

FATTY ACIDS OF INDIGENOUS RESOURCES FOR POSSIBLE INDUSTRIAL APPLICATIONS

Part XVI. Fatty Acid Composition of the Seed Oils of *Citrus limon* Var. Lemon and *Citrus aurantifolia* Var. Khagzi Nimbu

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The physico-chemical evaluation of the seed oils of the local varieties of *Citrus limon* var. Lemon and *Citrus aurantifolia* var. Khagzi Nimbu was carried out. The yield of seed oil from the two varieties was 31.2% and 33.7% respectively. The gas chromatographic analysis of the methyl fatty esters derived from the two seed oils revealed the presence of C_{10:0} (0.8%, 0.9%), C_{12:0} (0.3%, 0.8%), C_{14:0} (0.5%, —), C_{16:0} (20.9%, 26.3%), C_{18:0} (7.8%, 6.1%), C_{18:1} (27.8%, 23.0%), C_{18:2} (34.8%, 24.4%), C_{18:3} (5.7%, 11.5%) and C_{20:0} (1.0%, 6.8%) respectively.

Key words: Seed oils, N.O. Rutaceae, *Citrus limon* var. Lemon, *Citrus aurantifolia* var. Khagzi Nimbu.

INTRODUCTION

Citrus limon var. Lemon and *Citrus aurantifolia* var. Khagzi Nimbu (N.O. Rutaceae) are commercially important fruit crops of Pakistan. The fruits are being processed into juice in the country on a limited scale for the production of squashes. The major portion of the fruits are consumed for 'Acidic squeeze' to flavour foods and beverages and for making pickles. During juice extraction some of the seeds get crushed which release seed oil in the juice. This oil adds bitterness to the juice and can also become a source of rancidity of the juice, if it contains large amounts of unsaturated fatty acids. A knowledge of the composition of the seed oils of these fruits is therefore essential to the citrus processing industry.

Extensive studies [1] have been carried out on the fatty acid composition of the seed oils of various citrus fruits. Many seed oils of indigenous varieties have also been analysed [2] for their physico-chemical values and fatty acid composition but the seed oils of commercially important local varieties including *C. limon* var. Lemon and *C. aurantifolia* var. Khagzi Nimbu have not so far been investigated. This communication describes the fatty acid composition of the seed oils of these two varieties of citrus fruits as part of our earlier studies [2,3].

EXPERIMENTAL

Fresh and mature lemon and lime fruits were purchased from the local market. The fruits were cut into small pieces and their seeds were hand picked. The seeds were washed thoroughly with water and dried under shade. The

dry seeds were crushed coarsely and then subjected to solvent extraction with hexane using a soxhlet apparatus. The solvent was removed under vacuum on a rotary evaporator to obtain pale yellow oils as residues. The physical and chemical values of the oils were determined according to standard procedures [4].

Fatty acid methyl esters. Weighed amounts of the oils (1.0g each) were placed in separate flasks fitted with condensers and 0.5M methanolic potassium hydroxide (17ml) was added to each. The mixture was refluxed for about ten minutes to complete the saponification. Esterification of the free acids was carried out with methanol in the presence of catalytic amount of BF₃-methanol complex according to the procedure of Solomon *et. al.* [5].

Gas chromatographic analysis. The methyl ester fractions were analysed for the determination of fatty acid composition of the oils by gas chromatography using a 1.5m x 4mm packed with 10% DEGS on celite (80-100 mesh). The glc operating conditions were: column temperature 210^o, injection port temperature 240^o, FID temperature 250^o and nitrogen carrier gas flow 40 ml/min. Identification of the fatty acids was carried out by comparing the retention time of the various peaks in the mixture of fatty acid esters of the oils with standard methyl esters and confirmation was made by the co-injection technique.

RESULTS AND DISCUSSION

Both the fruits reach maturity during the same period of the year (July to September) but limes reach the market

Table 1. Physico-chemical properties of the seed oils of *C. limon* and *C. aurantifolia*.

	<i>C. limon</i>	<i>C. aurantifolia</i>
Yield of oil	31.2%	33.7%
Colour	Light yellow	Yellow
Refractive index	1.4662	1.4724
Specify gravity	0.8905	0.8946
Saponification value	231.7	272.3
Free fatty acids	1.06	10.2
Unsaturated fatty acids	68.3%	58.9%
Saturated fatty acids	31.3%	40.9%

Table 2. Fatty acid composition of seed oils of *C. limon* and *C. aurantifolia*

Fatty acid	C _{10:0}	C _{12:0}	C _{14:0}	C _{16:0}	C _{18:0}	C _{18:1}	C _{18:2}	C _{18:3}	C _{20:0}
<i>C. limon</i>	0.8	0.3	0.5	20.9	7.8	27.8	34.8	5.7	1.0
<i>C. aurantifolia</i>	0.9	0.8	—	26.3	6.1	23.0	24.4	11.5	6.8

a little earlier than lemons. The juice of both the varieties is acidic but lime juice has higher levels of acidity than that of lemon juice.

The physico-chemical values of fixed oils from seeds of both the varieties of fruits compare well with good quality vegetable oils [6]. The yield of oils on the basis of dry seeds of lemon and lime when extracted by hexane in a soxhlet apparatus was found to be 31.2% and 33.7% respectively. The refractive indices, specific gravity, free fatty acids and saponification values as determined by standard methods (Table 1) resembled with those of other citrus seed oils except for the lime seed oil which had high FFA (10.2%) value.

The gas chromatographic data obtained by running the methyl fatty esters of these oils on 10% DEGS column showed that unsaturated acids dominated the fatty acid profile of both the oils (Table 1 and 2). Oleic acid (27.8%, 23.0%) and linoleic acid (34.8%, 24.4%) were the major acids occurring in the oils followed by linolenic acid (5.7%, 11.5%) respectively. This acid has not been found in the previous studies [1] to the extent (11.5) in lime seed oil as it has been shown in the present studies. The major saturated fatty acid was palmitic acid which occurred up to 20.9% in lemon and 26.3% in lime seed oils. Another

departure from the earlier studies was the presence of arachidic acid (6.8%). Until this present study arachidic acid has not been found in amounts greater than 0.5% in *Citrus* seed oils.

From the physico-chemical properties and gas chromatographic analysis it can be concluded that the two seed oils can be classed as moderately unsaturated oils and consequently after refining could be used for edible purposes. The presence of large amounts of linoleic and linolenic acid in the oils will have deleterious effects in the storage quality of the juices of these fruits. It is recommended that juice manufacturers be fastidious in their seed removal to prevent the potential storage problems.

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