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Chemical Components of some Hydrola (Distillated Waters) from Iranian Medicinal Plants

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Abstract

Medicinal distilled waters (hydrola) are substances prepared by distilling water in the presence of aromatic plants or plants without fragrance. In Iran, these waters are often used for medicinal properties. Their taste and smell are similar to plants and volatile substances from which aromatic water is prepared. Some of these aromatic waters have been studied previously. In this manuscript, we have analyzed some hydrolas from some medicinal herbs in Iranian Traditional Medicine. It may be used to identify and standardize such waters. The hydrolas of 13 Iranian medicinal herbs were prepared and analyzed by GC/MS. Major components of *Tripleurospermum disciforme, Citrus aurantium, Alhagi pseudoalhagi, Foeniculum vulgare, Cuminum cyminum, Bunium persicum, Cichorium intybus, Mentha spicata, Anethum graveolens, Salix aegyptica, Zataria multiflora, Rosa damascana* and *Fumaria parviflora* were identified. It is the first report analysis of some hydrola from Iranian medicinal plants except for rose water. This analysis may be a help to the standardization of high-consumption aromatic waters.

Keywords: Medicinal distilled waters, GC/MS, hydrola analysis, Iranian Medicinal Plants, standardization, aromatic plants.

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1. Introduction

Medicinal distilled waters (hydrola) are substances prepared by distilling water in the presence of aromatic plants or plants without fragrance. In addition to water, these products contain effective volatile substances, usually prepared by simple distillation.

Medicinal distilled waters are straightforward solutions that are usually saturated with essential oils and other water-soluble volatiles. The active ingredients of these waters are often essential oils. Some of these waters have a mild therapeutic effect. In Iran, these waters are often used for medicinal properties, and their taste and smell are similar to plants and volatile substances from which aromatic water is prepared.

The use of hydrola(s) in Iran is high, and there is a strong belief in their therapeutic effect in traditional Iranian medicine [1]. The most important hydrola used in Iran is rose water, which is used in religious ceremonies and celebrations. Some hydrolas in Iran, are using in some countries, too (such as mint water, caraway water, fennel water, cumin water, dill water, etc.), but some hydrolas are unique in Iran and don't use in other countries, such as fumitory, borago, chicory, willow, neroli, Egyptian willow and platanus waters.

Some of these aromatic waters have been studied, previously. In a study, the chemical composition of hydrola extract of aerial parts of *T. capitata* from Morocco determined [2]. The results showed that carvacrol (98.5 %) is the most dominant compound of it alongside some compounds in the form of traces. The hydrola of the aerial part and root of *Geum iranicum* grown at Shirvan, in the northeast of Iran, were obtained by hydrodistillation and analyzed by GC and GC/MS. The hydrola of the root were characterized by a high amount of eugenol (65.4%) and myrtenol (9.9%), whereas eugenol (45.7%) and linalool (7.3%) were identified as major components in the hydrolat of the aerial part of *G. iranicum* [3].

In other studies, aerial parts of three cultivated species, Thymus vulgaris, T. daenensis and T. kotschyanus were collected from the Semnan natural resources research field in Shahmirzad. At first, the aromatic waters of dried plants were extracted by the water distillation method. Then the essential oils of the aromatic waters were isolated using pentane and analyzed by GC/MS. Thymol was the major component of the derived essential oils of two species *T. vulgaris* (38.4 %) and *T. daenensis* (56.8 %). In contrast, *α*-terpinyl acetate (31.1 %) was the main ingredient of the essential oil of *T. kotschyanus* [4].

Analysis revealed that floral waters of *Mentha longifolia* from Senegal were characterized by the same major compounds as essential oils, in these floral waters, pulegone constituted 60.2 and 47.0%, 1,8- cineole 7.9 and 19.6%, isomenthone 7.2 and 10.7%, menthone 6.4 and 9.2%, chrysanthenone 6.4 and 3.2% and α-terpineol 3.0 and 2.7% in the fresh and dried plants, respectively [5].

In floral waters of *Cymbopogon citratu*s (DC.) Stapf (Poaceae) from Senegal (were collected in two different localities, Dakar and Kaolack), it is identified 42.8- 33.6% geranial, 38.4-27.6% neral, and 12.5-24.5% geraniol, respectively [6]. The most representative compounds identified in the floral waters of *Ocimum basilicum* L. from Dakar and Kaolack regions, Senegal was linalool. It was 50.5 and 51.3% in Dakar and was followed by camphor (15.4 and 17.0%), estragole (14.9 and 12.1%), and 1, 8-cineole (5.9 and 6.4%). In the

floral waters from Kaolack, linalool constituted 57.9 and 56.6%. Other representative components were estragole (10.0 and 9.1%), 1,8-cineole (5.9 and 6.4%), geraniol (5.2 and 5.1%), and camphor (4.1 and 4.1%) in the floral waters from fresh and dried plants from Kaolack, respectively [7].

