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Design and fabrication of portable food dehydrator

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Abstract
A research work was performed to design and fabricate a portable dehydrator which could be used for drying foodshousehold. The developed dehydrator consists of advantages like ease of carrying to different locations and cost-effective product which could be purchased at an affordable price. This portable dehydrator can be used to remove moisture, reduce product volume thereby decreases the storage area of the products and also to preserve the nutrients. The developed portable dehydrator was also subjected to a comparative study with laboratory tray dryer. Experimental studies of drying was performed on green peas at temperatures of 40 °C, 45 °C and 50 °C, 100 fpm in portable dehydrators and tray dryers. As a result of the analysis, when the temperature rises, the drying time is short and the drying speed is high. Lower drying temperatures improve drying efficiency. If the position of the tray differs at 50 ° C, tray 3 of the dehydrator dries faster than the tray dryer. Sections 1 and 2, on the other hand, dry faster in a tray dryer than in a dehydrator. After monitoring, the dehydrator dries more slowly, so it can be worn for home use.

Keywords: food dehydrator, design, fabrication, drying, green peas

1. Introduction

Food dehydrators are electrical devices that store food by completely removing moisture (bound and unbound water) from food. Food dehydration is a method recently used to preserve food and products such as vegetables, fruits, and meat to completely remove moisture. Methods of drying foods become more complex over time, but dehydration is one of the oldest methods of preserving foods. For many of us, food dehydrated in a home dehydrator is a convenient and best way to store food.

Microbes, such as bacteria, fungi, yeast, and fungi, need water to survive in food and grow efficiently in food. When food is dried or dehydrated, this type of microorganism cannot survive and grow. Microorganisms can be destroyed and destroyed by dehydration, and food cannot be easily damaged. Fruits, vegetables, dry skin and skin can be used as snacks, adding instant, soup and baby food to the magic. Dehydrated products are easy to transport and do not require efficient operation. Dehydrated foods are lightweight, and the quality of canning can be high, making cooking cheap and easy. In some cases, the nutritional value of food is slightly dependent on the dehydration process, but in most cases it does not depend on how the temperature is regulated.

An electric dehydrator produces a superior quality dried item than some other strategy for drying. Electric dehydrators are independent units with a warmth source, a ventilation framework, and plate to put the nourishment on. They are utilized to dry nourishments inside. Accordingly, likewise with stove drying, they don't rely upon the climate. Such dryers can be bought or made at home and differ in advancement and effectiveness. An electric nourishment dehydrator keeps up low temperature and uses less vitality than a stove here it very well may be savvy.

Food drying out alludes to evacuation of dampness (bound just as free water) from a food item however drying is the procedure of halfway expulsion of moisture (removal of just unbound water) from nourishment and nourishment stuff. There are numerous destinations for drying out of nourishment items. Conservation of nourishment through drying out is the clearest one. The preservation of fruits and vegetables through drying dates back many centuries and is based on sun and solar drying techniques. The poor quality and product contamination lead to the development of alternate drying technologies (Bezyma and Kutovoy (2005).

By lessening the dampness substance of the item, the lack of hydration process makes it conceivable to constrain microbial development or different responses. Notwithstanding safeguarding the nourishment from a microbiological stance, this procedure likewise empowers protection of its flavor and dietary qualities. The main objectives of our study is:

- To design a portable food dehydrator.
- To optimize and fabrication of portable food dehydrator.
- To calculate the efficiency of the dehydrator.
- To conduct the sample study on fruits and vegetables.

2. Materials and Methods

2.1 Experimental Material

The Green Peas variety was used in the present sample study. The harvest period is 2 months. After harvest, Green Peas were weighed for 5 gram. The air flow rate is 1m/s and the drying of Peas was done at Temperature of 40, 45 and 50°c with 3 different Trays.

