

## **Chemical Constituents of Indigenous Plants Used in Native Medicine of Saudi Arabia. II.**

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**ABSTRACT.** The test results of 173 species in a phytochemical screening program of Saudi plants are reported with data on alkaloids, leucoanthocyanidins, flavonoids, unsaturated sterols (or triterpenoids), cardiac glycosides, coumarins, and saponins. The plants represent 32 families. The results of phytochemical testing which gave high concentration (+++) are recorded and can be summarised in the following statements: Alkaloids were detected in 23 species, leucoanthocyanidins in 13 species, nonsteroidal unsaturated compounds in 33 species, coumarins in 54 species and saponins in 11 species.

The continuing and even intensifying desire to hunt for biologically active products in nature suggests that phytochemical and phytopharmacological surveys continue to be sound in objective and feasible in pursuit. For biological evaluations of natural materials of vegetable origin, the use of purified, preferably water-soluble extracts, can offer more meaningful results than the corresponding crude extracts of the plant sources. Thus, phytochemical approaches to plant screening has become an acceptable means for rapid and economical, yet still informative, plant evaluation work. Phytopharmacological surveying employs gross extracts or select and suitably processed extract fractions – in which very specific types of activities (such as antineoplastic and antimicrobial) are sought.

General considerations of phytochemical screening techniques have been covered in an excellent review (Farnsworth 1966). This included discussions of phytoconstituent categories in major published surveys of screening programs. It was pointed out that many problems could result from diverse screening methods; these include solubility problems and false-positive and false-negative reactions.

Several of the major surveys (Persinos and Quimby 1967, Carrick *et al.* 1968, Chan and Teo 1969, Raffauf and Altschul 1968, Maiti 1968, Bnattacharjee and Das 1969, Dominguez *et al.* 1970, Das and Bnattacharjee 1970, Bandoni *et al.* 1972, 1976, Hnatyszn 1976, Chan *et al.* 1977, Medina 1977) published since then have not heeded his suggestions on how to overcome some of these problems.

The present phytochemical survey constitutes a program (Tawfik *et al.* 1978) which aims at the gross examination of wild and cultivated Saudi Arabian plants, many of which are employed as folkloric medicinals, for alkaloids, leucoanthocyanidins, flavonoids, unsaturated sterols or terpenes, cardiac glycosides, and coumarins. The methodology of screening in the present program utilizes the previous reports (Farnsworth 1966, Wall *et al.* 1961, Tin-Wa 1972).

### Material and Methods

The taxa studied were collected by the author and identified by Batanouny (Cairo University, Faculty of Science), according to the artificial keys of Tackholm (1974) and or Migahid (1978). The taxa were further matched, after collection, against dried specimens in the herbaria of the Faculty of Science, King Abdulaziz University. The collected material was air dried in the shade, powdered, and 50 g extracted with 80% ethanol in Soxhlet extractor, and the whole volume of alcoholic extract was made up to 500 ml (1 g of dry plant extracted with 10 ml ethanol) for 24 hr; half of this alcohol extract was subjected to the various tests described herein, and the other half was submitted for anticancer testing.

#### A. Alkaloids

Alkaloid test methods used in phytochemical screening have been classified into 6 major groups, and the advantages and disadvantages of each have been discussed (Farnsworth 1966). Fifty ml of the alcohol extract (equivalent to 5 g of dried plant material) are evaporated to dryness on a steam bath, and the residue is dissolved in 5 ml of 1% HCl. A few grains of powdered NaCl are added to the filtrate to 'salt out' nonalkaloids, and the solution is filtered.

##### 1. Preliminary test

One ml of the filtrate is treated with a few drops of Valser's reagent (Martello and Farnsworth 1962) and another 1 ml is treated similarly with another alkaloid detecting agent, such as silicotungstic acid reagent (12% aqueous), which forms an alkaloid complex by a different mechanism than that given by Valser's reagent. Production of a precipitate is positive test. It should be followed by a confirmatory test which removes nonalkaloid compounds capable of eliciting 'false-positive' reactions (Farnsworth and Euler 1962).

## 2. Confirmatory test

The remaining acidic aqueous extract is made alkaline with ammonia (28%) solution and extracted several times with chloroform, and the chloroform extracts are combined. The aqueous alkaline solution is saved for assays of quaternary alkaloids. After evaporating the chloroform extract to dryness, the residue is dissolved in 2 ml of 1% HCl, a few grains of powdered NaCl are added, and the solution is filtered. The filtrate is divided into two portions, and each is tested with the two alkaloid reagents as above. Precipitation is indicative of primary, secondary, or tertiary alkaloids.

The aqueous alkaline solution is acidified with 10% HCl, a few grains of powdered NaCl are added, the solution is filtered, and the filtrate is divided into two portions. Each half is tested with the two alkaloid reagents. Quaternary alkaloids are indicated by the formation of precipitates.

## B. Flavonoids and Related Compounds

Although a number of specific colour reactions given by various types of flavonoids (Seikel 1962) can be adapted to screening procedures, the so-called 'cyanidin' reaction of Willstätter (1914) which detects the presence of the  $\gamma$ -benzopyrone nucleus (Bryant 1950) is most often employed. Thirty ml of ethanol extract (equivalent to 3 g of dried plant material) is evaporated to dryness under rotary vacuum, cooled to room temperature, triturated with 15 ml of petroleum ether, and filtered. Trituration of the residue is repeated until the petroleum ether is colorless. The combined petroleum ether extracts are evaporated and set aside to be used in screening for unsaturated sterols and triterpenes, and the defatted residue is dissolved in 30 ml of ethanol and subsequently used for the flavonoid, leucoanthocyanidins, and cardiac glycoside tests.

## C. Unsaturated Sterols and Triterpenes

These two classes of compounds will give characteristic color reactions when they are treated with strong acids under dehydrating conditions. Two specific tests often applied using this principle are the Salkowski and the Liebermann-Burchard (L-B) reactions. In the L-B test, Simes noted blue or blue-green colors with sterols and red, pink or purple colors with triterpenes. There is a possibility that other non-steroidal unsaturated compounds such as carotenes, xanthophylls, ... etc., may interfere with this reaction. In such instances, the color intensities are attained immediately (Wall *et al.* 1954). In the absence of interfering substances, the color intensity observed with these compounds were minimal at first, increasing slowly to a maximum in about 15 to 20 min. The mechanism of the L-B reaction has been investigated by Brieskorn and Herrig (1959) who discovered that certain structural features are essential for the color formations.

For the test, petroleum ether extract from the flavonoid test above is dissolved in 15 ml of  $\text{CHCl}_3$ . After drying the  $\text{CHCl}_3$  solution over anhydrous sodium sulfate (this is an essential step since these tests are dehydration reactions), the solution is filtered into 3 dried test tubes.

1. *Liebermann-Burchard test*

To the first tube, 0.3 ml of acetic anhydride are added and mixed gently. Color changes are noted after the addition of drop of conc.  $\text{H}_2\text{SO}_4$  over a period of 60 min.

2. *Salkowski test*

A ring test is performed with the second test tube using conc.  $\text{H}_2\text{SO}_4$ , and the color of the 'ring' noted. After 1-2 min, the tube is shaken and the color changes observed. A cherry red color indicates the presence of unsaturated sterols.

3. *Control*

The third tube serves as a control.

D. *Saponins*

Saponins were detected by their hemolytic effects using a volume of the ethanol extract corresponding to approximately 0.05 g dry plant weight and a standardized human red blood cell suspension in 0.85% Sodium chloride solution (Wall *et al.* 1952). A positive response was taken as an indication of the presence of saponins without differentiation between steroidal and triterpenoid products; the latter also being known to be powerful hemolysers. The test was so controlled as to give a positive response when the plant material contains approximately 0.1% digitonin equivalent or more (dry weight basis). A negative hemolysis test may be taken as evidence for the absence of saponins.

E. *Cardiac Glycosides*

All cardiac glycosides are classified as steroids (sterols), having in common the cyclopentanoperhydrophenanthrene nucleus, an  $\alpha,\beta$ -unsaturated lactone ring (5- or 6-membered) at  $\text{C}_{17}$  and one or more sugars usually desoxyhexomethyloses, attached at the  $\text{C}_3$  position (Hoch 1961). Consequently, this class of compounds is screened effectively by means of chemical tests designed to detect the presence of one or more of these functional groups. Farnsworth (1966) has listed a number of chromogenic reagents which can be used for this purpose.

1. *Presence of unsaturated sterols*

The Liebermann-Burchard test.

### 2. Presence of unsaturated lactones

To 5 ml of ethanol extract (representing  $\frac{1}{2}$  g of dry plant material) in an evaporating dish, 5 ml of kedde reagent (Kedde 1947) are added, followed by 2 ml of 1 N NaOH. A purple colour is indicative of this functional group.

