20	22.50 ± 3.98	4.99 ± 0.92	2.82 ± 0.50	1.09 ± 0.20	3.64 ± 2.15	0.88 ± 0.26	41.50 ± 6.96	1.21 ± 0.5	0.39 ± 0.16	28.01 ± 7.78	3.00 ± 0.00	erect
ML8	84.00 ± 29.05	1.02 ± 0.20	0.36 ± 0.07	24.00 ± 3.65	2.93 ± 0.54	2.94 ± 0.53	1.03 ± 0.16	3.24 ± 1.41	0.98 ± 0.20	40.50 ± 6.06	1.87 ± 0.16	0.59 ± 0.05	24.38 ± 1.44	4.10 ± 0.99	erect
ML9	49.90 ± 8.20	0.90 ± 0.12	0.31 ± 0.05	18.60 ± 2.37	3.43 ± 0.58	2.94 ± 0.54	1.40 ± 0.24	3.75 ± 1.4	1.05 ± 0.17	42.00 ± 5.33	.83 ± 0.11	0.26 ± 0.03	19.95 ± 2.81	3.70 ± 0.48	erect
ML10	76.15 ± 8.60	1.34 ± 0.41	0.47 ± 0.15	25.20 ± 3.68	3.79 ± 0.72	2.33 ± 0.61	1.05 ± 0.18	7.52 ± 3.63	0.69 ± 0.32	40.50 ± 4.45	1.88 ± 0.21	0.60 ± 0.07	25.98 ± 3.30	3.60 ± 0.97	erect
ML11	100.90 ± 38.10	1.19 ± 0.4	0.42 ± 0.14	28.30 ± 4.57	5.90 ± 1.66	3.08 ± 1.03	1.30 ± 0.39	3.29 ± 1.13	0.75 ± 0.11	41.00 ± 4.55	1.50 ± 0.47	0.48 ± 0.15	30.01 ± 6.91	3.20 ± 0.42	erect
ML12	73.25 ± 29.31	1.48 ± 0.42	0.52 ± 0.15	28.20 ± 5.59	4.86 ± 1.88	3.54 ± 0.49	1.58 ± 0.46	5.38 ± 3.31	0.97 ± 0.23	40.60 ± 3.27	1.59 ± 0.46	0.49 ± 0.14	29.90 ± 4.93	3.30 ± 0.48	erect
ML13	97.10 ± 27.35	1.56 ± 0.57	0.55 ± 0.20	27.30 ± 1.89	4.86 ± 0.68	3.03 ± 0.63	1.31 ± 0.28	6.53 ± 1.76	1.11 ± 0.23	38.50 ± 2.46	1.69 ± 0.31	0.54 ± 0.10	29.05 ± 3.78	4.20 ± 1.23	erect
ML14	81.05 ± 17.24	1.60 ± 0.18	.570 ± 0.07	22.60 ± 4.14	5.21 ± 1.61	5.64 ± 1.78	2.05 ± 0.50	5.96 ± 3.34	.91 ± 0.33	41.80 ± 7.79	1.72 ± 0.33	0.55 ± 0.11	16.58 ± 2.99	3.80 ± 0.79	erect
ML15	84.50 ± 35.15	1.13 ± 0.16	0.40 ± 0.06	22.70 ± 3.68	5.20 ± 1.25	4.37 ± 0.81	1.74 ± 0.48	3.16 ± 2.15	1.00 ± 0.27	44.50 ± 6.84	1.59 ± 0.40	0.51 ± 0.13	26.60 ± 6.53	4.60 ± 0.70	erect
ML16	67.25 ± 12.61	1.75 ± 0.34	0.62 ± 0.12	24.20 ± 4.83	8.64 ± 1.72	5.37 ± 1.30	1.99 ± 0.24	3.92 ± 1.64	.95 ± 0.3	40.80 ± 5.67	1.97 ± 0.19	0.63 ± 0.06	34.27 ± 4.18	4.80 ± 0.92	erect
ML17	87.20 ± 29.84	1.02 ± 0.39	0.36 ± 0.14	29.00 ± 3.4	6.48 ± 1.34	4.47 ± 0.94	1.73 ± 0.31	4.67 ± 3.55	1.03 ± 0.28	42.30 ± 5.08	1.66 ± 0.48	0.53 ± 0.15	19.31 ± 3.93	4.80 ± 0.79	erect
