

Phytotherapy of Diabetes in West Algeria

H. ALLALI*, H. BENMEHDI, M.A. DIB, B. TABTI, S. GHALEM and N. BENABADJI†

Laboratory of Organic Chemistry, Natural Products and Analysis (COSNA)

Department of Chemistry, Faculty of Sciences, University of Aboubekr Belkaid

BP 119, 13000 Tlemcen, Algeria

Fax: (213)43286530; E-mail: h_allali72@yahoo.fr

Medicinal plants have been used since remote times in folk medicine and they are now a part of the people inheritance. Through North African countries, today's folk medicine has been boosted as a consequence of hard economic conditions. Because of its geographical situation, climate and soil composition, Tlemcen's region offers a wide variety of plants and flowers. The frequent usage of medicinal plants in the Tlemcen's region by diabetics prompted us in development of these plants. This induced us to set up traditional hypoglycaemic plants sample survey with a view to setting forth the benefit they could bring about for patients affected by diabetes. The results gathered from 634 inquiry forms (435 women and 199 men) were separated into two groups: diabetics using medicinal plants (62 %) and using industrial hypoglycaemic medicines (38 %). Those results showed that phytotherapy was widely adopted by west Algerian society. The survey undertaken allowed us to observe that more than 58 plants were used in traditional care of diabetes of which the most used were *Trigonella foenum graecum* L. (Leguminosae), *Citrullus colocynthis* L. Schrad. (Cucurbitaceae), *Saccocalyx satureioides* Coss. and Dur. (Labiatae), *Berberis vulgaris* L. (Berberidaceae) and *Aloe vera* Trabut (Liliaceae). Moreover, present findings showed that non-insulin dependent patients used more medicinal plants than insulin-dependent patients.

Key Words: Phytotherapy, Diabetes, Medicinal plants, Ethnopharmacology, Tlemcen.

INTRODUCTION

Among all endocrinal diseases, diabetes is the most commonly encountered and many people are hit whichever their social background. The main characteristic of the disease is a chronic syndrome related to a failure in carbohydrates metabolism that brings about a high level glycaemia.

†Laboratory of Botany, Department of Biology, University of Aboubekr Belkaid, BP 119, 13000 Tlemcen, Algeria.

According to a 1998 WHO's report, 140 million people were hit by this disease all over the world and this figure would reach a peak of 300 million people by 2025. In Algeria, a 1997 national survey indicated a 7.1 % of people hit by the disease¹. In 2002, at touareges of the South Algerian, the prevalence is 0.7 %².

Occurrence of insulin-dependent diabetes was usually situated between 5 and 40 years (one case out of two before the age of 20 years).

Non insulin-dependent diabetes represents 80 to 85 % of all known diabetes and was found mainly in people over 40 years. In Tlemcen region, we have observed an important increase of the number of diabetics in recent years. Some endogenous and environmental factors such as obesity might increase the incidence of non insulin-dependent diabetes. The latter was most frequently encountered when some conditions such as a settled way of life, stress, inadequate diet, ageing and change in the habits (food uptake, sedentarity) especially for the women were joined. These results clearly showed that Tlemcen society was well accustomed with phytotherapy^{3,4}. Another investigation was carried out at the hospital during 14 years (1986-1999). The results showed that there were more than 15000 diabetics in Tlemcen area.

Tlemcen region is located at the North-West of Algeria next to Mediterranean Sea. It is bordered to the West by Morocco, to the East by the Department of Ain Temouchent and to the South by the department of Naama. The average altitude is 800 m and the region is situated at latitude 34°52' North and at longitude 1°21' West. The present investigations were carried out all over Tlemcen Mounts where the weather is hot and dry during 6 months, whereas it is rainy (570 mm) and cold the remaining time of the year.

Tlemcen soil is fertile so that people settled there from remote times setting up some important manufactures in the recent years. The census of 1998 indicated a figure of 325864 people that made about 140 people by square km whereas the 2000 census showed a moderated increase of population (338 971 people).

