Qatar Univ. Sci. Bull. (1984) 4: 37-44

ECOLOGICAL AND PHYTOCHEMICAL STUDIES ON THE "MISWAK", *SALVADORA PERSICA L.*

By

H. A. MA'AYERGI*, S. I. ISMAIL**, K. H. BATANOUNY* and A. M. RIZK*

* *Scientific and Applied Research Centre, Univ. of Qatar, Doha, Qatar*

** *Pharmaceutical Sciences Lab., National Research Centre, Dokki, Cairo, Egypt*

Key words: Ecology, Geographical distribution, "Miswak", Phytochemistry, *Salvadora persica,* Sterols, Mucilage.

ABSTRACT

The "*Miswak*", which is produced from the stolons and branches of *Salvadora persica* is used as a substitute for ordinary tooth brushes. The use of "Miswak" has been recommended by Islam. It is endowed by several characteristics supporting its use. In view of such facts, the ecology, geographical distribution and the chemical constituents of the plant have been investigated. It has been found that "Miswak" contains mucilage (2.2%) and sterols (β-sitosterol, stigmasterol, campesterol and cholesterol). The analysis of the fatty acids was also carried out.

INTRODUCTION

"*Miswak*" is the Arabic name of the prepared pencil-like pieces of the roots, and sometimes the branches, of *Salvadora persica* to be used as toothbrushes. It occurs in commerce in long, cylindrical, woody and fibrous, pencil-like pieces, varying from 0.5 to 2 cm in diameter and are about 25 cm in length (Fig. 1). They are usually pale yellowish-grey in colour, showing small transversely elongated lenticels, and fine longitudenal striations. Scars of lateral rootlets and white patches caused by the partial removal of the corky layer are observed on the prepared "*Miswak*". At one end, the thin cortical layer is removed exposing the thick fibrous yellowish-white wood. This end is frayed like the bristles of a toothbrush.

The "*Miswak*" is used as a substitute for ordinary toothbrushes. This may be referred to some characteristics e.g.

a) the lumen of the vessels and of the xylem fibres functions like capillaries when brushing the teeth.

b) the "*miswak*" possesses refreshing properties.

c) the "*miswak*" does not need any tooth powder for its application.

d) there may be a chemical factor, since it is reported that the roots contain trimethylamine (Nadkarni, 1954) and a mustard-like substance (Watt and Breyer-Brandwijk, 1962). β-Monoclinic sulphur and glucotropaeolin, a glucosinolate were isolated from the roots (Ezmirly and Seif El-Nasr, 1979). The latter is certainly found in the leaves giving them their pungent taste.

e) *S. persica* is used in many countries in curing different diseases (Watt and Breyer-Brandwijk, 1962). Pharmalogical data of the roots indicated antiinflammatory, antibacterial and hypoglycemic activities (Ezmirly *et al.*, 1979).

Recently, some companies produced a toothpaste containing the extract of *Salvadora persica* and was given the name "Miswak" (Fig. 1).

The "Miswak" is sold at the markets of Cairo, Jeddah, Mecca, Medina, Doha and other cities in the Islamic world. Prophet saying "Sewak is hygene for the mouth and satisfying for Allah".

It is to be noted that the best commercial variety of "*Miswak*" used in the Islamic world are those obtained from Hejaz in Arabia. It is obtained from plants growing in the southern Tihama plain along the Red Sea coast.

Of interest is that the excellence of *S. persica* as a toothbrush keeping the teeth white and beautiful is also attested by many Arab poems. Suwayed ibn Abi Khalil al-Yashkuri in the 7th Century A.D. (Al Mufaddliyat, 1942) wrote:

"Free born is she: she shows when she smiles a row of white teeth regularly spaced. Like the rays of the sun breaking forth from midst of a cloud. She has polished it with a green sappy twig of arak, sweet of savour, so that it is perfectly lustrous".

