Effect of Different Drying Methods on Essential Oil and Antioxidant Activity (DPPH%) of Some Aromatic Plants

Z.A.Abd El-Hafez [1] A.H.Elnaggar[2] and M.R.Hassan[2]

ABSTRACT

Different drying methods (Shade, Sun and Electric oven at 35 C° and 50 C° were studied. Effects of these methods on percentage and composition of volatile oils and antioxidant activity (DPPH) of chamomile, peppermint, rosemary and sweet basil plants were studied.Using dry method in shade gave the highest mean value of DPPH% for all experimental plants compared with other drying methods. Shade drying generally seemed better, especially with regard to essential oil and major's compounds percentage of plants experiment followed by oven at (35 C°) drying method.

ADDITIONAL INDEX WORDS: Drying methods, chamomile, peppermint, rosemary and sweet basil, DPPH%, chamazulen, menthol, borneol and linalool

INTRODUCTION

Medicinal, aromatic and herb spices from family Lamiaceae such as peppermint (*Mentha piperita*), sweet basil (*Ocimum basilcum* L.) and rosemary (*Rosmarinus officinalis,*L.), are widely distributed in Egypt. These plants are used as stomachic, spasmolytic, carminative, and expectorant agents in folk medicine and in official medicine. Ethereal oils extracted from Lamiaceae family plants can contribute the quality of food with better odor and flavor what is consider as very important quality parameter in food manufacturing (Kovaaevia, 2001). Other benefits could be applied due to ethereal oils in therapeutics purposes due to their antimicrobial (bactericidal and fungicidal) effects on some pathogen microorganisms (Stefanini *et al*., 2001 and Klaus *et al*., 2007).Chamomile (*Matricaria recutita* L.*)* (Family Asteraceae*)*, is a well-known medicinal plant in folk medicine cultivated all over the world. Chamomile essential oil is widely used in pharmaceutic, cosmetic, and food industries. The pharmacological effect of chamomile is mainly connected with its essential oil for its spasmolytic,antimicrobial, and disinfective properties. The biologically active substances in chamomile essential oil are α-bisabolol, bisabolol oxides, chamazulene, and enyn-dicycloethers (Arak.,1981,Arak *et al.*1981*,*Brunke *et al*., 1992 and Grgesina *et al*.,1995).

Dry herbs have a great importance, not only for the culinary purposes, but also for the medicinal uses (Hedrick, 1972). Drying method is the most critical process in the production of dried herbs and spices. The aim of drying is to reduce the moisture content of the product from actively growing in the field to a level that prevents deterioration of the product and allows storage in a stable condition. Drying is a two stage process: firstly the transfer of heat to the moist product to vaporize the water in the product and secondly mass transfer of moisture from the interior to the product surface where it evaporates. The most important and immediate management concern is to ensure that the harvested herbs will not rot or become grossly invaded with yeasts, bacteria and mould (producing aflatoxins) or become contaminated by pests. This is the start of the preservation process, which for most spice crops requires drying that will enable the long-term crop storage and the opportunity for further processing. In some cases, washing prior to processing is desirable to remove field contaminants (dust, soil) using anti-microbial solutions to reduce the microbial populations to a low level prior to the drying process.

The traditional open sun drying that is widely used in developing countries has major inherent limitations when trying to preserve product quality. High crop loss and low product quality result from inadequate drying, long drying times, fungal spoilage, insect infestations, bird and rodent damage and contamination plus the effects of sunlight and the weather. Even in the most favourable climate it is often not possible to get the moisture content of the product low enough for safe storage. In the tropics the high relative humidity of the air prevents drying of harvested crop products during the wet season

The traditional medicine still plays an important role in the primary health care in Egypt and most Arab countries. On the other hand, many herbs and spices have been shown to contain high levels of polyphenolic compounds with potent antioxidant properties.

