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Influence of the drying Process on the Quality of Essential Oils in Artemisia absinthium*

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Introduction

Although the variable composition of the essential oils obtained from different species of Artemisia is reported in a relatively large number of experimental papers (1–6), to our knowledge there has been no paper published on the influence of technological factors, such as those relating to the drying process.

The drying process used on aromatic plants has a significant impact on production costs since it is possible to shorten drying time, increase productivity per hour and thereby reduce costs.

Companies that process aromatic herbs use various types of drying systems, but the operative conditions under which drying is generally carried out are not always optimal. The choice of drying process should be based on preliminary evaluations of the nature of, possible damage to and final use of the aromatic and medicinal plants to be dried. Sensory analysis and analytical tests can be very useful in this regard.

This paper presents a study of the relationship between drying procedure and the quality of dried plants. This study refers to an experiment conducted on Artemisia absinthium L., an aromatic plant which is an important ingredient used in the preparation of many alcoholic (e.g. vermouth) and non-alcoholic beverages (e.g. ginger, bitter orange, etc.).

The data presented here refer to sensory and analytical testing of samples of Artemisia absinthium L. dried with three different methods, including natural drying at room temperature. Measurements of variations in moisture as a function

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of time made it possible to define the mathematical function that links these two parameters under the standard drying conditions adopted.

Experimental

Part A. of this section describes drying conditions and Part B. explains the operative parameters adopted for GC/MS analysis of the essential oils. Part C. describes the criteria adopted for organoleptic evaluation.

A. An experimental drier was used that made it possible to continuously evaluate the following values:
– room temperature;
– air temperature at the inlet and outlet (to calculate inlet and outlet relative humidity of the drying air);
– air flow rate.

The experimental drier used for these trials is shown in figure 1. It consisted of a centrifugal fan which provides for the air inlet into a rectangular cabinet equipped with four openings for air outlet. The vegetable matter to be dried was placed on punched steel plates located at the same level as the openings. A structure with a psychrometer device was placed at one of the air outlets.