Because of its geographical position Tlemcen's region is characterized by a climatic diversity which is favourable to the growth and development of medicinal plants⁵.

The aim of the present work is to identify species of plants that are commonly used by the population to treat the diabetes mellitus.

EXPERIMENTAL

The survey was undertaken in different areas of Tlemcen and carried out by means of a questionnaire based on such data as sex, age, pathology of persons interviewed and the frequency medicinal consultations and type of diabetes and kind of treatment. It also contained data on name and used

part plants, dose, mode of preparation and administration, duration of treatment, treatment number, patients' health condition and glycaemia level after treatment as well as any secondary effects which might have been observed after treatment with medicinal plants.

The survey and data collection was undertaken in collaboration with the Hospital's Internal Medicine Department and the Tlemcen Diabetic Association. The present survey was completed with interviews made with as many people affected by the disease as possible.

We did a sampling of the whole plants deducted and represented on floristic lists. By definition, the sampling is the whole of operations which have for object to take from population samples⁶. Vegetal formations of the studied region (West Algeria) are enough diversified. One can meet: (1) raised formation: it is ligneous species formed by vegetals of 2 meters of height. One can allege to title of example: *Quercus ilex*, *Quercus suber*. (2) sylvical formation: it concerns ligneous species of less than 2 meters height, let us allege to title of example: *Cistus ladaniferus* (Ciste), *Calycotome spinosa* (Calycotome). (3) herbaceous formation: it regroups the whole vegetals of which the aerial part is not ligneous, for example: *Plantago lagopus* (Plantin), *Papaver rhoeas* (Poppy).

Knowing those different formations, we have been brought to prospect places in order to mark those different vegetal species. The prelevments has been realized during spring and summer periods, *i.e.*, the time when the plants in question are to their optimum development with presence of inflorescences (flowers).

After having done prelevments on the field, we have proceeded to their identification from botanic flora⁷⁻¹². Sampling was carried out on the original area of growth and according to usual procedures, especially the Braun-Blanquet's method¹³. Braun-Blanquet method is a method that consists in taking the plant species *in situ*. On every floristic card, are mentioned the general characters of the place (altitude, slope, exhibition, nature of the substratum, middle height of vegetation and the surface). Every species is affected of two indications (abundance-dominance, sociability).

Species harvested on the land have been dried then identified from the botanical flora. Characteristics of different species under survey were determined on spring since it is the period as many taxonomic features as possible can be encountered¹¹. Plants were collected by students and the investigators in biology over the year. These species were kept in nylon bags. The harvest was carried out all over the different Tlemcen mounts and in the South West Algerian Region.

Taxonomic identification of plants was performed in collaboration with the Botany Laboratory of the Department of Biology at Aboubekr Belkaid-Tlemcen University. Glycaemia level was measured in Tlemcen's Hospital in presence of medical qualified staves.

RESULTS AND DISCUSSION

The survey identified 634 diabetics (435 women and 199 men) of which 394 used just the plants and 240 used oral hypoglycaemic medicines with no plants. On the average, 62 % of patients regularly use medicinal plants.

The patients were categorized into sex and age. In present sampling, Table- 1 shows that women (68.6 %) were more exposed to diabetes than men (31.4 %). This might be related to some factors like: sedentarity, stress, obesity *etc.* Besides that, it has been observed in present survey that women (70 %) used more plants than men (30 %). It is probably related to their rich knowledge and deep faith in traditional medicine (Table-2). All the data gathered showed that for both sexes, the non-insulin dependent diabetics (NIDD) patients (66.2 %) used more plants than insulin dependent diabetics (IDD) patients (33.8 %). However IDD patients mainly used insulin and when necessary, they treated themselves with plants or their extracts^{14,15}. In all categories, the proportions of the plant users remain high and appear to be independent of sex and age of the patients (Table-1). These results clearly show that phytotherapy is widely adopted by west Algerian society.