Free radicals are generated by a process known as redox cycling and they are catalysed by transition

[1]Medicinal and Aromatic Plants Res.Dept.Hort.Res.Inst.A.R.C. Alexandria, Egypt.
[2]Departments of Floriculture. Ornamental Horticulture and land scape Gradening.
Faculty of Agr. (Elshatby), Alexandria Univ.Egypt
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metals, to cause DNA and RNA damage, thiol oxidation and lipid peroxidation (Halliwell and Guttridge, 1999; and Halliwell 1994).The great potential of free radicals to react with various compounds by electron transfer, proton transfer, H-atom abstraction or addition reaction may involved in the pathological of various diseases (Halliwell., 1993; and Havsteen, 1983). Many plant compounds can scavenge reactive oxygen species (ROS) and thereby directly reduce-oxidative stress (Walgren *et al*., 2000). Among these, flavonoids seem to be potent candidates because they show broad pharmacological activities and widely distributed in many edible plants (Rice-Evans *et al*., 1996). The beneficial effect of flavonoids is mainly associated with the different various antioxidative mechanisms which act as enzyme inhibitor, reducing agents, trapping free radical and by acting as iron-chelating (Bravo., 1998; and Hollman, 2001).

There is no study on the antioxidative activity of some aromatic plants up to the present. The aim of this study was to investigate the essential oil percentage, chemical composition of oil and the antioxidative activity of different drying methods of the aromatic plants (chamomile, peppermint, rosemary, and sweet basil) extracts as new potential source of natural antioxidants.

MATERIALS AND METHODS

Plant material

The samples of aromatics plants (chamomile, peppermint, rosemary, and sweet basil) were collected from Sabhia Horticulture Researches Station, Alexandria in March 2009 for chamomile and July 2009 for peppermint, rosemary, and sweet basil.

Three methods of drying were used; the traditional shade drying, open-sun drying and oven drying at 35 and 50 °*C*. To establish the effect of drying techniques on oil content and antioxidative activity in some aromatics plants (chamomile, peppermint, rosemary and sweet basil).The plants were selected because they are the most export herbs in Egypt.

Shade drying

One kilogram (fresh weight) of each sample was used for the experiment. The samples were evenly spread on a tray and left to dry in the shade until constant weight (until the herbs were brittle and considered to be dry).

Sun Drying

One kilogram (fresh weight) of each sample was used for the experiment. The samples were evenly spread on a tray and left to dry in the sunshine until constant weight (until the herbs were brittle and considered to be dry).

Oven drying

Four hundred grams (fresh weight) of each sample were then packed in envelopes which were punched with holes to allow for moisture escape. The envelopes were placed in the oven at 35 and 50 °*C* and left to dry until constant weight (until the herbs were brittle and considered to be dry).

Dry weight percentage

This may be done by taking a sample of the fresh herb prior to its harvesting, then promptly and accurately weighing it before carefully drying. A scientific method of establishing the dry weight is to take the weight of the sample and continuing the drying process until no further weight is lost. The herb can then be assumed to be dry and the percentage of water loss and thus dry weight be attained. A simpler method is by feel and testing when any pieces in the sample break sharply. To calculate the dry weight percentage: Dry weight of herb / wet weight of herb x 100.

Determination of radical scavenging activity (DPPH) in drying herbs

The ability to scavenge the stable free radical (1, 1-diphenyl-2-picrylhydrazyl) (DPPH) was determined based on the method of Ohinishi *et al*., 1994.with minor modifications. A solution of 0.2 mM DPPH in methanol was prepared and 1 ml of this solution was mixed with 1 ml of extract in methanol (5 to 150 [micro]g/ml). The reaction mixture was vortexed thoroughly and left in the dark at room temperature for 30 min. A control sample containing the same volume of solvent in place of extract was used to measure the maximum DPPH absorbance. The absorbance of the mixture was measured spectrophotometrically at 517 nm. Ascorbic acid and quercetin were used as references. Results were expressed as percentage of inhibition of the DPPH radical according to the following equation:

