

COMPARISON BETWEEN MEDICINAL PLANTS USED AGAINST ORAL DISEASES AND PHARMACEUTICAL DENTAL PRODUCTS IN MOROCCO

Hazim Harouak, Jamal Ibijbijen, Laila Nassiri

Soil Microbiology and Environment Unit, Faculty of Sciences, Moulay Ismail University of Meknes, 50 000, Morocco.

ABSTRACT

In order to compare aromatic and medicinal plants used against different oral diseases and medicinal products commercialized around the kingdom of Morocco for oral use, two surveys were carried out in Meknes city; the first one was with herbalists operating traditional medicine sector and the second one at pharmacies or parapharmacies. The results revealed the use of certain active principles such as limonene, linalool, eugenol, eucalyptol, thymol, menthol which are present both in medicinal plants and commercialized medicines with oral effect; as well, some plants used in herbal medicine such as thyme, chamomile, walnut barks, sage, and many others are also included in dental products based on plants.

Key words: Oral phytotherapy, Aromatic and Medicinal Plant, Pharmaceutical dental products, Meknes (Morocco).

Introduction

According to the World Health Organization (WHO), traditional African medicine could also be considered as all the practices, measure ingredients, interventions of any kind, material or others that have allowed the Africans forever to guard against illness, to relieve one's suffering and to heal oneself. ¹ Thus, Medicinal and Aromatic Plants (MAP) constitute an important resource in Morocco with economic, societal, and scientific stakes. In 2000, WHO called for the integration of modern medicine and traditional medicine as the best way to achieve the goal of health for all. ²

In dentistry, medicinal plants continue to enjoy a high reputation, especially in companionships where the lack of dental care facilities within the reach of the patient, and the attachment to a number of traditions and beliefs favor the

transmission of these practices in rural areas. As such, the present work aimed to compare the aromatic and medicinal plants used against various oral diseases with the drugs sold in the health market and which are used for oral treatments or oral hygiene.

Material and Methods

Study area:

According to the last administrative division of 2015, Meknes city covers a surface of 1786 Km². The Prefecture of Meknes is part of the Fez-Meknes region; It is bordered to the north by Sidi Kacem province, on the West by Khemisset province, on the South as well as in the South East by Elhajeb Province, on the North East by Moulay Yacoub province, and on the North West by Sidi Slimane province (**Figure 1**). ³

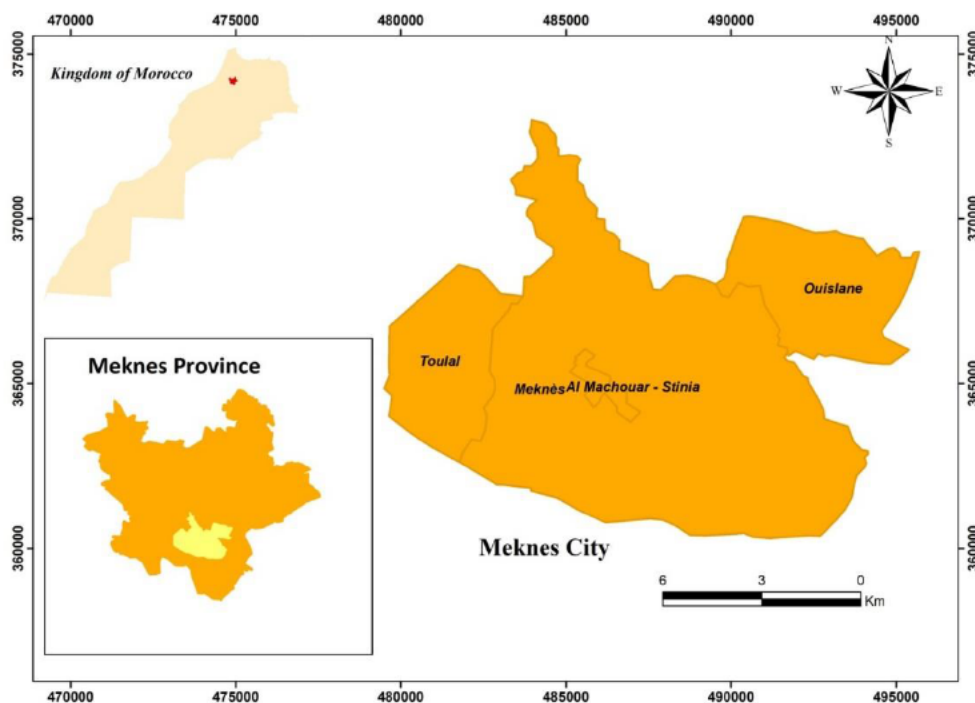


Figure 1: Location map of Meknes city-Morocco (Harouak et al, 2018)

