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FATTY ACID COMPOSITION OF THE OIL OF SUNFLOWER SEEDS CULTIVATED IN PAKISTAN

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Abstract. Experimental cultivation of the "Peredovik" variety of sunflower has been started in Pakistan. The fatty acid composition of the oil obtained from the kernel of these cultivated sunflower seeds as determined by GLC is myristic (1.5%), palmitic (11.5%), stearic (traces), oleic (55.0%) and linoleic(32.0%) acids.

Introduction

In Pakistan the consumption of vegetable oils has been increasing at a steady rate of about 15% per annum during the last ten years. This demand has invariably been met by imports as the local production has lagged behind for various reasons. For the year 1977-78 alone 2,70,000 tons of edible oil were imported in Pakistan.[1]

The traditional oil seed crops of Pakistan are cotton and such cultivated varieties of Crucifereae such *Brassica compestris* ('sarson'), *Brassica juncia* ("toria" or "raya"), *Eruca sativa* ("taramira"), commonly called the rape and mustard seeds, while sesame, linseed and ground-nuts are grown only on a limited scale and for specific purposes.

Realizing the significance of the shortage of oils and fats in the country, the agriculture sector has adopted a number of measures to minimize it. Increasing the yield of existing and introducing better yielding and new crops are some of the steps in this direction. Experimental cultivation of sunflower and saffiower has, however, been started in recent years as the potential oil seed crops of the future.

Cultivation of sunflower (locally known as "suraj mukhi", N. O. Compositeae) as an oil crop was first started by the USSR after developing hybrids belonging to *Helianthus annus* species,[2] and it is now also commercially grown in other countries like the USA, Argentina, Turkey, Romania and Bulgaria. As a result of subsequent developments both in the USSR and USA, there now are available such hybrids as yield 60% of an oil compared to the original 25% yielding variety.[3-5] Sunflower is thus becoming a promising oil seed crop and world-wide efforts are being made to develop still better yielding varieties because the fatty acid composition of its oil is rather attractive for edible purposes. Sunflower is unusual in that its fatty acids profile is dependent upon the temperature during seed development. Oil produced in cooler climates is linoleic acid rich while the one produced in warmer climates has more oleic acid in it.[6-9] Sunflower oil should thus be considered as a specific oil for particular use and application.

Sunflower seeds of the "Peredovik" variety were experimentally grown at the Punjab Agriculture Research Institute, Faisalabad to obtain an yield of 480-600 kg per acre.

An yield of 680-1012 kg per acre for the same variety is reported when grown in the USA.[10] The present study reports the fatty acid composition of the oil obtained from sunflower seeds grown at the Faisalabad Institute. The oil yield was determined to be 50% for decorticated seeds and the percentage composition of its constituent fatty acids like myristic (1.5%), palmitic, (11.5%), stearic (traces), oleic (55.0%) and linoleic (39.0%).

Materials and Methods

1. *Extraction and characterization of the oil.* Decorticated sunflower seeds (5 g) of the "Peredovik" variety grown at Faisalabad were crushed and extracted in a Soxhlet apparatus with hexane. The extracts were dried over sodium sulphate and then filtered. The solvent was removed from the filtrates and the residual yellow coloured oil (2.5 g, 50%) was stored under nitrogen.

2. *Saponification of the oil, liberation and methylation of the fatty acids.* The oil (1 g.) was saponified with 0.5N ethanolic potassium hydroxide solution (13 c.c.) under reflux for ½ hr. The fatty acids were liberated from the saponified mass by heating with 2N sulphuric acid.[12] The liberated acids were converted to their methyl esters by reacting with methanol in the presence of concentrated sulphuric acid.[13]

3. *Spectrophotometry and chromatography of methyloted acids.*

(*i*) Thin layer Chromatogryyhy : Glass plates (20 cm × 20 cm) were thoroughly cleaned and dried. A slurry of silica gel (30 g) was prepared with distilled water (45 c.c.). Thin-layer chromatograms of 0.25 mm thickness were prepared using a quick-fit TLC apparatus and then activated by heating at 105° for 60 min.[14] Methyl esters of the acids (100 mg) were dissolved in ether and loaded evenly on chromatograms which were developed with ether-hexane solvent system in the ratio of 1 : 9 in a glass tank lined with filter paper. A solution of 2,7 dichlorofluorescein (200 mg) in Analar methanol (100 c.c.[3]) was used as locating reagent. Purple yellow coloured bands were easily visible when examined under uv light at 254 mμ.