% Inhibition of DPPH = (Absorbance of control - Absorbance of sample) x 100/Absorbance of control

Essential oil analysis:

The percentage of essential oil were extracted separately by the hydro distillation method utilizing apparatus similar to European Pharmacopoeia (EP).The essential oils were diluted in diethyl ether (20 ml in 1 ml) and analyzed with GC-MS (HP 8644) with flame ionization detector (FID) on a fused silica 132 capillary column DB-5, 25 m in length, 0.32 mm i.d., and 0.5 mm film thickness.133 Helium was used as the carrier gas with a flow rate of 1.6 ml/min; the detector 134 temperature was 260 °C, the oven temperature was programmed to increase from 130 to 260 °C at a rate of 4 °C/min. The split injector was heated at 250 °C, the split 136 ratio was 15:1. Data were processed on a DP

800 integrator. The percentage of majors constituents were estimated by measuring the peak area of the different compounds of the chromatogram according to Heftman (1967) and Gunther and Joseph (1978).Sources of the principal components of volatile oils which used as reference for determined essential oil of chamomile, peppermint, rosemary and sweet basil by GC were Ciba Gigi, NY, USA.

There were three replications for each specimen; all the results obtained were statistically analyzed. The layout of the experiment was randomized complete blocks design (Snedecor and Cochran, 1974).

RESULTS AND DISCUSSION

Generally, data represent in Table (1) and Fig.(1 and 2) indicate that using drying methods in shade and oven (35 C^o) gave the highest mean value of dry weight percentage for all experimental plants compared with other drying methods. But all drying methods gave the allowable percentage of dry weight percentage of herbs according to Food Standards Agency (UK).Also, using dry method in shade gave the same trend (highest mean value) of DPPH%. On the other hand the decline in the percentage of dry weight by drying methods in sun and oven (50 C^o) led to a low percentage of DPPH. Comparing between essential oils percentage of chamomile, peppermint, rosemary and sweet basil by different methods (shade drying, sun drying and oven drying (35 C^o and 50 C^o) show that, shade drying generally seemed better, especially with regard to essential oil percentage of plants experiment followed by oven (35 C^o) drying. These results are in agreement with the findings observed in earlier studies (Osman, 2000,. and Muller and Heindl 2006).