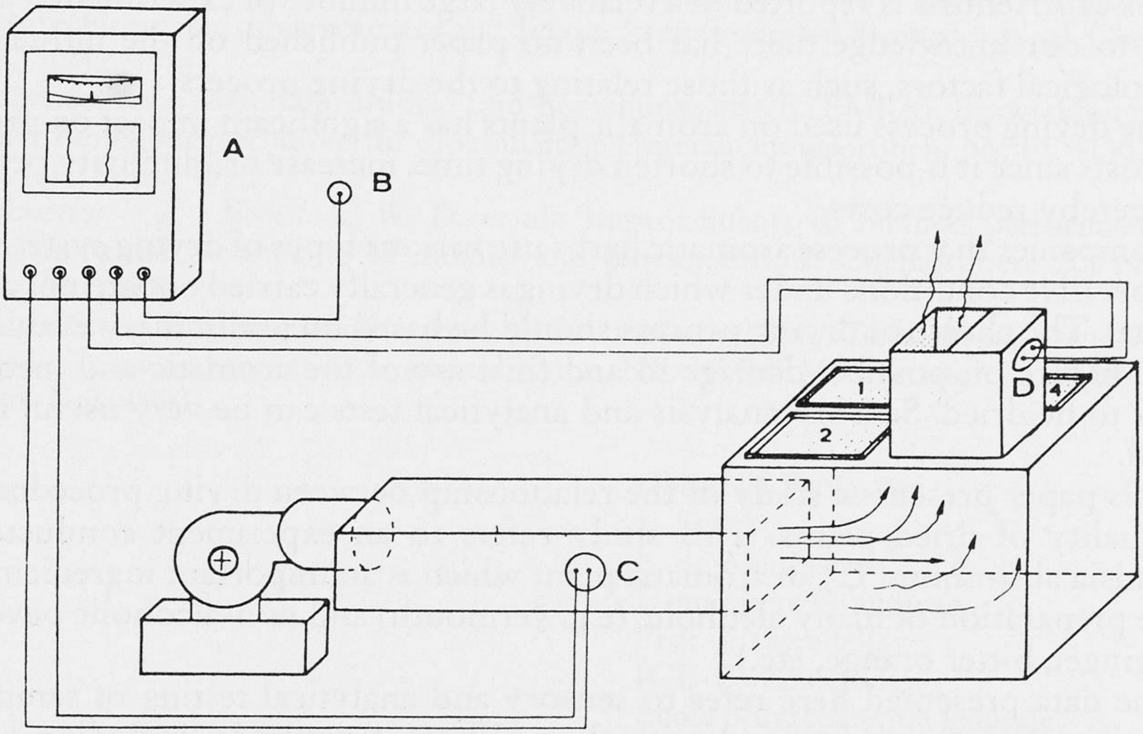

Fig. 1. Experimental drier used in trials:
A = galvanometric recorder
B = room temperature probe
C = psychrometer
D = psychrometer

A galvanometric recorder with probes made it possible to read the various temperatures (room temperature, temperature of the air at, respectively the dry and wet bulbs). The flow rate of the air was measured with an anemometer placed at the duct mouth and vents. During these trials, room temperature values ranged from 25 to 30 °C.

The flow rate of the air was approximately 1.000 m^3 per hour. The relative humidity of the air during the trials ranged from 45 to 60%. These conditions correspond to those at which absinthium is usually grown and harvested. These experiments were carried out during the first week of August. The initial moisture level of the vegetable matter used in the trials was 59%. This low value is due to the plant's botanical structure, which is mainly characterized by woody stalk. The Artemisia absinthium L. used here was cultivated in the region of Lombardy on an experimental field cultivated by the University of Milan.

The essential oils resulting from the three different drying conditions were identified as follows:

- ART 1: natural drying at room temperature;
- ART 2: artificial ventilation with air at room temperature (see introduction);
- ART 3: artificial ventilation with air heated to 35–39 °C.

B. A comparison of the three essential oils extracted with a Clevenger from the corresponding Artemisia absinthium L. samples was based on GC/MS analysis under the following operative conditions:

Equipment:	GC Hewlett Packard 5890
	MS Hewlett Packard 5971 A
Column:	capillary, HP1 cross-linked methyl silicone
	column length: 25 m
	i.d.: 0.20 mm
	film thickness: 0.33 µ
Program:	split – 1/50
	isoth. 80 °C for 10 min
	incr. 1 °C/min to 120 °C
	isoth. 120 °C for 10 min
	incr. 3 °C/min to 280 °C.

C. The organoleptic evaluation was carried out by a group of flavorists with industrial experience. The flavorists were asked to state their opinions in terms of top notes and body notes in the oil samples. The goal was to identify the presence or absence of notes that are traditionally considered to be «characteristics» of high quality essential oil obtained from Artemisia absinthium L.

Results

A. The essential oil yield ranged from 5.0% for the product dried with heated air ventilation to 5.8% for the product dried at room temperature. Measurements of the moisture level *(X)* under the three different conditions considered made it possible to come up with a mathematical rule for the moisture curve as a function of drying time. The function $X = f(t)$ is exponential, and the resolving equation is:

$$X = a + \frac{B - A}{1 + k e^{-a (B-A) t}}$$

where X is the % of moisture calculated with respect to dry matter. The initial value of X is thus equal to:

$$(59/41)\ 100 = 144\%$$

where 59 and 41 are the % values of moisture and dry matter, respectively, calculated in the vegetable substance before drying.

The coefficients of the drying curve $X = f(t)$ for the three trials are presented in table 1.

The curves A, B and C in figure 2 represent the changes in moisture X (calculated as the % of dry matter) during the three drying trials.