ML18	101.34 ± 36.09	1.60 ± 0.18	0.57 ± 0.07	22.60 ± 4.14	5.21 ± 1.61	5.18 ± 2.25	2.28 ± 1.12	5.67 ± 2.74	1.17 ± 0.18	44.70 ± 5.52	1.72 ± 0.33	0.55 ± 0.11	16.58 ± 2.99	4.40 ± 0.70	erect
ML19	74.10 ± 24.81	1.46 ± 0.28	0.52 ± 0.1	32.30 ± 5.25	6.55 ± 2.14	3.60 ± 0.93	1.25 ± 0.4	4.35 ± 2.51	1.00 ± 0.22	54.20 ± 14.48	1.74 ± 0.44	0.55 ± 0.14	32.51 ± 5.10	5.20 ± 0.63	erect
ML20	77.73 ± 30.16	1.34 ± 0.44	0.47 ± 0.16	28.50 ± 5.66	5.30 ± 1.77	3.03 ± 0.64	1.11 ± 0.33	2.85 ± 0.86	.32 ± 0.09	42.20 ± 6.05	1.41 ± 0.45	0.45 ± 0.14	29.15 ± 6.48	4.80 ± 1.03	erect
ML21	67.60 ± 13.17	1.38 ± 0.23	0.49 ± 0.08	23.80 ± 4.18	4.18 ± 0.83	3.04 ± 1.27	1.19 ± 0.43	3.20 ± 1.54	.40 ± 0.14	39.90 ± 5.00	1.26 ± 0.32	0.40 ± 0.10	23.04 ± 3.89	4.70 ± 0.82	erect
ML22	80.90 ± 20.17	1.31 ± 0.28	0.46 ± 0.10	25.40 ± 4.3	4.31 ± 0.78	3.42 ± 1.07	1.47 ± 0.44	5.50 ± 3.41	1.09 ± 0.18	40.20 ± 3.99	1.42 ± 0.33	0.45 ± 0.10	26.29 ± 4.00	5.00 ± 0.82	erect
ML23	56.70 ± 22.84	1.84 ± 0.26	0.65 ± 0.09	24.00 ± 4.14	4.16 ± 0.53	2.81 ± 0.74	1.23 ± 0.32	6.93 ± 3.20	1.20 ± 0.17	43.10 ± 4.28	1.56 ± 0.46	0.50 ± 0.15	27.89 ± 5.59	3.60 ± 0.70	erect
ML24	98.65 ± 26.47	1.47 ± 0.34	0.52 ± 0.12	24.70 ± 3.65	5.10 ± 0.82	2.62 ± 0.83	1.18 ± 0.42	6.86 ± 2.45	.99 ± 0.23	38.00 ± 3.77	1.50 ± 0.48	0.48 ± 0.15	27.95 ± 5.91	4.40 ± 0.52	erect
ML25	101.80 ± 41.40	1.26 ± 0.31	0.44 ± 0.11	23.10 ± 3.84	6.51 ± 1.36	3.92 ± 1.91	1.20 ± 0.61	5.68 ± 2.58	1.03 ± 0.18	40.40 ± 6.00	1.80 ± 0.27	0.58 ± 0.08	19.60 ± 3.87	4.80 ± 1.03	erect
ML26	58.17 ± 8.58	1.69 ± 0.33	0.60 ± 0.12	29.60 ± 6.19	7.50 ± 2.1	2.86 ± 0.31	0.86 ± 0.13	2.64 ± 1.45	.67 ± 0.18	43.30 ± 3.97	1.75 ± 0.26	0.56 ± 0.08	31.17 ± 4.69	4.00 ± 0.67	erect
ML27	86.60 ± 19.62	1.41 ± 0.43	0.50 ± 0.15	24.50 ± 3.63	4.88 ± 0.92	3.16 ± 0.47	1.21 ± 0.52	5.11 ± 2.33	.87 ± 0.23	43.60 ± 5.52	1.51 ± 0.37	0.48 ± 0.11	25.56 ± 4.39	5.00 ± 0.82	erect