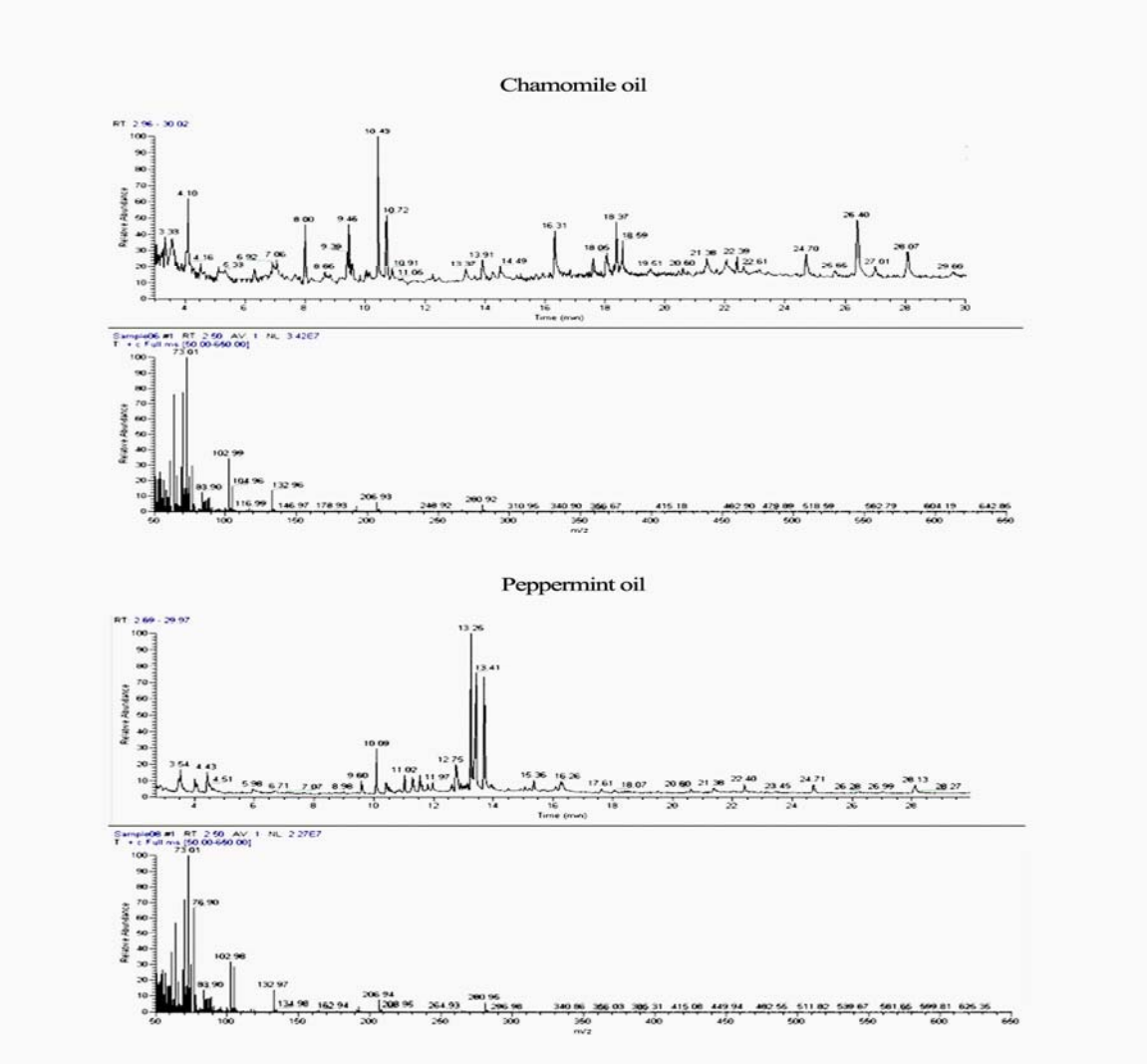

Fig. 1. Typical GC-MS Chromatograms of Chamomile and Peppermint oils

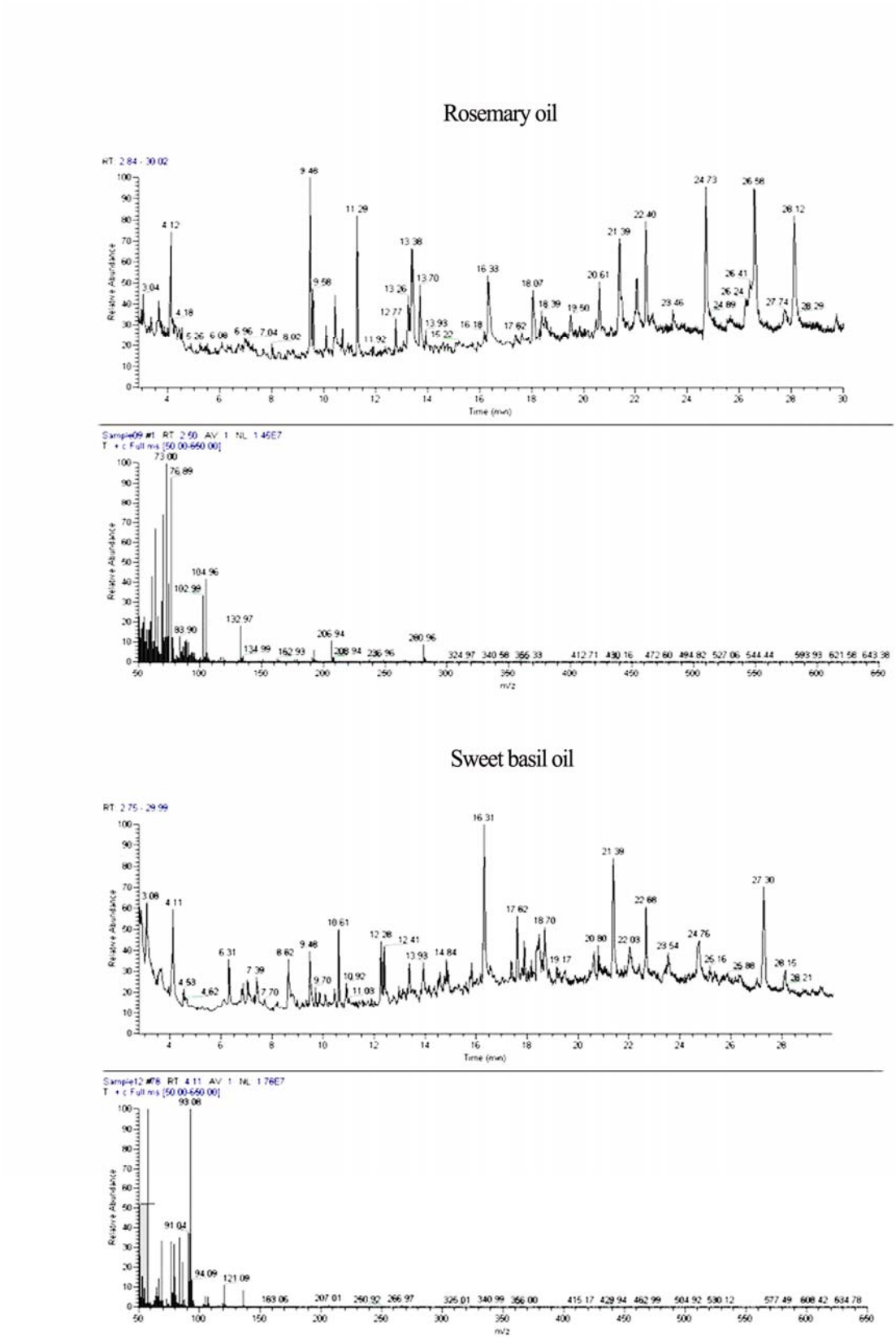

Fig. 2. Typical GC-MS Chromatograms of Rosemary and Sweet basil oils

Table 1 . Effect of different drying methods on DPPH, essential oil and major's compounds %