### 3. Presence of 2-desoxy sugars

Keller-Kiliani test (Moza 1958). To the residue from 10 ml of ethanol extract (representing 1 g of dry plant material), 3 ml of  $\text{FeCl}_3$  T.S. are added, and the solution is transferred to a small test tube. Concentrated sulphuric acid (1 ml) is allowed to run down the inside wall of the test tube. The presence of 2-desoxy sugars is indicated by the formation of a purple 'ring' at the interphase.

### F. Coumarins

Fayez and Abu-Mustafa (1961, 1965) in their studies for the phytochemical screening of Egyptian plants, utilized the following coumarin detection procedure. Ten ml of plant extract (representing 1 g of dry plant material) are concentrated to 5 ml. The alcoholic extract is treated with 5 ml of aqueous 10% KOH at room temperature and left for one hour, with subsequent shaking from time to time to open the lactone ring. The alkaline aqueous-alcoholic solution was defatted with ether (noncoumarin fat soluble substances). The alkaline aqueous layer was acidified with 10% HCl until it is strongly acidic to close the lactone ring. The acidified mixture was refluxed for one hour, to cleave any glycosidic linkages, cooled, extracted with chloroform; and the chloroform is washed with dilute  $\text{NaHCO}_3$ , filtered into a sublimation tube and evaporated to dryness. Sublimation was performed at  $100^\circ\text{C}$  for one hour under vacuum (0.1 ml mercury) using an oil pump. The sublimate was taken up with chloroform and evaporated to dryness. The residue is dissolved in 10 ml spectroscopic alcohol 0.1 ml of the above solution was made up to 5 ml with spectroscopic alcohol and ultraviolet absorption measurements were taken in the regions of 275-340 nm.

### Preparation of the Standard Solutions

500 g of dry leaves of *Agave americana* L. var. *marginata* was extracted with ethanol 80% (5 l) (1 g for each 10 ml).

Standard solutions were prepared as follows:

#### Standard Solution (+)

One l ( $\equiv$  100 g dry plant) was prepared from the stock *Agave* alcoholic extract containing the reference samples:

- 50 mg alkaloid (*e.g.*, solasodine)
- 50 mg flavonoid (norin)
- 50 mg sterols ( $\beta$ -sitosterol)
- 50 mg coumarin (xanthotoxin)
- 50 mg cardiac glycoside (strophanthin)

These quantities corresponding to 0.05% each type in plant (moisture-free basis).

*Standard Solution* (++)

One l ( $\equiv$  100 g dry plant) was prepared from the stock *Agave* alcoholic extract containing the same reference samples:

- 200 mg alkaloid
- 200 mg flavonoid
- 200 mg sterols
- 200 mg coumarin
- 200 mg cardiac glycoside

These quantities corresponding to 0.2% each type in plant (moisture-free basis).

*Standard Solutions* (+++)

- 400 mg alkaloid
- 400 mg flavonoid
- 400 mg coumarin
- 400 mg cardiac glycoside

These quantities corresponding to 0.4% each type in plant (moisture-free basis).

*N.B.* The choice of the *Agave* plant; because it represents the constituents of any plant (containing chlorophylls, waxes, ... and it contains only steroid saponins).

At first we must make the above tests for all the desired groups (alkaloids, flavone, ...) on these standard stock solutions to see the behaviour of the tests and compare it with our plant extract.

*Approximate Estimation of the Coumarin Content*

Since the purpose of the screening study of the plants was to obtain an approximate estimate of their coumarin content, it was only necessary to set the levels of coumarin concentration expected. This was made in terms of (+) for low coumarin content, (++) for medium content and (+++) for high content. To obtain a graphical representation of such levels by spectrophotometric measurements, three standard coumarin solutions were prepared.

### *Preparation of the standard solutions*

200 g of fresh *Agave americana* (coumarin free) were extracted in the manner previously described and the whole volume of alcoholic extract was made up to one litre. 25 mg of xanthotoxin and 25 mg of marmesin were dissolved in 100 ml of the alcoholic extract of *Agave americana* and kept as a stock solution. Standard solutions were prepared as follows:

#### *Solution (+)*

5 ml of the previous stock solution were pipetted and the whole volume was raised up to 250 ml with *Agave americana* alcoholic extract. This solution represents 0.05% of coumarin content which contained 2.5 mg of xanthotoxin and marmesin in the ratio of 1:1 in 250 ml and was taken as low concentration (+).

#### *Solution (++)*

15 ml of the previous stock solution were pipetted and the whole volume was raised up to 250 ml with *A. americana* alcoholic extract. This solution represents 0.15% of coumarin content, which contained the same composition of coumarins in a concentration of 7.5 mg/250 ml to represent a medium content (++) of coumarins.

#### *Solution (+++)*

30 ml of the previous stock solution were pipetted and the whole volume was raised up to 250 ml with *A. americana* alcoholic extract. This solution represents 0.3% of coumarin content which contained also the same composition in a concentration of 15 mg/250 ml, to represent a high coumarin content (+++).

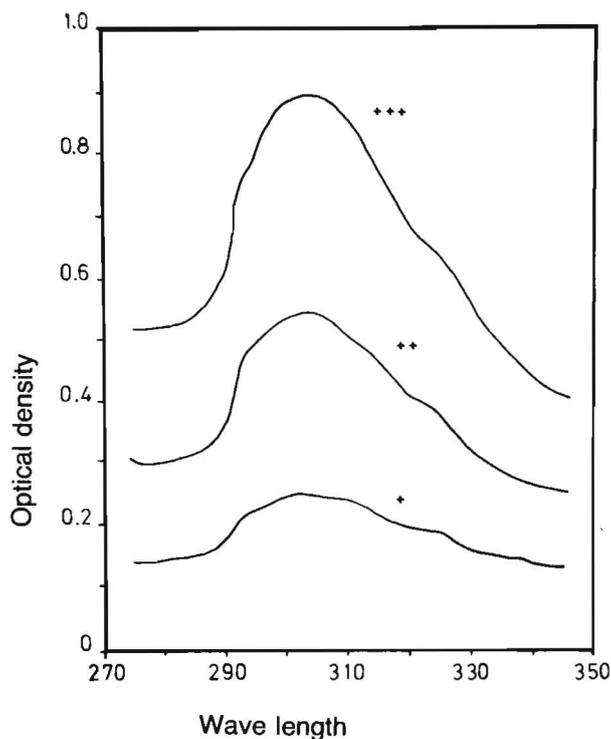
The measurements of these three standards in the ultraviolet region of the spectrum between 275 and 345 nm gave the curves shown in Fig. 1. The three levels of concentration expressed in terms of optical density were taken as reference in the study of the crude coumarin mixtures isolated by sublimation as before.

## **Results and Discussion**

The virtues of active wild medicinal plants has long been ignored in Saudi Arabia except in certain Bedouin tribes. The present work represents an attempt at research of 173 plant species.

### *A. Phytochemical Screening*

The results of phytochemical testing for species screened which gave a score of (+++) were recorded in (Table 1) and can be summarised in the following statements:



**Fig. 1.** Chemical constituents of indigenous plants used in native medicine of Saudi Arabia.

1. Alkaloids are present in 23 species, 8 species give the primary, secondary and tertiary alkaloids, while quaternary alkaloids are present in 22 species.

2. Leucoanthocyanidins are present in 13 species.

3. Flavonoids are present in only 6 species.

4. Terpenes and/or sterols are detected in 17 species, while 33 species are rich in the nonsteroidal unsaturated compounds.

5. Cardiac glycosides are present in one sample, *Calotropis procera* Ait. f, in the roots.

6. Coumarins are indicated in 54 species.

7. Saponins are found in 11 species.

The plants that proved to be rich in one or more of these different categories of active constituents, are identified in the present work for further investigation with the prospect of finding new, potentially active, drug molecules and their sources for the drug industry.

Some 65 species gave results in terms of scores between (0, +, and ++); these samples, with the plant parts studied and their collection numbers in parenthesis, are listed in (Table 2).

### B. Screening for Anticancer Activity

Some assays for anticancer activity were carried out through the Division of Cancer Treatment, National Cancer Institute, NIH, Bethesda MD 20014 USA. Some samples were discarded as they had been tested previously by NCI and found to be inactive. From the tested samples *Convolvulus hystrix* shows preliminary cytotoxic activity *in vitro* in case of human epidermoid carcinoma of the nasopharynx (9KB). *Achillea arabica* and *Anastatica hierochuntica* also need further anticancer testing. This anticancer work is continuing.

### C. Literature of Pharmacological Surveys

A number of interesting reports concerning the possible medicinal uses of these plants, are available in the literature; these are summarized in Table 3.

