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EFFECT OF DIFFERENT DRYING METHODS ON THE ESSENTIAL OIL CONTENTS OF *Matricaria chamomilla* FLOWER; A MEDICINAL PLANT

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ABSTRACT

An experiment was conducted at the New Developmental Farm of The University of Agriculture Peshawar Pakistan during 2014 to determine the effect of different drying treatments on the essential oil contents of the flower of a medicinal plant, Matricaria chamomilla. Matricaria chamomilla was dried through various methods such as Flat plate solar dryer (FPSD), direct sunlight, shade and oven drying at 30°C, 40°C, 50°C, 60°C and 70°C.The essential oil contents were extracted from the dried flower of Matricaria chamomilla, by water distillation using Clevenger type apparatus. Three parameters were studied such as essential oil contents, drying period, and moisture content in dried product. Data were analyzed statistically under completely randomized design (CRD). Maximum essential oil was obtained 0.29% under shade drying and 0.28% by Flat Plate Solar drying (FPSD), oven drying at 30°C and 40°C, however these methods were non-significant from each other. High temperature and direct sun drying significantly decreased essential oil content. Maximum period consumed under drying at shade, sun and oven drying at 30°C were 288, 504,and 168 hours, respectively, and their dried sample having high moisture contents (11.91%, 10.91%, 11.79%), as compared to Flat plate solar drying and Oven drying at 50°C, 60°C and 70°C.

Key words: Drying methods, drying period, essential oil, *Matricaria chamomilla*, moisture contents

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on the essential oil contents of *matricaria chamomilla* flower, a medicinal plant. Pak. J. Weed Sci. Res. 22(1): 69-79.

INTRODUCTION

Matricaria chamomilla L. is a traditionally aromatic herb belonging to family Asteraceae, locally named as Gulbabuna. It is widely grown as herbal plant in many countries of the world. The annual world consumption of Chamomilla flowers is more than 4000 tons (Franz *et al*., 1986). It has various uses in homoeopathic medicines like anti-allergic, treatment of depression and anti- cancer etc. Infusions and essential oil from fresh or dried flower heads have perfumed, seasoning and coloring properties (Vikas *et al*., 2010).

According to Vikas *et al*. (2010), one of the most commonly consumed single ingredient herbal tea is chamomilla, prepared with dried flower from *Matricaria chamomilla.* Their flowers contain 0.2% to 1.99% essential oil (Bradley, 1992). Yanive and Palevitch (1982) reported that the yield of essential oil and compositions varies due to environmental and genetic factors. Quality and quantity of essential oil contents control still remains a big issue for drying of ethno medicinal plants (Xuesong *et al*., 2011). Plants are usually containing a maximum level of moisture and microorganism, therefore immediate drying is the most important process. Usually pharmaceutical herbs are dried in shaded area and direct sun light. These methods for drying having disadvantage, such as low quality for the dried commodity and it needs large area to carry out the drying operations (Ahmed, 2010).

The quality of solar dried product was good in term of essential oil contents, color, test and flavors (Janjai *et al*., 2009). A flat plate solar dryer (FPSD) having an efficiency of 34.9% to 44.0% is the better choice for drying of medicinal herbs. A lot of research studies have proven that on farm FPSD, use for drying of medicinal plants and other agro-product, was found economical source. Solar dryer with active heat flow provide best solar dried yield as compared to shade and direct sun light (Hanif *et al*., 2014). The aims of research study were to compare Flat Plate Solar Drying for *Matricaria chamomilla* with traditional and oven drying at 30^{o}C, 40^{o}C, 50^{o}C, 60^{o}C and 70^{o}C, and to assess the effect of various drying methods on essential oil yield in dried product.

MATERIALS AND METHODS

Site Selection

The experiment was conducted at the University of Agriculture Peshawar Pakistan during year 2014. *Matricaria chamomilla* flowers were selected for the experiment and collected from medicinal plants

garden at New Developmental Farm of the University of Agriculture Peshawar-Pakistan.

Drying methods

The following treatments were adopted for drying of chamomilla medicinal plant:

Flat plate solar drying

System description of Flat Plate Solar Drying (FPSD) device, has two basic units such as drying chamber and flat plate solar collector (Fig. 1). The drying chamber consists of wooden box with 1.06×0.91m×0.61 dimension connected to outlet pipe of Flat Plate Solar Drying (FPSD). Three trays were arranged in chambers, each provided 0.37 m^2 areas with 0.76 m long and 0.49 m wide. Flat plate solar collector consisted of wooden collector box, black insulation, metallic absorber, front glazing sheet, inlet and outlet duct with 0.152 m in diameter. The exhaust fan was fixed at the inlet duct for threshing of ambient air into drying chamber passing throw solar collector.

