10.1.1. ***Carissa spinarum*** L., Mant. Alt. 559 (1771), non Lodd. ex A. DC., Prodr. 8: 336 (1844); Boulos, Fl. Egypt 2: 210 (2000).
Syn. *Carissa edulis* (Forssk.) Vahl, Symb. Bot. 1:11 1790); Täckh., Stud. El. Egypt, ed. 2, 408 (1974).

Common names: Conkeberry; Burrum Bush; Bush Plum; Black Currant; Currant Bash.

Proximate Composition and Lipids

Carissa spinarum was reported deficient in Zn and contains enough Fe (Sawhney *et al*., 1977). Parmar and Kaushal (1982) reported that the fruits of *Carissa spinarum*, growing in India, contains moisture (64%) and the total soluble solids of the fruit juice are 25.8%. The fruits contain protein (4.09%), acids (1.51%), total sugars (10.80%), reducing sugars (10.77%), tannins (0.42%), pectin (1.39%), ash (1.62%), P (0.057%), K (0.504%), Ca

(0.051%), Mg (0.052%), Fe (0.007%) and vitamin C (1.83 mg/100 g). The proximate composition of the seeds is as follows: moisture (9.8%), oil (22.4%), protein (10.1%), ash (2.2%) and crude fiber (21.6%). The fatty acids of the fruits were palmitic, 12.6; stearic, 7.6; oleic, 72.7; linoleic, 5.2; linolenic, 0.9 and arachidic, 1.0 (Rao *et al.*, 1984). Also, the following data were reported for the proximate analysis of the fruits: moisture, 73.2±1.37; carbohydrates, 12.43±0.39; total sugars, 8.37±0.40; protein, 3.64±1.04; reducing sugars, 8.2±0.29; non0reducing sugars, 0.17±0.16; phenolics, 0.72±0.16 and acid content, 0.2±0.2 (Mhapatra *et al.*, 2012). The amino acids composition of the fruit protein (4.8%) (of *C. edulis*,"African plum", growing in Burkina Faso) were as follows: asparagine, 12.4; glutamine, 5.62; serine, 2.07; glycine, 3.38; histidine, 0.97; arginine, 2.75, threonine, 1.49; alanine, 1.95; proline, 2.59; tyrosine, 1.62; valine, 2.22;, methionine, 0.43; isoleucine, 1.86; leucine, 2.43; phenylalanine, 1.49; lysine, 1.84; cystine, 2.38 and tryptohan, 0.42 mg/g. The following fatty acids were detected in the lipid (3.0%): $C_{14:0}$, traces; $C_{16:0}$, 0.032; $C_{18:0}$, 0.018; $C_{18:1n-9}$, 0.043, $C_{18:2n-6}$, 0.0959 mg/g and $C_{20:0}$, traces. The fruits contain the following minerals: Fe, 10.5; Ca, 3730; Mg, 399; Mn, 10.3; Na, 21.9 and P, 859 µg/g dry weight (Glew *et al.*, 1997).

Chemical constituents as well as different fractions of protein and carbohydrate of mature leaves and twigs from 9 browse trees and 12 shrubs (including *Carissa spinarum*) were estimated. Soluble protein as percentage of crude protein among different tree and shrubs species varied from 57.46 to 86.27% and 61.97 to 90.30% respectively (Bhadauria *et al*., 2002).

The seed oil (22.4%) has nonsaponifiable matter (5.2%) and the following fatty acids: palmitic (12.6%), stearic (7.6%), oleic (72.7%), linoleic (5.2%), linolenic (0/9%) and arachidic (1.0%) acids (Rao *et al*., 1984).

Qualitative and quantitative composition of epicuticular wax from leaves of 17 woody weeds (including *Carissa spinarum*) of the local semiarid shrubs land, in India, were determined in 3 different seasons. The amount of wax inherently formed on leaves was directly related to ambient temperatures and light intensity and inversely correlated with precipitation and humidity. During the summer season, all the species possessed relatively higher levels of wax and cuticle, whereas these were min. during the winter period. Alcohols, mixture of hydrocarbons, esters and ketones, fatty acids, hydroxy β-diketones, and aldehydes were present in decreasing order in the epicuticular wax of the species studied. Irrespective of season, a high rate of cuticular transpiration was attributed to greater levels of fatty acids, and higher levels of alcohols and aldehydes were correlated with lower rates of cuticular transpiration. New classes of wax components such as β-diketones, secondary alcohols, and aldehydes appeared during the monsoon season in most of the species, which resulted in lower rates of cuticular transpiration than summer or winter seasons (Rao and Reddy, 1980).