2.2 Equipment design and construction

The equipment is a PORTABLE FOOD DEHYDRAOR with IoT technologies. The design of equipment was performed by using Sketch. The portable food dehydrator is constructed by using Stainless Steel with proper arrangements. Stainless Steel is used for fabricate the equipment because of the property of heat stable and resistant to corrosion we chosen have chosen this. The pirtable food dehydrator has the following components: A heating coil, A blower, Drying Chamber, Tray to hold food, Humidity sensor, Temperature Sensor and LED temperature controller. The function of each part are given below

2.2.1 Heating Coil
Heating coil is an element which converts the energy into heat from the electric energy. Heating coil is positioned in the dehydrator in the bottom of the trays. Here we 30 watt is used to generate the heater, Heating coil collects the air from the surroundings.

2.2.2 Blower
Blower in the dehydrator is the main component of dehydrator. Blower takes the heat from the heating element and circulates the hot air uniformly through the dehydrator. It also distributes the heat parallel to remove the moisture content present in the food stuff. Blower is positioned above the heating coil.

2.2.3 Drying Chamber
Drying chamber is a chamber, which comprises inside of trays, heating coil, temperature sensor and blower, in particular the drying chamber used whenever there is a need of requiring low humidity level. It mainly used for storage of foods inside the chamber to avoid contamination abd impurities from outside the chamber. The chamber is in square shape. Height is 30cm, Length is 15cm and Width is 15cm.

2.2.4 Trays
Trays are used to hold the foods. In this dehydrator the tray is provided with mesh and it consist of 3 trays to hold the foods. The trays are also made of stainless steel.

2.2.5 Temperature Sensor
Temperature sensor is a main device used to collects the temperature and converts it into data by using particular source. Here we use LM35 Sensor that sense maximum of 75ºc. this does not require any external circuitry. It measures accurately that thermistor.

2.2.6 Humidity Sensor
Humidity sensor contain humidity sensing element to measure temperature along with thermistor, it measures and report the moisture and the temperature of the air.

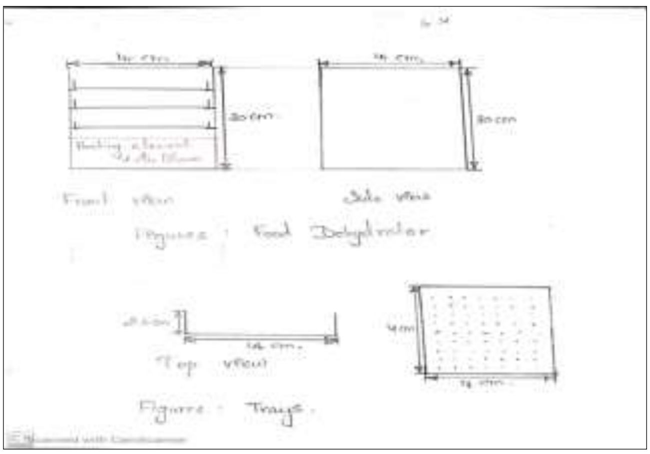

Fig 1: Design of portable food dehydrator

Fig 2: Portable food dehydrator equipment

2.3 Experimental Equipment
The exploratory gear is the compact nourishment dehydrator and plate dryer. Two drying gear is utilized right now, drying the versatile nourishment dehydrator blower air from the base and plate dryer blow the air from the posterior of the dryer. Two strategy is use to gauge the mass of the item during drying. Temperature and mass of the item are recorded at regular intervals.

2.4 Moisture Content, Moisture Ratio and Drying Rate
Dampness content (moisture content) is the aggregate sum that is amount of water present in a material. Dampness substance can be communicated as rate. Dampness substance of the green peas can be determined by the accompanying condition:

$$Mc= ((w-d)/w) *100 \quad (1)$$

Where, Mc is the Moisture Content
w is the underlying load of the example
d is the last weight of the example subsequent to drying
Dampness proportion is the measure of dampness content staying in the examples answered to introductory dampness content. Dampness proportion is in dimensionless structure, dampness proportion can be communicated in the condition as follows:

$$MR= M-Mo/Mo-Me \quad (2)$$

Where, Me is the harmony dampness content, this worth is disregard as a result of little worth when contrasted and mean dampness substance and introductory dampness content.

M is the mean dampness content
Mo is the underlying dampness content
MR is rearranged in following condition:

$$MR=M/Mo \quad (3)$$

Drying Rate can be determined by utilizing the sample as follow:

$$dA=Wf*(xo-xc/t) \quad (4)$$

where, t is the Time for drying
wf is the general last dampness content
xo is the underlying dampness content,
xc is the last dampness.