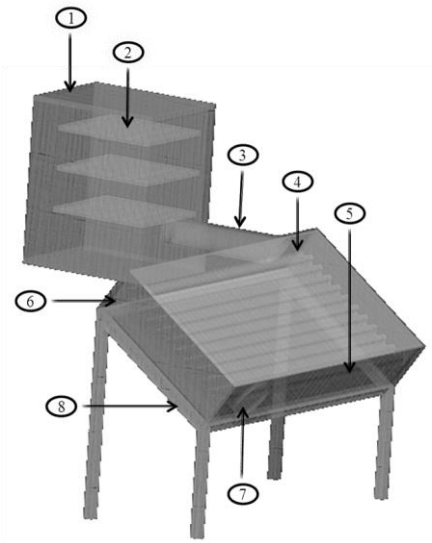

Figure 1. *Isometric view of flat plate solar dryer*

where dimensional justifications of flat plate solar dryer are; 1. Drying box (1.06m×0.91m×0.61m), 2. Trays stainless steel wire mesh (0.76 × 0.49m), 3. Outlet, diameter = 0.145m with PVC pipe, 4. Glass sheet (0.9 × 1.82m × 5mm), 5.Absorber V-corrugated steel sheet (0.9 × 1.82m × 0.32mm), 6. Insulation box(0.92 × 1.82 × 0.32m), 7. Inlet, diameter= 0.152m with exhaust fan, 8. Frame two legs having a height (0.36 and 1.12m) making tilted angle at 38^o with horizontal facing south

Shade and direct sun light drying

A wooden box (1m × 1.5m × 0.1m) was used to dry *Matricaria chamomilla* flowers in a conventional shaded area and open air under sunlight.

Oven drying

Drying of sample flowers in this method was done in oven at continuous temperature of 30°C, 40°C, 50°C, 60°C and 70°C for a period of 168,42,30,16 and 12 h, respectively.

Environmental data during drying periods

Temperature and relative humidity of ambient air and solar dryer was determined with the help of digital thermo hygrometer with the procedure described by Hanif *et al*. 2014.

Moisture loss by *Matricaria chamomilla*

Moisture content in fresh sample was determined through oven method suggested by Association of Official Analytical Chemist (AOAC, 2000), While the moisture loss after interval time was calculated by procedure and formula followed by (Hanif *et al.2014)*

$$M.C = [(W_i - W_f)/W_f] \times 100$$

where M.C. is moisture content, W_i is initial weight of sample before drying, and W_f is final weight of sample after drying.

Determination of essential oil contents

Dried sample were analyzed for essential oil contents by hydro distillation procedure (Basma *et al.,* 2013), 500 ml of distilled water was added with 60 g of dried sample in the round bottom flask of Clevenger type apparatus and heated at 80°C for 3 h. The vapor evaporate from boiling mixture was condensed and collected in a glass container, oil sample were transferred to test tube and labeled. The essential oil contents were determined using the formula described by Tajidin *et al*. (2012). The essential oil percentage was calculated as follows:

$$\text{Essential oil (\%)} = \frac{\text{Essential oil weight}}{\text{Dry sample weight}} \times 100$$

Statistical analysis

The experiment was laid out in completely randomized design (CRD) as described by Steel and Torrie (1981) with eight drying treatment and four replications. Data were analyzed by using a Statistical package version 8.1, and means were compared using least significant difference (LSD) test at 5% level of significance.

RESULTS AND DISCUSSION

Environmental data during drying periods

Relative humidity and ambient temperature were determined throughout the drying time at flat plate solar dryer, shade, and direct sunlight as shown in Fig. 2a-b for drying of *M. chamomilla* during 28 February to 20 March 2014. Maximum drying temperature range (40-

50°C) was recorded at flat plate solar dryer up to 6 hr. daily and average relative humidity was 25%. This temperature and humidity is recommended by Wilcke (1980) and Henderson (1976), respectively for drying of medicinal plants and other agro products. Average drying temperature at direct sunlight and shade drying was recorded 20°C and 17.5°C and the average relative humilities were 53% and 62%, respectively. According to Henderson (1976) the humidity must be less than 50% for drying of medicinal plants. Therefore in month of March at Peshawar Pakistan direct sun light and shade drying environment are not suited for drying because of high humidity and rainfall during this month.

