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Effect of Drying Geranium Fresh Herb Before Distillation on Essential Oil Yield and Composition

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THE herb of *Pelargonium graveolens* L. Herit. was harvested from the farm of Medicinal and Aromatic Plants Research Department, Horticulture Research Institute, Agriculture Research Center. in April, 2010. Samples were taken at flowering stage for distillation, the essential oil percentage in the fresh and dry herb was determined. Seven periods before distillation were studied (zero time directly after harvesting, after 1, 2, 3, 4, 5 and 6 days from harvesting). These samples of geranium fresh herb were completely air dried. The volatile oil obtained from herb analyzed using Ds-Chrome 6200 Gas Chromatograph equipped with a flame ionization detector for separation of volatile oil constituents.

This research amid to study the drying geranium herb to allows the possibility of dry herb distillation without affecting the quality of the oil and its components as well as the ease of portability dry herb to places with distillation taking into account the reduced cost of transportation.

The results indicated that, the herb weight was reduced, oil percentage and oil yield was increased and the oil component was improved. The best drying period for distillation geranium herb was three days from harvesting. This treatment gave the best results of oil yield and quality.

Keywords: Pelargonium graveolens, Geranium oil, Drying, distillation.

Geranium (Pelargonium graveolens L. Herit.) is member of the family *Geraniaceae*. It has a major part in the production of medicinal and aromatic plants in Egypt.

China is now by far the biggest producer of Geranium oil, Egypt is the second. Egyptian geranium essential oil is considered of good quality, while Reunion product is superior to both. ADC (1998).

Major areas of the production (about 4000 fed.) are primarily in Upper Egypt, mainly Bani Sweif followed by Fayoum and Gharbia Governorates, where the distillation factories are nearby. Two harvests (cuts) are taken per year; a spring crop from April to June and a summer crop from September to October. Generally, the production averaged by 50–55 t per year in the past 10 years.

The essential oil is obtained by steam distillation of the green herb either directly after harvesting, or after 24 hr. in order to reduce the volume and to release the oil from the glucosidal form. Also ADC (1998) reported that, the harvestings may be left to wilt in the field for 24 to 48 hr to allow for better vaporization of oil during distillation and greater packing of biomass in the distill vessel.

Distillation is carried out in hundreds of small field distiller operated near the plantings. Where abundant herb material and running water are available, distillation post may comprise several field distiller, Guenther (1961). Yields of oil vary according to the time of harvesting, growth stage and other environmental factors. Maximal oil content of up to 0.4 % may be obtained from herbage harvested just before and during flowering stage, Fleisher and Fleisher, (1985). The geranium oil possesses a very strong, heavy rose-like odor, occasionally slightly harsh and minty. The physicochemical properties of the Reunion and Egyptian geranium oils vary within these limits as shown in Table 1.

TABLE (A): physicochemical properties of geranium oil.

Physicochemical properties	References	
	Guenther, 1961	**Harridy *et al*., 1998**
Solubility	usually clearly soluble in 2 to 4 vol. of 70 % alcohol	usually clearly soluble in 2.2 to 8.8 vol. of 70 % alcohol
Specific Gravity at 15^{o}C	0.888 to o.896	0.880 to 0.907
Refractive Index at 20^{o}C	1.461 to 1.468	1.460 to 1.474
Acid number	1.5 to 12	1.0 to 14.0
Ester number	50 to 78	30.0 to 110.0

Commercial geranium oil is a complex mixture of over 120 mono-and sesquiterpenes and low molecular weight aroma compounds, the main components are geraniol, citronellol, linalool, menthol, eugenol and other esters. Together these components constitute 60-70 % of the total oil Vernin *et al. (*1983). Harridy *et al.* (1998) pointed out that, the main recorded components of Egyptian geranium oil were citronellol (36.65%), geraniol (22.84%), linalool (2.27%) and limonene (2.36%). Also International Journal of Aromatherapy (2002) reported that, thirty compounds accounted for 99.1% of the oil were identified. The main identified components of *Pelargonium graveolens* L. Herit. were citronellol (33.6%), geraniol (26.8%), linalool (10.5%), citronellyl formate (9.7%) and *p*-menthone (6.0%).

