International Journal of Electrical and Electronics Research ISSN 2348-6988 (online)
Vol. 6, Issue 1, pp: (1-5), Month: January - March 2018, Available at: www.researchpublish.com

Microwave System for Fruit Drying

[1]Rohini K Parit, [2]Dr. Uttam L. Bombale

[1]Student, M.Tech Electronic Technology, Department Of Technology, Shivaji University Kolhapur, Maharashtra, India
[2]Associate Professor, Department Of Technology, Shivaji University Kolhapur, Maharashtra, India

Abstract: **Drying is probably one of the most oldest, popular and common fruit preservation technique. Drying preserves foods by removing enough moisture contain from food and reduces microbiological activity and minimizes physical and chemical changes during storage to prevent it from spoilage. Fruits are dried to extend storage life and reduce transport weight. The use of microwaves in drying has been growing in recent years. In recent research on microwave drying have some limitations like excessive heating at the edges and corners of the product. It causes to scorching problem, due to this problem fruit becomes off-flavor. To reduce the energy wastage and operational cost new dimensions came up in drying techniques. The advantages of MW combination drying techniques include shorter drying times, improved product quality and Flexibility in producing a wide variety of dried products. The microwave drying increases the nutritional value, color, and original flavor and puffing.**

Keywords: **Microwave drying, Energy saving, conventional heating, moisture content.**

I. INTRODUCTION

Fruit drying is the process of removing moisture. Fresh fruits or vegetables last for few days; if we use the drying methods for fruit preservation then they can be stored for months or even years.

The major objective in drying agricultural products is the reduction of moisture. .Hot air drying is the most common method to preserve foods. This method results in dehydrated products that have an extended shelf life. However this process has negative impact on product quality, due to the long drying times and high temperatures employed. The quality of a conventionally dried product is often lower than that of the original foodstuff, with an impact on color, rehydration ratio, texture, and other characteristics.

The development of new, high quality and customer attractive dried fruit product is need of the market. Preservation of fruit with drying by sun and solar technique, yield poor quality.

The dried product's quality depends upon the drying conditions and methods to be used. To reduce these problems, faster and more effective drying process, such as microwave drying method, should be considered for fruit dehydration. Recently, microwave drying method has been proposed as a efficient drying alternative to conventional hot air drying. Microwave leads to a volumetric heating which means that all the materials like fruits and vegetables can be heated to the desired temperature at the same time.

In the microwave heating, microwaves are directly absorbed and convert it in to the heat. Heating process is started from the inside of the fruit and this is faster than the conventional heating.

Advantage of microwave heating is the shorter drying time, improved food quality and original flavor can be maintained. Due to shorter drying time heat loss also minimized. Microwave drying can be operated at lower temperatures suitable for processing heat-sensitive materials. In microwave all the material can be heated to the desired temperature at the same time.

One of the applications of microwave drying is in food industries to make different flavors of different fruits.

II. PROPOSED METHOD

The final product temperature in MW drying is difficult to control compared to hot air drying. Which is the product temperature never rises beyond the air temperature. However, this may or may not be a limitation, depending upon the desired quality attributes of the final products. Certain combined methods have been successfully used to avoid these effects. One of the most common combined methods is microwave-assisted hot air drying which has been widely used for drying agricultural products.

Fruits and vegetables are important sources of essential dietary nutrients such as vitamins, minerals and fiber. Fruits and their products are dried to enhance storage time, minimize packaging requirements and reduce transport weight. The preservation of fruits and vegetables should be cost effective, shorter drying time and with minimum damage to the product.

Recent research on microwave drying focusing primarily on fruits and vegetables. They listed the limitations of microwave method as follows:

Excessive heating at the edges and corners of products may lead to overheating and irreversible drying, resulting in possible scorching and development of off-flavors. Due to the non-uniform electromagnetic field, the materials to be dried must be in constant motion in the cavity to avoid hot spots. Because only a limited amount of water is present during the final stages of the drying processes. The material temperature can easily rise to a level that causes scorching. If we maintain power level and moisture level the scorching problem will be solved.

III. BLOCK DIAGRAM

Block diagram of microwave system is shown in figure 1.