Table 1. Coefficients on the drying curve $X = f(t)$

Sample	a	A	B	k	X_0
1	0.00041963	8.53730	– 30.1808	–1.28603	143.9
2	0.00067007	7.30875	– 26.25596	–1.24571	143.9
3	0.00026717	7.75210	–588.2042	–5.37727	143.9

1 = natural drying at room temperature
2 = artificial ventilation with air at room temperature
3 = artificial ventilation with air heated to 35–39 °C

B. Drying the vegetable by artificial ventilation results in substantial changes in the composition of the essential oil produced. A comparison between normalized T. I. C. pairs, that is, ART 1 versus ART 2 and ART 1 versus ART 3 (fig. 3 and 4), shows the significant changes that appear in sections of the chromatogram within 30 minutes.

The ART 2 and ART 3 essential oil samples contain a lower quantity of monoterpene hydrocarbons (ret. time under 10 min). The same samples are lacking cis-epoxy-ocimene and contain an extremely low quantity of alpha-thujone. In other words, the oils ART 2 and ART 3, as compared to ART 1, have a very different alpha-thujone, beta-thujone, cis-epoxy-ocimene and trans-epoxy-ocimene ratio.

Examination of the peaks on the mass spectra at ret. time 25+/–0.2 min and ret. time 28–30 min show the clear occurrence of other isomerization phenomena.

There are no apparent changes in the part of the chromatogram that contains the sesquiterpenes (ret. time over 50 min).

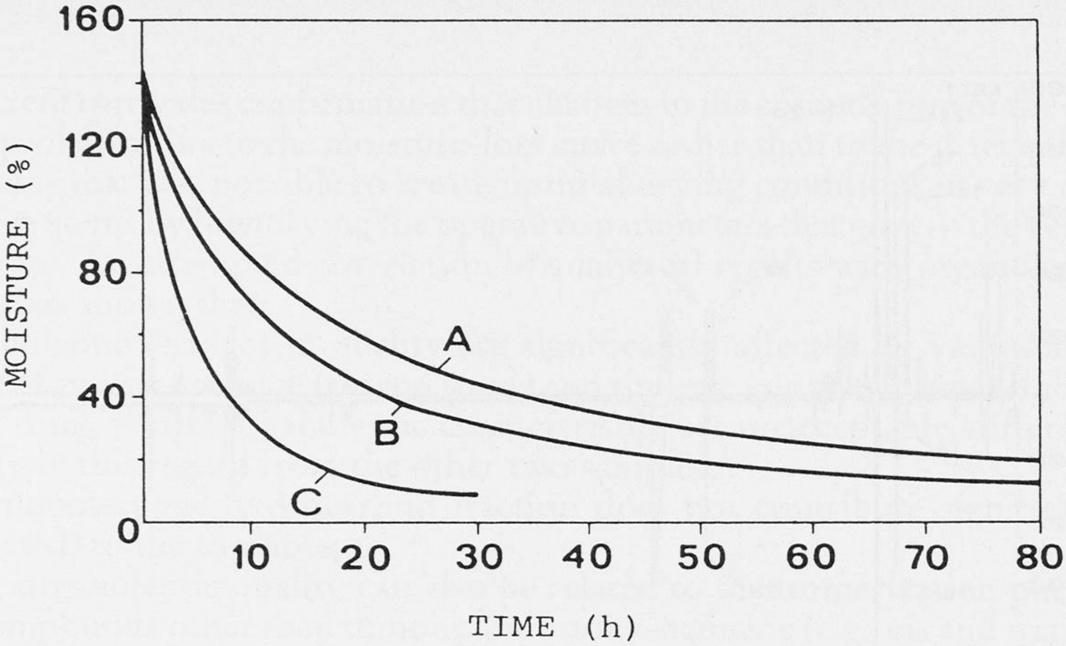

Fig. 2. Moisture curve (calculated with respect to dry matter) of Artemisia absinthium L. dried under the following conditions:

A = natural drying at room temperature
B = artificial ventilation at room temperature
C = artificial ventilation with air heated to 35–39 °C