Evenari and Gutterman (1973) rectified an error concerning the name "*Arak*" of *Salvadora* given by Low 1924 in his famous "Flora der Juden". The latter author writes concerning *S. persica:* "In Koran ist an s Stellen die Rede von Arak nach dem die Frommen in Paradiese schauen und in dessen Schatten sie sitzen". The Quran really mentions "*Arak*" five times: (18:1, 36:36, 76:13, 83:23, 83:35), but "*Arak*" does not mean "*Salvadora persica*". It is the plural of "*areka*" i.e. throne.

The studied species

Salvadora persica L., Sp. Pl., ed. 1, 122 (1753); Vahl, Symb. Bot. 1:12, t.4 (1790); Del., Frag. Fl. Arab. Petr., no. 10 (1833); Decsne, Fl. Sinaica in Ann. Sci. Nat. ser. 2 (Bot): 245 (1834); Anders, in J. Linn. Soc. 5, suppl. 29 (1860); Hook, Fl. Ind. 3:619 (1872-1897); DC., Prodr. 17:28 (1873); Boiss. Fl. Orient. 4:43 (1875); Defl. Voy. Yemen, 162 (1889); Baker in Kew Bull., 334 (1894); Krause, Beitr. Fl. Aden in Engl. Bot. Jahrb. 35:48 (1905); Muschl., Fl. el Tor in Verh. Bot. Ver. Prov. Brandenberg 49:66-146 (1907) et Man. Fl. Egypt, 728 (1912); Blatt, Fl. Aden, 237 (1915) et Fl. Arab., 290 (1919); Post, Fl. Syr., Pal. et Sinai 2:186 (1933); Taeckholm, Stud. Fl. Egypt, 2 ed., 343 (1974); Migahid, Fl. Saud. Arab., ed. 2, 1:183 (1978).

Salvadora crassinervia Hochst. in Schimp. Fl. Abyssin. no. 2218 (1851).

Cissus arborea Forssk., Fl. Aegypt. Arab. 32, no. 95 (1775).

Rivina panicultat L., Syst. ed. 10, 889 (1759).

Salvadora persica L. is a much branched shrub or small tree, 2-3 metres high. A shrub may cover an area of 30 sq.m. The plant is glabrous in all parts. The branches are opposite and the branchlets are white terete. The leaves are ovate-oblong to oblong-linear, obtuse, tapering at base, entire, pale-green, opposite, 4-6 cm long and carried on short petioles.

The small, regular usually hermaphrodite flowers are arranged in terminal, copiously branched

