International Archive of Applied Sciences and Technology
Int. Arch. App. Sci. Technol; Vol 8 [2] June 2017: 47-50

[ISO9001: 2008 Certified Organization]
www.soeagra.com/iaast.html

IAAST
ONLINE ISSN 2277- 1565
PRINT ISSN 0976 - 4828

CODEN: IAASCA **ORIGINAL ARTICLE**

DOI: .10.15515/iaast.0976-4828.8.2.4750

Effects of Characteristics on drying Fenugreek leaves and their studies during storage periods

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ABSTRACT
Fenugreek is one of the oldest cultivated spice crops of the world and grown for its medicinal value and forage in India,Western Asia and Nile Valley since remote antiquity. It is found growing wild in parts of northern India and cultivated all over the subcontinent for its green leaves and seeds. Recent studies have shown that Fenugreek helps lower blood glucose and cholestrol levels, and may be an effective treatment for both type 1 and 2 diabetes. It is also being studied for its cardiovascular benefits. Investigations were also carried out to develop the process flow chart for dehydration and drying kinetics of Fenugreek leaves, optimization of process parameters with respect to dehydration ratio, rehydration ratio and sensory quality attributes of fenugreek leaves during its storage. The untreated samples of fenugreek were dried as control samples. The drying process was continued till the constant weight of the samples achieved The weight of the samples were recorded at an interval of 30 min till end of drying and corresponding moisture content was computed through mass balance.
Key Words:- *Fenugreek, Drying, Pretreatments and storage.*

Received 11.01.2017 Revised 20.02.2017 Accepted 29.03.2017

Citation of this article
S Singh, V Kumar, U Singh and B.R. Singh .Effects of Characteristics on drying Fenugreek leaves and their studies during storage periods. Int. Arch. App. Sci. Technol; Vol 8 [2] June 2017. 47-50.

INTRODUCTION

Fenugreek (also known as Greek Hay and Fenigreek), is an herb that is commonly found growing in the Mediterranean region of the world. While the seeds and leaves are primarily used as a culinary spice, it is also used to treat a variety of health problems in Egypt, Greece, Italy, and South Asia. Fenugreek seeds have been found to contain protein, vitamin C, niacin, potassium, and diosgenin (which are a compound that has properties similar to estrogen). Other active constituents in fenugreek are alkaloids, lysine and L-tryptophan, as well as steroidal saponins (diosgenin, yamogenin, tigogenin, and neotigogenin). Due to its estrogen-like properties, fenugreek seeds have been found to help increase libido and lessen the effect of hot flashes and mood fluctuations that are common symptoms of menopause and PMS. In India and China it has also been used to treat arthritis, asthma, bronchitis, improve digestion, maintain a healthy metabolism, increase libido and male potency, cure skin problems (wounds, rashes and boils), treat sore throat, and cure acid reflux. Fenugreek also has a long history of use for the treatment of reproductive disorders, to induce labor, to treat hormonal disorders, to help with breast enlargement, and to reduce menstrual pain.

The most commonly used leafy vegetables are Fenugreek, amaranth, chakota, spinach (Palak), poddina, coriander, drumstrick which has flavour, green colour, minor nutrients and medicinal properties. The nutritional significance of fenugreek is well recognized world over as a vital source of essential minerals, vitamins and dietary fibers. The fenugreek green leaves supply 35 calories and contain moisture 86.1%, protein 4.4%, fat 0.9 %, fibre 1.1 %, other carbohydrates 6.0 % and ash 1.5 %. In addition, the Fenugreek green leaves are rich in vitamins and contain carotene content 2.34 mg, thiamine 0.04 mg, riboflavin 0.31 mg, nicotinic acid 0.8 mg and vitamin c 52.0 mg/ 100 gm edible portion [1]**.** Fenugreek leaves also contain about 296 and 59 µg/g dry weights of aliphatic and aromatic secondary amines, respectively [2]**.**

Drying is one of the traditional methods of preservation, which converts the vegetables in to light weight, easily transportable and storable product. Advantages of these methods are that the vegetables can be easily converted in to fresh like form by rehydrating these and can be used throughout the year. In

addition to increasing variety in the menu, reducing losses, labour and storage space. Dehydrated vegetables are simple to use and have longer shelf like than fresh vegetables [3]**.** Drying in the solar light is least expensive method and quite viable if the climate is hot and dry during harvesting time but it is also the slowest method, large area requirements, and high labour consuming method, insect infection and poor quality of end products. Drying is one of the cheap and common preservation methods for biological products.