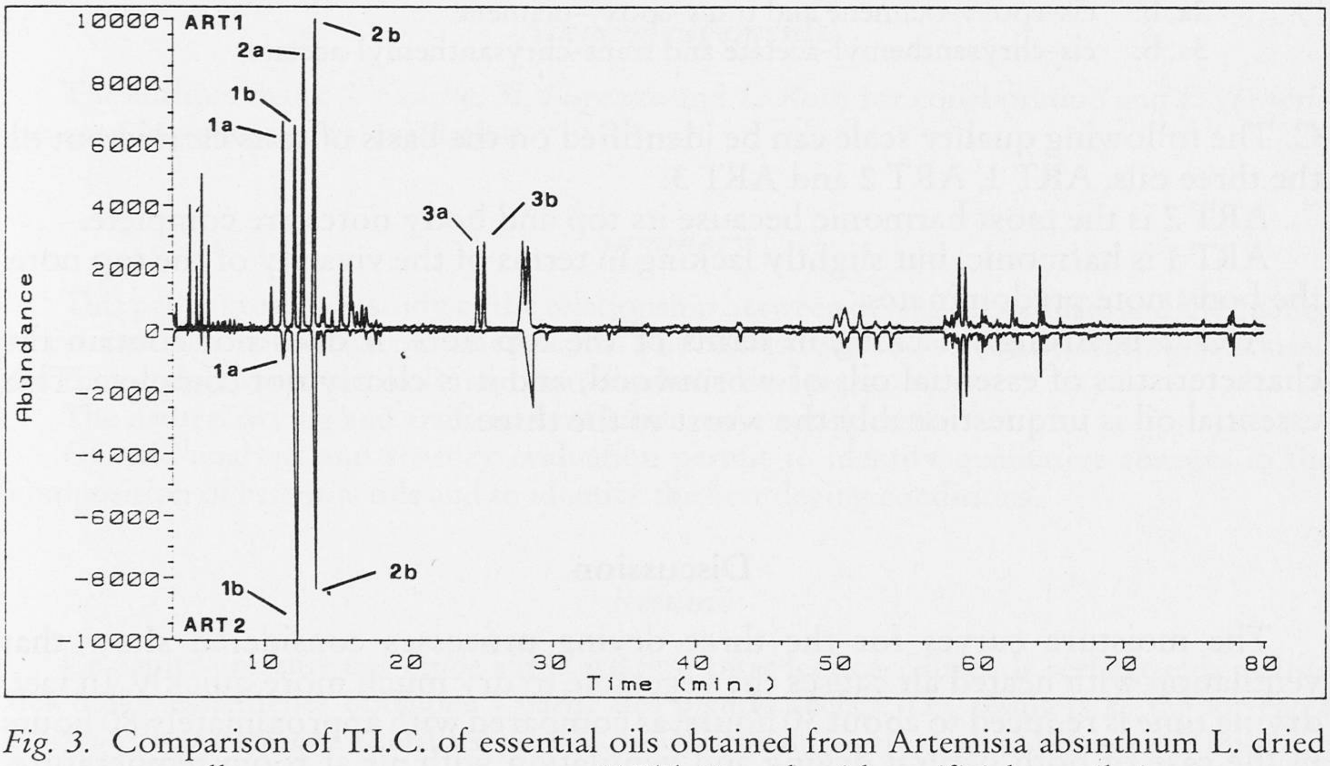

Fig. 3. Comparison of T.I.C. of essential oils obtained from Artemisia absinthium L. dried naturally at room temperature (ART 1) and with artificial ventilation at room temperature (ART 2).

1a, b: alpha-thujone and beta-thujone
2a, b: cis-epoxy-ocimene and trans-epoxy-ocimene
3a, b: cis-chrysanthemyl-acetate and trans-chrysanthemyl-acetate