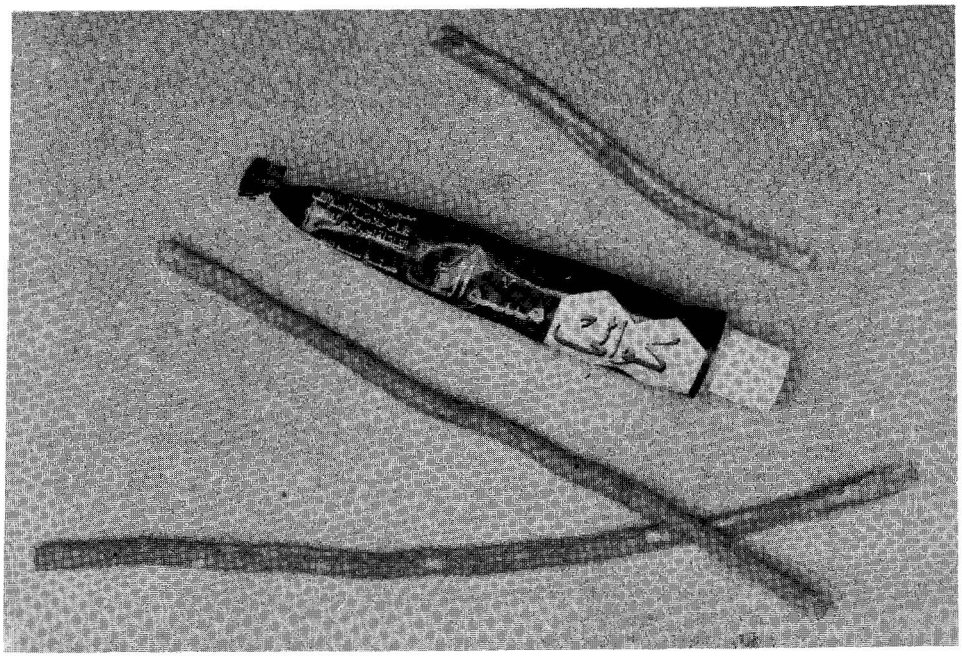

Fig. 1. Specimens of the *"Miswak"* obtained from the stolons of *Salvadora persica* and a tube of a toothpaste from the same plant.

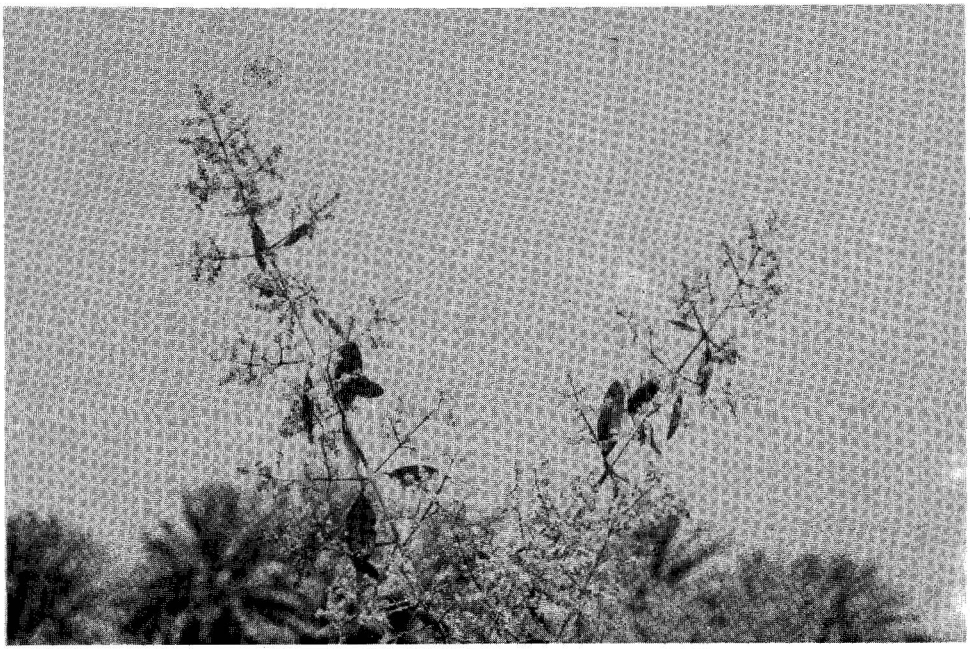

Fig. 2. A flowering branch of *Salvadora persica* growing in Al-Batinah, Oman.

panicles (Fig. 2). They have short pedicles and minute bracts. The calyx tube is broadly campenulate with 4 pale-green segments, about 1 mm long. The four petals are greenish-white, imbricate, about 2 mm long. The stamens are 4, shorter than the petals. The ovary is ovoid, unilocular with a single basal erect ovule.

The fruits are grouped in clusters. They are dark-red, globose, sweet, slightly acrid, edible berries, about 0.5 cm in diameter.

