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EFFECT OF SOME DRYING METHODS ON THE QUALITY OF BASIL PLANT (*Ocimum basilicum, L.)*

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ABSTRACT

The present study was carried out in the summer season (2005) to investigate the effect of some drying methods on the quality of basil plant (*Ocimum basilicum L.*). The sun drying (50ºC), shade drying (35ºC) and oven drying (40ºC). The physico chemical properties of the plant were determined. The results showed that the higher value of volatile oil percentage, methyl chavicol compound and chlorophyll content were noticed by shade drying method, meaning that shade drying method was the best treatment to keep the quality of basil plant as high as possible. On the other hand, sun drying method was the lowest one since it caused a decrease in the plant quality i.e the essential oil content, chemical composition in linalool, methyl chavicol and other main components beside a decrease in its chlorophyll content. Oven drying was a moderate treatment to keep the plant quality. As for microbial load (ML), the three treatments showed insignificant effect and was within the range reported by Egyptian specification standard on dried basil.

INTRODUCTION

Ocimum basilicum, L. (sweet basil) is an annual herb of Labiateae family. The plant is widely used in food and oral care products (Sajjadi, S.E. 2006). The leaves and flowering tops of sweet basil are used as carminative, galactogogue, stomatic and antispasmodic medicinal plant in folk medicine (*Duke, 1989*). The essential oil of basil (*Ocimum basilicum, L.*) has been used extensively in food products, perfumery and dental products. Essential oil basil and their principal constituents were found to exhibit antimicrobial activity against a wide range of gram-negative and gram-positive bacteria, yeast and mold (*Suppakul et al., 2003*), also, (*Chiang et al., 2005*) reported that this plant has been used as antiviral.

The chemical composition of basil oil was investigated by *Maroti et al., (1996*). *Chalchat et al., (1999*) and *Gange et al., (2001*). However methyl chavicol, linalool, methyl cinamate, methyl eugenol, eugenol and geraniol are reported as major components of the oils of different chemotypes of *O. basilicum.*

Volatile aroma compounds are the most sensitive components in the process of food drying, the effect of drying process on the composition of volatile flavor constituents of various aromatic plants has been the subject of numerous studies, which show that the change in the concentrations of the volatile compounds during drying depend on several factors, such as the drying method and parameters that are characteristic of the product subjected to drying, the main preservation process for spices, can be carried out conventionally by air drying (with or without heat). It is obvious that the

drying process may have an influence on the content of aroma compounds *Venskutonis, (1997*).

Guenther (1961) stated that the direct exposure of plants to the sun tended to break the stalks and made the leaves brittle. Balbaa *et al*., (1974), found that shade drying increased glycosidal content in *Digitalis lanata*, and they added that shade drying had provided favorable and satisfactory method for quality as well as a practical and economic one. Oven drying was studied by many investigators; some of them found that it was favorable and satisfactory method. *Mettivier et al., (1960*) found that drying at high temperature (100^{o}C) gave a satisfactory product with *Labiatac* plants and Umbelliferous herbs and the best results were obtained at 30-40^{o}C.

The medicinal plants loss a great quantity of essential oil and chlorophyll content during the drying process. (*Kassem et al., 2006*) reported that the drying methods decreased essential oil and chlorophyll content in lemongrass, oregano, spearmint and peppermint plants and the solar drying method was better than the natural drying (sun drying) and artificial drying (in oven 45^{o}C).

MATERIALS AND METHODS

Materials:-

Plants of *O.basilicum* was cultivated in the experimental farm of Horticulture research station in kassassen, Ismailia governorate, Egypt during the summer season of 2005. The plants were collected from three plots (3 replicates). The basil stalks were cut 15 cm above the ground in the morning.

Methods:-

Sample of basil were divided into three sets, the first set was sun dried at 50 ^{0}C for 20 h. the second set was dried in shade in open ventilated area for 48 h. the third was dried in oven at 40 ^{0}C for 20-24 h, until the complete drying. The moisture percentage in the different samples was calculated on the dry matter of the plant. This was obtained by drying 30 g of the sample at 70^{o}C in oven with air circulation until a constant weight.

The essential oil was determined according to the method described in *British pharmacopeia (2000)* using clavenger's apparatus for 3 hours. Samples of essential oil stored under refrigeration and protect from light in glass flasks with screwed cups and scaled with parafilm.

Determination of physical and chemical properties of essential oil:

Specific gravity, refractive index, optical rotation, acid value, ester number and ester number after acetylating were determined according to the method described by *Guenther (1961)*.

