Detection of Palm Oil in Vanaspati by Thin Layer Chromatography

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ABSTRACT

Palm oil (raw or refined), as such, or the unsaponifiable matter of palm oil and vanaspati (mostly hydrogenated soybean oil containing 5% sesame oil), when separated on a silver nitrate impregnated Silica Gel G plate or a Silica Gel G plate using (a) hexane/ether/acetic acid (80:20:1.5) or (b) chloroform, respectively, for development showed distinct differences. On the basis of this, two systems have been suggested for the detection of palm oil in vanaspati. About 5% adulteration can be detected by the first method and 10% by the second.

INTRODUCTION

The oil palm (*Elaeis guineensis*) (1), along with the coconut palm are two of the most important oils in the world. The oil palm fruit is unusual in that it yields two distinct oils. Palm kernel oil is obtained from the kernels and palm oil from the pulp. Palm oil is by far the more important of the two. Palm oil is isolated by various methods, including boiling the fruit, centrifugation and pressing. Because palm fruits are subject to strong enzymatic hydrolysis during harvesting and handling prior to expression of the oil, some palm oil may contain as high as 50% of free fatty acids (2). Even the better grades of palm oil contain a higher free fatty acid content than do most oils.

Palm oil is colored deep orange-red by the large amounts of carotene and lycopene (3). It has a pleasant, characteristic odor, is very stable to oxidation and has no drying properties. At room temperature, it is semisolid and has a melting point of 37 C or higher. It contains both saturated and unsaturated acids in approximately equal amounts (4-7). Good quality palm oil contains 500-800 ppm tocopherols (8).

The characteristic orange color of palm oil is removed by refining and bleaching, but a straw-yellow color remains even after several treatments.

Palm oil can be differentiated from other vegetable oils by its high melting point, high carotene and tocopherol contents. The physical appearance of palm oil and vanaspati are similar. Because of its cheaper price, palm oil is often found to be mixed with vanaspati (hydrogenated vegetable oil). No distinctive test exists for palm oil; thus it is difficult to distinguish it in admixture with vanaspati. There is a need, then, to establish a method for its identification in vanaspati when used as an adulterant. The color test (P. Sengupta, unpublished data) due to carotene for palm oil is not applicable in vanaspati, as the added vitamin A present in vanaspati interferes with the test. The melting point determination also fails, as the melting point of vanaspati ranges from 34-37 C and sometimes higher.

In this communication, a simple and rapid thin layer chromatographic (TLC) test is described which is suitable for the detection of as little as 5% palm oil when mixed in vanaspati.

MATERIALS AND METHODS

Preparation of the Sample

Refined, deodorized, bleached palm oil and vanaspati from authentic sources were collected and used throughout the experiment; both 5 and 10% portions of palm oil were mixed with vanaspati (w/w).

The chromogenic reagent was 1:1 *o*-phosphoric acid in water. Solvent systems were (a) *n*-hexane/ether/acetic acid (80:20:1.5) and (b) chloroform.

Isolation of Unsaponifiable Matter

Ten g of the samples (palm oil, vanaspati, 5 and 10% admixture of palm oil in vanaspati) were used to collect the unsaponifiable matter. The column chromatographic method described by Kundu et al. (9) was followed for the extraction of unsaponifiable fraction from the oil. The procedure involves saponification of the oil and elution of the unsaponifiable fraction through a mixed bed consisting of an upper layer of calcium oxide and lower layer of basic aluminum oxide using diethyl ether as the eluting solvent. The ether was then evaporated to dryness under vacuum and the residue was ready for chromatographic analysis.

Preparation of Plates

Silica Gel G plates were prepared according to Stahl (10). Silver nitrate impregnated Silica Gel G plates were prepared according to Galanoz et al. (11) as follows: 7.5 g of silver nitrate was dissolved in 60 ml of 3.5% of ammonium hydroxide followed by conc. ammonia until complete solubilization of residual silver hydroxide was obtained. This $AgNO_3$ solution was then used to make a slurry with Silica Gel G and the plates were coated as usual (thickness 300 μm). After a brief drying at room temperature, they were activated at 110 C for 1 hr and stored in desiccator.

Spotting and Development

To the silver nitrate impregnated Silica Gel G plate, a solution of 1% oil in chloroform was spotted (i.e., palm oil, vanaspati and their mixtures) and developed using solvent system a in an ascending manner. After development to 10-12 cm, the plate was taken from the chamber and sprayed with 1:1 phosphoric acid reagent in water and heated at 120 C for 5-10 min. The components appeared as gray spots (Fig. 1).

To the Silica Gel G plate, a chloroform solution of nonsaponifiable fractions of palm oil, vanaspati and their mixtures were spotted and developed in solvent system b and sprayed with the phosphoric acid reagent. After spraying, the plates were carefully heated at 90-100 C until the spots appeared. A blue spot characteristic to palm oil was identified along with the other spots (Fig. 2).