Geographical Distribution

S. persica is a Sudano-Deccanian tropical element with a strong affinity to the Sahara-Sindian region (Zohary 1962). It has a wide geographical distribution (Evenari and Guttermam 1973). Its distribution ranges from Rajasthan in the East (Gupta and Sakera 1968) and the north of Ceylon through South Iran, (Zohary 1973) Oman, Hadramaut, Yemen, Saudi Arabia mainly Tihama (Blatter, 1919-1936) Palestine (Post 1933), Egypt: Gulf of Aqaba coast (Hume 1906), El Tor (Muschler 1912), Red Sea region (Kassas and Zahran, 1965), Nubian desert (Kassas and Girgis 1969-1970) to Mauritania in the west. From north to south, it extends from North Africa through Sudan (Kassas 1960), Ethiopia, Central Africa, South West Africa (Engler and Prantl 1942).

It is interesting to note that there is another species of *Salvadora,* namely *S. oleoides* Dcne which is found in Aden, and India.

Ecological Considerations

Records of *S. persica* indicate that its growth is mainly in moist hot places. In Arabia, it occurs mainly in southern Tihama, e.g. in Jizan, where the soil is slightly saline, the groundwater is near the west zone and the weather is hot all the year around. It grows on fine-textured soil in the deltas of wades draining towards the Red Sea. In the Sudan, Kassas (1960) states that the *S. persica* belt abounds in the summer rain coutry of the Red Sea hills. In Egypt, the plant grows in the delta of Wadi Kid, which drains a large catchment basin of the mountain range of Central Sinai (Evenari and Gutterman 1973). It grows also on the silt terraces of the Wadis in the Nubian desert where the soil is slightly saline (Kassas and Girgis 1969-1970). Evenari and Gutterman (1973) report that the plant grows in the Jordan and Arava valleys in habitats with high temperatures during the rainy seasons in fans of the layer wadis where either running water is available during the whole year (Ein Gedi) or not too saline ground water present at a relatively shallow depth. It is to be noted that the locality where *S. persica* grows in Ein Gedi is 350 m below sea level, 150 m west of the Dead Sea. Zohary (1973) reports on a stand with *S. persica* as a component in Ein Gedi in 1926, where it grows on colluvial fans, grey soil mixed with coarse gravel. He states that the plant has an altitudenal range of -350 to 100 m.

The plant has two different growth forms. The growth form of this species may be a tree or a cushion like patch of short branches covering mounds of soft deposits. The cushion growth form may be the result of repeated cutting. It is a common practice to cut the branches and stolons of this plant to use the cut parts as toothbrushes. Moreover, the plant is usually grazed by camels, which after having eaten "*arak*" (the Arabic name of *S. persica*) produce superior milk. There is even some names for such camels: "*Awarik*" (Lisan Al Arab 1956) and these camels are known to "*Arekat*" denoting that they ate the "*Arak*" twigs (Al-Sahah 1975). Fruits are eaten by Bedouins.

In localities where *Salvadora persica* forms patches of dense growth, it provides the main part of the vegetation cover, whereas associates occupy the species among these patches. Among the associate species recorded we may mention: *Acacia raddiana, Leptadenia pyrotechnia, Balanites aegyptiaca* (in the Nubian Desert) (Kassas and Girgis 1969-1970); *Seddera latifolia, Helitropium strigosum* and *chrozophora allongifolia* (in the Sudan, Hume 1906).

MATERIALS AND METHODS

Plant Material:

The material has been collected from the local market in Doha, Qatar, in the form of dry stolons sold as tooth brushes.

I. **General Analysis:**

The phytochemical screening (Rizk 1982) as well as the moisture and ash contents (AOAC 1973) were carried out.

II. **Carbohydrates:**

(i) **Free sugars:**

The free sugars were extracted from the defatted powder with the pyridine method (Malpress and Morrison 1949). Investigation of the sugars was carried out by paper chromotography, using n-butanol-acetic acid-water (4:1:5) and ethyl acetate-pyridine-water (2:1:2) systems.

(ii) **Mucilage:**

The mucilage of about 200 gm of the plant material, was prepared in the usual manner (Rizk and Hammouda 1970) and its hydrolysis was affected by 1N H_2SO_4. The hydrolyzate solution was neutralized with $BaCO_3$ then filtered. The filtrate was deionized by passing through ion-exchange resin, (Amberlite IRA-120), then evaporated until dryness and the residue was dissolved in 10% isoproanol and investigated by paper chromatography as mentioned above.