Essential Oil

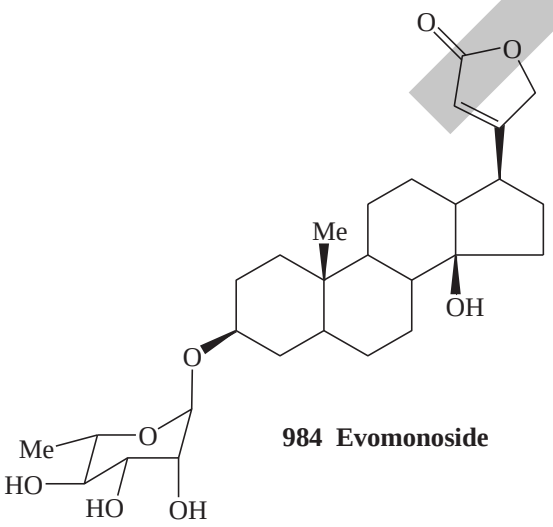
Six components were identified from the root essential oil of *C. edulis*. The main constituent was 2-acetylphenol (92.7%) with lesser amounts of limonene (1.2%), γ-eudesmol (1.2%), α-pinene (0.3%), sabinene (0.3%) and myrcene (0.8%) (Moudachirou *et al.*, 1998).

Terpenes and Sterols

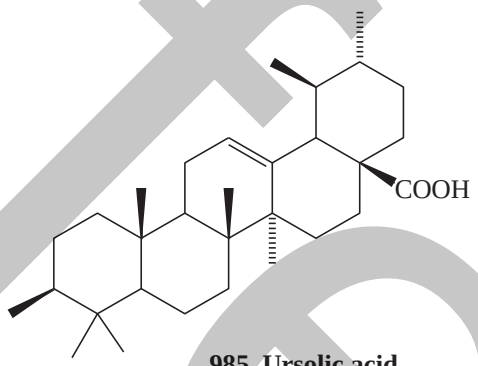
Five cardiac glycosides were isolated from *Carissa spinarum*. Three of these were identified as odoroside H, evomonoside and odoroside G. The remaining two substances, B and C, are a rhamnoside and rhamnoglucoside respectively, whose genins have not been characterized (Rastogi *et al*., 1969). Bisset (1957) reported that *C. spinarum* contained

cardiac glycosides; a minor component may be odoroside H, and *C. edulis* did not have any glycosides. Digitoxigenin 3-*O*-β-D-digitalopyranoside and evomonoside (**984**) were isolated from the stems of *C. spinarum* (Wangteeraprasert *et al.*, 2012). Lupeol, β-sitosterol (Pakrashi *et al*., 1968) and ursolic acid (**985**) (Mathuram *et al*., 1998) were isolated from the root bark of from *C. spinarum* and leaves respectively. In addition, Hegde *et al*. (2012) isolated the following six compounds from the roots: sitosterol, ursolic acid, lupeol, campesterol, 17-hydroxy-11-oxo-nor-β-amyrone and urs-12-ene-3β,22β-diol-17-carboxylic acid. A germacrane derivative, carenone was isolated from the stems of *Carissa spinarum* together with an ester, 3'-(4"-methoxyphenyl)-3'-oxo-propionyl hexadecanoate (Rao *et al*., 2005).

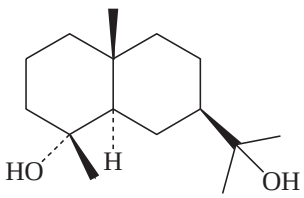
Lupeol was isolated from the root bark of *C. spinarum* (Pakashi *et al.*, 1968). Lupeol, carissol and β-amyrin were identified in the root bark of *Carissa edulis* (Forssk.) Vahl (Festus *et al*., 2009; Tolo *et al.*, 2010). The root of *Carissa edulis* contains about 5% sesquiterpenes (Achenbach *et al*., 1985). Eudesmane-type sesquiterpenes seem to be typical constituents of the genus *Carissa* (Achenbach *et al.*, 1985). Carissone, the main sesquiterpene of *Carissa edulis*, has also been found in *Carissa carandans*, *Carissa congesta* and *Carissa lanceolata* (Mohr *et al*., 1954; Joshi and Boyce, 1957; Rastogi *et al*., 1966). This sesquiterpene was also identified from the stems of *C. spinarum* (Wangteeraprasert *et al.*, 2012). *Carissa edulis* contains in addition to carissone, cryptomeridiol (**986**), β-eudesmenol (**987**), three hydroxylated carissones (**988-990**) and the germacrane type sesquiterpene (Achenbach *et al*., 1985). Chemical investigation of the aerial parts of *Carissa edulis*, growing in Saudi Arabia afforded the following compounds: chlorogenic acid 1-ethyl ether-1-methyl ester, caffeic acid methyl ester, kaempferol, quercetin 3-*O*-glucoside-7,3',4'-trimethyl ether, rutin, pinitol, β-amyrin, lupeol, stigmasterol glucoside, β-sitosterol and β-sitosterol glucoside (Al-Youssef and Hassan, 2010).