METHODS AND SAMPLES COLLECTED

Preservation can prevent such huge wastage and also increases their availability in the lean season. A number of preservation techniques are available of which drying and dehydration is a traditional and user friendly method. Dehydration is a suitable method of extending shelf-life of vegetables. Fenugreek leaves sample was collected from the one farm only to ensure the uniformity and to avoid the effect of soil variation on the nutrient content of the sample. The fresh and green fenugreek leaves were selected and discoloured, as well as wilted leaves removed to avoid bad odour and loss of nutrients after dehydration.
The study was undertaken to develop the drying characteristics of fenugreek leaves and its qualitative evaluation for storage purpose in the Department of Agricultural Engineering and Food Technology, S.V.P. University of Agriculture and technology, Meerut. The present investigation on drying of fenugreek leaves was carried out. The samples of fenugreek leaves were subjected to two pretreatments viz. dipping in the solution of 0.1% $MgCl_2$ + 0.1% $NaHCO_3$ + 2% KMS for 15 min and blanching in boiling water in the ratio of 1:5 (leaves: water) containing 0.5% sodium bisulphite ($NaHSO_4$) for 2 min.

RESULT AND DISCUSSIONS

The moisture losses after every 30 min were considered as base data for the determination of moisture content, moisture ratio and drying rate. The experimental data of the drying behaviour of fenugreek leaves in relation to moisture content, moisture ratio. Because the movement of water to the surface is not enough to maintain the surface in a saturated condition in drying process and the condition of equilibrium at the surface no longer holds and the rate of drying begins to reduce [4]. Similar results are obtainable for aromatic plants in the earlier studies [5, 6]**.**

Effect of Moisture Content

As expected, the drying time varied with drying method and loading density. The drying time ranged from 450 min to 660 min, being generally lower at higher drying temperatures. It was observed that drying time increases with loading density e.g. under open sun drying. It was observed in case of greenhouse type solar dryer that chemically treated samples took lesser time as compared to open sun drying. Similar trend was also observed in case of open sun drying. The final moisture content varied from 4.496% to 4.910% (d.b.). Initially moisture content decreased rapidly with time and their after it becomes slow and slower at last a stage comes where it becomes saturated in cabinet tray dryer. In heat transfer, heat energy is transferred under the driving force provided by a temperature difference. The rate of heat transfer is proportional to the temperature difference and the properties of the transfer system characterized by the heat-transfer coefficient. The drying time ranged from 450 min (chemically treated at 2.0 and 2.5 kg/m^2 under greenhouse type solar dryer) to 660 min (chemically blanched treated at 3.0 kg/m^2 under open sun), being generally lower at higher drying temperatures. It was observed that drying time increases with loading density e.g. under open sun drying (540 min at 2.0 kg/m^2, 570 min at 2.5 kg/m^2 and 630 min at 3.0 kg/m^2 for chemically treated samples).It was observed in case of greenhouse type solar dryer that chemically treated samples took lesser time (450 min at 2.0 kg/m^2) as compared to untreated samples (480 min at 2.0 kg/m^2). Similar trend was also observed in case of open sun drying.

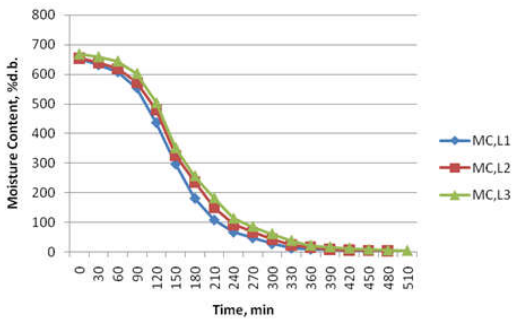

Fig 1.0 Moisture content effect on fenugreek leaves during green house type solar dryer

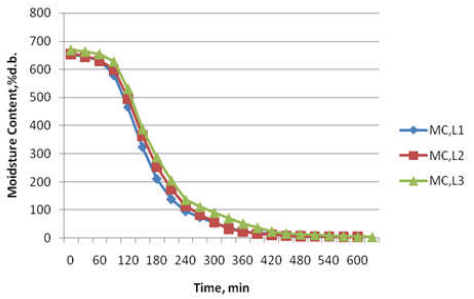

Fig 1.1 Moisture content effect on fenugreek leaves during open sun drying

Effect of Drying Rate

The average drying rate represents the rate of change of moisture content (% d.b.) over a particular time interval and is attributed to the middle of the time interval. As expected, the rate of drying was affected by temperature, loading density and to some extent by pretreatments. The effect of temperature and comparison between moisture content and moisture ratio depend on the thickness of tomato slices. Drying rate decreased very slowly after 300 min. Similar trend was also observed in other experiments as well as in open sun drying experiments. For example, under greenhouse type solar dryer for chemically treated sample at 2.0 kg/m^2 loading density, the rate of drying was in the first 30 minute was 0.698 which increased up to 5.136% d.b./min at 150 minute, then started decreasing and finally decreased to a value of 0.090% d.b./min at the end The drying rate is affected by many factors such as the size, composition, structure, and the amount of food to be dried. For example, in the constant-rate period smaller pieces have a larger surface area available for evaporation whereas in the falling-rate period smaller pieces have a shorter distance for moisture to travel through the food. Furthermore, the effect of the composition and structure of the food on the mechanism of moisture removal is also observable. Kiiru and Ojijo [7] reported by, the greater the temperature and the air flow speed of dryer could lead drying process faster. The greater the temperature difference between the particle and the drying air, the greater the heat transfers into the particle and thus, the greater the evaporation rate.