TABLE-1
DISTRIBUTION OF PATIENTS ACCORDING TO SEX, AGE AND
PROPORTION OF PLANT USERS IN EACH CATEGORY

	Sex		Age	
	Women	Men	Young	Adults
Per cent	68.6	31.4	3.0	97.0
% of plant users	63.4	59.3	47.4	62.6

TABLE-2
IDD AND NIDD DIABETES USING PLANTS

Sex	Diabete		% of plant users
	NIDD	IDD	
Women	48.7	21.3	70
Men	17.5	12.5	30
Total	66.2	33.8	—

Inventory of medicinal plants: During the ethnopharmacological survey, we made an inventory of 58 plants that were of common use in the folk therapy of diabetes. The indexed plants were harvested and collected on the basis of their vernacular name. Table-3 provides the following data: local name (Arabic), botanical name, botanical family and the parts of the plant used, dose, preparation procedure and administration, treatment duration, number of treatment and glycaemia results.

TABLE-3
MEDICINAL PLANTS USED FOR TREATMENT OF DIABETES MELLITUS IN TLEMCEM REGION

Scientific name	Vernacular name	Ecological distribution		Part used and dose	Number of use	Mode of administration	AA	Duration of treatment	Glycemia results (g/L)
		North	South						
<i>Trigonella foenum graecum</i> L. (Leguminosae)	Holba	C(++)	C(+)	One cup of leaves or seeds in decoction	Once to twice a day	Oral	4.00	25 min to 1 h	0.90
<i>Citrullus colocynthis</i> L. Schard (Cucurbitaceae)	Pastèque	S(+)	S(+++)	One fresh fruits parts	Once to three times a month	Under feet in bath	3.00	10 to 15 min	1.20
<i>Saccocalyx satureioides</i> Coss. et Dur. (Labiatae)	Zaater	S(+)	S(++)	One cup of leaves decoction	Once a day	Oral	2.00	0.5 to 1 h	1.20
<i>Berberis vulgaris</i> L. (Berberidaceae)	Epine-vinette	S(++)	S(+)	One spoon of bark in decoction	Twice a day	Oral	3.00	1 to 2 h	1.87
<i>Aloe vera</i> Trabut (Liliaceae)	Sbeur	S(+)	S(+)	One cup of leaves infusion extract or seed	Once a day	Oral	3.00	0.5 to 2 h	1.50
<i>Nerium oleander</i> L. (Apocynaceae)	Defla	C(+++)	S(+)	Vegetal bath	Once a week	Vegetal bath	4.50	1 h	1.20
<i>Ammoides verticillata</i> (Desf.) Briq. (Ombeleferae)	Ammoïdes	S(+)		One spoon of leaves powder and honey	Once a day	Oral	2.00	4h	0.80
<i>Globularia alypum</i> L. (Globulariaceae)	Chebra	S(+++)	S(+)	A big cup of leaves decoction and small amount of sugar	Once day	Oral	3.50	1h	1.70
<i>Juniperus phoenicea</i> L. (Cupressaceae)	Genevrier rouge	S(++)	S(+)	One cup of leaves decoction extract	Once to four times a month	Oral	3.50	1 h 30	1.10
<i>Ajuga iva</i> L. Schreb (Labiatae)	Ivette	S(+++)	S(+)	One spoon of leaves powder	Once a day	Oral	2.50	25 min to 1 h	1.15
<i>Artemisia herba-alba</i> Asso. (Compositae)	Armoise blanche	S(++)	S(+++)	One cup of leaves infusion	Once to twice a day	Oral	3.00	1 to 3 h	1.87
<i>Inula viscosa</i> L. Ait. (Compositae)	Inule	S(+++)	S(+)	One cup of leaves infusion	Once a week	Oral	3.80	4 h	2.00
<i>Marrubium vulgare</i> L. (Labiatae)	Marrube	S(+++)	S(+)	One cup of leaves infusion or vegetal bath	Twice a day	Oral	3.00	0.5 to 1 h	1.20