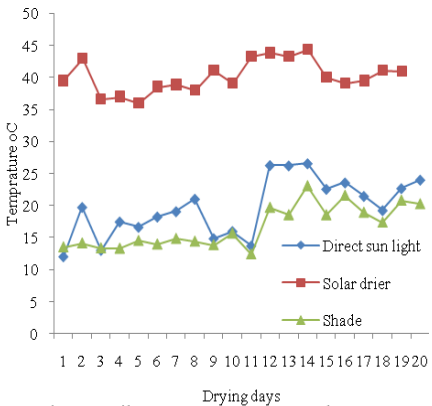

Fig. 2a: Daily average temperature °C data recorded at direct sun light, solar drier and shade during drying period

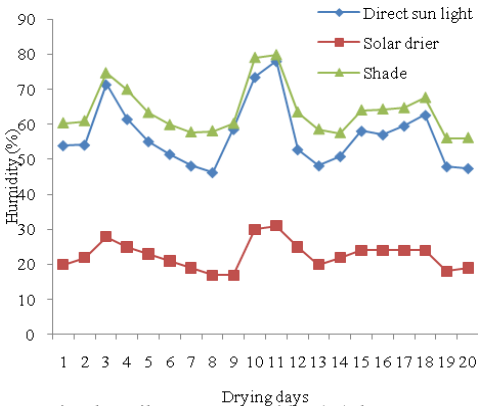

Fig. 2b: Daily average Humidity (%) data recorded at direct sun light, solar drier and shade during drying period

Moisture lost by various drying treatments

Moisture losses by the drying of *M. chamomilla* are shown in Fig 3 a-h. Initial moisture in fresh sample was 80%. Drying period and final moisture content in dried product are given in Table1. Drying treatment were shown two terms such as exponential module and their good correlation between moisture loss and day time with R^2 greater than 0.964. These results are similar with Kumar *et al*. (2005) and Hanif *et al.* (2013) where he recorded moisture loss at same drying environments using a flat plate solar dryer. Shade and direct sun light drying required long period because of their low temperature and high humidity results were founded similar with Ghasemi *et al*. (2013), therefore these methods were inferior as compared to Flat Plate Solar drying.

Table-1. Drying period of *Matricaria chamomilla* and its two term exponential model

Drying treatments		Equations	R^2
Drying medium	Drying temperature (°C)		
Flat Plate Solar dryer	40-50	$y = 0.161x^2 - 6.548x + 75.34$	0.989
Direct Sun	10-30	$y = 0.001x^2 - 0.570x + 62.00$	0.828
Shade	9-26	$y = 0.000x^2 - 0.287x + 62.54$	0.907
Oven	30	$y = 0.004x^2 - 1.058x + 75.07$	0.970
	40	$y = 0.052x^2 - 3.749x + 76.55$	0.996
	50	$y = 0.091x^2 - 5.036x + 77.27$	0.998
	60	$y = 0.416x^2 - 11.19x + 80.06$	0.997
	70	$y = 0.483x^2 - 12.15x + 80.41$	0.999

Moisture content in dried flower of *M. chamomilla* was found significantly different. Highest moisture contents were observed at drying in shade (11.91%) and oven at 30°C (11.79%). Moisture contents at drying in oven at 40°C (7.79%), 50°C (6.89%), 60°C (5.00%) and 70°C (4.25%), proved that moisture decreased with increased drying temperature. These results were founded similar with Mehdi and Sayed (2013). Drying treatments had significant effect on moisture content. Maximum and minimum moisture contents were obtained, when plant dried in shade and oven at 50°C, 60°C and 70°C, respectively.