Identification and determination of the essential oil composition:

The relative content of the major components in the herb was determined by gas chromatography. They were analyzed in chromatography in gas phase. A chromatograph equipped with flame ionization detector (FID) and capillary tubes BPx-5 (30 ml length and 0.25 mm of internal diameter (ID) was used. The plunging gas was nitrogen. The initial temperature of the column was 70-80 ^{o}C, at rate of 5^{o}C/min, from 80-120 ^{o}C, programmed to

raise 10 °C/min until the maximum temperature 190 °C. The temperature of the injection and detector were fixed at 250 °C and 300, respectively.

Determination of chlorophyll (a + b) content:

Chlorophyll (a + b) content was calculated according to Arnon, (1949). Two g of samples were homogenized in 10 ml of 80% acetone and centrifuged for 15 min. The transparent was filtered and brought to 10 ml with 80% acetone. Absorbance (A) was measured at 645 and 663 nm using Perkin-Elmer lambda-Bio 40 spectrophotometer.

Determination of microbial Load (ML) in basil plant:

1- Place 10 gm of dry basil plant in a flask (100 ml), then add distilled water and shake well.
2- Prepare 10 test tubes, each one contain 9 ml distilled water where each two tubes represent a duplicate.
3- Put 1ml of the flask content in the 1st two test tubes (1ml in each tube), so the concentration become 1/10.
4- Take 1ml from each tube of the 1st duplicate and place it in the 2 tubes of the 2nd duplicate, so the concentration become 1/100.
5- Repeat this serial dilution to prepare the concentrations 1/100, 1/1000, 1/100000.
6- Prepare 10 petrie dishes (10ml); each 2 dishes represent a duplicate.
7- Prepare nutrient agar in a flask (25ml), where the agar is sterilized and left to cool to 40 °C.
8- Pour the content of each duplicate of the test tubes into the dish duplicate that represents it, then add agar to all dishes.
9- Incubate the dishes at 37 °C for 24 hours.
10 - Divide the dishes by the marker into 4-quarters.
11- Draw a circle by a marker around each colony and determine total count of microbes in 1gm.

$$ML = \frac{\text{No. of colonies x 4 x conc.}}{10}$$

This method was modified from the method reported by Smith et al, (1999).

RUSULTS AND DISCUSSION

The most important physical and chemical properties of the essential oil of basil were determined and the results are shown in Table (7). Most of the values were to be within the range mentioned by Guenther (1961).

Table (1): Physical and chemical properties of the tested basil essential oil.

Oil	Specific gravity at 15 °C	Refractive index at 20 °C	Optical rotation	Acid number	Ester number
Local basil	0.9472	1.4890	-11°	0.49	6.9

Effect of drying methods on the basil essential oil content:

Regarding the influence of drying methods, it could be seen in Table (2), that there was a decrease in the oil content in the three methods of drying compared with fresh sample. The higher value of volatile oil% of the herb dried in shade (35 ^{o}C) and in oven at (40 ^{o}C) than the herb dried in the sun at 50 ^{o}C and the volatile oil% of the dried herb was higher due to air drying in shade at (35 ^{o}C) than in case of oven drying at 40 ^{o}C. However, the loss of volatile oil during sun drying was considerably higher than those of air drying and oven drying. These results are in agreement to those obtained by *Hasnaa et al., 2007* on basil plant.

Table (2): Effect of drying method on the essential oil percentage (dry weight basis) of *Ocimum basilicum, L.*

Method of drying	The oil percentage of the herb %
Control (fresh)	0.92
Sun drying at 50 ^{o}C	0.44
Shade drying at 35 ^{o}C	0.81
Oven drying at 40 ^{o}C	0.69

Table (3): Chemical components of the essential oil of fresh basil plant.

Peak No.	Compounds	Local basil
1	α- pinene	0.74
2	B- pinene	0.21
6	1,8 cineole	2.23
7	Linalool	16.51
10	Methyl chavicol	56.37
15	Linalyl acetate	1.83
16	Eugenol	3.30

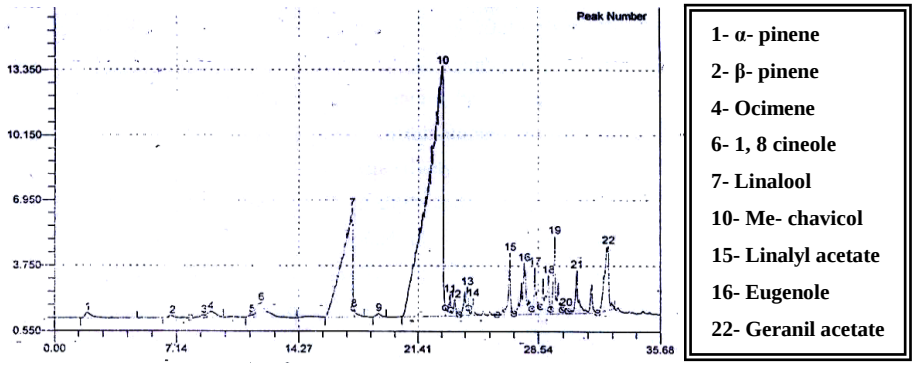


Fig. (1): GLC chromatogram of fresh basil essential oil.