ML28	106.95 ± 25.49	1.56 ± 0.32	0.55 ± 0.12	24.60 ± 4.99	5.33 ± 1.64	2.76 ± 1.03	1.09 ± 0.31	5.56 ± 2.12	1.05 ± 0.13	45.10 ± 5.40	1.48 ± 0.38	0.47 ± 0.11	28.03 ± 5.59	4.50 ± 0.53	erect
ML29	66.60 ± 17.82	.96 ± 0.21	0.34 ± 0.07	18.00 ± 3.3	4.61 ± 1.11	3.46 ± 0.5	1.30 ± 0.21	4.89 ± 2.07	.93 ± 0.20	42.80 ± 6.94	1.48 ± 0.41	0.47 ± 0.13	19.02 ± 3.26	4.60 ± 0.70	erect
ML30	52.20 ± 8.53	1.00 ± 0.19	0.35 ± 0.07	17.70 ± 2.58	4.98 ± 1.37	2.67 ± 0.58	1.58 ± 0.34	8.13 ± 3.36	1.10 ± 0.31	45.00 ± 4.92	1.17 ± 0.35	0.37 ± 0.11	17.87 ± 4.09	4.70 ± 0.67	erect
ML31	59.35 ± 7.93	1.33 ± 0.45	0.47 ± 0.16	24.50 ± 4.74	5.23 ± 1.33	3.89 ± 0.76	1.71 ± 0.41	4.70 ± 2.45	.88 ± 0.27	43.20 ± 5.45	1.80 ± 0.25	0.57 ± 0.08	25.38 ± 5.51	4.40 ± 0.52	erect
ML32	54.65 ± 10.51	1.40 ± 0.36	0.49 ± 0.13	22.70 ± 3.56	4.79 ± 0.65	3.42 ± 0.7	1.31 ± 0.30	2.67 ± 0.99	.74 ± 0.12	38.50 ± 5.08	1.42 ± 0.30	0.45 ± 0.09	22.21 ± 3.56	5.30 ± 1.16	erect
MS1	75.4 ±20.68	0.89 ± 0.17	0.31 ±0.06	26.5 ± 3.50	8.79 ± 1.76	3.92 ± 0.66	1.89 ± 0.42	9.35 ± 4.61	0.94 ± 0.28	49.2 ± 3.61	0.52 ± 0.11	0.17 ± 0.03	16.63 ± 2.97	5.9 ± 1.45	erect
MS2	85.81 ±17.98	0.89 ± 0.15	0.32 ± 0.05	31.4 ± 4.03	11.26 ± 1.65	4.11 ± 0.3	1.9 ± 0.45	11.49 ± 2.86	0.98 ± 0.24	50 ± 1.56	0.67 ± 0.18	0.21 ± 0.06	16.56 ± 2.98	5.3 ± 1.06	erect
MS3	18.4 ± 3.48	0.61 ± 0.10	0.21 ± 0.04	10.4 ± 1.17	2.1 ± 0.21	2.95 ± 0.47	1.93 ± 0.23	7.28 ± 1.51	0.49 ± 0.16	34.9 ± 1.29	0.51 ± 0.07	0.16 ± 0.02	8.11 ± 1.37	4.7 ± 0.82	prostrate
MS4	64.38 ± 25.41	0.94 ± 0.21	0.33 ± 0.07	19 ± 2.49	3.75 ± 0.66	2.54 ± 0.52	1.52 ± 0.3	7.24 ± 2.8	1.08 ± 0.13	42.6 ± 5.34	0.61 ±0.09	0.2 ± 0.03	12.31 ± 1.49	4.9 ± 0.99	prostrate
MS5	27.83 ± 1.81	0.90 ± 0.11	0.32 ± 0.04	8.5 ± 0.85	3.57 ± 0.47	2.74 ± 0.34	1.65 ± 0.23	3.63 ± 0.47	0.84 ± 0.14	32.4 ± 2.07	0.71 ± 0.06	0.23 ± 0.02	10.5 ± 1.38	14 ± 0.94	prostrate
MP	19.97 ± 2.24	0.8 ± 0.07	0.28 ± 0.02	10.1 ± 1.52	1.99 ± 0.20	2.72 ± 0.40	1.64 ± 0.25	3.44 ± 0.67	0.88 ± 0.09	41.7 ± 5.12	0.7 ± 0.07	0.22 ± 0.02	10.15 ± 1.28	16.2 ± 0.63	erect