<i>Mentha pulegium</i> L. (Labiace)	Pouliot	S(+++)		One cup of leaves infusion	Once a day	Oral	1.60	2h to 4h	0.80
<i>Ammi visnaga</i> Lamk (Apiaceae)	Curedent du Prophète	C(+)		One cup of stems decoction extract	Once to three times a week	Oral	2.28	5 h	1.74
<i>Olea europaea</i> L. (Oleaceae)	Olivier	C(+++)	C(+)	Big cup of leaves decoction	Once to three times a day	Oral	2.00	2 to 5 h	1.20
<i>Myrtus communis</i> L. (Myrtaceae)	Myrte	S(+++)	S(+)	One spoon of seeds powder	Three times a day	Oral	1.60	10 min to 1 h	1.50
<i>Ziziphus lotus</i> L. Desf. (Rhamnaceae)	Jujubier sauvage	S(+++)	S(+)	One cup of roots decoction.	Once to twice a week	Oral	1.50	1 to 6 h	0.80
<i>Prunus amygdalus</i> Stokes var. amara CD. (Rosaceae)	Amandier	C(+++)	C(+)	Half spoon of fruit powder with milk	Seven times a week	Oral	2.50	1 to 2 h	1.20
<i>Ruta chalepensis</i> L. (Rutaceae)	Rue	S(+)	S(++)	One cup of leaves infusion	Once week	Oral	1.80	3 to 5 h	1.10
<i>Peganum harmala</i> L. (Zygophyllaceae)	Harmel	S(+)	S(+++)	One spoon of fruit powder	Once to twice a day	Oral	2.10	1 to 2 h	1.52
<i>Zygophyllum album</i> L. (Zygophyllaceae)	Bougribba	S(+)	S(+++)	One cup of leaves infusion or one spoon of leaves powder	Once a day	Oral	3.00	4 h	1.80
<i>Papaver rhoeas</i> L. (Papaveraceae)	Coquelicot	S(+++)	S(+)	One cup of stems decoction extract	Three times a day	Oral	2.70	4 h	1.00
<i>Mentha rotundifolia</i> L. (Labiatae)	Timija	S(+++)	S(+)	One cup maceration of aerial parts	Once to three times a week	Oral	3.15	2 h	1.40
<i>Lawsonia alba</i> Trabut (Lythraceae)	Henné	C(+)	C(+++)	Leaves	Once day	Massage	3.00	9 h	1.20
<i>Lavandula staechas</i> L. (Labiatae)	Helhal	S(+++)		One cup of leaves infusion.	Once day	Oral	3.00	10 min to 1 h	1.20
<i>Ferula foetida</i> Asso. (Ombelliferae)	Férule	S(+++)	S(+)	One cup of aerial parts decoction	Once week	Oral	3.00	12 h	1.60
<i>Arbutus unedo</i> L. (Ericaceae)	Arbousier	S(+++)		One cup roots infusion extract	Once to three times a week	Oral	3.35	4 to 7 h	1.68
<i>Rhamnus alaternus</i> L. (Rhamnaceae)	Alaterne	S(++)	S(++)	One cup of leaves infusion extract	In case of need	Oral	1.60	0.5 to 1 h	1.40

2706 Allali et al.

Asian J. Chem.

