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THE FATTY ACID COMPOSITION OF SEED OILS OF *CITRUS SINENSIS* VARIETIES: *VALENCIA* AND *SALUSTIANA*

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The percentage yield and chemical composition of fixed oil of *Citrus sinensis* varieties Valencia and Salustiana have been studied. The percentage yield of fixed oils from the seeds of these two varieties were 40.01 and 36.66% respectively. The percentage fatty acids composition of the respective oils were characterised as C_{12} (1.55, 0.0), C_{14}(5.04, 0.0), C_{16}(47.33, 29.13), $C_{18:0}$(7.50, 4.23), $C_{18:1}$(18.40, 26.03),$C_{18:2}$(18.39, 37.51) and $C_{18:3}$(0.0, 3.07) respectively. This chemical composition suggests that the oils, when available in quantity can find application both for edible or soap making purposes.

Key words: Fatty acid, *Citrus sinensis*, Seed oils.

Introduction

Citrus sinensis (Rutaceae) is the major fruit crop among citrus species which includes all the oranges or reddish fruit varieties of the orange itself (Mumtaz 1986). Only a few *Citrus sinensis* varieties are grown in Pakistan. Among them better known and largely grown *C. sinensis* var. *valencia* and *salustiana* have been selected for study of their seed oils. *Citrus sinensis* fruits are fairly difficult to cultivate satisfactorily as they are very sensitive to atmospheric conditions and require a warm / temperate or subtropical climate. They cannot tolerate dry winds, cold driving rain or intense late frosts. Although the production of citrus seed oils is of minor importance, yet it is a non conventional source of oil in some citrus growing countries where citrus fruit is processed in large quantities for juices and jams. The citrus seed oils can be used for edible purposes as well as for soap and cosmetic preparations. Extensive studies (Kefford and Caudler 1970) have been carried out on the fatty acid composition of the seed oils of various citrus fruits. Many seed oils of indigeneous varieties have been analysed (Saleem *et al* 1977), but the fatty acid composition of seed oils of *Citrus sinensis* var. *valencia* and *salustiana* have not been reported earlier. The present report thus describes the fatty acid composition of seeds of these varieties as part of a programme to explore the indigenous and non conventional sources of vegetable oils (Saleem *et al* 1977; Sattar *et al* 1987a & b, 1988, 1991).

Experimental

Selection of seeds. Fresh, mature and virus free fruits of varieties *valencia* and *salustiana* were collected from Horticulture Research Institute, Sahiwal. The fruits were cut out in halves and seeds were transfered into petri-dishes. The seeds were then washed with distilled water and dried in the shade.

Extraction of oil. The seeds of the two varieties (*valencia* and *Salustiana*) were ground to a fine powder and extracted with distilled hexane in a Soxhlet apparatus for 12 h (Swern and Baily 1964). The hexane extracts were dried over anhydrous sodium sulphate and after removal of solvent produced a pale yellow oil. The yield of the oils of both varieties were noted as 40.01 and 36.66 respectively.

Examination of the oils. The physical and chemical properties of the oils were determined according to standard procedures. (Swern and Baily 1964) and are reported in Table 1.

Preparation of methyl esters of fatty acids of oils. About 1.0 g of oil was placed in a teflon test tube. 10 ml/0.5 N methanolic potassium hydroxide was added to each samples. The mixture was refluxed until the globules of oil went into solution (about 90 min) . Sulphuric acid (2N) was added to the

Table 1
Physico - chemical properties of *valencia* and *salustiana* seed oils

Properties	*valencia* seed oil	*salustiana* seed oil
Yield (%)	40.01	36.66
Colour	yellow	yellow
Refractive index	1.4642	1.4637
Specific gravity	0.8912	0.8898
Acid value	0.7942	0.8386
Saponification value	179	182
Free fatty acid	0.392	0.4218

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cooled mixture to liberate the fatty acids. Esterification of the liberated fatty acids was carried out in the presence of a catalytic amount of methanol BF_3 reagent (about 10 ml) and boiled for about 20 min. The esterified mixture was cooled and extracted with hot hexane. Separated hexane layers were washed with water and dried over sodium sulphate (Solomon *et al* 1974).

Determination of methyl esters of fatty acids by gas chromatography. The fatty acids composition of the oils was determined by gas liquid chromatography using a column (4 mm dia x 1.5 mm long), packed with celite coated with 10 % DEGS. The GLC operating conditions were, column temperature 200° C, FID temperature 250°C/carrier gas nitrogen, flow rate 40 ml min^{-1} (Mumtaz 1986) .The determined percentage fatty acid composition is given in Table 2.