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Table 1.

| Collection No.<br>(Code designation) | Plants species   | Plant Part | Alkaloids            |                 | Leucoanthocyanidins | Flavonoids |            | Terpenes and/or sterols | Cardiac glycosides | Coumarins | Saponins |
|--------------------------------------|--|------------|----------------------|-----------------|---------------------|------------|------------|-------------------------|--------------------|-----------|----------|
|                                      |  |            | 1ry,<br>2ry,<br>3ry, | Quater-<br>nary |                     | Aglycones  | Glycosides |                         |                    |           |          |
| 1                                    | 2  | 3          | 4                    | 5               | 6                   | 7          | 8          | 9                       | 10                 | 11        | 12       |
| 8                                    | AMARANTHACEAE<br><i>Aerva persica</i> (Burtt.f.) Merv.<br>(= <i>A. javanica</i> Juss.) | s + l      | 0                    | 0               | 0                   | +          | 0          | N                       | 0                  | +         | +++      |
| 32                                   | APIACEAE<br><i>Petroselinum crispum</i>  | s          | 0                    | 0               | 0                   | 0          | 0          | +++                     | 0                  | ++        | 0        |
| 144                                  | <i>Pituranthos triradiatus</i> (Hochst.)<br>Asch. & Schweinf.                          | wa         | +                    | ++              | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |
| 4                                    | APOCYNACEAE<br><i>Nerium oleander</i> L.   | f          | 0                    | 0               | ++                  | +++        | 0          | N                       | 0                  | ++        | 0        |
| 5                                    | <i>Nerium oleander</i>   | fr         | 0                    | 0               | +++                 | ++         | 0          | N                       | 0                  | +++       | 0        |
| 161                                  | <i>Plumeria acuminata</i> Ait.   | fr         | 0                    | +               | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |
| 174                                  | <i>Rhazya stricta</i> Decne  | s + l + f  | +++                  | ++              | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |
| 175                                  | <i>Rhazya stricta</i>  | r          | ++                   | ++              | 0                   | 0          | 0          | 0                       | 0                  | +++       | ++       |
| 205                                  | <i>Rhazya stricta</i>  | fr         | +++                  | +++             | 0                   | 0          | 0          | +                       | 0                  | 0         | 0        |
| 220                                  | <i>Rhazya stricta</i>  | wa         | +++                  | +++             | 0                   | 0          | 0          | N                       | 0                  | 0         | 0        |
| 177                                  | ARECACEAE<br><i>Phoenix dactylifera</i> L.   | s          | 0                    | 0               | +++                 | ++         | 0          | 0                       | 0                  | +         | 0        |
| 146                                  | ASCLEPIADACEAE<br><i>Calotropis procera</i> (Ait.) Ait.                                | r          | 0                    | +               | 0                   | 0          | 0          | +                       | +++                | +++       | 0        |
| 147                                  | <i>Glossonema nubicum</i>  | wa         | +                    | ++              | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |
| 148                                  | <i>Glossonema nubicum</i>  | r          | 0                    | +               | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |
| 140                                  | <i>Gomphocarpus sinaicus</i> Boiss   | w          | +                    | ++              | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |
| 215                                  | <i>Periploca aphylla</i> Decne   | r          | 0                    | +               | 0                   | 0          | 0          | 0                       | 0                  | ++        | +++      |
| 160                                  | <i>Pergularia tomentosa</i> L.   | l + fr     | 0                    | ++              | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |
| 114                                  | ASTERACEAE<br><i>Achillea arabica</i> Ky.  | w + f      | 0                    | +++             | ++                  | ++         | ++         | N                       | 0                  | ++        | 0        |
| 283                                  | <i>Achillea arabica</i>  | r          | 0                    | 0               | 0                   | 0          | 0          | N                       | 0                  | +++       | +        |
| 273                                  | <i>Ambrosia maritima</i> L.  | w          | ++                   | ++              | 0                   | 0          | 0          | +                       | 0                  | +++       | 0        |

|                |  |        |     |     |   |   |   |     |   |   |     |     |
|----------------|--|--------|-----|-----|---|---|---|-----|---|---|-----|-----|
| 271            | <i>Carthamus oxyacantha</i> M.B.                           | w      | ++  | ++  | 0 | 0 | 0 | 0   | 0 | 0 | +++ | 0   |
| 225            | <i>Conyza linifolia</i> Willd Tackh.                       | wa     | 0   | 0   | 0 | 0 | 0 | N   | 0 | 0 | +++ | 0   |
| 275            | <i>Echinops hussoni</i> Boiss.                             | w + fr | 0   | 0   | 0 | 0 | 0 | +++ | 0 | 0 | ++  | 0   |
| 284            | <i>Euryops pinifolius</i> A. Rich                          | r      | 0   | 0   | 0 | 0 | 0 | 0   | 0 | 0 | +++ | 0   |
| 117            | <i>Euryops pinifolius</i>                                  | wa     | 0   | +   | 0 | 0 | 0 | N   | 0 | 0 | +++ | 0   |
| 279            | <i>Francoeuria crispa</i> (Forssk.) Cass.                  | r      | 0   | 0   | 0 | 0 | 0 | N   | 0 | 0 | +++ | 0   |
| 248            | <i>Pulicaria undulata</i> (L.) Kostel                      | w +    | 0   | 0   | 0 | 0 | 0 | +++ | 0 | 0 | +   | 0   |
| BORAGINACEAE   |  |        |     |     |   |   |   |     |   |   |     |     |
| 249            | <i>Atkanna tinctoria</i> (L.) Tausch.                      | w + f  | 0   | 0   | 0 | 0 | 0 | ++  | 0 | 0 | 0   | +++ |
| 170            | <i>Anchusa hispida</i> (Forssk.) Bunge                     | wa     | 0   | +   | 0 | 0 | 0 | 0   | 0 | 0 | +++ | ++  |
| 224            | <i>Heliotropium ramosissimum</i> (Lehm.)<br>Sieb. ex Dc.   | wa     | +++ | +++ | 0 | 0 | 0 | N   | 0 | 0 | 0   | 0   |
| CAPPARACEAE    |  |        |     |     |   |   |   |     |   |   |     |     |
| 259            | <i>Cadaba farinosa</i> Forssk.                             | l      | +++ | +   | 0 | 0 | 0 | N   | 0 | 0 | 0   | 0   |
| 260            | <i>Cadaba farinosa</i>                                     | s      | 0   | +++ | 0 | 0 | 0 | ++  | 0 | 0 | 0   | 0   |
| 73             | <i>Capparis decidua</i> (Forssk.) Edgew                    | b      | 0   | +++ | 0 | 0 | 0 | N   | 0 | 0 | 0   | 0   |
| 74             | <i>Capparis decidua</i>                                    | fr     | +   | +++ | 0 | 0 | 0 | N   | 0 | 0 | +   | 0   |
| CHENOPODIACEAE |  |        |     |     |   |   |   |     |   |   |     |     |
| 184            | <i>Anabasis setifera</i> Mog.                              | r      | 0   | +   | 0 | 0 | 0 | +   | 0 | 0 | +++ | +++ |
| 220            | <i>Chenopodium murale</i> L.                               | wa     | +   | +++ | 0 | 0 | 0 | N   | 0 | 0 | ++  | 0   |
| 145            | <i>Halopeplis perfoliata</i> (Forssk.)<br>Bge ex Schweinf. | r, wa  | 0   | +   | 0 | 0 | 0 | 0   | 0 | 0 | +++ | +++ |
| 70             | <i>Hammada elegans</i> (Bunge) Botsch.                     | r      | 0   | +++ | 0 | 0 | 0 | 0   | 0 | 0 | +   | +++ |
| 71             | <i>Hammada elegans</i>                                     | wa     | +++ | +++ | 0 | 0 | 0 | N   | 0 | 0 | ++  | 0   |
| 182            | <i>Salsola baryosma</i> Dandy                              | r      | 0   | +   | 0 | - | - | +   | 0 | 0 | ++  | +++ |
| 150            | <i>Suaeda monoica</i> Forssk.                              | wa     | +   | +++ | 0 | 0 | 0 | N   | 0 | 0 | ++  | 0   |
| 152            | <i>Suaeda monoica</i>                                      | r      | 0   | +++ | 0 | 0 | 0 | 0   | 0 | 0 | +   | ;   |
| 56             | <i>Suaeda</i> sp.  | wa     | 0   | 0   | 0 | 0 | 0 | N   | 0 | 0 | +++ | 0   |
| 65             | <i>Suaeda</i> sp.  | r      | 0   | ++  | 0 | 0 | 0 | ++  | 0 | 0 | +++ | 0   |
| 179            | <i>Suaeda vermiculata</i> Forssk.                          | wa     | 0   | +++ | 0 | 0 | 0 | 0   | 0 | 0 | ++  | 0   |
| 180            | <i>Suaeda vermiculata</i>                                  | r      | 0   | ++  | 0 | 0 | 0 | 0   | 0 | 0 | +++ | 0   |
| 153            | <i>Suaeda volkensis</i> C.B.Cl.                            | wa     | +   | +++ | 0 | 0 | 0 | 0   | 0 | 0 | ++  | 0   |
| 154            | <i>Suaeda volkensis</i>                                    | r      | 0   | ++  | 0 | 0 | 0 | 0   | 0 | 0 | +++ | +   |
| CISTACEAE      |  |        |     |     |   |   |   |     |   |   |     |     |
| 272            | <i>Helianthemum lipii</i> (L.) Pers.                       | w      | 0   | +++ | 0 | 0 | 0 | N   | 0 | 0 | +   | +++ |
| CONVOLVULACEAE |  |        |     |     |   |   |   |     |   |   |     |     |
| 63             | <i>Convolvulus aeyranis</i> L.                             | w      | 0   | 0   | 0 | 0 | 0 | N   | 0 | 0 | +++ | +   |
| 68             | <i>Convolvulus hystrix</i> Vahl                            | r      | 0   | 0   | 0 | 0 | 0 | 0   | 0 | 0 | +++ | 0   |
| 69             | <i>Convolvulus hystrix</i>                                 | wa     | 0   | 0   | 0 | 0 | 0 | N   | 0 | 0 | +++ | 0   |