Cost of Drying can be determined by utilizing the accompanying equation:

Cost=Watts/1000*Hours Used*Cost Per 1000 Kwh (5)

3. Result and Discussion

The result of the experiment conducted on Portable Food Dehydrator and the sample study were conducted on Portable food Dehydrator and Tray Dryer with varying the position of the tray and with varying the temperature 40oc, 45oc and 50oc are discussed.

3.1 Analysis of Moisture Content

Analysis of moisture content of product is so significant in the comparison of drying with Portable Food Dehydrator and Tray Dryer with three different temperatures (40, 45 and 50oc). Moisture content was measured every 5 minutes. Moisture content differs for different temperature. Moisture content is decreased with increase in drying time and temperature. Moisture content can be expressed in percentage is shown in the graph. The moisture content decreased continuously with time and an increase in temperature resulted in reduced drying time. These results are closed to that obtained by (akoy., 2014) [3].

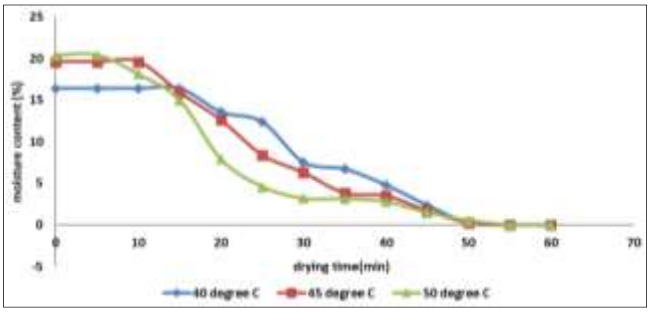

Fig 3: Effect of drying temperature on the moisture content of green peas in food dehydrator

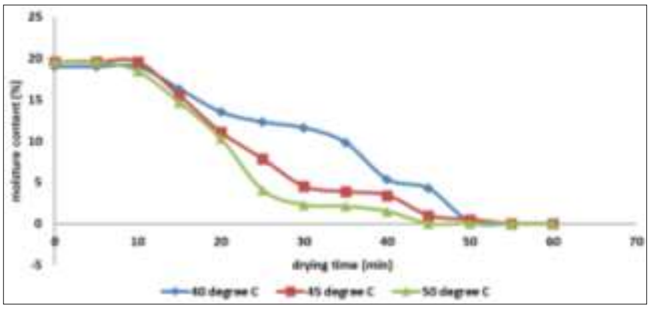

Fig 4: Effect of drying temperature on the moisture content of green peas in tray dryer

On the correlation of green peas with three diverse temperatures in versatile food dehydrator and in plate dryer were broke down. From the figure plainly the dampness substance of the example bit by bit diminished with increment in drying time (min). increase in temperature will resultant in lessening drying time.

The longest and briefest drying times were recorded at 40ºc (60 min), 45ºc (53 min) and 50ºc (45 min) in Traydryer and in nourishment dehydrator it is consistent at three distinctive temperature is 50 min. There is little contrast in decrease of dampness content at three distinctive temperatures.

3.2 Effect of Tray Position on Drying Time

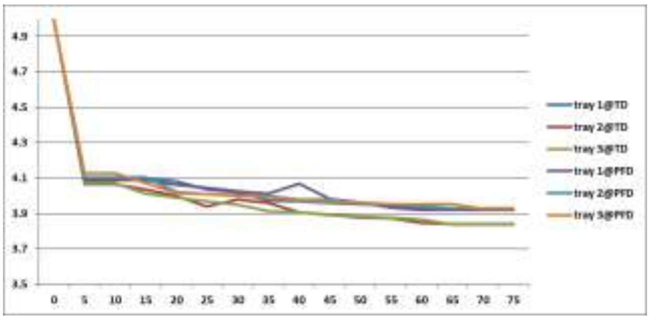

Fig 5: Effect of tray position on green peas drying time at 50ºc at portable food dehydrator (PFD) and tray dryer (TD)

Fig 5 represents the relation between moisture ratio and drying time at 50ºc, 100fpm for three positions of trays in the portable food dehydrating and tray drying. It was observed in the two cases that the constant drying rate period was detected in the drying curves. The final moisture ratio differed with the position of the tray in the dehydrator and dryer. All the trays have the different final moisture ratio at the end of dehydration. Drying rate differs at the position of the tray. Tray 3 holds the product in food dehydrator dries better than in tray dryer. On the other hand, tray 1 and 2 in tray dryer dries better than in food dehydrator dries the green peas. These results are agrees with that obtained by (Matuam Balbine *et al*., 2015) [5].