The surveys

Using questionnaire cards, two field campaigns were carried out in Meknes city, with herbalists and pharmacies or parapharmacies in order to know the maximum of plants and medicines used for oral disease treatment by the local population. The sampling procedure was the "snowballs method" with 's' steps and 'k' names. This is a non-probabilistic method developed by Leo A. Goodman in 1961. ⁴

Analysis and data processing

All the results obtained were collected and treated by using the computer software (Excel 2007) in order to know which

plants, therapeutic classes, and medicine form are most commonly used against oral diseases, whether in herbal medicine or in dental products, as well as to confront by chemical composition the plants found with herbal or synthetic products commercialized in the pharmaceutical market.

Results and Discussion

Plants used for oral affections and their active ingredients

Scientific Name	Local Name/Plant English Name	Plant State	Active Ingredients	Use Percentage
<i>Origanum compactum</i> Benth.	Zaatar/Oregano	Autochthonous	Thymol, Carvacrol ⁵	13,62%
<i>Syzygium aromaticum</i> L.	Lakranfal/Clove	Allochthonous	Eugenol, Eugenol acetate ⁶	12,69%
<i>Juglans regia</i> L.	Swak/Walnut barks	Autochthonous	α -pinene, β -pinene, β -caryophyllene, germacrene D and limonene ⁷	12,07%
<i>Olea europaea</i> L.	Zaytoun bari/Oleaster	Autochthonous	Caffeic acid, verbascoside, oleuropein, luteolin 7-O-glucoside, rutin, apigenin 7-O-glucoside and luteolin 4'-O-glucoside ⁸	8,05%
<i>Punica granatum</i> L.	Kchour roman/Pomegranate peel	Autochthonous	Hydroxybenzoic acids, Hydroxycinnamic acid, Cyclitol carboxylic acid, Flavonoids, Anthocyanins, Ellagitannins, Alkaloids ⁹	7,43%
<i>Myrtus communis</i> L.	Rayhan/Myrtle	Autochthonous	Phenolic compounds ¹⁰ , α -pinene, 1,8-cineole, and limonene ¹¹	5,26%