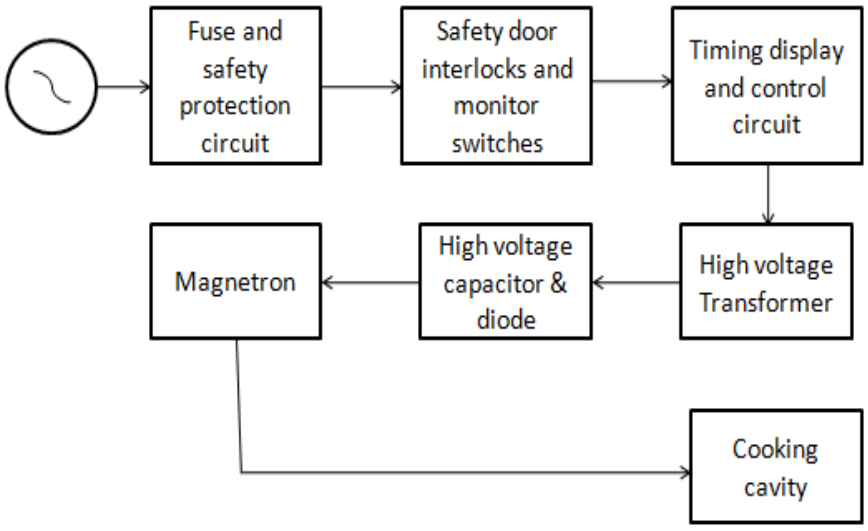

Fig. 1 Block diagram of microwave system

The microwave power and the drying time can be programmed. A microwave system converts only part of it electrical input into microwave energy. Microwave ovens are so quick and efficient because they channel heat energy directly to the molecules inside food. All the microwave systems have at least two safety interlock switches which stop microwave generating immediately when the door is opened.

The microwaves bounce back and forth off the reflective metal walls of the food compartment, just like light bounces off a mirror. When the microwaves reach the food itself, they don't simply bounce off. Just as radio waves can pass straight through the walls of your house, so microwaves penetrate inside the food. As they travel through it, they make the molecules inside it vibrate more quickly. Vibrating molecules have heat so, the faster the molecules vibrate, the food becomes hotter. Thus the microwaves pass their energy on to the molecules in the food, rapidly heating it up. The rate of heating depends on shape, moisture contains and weight of food. In this system, it consists of outlet to exhaust internal vapor generated in the microwave system. It helps to dry and shrink the fruits.

Magnetron:

Magnetron is an electronic tube that produces high frequency microwave oscillations. This oscillation generates the microwaves. Magnetron is a self-oscillating device requiring no external devices other than the power supply. The magnetron is classed as a diode because it has no grid. The anode of a magnetron is fabricated into a cylindrical solid copper block. The cathode and filament are at the center of the tube and are supported by the filament leads. The filament leads are large and rigid enough to keep the cathode and filament structure fixed in position. The cathode is indirectly heated and is constructed of a high-emission material. The 8 to 20 cylindrical holes around its circumference are resonant cavities. A narrow slot runs from each cavity into the central portion of the tube dividing the inner structure into as many segments as there are cavities. Each cavity work like a parallel resonant circuit.

Microwave energy is more easily directed, controlled, and concentrated than low frequency EM waves. The main mechanism for microwave heating is bipolar polarizations where molecules already permanently polarized due to their chemical bonds are realigned in the fluctuating field. This realignment occurs millions of times each second, causing a heating effect within the whole volume of the material. Microwaves radiation penetrates deep into the object heated. Within the heated material, the electromagnetic energy is transformed into heat by means of several complex conversion mechanisms.

IV. ENERGY SAVING AND BENEFITS OVER CONVENTIONAL HEATING:

1. Reduce man-hours and downtime involved in cleaning

2. Smaller equipment footprint

3. Eliminate warm up and cool down time

4. Microwave energy does not heat the room only the material

Microwave drying works fast. This is because instead of applying energy only to the outside of the product, microwaves work directly to dry material from the inside out. Most conventional heating and drying methods approach material from the surface, applying heat only to the outside edges. This technique removes surface moisture very quickly, but it is highly inefficient when it comes to removing liquid trapped inside the material. If external temperatures are kept high enough, as in an oven, the material's inner moisture will diffuse to the surface and evaporate, but this is a passive and lengthy process.

By contrast, in microwave heating, moisture is forced out in the form of a vapor, such as steam. It can dry most materials in less of the time required by conventional methods.

V. MICROWAVE DRYING OF GRAPES

The drying of grapes is a long time process. various pre-treatments were applied to grapes like grapes dipped in ethyl oleate plus potassium carbonate solution. Microwave drying of grapes at 60 degree Celsius gives the better results. This temperature is maintained with the help of temperature sensor. The temperature sensor help to control the microwave power to ensure the grapes should not exceeds the set temperature value. The drying process was progressed through two stages, in the first stage the samples were put in a microwave oven until drying took place mainly in constant rate period, approximately 55% of the water was removed in this period. Due to exhaust fan moisture is removed successfully from the internal system.

The nutrient element and compound contents of MW-vacuum dried grapes were compared with those of fresh fruit and sun-dried fruits. The sun-dried grapes were produced using the traditional method.

Heating with microwaves has provan to greatly reduce the drying time of many agricultural product. With proper control of drying parameters like inlet air temperature and microwave power. Temperature, time, specific energy, fresh fruit sugar, and fresh fruit moisture content were analyzed using multiple linear regression analysis to develop surface plots and content of the dried grapes.