GLC analysis of basil fresh essential oil in Table (3) and its chromatogram in Fig. (1) showed that basil essential oil was characterized by presence of Methyl chavicol compound (56.3%), it was the major component and a great amount of linalool (16.5%), besides. 1,8 cineole and Eugenol (2.23 and 3.30%), respectively.

Effect of drying methods on the essential oil components:

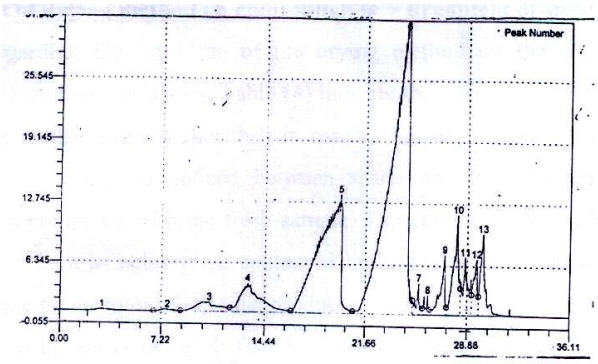
The relative percentages of the major constituents of essential oil of basil herb as affected by drying methods are shown in Fig. (2,3 and 4). the major constituents of the basil oil samples were found to be 1,8 cineole, eugenol, linalool and methyl chavicol and ranged from 2.23 to 56.37%.

All chromatograms of drying methods as are shown in Fig. (2,3 and 4) caused a decrease in peaks numbers and differences in peaks sequences.

Shade drying gave the higher percentage of methyl chavicol compound. Compared with the other treatments, however, sun drying gave the lowest one. There was disappearance in both of 1, 8 cineole and linalool compounds in sun drying and severe decrease in eugenol compound. On the other hand, the data cleared that oven drying at 40 ^{o}C gave the highest percentage of eugenol compound in the volatile oil. Also, oven drying at 40 ^{o}C increased linalool compound by 70.9% from the fresh sample. However, shade drying increased this compound by 51.3% from the fresh sample. As for 1.8 cineole compound, both of shade and oven drying at 40 ^{o}C caused higher increase in this compound reached to 1.4 and 2.1 time than the fresh sample, respectively.

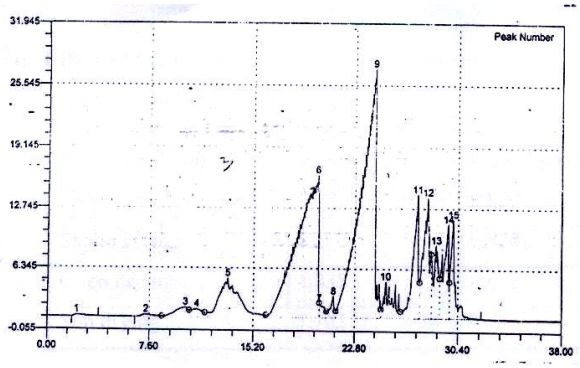
The main components linalool and methyl chavicol appear better indicators of sensory quality and minor components should be taken into consideration for more complete characterization (*Krebbers et al., 2002*).

It can be concluded from the above mentioned results that shade drying was the best treatment followed by oven drying at 40 ^{o}C to obtain the best yield of volatile oil with the highest quality. These results are similar with those of Hasnaa *et al*, (2007).



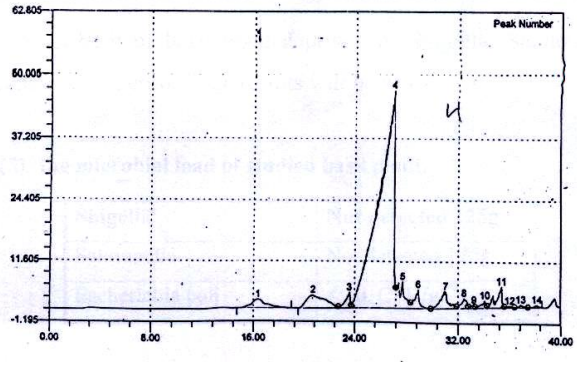
4- 1, 8 cineole
5- Linalool
6- Me- chavicol
10- Eugenol

Fig. (2): Essential oil component of basil plant dried in shade at 35 ºC.



