

PIGMENTS IN COTTONSEED OIL AND THEIR PROPERTIES

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Abstract: *Cottonseed oil (CSO) is an important edible oil and a by-product of cotton cultivation. Its affordability, high smoke point, and oxidative stability make it widely used for frying and food preparation. This review presents an analysis of cottonseed oil. Among the natural coloring components found in the oil, gossypol, carotenoids, chlorophyll, and various gossypol derivatives play a significant role. Gossypol, in particular, is a polyphenolic compound characteristic of cottonseed oil; beyond its color-forming properties, it is also notable for its biological activity and toxicological significance. Carotenoids contribute to the oil's yellow-orange hue, while chlorophyll is responsible for its green tint.*

Key words: *Cottonseed oil, free fatty acids, phospholipids, pigments*

Cottonseed oil extracted from cotton seeds is commonly used in cooking. The majority of impurities in untreated or crude cottonseed oil are gossypol, free fatty acids (FFAs), phospholipids, pigments and solids, so crude cottonseed oil appears black or dark brown in color. Carotenoids are present in oil-bearing raw materials and determine the color of the oil. The carotenoid content in solvent-extracted cottonseed oil can range from 0.225 to 0.301 mg/kg.

A reduction in the carotenoid content of the oil is observed during the alkali refining process. Colloidal particles in cottonseed oil, normally less than 1 μm in size, are in Brownian motion. The energy of this motion is sufficient to prevent particles from settling under gravity so that the particles may remain in suspension for a long period of time.

Chemical refining in batch or continuous operation mode is the most commonly used approach to refine vegetable oils [1], which involves degumming with acid and water to remove hydratable and non-hydratable phospholipids, vacuum drying, coagulating by caustic treatment, settling, water washing and steaming. In addition, coloring pigments from carotenoids are removed by bleaching earths, which are activated by heating with a strong acid [2], [3], [4], [5], [6].

In comparison to crude vegetable oils, it is more difficult to refine cottonseed oil because it contains gossypol, 2,2'-bis(formyl-1,6,7-trihydroxy-5-isopropyl-3-methylnaphthalene), which is a yellow pigment naturally present in various parts of cotton plants [7]. The numerous phenolic hydroxyl and aldehyde groups in the gossypol molecule are the key structural elements determining its physicochemical properties.

Phenolic -OH groups can participate in the formation of hydrogen bonds, while aldehyde groups have the ability to react with amines and other nucleophilic centers.

“Free” gossypol is a physiologically active form that is toxic to animals and humans. For the crude cottonseed oil to be cooking oil, gossypol in it must be either removed or deactivated to a minimum level. Normally, deactivation is carried out prior to oil extraction, but desired deactivation is not always attained. Structure modification or physical evaporation has been reported effective as a new supplemental method for gossypol deactivation [8], [9], but it is complicated and energy-consuming. Therefore, how to improve the efficiency of cottonseed oil refining remains a challenge in cottonseed oil industry. It is believed that flocculation with polymers has a great potential as a more effective approach to refine cottonseed oil compared to traditional processes, particularly when time and cost are taken into account.

According to flocculation mechanisms, polymeric flocculants destabilize suspension by compressing electrical double layers, neutralizing charges, adsorbing and subsequently forming particle–polymer–particle bridges. High removal efficiency can be achieved even with a small amount of polymeric flocculants, generating a small volume of sludge [10], [11].

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