Purified bands of methylated acids were scratched out and the material from silica gel was eluted by using ether as a solvent. After removal of the solvent, pure methyl esters of the fatty acids were obtained.

(*ii*) Infrared spectrophotometry : The purity of the methylated fatty acids was further checked by qualitative thin layer chromatography and with infrated spectrophotometer (Becman-IR Model 5A) at 1380 cm^{-1} (CH_3 *bend*) 1460 cm^{-1} (CH_2 bend) 2860 cm^{-1} (CH_3 stretch), 2940 cm^{-1} (CH_2 stretch) and 1760 cm^{-1} (C=D stretch).

(*iii*) Gas liquid chromatography : The purified methyl esters were identified on a gas liquid chromatogram (phase separation, LC 2F Model) by using a column (9 ft × 1/8″) of polyethylene glycol succinate (PEGS, 10%) on a gas chrome Z (80-100 mesh) support with nitrogen as the carrier gas at a rate of 40 ml/minute at 180°.

Results and Discussion

The oil under study was obtained from the decorticated sunflower seeds of the 'Peredovik' variety. This variety of sunflower is being propagated at the Punjab Agriculture Research Institute, Faisalabad with a view to developing a new oil seed crop suitable to the climatic conditions of Pakistan. Various characteristics of this oil as determined by standard physico-chemical methods are given in Table 1.

TABLE 1. PHYSICO-CHEMICAL CHARACTERISTICS OF OIL FROM OF SUNFLOWER SEED KERNELS.

1.	Refractive Index at 40°	1.4780
2.	Iodine Number	116
3.	Saponification Number	190
4.	Non-saponifiable matter (percentage)	0.54
5.	Acid Value (percentage)	12.75

It is reported that sunflower seed oil contains (1.5%) unsaponifiable matter[15] whereas in the present studies it has been found to be only 0.5%. This is explainable by the fact that the oil was extracted from decorticated seeds. The hulls have a wax coating which gets extracted when the whole seed is extracted. On saponification this wax is degraded and higher alcohols are liberated. These alcohols are then extracted in the unsaponifiable matter and thus raise its percentage.

The fatty acid composition of the oil is given in Table 2. It will be noticed that the oil under study has a higher oleic acid content (55%). Literature survey reveals that variable oleic and linoleic acid contents in sunflower oil have been encountered. The variation for oleic is from 13.9-60% and for linoleic it is from 29.9-76.4%.[7-10] This variation is explained on the basis of climatic conditions in which the crop grows. As was stated in the introduction, sunflowers grown in warmer climates have higher oleic acid contents in their oil. Faisalabad being a warmer place, the percentage of oleic is higher than linoleic acid in the oil obtained from the seeds grown at Faisalabad.

TABLE 2. FATTY ACID COMPOSITION OF THE SUNFLOWER SEED KERNEL OIL

No.	Methyl esters	Percentage
1.	Myristic	1.5
2.	Palmitic	11.5
3.	Stearic	Traces
4.	Oleic	55.0
5.	Linoleic	32.0

The low saturated acid content, palmitic acid (11.5%) and stearic acid (traces), and the absence of linoleic acid in the oil make it ideal not only for nutritive purposes but also for storage.[16]

Crude sunflower oil is yellow in colour and attains a light yellow to pale appearance when refined. The oil has a relatively lower level of natural anti-oxidants[17] and always contains wax esters which have their origin in the hull fraction. Whenever the oil is extracted from seeds instead of the kernel, it gives cloud formation when chilled.[18, 19] It is probably because of the wax esters that this cloud formation occurs in chilled sunflower oil.

In case sunflower becomes a commercial oilseed crop, and depending upon climatic conditions, a good-quality edible oil can become available in the country. It will be noticed that an oil of varying oleic acid-linoleic acid ratio can be obtained from the same crop when grown at different places and for specific utilization.

In view of the excellent oil yield (50%), comparable with the earlier reports,[3-5] and the presence of higher content of essential fatty acids in it, sunflower presents itself as a premium oil seed crop for Pakistan.

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