<i>Juglans regia</i> L. (Juglandaceae)	Noyer	C(+++)		One cup of leaves decoction extract	Once to three times a week	Oral	2.20	3 to 6 h	1.40
<i>Laurus nobilis</i> L. (Lauraceae)	Laurier	C(++)	S(+)	One cup of leaves infusion extract	In case of need	Oral	2.00	Indetermi nate	1.50
<i>Punica granatum</i> L. (Punicaceae)	Grenadier	C(+++)	C(+)	Barks decoction extract	In case of need	Oral	4.50	Indetermi nate	1.50
<i>Nigella sativa arvensis</i> L. (Ranunculaceae)	Nigelle	C(+++)	C(+)	One spoon of seeds powder	Once a day	Oral	2.30	2 h	1.20
<i>Anacyclus pyrethrum</i> L. Coss. (Compositae)	Pyrèthre	C(+)	C(++)	One cup of leaves infusion	Once a day	Oral	2.85	1 h	2.18
<i>Arthrophytum scoparium</i> (pomel) Iljin (Chenopodiaceae)	Remt	S(+)	S(+++)	Stems infusion	In case of need	Oral	1.85	Indetermi nate	1.20
<i>Stipa tenacissima</i> L. (Gramineae)	Alfa	S(+)	S(+++)	One cup of roots decoction extract	Once to twice a week	Oral	3.00	25 min to 1 h	1.30
<i>Juniperus oxycedrus</i> L. (Cupressaceae)	Oxycèdre	S(++)	S(+)	One cup of leaves decoction extract	Once to three times a week	Oral	2.00	4 to 7 h	1.50
<i>Pinus halepensis</i> Mill. (Pinaceae)	Pin d'Alep	S(+++)	S(+)	One cup leaves infusion	In case of need	Oral	2.00	Indetermi nate	1.80
<i>Pistacia lentiscus</i> L. (Anacardiaceae)	Lentisque	S(+++)	S(+)	Leaves decoction extract	Once a day	Oral	2.00	1 h	1.30
<i>Bryonia dioica</i> Jacq. (Cucurbitaceae)	Bryone	C(++)	C(+)	One spoon of aerial parts powder	In case of need	Oral	2.45	2 h	1.64
<i>Anvillea radiata</i> Coss. et Dur. (Compositae)	Horf		S(++)	Fruit	Twice a day	Oral	3.50	2 to 4 h	1.80
<i>Capsicum frutescens</i> Medik (Solanaceae)	Piment de cayenne	C(+)		Hot pepper's seeds	In case of need	Oral	2.80	Indetermi nate	1.65
<i>Artemisia arborescens</i> L. (Compositae)	Chiba	S(+++)		One spoon of seeds powder	In case of need	Oral	2.36	1 to 3 h	1.40
<i>Satureja calamintha</i> Scheele (Rabieae)	Calament	S(++)		One cup of roots decoction extract	In case of need	Oral	2.00	Indetermi nate	1.10
<i>Rubus ulmifolus</i> Schott (Rubiaceae)	Ronce	S(+++)	S(+)	One cup of leaves infusion extract	Twice a day	Oral	1.50	1 to 4 h	0.75

<i>Chamaerops humilis</i> L. (Palmaceae)	Palmier nain	S(+++)		One cup of roots decoction extract	In case of need	Oral	3.00	1 day	1.90
<i>Calycotome spinosa</i> L. (Papilionaceae)	Gendoul	S(+++)	S(+)	One spoon of roots decoction extract	In case of need	Oral	2,90	6 h	1.50
<i>Musa paradisiaca</i> Trabut (Musaceae)	Mouza	S(+)		One spoon of leaves decoction extract	In case of need	Oral	1.88	4 h	1.10
<i>Eucalyptus globulus</i> L. (Murtaceae)	Eucalyptus	S(+++)	S(+)	One spoon of leaves infusion extract	In case of need	Oral	5.00	8 h	1.50
<i>Ficus carica</i> L. (Moraceae)	Figuier	C(+++)	C(+)	One cup of leaves infusion extract	Three times a week	Oral	4.00	1 h	1.60
<i>Allium cepa</i> Cupani Raf. (Liliaceae)	Ail	C(+++)	C(++)	One spoon of leaves decoction extract	In case of need	Oral	1.80	6 h	0.57
<i>Cynara scolymus cardunculus</i> L. (Compositae)	Cardon sauvage	C(+++)	C(+)	One cup of leaves infusion extract	Once a day	Oral	1.95	0.5 h	1.55
<i>Zea mays</i> Assengas Trabut (Gramineae)	Maïs	C(+++)	C(+)	One cup leaves infusion extract	In case of need	Oral	2.30	7 h	0.50
<i>Urtica urens</i> L. (Urticaceae)	Ortie	S(+++)	S(+)	One spoon of leaves and stems decoction extract	In case of need	Oral	1.80	4 h	1.20
<i>Coriandrum sativum</i> L. (Ombelliferae)	Gousbir	C(+++)	C(+)	One cup of aerial parts maceration	In case of need	Oral	1.75	2 h	1.36
<i>Quercus ilex</i> L. (Fagaceae)	Chêne vert	S(+++)	S(+)	Roots decoction extract	In case of need	Oral	1.90	Indetermi nate	1.10
<i>Ampelodesma mauritanicum</i> (Poir.) Dur. et Sch. (Gramineae)	Diss	S(+++)		Roots decoction extract	In case of need	Oral	2.60	Indetermi nate	1.15
<i>Opuntia ficus-indica</i> Trabut (Coctaceae)	Figuier de barbarie	C(+++)	C(+)	Flowers decoction extract	In case of need	Oral	2.50	Indetermi nate	1.40