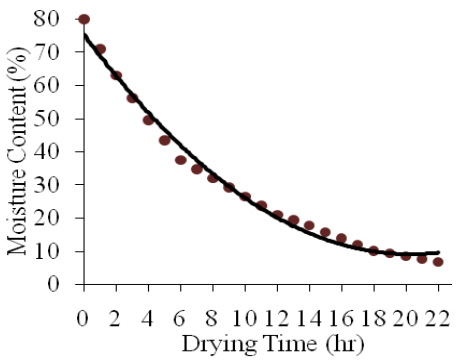

Figure 3a. Flat late Solar Drying

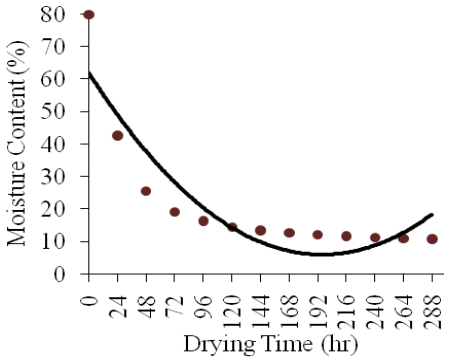

Figure 3b. Direct Sunlight Drying

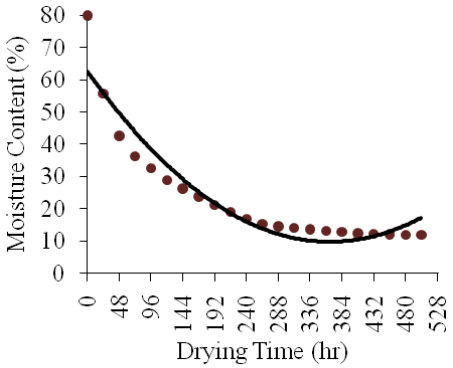

Figure 3c. Shade Drying

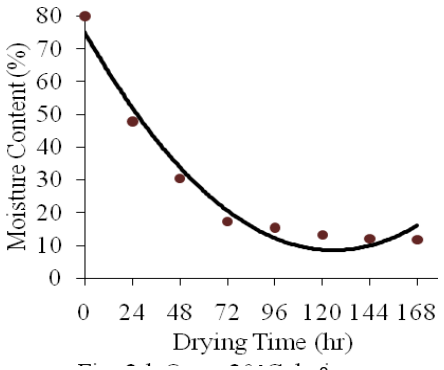

Figure 3d. Oven 30 ^{0}C Drying

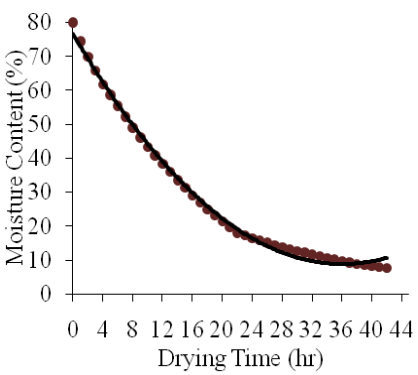

Figure 3e. Oven 40 ^{0}C Drying

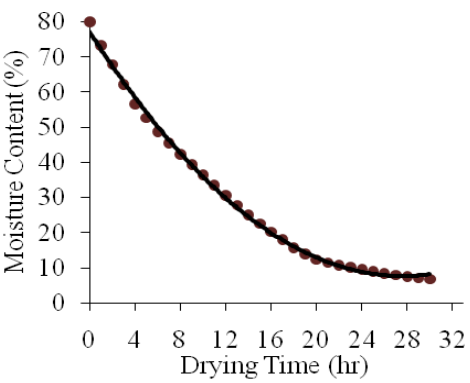

Figure 3f. Oven 50 ^{0}C Drying

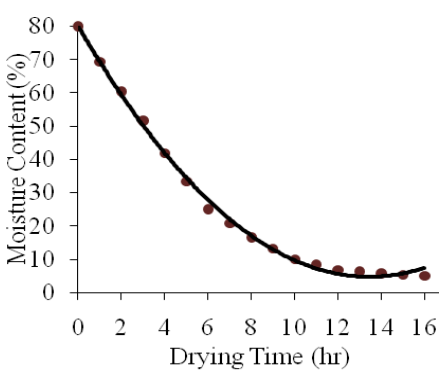

Figure 3g. Oven 60 ^{0}C Drying

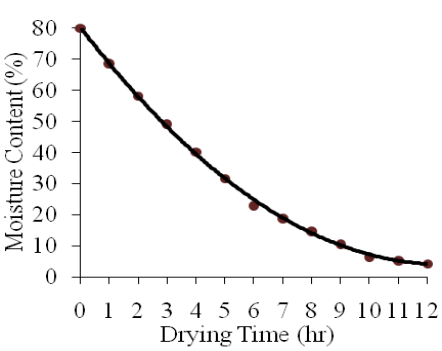

Figure 3h. Oven 70 ^{0}C Drying

Determination of essential oil contents

Effect of drying treatments on the essential oil contents (%) of *Matricaria chamomilla* flower is illustrated in Fig. 4.