RESULTS AND DISCUSSION

The patterns of separation obtained from the oil as such on silver nitrate plate and from unsaponifiable matter of palm oil, vanaspati and their mixtures at different concentrations are shown in Figures 1 and 2. In Figure 1, the number of spots is more in palm oil than that of vanaspati. Five percent palm oil in vanaspati could be differentiated by this method.

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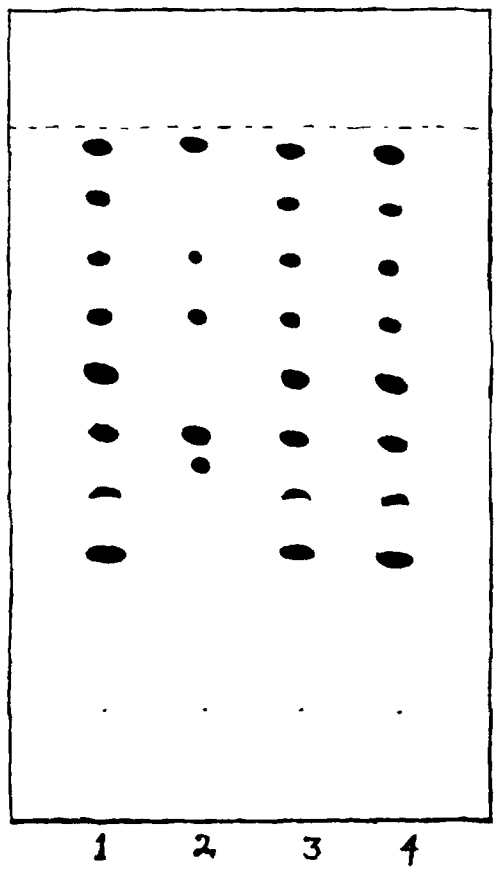

FIG. 1. Chromatogram showing the separation of (1) palm oil, (2) vanaspati, (3) 5% palm oil in vanaspati, (4) 10% palm oil in vanaspati on silver nitrate impregnated Silica Gel G plate using solvent system *n*-hexane/ether/acetic acid (80:20:1.5).

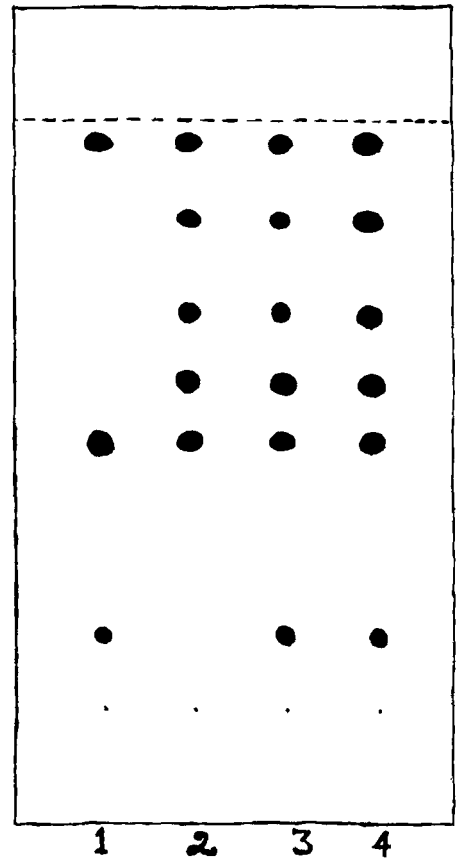

FIG. 2. Chromatogram showing the separation of unsaponifiable matter of (1) palm oil, (2) vanaspati, (3) 5% palm oil in vanaspati and (4) 10% palm oil in vanaspati on Silica Gel G plate using chloroform as eluent.

In the second solvent system, palm oil gave a distinct blue spot along with other spots which was absent in vanaspati (Fig. 2). This blue spot is perhaps due to a sterol present in palm oil which is confirmed by the Liebermann-Burchard test (12,13). It was reported that the sterol content of palm oil is as low as 0.03% of the oil (14,15). Alkali refining of oils reduces their sterol contents (16,17) which may be further reduced during deodorization (18). In our study, the detectable amount of sterol was found in refined and bleached oil by TLC of the unsaponifiable fraction which easily assists in the detection of adulteration up to the 10% level. Both systems described for the detection of palm oil in vanaspati are reliable, but the first system is simpler and faster, and adulteration of palm oil at a level of 5% may be easily detected by this method.

System b is time-consuming, as the preparation of unsaponifiable matter is tedious and lengthy and, further, in case of 5% adulteration it sometimes fails to yield the particular blue spot with some varieties of double-refined, deodorized palm oil.

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