VI. RESULTS

Microwave drying of grapes without exhaust fan is shown in fig. 2 Microwave drying without exhaust fan and without pretreatment results the bursting of grapes. By using the exhaust fan and temperature sensor the resultant microwave heating shown in fig.3

The conventional heating of grapes shown in fig 4.

Fig. 2

Fig. 3

Fig. 4

VII. CONCLUSION

There are many advantages of microwave drying technology. Microwave drying has decreased the dehydration time of fruits and vegetables with higher energy and drying efficiency. Microwave drying is also able to maintain good quality of the fruits and vegetables such as smell, color and texture. Thus, microwave drying is an excellent method to dehydrate fruits and vegetables to extend storage life. Microwave dehydration enables the production of dried fruits and vegetables with good quality.

Many new dimensions came up in drying technology to reduce the energy utilization and operational cost. Selective and volumetric heating effects, microwaves bring new characteristics such as increased rate of drying, enhanced final product quality and improved energy consumption. However, several factors should be taken into consideration when developing drying system for the fruits and vegetables. The microstructure of microwave-dried samples showed certain discontinuities; however, the overall mechanical strength is improved.

REFERENCES

[1] G. R. Askari , Z. Emam-Djomeh& S. M. Mousavi (2009)" An Investigation of the Effects of Drying Methods and Conditions on Drying Characteristics and Quality Attribute of Agricultural Products during Hot Air and Hot Air/Microwave-Assisted Dehydration", Drying Technology, 27:7-8, 831-841, DOI: 10.1080/07373930902988106 (14 Aug 2009.)

[2] S. R. S. Dev , T. Padmini , A. Adedeji , Y. Gariépy& G. S. V. Raghavan (2008) "A Comparative Study on the Effect of Chemical, Microwave, and Pulsed Electric Pretreatments on Convective Drying and Quality of Raisins", Drying Technology, 26:10, 1238-1243 (11 Sep 2008)

[3] Peng Liu , Arun S. Mujumdar , Min Zhang & Hao Jiang (2015) "Comparison of Three Blanching Treatments on the Color and Anthocyanin Level of the Microwave Assisted Spouted Bed Drying of Purple Flesh Sweet Potato", Drying Technology, 33:1, 66-71, DOI: 10.1080/07373937.2014.936558 (17 Oct 2014.)

[4] Dariusz Piotrowski, Andrzej Lenart, Andrzej Wardzy_nski "Influence of osmotic dehydration on microwave convective drying of frozen strawberries" Journal of Food Engineering 65 (2004) 519–525. (Received 23 July 2003; accepted 9 February 2004).

[5] Garcia-Noguera, Juan; Oliveira, Francisca I. P.; Gallão, Maria Izabel; Weller, Curtis L.; Rodrigues, Sueli; and Fernandes, Fabiano A. N.,"Ultrasound-Assisted Osmotic Dehydration of Strawberries: Effect of Pretreatment Time and Ultrasonic Frequency"(2010). (1 Jan 2010)

[6] Viboon Changrue, G.S. Vijaya Raghavan, Yvan Gariépy and Valérie Orsat "Microwave vacuum dryer setup and preliminary drying studies on strawberries Carrots." (31 Aug 2007)

[7] Palmiro Poltronieri, Angelo Santino, Loredana F. Ciarmiello, Jan Hubert, "Application of Microwave and RF in food processing, microorganisms and pest control" 978-1-4673-7602-0/15/$31.00 ©2015 IEEE

[8] M. Zhanga, J. Tangb, A.S. Mujumdarcand S. Wang "Trends in microwave related drying of fruits and vegetables" Trends in Food Science & Technology 17 (2006) 524e534

[9] Thomas Kivevele, Prof. Zhongjie Huan, "Experimental comparative study of an open and completely closed air source heat pump for drying sub-tropical fruits" The paper is presented by Mr Thomas Kivevele (2015)

[10] Mehdi Torki-Harchegani, Mahdi Ghasemi-Varnamkhast, Davoud Ghanbarian Morteza Sadegh, Mojtaba Tohidi "Dehydration characteristics and mathematical modelling of lemon slices drying undergoing oven treatment" © Springer-Verlag Berlin Heidelberg 2015 (Received: 6 March 2014 / Accepted: March 2015)

[11] Suwit Paengkanya, Somchart Soponronnarit, Adisak Nathakaranakule "Application of microwaves for drying of durian chips" Food and Bioproducts Processing. (Received 10 March 2015Received in revised form 3 June 2015Accepted 8 June 2015Available online 17 June 2015)

[12] Valérie Orsat, Viboon Changrue and GS Vijaya Raghavan "Microwave drying of fruits and vegetables" (Published online 01 December 2006)

[13] Albanese, D., Cinquanta, L., Cuccurullo, G., & Di Matteo, M. (2013). Effects of microwave and hot-air drying methods on color, β-carotene and radical scavenging activity of apricots. International Journal of Food Science and Technology, 48(6), 1327–1333.