Table (3):The distribution and molecular weights of the protein bands in the electrophoregrams of the *Mentha* accessions

No.	M.Wt.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1	103.6	0	1	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	98.73	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	95.4	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
4	93.81	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	92.95	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	91.66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
7	88.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
8	88.5	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
9	84.84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
10	84.54	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
11	80.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1
12	79	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	78.52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
14	76.4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	74.84	1	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	0	0	0	0	1	1	1	0	0	1	0	0	1	1	0	0	0
16	74.32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
17	72.48	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
18	71.86	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
19	70.82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	1	1	0	1	0	1	1	0	0	0	0
20	70.31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
21	69.15	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	69	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	67.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
24	65.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
25	65.4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
26	64.89	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
27	62.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
28	61.91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
29	60.6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	58.26	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	57.81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
32	57.73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
33	56.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
34	55.59	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
35	53.5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	52.89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
37	51.82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
38	51.73	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1

Table (3) (cont.):The distribution and molecular weights of the protein bands in the electrophoregrams of the *Mentha* accessions

No.	M.Wt.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
39	50.4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	0	1	1	0	0	0
40	49.7	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	48.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
42	47.86	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	0	1	1	0	0	0
43	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
44	46.71	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	45.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1
46	44.56	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
47	43.3	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
48	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
49	41.82	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
50	41.4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	41.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
52	40.93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
53	40.57	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	38.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
55	38.7	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	38.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
57	37.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
58	36.93	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	1	1	0	1	0	0	0	1	0	0	0
59	35.63	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	35.52	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
61	35.5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	34.66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
63	34.8	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	1	0	1	0	0	1	1	0	1	0
64	33.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
65	33.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
66	32.9	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	1	1	1	1	0	1	0	0	1	1	1	0	0
67	31.55	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
68	31	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
69	30.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
70	29.3	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
71	28.72	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
72	28.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	1	1	0	0	0
73	27.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
74	26.73	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	0

Table (3) (cont):The distribution and molecular weights of the protein bands in the electrophoregrams of the *Mentha* accessions

No.	M.Wt.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
75	25.9	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0
76	25.71	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	0	1	0	0	0	0	1	0	0
77	25.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0
78	24.84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
79	24	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	23.73	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
81	23.5	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
82	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
83	22.9	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
84	22.72	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	22.1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
86	21.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
87	21.44	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
88	21.31	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
89	20.7	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
90	20.5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
91	20.25	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
92	19.8	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
93	19.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
94	19.35	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	0	0	0	0	0	1	1	1	1	1	0	0	1	1	0	0	0
95	19.67	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	18.46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
97	17.6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
98	17.5	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	17.1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
100	16.93	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
101	16.8	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
102	16.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
103	15.9	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
104	15.3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
105	14.39	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	1	0	1	1	0	1	0	0	1	1	0	1	1
106	12.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
107	10.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Total No.		20	20	26	26	25	25	26	27	26	24	23	20	35	25	28	31	29	24	29	20	20	26	29	29	28	33	27	19	18	27	29	27	27	33