Results and Discussion

The seeds of the *Citrus sinensis* var. *valencia* and *salustiana* were found to be valuable non-conventional source of fixed oils. In order to evaluate the oil with respect to their suitability both for industrial and edible purposes, the oils were subjected to physico-chemical characterisation and the determination of chemical composition. The percentage yield of oil from dry seeds of *valencia* and *salustiana* were 40.01 and 36.66 respectively. The physico- chemical constants and chemical composition of the oils are reported in Tables 1 and 2.

Saponification values of oils indicate that the mean molecular weight of the combined fatty acids is normal and thus showing the presence of C_{16} and C_{18} fatty acids. The physico-chemical characteristics of the oils from the two varieties (as listed in Table 1) are also normal and do not show any rancidity. Because of this property, the extracted oils can be used for edible purposes.

The chemical compositions of the oils were determined by GLC of the methyl esters of fatty acids. Apart from the solvent peak, the chromatograms of methyl esters of the species indicated the presence of lauric, myristic, palmitic, stearic, oleic, linoleic, and linolenic acids respectively in varying concentrations. The presence of these acids was further confirmed by running standard mixtures under the same set of conditions and comparing the chromatograms.. The *valencia* seed oil contained higher saturated fatty acids(61 %) as compared to *salustiana* seed oil (33.13%) which had more of unsaturated fatty acid (56.03%). *Valencia* seed oil contained palmitic acid (47.33%), stearic acid (7.50%), oleic acid (18.40 %) and linoleic acid (18.39%) as the major fatty acids and less amount of myristic (1.55 %), palmitoleic (5.04%) acids were the minor fatty acids. In *salustiana* seed oil, palmitic (29.13 %), oleic 26.03 %) and linoleic (37.51 %) were the major fatty acids. It is interesting to note that the two varieties have very different fatty acid profiles although they grow under similar conditions. The oil from the variety *valencia* has a higher percentage of palmitic and linoleic acids which is more like a saturated moiety compared with the unsaturated nature of the oil from *salustiana* having more linoleic and palmitic acids. The fatty composition of the two varities have a domainant presence of $C_{16:0}$ $C_{18:1}$ & $C_{18:2}$ acids like other vegetable oils and animal fats and can be used for edible and soap making purposes.

Table 2
Percentage fatty acids composition of *valencia* and *salustiana* seed oils

Varieties	Fatty acids%						
Fatty acids	$C_{12:0}$	$C_{14:0}$	$C_{16:0}$	$C_{18.0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$
Valencia	1.55	5.04	47.33	7.50	18.40	18.39	-
Salustiana	-	-	29.13	4.23	26.03	37.51	3.07

References

Kefford J F, Caudler B V 1970 *The Chemical Constituents of Citrus Fruits*. Academic Press, NY, London p 81.

Mumtaz M Ali, 1986 *Twenty Five Years of Education and Research* 1961-1986 University of Agriculture, Faisalabad, Pakistan pp145.

Saleem M, Sarwar M, Khan S A, Bhatty M K 1977 Fatty acids of indigenous resources for possible industrial applications. Part V. Investigations on the commercial species of Rutaceae. *Pak J Sci Ind Res* **20** 305-306.

Sattar A, Mahmud Shahid, Khan S A 1987a Fatty acid of indigenous resources for possible industrial applications Part XIII Physico-Chemical investigation on the seed oil of feutral and tangarine varieties of *Citrus reticulata* balanco. *Pak J Sci Ind Res* **30** 630-631.

Sattar A, Mahmud Shahid, Khan S A 1987b Fatty acid of indigenous resources for possible industrial applications. Part XIV Fatty acid composition of the seed oil of *Citrus limon* Var. *Eureka*. *Pak J Sci Ind Res* **30** 710-711.

Sattar A, Mahmud Shahid, Khan S A 1988 Fatty acid of indigenous resources for possible composition of the seed oils of *Citrus limon* Var. *Lemon* and *Citrus aurantifolia* Var Kaghzi Nimbu. *Pak J Sci Ind Res* **31** 743-744.

Sattar A, Mahmud Shahid, Khan S A 1991 Fatty Acids of

indigenous resources for possible industrial applications Part. XIX Fatty acid Composition of *Citrus grandis* and *Citrus reticulata* (var. sangtra). *Pak J Sci Ind Res* **34** 238-339.

Solomon H L, Hubbar W D, Prosser A R, Sheffard A J 1974 Sample size influence on boron triflouride-method procedure for preparing fatty acid methyl esters. *J Am Oil Chem Soc* **51** 244.

Swern D, Baily S 1964 *Industrial Oil and Fat Products.* Interscience Publishers, NY pp 195-212.