Modifying Vegetable Oil for Encaustic Painting

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Abstract
The work depicted in this article results from collaboration among lipid scientists and an artist. The collaboration started seven years ago when Barbara Walton, an art professor at Iowa State University (ISU) in Ames, USA, read a news story about soywax candles with clean-burning properties characterized by a lipid professor at ISU, Tong Wang.

Disciplines
Food Chemistry | Food Science | Human and Clinical Nutrition | Molecular, Genetic, and Biochemical Nutrition | Plant Sciences

Comments
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Linxing Yao, Barbara Walton, and Tong Wang

Encaustic painting, an ancient form of art, uses wax as the base medium. This art form has been experiencing a renaissance for the last 10–15 years, partly because of the availability of more effective equipment and encaustic art supplies. The fascination with the luminous and jewel-like quality of wax, as well as the exploration of contemporary encaustic painting techniques, continues to expand the field of encaustic painting.

Beeswax has been used as a painting medium since approximately 500 C.E. More recently, microcrystalline wax has also been used. Both waxes have excellent pliability, color compatibility, and the stability required by contemporary painters. The physical and textural property of the paint medium determines the technique and the support material to use. For example, beeswax should be applied to a rigid support, such as a wood panel; whereas, microcrystalline wax can be painted on a flexible support, such as canvas. Hydrogenated and structurally modified vegetable oil can provide an alternative to the short supply and/or high cost of beeswax and offer improved functionalities.

The researchers, led by Wang, developed a vegetable oil-based "wax" in which the triacylglycerol (TAG) structure was modified to

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FIG. 2. An encaustic painting of a soybean made using vegewax.

provide versatile textural properties similar to that of beeswax and microcrystalline wax. Walton tests the wax by heating, adding colorants to the medium, and applying it to a wood panel or canvas with various brushes and metal tools. The textural evaluation can be seen in Figure 1 on page 473.

Hardness is defined as the peak force in the penetration test. Brittleness is the difference between the peak force and the valley force in a compression test divided by the peak force as a percentage. Bars represent standard deviations. Different letters denote a significant difference at $p = 0.05$. MDWAX is a mixture of partial acylglycerides. Other waxes are based on MDWAX with various amounts of additives including dammar resin, fatty alcohol, free fatty acid (FFA), dihydroxy TAG (OHWAX), acetylated monoglycerides (AM). The detailed description of the composition of each wax can be found in the reference of Yao and Wang (2012).

Soywax, a partially hydrogenated soybean oil, cannot be directly used as a painting medium because of its hard and brittle texture, which results from the ordered TAG molecular packing. To change the crystalline pattern of fat molecules and enhance the cohesiveness of the wax, mixtures of lipid molecules with various structures are needed. To achieve this, the scientists modified the TAG structure by adding branches and hydrophilic groups on the acyl chains and also used shorter acyl chains. Their first-generation wax (G1), with modifications on the double bonds to produce dihydroxy TAG, has a greatly improved cohesiveness when compared with unmodified soywax. However, this material is too soft for painting. The second-generation wax (G2) is based on a mixture of mono- and diacylglycerols. These partial glycerides with lipid-based modifiers provide high melting points as well as excellent cohesiveness. The development of third-generation wax (G3) will ensure the long-term physical stability of the artwork (e.g., avoid fine lines of cracking). The G3 wax will have either shorter acyl chains or a molecular makeup similar to that of beeswax, to provide a glossy surface, high plasticity, and physical stability. Currently, Wang’s research group is developing a variety of vegewaxes that not only will allow the creation of high-quality artwork but may also be used in various coating applications.

Art exhibits and workshops have been given at ISU’s Brunner Art Museum and the Octagon Center for the Arts in Ames. The vegewax encaustic paintings (see Fig. 2) are currently on permanent display in the new Biorenewable Laboratory Building and the Center for Crops Utilization Research on the ISU campus.

The displays and conversation with the students and general public have created great interest and inspiration for green chemistry and innovations in art creation that may result from the interaction between art and science. You can visit a gallery of the paintings, available only in the digital edition. Log in to read at aoacs.org/login.

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