Similarly**,** the physical changes in dried food products are frequently caused by storage in inappropriate conditions. As a result, the shelf life of the products may be significantly reduced. For example, when dehydrated foods are stored at high humidity, the process of moisture uptake will take place. Most commercial dryers are insulated to reduce heat losses, and they re-circulate hot air to save energy. Many designs have energy-saving devices, which recover heat from the exhaust air or automatically control the air humidity.

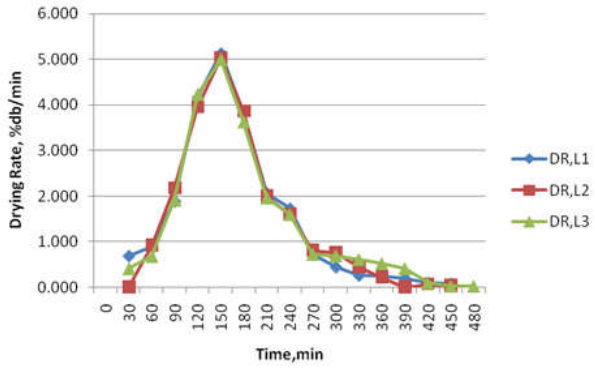

Fig 1.2 Drying rate effect on fenugreek leaves during green house type solar dryer

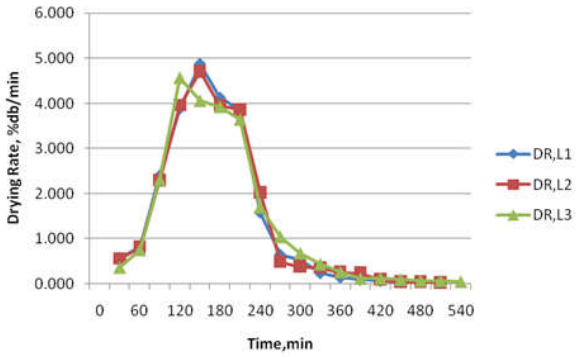

Fig 1.3 Drying rate effect on fenugreek leaves during open sun drying

Effect on moisture ratio

The moisture ratio value at zero time of drying was one in all the cases and in successive drying it decreases nonlinearly. So, moisture ratio versus drying time curve could better describe the drying phenomena than the curves of moisture content verses drying time (Fig 1.4 to 1.5), because the former had same initial value of moisture ratio (MR=1) but latter had different initial moisture content. Similarly**,** the physical changes in dried food products are frequently caused by storage in inappropriate conditions. As a result, the shelf life of the products may be significantly reduced. For example, when dehydrated foods are stored at high humidity, the process of moisture uptake will take place. As a result, the products become soggy, leading to degraded quality and shortened shelf life [8]**.** Moreover, when food powders are exposed to moist atmospheres or elevated storage temperatures, the phenomenon of caking or spontaneous agglomeration will occurs due to the sorption of moisture. The main reason for these occurrences is an inadequate barrier being provided by the packaging [9]**.**

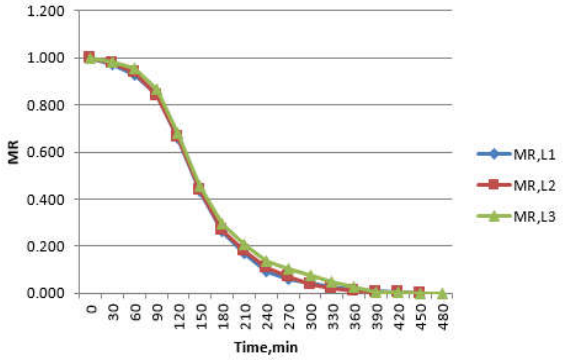

Fig 1.4 Drying rate effect on fenugreek leaves during green house type solar dryer

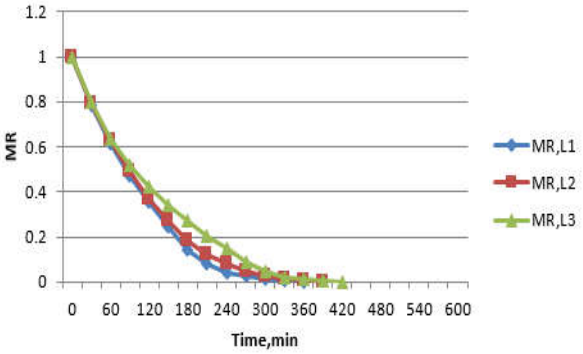

Fig 1.5 Drying rate effect on fenugreek leaves during open sun drying

CONCLUSION

Moreover nutrients like protein and fat shows more retention in cabinet solar dryer than open sun drying The average drying rate increased with increase in temperature and decrease with increase in time and loading density. However, drying rate was slower in the first hour in case of greenhouse type solar dryer and open sun. The average relative humidity inside the dryer was found lesser due to ventilation. Because of the lower value of relative humidity inside the dryer than that of the ambient air for most of the day, the air in the dryer has significantly higher drying potentials than the ambient air.

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