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THE FATTY ACIDS OF INDIGENOUS RESOURCES FOR POSSIBLE INDUSTRIAL APPLICATIONS

Part IV. Investigations of the Species of Salvadoraceae Family

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Abstract. The seed fats from *Salvadora oleoides* and *Salvadora persica* (N.O. *Salvadoraceae*) have been analysed for their fatty acid composition. They have been shown to be a rich source of both myristic and lauric acids and thus a good substitute of coconut oil for the soap industry in Pakistan.

Palm and coconut oils and tallow are the three important fats required by the soap industry in the country. These fats are almost wholly imported and their shortage continues to affect the soap industry adversely. In order to find a local source of or a substitute for such fats and also in continuation of our general programme for finding newer sources of oils,[1–3] we have now examined the seed oils of *Salvadora oleoides* and *Salvadora persica* (N.O. *Salvadoraceae*) for their fatty acid composition. Although the seeds have been examined by various workers at different times and the composition of their fat reported, the seed fat has not been utilised anywhere so far, and has thus remained neglected.[4] These studies have been prompted by the fact that, firstly, this source is quite extensively available in Pakistan and, secondly, the reported compositions of its fat are so conflicting as to necessitate a reexamination. Present studies were, therefore, undertaken with a view to reexamine this source for the soap-fatty acids and also to elucidate the composition of the fat by the use of modern techniques. As a result of the present findings it has been shown that *Salvadora* seed fat can be a good local substitute for the imported soap-making oils and fats.

Salvadora oleoides and *Salvadora persica*, locally known as 'jhal' and/or 'peelo' respectively, are ever green shrubs or small trees that grow wild in the western parts of Pakistan. Both species bear small fruits containing single seeds in the summer season (May–July). The seeds from both species are similar and on extraction yield a good quality saturated fat whose characteristics and composition are also similar. These observations have previously been recorded by Hooper,[5] Watson *et al.*,[6] and Hilditch *et al.*[7] and the same are reproduced below alongwith the present findings (Table 1).

The fruits of *S. oleoides* and *S. persica* were collected from Multan while they were fresh, preserved in alcohol, and the seeds were then separated by maceration. These shade dried seeds were then used for all experiments reported here.

Experimental

All extracts were dried (Na_2SO_4).

Analysis of the Seeds. The protein, oil, carbohydrate, moisture and fibre contents of the seeds were determined according to the standard procedures[8] and the results are given in Table 2.

Examination of the Oils. The seeds were crushed separately in a pestle and mortar and then extracted in a Soxhlet extractor with petroleum ether (40–60°C). The extracts were dried and the solvent removed under reduced pressure to afford a light yellow solid fat from both the varieties. The amounts of the fats and their important physicochemical values as determined by the common methods[8] are recorded in Tables 1 and 2.

Analysis of the Component Fatty Acids of the Fats. The fat (5.0 g) of both the species, was separately saponified with 0.5N alcoholic KOH (50 ml) by refluxing under nitrogen atmosphere for 6 hr. After the removal of nonsaponifiable matter by extraction with diethyl ether, the soap solutions were acidified with 4N H_2SO_4. After extraction with diethyl ether and removal of the solvent from the dried extracts, the liberated fatty acids were converted to their methyl esters. These methyl esters were subjected to vapour phase chromatographic analysis on a diethylene glycol succinate (DEGS) column at 190°C using argon as the carrier gas and radium ionisation detector. The identity and the percentage composition of the constituent fatty acids in each oil were determined from the retention times and the peak areas of their methyl esters respectively (Table 1).

Discussion

Present findings confirm that the seed fats from *Salvadora* species are almost identical in composition and that they contain more myristic acid and less lauric acid and not vice versa as reported by Watson *et al.*[6,7] *Salvadora persica* is found in some districts of the Punjab only whereas *Salvadora oleoides* grows wild throughout West Pakistan excepting mountain ranges and their neighbouring lower basis due to the moist climate in these areas. The dry climate of West Pakistan is rather suitable for the growth of *S. oleoides* and the plant is abundant in various forest ranges of Sind and Punjab. When in season, the ripe fruit finds no use other than for edible purposes to a small extent and thus largely goes to waste.

The major component acids of *Salvadora* seed fat are lauric, myristic and palmitic. Lauric and myristic

TABLE 1. PHYSICOCHEMICAL CHARACTERISTICS AND FATTY ACID COMPOSITION OF *Salvadora oleoides*, *Salvadora persica* SEED FATS.