Drying geranium herb before distillation may allow geranium plantations to extend in new areas far from distillation factories and led to reduce the cost of herb transportation as well. So, the aim of the present work is to study the effect of drying geranium herb before distillation on the essential oil yield, chemical composition and quality, to cancelling or confirming the former idea.

Material and Methods

The herb of *Pelargonium graveolens* L. Herit. was harvested from the farm of Medicinal and Aromatic Plants Research Department at El-kanater El-khairya, Horticulture Institute Research, A.R.C. in April, 2010. Samples were taken at the flowering stage for distillation. The distillation period was 3 hours for all treatments British Pharmacopoeia (1963).

Seven interval periods between harvesting and distillation were studied; no drying (directly after harvesting), 1, 2, 3, 4, 5 and 6 days from harvesting.

The volatile oil was analyzed in the laboratory of Medicinal and Aromatic Plants Research Department using Ds-Chrome 6200 Gas Chromatograph equipped with a flame ionization detector for the separation of volatile oil constituents. The analysis conditions were as follows: The chromatograph apparatus was fitted capillary column BPX-5, 5% phenyl (equiv.) polysillphenylene-siloxane 30m x 0.25mm ID x 0.25μm film. Temperature program ramp increases with a rate of 8^0C/min from 70^0C to 200^0C. Flow rates of gases were nitrogen at 1 ml/min, hydrogen at 30 ml/min and 330 ml/min for air. detector and injector temperatures were 300^0C and 250^0C, respectively. The obtained chromatogram and report of GC analysis for each sample were analyzed to calculate the percentage of main components of volatile oil.

Following data were recorded for both geranium herb and essential oil:

- Fresh and dry herb yield gram/plot then converted to ton /Fed).
- Oil percentage according to BP (1963).
- Oil yield (liter /Fed).
- Physicochemical properties of oil.
- Oil constituents.

Data were subjected to analysis of variance and the obtained means were compared at 1% level using least significant difference (LSD) according to Snedecor and Cochran, (1980).

Results and Discussion

Effect of drying geranium herb before distillation on herb weight and oil

Actual data in Table 1 indicated that, geranium yield of herb (ton/fed.) gradually decreased as the drying period increased. In this respect, geranium yield of herb which was 35ton/fed after harvesting (no drying) decreased to 28, 24, 20, 15, 14 and 11 ton /fed after drying herb for 1, 2, 3, 4, 5 and 6 days respectively. The long drying period of six days caused the highest herb weight loss by 68% and vice versa, the shortest drying period of one day resulted in the lowest herb weight loss by 20 %, in comparison with the zero time treatment.

TABLE 1. Effect of drying geranium herb before distillation on herb weight (gm), Rate of herb weight loss, Average of oil yield liter/Fed and Herb weight after drying ton/Fed.

Drying period	Herb weight (gm)	Rate of herb weight loss	Herb weight after drying (ton)/Fed	Average of oil yield (liter)/Fed
Zero time (directly after harvesting)	1000	00	35	52.5
1 days from harvesting	800	20	28	58.8
2 days from harvesting	680	32	24	60.0
3 days from harvesting	560	44	20	64.0
4 days from harvesting	420	58	15	54.0
5 days from harvesting	400	60	14	46.2
6 days from harvesting	320	68	11	34.3

(using the Fig. 1 is redundant, since it is repetition of the Table 1; it should be used either or, and I recommend the table as more documenting in a scientific paper, while figure better used in a presentation. This involves Fig. 2 as well).