In this manuscript, we have analyzed some hydrolats from some medicinal herbs in Iranian Traditional Medicine. It may be used to identify and standardize such waters (Tab. 1). A comprehensive literature review indicated that no accounts were rendered regarding the analysis. This study is the first research conducted on the species.

2. Materials and Methods

2.1. Hydrola Extraction

13 medicinal herbs [from the most widely used Iranian hydrola(s)] were purchased from an herbal market (in Tehran) in 2016 and identified in Medicinal Plant Lab. (Table 1), voucher specimen have saving in Herbarium of School of Pharmacy (SBMU). 100 g. of the each herb, after grinding, water-distillated, separately and after 3 h., distillated water, collected. The water collected from each herb is extracted by n-hexane (X 3) in a separation funnel. The *n*-hexane fractions were concentrated under nitrogen pressure.

2.2. Analysis of Hydrola(s)

The concentrated oil in each sample was dehydrated and subjected to gas chromatography mass spectrometry (GC/MS) to analyze the constituents (Agilent Technologies 7890 gas chromatograph coupled with an Agilent Technologies model 5975C mass detector, Palo Alto, CA). The apparatus was equipped with a HP-5MS capillary column [phenyl-methylsiloxane, 30 m X 0.25 mm i.d., Agilent Technologies (60–325/350°C)]. The oven temperature increased from 60°C (0 min) to 220°C in increments of 5°C/min and held there for 10 min. Helium was selected as the carrier gas, and the flow rate was adjusted at a rate of 1 ml/ min. The mass spectrometer operated in EI mode at 70 eV. The interface temperature was 280°C, and the mass range was 30–600 m/z. Identification of the components was based on a comparison of their mass spectra with reference [8] and the suggestion of a mass library.

3. Results and Discussion

The data from GC/MS were used to identify the components of the samples. This process compared the resulting mass spectra data of the components with those mentioned in the literature [8]. Table 2 shows the percentage of the major components identified in each sample. In some hydrolas major components that were identified are from the alkanes group. Decane (10.4%) and dodecane (8.2%) in *Tripleurospermum disciforme* hydrola; decane (11.0%), dodecane (15.1%), tetradecane (13.2%) and hexadecane (12.2%) in *Citrus aurantium* hydrola; hexadecane (14.5%), decane (12.0%) and dodecane (9.9%) in *Cichorium intybus*; decane (29.0%), dodecane (18.1%) and tetradecane (10.4%) in *Alhagi pseudoalhagi* (*A. camelorum*); decane (12.0%) and dodecane (9.7%) in *Foeniculum*

vulgare; hexadecane (15.2%), decane (17.1%) and tetradecane (27.5%) in *Cuminum cyminum*; and hexadecane (10.0%), dodecane (16.4%) and tetradecane (16.7%) in *Bunium persicum*. Nevertheless, the major components of their essential oils were reported recently: *T. disciforme* (*p*-methoxy- *β*-cyclopropyl styrene (18.8%) and (*E*)-*β*-farnesene (15.6%) [9]), *C. aurantium* (linalool [10]), *C. intybus* (palmitic acid (32.9 %) and nonadecane (26.1 %) [11]), *A. pseudoalhagi* (drimenol (23.2) and neophytadiene (39.2) [12]), *F. vulgare* ((*E*)-anethole [10]), *C. cyminum* (cumin aldehyde [10]), and *B. persicum* (cumin aldehyde [13]). The main ingredients identified in these hydrola(s) are different from the main ingredients of the essential oils of these plants. We could not justify the presence of normal alkanes instead of the major essential oils in these distillates based on their artefact or solubility.

In some cases, the major component of essential oil (from the herb) and hydrola were similar, e.g., carvone in *Mentha spicata* [10] and in *Anethum graveolens* [10], 1,4-dimethoxybenzene in *Salix aegyptica* [14] and thymol in *Zataria multiflora* [15]. Phenyl ethanol was identified in *Rosa damascana* hydrolas (rose water) as a major component; this component was reported previously from rose water [16-18]. But, major components of *R. damascana* essential oils were reported geraniol, nerol, citronellol and normal paraffin 14-23 C [10]. Finally, carvacrol (and thymol) were identified in *Fumaria parviflora* hydrola. The components of *F. parviflora* oil have not reported, previously.