Characteristics	*S. oleoides*				*S. persica*			
	Hooper	Watson[6]	Hilditch[7]	Present work	Hooper	Watson[6]	Hilditch[7]	Present work
Chemical								
Acid value	11·26	2·02	1·0	1·6	9·3	—	2·2	2·0
Iodine value	7·5	14·0	5·5	7·1	5·9	—	6·1	6·0
Thiocyanogen value	—	—	—	5·6	—	—	—	5·9
Polenski value	—	11·6	—	4·3	—	—	—	4·2
Reichert-Meissl value	1·3	5·1	—	1·25	—	—	—	1·24
Saponification equivalent	231·6	226·6	240·6	248·0	228·3	—	243·1	246·8
Unsaponifiable matter (%)	—	—	0·7	1·3	—	—	0·8	1·1
Physical								
Specific gravity (50°C)	—	—	—	0·8672	—	—	—	0·8674
Refractive index (50°C)	—	—	—	1·4472	—	—	—	1·4472
M. p. (°C)	41·0	31·1	—	42·5	—	—	—	42·5
Component fatty acids (%)								
C_8 : 0	—	4·4	—	4·2	—	—	—	4·2
C_{10} : 0	—	6·7	1·5	—	—	—	1·0	—
C_{12} : 0	—	47·2	21·2	22·5	—	—	19·6	20·8
C_{14} : 0	—	28·4	52·9	51·1	—	—	54·5	53·0
C_{16} : 0	—	—	18·9	15·4	—	—	19·5	17·1
C_{18} : 0	—	—	—	—	—	—	—	—
C_{18} : 1	—	12·0	5·5	4·9	—	—	5·4	3·9
C_{18} : 0	—	1·3	—	1·9	—	—	—	1·0

TABLE 2. CHEMICAL COMPOSITION OF THE SEEDS OF *S. oleoides* AND *S. persica* (% m/m).

Component	*S. oleoides*	*S. persica*
Crude proteins (N×6.25)	17.60	18.20
Oil	45.50	45.90
Fibre	5.95	6.10
Ash	3.85	3.90
Moisture	3.30	2.50
Carbohydrates (by difference)	23.80	23.40

TABLE 3. PERCENTAGE COMPOSITION OF COCONUT OIL AND *S. oleoides* FAT.

Component acids	Coconut oil	*S. oleoides* fat
Caproic	0.5–0.8	—
Caprylic	5.0–9.0	—
Capric	6.8–8.4	4.31
Lauric	45.4–48.0	22.52
Myristic	15.5–18.0	51.14
Palmitic	9.0–10.5	15.40
Stearic	1.0–2.6	—
Oleic	5.7–7.6	4.87
Linoleic	1.6–2.6	1.67

acids form about 74% of the total acids, and the percentage of myristic acid is slightly greater than 50%. With this composition the *Salvadora* seed fat could be an ideal substitute for coconut oil for soap making as the latter oil is imported into Pakistan. The composition of coconut oil and *Salvadora oleoides* fat is given in Table 3 for comparison. It is seen from this table that lauric acid content of coconut oil is almost double the amount present in the seed fat of *S. oleoides*, while myristic acid content of the *S. oleoides* seed fat is three times that present in coconut oil.

All the toilet soaps which are customarily milled in Pakistan are usually made from coconut oil. Because of their lathering properties these soaps are quite popular in places where the water is hard. These soaps, however, are considered to have a harsh action on the skin in view of the higher content of C_{10} and C_{12} fatty acids in them. The soaps with high myristic acid content and containing lesser amounts of C_{10} and other lower fatty acids are devoid of these drawbacks and, therefore, *S. oleoides* seed fat can be used for making toilet soaps with advantages over other fats.

Considerable quantities of *S. oleoides* seed fat can be made available to the soap manufactures in Pakistan provided adequate arrangements are made to collect the fruits in the summer months. These arrangements should either be made by the Forest Department directly or by privately interested persons through the Forest Departments of both the Punjab and Sind provinces. It is estimated that the fat obtained from this so far neglected minor source will not only be sufficient to replace all imports of coconut oil but also help considerably in easing the pressure on cottonseed oil which now is partly utilised for soap making. As a result, therefore, there will be available better quality toilet soap for the common man and more cotton-seed for hydrogenation purposes.

Survey conducted by a private party regarding the peelo plantations in Pakistan reveals that the extent of natural growth of peelo is considerable in the Punjab and the Sind. On the average a tree yields about 40 lb fruits and/or 15–20 lb of seeds. On this basis of the percentage of the fat in the seeds (46%) it has been calculated that about 9000 tons of this fat can be available in the country for the manufacture of soaps.[9] Pilot scale experiments dealing with the commercial exploitation of this source are in an advanced stage at the PCSIR Laboratories, Lahore. The results of these experiments will be published later on.

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