<i>Ammi visnaga</i> L.	Lbachnikha/Khella	Autochthonous	Isobutyl isobutyrate, linalool, 2,2-dimethylbutanoic acid, thymol, bornyl acetate and croweacin ¹²	4,95%
<i>Camellia sinensis</i> L.	Hboub atay/Green tea	Allochthonous	Sodium, calcium, fluoride, aluminum, manganese, and iron ¹³	3,72%
<i>Tetraclinis articulata</i> (Vahl) Masters	Elaafs=Araar/Thuya	Autochthonous	Bornyl acetate, camphor and α -pinene ¹⁴	3,72%
<i>Artemisia herba alba</i> Asso.	Chih/White wormwood	Autochthonous	Cis-chrysanthenyl acetate, sabinyl acetate, α -thujone and arbusculones ¹⁵	3,10%
<i>Mentha pulegium</i> L.	Flio/Pouliot Mint	Autochthonous	Piperitone, piperitenone, α -terpineol, and pulegone ¹⁶	2,17%
<i>Salvadora persica</i> L.	Oud arak/Wood of araq	Allochthonous	Salvadoricine alkaloid ¹⁷	2,17%
<i>Nerium oleander</i> L.	Dafla/Oleander	Autochthonous	Nériine, other predominant components were digitoxigénine, Amorphane, 1,8-cineole, α -pinene, calarene, Limonene, β -Phellandrene ¹⁸	1,86%
<i>Pistacia atlantica</i> Desf.	Labtam/Atlas pistachio	Autochthonous	α -pinene/ α -thujene, spathulenol and bicyclogermacrene, δ -3-carene ¹⁹	1,86%
<i>Anacyclus pyrethrum</i> L.	Ikandaz/African pyrethrum	Autochthonous	Alkaloids, reducing compounds, tannins, flavonoids and coumarins ²⁰ , pellitorin, anacyclin, phenylethylamine, inulin, polyacetylenic amides I-IV, and sesamin ²¹⁻²³	1,55%
<i>Thymus</i> sp.	Zeitra/Thyme	Autochthonous	Borneol, thymol, carvacrol ²⁴	1,55%
<i>Acacia raddiana</i> Savi.	Esalaha=Talh / Acacia	Autochthonous	Flavonoïdes, saponosides, and tanins ²⁵	1,24%
<i>Glycyrrhiza glabra</i> L.	Aark sous/Licorice	Allochthonous	Glycyrrhizin, glycyrrhetic acid, isoliquiritin, isoflavones ²⁶	1,24%
<i>Lavandula multifida</i> L.	Lakhzama/lavender	Autochthonous	β -pinene, lavandulyl acetate, linalyl acetate, linalool ²⁷	1,24%
<i>Foeniculum vulgare</i> P. Mill.	Nafaa/Fennel	Autochthonous	Trans-anethole and estragole ²⁸	0,93%
<i>Chamaemelum nobilis</i> L.	Elbabonj / Chamomile	Autochthonous	Cis-tonghaosu, spathulenol, α -bisabolol oxide B, and α -bisabolol oxide ²⁹	0,62%
<i>Eucalyptus</i> sp.	Lkalibtous/ Eucalyptus	Allochthonous	1,8-cineole ³⁰	0,62%
<i>Pimpinella anisum</i> L.	Lyansoun / Green anise	Allochthonous	Trans-a nethole and estragole ³¹	0,62%
<i>Peganum harmala</i> L.	Elharmal/Harmal	Allochthonous	Harmine ³²	0,62%
<i>Majorana hortensis</i> Moench.	Mardadouch/Marjoram	Allochthonous	Terpinen-4-ol, γ -terpinene, trans-sabinene hydrate, linalool, trans-sabinene hydrate acetate, thujanol, terpinolene, and thymol ³³	0,62%
<i>Rosmarinus officinalis</i> L.	Azir/Rosemary	Autochthonous	cineole, camphor, and alpha-pinene ³⁴	0,62%
<i>Salvia officinalis</i> L.	Salmia/Sage	Allochthonous	α -thujone, camphor, borneol, γ -muurolene, and sclareol ³⁵	0,62%
<i>Citrus limonum</i> L.	Alaymoun/Lemon	Allochthonous	phenols, flavonoids, reducing sugars, terpinedes, and tannins ³⁶	0,62%
<i>Marrubium vulgare</i> L.	Mariwta/White horehound	Autochthonous	γ -eudesmol, β - citronellol, citronellyl formate, and germacrene ³⁷	0,62%
<i>Malus domestica</i> Borkh.	Atafah/Apple	Allochthonous	Eucalyptol, phytol, α -farnesene, and pentacosane ³⁸	0,31%
<i>Nigella sativa</i> L.	Elhaba	Allochthonous	Alkaloids, flavonoids, and steroids ³⁹	0,31%

	sawda/Nigelle			
<i>Cinnamomum burmannii</i> (Nees & T. Nees) Blume	Elkarfa/Cinnamon	Allochthonous	Cinnamyl alcohol, coumarin, cinnamic acid, cinnamaldehyde, anthocynin, and volatile oil ⁴⁰	0,31%
<i>Alpinia officinarum</i> Hance	Elkhodanjel/Galang a officinal	Allochthonous	Volatile oil, diaryheptanoid, sterol, and flavonoids ⁴¹	0,31%
<i>Laurus nobilis</i> L.	Waraq sidna moussa/Laurel sauce	Autochthonous	Carvacrol, 1,8-cineole, fenchone, and trans-anethole ⁴²	0,31%
<i>Linum usitatissimum</i> L.	Zariaat al katan/Linseed	Allochthonous	Linolenic, oleic, palmitic, and stearic ⁴³	0,31%
<i>Mentha spicata</i> L.	Naanaa/Mint	Allochthonous	Carvone, cis-carveol, and limonene ⁴⁴	0,31%
<i>Teucrium Polium</i> L.	Jeidiya/Pennyroyal	Autochthonous	α -pinene, β -pinene, and p-cymene ⁴⁵	0,31%
<i>Capparis spinosa</i> L.	Al kabbar/Common caper	Autochthonous	Spermidine, rutin, quercetin, kaempferol, stigmasterol, campesterol, tocopherols, and carotenoids ⁴⁶	0,31%
<i>Rosa Damascena</i> Mill.	Lward Ifilali/Damascus rose	Autochthonous	Linalool, nerol, geraniol, 1-nonadecene, n-tricosane, hexatriacontane, and n-pentacosane ⁴⁷	0,31%
<i>Curcuma longa</i> L.	Al kharkoum/Turmeric	Allochthonous	Aromatic-turmerone, alpha-santalene, and aromatic-curcumene ⁴⁸	0,31%
<i>Lepidium sativum</i> L.	Elharf or Hab rchad/Garden pepperwort	Allochthonous	α -Linolenic, oleic, linoleic, eicosanoic, palmitic, erucic, arachidic, and stearic acids ⁴⁹	0,31%
<i>Salix alba</i> L.	Waraq safsaf/White willow	Autochthonous	Salicyl Alcohol, Linolenic acid, Galactose, 4, 6-O-nonylidene, 4-Acetoxy-3-methoxycinnamic acid, Stearic acid, and Stearyl aldehyde ⁵⁰	0,31%