S, spontaneous; C, cultivated ; +++, very abundant ; ++, moderate ; +, scarce.

Notice: - In Table-3, the authors have mentioned the average values of glycaemia results.

- Decoction, maceration and infusion of different parts plant were made up in water.

AA = Blood glucose level before treatment with plants (g/L)

Among the 58 plants reported the most used in Tlemcen's region as antidiabetic were: *Trigonella foenum graecum* (Leguminosae), *Citrullus colocynthis* (Cucurbitaceae), *Saccocalyx satureioides* (Labiatae), *Berberis vulgaris* (Berberidaceae), *Aloe vera* (Liliaceae) and *Globularia alypum* (Globulariaceae).

As regards in present interviews conclusions, we can set forth that patients generally use more than one plant to cope with their illness. Methods usually in practice to prepare folk medicine include maceration, infusion, decoction and powdering of leaves, roots and stems. As results obtained, the treatment is made through oral administration, massage or by means of baths with water which contains the part of the plant of interest. These data are correlated by bibliographical source^{16,17}.

According to the data collected in present investigation, we observed that the frequency of use of plants by patients was either once to three times a day, once to seven times a week or once to four times a month. They checked their glycaemia within 10 min to 12 h after treatment. Besides, there were patients who used plants and hypoglycaemic tablets on the same time. On the other hand, patients who used insulin also treated themselves with plants in case of need. We have also observed that patients took into account instructions about plants uses that were provided by the herbalists, older women *etc.* Sometimes the patients use more than one plant to treat their pathology. So we observed for example that some patients use for example mixtures of three to four plants (*Citrullus colocynthis*, *Trigonella foenum graecum*, *Saccocalyx satureioides*, *Berberis vulgaris*) or mixture of two plants such as (*Trigonella foenum graecum*, *Saccocalyx satureioides*) in the same time.

Conclusion

The present survey has revealed the importance of folk medicine as a useful tool for the development of new strategies of both care and scientific policies in developing countries. The widespread use of plants in the treatment of various diseases set forth that plants could serve as cheap sources for new hypoglycaemic drugs. Our preliminary results are encouraging and induce us to explore in more details the scientific fundamentals of some folk medicines especially in the field of diabetes whose incidence dramatically grew over the recent years.

The present investigation has revealed the importance given by the diabetics to traditional plants medicine. Therefore we have been able to set up a bank data concerning the names of plants (local and botanical names), dosage and preparation method (maceration, decoction, infusion, powder, vegetable bath *etc.*) as well as glycaemia results before and after treatment.

