A Tripartite Approach to Biomolecule Analysis for the Identification of Chia Oil in Paintings and Lacquerware from New Spain (Mexico)

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The Spanish presence in Mexico from 1521 to 1821 brought unprecedented technical interactions to the region resulting in changes to indigenous art forms as well as introducing European painting materials and techniques. In many cases, colonial artworks mimicked European styles and combined them with local iconography and materials. Research of these artworks needs to expand its analytical scope to create new ways to uncover the wide variety of both expected and unexpected materials and to develop methods to identify them.

During the existence of the Viceroyalty of New Spain, a vibrant community of easel painters flourished in its capital, Mexico City. Recently discovered in archival documents, chia oil, extracted from the seeds of the *Salvia Hispanica* L. plant native to Central America, has been listed as a binder for pigments by well-known New Spanish painters. This has motivated us to undertake research to identify the binding media of paintings from the region and the implications of the use of non-traditional drying oils on their preservation and conservation. Current conservation treatments are based on European paintings made with linseed or walnut oil, and often do not consider the unique materials that may be present within non-European painted artworks. Furthermore, the motives informing an artist's choice of chia oil over imported linseed oil remain to be studied, but its use by painters has broad implications on the aesthetic, cultural, and economic dimensions of New Spanish artistic practice.

A tripartite scientific approach combining mass spectrometry for (1) proteomics and (2) lipidomics, and next generation sequencing for (3) DNA analysis was employed to target the biomolecules within plant oils to investigate chia oil. The Mesoamerican chia oil extraction technique is unrefined compared to modern oil processing and portions of the seed coat and mucilage, rich in genetic information, remain as impurities. Proteomics and DNA analysis can provide complimentary information on the plant species (linseed, chia), tissue type (seed coat, endosperm), and state of degradation (oxidation, cross-linking), all of which provide valuable insight on the nature of the oil used and its handling properties. Additionally, metagenomic DNA approaches can provide a bigger picture of an object's lifetime and environment: where has it been, who has handled it, how was it stored? While lipids do not directly contain genetic information, their concentration is highest in oils, facilitating analysis of micro-sized samples. Lipidomics data can provide information on degradation and cross-linking/curing of the binder, and lipid fingerprints can be correlated to plant species. Optimizing multiple methods is necessary to determine the best approach for characterizing drying oils in these complex samples. To begin, the tripartite approach has been developed using Mexican lacquer as a model system. Mexican lacquer is a pre-Hispanic technique used to coat gourds and wooden objects to create a lustrous surface, containing layers of pigmented chia oil. Following validation using lacquer known to contain chia oil, the methods will then be applied to investigate the potential use of chia oil in New Spanish paintings.