Table 1. Continued

| Collection No.<br>(Code designation) | Plants species  | Plant Part | Alkaloids            |                 | Leucoanthocyanidins | Flavonoids |            | Terpenes and/or sterols | Cardiac glycosides | Coumarins | Saponins |
|--------------------------------------|---|------------|----------------------|-----------------|---------------------|------------|------------|-------------------------|--------------------|-----------|----------|
|                                      |   |            | 1ry,<br>2ry,<br>3ry, | Quater-<br>nary |                     | Aglycones  | Glycosides |                         |                    |           |          |
| 1                                    | 2   | 3          | 4                    | 5               | 6                   | 7          | 8          | 9                       | 10                 | 11        | 12       |
| 245                                  | <i>Convolvulus prostratus</i> Forssk.<br>(= <i>C. microphyllus</i> Sieb.) | 3 + fr     | 0                    | 0               | 0                   | 0          | 0          | N                       | 0                  | +++       | 0        |
| 191                                  | <i>Cressa cretica</i> L.  | w          | 0                    | +               | 0                   | 0          | 0          | N                       | 0                  | +++       | 0        |
| CUCURBITACEAE                        |   |            |                      |                 |                     |            |            |                         |                    |           |          |
| 87                                   | <i>Citrullus colocynthis</i> (L.) Schrad.                                 | fr         | 0                    | ++              | 0                   | ++         | ++         | +++                     | 0                  | 0         | 0        |
| 250                                  | <i>Cucumis prophetarum</i> Jusl. ap. L.                                   | fr         | 0                    | 0               | 0                   | 0          | 0          | +                       | 0                  | 0         | +++      |
| 49                                   | <i>Luffa cylindrica</i> L.  | l          | 0                    | ++              | 0                   | 0          | 0          | +++                     | 0                  | 0         | 0        |
| CUPRESSACEAE                         |   |            |                      |                 |                     |            |            |                         |                    |           |          |
| 277                                  | <i>Juniperus polycarpus</i> C. Koch.                                      | r          | 0                    | 0               | +++                 | 0          | 0          | ++                      | 0                  | 0         | 0        |
| CYPERACEAE                           |   |            |                      |                 |                     |            |            |                         |                    |           |          |
| 162                                  | <i>Cyperus laevigatus</i> L.  | wa, r      | 0                    | 0               | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |
| EUPHORBIACEAE                        |   |            |                      |                 |                     |            |            |                         |                    |           |          |
| 251                                  | <i>Chrozophora plicata</i> (Vahl) A. Juss.<br>ex Spreng                   | s + l      | 0                    | 0               | 0                   | 0          | 0          | N                       | 0                  | +++       | 0        |
| FABACEAE                             |   |            |                      |                 |                     |            |            |                         |                    |           |          |
| 58                                   | <i>Acacia ehrenbergiana</i> Hayna   | wa         | 0                    | 0               | 0                   | 0          | 0          | +++                     | 0                  | +         | 0        |
| 156                                  | <i>Acacia ehrenbergiana</i>   | r          | 0                    | +               | 0                   | 0          | 0          | 0                       | 0                  | +++       | ++       |
| 197                                  | <i>Cassia italica</i> (Mill.) Lam. ex Steud.                              | f          | 0                    | +++             | 0                   | 0          | 0          | 0                       | 0                  | ++        | 0        |
| 137                                  | <i>Crotalaria aegyptiaca</i> Benth.                                       | wa         | 0                    | 0               | 0                   | 0          | 0          | N                       | 0                  | +++       | 0        |
| 138                                  | <i>Crotalaria aegyptiaca</i>  | r          | 0                    | +               | 0                   | 0          | 0          | 0                       | 0                  | +++       | +++      |
| 202                                  | <i>Indigofera argentea</i> Burm. f., non L.                               | r          | 0                    | 0               | +++                 | 0          | 0          | 0                       | 0                  | +         | 0        |
| 207                                  | <i>Indigofera spinosa</i> Forssk.   | wa         | 0                    | +               | 0                   | 0          | 0          | +                       | 0                  | ++        | +++      |
| 208                                  | <i>Indigofera spinosa</i>   | r          | +                    | +               | 0                   | 0          | 0          | 0                       | 0                  | ++        | +++      |
| 254                                  | <i>Indigofera spinosa</i>   | l          | 0                    | 0               | 0                   | 0          | 0          | +++                     | 0                  | +++       | 0        |
| 159                                  | <i>Lotus garcinii</i> Dc.   | w          | 0                    | ++              | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |
| 157                                  | <i>Parkinsonia aculeata</i> L.  | fr         | 0                    | +               | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |
| 158                                  | <i>Parkinsonia aculeata</i>   | l + s      | +                    | ++              | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |

|     |   |            |    |     |     |     |     |   |         |   |     |   |
|-----|---|------------|----|-----|-----|-----|-----|---|---------|---|-----|---|
|     | LAMIACEAE   |            |    |     |     |     |     |   |         |   |     |   |
| 286 | <i>Lavandula dentata</i> L.   | r          | 0  | 0   | 0   | 0   | 0   | 0 | ++      | 0 | +++ | 0 |
| 120 | <i>Lavandula dentata</i>  | w + f      | +  | +   | 0   | 0   | 0   | 0 | N       | 0 | +++ | 0 |
|     | LAIURACEAE  |            |    |     |     |     |     |   |         |   |     |   |
| 44  | <i>Cinnamomum camphora</i> L.   | l          | 0  | 0   | 0   | 0   | 0   | 0 | +++     | 0 | 0   | 0 |
|     | LORANTHACEAE  |            |    |     |     |     |     |   |         |   |     |   |
| 264 | <i>Loranthus curviflorus</i> Benth. ex Oliv. in Hook on ( <i>Acacia</i> ) | t, p, s, l | 0  | 0   | +++ | 0   | 0   | 0 | 0       | 0 | 0   | 0 |
|     | MALVACEAE   |            |    |     |     |     |     |   |         |   |     |   |
| 229 | <i>Malva parviflora</i> L.  | w          | 0  | +   | 0   | 0   | 0   | 0 | N       | 0 | +++ | 0 |
|     | MELIACEAE   |            |    |     |     |     |     |   |         |   |     |   |
| 15  | <i>Melia azederach</i> L.   | l          | 0  | +   | 0   | 0   | 0   | 0 | N       | 0 | +++ | 0 |
| 16  | <i>Melia azederach</i>  | s          | 0  | +   | 0   | ++  | 0   | 0 | +++     | 0 | +++ | 0 |
| 18  | <i>Melia azederach</i>  | fr         | 0  | +++ | 0   | 0   | 0   | 0 | Terpene | 0 | 0   | 0 |
| 19  | <i>Melia azederach</i>  | k          | 0  | 0   | 0   | +++ | +++ | + | +       | 0 | +   | 0 |
|     | MORACEAE  |            |    |     |     |     |     |   |         |   |     |   |
| 40  | <i>Ficus benghalensis</i> L.  | s          | 0  | 0   | +++ | +++ | 0   | 0 | Terpene | 0 | 0   | 0 |
| 41  | <i>Ficus benghalensis</i>   | l          | 0  | 0   | 0   | +++ | 0   | 0 | +++     | 0 | 0   | 0 |
| 2   | <i>Ficus elastica</i> Roxb.   | fr         | 0  | 0   | 0   | 0   | 0   | 0 | +++     | 0 | 0   | 0 |
| 72  | <i>Ficus elastica</i>   | r          | 0  | 0   | +++ | +   | +++ | 0 | +++     | 0 | ++  | 0 |
| 6   | <i>Ficus nitida</i> L.  | s +        | 0  | 0   | +++ | +++ | 0   | 0 | N       | 0 | 0   | 0 |
| 282 | <i>Morus nigra</i> L.   | r          | 0  | 0   | 0   | 0   | 0   | 0 | ++      | 0 | +++ | 0 |
|     | PLUMBAGINACEAE  |            |    |     |     |     |     |   |         |   |     |   |
| 57  | <i>Limonium axillare</i> (Forssk.) Ktze                                   | r          | 0  | 0   | +++ | 0   | 0   | 0 | 0       | 0 | ++  | 0 |
|     | POACEAE   |            |    |     |     |     |     |   |         |   |     |   |
| 166 | <i>Aeluropus massauensis</i> (Fres.) Mattei                               | wa         | 0  | +   | 0   | 0   | 0   | 0 | 0       | 0 | +++ | 0 |
| 167 | <i>Aeluropus massauensis</i>  | r          | 0  | 0   | 0   | 0   | 0   | 0 | 0       | 0 | +++ | + |
| 165 | <i>Sporobolus spicatus</i> (Vahl) Kunth                                   | r          | 0  | +   | 0   | 0   | 0   | 0 | 0       | 0 | +++ | 0 |
|     | POLYGONACEAE  |            |    |     |     |     |     |   |         |   |     |   |
| 210 | <i>Polygonum plebejum</i> R. Br.  | r          | 0  | 0   | +++ | -   | -   | 0 | 0       | 0 | ++  | 0 |
|     | RUTACEAE  |            |    |     |     |     |     |   |         |   |     |   |
| 116 | <i>Ruta chalepensis</i> L.  | wa, fr     | ++ | +++ | 0   | 0   | 0   | 0 | N       | 0 | +++ | 0 |
|     | SALVADORACEAE   |            |    |     |     |     |     |   |         |   |     |   |
| 128 | <i>Salvadora persica</i> L.   | l          | 0  | +++ | 0   | 0   | 0   | 0 | N       | 0 | ++  | 0 |
|     | SAPINDACEAE   |            |    |     |     |     |     |   |         |   |     |   |
| 129 | <i>Dodonaea viscosa</i> Jacq.   | s + l + f  | 0  | 0   | +++ | 0   | 0   | 0 | +       | 0 | +++ | 0 |
|     | SOLANACEAE  |            |    |     |     |     |     |   |         |   |     |   |
| 135 | <i>Datura stramonium</i> L.   | w          | ++ | ++  | 0   | 0   | 0   | 0 | N       | 0 | +++ | 0 |
| 126 | <i>Lycium barbarum</i> L.   | wa         | 0  | 0   | +++ | 0   | 0   | 0 | N       | 0 | ++  | 0 |
| 198 | <i>Lycium barbarum</i>  | r          | 0  | 0   | +++ | 0   | 0   | 0 | 0       | 0 | +   | 0 |
| 243 | <i>Solanum dubium</i> Fres.   | fr         | 0  | +++ | 0   | 0   | 0   | 0 | ++      | 0 | 0   | 0 |

Table 1. Continued

| Collection No.<br>(Code designation) | Plants species                                 | Plant Part | Alkaloids            |                 | Leucoanthocyanidins | Flavonoids |            | Terpenes and/or sterols | Cardiac glycosides | Coumarins | Saponins |
|--------------------------------------|--|------------|----------------------|-----------------|---------------------|------------|------------|-------------------------|--------------------|-----------|----------|
|                                      |  |            | 1ry,<br>2ry,<br>3ry, | Quater-<br>nary |                     | Aglycones  | Glycosides |                         |                    |           |          |
| 1                                    | 2  | 3          | 4                    | 5               | 6                   | 7          | 8          | 9                       | 10                 | 11        | 12       |
| 241                                  | <i>Solanum dubium</i><br>URTICACEAE            | fr         | 0                    | 0               | 0                   | 0          | 0          | +                       | 0                  | +++       | ++       |
| 240                                  | <i>Forskalea tenacissima</i> L.<br>VERBENACEAE | w          | 0                    | 0               | 0                   | 0          | 0          | +++                     | 0                  | 0         | 0        |
| 235                                  | <i>Avicennia marina</i> (Forssk.) Vierh.       | l          | 0                    | 0               | 0                   | 0          | 0          | +++                     | 0                  | ++        | 0        |
| 239                                  | <i>Avicennia marina</i><br>ZYGOPHYLLACEAE      | z          | 0                    | 0               | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |
| 219                                  | <i>Peganum harmala</i> L.                      | s + l + fr | +++                  | +++             | 0                   | 0          | 0          | +                       | 0                  | ++        | 0        |
| 115                                  | <i>Peganum harmala</i>                         | w + f      | +++                  | +++             | 0                   | 0          | 0          | N                       | 0                  | +         | 0        |
| 41                                   | <i>Tribulus longipetalus</i> Viv.              | wa + fr    | 0                    | 0               | 0                   | 0          | 0          | +++                     | 0                  | 0         | 0        |
| 151                                  | <i>Zygophyllum album</i> L. f.                 | wa         | 0                    | ++              | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |
| 171                                  | <i>Zygophyllum album</i>                       | r          | ++                   | ++              | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |

Plant part corde: fr, Fruit; sd, Seed; f, Flower; l, Leaf; s, Stem; r, Root; w, Whole plant; wa, Whole plant above ground; k, Bark; t, Testa; p, Putamen; z, Rhizophore.  
N = Nosteroidal unsaturated compounds such as carotenes, xanthophylls, etc.....

Table 2.

| Collection No.<br>(Code designation) | Plant species   | Plant Part | Alkaloids            |                 | Leucoanthocyanidins | Flavonoids |            | Terpenes and/or sterols | Cardiac glycosides | Coumarins | Saponins |
|--------------------------------------|---|------------|----------------------|-----------------|---------------------|------------|------------|-------------------------|--------------------|-----------|----------|
|                                      |   |            | 1ry,<br>2ry,<br>3ry, | Quater-<br>nary |                     | Aglycones  | Glycosides |                         |                    |           |          |
| 1                                    | 2   | 3          | 4                    | 5               | 6                   | 7          | 8          | 9                       | 10                 | 11        | 12       |
|                                      | AMARANTHACEAE   |            |                      |                 |                     |            |            |                         |                    |           |          |
| 118                                  | <i>Aerva lanata</i> (L.) Juss.  | wa         | 0                    | 0               | 0                   | 0          | ++         | N                       | 0                  | 0         | 0        |
| 9                                    | <i>Amaranthus caudatus</i> L.   | s + f      | 0                    | 0               | 0                   | 0          | 0          | N                       | 0                  | 0         | ++       |
|                                      | APIACEAE  |            |                      |                 |                     |            |            |                         |                    |           |          |
| 91                                   | <i>Coriandrum sativum</i> L.  | sd         | +                    | ++              | 0                   | 0          | 0          | N                       | 0                  | ++        | 0        |
| 32                                   | <i>Petroselinum Crispum</i> Miller  | s          | 0                    | 0               | 0                   | 0          | 0          | +++                     | 0                  | ++        | 0        |
|                                      | APOCYNACEAE   |            |                      |                 |                     |            |            |                         |                    |           |          |
| 161                                  | <i>Plumeria acuminata</i> Ait.  | s + l      | +                    | ++              | 0                   | 0          | 0          | 0                       | 0                  | ++        | 0        |
| 3                                    | <i>Nerium oleander</i>  | s + l      | 0                    | 0               | 0                   | 0          | 0          | +                       | 0                  | +         | 0        |
| 42                                   | <i>Vinca rosea</i> L.   | w          | 0                    | 0               | 0                   | 0          | 0          | N                       | 0                  | 0         | 0        |
|                                      | ASCLEPIADACEAE  |            |                      |                 |                     |            |            |                         |                    |           |          |
| 146                                  | <i>Calotropis procera</i> Ait. f.   | w + fr     | 0                    | +               | 0                   | 0          | 0          | +                       | +++                | +++       | 0        |
| 61                                   | <i>Leptadenia pyrotechnica</i> Forssk.  | wa         | 0                    | 0               | 0                   | 0          | 0          | N                       | 0                  | +         | 0        |
| 213                                  | <i>Periploca aphylla</i> Decne  | wa + fr    | 0                    | ++              | 0                   | 0          | 0          | N                       | 0                  | ++        | 0        |
|                                      | ASTERACEAE  |            |                      |                 |                     |            |            |                         |                    |           |          |
| 271                                  | <i>Carthamus oxyacantha</i> M.B.  | w + r      | ++                   | ++              | 0                   | 0          | 0          | 0                       | 0                  | +++       | 0        |
| 211                                  | <i>Francoeuria crispa</i> (Forssk.) Cass.<br>(+ <i>Pulicaria crispa</i> (Forssk.) Benth.<br>et Hook. f. | wa + r     | ++                   | +               | 0                   | 0          | 0          | 0                       | 0                  | ++        | 0        |
| 274                                  | <i>Carduus pycnocephalus</i> L.   | w + f      | 0                    | 0               | 0                   | 0          | 0          | N                       | 0                  | ++        | 0        |
| 125                                  | <i>Xanthium brasiliicum</i> vellozo   | w          | 0                    | ++              | 0                   | 0          | 0          | N                       | 0                  | 0         | 0        |
|                                      | CAPPARACEAE   |            |                      |                 |                     |            |            |                         |                    |           |          |
| 259                                  | <i>Cadaba farinosa</i> Forssk.  | l + r      | +++                  | +               | 0                   | 0          | 0          | N                       | 0                  | 0         | 0        |
| 75                                   | <i>Capparis decidua</i> Forssk. Edgew   | b + r + fr | 0                    | +0              | 0                   | 0          | 0          | 0                       | 0                  | 0         | +        |
|                                      | CARYOPHYLLACEAE   |            |                      |                 |                     |            |            |                         |                    |           |          |
| 258                                  | <i>Polycarpaea repens</i> (Forssk.) Asch. et<br>Schweinf.   | w + f      | +                    | 0               | 0                   | 0          | 0          | ++                      | 0                  | ++        | 0        |