The hypoglycaemic effect of the following species has also been established: *Trigonella foenum graecum*, *Artemisia herba-alba* Asso., *Ammi visgana*, *Allium sativum*, *Myrtus communis*¹⁸. Nevertheless and despite their

widespread use the mechanism of action of these plants still remains unclear. As far as literature is concerned, we have found few studies concerning the hypoglycaemic activity of *Citrullus colocynthis*. In some cases, we noted that a mixture of plant was used for the treatment of the NIDD diabetes.

ACKNOWLEDGEMENT

The authors thank Pr. M. Bouazza, Botany Laboratory, Department of Biology, Aboubekr Belkaïd-Tlemcen University for identification of plant materials.

REFERENCES

1. A. Daoud, M. Belhadj, S. Khalfa and R. Malek, Le diabète en Algérie, Présentation au deuxième congrès maghrébin d'Endocrinologie Diabétologie Nutrition. Fès, 24-27 Novembre, pp. 34-40 (2005).
2. M. Belhadj, M. Oudidhoum, N. Midoune, A. Cherrak, S. Aribi and M. Bachaoui, The Prevalence of type 2 diabetes mellitus in Touaregs of South Algeria, (Abstract 1370). *Diabetes Metab.*, 29 (Suppl 4) : 4S24 (2003).
3. L.C. Di Stasi, C.A. Hiruma, E.M. Guimarães and C.M. Santos, *Fitoterapia*, **65**, 529 (1984).
4. L.C. Di Stasi, G.P. Oliveira, M.A. Carvalhaes, M. Queiroz-Junior, O.S. Tien, S.H. Kakinami and M.S. Reis, *Fitoterapia*, **73**, 69 (2002).
5. M. Blumental, The Complete German Commission E Monographs: Therapeutic Guide to Herbal Medicine, Integrative Medicine Communications, Boston (1998).
6. P. Dagnelie, Théorie et méthodes statistiques: Vol. 2. Presses Agron. Gembloux, Duculot, Gembloux, p. 451 (1970).
7. L. Trabut, Flore du Nord de l'Afrique, Répertoire des noms indigènes des plantes spontanées, cultivées et utilisées dans le Nord de l'Afrique, Collection du centenaire de l'Algérie : Imprimerie Carbonel, Alger, p. 1-355 (1934).
8. R. Maire, Flore de l'Afrique du Nord, 15 vols. Edition Le chevalier, Paris, (1952-1980).
9. P. Ozenda, Flore du Sahara Septentrional et Central : Editions C.N.R.S., Paris, p. 1-485 (1958).
10. P. Ozenda, Flore du Sahara : Editions C.N.R.S., Paris, p. 1-622 (1977).
11. P. Quezel and S. Santa, Nouvelle flore de l'Algérie et des régions méridionales : Tome I et II. Editions C.N.R.S., Paris, p. 1-1170 (1962).
12. G. Bonnier, La grande flore en couleurs : Tomes I, II, III, IV & Index (729 planches, 1401 pages texte, 191 pages index), Edition Belin, Paris (1990).
13. J. Braun-Blanquet. Pflanzensoziologie Grundzuge der vegetations Kunde: 2eme Ed. Springer, Vienne, Autriche, p. 631-632 (1951).
14. A. Ziyat, A. Legssyer, H. Mekhfi, A. Dassouli, M. Serhrouchni and W. Benjelloun, *J. Ethnopharmacol.*, **58**, 45 (1997).
15. H.K. Sharma, L. Chhangte and A.K. Dolui, *Fitoterapia*, **72**, 146 (2001).
16. E. Tuzlaci and M.K. Erol, *Fitoterapia*, **70**, 593 (1999).
17. M.T. Palmese, E.U.M. Rita and E.T. Paolo, *Fitoterapia*, **72**, 619 (2001).
18. L.A. Al-Shamaony, S.M. Al-Khazraji and H.A.A. Twaij, *J. Ethnopharmacol.*, **40**, 163 (1993).

(Received: 3 April 2007;

Accepted: 7 January 2008)

AJC-6169