Table 1: The list of active ingredients and use percentage of medicinal plants used on oral diseases in Meknes

According to Table 1, 42 plants were identified⁵¹ from herbalists ranked in a decreasing way. According to their percentage of use by the population, the most cited ones are *Origanum compactum*, *Syzygium aromaticum*, and *Juglans regia*. The plants found are very rich in secondary

metabolites according to the bibliography. Also, 24 plants (57%) among 42 inventoried are autochthonous, divided between wild and cultivated ones.

Therapeutic class	Treated problems	Plants used	Chemical compounds used
Antiseptics 68.18%	bad breath, sensitive and bleeding gums, caries prevention, disinfectant in pre and post-surgery, gingivitis, stomatitis, canker sores, eliminate bad inhale, refreshes the mouth, calms the dental and gingival pain, reduce the accumulation of dental plaque, gingival bleeding when brushing	Walnut, green tea, sage, thyme, clove, licorice, myrtle, eucalyptus, chamomile, mint, lemon, khella, nigelle	Xylitol, chlorhexidine, cetylpyridinium chloride, soothing bisabolol, tannic acid, trimethylamine, alkaloid salvadorine, vitamin C, chloride, fluoride, sulfur, phosphorus, calcium, silicon, saponins, flavonoids, steroids, chlorophyll, magnesium sulfate, lactose, limonene, linalool, eugenol, sodium bicarbonate, eucalyptol, thymol, menthol.
Antibiotics 50%	Caries prevention, pre- and post-surgery disinfectant, reduce plaque accumulation	Green tea, sage, chamomile, licorice, cinnamon, clove, mint, anise, lemon, pine, eucalyptus, thyme, khella, nigelle, walnut	Xylitol, carbamide, chlorhexidine, cetylpyridinium chloride, soothing bisabolol, sodium, benzyl benzoate, benzyl cinnamate, cinnamal, eugenol, linalool, limonene, fluorine, sodium bicarbonate, eucalyptol, thymol, menthol

Antalgics 9.09%	Oral-gingival mucosa irritation, infant and small child dental eruption, gingival involvement, oral-gingival mucosa hygiene, damage due to dental prostheses.	Orange, chamomile	Glycerol, hydroxyethylcellulose, saccharin, sorbic acid, methyl parahydroxybenzoate, propyl parahydroxybenzoate,
Astringents 9.09%	Bad breath, sensitive and bleeding gums, caries prevention, ideally completes the brushing of the teeth	Walnut	Fluorine, magnesium sulfate, lactose, limonene, linalool, eugenol
Anti-inflammatories 4.54 %	Irritated gums	Green tea, sage	Xylitol, vitamin B5, polyphenols

Table 2: Therapeutic class, treated problems, plants used, and chemical compounds used of the natural oral products.

We note that the plants used mentioned in bold (Table 2) are both found as plants for traditional use and in dental products based on medicinal plants. Also, the chemical compounds mentioned in bold of these drugs in the same table were found as active ingredients of some medicinal plants. Table 2 shows aromatic and medicinal plants used in some commercialized oral products, which represents a percentage of 26.19% (22 natural products) from a total of 84 products mentioned in our pharmaceutical survey. The antiseptics (68.18%) and antibiotics (50%) were the most cited therapeutic classes of commercialized oral products based on medicinal plants, especially in the form of mouthwashes (68.18%), toothpaste (63.63%), and gels (63.63%) (Figure 2). So, according to tables 1 and 2, the confrontation allows us to find some common plants in

dental phytotherapy and in commercialized natural dental products, that are about 5 autochthonous plants (walnut, thyme, Myrtle, chamomile, and khella), 10 allochthonous plants (clove, licorice, green tea, nigelle, cinnamon, sage, eucalyptus, mint, lemon, and anise). Furthermore, according to this survey, from the 24 autochthonous plants revealed by the ethnobotanical survey, only 5 plants (20.83%) have been found in the dental products. This means that 19 plants (oregano, oleaster, pomegranate peel, thuya, white wormwood, Pouliot mint, oleander, atlas pistachio, African pyrethrum, acacia, lavender, fennel, rosemary, white horehound, laurel sauce, pennyroyal, common caper, Damascus rose, white willow) could be subject to valorization and formulation of new native herbal products.