Table 2. Continued

| Collection No.<br>(Code designation) | Plant species   | Plant Part | Alkaloids            |                 | Leucoanthocyanidins | Flavonoids |            | Terpenes and/or sterols | Cardiac glycosides | Coumarins | Saponins |
|--------------------------------------|---|------------|----------------------|-----------------|---------------------|------------|------------|-------------------------|--------------------|-----------|----------|
|                                      |   |            | 1ry,<br>2ry,<br>3ry, | Quater-<br>nary |                     | Aglycones  | Glycosides |                         |                    |           |          |
| 1                                    | 2   | 3          | 4                    | 5               | 6                   | 7          | 8          | 9                       | 10                 | 11        | 12       |
|                                      | CHENOPODIACEAE  |            |                      |                 |                     |            |            |                         |                    |           |          |
| 183                                  | <i>Anabasis setifera</i> Mog.                           | wa         | 0                    | +               | 0                   | 0          | 0          | 0                       | 0                  | +         | ++       |
| 71                                   | <i>Hammada elegans</i> (Beunge) Botsch                  | wa         | 0                    | ++              | 0                   | 0          | 0          | N                       | 0                  | +         | ++       |
| 181                                  | <i>Salsola baryosma</i> Dandty                          | wa         | 0                    | +               | 0                   | 0          | 0          | 0                       | 0                  | ++        | 0        |
| 218                                  | <i>Schaginia baccata</i> (Forssk.) Mogg.<br>Taud.       | w          | 0                    | +               | 0                   | 0          | 0          | 0                       | 0                  | ++        | 0        |
|                                      | CUCURBITACEAE   |            |                      |                 |                     |            |            |                         |                    |           |          |
| 216                                  | <i>Citrullus colocynthis</i> (L.) Schard                | fr         | 0                    | +               | 0                   | 0          | 0          | N                       | 0                  | +         | 0        |
| 50                                   | <i>Luffa cylindrica</i> L.                              | s          | 0                    | 0               | 0                   | 0          | 0          | ++                      | 0                  | 0         | 0        |
|                                      | CUPRESSACEAE  |            |                      |                 |                     |            |            |                         |                    |           |          |
| 119                                  | <i>Juniperus procera</i> Hochst. ex Bndl.               | wa         | 0                    | 0               | 0                   | 0          | 0          | N                       | 0                  | ++        | 0        |
| 277                                  | <i>Juniperus polycarpus</i> C. Koch                     | wa + fr    | 0                    | 0               | +++                 | 0          | 0          | ++                      | 0                  | 0         | 0        |
|                                      | EUPHORBIACEAE   |            |                      |                 |                     |            |            |                         |                    |           |          |
| 251                                  | <i>Chrozophora plicata</i> (Vahl) A. Juss.<br>ex Spreng | s + f      | 0                    | 0               | 0                   | 0          | 0          | N                       | 0                  | +++       | 0        |
| 131                                  | <i>Ricinus communis</i> L.                              | w          | 0                    | +               | 0                   | 0          | 0          | 0                       | 0                  | ++        | 0        |
|                                      | FABACEAE  |            |                      |                 |                     |            |            |                         |                    |           |          |
| 230                                  | <i>Acacia saligna</i>                                   | wa         | 0                    | 0               | 0                   | 0          | 0          | N                       | 0                  | 0         | 0        |
| 196                                  | <i>Cassia italica</i> (Mill.) Lam. ex Steud.            | w + fr     | 0                    | ++              | 0                   | 0          | 0          | N                       | 0                  | ++        | 0        |
| 201                                  | <i>Indigofera argentea</i> Burm. f., non. L.            | w          | 0                    | 0               | 0                   | 0          | 0          | N                       | 0                  | ++        | +        |
|                                      | GERANIACEAE   |            |                      |                 |                     |            |            |                         |                    |           |          |
| 10                                   | <i>Erodium glaucophyllum</i> (L.) Aiton.                | wa         | 0                    | +               | 0                   | 0          | 0          | N                       | 0                  | 0         | 0        |
|                                      | LAMIACEAE   |            |                      |                 |                     |            |            |                         |                    |           |          |
| 102                                  | <i>Asphodelus fistulosus</i> L.                         | w          | +                    | ++              | 0                   | 0          | 0          | N                       | 0                  | +         | 0        |
| 132                                  | <i>Lavandula stricta</i> Del.                           | w          | 0                    | +               | 0                   | 0          | 0          | N                       | 0                  | ++        | 0        |
| 121                                  | <i>Marrubium vulgare</i> L.                             | w + f      | 0                    | ++              | 0                   | 0          | 0          | 0                       | 0                  | 0         | 0        |
| 105                                  | <i>Mentha microphylla</i> C. Koch                       | wa         | 0                    | 0               | 0                   | 0          | 0          | N                       | 0                  | ++        | 0        |