5- 1, 8 cineole
6- Linalool
9- Me- chavicol
12- Eugenol

Fig. (3): Essential oil component of basil plant dried in oven at 40ºC.



4- Me- chavicol
11- Eugenol

Fig. (4): Essential oil component of basil plant dried in sun at 50 ºC.

Effect of drying method on chlorophyll (a and b) content (mg/g) of the studied plant:

With regard to the effect of the drying methods on the chlorophyll (a and b) content, the data in Table (4) indicated that shade and oven drying methods were higher than in case of sun drying and insignificant difference could be noticed between shade and oven drying methods compared with the fresh sample. Therefore, plant dried by these methods kept its chlorophyll content as high as possible, meaning giving the same green color of the final product.

From the previous result found that shade drying or oven drying are more suitable from sun drying for medicinal plant.

Table (4): Effect of the drying methods on the chlorophyll (a and b) content (mg/g) of the studied plant.

Drying method	Chlorophyll a	Chlorophyll b
Fresh sample	6.251	0.852
Shade drying	5.172	0.728
Oven drying	4.835	0.672
Sun drying	1.762	0.353

Effect of the drying methods on the microbial load of basil plant:

The fresh herb of basil plant deprived of Shigella, Salmonella and Escherichia coli microbes, the results will be as follows.

Table (5): the microbial load of studied basil plant.

Shigella	Not detected 125g
Salmonella	Not detected 125g
Escherichia coli	< 10. CFU/g

Data in Table (6) indicated the lowest average of 8.2 thousand/gram of microbial Load (ML) was occurred with sun drying treatment. However, shade drying and oven drying gave a moderate account 9.2 thousand/gram and 9.8 thousand/gram respectively. These percentages of microbes in three drying methods were within the range reported by Egyptian specification standards (2003) on dried sweet basil who reported that ML of dried basil should not more than 10 thousand microbes/gram.

Table (6): Effect of drying method on total account of microbes of basil plant.

Drying method	Microbial Load (ML)
Sun drying	8.2 thousand/gram
Shade drying	9.2 thousand/gram
Oven drying	9.8/gram

CONCLUSION

It could be concluded that shade drying method was the best process kept the essential oil content as high as possible and regarding the main

component it gave the higher percentage of methyl chavicol compound, regarding the chlorophyll content it gave the same green color of the final product, followed by oven drying, and sun drying method was the lowest one.

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تأثير بعض طرق التجفيف على جودة نبات الريحان

فاتن رمزي موسى ، نوال جورج غالى و ممدوح محمد أبو الفتوح عطية

قسم بحوث النباتات الطبية والعطرية – معهد بحوث البساتين - مركز البحوث الزراعية - الجيزة

أجريت هذه الدراسة في الموسم الصيفي لسنة ٢٠٠٥ لدراسة تأثير استخدام بعض طرق التجفيف وهي التجفيف في الشمس المباشرة على درجة ٥٠°م لمدة ٢٠ ساعة والتجفيف في الظل على درجة ٣٥°م لمدة ٤٨ ساعة والتجفيف في الفرن على درجة ٤٠°م لمدة ٢٠-٢٤ ساعة على جودة نبات الريحان (*Ocimimum basillicum L.*) ولقد قدرت أولاً الصفات الطبيعية والكيماوية لنبات الريحان . وأوضحت هذه النتائج أن التجفيف في الظل كان أحسن طرق التجفيف وهو الطريقة المثلى وذلك للمحافظة على نسبة الزيت العطري في النبات وكذلك التركيب الكيماوي للزيت العطري بما فيه من المركبات الفعالة مثل اللينالول والمثيل شافيكول وغيرها من المركبات الفعالة . وكذلك نسبة الكلوروفيل . وعلى العكس في حالة التجفيف الشمسي حيث كان أسوأ الطرق حيث أدى إلى انخفاض في نسبة الزيت العطري في النبات وانخفاض في نسب المركبات الفعالة وكذلك نقص واضح في نسبة الكلوروفيل مما أدى إلى انخفاض جودة النبات . أما التجفيف في الفرن فقد أعطى نتائج متوسطة وهو يقارب التجفيف في الظل تقريبًا .

أما بالنسبة للحمل الميكروبي فقد أعطت طرق التجفيف الثلاثة نتائج متقاربة بالنسبة للعدد الكلي للميكروبات وكلها تقع في الحدود المسموح بها في الريحان المجفف كما ورد في المواصفة القياسية .