III. **Lipids:**

About 1.25 kg of the powdered roots were extracted with petroleum ether (b.r. 60-80^{0}C). The extract was evaporated *in vacuo*. The solvent free residue (6.25 gm), was dissolved in boiling acetone, concentrated and left overnight.

An amorphous white precipitate (aliphatic alcohol) was filtered. Chromatographic fractionation of about 5 gm of the acetone soluble fraction, on neutral aluminium oxide packed in a glass column (60 cm x 2 cm i.d.), afforded an oily hydrocarbon fraction and a sterol fraction. Upon crystallization of the sterol fraction from methanol/chloroform, it melted at 134-136^{0}C. The sterol fraction was further purified by percipitation with digitonine then subjected to GLC after converting to its trimethylsilyl derivative.

About 0.2 gm of the acetone soluble fraction was saponified in the usual manner. The unsaponifiable fraction yielded about 74 mg (37%) in addition to 7.6 mg of an ether insoluble fraction (3.8%). The fatty acids (obtained from the saponified solution) yielded about 117 mg (58.3%) and were subjected to GLC analysis as their methyl esters (Burchfield and Storrs 1962).

Conditions for GLC:

Sterol: Gas chromatograph Hewlett-Packard 5830 A with FID, glass column 4 feet x 3 mm. packed with 2% Ov-101 on gas chromosorb WHP (100-120 mesh); temperature 1) isothermic at 250^{0}C, 2) Programmed; 210^{0}C for 8 min. 210-270^{0}C, rate 4^{0}C/1 min. and 270^{0}C until run stop.

Fatty Acids: Gas Chromatograph Pye-Unicam 104; Column 10%; silar 10 C; temperature: column 185^{0}C, injection part 210^{0}C, detector 270^{0}C.

RESULTS

The results obtained from the preliminary phytochemical screening revealed the presence of sterols and/or triterpenes, and the probable presence of alkaloids (weak positive reaction). The moisture content and ash content were found to be 8.5% and 18.6% and respectively.

The free sugars were identified as glucose, galactose and sucrose and the components of the mucilage (2.2%) as glucose, galactose, arabinose, xylose and glucuronic acid.

Treatment of the purified lipid fraction with acetone afforded an alcohol fraction. Chromatographic fractionation afforded the separation of a sterol fraction which was proved by GLC to be a mixture of β-sitosterol (82.7%), stigmasterol (15.2%), cholesterol (2.1%) and campesterol in trace amount. (Table 1).

GLC of the methyl esters of the total fatty acids revealed the presence of lauric (0.93%), myristic (0.56%), palmitic (22.79%), palmitoleic (8.97%), stearic (19.93%), oleic (11.33%), linoleic (26.15%) and arachidonic (9.34%) acids.

Table 1.
Retention times and relative % of the Sterol Fraction

Component	Rt in Minutes	%
β-sitosterol	10.6	82.7
Stigmasterol	9.25	15.2
Campesterol	8.4	traces
Cholesterol	6.8	2.1

REFERENCES

Al-Sehah. 1975. Dar Al-Hadarah Al-Arabia, Beirut, p. 17.

Anonymous. 1942. Al Mufaddliat (An Anthrology of Ancient Arabic) Cairo.

Association of Official Agricultural Chemists. 1973. Official Methods of Analysis. The Association Washington, D.C., 11th ed.

Blatter, E. 1919-1936. Flora Arabica. Rec. Bot. Surv. India, No. 8:1-519, 1 map, Calcutta.

Burchfield, H.P. and **Storrs, E.C.** 1962. Biochemical Application of Gas Chromatography, Academic Press, London.