|                  |   |           |    |    |     |   |    |    |        |   |    |   |
|------------------|---|-----------|----|----|-----|---|----|----|--------|---|----|---|
| 270              | <i>Nepeta deflersiana</i> Schweinf.                               | w + f     | 0  | 0  | 0   | 0 | 0  | 0  | ++     | 0 | ++ | 0 |
| 133              | <i>Salvia sclarea</i> L.  | wa        | 0  | ++ | 0   | 0 | 0  | 0  | N      | 0 | ++ | 0 |
| 142              | <i>Salvia verbenaca</i> L.  | wa        | +  | ++ | 0   | 0 | 0  | 0  | +      | 0 | 0  | 0 |
| 94               | <i>Thymus capitatus</i> (L.) Hoffmgg. et Link                     |           | 0  | 0  | 0   | 0 | 0  | 0  | Terpne | 0 | ++ | 0 |
| LILIACEAE        |   |           |    |    |     |   |    |    |        |   |    |   |
| 143              | <i>Aloe vera</i> L.   | w + f     | 0  | 0  | 0   | 0 | 0  | 0  | 0      | 0 | +  | 0 |
| MALVACEAE        |   |           |    |    |     |   |    |    |        |   |    |   |
| 7                | <i>Abutilon pannosum</i> (Forst. f.) Schlecht.                    | wa        | 0  | 0  | 0   | 0 | 0  | 0  | N      | 0 | +  | 0 |
| MORACEAE         |   |           |    |    |     |   |    |    |        |   |    |   |
| 2                | <i>Ficus elastica</i> L.  | wa        | 0  | 0  | 0   | 0 | 0  | 0  | +++    | 0 | 0  | 0 |
| MYRTACEAE        |   |           |    |    |     |   |    |    |        |   |    |   |
| 11               | <i>Lawsonia inermis</i> L.  | wa        | 0  | 0  | 0   | 0 | 0  | 0  | N      | 0 | 0  | 0 |
| PLUMBAGINACEAE   |   |           |    |    |     |   |    |    |        |   |    |   |
| 57               | <i>Limonium axillare</i> (Forssk.) Ktze                           | w         | 0  | 0  | +   | 0 | ++ | N  | 0      | 0 | +  | 0 |
| POACEAE          |   |           |    |    |     |   |    |    |        |   |    |   |
| 247              | <i>Aristida funiculata</i> Trin & Puper                           | w         | 0  | 0  | 0   | 0 | 0  | ++ | 0      | 0 | +  | 0 |
| 221              | <i>Cymbopogon schoenanthus</i> (L.) Spreng.                       | wa        | +  | ++ | 0   | 0 | 0  | N  | 0      | 0 | ++ | 0 |
| 164              | <i>Sporobolus spicatus</i> Kunth                                  | wa        | 0  | 0  | 0   | 0 | 0  | +  | 0      | 0 | +  | 0 |
| POLYGONACEAE     |   |           |    |    |     |   |    |    |        |   |    |   |
| 209              | <i>Polygonum plebejum</i> R. Br.                                  | wa        | 0  | 0  | 0   | 0 | 0  | N  | 0      | 0 | +  | 0 |
| 268              | <i>Rumex dentatus</i> L.  | wa + fr   | 0  | 0  | 0   | 0 | 0  | N  | 0      | 0 | ++ | 0 |
| POTAMOGETONACEAE |   |           |    |    |     |   |    |    |        |   |    |   |
| 134              | <i>Potamogeton nodosus</i> Poir                                   | w         | 0  | 0  | 0   | 0 | 0  | 0  | 0      | 0 | ++ | 0 |
| RESEDACEAE       |   |           |    |    |     |   |    |    |        |   |    |   |
| 262              | <i>Ochradenus baccatus</i> Del.                                   | wa + fr   | ++ | 0  | 0   | 0 | 0  | 0  | +      | 0 | ++ | 0 |
| ROSACEAE         |   |           |    |    |     |   |    |    |        |   |    |   |
| 45               | <i>Cinnamomum caphora</i> L.                                      | s         | 0  | 0  | 0   | 0 | 0  | 0  | +      | 0 | 0  | 0 |
| SALVADORACEAE    |   |           |    |    |     |   |    |    |        |   |    |   |
| 92               | <i>Salvadora persica</i> L.                                       | s         | +  | ++ | 0   | 0 | 0  | 0  | +      | 0 | +  | 0 |
| SOLANACEAE       |   |           |    |    |     |   |    |    |        |   |    |   |
| 126              | <i>Lycium barbarum</i> L.   | w         | 0  | 0  | +++ | 0 | 0  | 0  | N      | 0 | ++ | 0 |
| 280              | <i>Solanum albicaule</i> Key ex Dun. in Dc.                       | w + fr    | 0  | 0  | 0   | 0 | 0  | 0  | 0      | 0 | +  | 0 |
| 244              | <i>Solanum dubium</i> Res   | s + l     | 0  | 0  | 0   | 0 | 0  | 0  | N      | 0 | 0  | 0 |
| 232              | <i>Withania somnifera</i> (L.) Dun. in Dc.                        | wa + fr   | 0  | +  | 0   | 0 | 0  | 0  | +      | 0 | 0  | 0 |
| TILIACEAE        |   |           |    |    |     |   |    |    |        |   |    |   |
| 192              | <i>Corchorus depressus</i> (L.) Christens.                        | w         | 0  | 0  | 0   | 0 | 0  | 0  | 0      | 0 | ++ | 0 |
| VERBENACEAE      |   |           |    |    |     |   |    |    |        |   |    |   |
| 255              | <i>Avicennia marina</i> (Forssk.) Vierh.                          | l + s + z | 0  | 0  | 0   | 0 | 0  | 0  | +++    | 0 | ++ | 0 |
| ZYGOPHYLLACEAE   |   |           |    |    |     |   |    |    |        |   |    |   |
| 187              | <i>Fagonia brugieri</i> Dc.                                       | w         | 0  | +  | 0   | 0 | 0  | 0  | 0      | 0 | +  | 0 |
| 62               | <i>Fagonia indica</i> Burm. f.<br>(= <i>F. parviflora</i> Bioss.) | w         | 0  | +  | 0   | 0 | 0  | 0  | N      | 0 | +  | 0 |
| 188              | <i>Zygodphyllum coccineum</i> L.                                  | w         | 0  | +  | 0   | 0 | 0  | 0  | 0      | 0 | ++ | 0 |

**Table 3.** Literature of pharmacological surveys

| <b>Plants species</b>                    | <b>Medicinal uses</b>   | <b>References</b>                            |
|--|---|--|
| <i>Achillea arabica</i> Ky.              | A decoction, used as an eye wash.   | Lewis and Elvin-Lewis (1976)                 |
| <i>Aerva persica</i> (Burm. f.)          | A paste of the roots is applied to acne like conditions of the face.  | Perry (1980)                                 |
| <i>Alkanna tinctoria</i> (L.) Tausch.    | Colouring agent for oils and ointments.   | Mahran (1967)                                |
| <i>Aloe vera</i> (Haw.) Berger           | The sap is used both fresh and inspissated, as a laxative or purgative, taken with sugar, it is a treatment for asthma, in small doses a tonic for dyspepsia, it is medication against cough, and epilepsy; it is to be emmenagogue and also to increase bile secretion, as well as a remedy for rheumatism and certain liver disorders; it is chewed as a depurative.<br>In Philippines: it has been mixed with milk and ingested dysentery and pain in the kidneys. Externally, it is supposed to be helpful in alopecia, and valuable for keeping the hair in good condition. It has been applied to wounds, swellings, the abdomen post partum, burns, eczema and in wash with licorice to skin affections. it is designated as a remedy for itching nose caused by thread worms, also for some eye diseases. | Perry (1980)                                 |
| <i>Ambrosia martima</i> L.               | As aerollergens causing allergic rhinitis, bronchial asthma, hypersensitivity and pneumonitis; also as an antispasmodic, in renal colic, a diuretic, and to promote passage of kidney calculi.  | Lewis and Elvin-Lewis (1976), Mahran (1967)  |
| <i>Avicennia marina</i> (Forssk.) Vierh. | Possessing an aromatic, bitter juice, is an abortive used in tropical Africa and Asia.  | Lewis and Elvin-Lewis (1976)                 |
| <i>Calotropis procera</i> (Ait.) Ait.    | Containing the cardiac glycoside calotropin, is extremely potent, and is used on arrows in Africa. Minute amounts are said to produce death. It has also been used for murders and suicides in tropical America; root bark used to treat leprosy. Also as heart stimulant, emmenagogue, drastic purgative, and in certain skin diseases.  | Lewis and Elvin-Lewis (1976), Mahran (1967)  |
| <i>Capparis decidua</i> (Forssk.) Edgew  | Laxative, diaphoretic, alexetric, anthelmintic and useful against coughs, asthma and inflammations. Also for mental disease, hysteria, amnesia and vrtigo; and as powerful rube-faciants.   | Dalziel (1948), Lewis and Elvin-Lewis (1976) |

| Plants species                                  | Medicinal uses  | References  |
|---|---|---|
| <i>Cassia italica</i> (Mill.)<br>Lam. ex Steud. | Gives (rhein) used as an antibiotic.  | Leiwis and Elvin-Lewis (1976)   |
| <i>Chenopodium murale</i><br>(L.) J. S. Presel  | Aeroallergens causing allergic rhinitis, bronchial asthma, and/or hypersensitivity, pneumonitis; also provokes photodermatitis in man.  | Lewis and Elvin-Lewis (1976)  |
| <i>Cinnamomum camphora</i> L.                   | It is anticonvulsant and insecticidal. The part most largely used is the stearoptene obtained from the chipped trunk, root, and branches, it has diaphoretic carminative, sedative, anthelmintic and antirheumatic properties; externally, it is used to relieve aching teeth, and in ointment to treat favus. It has antiseptic and heart-stimulant properties. It is a remedy for diseases of the respiratory system, and as an antidote to opium poisoning. Give use as a disinfectant, a vermifuge, and a remedy for paralysis and cholera. | Perry (1980)  |
| <i>Citrullus colocynthis</i><br>(L.) Schrad.    | Dried pulp of the unripe fruit is a violent purgative, but because of the danger of poisoning it is not used; it is a gastro-intestinal stimulant or irritants, a powerful purgative acting as a hydrogogue cathartic, and antirheumatic in folklore medicine; against carcinoma and sarcoma.   | Lewis and Elvin-Lewis (1976), Mahran (1967), Belkin <i>et al.</i> (1952), Faust <i>et al.</i> (1958), Gitter <i>et al.</i> (1961) |
| <i>Conyza linifolia</i> Willd<br>Tackh.         | Is fatal to sheep.  | Lewis and Elvin-Lewis (1976)  |
| <i>Cariandrum sativum</i><br>L.                 | Aromatic, carminative, causing contact dermatitis.  | Lewis and Elvin-Lewis (1976), Mahran (1967)   |
| <i>Cressa cretica</i> L.                        | Considered significant tonic and expectorant.   | Lewis and Elvin-Lewis (1976)  |
| <i>Crotalaria aegyptiaca</i><br>Benth.          | As hepatocarcinogenic.  | Lewis and Elvin-Lewis (1976)  |
| <i>Cyperus laevigatus</i> L.                    | Used to relieve toothache.  | Mahran (1967)   |
| <i>Datura stramonium</i> L.                     | Has lectinic properties, allergy; source of commercial hyoscine; cerebral and spinal sedative, and against carcinoma.   | Lewis and Elvin-Lewis (1976), Mahran (1967)   |
| <i>Dodonea viscosa</i><br>Jacq.                 | Used to relieve toothache and against carcinoma.  | Lewis and Elvin-Lewis (1976)  |
| <i>Echinops hussoni</i><br>Boiss.               | As oral hygiene agent.  | Lewis and Elvin-Lewis (1976)  |