Drying methods	Chamomile							
	Dry Weight %	DPPH %	Oil %	Chamazulen %	Azulene %	Caryophyllene %	α-Bisabolol %	β-Farnesene %
Shade	13.02 a	44.7 a	0.90 a	21.00 a	34.50 a	3.42 a	12.70 a	8.43 a
Sun	11.48 b	32.5 c	0.75 c	19.03 b	33.02 b	2.98 d	10.87 c	7.68 a
35 C°	12.95 a	40.9 ab	0.85 b	20.80 a	33.11 b	3.32 b	12.61 ab	8.23 a
50 C°	11.34 b	38.1 b	0.73 d	18.31 b	33.00 b	3.26 c	11.46 bc	6.01 b
LCD 0.05	1.21	3.70	0.02	1.24	1.33	0.01	1.21	0.87
Drying methods	Peppermint							
	Dry Weight %	DPPH %	Oil %	Menthol %	Menthone %	1,8-cineole %	Isomenthone %	β-pinene %
Shade	14.88 a	67.2 a	0.98 a	55.0 b	11.10 a	8.24 ab	2.85 a	4.29 a
Sun	13.71 b	59.7 c	0.85 b	48.1 c	10.30 b	7.94 b	2.05 d	3.27 d
35 C°	15.03 a	64.3 ab	0.99 a	58.3 a	11.50 a	9.15 a	2.78 b	4.15 b
50 C°	12.47 c	63.9 b	0.86 b	49.3 c	10.41 b	8.03 b	2.64 c	4.02 c
LCD 0.05	0.93	2.97	0.07	3.07	1.06	1.03	0.02	0.03
Drying methods	Rosemary							
	Dry Weight %	DPPH %	Oil %	Borneol %	1,8-Cineol %	Limonene %	α-Pinene %	Camphene %
Shade	21.70 a	84.3 a	1.01 b	25.60 a	3.88 b	2.86 b	5.93 a	3.44 a
Sun	19.01 b	67.9 c	0.91 c	22.11 c	3.01 d	2.17 d	5.02 c	2.89 c
35 C°	20.93 a	79.3 b	1.06 a	25.98 a	3.95 a	2.88 a	5.87 a	3.02 b
50 C°	18.89 b	77.6 b	0.98 b	23.85 b	3.22 c	2.65 c	5.71 b	2.89 c
LCD 0.05	0.85	2.7	0.04	1.53	0.02	0.02	0.08	0.05
Drying methods	Sweet Basil							
	Dry Weight %	DPPH %	Oil %	Linalool %	Methyl Chavicol %	Eugenol %	Borneol %	1,8-cineole %
Shade	15.33 a	74.3 a	0.85 a	42.01 a	13.20 ab	23.61 a	3.47 a	5.82 a
Sun	13.46 b	66.1 b	0.79 b	38.08 b	12.81 b	19.26 c	3.22 c	4.91 d
35 C°	15.04 a	69.2 b	0.84 a	43.04 a	13.55 a	21.03 b	3.52 a	5.35 b
50 C°	12.39 c	65.9 b	0.81 b	38.14 b	12.90 b	19.38 c	3.01 d	4.99 c
LCD 0.05	0.93	3.34	0.03	2.39	0.94	0.51	0.07	0.04

The chromatographic fractionation of essential oils shows that the main compounds of chamomile oil is chamazulen (18.31 - 21 %) and azulene (33.0 - 34.5%) , peppermint oil is menthol (48.1-58.3%) and menthone (10.30 -11.50 %),rosemary oil is borneol (22.11-25.98%) and α-pinene (5.02-5.93%) and sweet basil is methyl chavicol (12.81-13.55%) and linalool (38.08-43.04%).The shade drying method gave the highest percentage of main compounds of essential oils. Also, the results indicated that using the two drying methods (shade and oven at 35 C^{o}) gave the highest percentage of DPPH, essential oil and the main compounds. This can be explained by the fact that the increase of percentage of main compounds for most essential oils lead to an increase in the percentage of DPPH (Rice-Evans *et al*., 1996).

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الملخص العربي

تأثير طرق تجفيف مختلفة علي الزيت العطري ونشاط مضادات الأكسدة لبعض النباتات العطرية

زينب علي عبد الحافظ، علي حسن النجار، محمد رجب حسن

تم دراسة تأثير طرق مختلفة للتجفيف(في الظل والشمس والفرن الكهربائي عند درجتي حرارة ٣٥ و٥٠ درجة مئوية) علي النسبة المئوية ومكونات الزيت العطري ونشاط مضادات الأكسدة لكل من البابونج والنعناع الفلفلي وحصي اللبان والريحان الحلو.

أعطي استخدام طريقة التجفيف في الظل أعلي متوسط لنشاط مضادات الأكسدة لكل نباتات التجربة مقارنة بطـرق التجفيـف الأخري. بدت طريقة التجفيف في الظل بصفة عامة أفضل الطـرق وبخاصة لنسبة الزيت العطري والنسبة المئوية للمكونات الرئيـسية لنباتات التجربة وتليها طريقة تجفيف الفرن الكهربائي عند درجـة ٣٥ مئوية.