Effect of drying geranium herb before distillation on the essential oil

Data in Table 2 indicated that, drying geranium herb after harvesting showed in general that, there was a gradual increase in oil percentage with the advance in drying period until 4 days period from harvesting then it decreased thereafter, the highest value in this respect was recorded at 0.37 % after 4 days from harvesting. It is worth to note also that, the oil percentage after 3 days of drying gave statistically the same result of 4 days. While the lowest value of 0.17 % was recorded directly after harvesting (no drying time). The oil percentage when converted to yield per Fed gave 52.5, 58.8, 60.0, 64.0, 54.0, 46.2 and 34.3 liter/Fed respectively.

TABLE 2. Effect of drying geranium herb before distillation on the essential oil percentage.

Drying period	Oil percentage
Zero time (directly after harvesting)	0.17
1 days from harvesting	0.21
2 days from harvesting	0.26
3 days from harvesting	0.36
4 days from harvesting	0.37
5 days from harvesting	0.33
6 days from harvesting	0.31
L.S.D. at 1%	0.03

It is obvious that, drying geranium herb 3 days before distillation leads to accumulation of the oil yield in the harvested material and to some fermentation (curing) and splitting of glycosides, which supposedly cause a slight increase of

the total oil yield These results agreed with those of Guenther (1961) who mention that, geranium plant material is stacked near the distills for about 24-hr. to dry and reduce in volume. ADC (1998) reported that, the herb may be left to wilt in the field for 72 hours (3days) to allow for better vaporization of moisture and greater packing of biomass in the distill vessel. Extending the drying time over 3-4 days caused reduction in oil yield, which may be attributed to volatile oil loses caused by wind, temperature and plant part loses.

Physical and chemical properties

Data in Table 3 showed that, physicochemical properties of geranium oil distilled after drying for 6 days were found to be unaffected by drying and remain mainly in the same range; *i.e.* solubility in ethyl alcohol 70 % (ml), specific gravity, refractive index, acid number and ester number values were within the standard range and met these of Guenther (1961) and Harridy (1998)

TABLE 3. Effect of drying geranium herb before distillation on Physical and chemical properties on geranium oil.

Drying period	Physical and chemical properties				
	Specific gravity	Refractive index	Acid number	Ester number	Solubility in ethyl alcohol 70 % (ml)
Zero time (harvesting)	0.9023	1.4737	6.17	53.61	5.0
1 day from harvesting	0.9047	1.4710	5.05	60.18	1.0
2 days from harvesting	0.9032	1.4715	5.05	59.94	1.0
3 days from harvesting	0.8987	1.4716	5.05	60.12	1.5
4 days from harvesting	0.9022	1.4718	4.94	70.71	1.0
5 days from harvesting	0.9052	1.4718	4.38	78.52	1.0
6 days from harvesting	0.9054	1.3699	3.53	81.75	1.5

Essential oil GLC analysis

Data on GLC analysis of the essential oil were presented in Table 4. The relative percentages of 10 major components revealed that, the citronellol represented the main constituent of geranium essential oil, followed by geraniol , limonene, linalool, citronellyl formate, eugenol, B-caryophyllene, P-cymene, α-pinene and myrecene in descending orde). The various constituents of geranium essential oil could be classified on the base of their functional group; as follow:

Alcoholic compounds: included geraniol, citronellol, and linalool recoded in almost the highest values in case of the 5^{th} day of drying (32.35 for geraniol & 32.98 for citronellol and 8.05 % for linalool), while the lowest values were found in case of no drying were ranged in the selected samples from (19.22 & 24.29 and 5.43 %) respectively.

Esters: included citronellyl formate the results recorded a range from 3.80 to 6.10 in almost the highest values in case of no drying, while the lowest value(3.87 %) were found in case of 3^{rd} day of drying.

Phenoles: included eugenol the results recorded a range from (0.91 to 4.35%) in almost the highest values in case of the 3rd day, while the lowest value were found in case of the zero time (directly after harvesting).

