Microwave Fruit & Vegetables Drying

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Abstract— now a day's microwave drying is the most common method for fruits. Fruits are dried to extend storage life and reduce transport weight. The use of microwaves in drying has been growing in recent years. In resent research on microwave drying have some limitations like excessive heating at the edges and corners of the product. Due to this scorching problem are occurred also it causes the 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 advantages of MW combination drying techniques include shorter drying times, improved product quality and Flexibility in producing a wide variety of dried products. The drying rate increases the nutritional value, color, and original flavor and puffing.

Key words: Microwave, Energy Saving, Conventional Heating

I. INTRODUCTION

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 unuiform 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 solve.

II. BLOCK DIAGRAM

Block diagram of microwave system is shown in figure 2. It consists of various electronic motors, relays and control circuits.

The microwave power and the drying time can be programmed. The door frame has small window to enable the cook to view the food while it is cooking. It consists of steel cavity. Near the top of the steel oven cavity is a magnetron. A microwave oven 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.

The control system consists of a microcontroller to control the operations of the dehydration systems. The high voltage power supply is interfaced with the magnetron input terminal to provide power for filaments and oscillations of magnetron fault protection are typically incorporated into this unit.

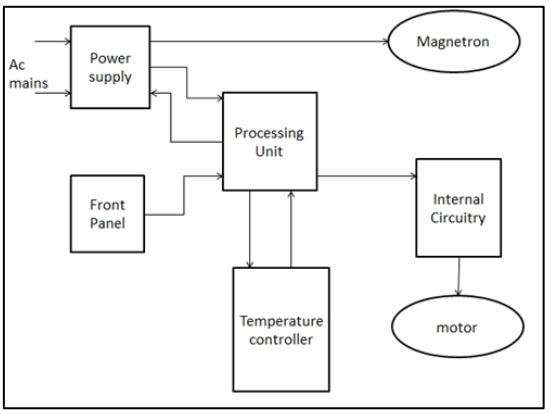

Fig. 1: Block diagram of microwave system

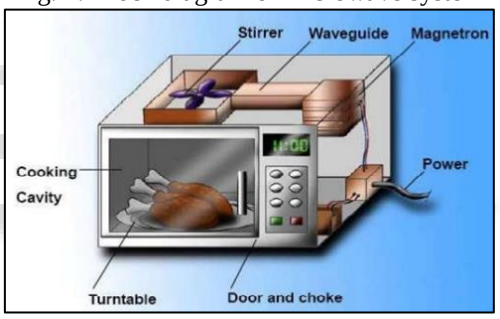

Fig. 2: Internal structure of microwave oven

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It consists of metal box. Inside the strong metal box, there is a microwave generator called a magnetron. When you start cooking, the magnetron takes electricity from the power outlet and converts it into high-powered radio waves. The magnetron blasts these waves into the food compartment through a channel called a wave guide. The food put on a turntable, spinning slowly round so the microwaves cook it evenly. 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, and the food becomes hotter. Thus the microwaves pass their energy on to the molecules in the food, rapidly heating it up.

It consists of outlet to exhaust internal vapour generated in the microwave system. It helps to dry and shrink the fruits. Also it includes fan to dry the product.

A. 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 such as dipole rotation and stretching of large

III. 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.

IV. MICROWAVE DRYING OF APPLE OF APPLE

Dried fruits are widely used as components in many food formulation such as pastry, confectionery products, ice cream, frozen desserts and yogurt. Among them, dried apples are a significant raw material for many food products. 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.

Fig. 3: Microwave drying of apple

After that the forced draft oven was used until the apple samples reached the final moisture content. The second stage, the apple samples were put in forced draft oven to reach the final moisture content. For one hour or two hours the value of the drying constant increased with increased microwave output power. The change in color values was dependent on the pre-treatment. The 45% sugar solution showed decrease drying rate than the other treatment. The increasing on the density power (W/g) the drying rate increased by 35%. The drying apple process, the apple samples could be microwave dried to20% moisture content wet basis in few minutes (rang 3 to 5 minutes)

V. CONCLUSION

The benefits of using microwave drying technology are very good. Microwave drying had 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 so that the storage life extended. 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 was 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] MehdiTorki-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.