3.3 Effect of Drying principle on Green Peas Drying Time and Drying Rate at Three Different Temperature

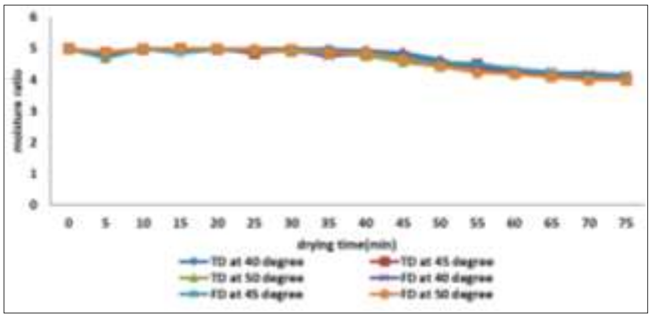

Fig 6: Effect of drying principle on green peas drying time at 40ºc, 45ºc and 50ºc

Fig. 6 represents the advancement of the dampness proportion of green peas in two examination arrangements and the proportion increment with increment in drying time. In all the instance of compact nourishment dehydrator and in plate dryer, dampness proportion expanding with input plate. In the temperature scope of investigation, the quicker drying rate is because of higher the temperature with short drying time. As drying temperature builds that last drying rate is higher because of the exchange of dampness from dried peas to surface and the expansion in vaporization of dampness in surface. these results are similar to those obtained by (Matuam Balbine *et al*., 2015) [5].

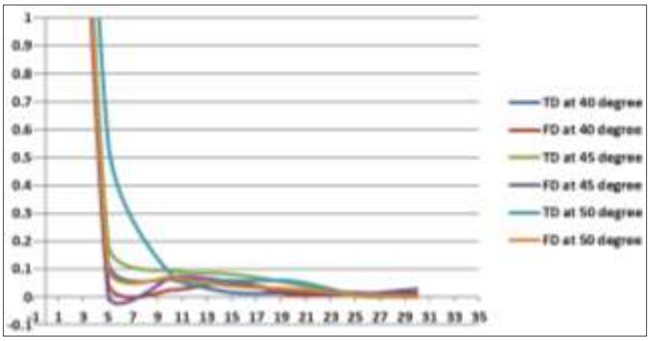

Fig 7: Effect of drying principle on green peas drying rate at 40^{o}c, 45^{o}c & 50^{o}c

Fig 7 shows the evolution drying rate under moisture ratio in two drying principle. For the range of experimental temperature, the constant rate period was observed. Drying rate increased initially of air-drying temperature in both techniques. During Food dehydration and Tray Drying the drying rate decrease and increase with drying time until the input of last tray in the dehydrator and dryer. These results proved that the drying principle process of green peas was affected drying rate.These results are agrees with that obtained by (Matuam Balbine *et al*., 2015) [5].

4. Conclusion

In this study, the design and fabrication of portable food dehydrator was successfully conducted. The sample study was led on Portable Food Dehydrator and Tray Dryer to recognize the dehydrator effectiveness. The impact of plate position on drying time, impact of drying guideline on green peas drying time and drying rate at 40, 45 and 50oc and the dampness substance of the examples likewise were dissected. It is cleared from the examination that the drying food dehydrator sets aside more effort to dry out when contrasted with tray dryer. During the impact of Tray position when contrasted and plate dryer the nourishment dehydrator plate 3 is progressively effective. On other hand tray 1 and 2 is less productive in food dehydrator. In the future we will studies the texture, color and nutrition analysis of the dried products and development of more efficient product.

5. Acknowledgement

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