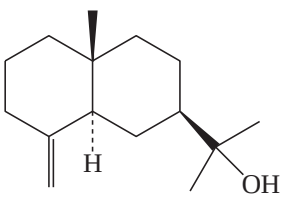
984 Evomonoside



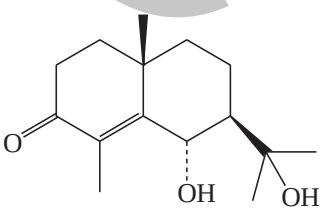
985 Ursolic acid



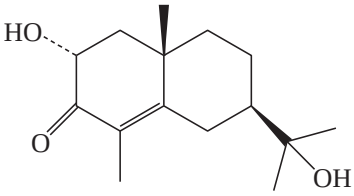
986 Cryptomeridiol



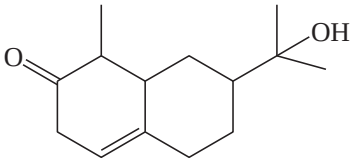
987 β-Eudesmenol



988



989



990

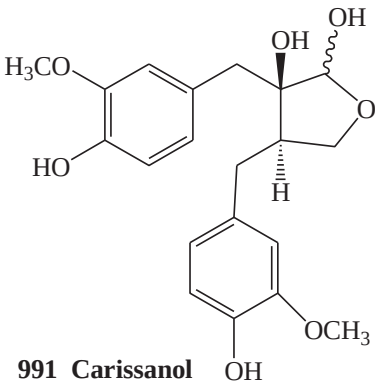
Flavonoids, Lignans and Other Constituents

Carissa spinarum has been early reported as a source of tanning material (Anon, 1928); the tannin content of which increases during summer (Rana *et al*., 2006). The flavonoid naringin was isolated from the leaves (Mathuram *et al.*, 1998). Caffeic acid was identified from the roots (Raina *et al*., 1971).

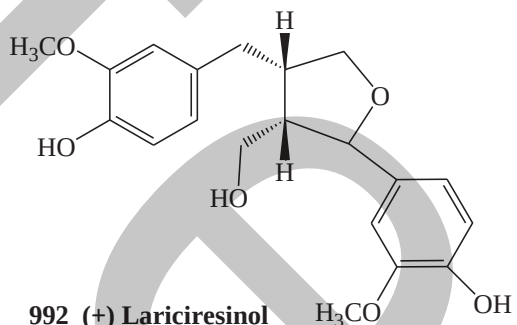
Carinol was identified from the plant (Pal *et al.*, 1975). The roots of *Carissa edulis* contain *ca* 5% lignans, identified as (-) nortrachelogenin, carinol, carissanol (**991**), (+)-lariciresinol (**992**), (-)-secoisolariciresinol (**993**) and olivil (Achenbach *et al*, 1983). A coumarin, scopoletin and eight lignans were isolated from the stems of *C. spinarum viz.* (-)-carinol, (-)-carissanol, (-)-nortrachelogenin, (-)-olivil, (+)-cycloolivil, (+)-8-hydroxypinoresinol, (-)-secoisolariciresinol and pinoresinol (Wangteeraprasert *et al.*, 2012).

Carissa edulis contains querbrachitol (a naturally occurring optically active cyclitol) in the twigs (Plouvier, 1965; Mathuram *et al.*, 1998), 2-hydroxyacetophenone (Bentley *et al.*, 1984), catalponol (Inouye *et al*., 1971; Shingu *et al*., 1971), vanillin, coniferaldehyde, scoploletin, isofraxidin, 4-hydroxy-(3-hydroxypropionyl)-benzan (Achenbach *et al*., 1983). The presence of oleuropein has been also reported (Maurice *et al*., 2011).

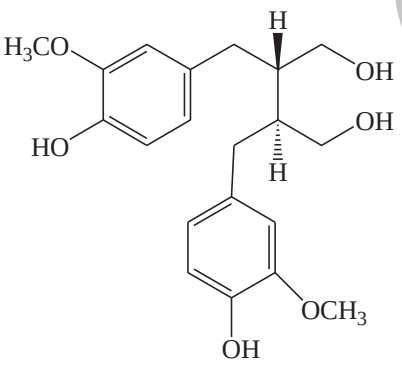
The macroscopical, microscopical characters of the different parts (root, leaf and fruit) were reported (Rose and Prasad, 2013; Salunke and Ghate, 2013).



991 Carissanol



992 (+) Lariciresinol



993 (-)-Secoisolariciresinol