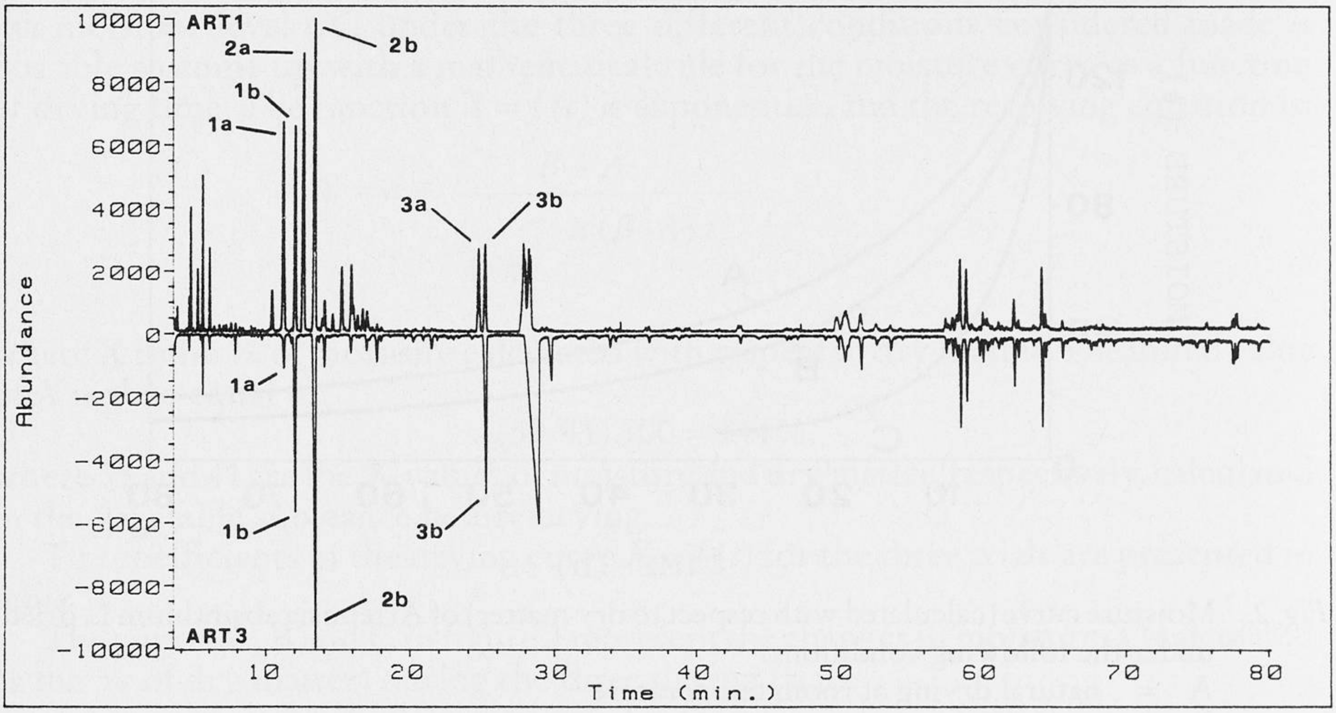

Fig. 4. Comparison of T.I.C. of essential oils obtained from Artemisia absinthium L. dried naturally at room temperature (ART 1) and with artificial ventilation with air heated to 35–39 °C (ART 3).
1a, b: alpha-thujone and beta-thujone
2a, b: cis-epoxy-ocimene and trans-epoxy-ocimene
3a, b: cis-chrysanthemyl-acetate and trans-chrysanthemyl-acetate

C. The following quality scale can be identified on the basis of tests carried out on the three oils, ART 1, ART 2 and ART 3:

ART 2 is the most harmonic because its top and body notes are complete.

ART 1 is harmonic, but slightly lacking in terms of the vivacity of the top note; the body note predominates.

ART 3 is strongly lacking in terms of the top note; it does not contain the characteristics of essential oils of wormwood, and it is clearly not complete. This essential oil is unquestionably the worst of the three.

Discussion

The moisture curves for the three drying processes considered show that ventilation with heated air causes the vegetable to dry much more quickly. In fact, drying time is reduced to about 30 hours, as compared with approximately 80 hours in the case of both natural drying and ventilation with air at room temperature. Although the curves corresponding to the last two processes look very similar, in this case as well the drying process has an effect on organoleptic quality.