Hydrocarbons: included α-pinene, myrecene, p-cymene & B-caryophyllene recorded in almost the highest values in case of the 3rd day of drying (0.87 for α-pinene, 0.54 for myrecene , 1.13 for p-cymene & 4.07 for B-caryophyllene), while the lowest values were found in case of zero time (directly harvesting) (0.46 for α-pinene, 0.29 for myrecene, 0.57 for p-cymene & 1.29 for B-caryophyllene).

TABLE 4. Effect of drying geranium herb before distillation on chemical constituents geranium essential oil.

Main constituents of geranium oil	Drying period after harvesting						
	Zero time (no drying)	1 day	2 days	3 days	4 days	5 days	6 days
α-pinene	0.46	0.53	0.63	0.87	0.49	0.46	0.50
Myrecene	0.29	0.38	0.48	0.54	0.49	0.42	0.32
P-cymene	0.57	0.74	0.75	1.13	1.04	0.87	0.86
Limonene	5.60	5.84	6.50	7.89	8.63	8.77	9.24
Linalool	5.43	6.17	6.60	6.62	6.73	8.05	7.71
Citronaellol	24.29	25.93	27.29	27.86	28.65	32.98	28.05
Geraniol	19.22	20.41	24.82	29.24	30.86	32.35	24.14
Citronellyl formate	6.10	3.88	4.32	3.87	4.73	4.74	4.73
Eugenol	0.91	3.47	3.50	4.35	1.73	1.04	1.30
B-caryophyllene	1.29	3.02	3.71	4.07	1.97	1.40	1.65
Total	64.16	70.37	78.60	86.44	85.32	91.80	78.50

It was observed that, the percentage of alcohol component mainly citronellol and geraniol, which is general responsible for geranium oil quality, was increased, while the esters component citronellyl formate decreased. This may be related to the above mentioned fermentation process during drying process; *i.e.* esters may decomposed and produced alcohols and vice versa. So, the increases in alcohol contents (citronellol, geraniol and linalool) in geranium essential oil may be excepted as the drying process may allow favor conditions for such process and thus drying geranium herb before distillation may improve oil quality as the geraniol and citronellol was found to increase till the 5*th* day of drying.

Conclusion

Based on the obtained results of this research, it can be concluded that, drying herbage yield of geranium up to 3 to 4 days before distillation does not affect the physicochemeical traits of the volatile oil, rather increases slightly the yield and quality, reduces the staking volume and thus the transportation and distillation costs, consequently encourage geranium plantations to extend in new areas far from distillation factories.

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تاثير تجفيف العشب الطازج للعتر قبل التقطير على نسبة ومحصول الزيت ومكوناتة وجودتة

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يهدف هذا البحث إلى دراسة اثرتجفيف عشب العتر قبل التقطير على جودة الزيت ومكوناتة مما سيقلل من تكاليف النقل ويزيد مساحات زراعتة. تم حصاد عشب العتر من قسم بحوث النباتات الطبية والعطرية بمعهد بحوث البساتين مركز البحوث الزراعية فى شهر إبريل ٢٠١٠. وقد تم أخذ عينات العشب للتقطير فى مرحلة التزهير، تم تقدير نسبة الزيت الطيار فى العشب الطازج والجاف. تم دراسة ٧ مواعيد تجفيف لتقطير عشب العتر(بعد الحصاد مباشرة ، وبعد ١، ٢، ٣، ٤، ٥، و٦ أيام من الحصاد. تم تقطير العشب بالتقطير البخارى لمدة ٣ ساعات. وتم تحليل الزيت الطيار الناتج من العشب بواسطة جهاز DS-Chrome 6200 Gas Chromatograph

أوضحت النتائج أن التجفيف حتى اليوم الثالث او الرابع قد زاد كل من نسبة ومحصول الزيت كما تحسنت جودتة ، مما سيتيح تجفيف عشب العتر لتقليل كلف النقل والتقطير