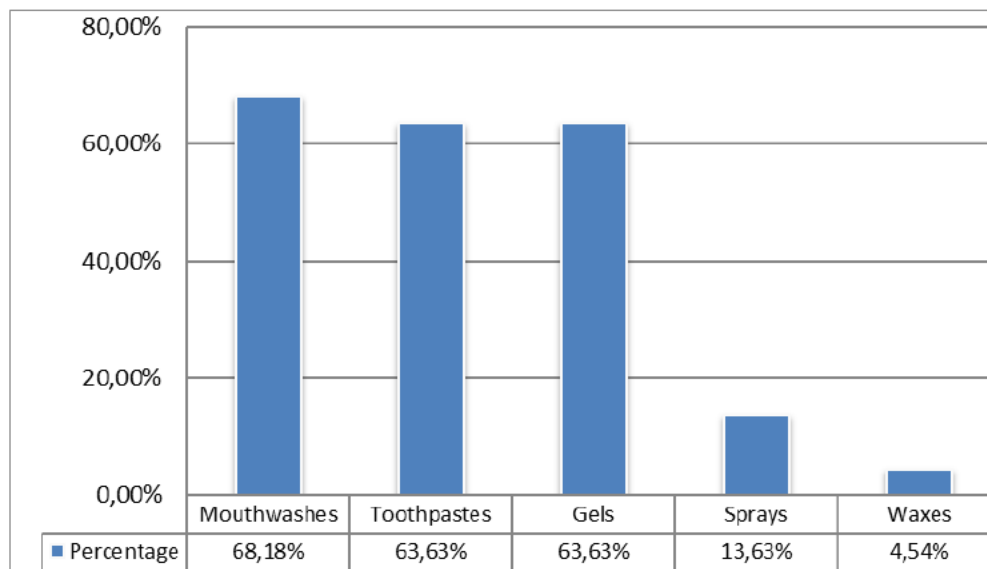


Figure 2: Natural oral products.

Therapeutic class	Treated problems	Active substances
Antibiotics 51.61 %	Dental abscess, phlegmons, perimaxillary cellulitis, pericoronitis, gingivitis, stomatitis, periodontitis, Sub-maxillitis parotitis, post-operative infectious complication in odontostomatological surgery	Amoxicillin, spiramycin, metronidazole, azithromycin, pristinamycin, cyclins, clavulanic acid, bacitracin
Antiseptics	Stomatitis, gingivitis, oropharyngeal disease, mouth	Chlorhexidine, hexetidine, sanguinarine, iodized

45.16 %	ulcers, small mouth-sores, local adjunctive treatment of oral cavity infections and post-operative care in stomatology. Intensive care of delicate gums, prevents cavities, reduces bad breath, eliminates the bacteria responsible for halitosis	derivative, halogenated derivatives, phenols , quaternary ammoniums, formaldehydes, fluorinated derivatives , oxidizing agents, cetalkonium chloride, chlorobutanol hemihydrate, chlorhexidine digluconate.
Anti-inflammatory 19.35 %	adjunctive treatment of painful inflammations of oral affections	Niflumic acid, diclofenac, ibuprofen, mefenamic acid, ketoprofen, tiaprofenic acid, glycyrrhetic acid , morniflumate, meloxicam.
Antalgics 12.90 %	Mild to moderate pain	Paracetamol, Paracetamol + codeine, paracetamol + caffeine, paracetamol + ibuprofen, aspirin, lidocaine.
Antifungals 1.61 %	Oral mycosis treatment	miconazole

Table 3: Therapeutic class, treated problems and active substances of synthetic oral products

We note that the chemical compounds mentioned in bold (Table 3) were found as active ingredients of some medicinal plants. According to Table 3, synthetic medicine for oral effect represents almost the quasi totality of the products mentioned in our survey (73.80%). Antibiotics (51.61%), antiseptics (45.16%), and anti-inflammatories (19.35%) were the most encountered therapeutic classes of synthetic medicine, especially in the forms of mouthwashes (43.54%), toothpaste (35.48%), and tablets (30.64%) (Figure 3).

