Morphological, Ecological, and Genetic Characterization of the *Pleurotus eryngii* Species Complex in Israel

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The genus *Pleurotus* (Jacq.:Fr.) P.Kumm. (Pleurotaceae, higher Basidiomycetes) covers a group of ligninotrophic mushrooms that are edible and medicinal. Species of the genus *Pleurotus* are important mushrooms because of their ease of cultivation, their nutritional value, and their medicinal properties. Traditional medicine attributes medicinal properties to *Pleurotus* spp. Scientific evidence supports their importance as producers of substances with antibiotic, antitumor, anti-inflammatory, and hypo-cholesterolaemic activities. Scientists in many countries, including Israel, contribute to the research of the genus *Pleurotus.* The evolutionary connections of species in the genus *Pleurotus* are still not clear, and many taxonomic problems are still controversial. The geography plays an important role in the evolutionary studies of this genus, but the ecological/genetic perspectives of the genus have not been investigated satisfactorily.

The present study focuses on the taxonomic, ecological, distribution, and genetic characterization of this species complex in Israel. The objective of this study was to characterize the ecogeographical variation of *Pleurotus eryngii* species complex in Israeli populations. The morphology characterization of *P. eryngii* defined the exact geographical distribution of this species. The taxonomic study and the collection from the Sataf springs (Judea Mountains) described *P. eryngii* var. *tingitanus* Lewinsohn et al. (Lewinsohn et al., 2002, Mycotaxon LXXXI, pp. 51–67) as a new variety. The ecogeographical study indicates that Israeli populations are well adapted to the hot and dry climate and can tolerate extreme temperature and aridity conditions. This study also showed that heat stress can influence the growth rate of the isolates subsequently grown under optimal temperature conditions. The ecogeographical distribution and habitats of *P. eryngii* showed a high correlation between the coefficient of growth and the mean colony diameter growth rate.

Comparison with European genotypes showed that the Israeli genotypes are better adapted to hot and dry climates. Humidity and rainfall have a stronger effect on the adaptability of this complex to different environments (Lewinsohn et al., 2000, Mycological Research 104:1184–1190). The genetic study included random amplified polymorphic DNA polymerase chain reaction (RAPD-PCR), which was used to assess the genetic diversity in 12 populations (a total of 144 genotypes) of *P. eryngii* complex, sampled in Israel. Results show a higher level of diversity of RAPD polymorphism in *P. eryngii* populations especially in the drier, stressful climatic regimes. The 12 primers used in this study amplified 164 scorable RAPD loci, of which 163 (99.4%) were polymorphic and only one was monomorphic. Out of

the 164 loci, 123 (75%) varied significantly ($p < 0.05$) in allele frequencies among populations. This total proportion (75%) of significant polymorphic loci far exceeds the 5% level expected by chance (binomial test, $p < 0.000001$). The levels of polymorphism and gene diversity appeared to be significantly different between the populations. Sixty-eight percent of the RAPD diversity was within populations, and 32% was between populations. Interpopulation genetic distances showed positive association with geographic distance, which was confirmed with spatial autocorrelation analysis of RAPD frequencies.

Spearman rank correlation revealed a strong positive association between high polymorphism and the aridity index. In multiple regression, the coefficient of determination of polymorphism and gene diversity was explained by climatic variables linked to temperature and humidity ($R^2 = 53.6\%$, $p = 0.032$). These findings further demonstrate the validity of the "environmental theory of genetic diversity" hypothesis within *P. eryngii* populations in Israel. The results suggest that natural selection develops a high level of RAPD polymorphism as adaptation to stressful and temporally heterogeneous environments (Lewinsohn et al., 2001, Mycological Research 105(8):941–951).

In conclusion, these results showed great ecogeographical variation of *P. eryngii* species complex in Israeli populations, distributed along a transect of increasing aridity. These differences are reflected in morphological, genetic, and adaptive polymorphisms that can be used in the future to select varieties with commercial value for cultivation of this important fungus species.