Engler, A. and **Prantl, K.** 1942. Die naturlichen Planzenfamilien. Bd. 20b, 2. Aufl.

Evenari, M. and **Gutterman, Y.** 1973. Some notes on *Salvadora persica* L. in Sinai and its uses as a toothbrush, Flora 162, 118-125.

Ezmirly, S.T., Cheng, J.C. and **Wilson, S.R.** 1979. Saudi Arabian Medicinal Plants: *Salvadora persica,* Planta Med., 35: 191-192.

Ezmirly, S.T. and **Seif El-Nasr, M.M.** 1981. Isolation of glucotropaeolin from *Salvadora persica* L., J. Chem. Soc. Pak., 3(1): 9-12.

Gupta, R.K. and **Sakena, S.K.** 1968. Resource survey of *Salvadora oleoides* Decne and *S. persica* Linn. for non-edible oil in Western Rajasthan, Trop. Ecol., 9: 140-152.

Hume, W.F. 1906. Topography and Geology of South Eastern Sinai, Survey Dept., Ministry of Finance, Cairo.

Kassas, M. 1960. Certain aspects of landform effects on plant water resources. Bull. Soc. Geogr. d'Egypte 60:47-71.

Kassas, M. and **Girgis, W.** 1969-1970. Plant life in the Nubian desert east of the Nile, Egypt. Bull. Inst. d'Egypte 33: 45-52.

Kassas, M. and **Zahran, M.** 1965. Studies on the ecology of the Red Sea coastal land. II. The district from El-Galala El-Qibliya to Hurgdada. Bull. Soc. Geogr. d'Egypte 38:155-193.

Lisan-El Arab. 1956. p. 388-390. Beirut Ed.

Malpress, F.M. and **Morrison, A.B.** 1949. Use of pyridine in the deionization of solutions for paper chromatography. Nature 164:963.

Muschler, R. 1907. Flora of el Tor. Ver. Bot. Ver. Prov. Brandenberg 49: 66-146.

Muschler, R. 1912. A Manual Flora of Egypt. Friedlaender, Berlin.

Nadkarny, A.K. 1954. Indian Materia Medica, 3rd ed.

Post, G.E. 1933. Flora of Syria, Palestine and Sinai. Amer. Univ. Publ. Beirut, ed. 2 by J.E. Dinsmore.

Rizk, A.M. 1982. Constituents of plants growing in Qatar. I. A Chemical survey of sixty plants, Fitoterapia, 52:35-44.

Rizk, A.M. and **Hammouda, F.M.** 1970. Phytochemical studies of *Asphodelus microcarpus* (lipids and carbohydrates). Planta Med., 18: 168-172.

Watt, J.M. and **Breyer-Brandwijk, M.G.** 1962. The Medicinal and Poisonous Plants of Southern and East Africa. 2nd ed., Edinburgh and London.

Zohary, M. 1962. Plant Life of Palestine, Ronald Press, N.Y.

Zohary, M. 1973. Geobotanical Foundation of the Middle East. Gustav Fischer Verlag, Stuttgart.

دراسات بيئية وفيتوكيميائية على المسواك

حسن المعايرجي ـ شمس الدين اسماعيل ـ كمال البتانوني
عبد الفتاح محمد زرق

يستعمل المسواك الذي يحصل عليه من جذور وسيقان نبات الآراك بديلا لفرش الأسنان ، وقد أوصى الأسلام باستعماله .

وللمسواك خصائص عديدة من النواحي الطبيعية والكيميائية تؤيد استعماله لهذا الغرض .

وفي ضوء هذه الحقائق أجريت على نبات الأراك والمسواك دراسات بيئية وتم تقصي توزيعه الجغرافي ومكوناته الكيميائية وتبين أن المسواك يحتوى بالاضافة الى الجليكوزيدات الكبريتية على مادة هلامية تم تعريف مكوناتها السكرية ، ستيروئيدات . كما تم تعريف الأحماض الدهنية .