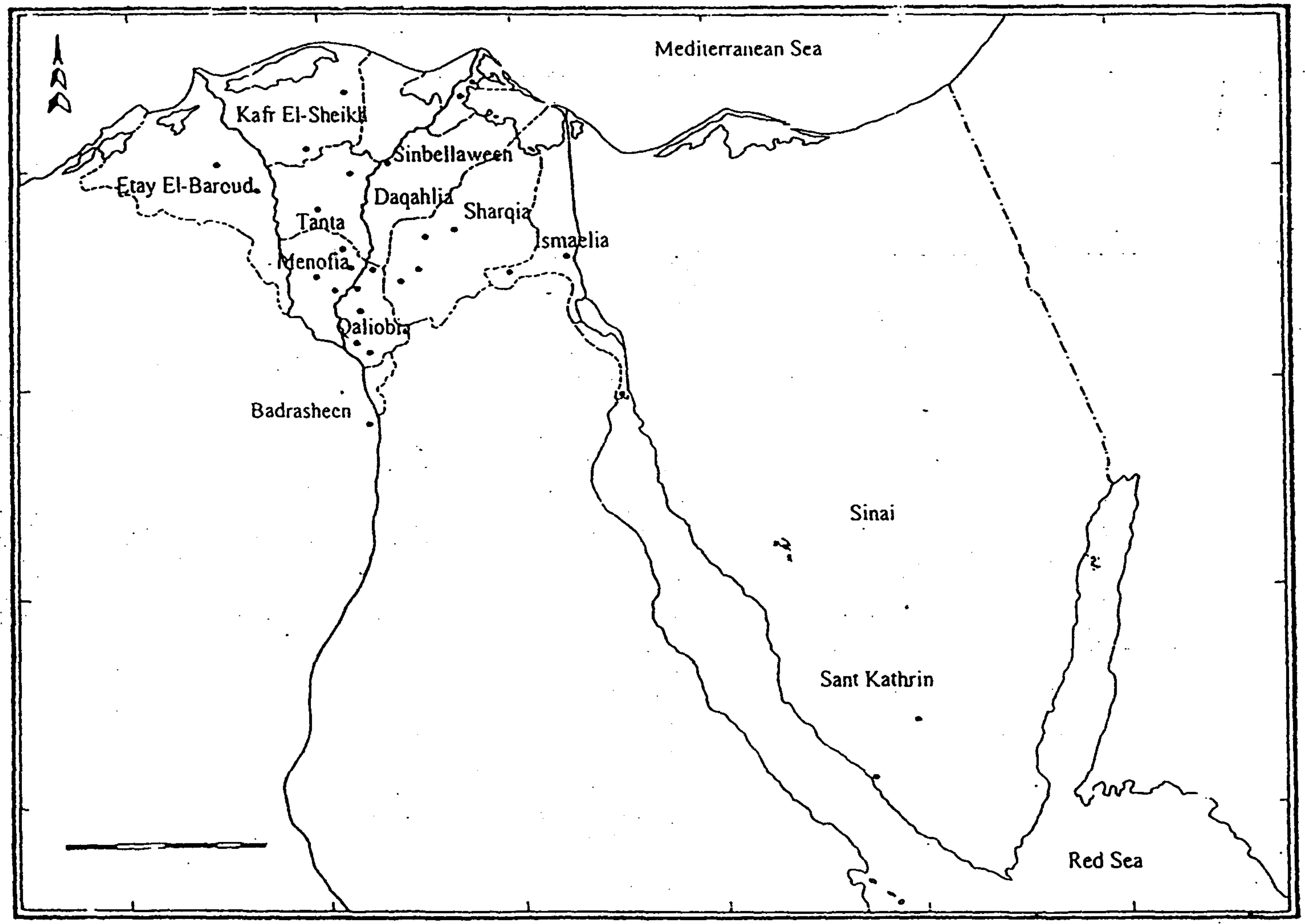

Fig. 1: Geographic distribution of different accessions of *Menth* spp

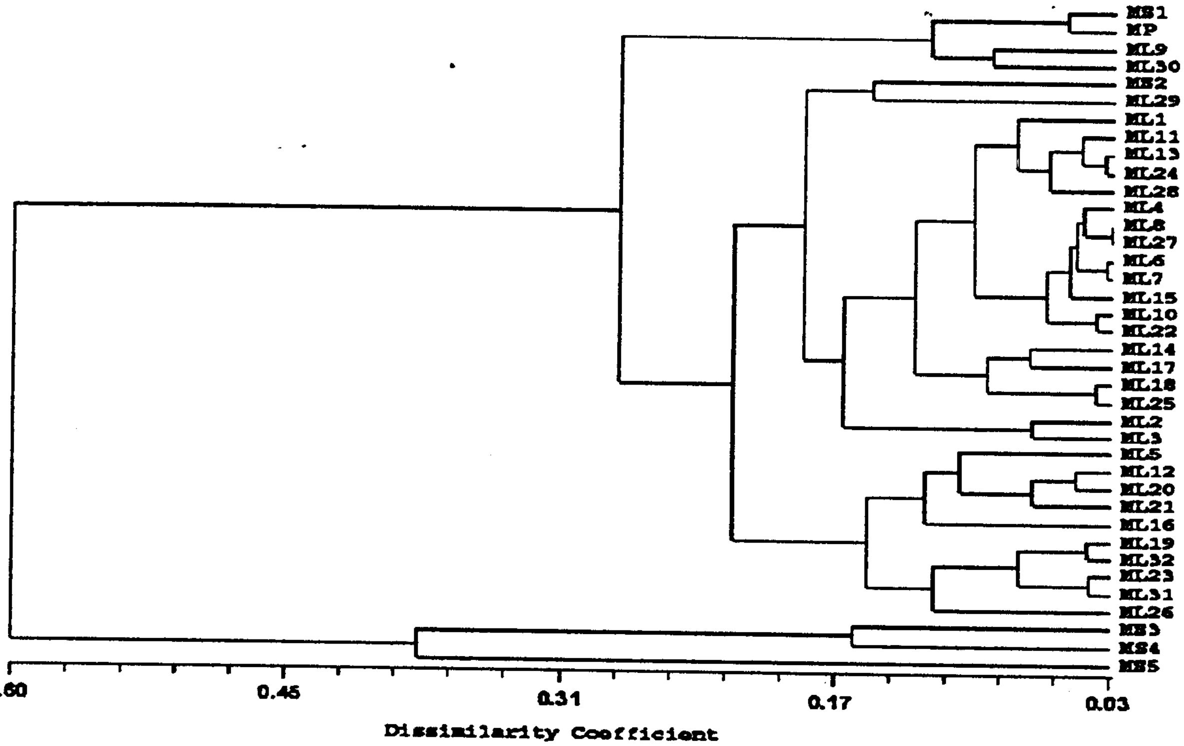

