

Technical Note

Determination of Trace Metals in Cottonseed Oil and Hydrogenated Cottonseed Oil

ABSTRACT

The main vegetable oils used in Egypt are cottonseed oil and hydrogenated cottonseed oil; these are used as salad oil and for cooking. Determination of trace heavy metals in the oils is important. This is because of the association of trace metals with the origin of the oils, metal processing equipment and catalysts used for hydrogenation, and toxicity of edible oils, and because of the effect of trace metals on the characteristics, such as colour and taste, of finished products.

Iron, copper, aluminium and magnesium were found in the cottonseed oil. These metals were also found in the hydrogenated cottonseed oil, together with lead, silver and calcium. The amounts of metals were below the limits permitted by public health and safety regulations.

INTRODUCTION

Interest in the occurrence of traces of heavy metals in oils and fats has increased in recent years. This interest derives from the association of trace metals with the origin of oils (soils and fertilizers), metal processing equipment and catalysts used for hydrogenation, the toxicity of edible oils and fats and the effect of trace metals on the characteristics of finished products such as colour and taste.

Alkali refining and adsorption bleaching appear to remove heavy metals from oils. On the other hand, catalytic hardening seems to introduce new metallic contaminants.

Exact determination of traces of metals is a major step in evaluating and testing oils and fats, especially edible grades. It is very important to determine cumulative poisons, such as lead, and probably silver, contaminants promoting rancidity, such as copper, trace metals affecting taste (copper and iron) and metal building up in kidney (tin) (Grove, 1971).

With the advent of atomic absorption spectrophotometry, analysis of fats and oils for trace metals has been greatly simplified (Cowley, 1978). Wet ashing of the oil is highly sensitive for the detection of metals (Farhan & Pazandeh, 1976).

The present study was carried out to determine the trace metals in cottonseed oil and hydrogenated cottonseed oil.

MATERIALS AND METHODS

Samples of cottonseed oil and hydrogenated cottonseed oil were obtained from the plants of three vegetable oil companies in the Alexandria region of Egypt.

The experiments were in triplicate. The samples were taken to dryness in concentrated H_2SO_4 , charred at 480°C until carbon free and the residue taken up in 10% HNO_3 before being taken to dryness again. The final residue was dissolved in (warm) 20% HCl and filtered prior to the metal analysis, which was by atomic absorption spectroscopy using a Varian Techtron Model 1100.

RESULTS AND DISCUSSION

Limits of tolerance for various heavy metals in vegetable oils and their products have been set by various governmental regulations. Limits of 0.1 ppm for lead and copper, and 0.05 ppm for mercury, have been established for most countries in the Middle East. The main vegetable oil in Egypt is cottonseed oil and hydrogenated cottonseed oil, used as a salad oil and for cooking and frying. Table 1 shows the trace heavy metals in these products. The concentrations of heavy metals were below the range permitted by regulations and for public health safety. Fortunately, no mercury or tin was found in any sample. The excess trace metals in

TABLE 1
Determination of Trace Metals of Cottonseed Oil and Hydrogenated Cottonseed Oil (ppm)

Sample	Fe	Cu	Ni	Pb	Ag	Al	Mg	Ca
<i>Cottonseed oil</i>								
Plant 1	1.2	0.08	—	—	—	0.9	1.0	—
Plant 2	1.4	0.09	—	—	—	0.9	1.2	—
Plant 3	1.6	0.01	—	—	—	1.1	1.3	—
<i>Hydrogenated cottonseed oil</i>								
Plant 1	1.4	0.07	0.8	0.04	0.02	1.1	1.0	1.0
Plant 2	1.3	0.06	0.8	0.06	0.02	1.0	1.4	0.6
Plant 3	1.5	0.08	0.8	0.06	0.02	1.1	1.2	1.0

hydrogenated oils came from the hydrogenation catalyst, where the compound nickel formate was used.

Farhan & Pazandeh (1976), in Iran, determined trace heavy metals in Iranian shortening; they found iron, 1.0 ppm; copper, 0.07 ppm; lead, 0.08 ppm; silver, 0.03 ppm; aluminium, 1.0 ppm and calcium, 1.0 ppm. Tsai *et al.* (1978), in Taiwan, determined trace heavy metals in soybean oil; they found iron, 2.5 ppm; copper, 0.02 ppm and lead, 0.01 ppm.

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