Metabarcoding of European Complex Herbal Food Supplements

The Norwegian-Romanian collaborative research project PhytoAuthent applies DNA barcoding and metabarcoding to complex herbal food supplements with the objective of evaluating the efficacy and efficiency of barcoding as a novel authentication method for these products.

Recent studies in the field of DNA barcoding of herbal supplements have highlighted widespread species substitution, adulteration and the use of unlabeled fillers. These studies have also launched a discussion about the suitability of DNA barcoding for the authentication of herbal supplements.

Both the US FDA and European EMA support the use of innovative methods but have not issued specific instructions on the use of DNA barcoding for this purpose.

In Europe less is known about the fidelity of herbal food supplement labeling, but the status quo is presumably similar to that in the United States. Monitoring and authentication of herbals in Europe is further complicated as enforcement of national and European legislation differs from country to country. The highly competitive market for these products has increased the incentive for the use of fraudulent substitutes and unlabeled fillers.

Moreover, nearly unrestricted sale and access, limited medical oversight, failing enforcement of national and international regulations and insufficient monitoring of adverse drug reactions, all hamper quality monitoring of these products. Even though many have a long history of use, there are rising concerns over these products’ efficacy, safety and quality in the wake of recent cases exposing discrepancies between labeling and constituents.
The project covers all major aspects concerning herbal food supplements from the legal framework to manufacturing processes and suppliers, and from consumers to safety issues and authentication. The aim is to gather information and test, develop and apply innovative molecular analysis methodologies for plant identification in herbal products, in real life case scenarios and in cooperation with local stakeholders in the herbal pharmaceutical industry.

The project investigates five cases or complexes in which substitution has varying significance: replacement of Hypericum perforatum by other Hypericum species and of Veronica chamaedrys by other Veronica species, which in both cases are likely to yield a less effective product; replacement of the threatened and protected Gentiana lutea by the poisonous Veratrnum album, a substitution with potentially lethal effects; exchange substitution of Echinacea species depending on availability and price, which could lead to mislabeled products; and replacement of Dactylorhiza orchids that are both CITES-listed and protected in most countries by synthetic congelants, a case of fraudulent substitution whereby the product does not breach national and international legislation.

The herbal complexes have been carefully selected to test the efficacy of species-level discrimination using short barcodes of up to 400 base pairs on the Life Technologies Ion-Torrent PGM platform. The completed runs have used DNA extracted from complex mixtures using modified Fusion primers for nrITS1, nrITS2 and trnH-psbA for constituent DNA matching. At this stage we are focusing on the five cases mentioned above, but the goal is to develop high-throughput DNA barcoding for species-level identification and authentication of herbal supplements in the general case.

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