Our results are consistent with the results of Diouf *et al.*⁵² who have mentioned that amoxicillin, spiramycin, metronidazole, azithromycin, pristinamycin, cyclins are

used as dental antibiotics. Also, chlorhexidine, hexetidine, sanguinarine, iodized derivative, halogenated derivatives, phenols, quaternary ammoniums, formaldehyde, fluorinated derivatives, oxidizing agents, cetalkonium chloride, chlorobutanol hemihydrate, chlorhexidine digluconate were antiseptic⁵², which is in line with our results and that of⁵³⁻⁵⁵. Anti-inflammatories including niflumic acid, diclofenac, ibuprofen, mefenamic acid, ketoprofen, tiaprofenic acid were the same as those found by^{52, 56}. Paracetamol and lidocaine are among the active ingredients of analgesics, that are in agreement with the previous studies^{52, 57}. Finally, miconazole which is used for oral mycosis treatment was also found by⁵⁸.

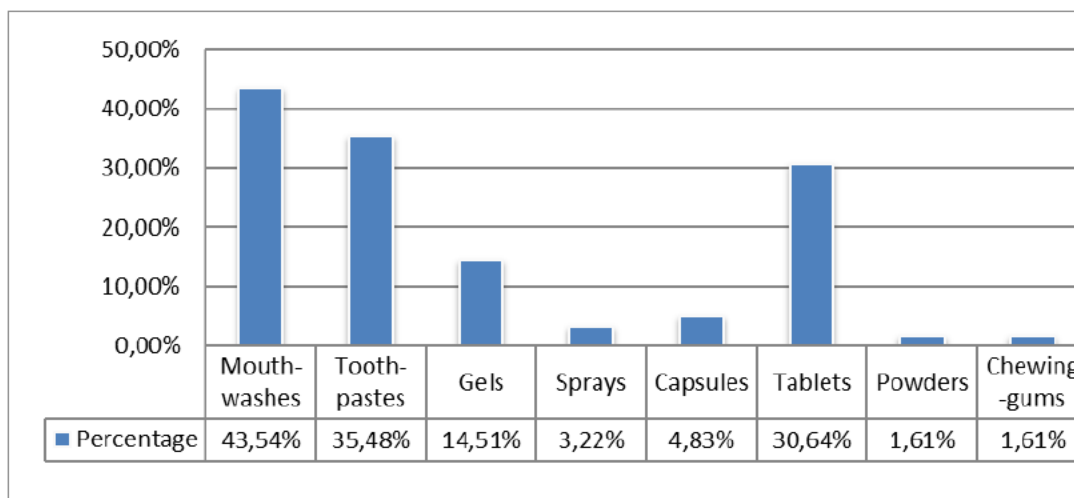


Figure 3: Synthetic oral products

It is clear from tables 1, 2, and 3 that certain chemicals of vegetable origin (glycyrrhetic acid, limonene, linalool, eugenol, fluorite, eucalyptol, thymol, menthol, cinnamal, salvadorine, bisabolol) are found in commercialized dental products.

Conclusion

Dental medicine commercialized in the Moroccan health market represents a considerable part of natural products. Also, synthetic ones represent some chemical molecules or principles active based on plants such as linalool, eugenol, eucalyptol, thymol, and menthol.

Also, many Moroccan plants most used against oral affections by herbalists in our ethnobotanical survey (oregano, oleaster, pomegranate peel, thuya, white wormwood, Pouliot mint, oleander, atlas pistachio, and African pyrethrum) have not been found in the dental products analyzed. This wide range of native plants is new alternatives against dental infections and oral diseases.

Acknowledgments

We would like to acknowledge all herbalists, parapharmacy staff and pharmacy doctors of Meknes (Morocco) for their participation in this survey. A special thanks to Dr. *Moussa AYACHI* from AYACHI pharmacy in Meknes for his help and orientation.

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Corresponding Author

Harouak Hazim

Ph.D. Student,

Soil Microbiology and Environment Unit, Faculty of

Sciences, Moulay Ismail University of Meknes

Postal code: 50 000, Meknes, Morocco.

Mobile : +212606241984

Email Id: hazim harouak @ gmail.com