A mathematical analysis of the function $X = f(t)$ and the fact that the mathematical rule governing drying is the same in all three cases (although the coefficients are different) provides confirmation that changes in the composition of the essential oils are probably due to the moisture-loss curve rather than to the drier's structure. This means that it is possible to create optimal drying conditions in very different types of systems by identifying the operative parameters that govern the vegetable's drying rate. An attempted correlation of analytical results with organoleptic evaluations has shown that:

– organoleptic changes in quality are significantly affected by variations in the ratio of epoxy-ocimene (cis and trans) and thujone (alpha and beta). Indeed, the ART 3 oil, whose organoleptic characteristics are unacceptable, differs significantly in this regard from the other two samples;
– the monoterpene hydrocarbon fraction does not contribute significantly (as expected) to the top note;
– poor organoleptic quality can also be related to the isomerization phenomena of compounds other than thujone and epoxy-ocimene (e.g., cis and trans chrysanthemyl acetate, peaks at ret. time 25 +/– 0.2 min).

These trials seem to confirm that although drying by artificial ventilation at room temperature causes structural changes in the composition of the essential oil of Artemisia absinthium L., it still results in a product with positive organoleptic characteristics. Small increases in drying air temperature cause alterations that make the quality of the essential oil unacceptable.

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Summary

This paper presents a study of the relationship between drying procedures and the quality of essential oils obtained from dried plants. The results refer to *Artemisia absinthium L.* used for the production of alcoholic and non-alcoholic beverages.

The natural drying and artificial ventilation were considered.

GC-MS analysis and sensory evaluation permit to identify qualitative changes in the composition of essential oils and to identify the best drying conditions.

Résumé

Ce papier présente une étude sur la relation entre les procédures de séchage et la qualité des huiles essentielles obtenues à partir des plantes sèches. Les résultats se rapportent à *l'Artemisia absinthium L.* utilisée pour la production de boissons alcooliques et de boissons sans alcool.

On a pris en considération le séchage naturel et la ventilation artificielle.

L'analyse GC-MS et l'évaluation sensorielle permettent d'identifier les modifications qualitatives dans la composition des huiles essentielles et le choix des conditions optimales de séchage.

Zusammenfassung

Die Beziehung zwischen Trocknungsverfahren und Qualität der aus den Pflanzen erhaltenen ätherischen Öle wurde am Beispiel *Artemisia absinthium L.* untersucht. Diese Pflanze wird zur Aromatisierung von alkoholischen und nicht alkoholischen Getränken benutzt.

Natürliche Abtrocknung und künstliche Lüftung sind beobachtet worden.

GC-MS Analyse und sensorische Bewertung bieten gute Möglichkeiten zur Erkennung von qualitativen Änderungen in der Zusammensetzung von ätherischen Ölen und zur Auswahl der besten Austrocknungsbedingungen an.

Literature

1. *Akhmedov, I.S., Kasymov, S. Z.* and *Sikyakin, G. P.:* A study of the chemical composition of Artemisia-absinthium. D. Khim Prur Soedin (Tashkent) **5** (1), 57–58 (1969).
2. *Sacco, T.* and *Chialva, F.:* Chemical constituents of the essential oils of Artemisia absinthium collected in Patagonia (Argentina). Planta Med. **54** (1), 93 (1988).
3. *Vostrowsky, O., Brosche, T., Ihm, H., Zintl, R.* and *Knobloch, K.:* The essential oil components from Artemisia absinthium L. Z. Naturforsch. C: Biosci. **36C** (5–6), 369–377 (1981).
4. *Kaul, V. K., Nigam, S. S.* and *Banerjee, A. K.:* Thin layer and gas chromatographic studies of the essential oil of Artemisia absinthium. Indian Perfum. **23** (1), 1–7 (1979).
5. *Sayed, M. D., El-Shamy, A. M., Soliman, F. M.* and *El-Shawbrawy, A. O.:* A study of the volatile oil and fatty acids of Artemisia absinthium. Bull. Fac. Pharm. (Cairo Univ.) **16** (1), 85–98 (1979).
6. *Chialva, F., Liddle, P. A. P.* and *Doglia, G.:* Chemotaxonomy of Wormwood (Artemisia absinthium L.). Z. Lebensm. Unters. -Forsch. **176,** 363–366 (1983).

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