Fig. 2: The Phenogram based on the morphological data of *Mentha* spp.

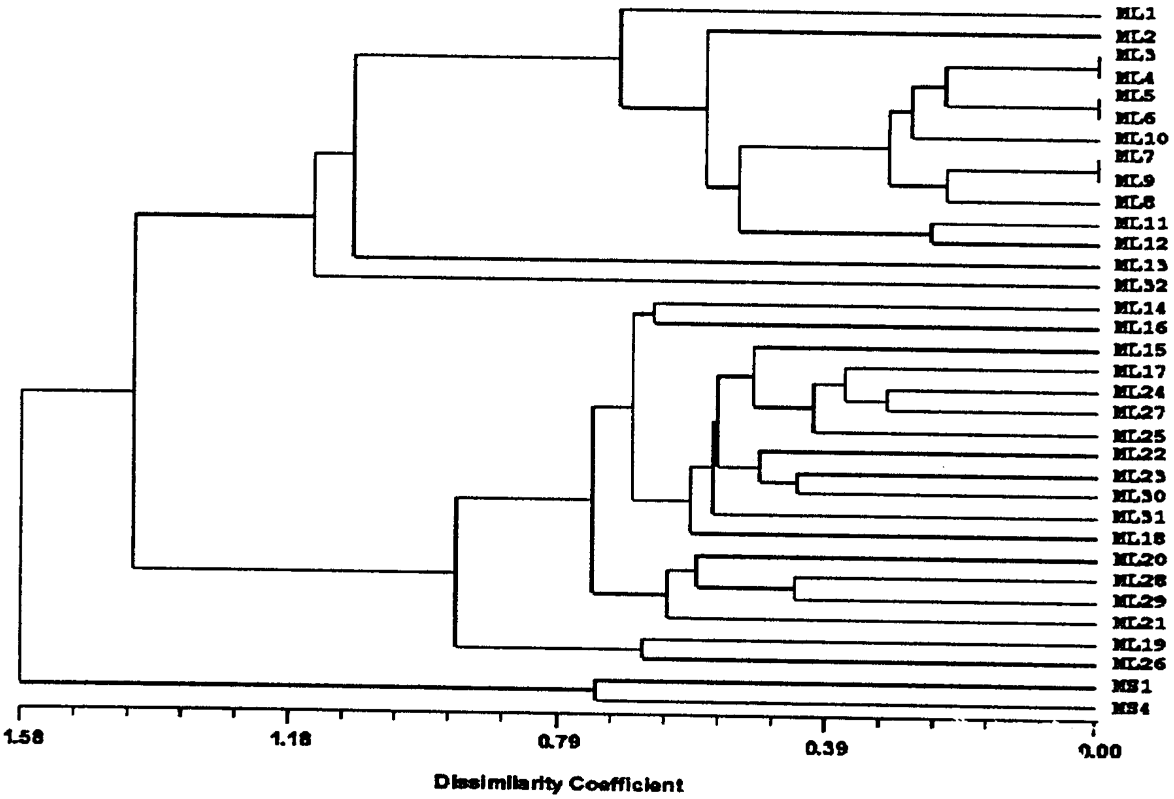

Fig. 3: The Phenogram based on the seed protein electrophoretic data of *Mentha* spp.