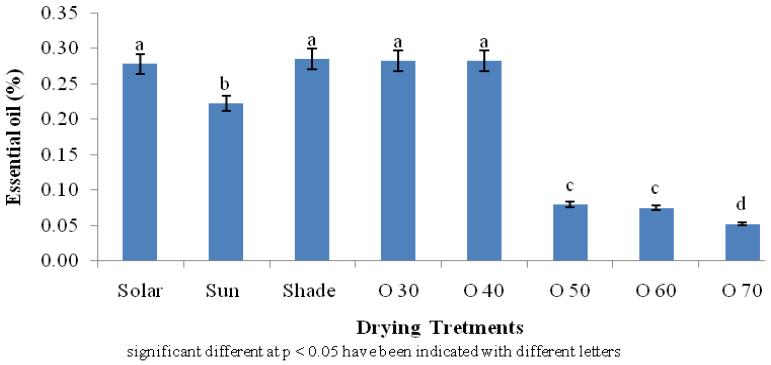

Figure 4. Effect of various drying methods on essential oil contents of *M. chamomilla*

Maximum essential oil content was obtained (0.29%) in shade follow by flat plate solar, oven drying at 30°C and 40°C (0.28%) while minimum oil was obtained from drying through direct sun light (0.22%) follow by oven drying at 50°C, 60°C, 70°C (0.08). This result is supported by Ebadi *et al*. (2011) reported that the highest percentage of *Matricaria chamomilla* essential oil was founded during the oven drying at 40°C.

Bagher *et al*. (2010) stated common basil dried in shade had maximum essential oil content as compared to sun and oven dried at 50°C and 60°C. Mehdi and sayed (2013) dried *Thymys daenesis* in oven at 50°C and direct sun light and found essential oil contents (1.45% and 1.41% respectively). These results were supported by Hao *et al.* (2014) who reported that sunlight having UV rays affected essential oil contents significantly Similar results were found by Buggle *et al.* (1999) who reported that the temperature from 50°C to 90°C affected the essential oil yield of lemon grass. Braga *et al*., (2005) reported that dried of *Piper hispidinervium* in a fixed-bed dryer with various drying temperatures (35, 40, 45, 50, 55 and 60°C) were significantly affected the yield of essential oil content. Jing *et al.* (2013) reported that maximum essential oil content was obtained by ambient drying temperature (22°C) as compared to oven at 60°C (0.31%). (Khangholi and Rezaeinodehi 2008) reported that shade drying of *Artemisia annua* obtained maximum essential oil content (1.11%) as compared to higher temperature (35, 45, 55 and 65°C) obtained (0.89%, 0.54%, 0.49% and 0.38%), respectively. According to Hamrouni-Sellami *et al.,* (2011) essential oil content decreased with increasing drying temperature in medicinal plants.

Table 2. Effect of various drying methods on essential oil content (%) of *Matricaria chamomilla*

Drying Methods	Essential oil contents (%)	Moisture content (%)	Drying period (hours)
Solar Drying at (40-50°C)	0.28 a	6.71 d	22
Direct Sun Drying at (10-30°C)	0.22 b	10.91 b	288
Shade Drying at (9-26°C)	0.29 a	11.91 a	504
Oven Drying at 30°C	0.28 a	11.79 a	168
Oven Drying at 40°C	0.28 a	7.79 c	42
Oven Drying at 50°C	0.08 c	6.82 d	30
Oven Drying at 60°C	0.08 c	5.00 e	16
Oven Drying at 70°C	0.05 c	4.25 f	12

CONCLUSION

Drying of *M. chamomilla* and *C. citratus* in Shade and oven at 30°C and 40°C had taken long drying period as compared to flat plate solar and oven at 50°C, 60°C and 70°C.Maximum essential oil content was obtained by shade drying, flat plate solar, and oven at 30°C and 40°C in both medicinal plants.The temperature in flat plate solar drier was (40°C to 50°C) and did not significantly decrease the amount of essential oil content. This temperature range was available up to 6 hours in day time from 10.00 am to 4.00 pm in month of February and March. It may be utilized for drying of medicinal plants.Further study should be required for economical comparison of flat plate solar, shade and Oven drying at 40°C.

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