| Plants species   | Medicinal uses  | References                   |
|--|---|------------------------------|
| <i>Ficus benghalensis</i> L.   | The roots are tonic, and with the leaves, are prescribed sometimes to treat dropsy. In Philippines: the bruised roots are a vulnerary. The bark contains some ethanol-soluble, orally effective, hypoglycemic principles. It is said to have specific value in diabetes.  | Perry (1980)                 |
| <i>Ficus elastica</i> Roxb.  | The rootlets is applied as a vulnerary; taken internally, it is said to cure phlhisis; against sarcoma.   | Perry (1980), Irie (1964)    |
| <i>Gomphocarpus sinai-</i><br><i>cus</i> Boiss.                      | Poisonous to sheep.   | Lewis and Elvin-Lewis (1976) |
| <i>Heliotropium ramo-</i><br><i>sissimum</i> (Lehm.)<br>Sieb. ex Dc. | As hepatocarcinogenic.  | Lewis and Elvin-Lewis (1976) |
| <i>Indigofera argentea</i><br>Burm. non L.                           | Used to relieve toothache.  | Lewis and Elvin-Lewis (1976) |
| <i>Juniperus polycarpus</i><br>C. Koch.                              | And other species give podophyllotoxin active against tumors.   | Lewis and Elvin-Lewis (1976) |
| <i>Limonium axillare</i><br>(Forssk.) Ktze                           | Is a powerful astringent, used against diarrhea and dysentery in the 19 <sup>th</sup> century.  | Lewis and Elvin-Lewis (1976) |
| <i>Lotus garcinii</i> Dc.  | With lectinic properties.   | Lewis and Elvin-Lewis (1976) |
| <i>Lycium barbarum</i> L.  | Diuretic.   | Lewis and Elvin-Lewis (1976) |
| <i>Malva parviflora</i> L.   | As stimulants and emollient.  | Lewis and Elvin-Lewis (1976) |
| <i>Marrubium vulgare</i> L.  | An infusion is employed in domestic medicine as a bitter tonic and expectorant. Frequently used in lozenges for cough.  | Webb (1955)                  |
| <i>Melia azederach</i> L.  | The bark has been utilized as an anthelmintic, indicates that tablets made from the bark removed 76% of the worms, but 26% of the patients experienced toxic reactions to the drug. It also has been recommended by chinese to treat kala azar, stomachache, intestinal disorder, and atrophy. The fruits are somewhat poisonous, but regarded as quieting, anthelminthic, antifebrile, and diuretic. They are employed to treat fever, delirium, hernia, uterine illness, and pollution. The coil of the seed is antiseptic. The plant is an insecticide. The leaves are used to treat mange of horses. The fruits improved from szechwan are used as a vermifuge and a febrifuge; the | Perry (1980)                 |

| Plants species                     | Medicinal uses  | References  |
|------------------------------------|---|---|
| <i>Nerium oleander</i> L.          | <p>very bitter root affords a treatment for skin diseases.</p> <p>In Philippines: The dried ripe fruits are mentioned as an external parasiticide, and a decoction of the root bark as an anthelmintic.</p> <p>All parts contain cardioactive glycosides, and oleandrin from the leaves, the prominent glycoside, has been used to treat cardiac insufficiency.</p> <p>Ingestion can be dangerous and may result in severe vomiting and bloody diarrhea, irregular heart beat, drowsiness, unconsciousness, respiratory paralysis and death. Also against the indurated tumors. Acting as a diuretic.</p> <p>The dried flowers are said to be administered to build up declining strength. A decoction of the leaves in oil is used to destroy maggots found in wounds, and to treat scabies or tinea (<i>i.e.</i> as a parasiticide); the bark and leaves, mixed with oil, are applied to skin eruptions or irritations in herpes.</p> | Lewis and Elvin-Lewis (1976), Perry (1980), Abu-Mansur (1893) |
| <i>Parkinsonia aculeata</i> L.     | Against carcinoma.  |   |
| <i>Peganum harmala</i> L.          | Of hallucinogenic use; used as aphrodisiacs; seeds possess undoubted hallucinogenic compounds; against carcinoma, Ehrlich.  | Lewis and Elvin-Lewis (1976)                                  |
| <i>Pergularia tomentosa</i> L.     | Expectorant, purgative, in skin diseases, uterine and heart stimulant.  | Mahran (1967)   |
| <i>Periploca aphylla</i> Decne     | Against tumors and swellings.   | Murray (1881), Chopra <i>et al.</i> (1956)                    |
| <i>Petroselinum crispum</i> Miller | Emenagogue in amenorrhoea and dysmenorrhoea, stimulant and diuretic.  | Mahran (1967)   |
| <i>Plumeria acuminata</i> Ait.     | Primarily responsible for irritant dermatitis.  | Lewis and Elvin-Lewis (1976)                                  |
| <i>Polycarphaea repens</i> R. Br.  | Used as snake bite antidotes.   | Lewis and Elvin-Lewis (1976)                                  |
| <i>Polygonum plebejum</i> R. Br.   | As antidiarrheal agent.   | Lewis and Elvin-Lewis (1976)                                  |
| <i>Ricinus communis</i> L.         | Drastic purgative; source of castor oil obtained from seeds; laxative, relieves toothache. The crushed seeds appear to be used as a remedy for many troubles; deafness, headache, scrofula, skin affections, hemorrhage,  | Lewis and Elvin-Lewis (1976), Perry (1980)                    |

| Plants species                          | Medicinal uses  | References    |
|---|---|---------------|
| <i>Ruta chalepensis</i> L.              | <p>dropsy, constipation, swellings, abscesses, and as a dressing for boils, a decoction is taken to cure piles, and the seed removed from the seed coat is administered to promote. In Philippines, the seeds are regarded as anti-rheumatic.</p> <p>The heated leaves may be applied to ease the pain of gout, rheumatism, chronic ulcers and sharp pain in the side with difficult breathing. The leaves may be oiled and heated, made into a poultice, or boiled in milk, then used as a softening remedy. A decoction is drunk as a expectorant and to dispel humors.</p> <p>In intestinal colic, atonic amenorrhoea and antirheumatic.</p> | Mahran (1967) |
| <i>Salsola boryosma</i> (Schult.) Dandy | Aeroallergens causing allergic rhinitis, bronchial asthma, hypersensitivity and pneumonitis.  |               |
| <i>Salvadora persica</i> L.             | Diuretic, gastritis, hook-worm, venereal disease, in Arabia this species has long been known as the tooth-brush tree and arak. Decoction of bark considered stimulant and tonic, given in amenorrhoea. Leaves heated and tied up in thin cloth are applied in rheumatism. Decoction of leaves given in cough and asthma. Flower yields an oil which is a stimulant and laxative.  |               |
| <i>Tribulus longipetalus</i> Viv.       | Used as aphrodesiacs, diuretics.  |               |
| <i>Zygophyllum coccineum</i> L.         | In rheumatism, gout, cough, asthma and as diuretic.   | Mahran (1967) |

## التركيب الكيميائي للنباتات المستعملة في الطب الشعبي بالمملكة العربية السعودية

بهجت الطويل

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السعودية

يتناول هذا البحث دراسة كيميائية أولية لبعض النباتات النامية في المملكة العربية السعودية ، وهذا جزء من برنامج يهدف إلى إجراء مسح كيميائي دقيق لأكثر عدد من نباتات المملكة . وقد تم عمل دراسة فيتوكيميائية للكشف عن مختلف المواد الفعّالة التي تحتويها هذه النباتات وتبويبها كل حسب مجموعته لبيان النباتات التي تحتوي على كميات عالية من القلويدات ( ثلاثة وعشرون جنساً ) ، الليكوانثوسياندين ( ثلاثة عشر جنساً ) ، الفلافونيات ( ستة أجناس ) ، المركبات غير الستيرولية غير المشبعة ( ثلاثة وثلاثون جنساً ) ، الكومارينات ( أربعة وخمسون جنساً ) والسابونينات (أحد عشر جنساً) .