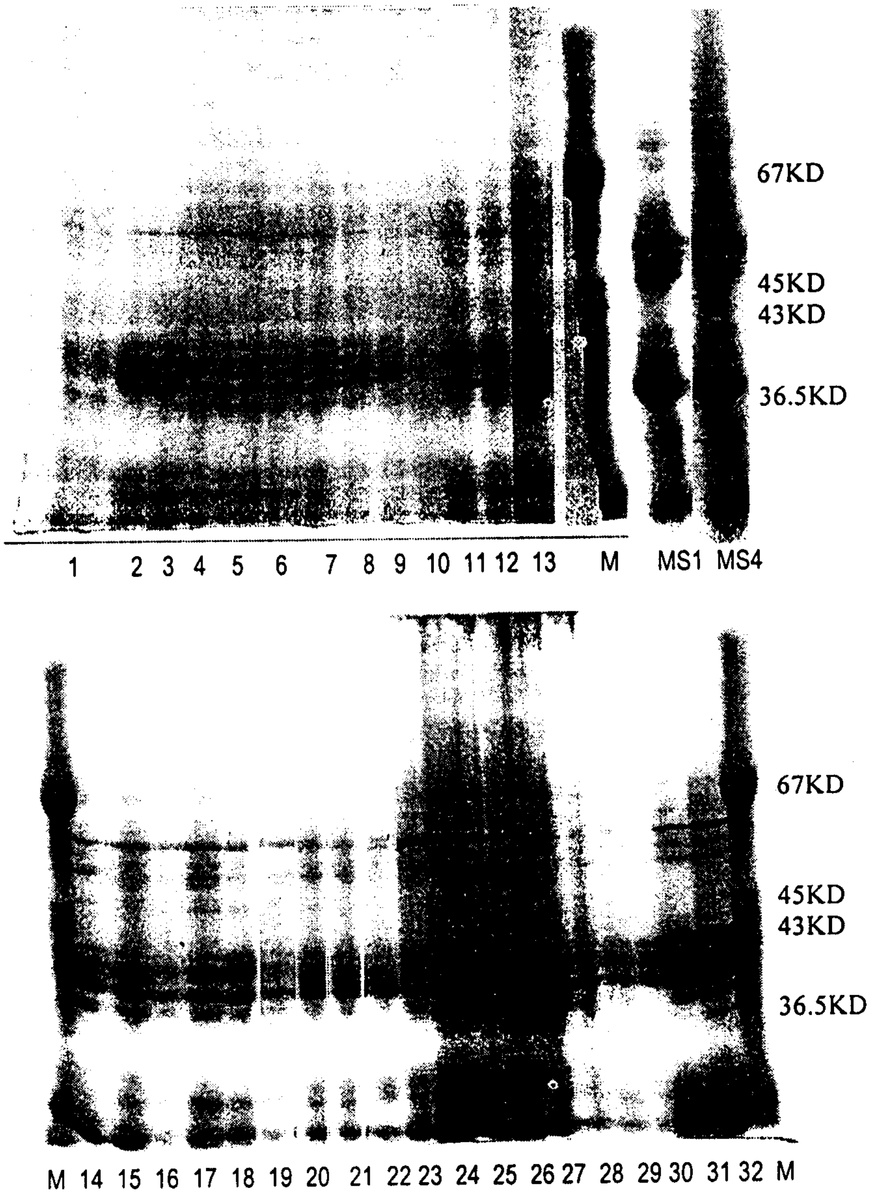

Fig.4: SDS-PAGE of total seed proteins of accessions of *M. longifolia* (1-32), and *M. spicata* (MS1, MS4)

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التنوع الوراثى بين عشائر نبات النعناع في مصر كما يعكسه التباين في الشكل الظاهري والتفريد الكهربي

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تم استخدام الصفات الظاهرية والتفريد الكهربي للبروتينات لدراسة التنوع الوراثى فيما بين المداخل لنبات النعناع التي جمعت من ثمان وثلاثين عشيرة موزعة في بيئات مختلفة في مصر، تم فحص الصفات الظاهرية لعينة من عشرة أفراد من كل عشيرة كما تم تفريد البروتينات المستخلصة من عينة بذرة مركبة لكل عشيرة بواسطة **SDS/PAGE** في وسط اختزالي . أظهرت التحليلات العنقودية للمعلومات التي تم الحصول عليها الدور القاطع للتغيرات البيئية وتأثيرها على كل من الصفات الظاهرية والتباينات الوراثية لنبات النعناع . كما أثير بعض الجدل فيما إذا كان النوع *Mentha longifolia* ممثلا في الفلورا المصرية باثنين أو ثلاثة تحت نوع .