Major components of essential oils and hydrolas from the herbs comprised in Table 3. The hydrola(s) of these plants have not been analyzed, previously, so the results of this research can be compared with them. Of course, there are reports in the literature of the analysis of some aromatic waters (3-7). Except for rose water [16-18], it's the first report analysis of some hydrola from Iranian medicinal plants. These analyses may help standardization of high-consumption aromatic waters and determine what the Iranian people consume of these hydrolas in large quantities.

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Tables:

Table 1. The herbs that used for hydrolate extraction.

Scientific name	Family	Common name
Anethum graveolens L.	Apiaceae	Dill
Tripleurospermum disciforme C. A. Mey.	Asteraceae	Wild chamomile
Citrus aurantium L.	Rutaceae	Neroli
Cichorium intybus L.	Asteraceae	Chicory
Alhagi pseudoalhagi (M. Bieb.) Fisch. (*A. camelorum* DC.)	Leguminosae	Camel thorn
Foeniculum vulgare Mill.	Apiaceae	Fennel
Cuminum cyminum J. F. Gmel.	Apiaceae	Cumin
Bunium persicum (Boiss.) B. Fedtsch.	Apiaceae	Iranian Caraway
Mentha spicata L.	Lamiaceae	Spearmint
Salix aegyptica L.	Salicaceae	Egyptian willow (Bid-e meshk)
Fumaria villantii Loisel.	Fumariaceae	Fumitory
Zataria multiflora Boiss.	Lamiaceae	Shirazian thyme
Rosa damascana Mill.	Rosaceae	Rose

Table 2. Major components identified in the hydrolase.

Herbs	Major components (%)
Anethum graveolens	Carvone (70.9), dillapiole (6.4), cis-Dihydrocarvone (5.6)
Tripleurospermum disciforme	Decane (10.4), Dodecane (8.2), 3-Allylguaiacol (7.1)
Citrus aurantium	Decane (11.0), Dodecane (15.1), Tetradecane (13.2), hexadecane (12.2)
Cichorium intybus	Hexadecane (14.5), Decane (12.0), Dodecane (9.9)
Alhagi pseudoalhagi (*A. camelorum*)	Decane (29.0), Dodecane (18.1), Tetradecane (10.4)
Foeniculum vulgare	Decane (12.0), Thymol (11.9), Dodecane (9.7)
Cuminum cyminum	Hexadecane (15.2), Decane (17.1), Tetradecane (27.5)
Bunium persicum	Hexadecane (10.0), Dodecane (16.4), Tetradecane (16.7)
Mentha spicata	Carvone (68)
Salix aegyptica	Linalool (6.8), 1,4-Dimethoxybenzene (33.3), Heptacosane (28.1)
Fumaria parviflora	Thymol (12.0), Carvacrol (16.7), Dihydroactinidiolide (13.8)
Zataria multiflora	Thymol (65.1)
Rosa damascana	2- phenyl ethanol

Table 3. Major components of hydrolas and essential oils from 13 plants.

Herbs	Hydrola (%)	Essential oil (%)
Anethum graveolens	Carvone (70.9)	Carvone (40-60) [10]
Tripleurospermum disciforme	Decane (10.4)	*p*-methoxy- *β*-cyclopropylstyrene (18.8), (*E*)-*β*-farnesene (15.6), and *β*-sesquiphellandrene (15.4) [9]
Citrus aurantium	Dodecane (15.1)	Linalool (28-44) [10]
Cichorium intybus	Hexadecane (14.5)	Palmitic acid (32.9), nonadecane (26.1), E-α-bergamotene (14.0) [11)]
Alhagi pseudoalhagi	Decane (29.0)	drimenol (23.2) and neophytadiene

(*A. camelorum*)		(39.2) [12]
Foeniculum vulgare	Decane (12.0)	Anethole (55-75) [10]
Cuminum cyminum	Tetradecane (27.5)	cumin aldehyde (25-35) [10]
Bunium persicum	Tetradecane (16.7)	cumin aldehyde (27.0) [13]
Mentha spicata	Carvone (68%)	Carvone (55) [10]
Salix aegyptica	1,4-Dimethoxybenzene (33.3)	1,4-Dimethoxybenzene (61.5) [14]
Fumaria parviflora	Carvacrol (16.7)	No reported.
Zataria multiflora	Thymol (65.1%)	Thymol (27-65) [15]
Rosa damascana	2- phenyl ethanol (33.2%)	Geraniol, nerol, citronellol, normal paraffin (14-23 C) [10[

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