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Design of RF based Dryer for Leafy Vegetables

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***Abstract*: The overall aim of this project is to bring about revolution in the traditional farming practices and to broaden the horizons of the agriculture products so as to achieve self-support to expand the exports and to develop the economic strength of agriculture dependent population. The objective of this initiative is to creatively utilize the richly available resources of the local area and to enable uninterrupted supply of the products to market throughout the year. The possibility is a humble effort to establish such processing unit & serving national community as well.**

The ability to preserve the food has enabled us to make food with good amount of nutrients available to consumers sitting in the other corner of the world. Added to this is the advantage of convenience, which has become very relevant in today's world as people are leading busier lives. The advent of new RF technologies has resulted in the affordability of the preserved food, which means nutrients preserved food reaching even the middle class kitchens. It will evolve from food in a raw form to prepared and processed foods and the amount of time spent in the kitchen will reduce. On other hand people get nutrients reached food in no time. We used LC circuit for frequency control.

***Keywords*: RF dryer, Microwave system, Nutrition values, temperature,**

1. Introduction

Agriculture being a significant segment always plays fundamental role in the economic development of the country. There are many revolutionary areas in agriculture to be explored for value addition in our produces that can be exploited by using the new techniques. To maintain the nutrition value of leafy vegetables while drying them and making them packaging accessible. Leafy vegetables don't get conserved over an extended duration of time, that's why it becomes extremely significant for us to find a measure to conserve them. Apart from that during transportation these vegetables may get completely destroyed and the transportation costs on top, this adds on to the losses incurred by farmers. Apart from that many vegetables are seasonal in nature and due to their low shelf life after harvest they are sold in the markets at very high prices.

2. Scope of the project

Dehydration reduces the mass and spaces required to store and transfer the products and remain stable in ordinary storage conditions. Dehydrated products can be used during off season and the fresh produce of far off places can be saved from decomposition due to severe weather conditions and ineffective transport facilities. Through the beginning of these innovative technologies, the income of public living in remote areas can be improved by using their produces, paying higher prices and providing them with employment opportunities in industry.

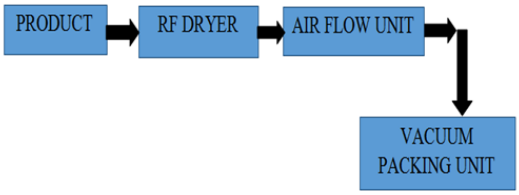

Fig. 1. Proposed design block diagram

3. Need for RF dryers

Radio frequency heating (RF), also known as dielectric heating, is an electrical technique which uses radio waves to directly heat suitable nonmetallic materials the entire product volumetrically. As a consequence, the intensity of heating may be much greater than conventional methods and can give rise to beneficial heat and mass transfer effects not possible with other forms of heating. Thus in comparison with conventional heating techniques RF offers the advantages of increased processing speed, smaller foot print, improved product quality and a cleaner working environment.

Radio frequency (RF) industrial dryer material to be dried is placed under the RF genera or producing he high frequency alternating fields between its two electrode his

alternating fields causes the polar movement in water molecules his results in friction with in the material water molecules, his friction causes the heating within the material. If sufficient amount of energy is applied it converts the water/ solvent in to steam and evaporate from the material result s in drying of material.

The heat is generated within the material hence there is no losses in terms of conduction of heat in surrounding, radio frequency (RF) industrial dryers are highly controllable as the rate of heat production is proportion of radio frequency energy supplied to the materials. RF dryers are designed to eliminate any type of losses, so that the material is uniformly heated to desired level.

The mechanism of radio frequency heating is that the molecules within a product placed in an RF environment reorient themselves (27 million times/s at 27 MHz) continuously in response to the applied field. This response initiates volumetric heating within the entire product due to frictional interaction between the molecules. Thus selectively

heats only the product and not the air or equipment surrounding it.

Radio frequency heating is accomplished through a combination of dipole heating and electric resistance heating resulting from the movement of dissolved ions present in the food. Although identical to the other electromagnetic heating methods, radio frequency with electromagnetic waves in 30-300MHz spectrum has the added advantage of uniform heating in homogeneous foods and most important of all, high penetration depth that could be used to pasteurize or sterilize liquid products. These early efforts employed RF energy for applications such as the cooking of processed meat products, heating of bread, dehydration and blanching of vegetables. here is a major difference between the way RF and microwave equipment are available in the market. Unlike microwave sources, one cannot purchase an RF high Power source. Due to the high impedance nature of RF coupling, the RF source and applicators normally need to be designed and built together. Manufacturers of RF equipment develop the whole system, rather than only the power source. therefore, developments in RF processing must involve the commercial RF manufacturers. the most common commercial RF frequencies are 13MHz, 27MHz, and 40MHz. Yet another advantage of RF equipment over microwave is in the control area. In high power RF systems, the source and the load are commonly locked together in a feedback circuit. Therefore, variations in the load can be followed by the source without external controls. RF equipment has another important advantage. Because of much longer wavelengths, they have better uniformity. Also, the depth of penetration is much higher. So, in cases where uniformity is a critical issue they may be a better choice. We test nutrition value before vs after RF Dryer used hplc for measurement of nutrition values.

The advantages of RFC Macrowave Systems over microwave are:

- greater uniformity of heating
- improved power control greater depth of penetration
- lower operating cost
- modular design considerations
- lower equipment cost
- greater processing versatility

RF waves have a larger penetration depth than MW and hence could find better application in larger size foods. Besides the popular domestic use of MW ovens, commercialized applications of MW/RF heating include blanching, tempering, pasteurization, sterilization, drying, rapid extraction, enhanced reaction kinetics, selective heating, disinfestations, etc.

4. Objectives

As the drying of vegetables can be achieved the focus can also be shifted to making it compact sizes as RF dryers have a potential of being small in size and still dry commodities just like any other dryers Also, many other day to day commodities such as milk etc. be made into powdered forms and providing as much nutrition as liquid milk would. Blood or plasma inside the blood can also be dried up in this ways making it easy to store or transport the applications of RF. Dryers can further be explored and experimented with many items.

5. Problem Definition

Types of existing food dryers:

- Tray Dryers.
- Tunnel Dryers.
- Roller or Drum Dryers.
- Fluidized Bed Dryers.
- Spray Dryers.
- Pneumatic Dryers.
- Rotary Dryers.
- Trough Dryers.

Most of these dryers are large scale and not in compact sizes which makes it very difficult for an average farmer or even person setting up a business to afford as it requires additional space hence, more infrastructure. The conventional dryers such as Microwave Dryers are concerned to have many health related issues amongst many other disadvantages .Long term exposure to microwave emitting from dryers can quickly cause harmful heating of body tissues. Initial setup cost for industrial size dryers is very high. These are the reasons which shows that there's need for small sized, compact dryers which can even retain the nutrition levels of food products

6. Problem solution

Radio frequency heating forms a part of innovative techniques based on electromagnetic heating and other non-thermal methods have the potential of providing high quality foods economically. Electro heating can be sub-divided into either direct electro heating where electrical current is applied directly to the food (e.g. ohmic heating (OH)) or indirect electro heating (e.g. microwave (MW) or radio frequency (RF) heating) where electrical power is firstly converted to electromagnetic radiation which consequently generates heat within the product. Radio frequency heating applications have been very successful in the non-food industry, including paper, lumber and plastic. Even though quite restricted in terms of its application in the food industry as a whole, consumer demand for the ever-tastier, the ever-cheaper, low or no-fat, chemical free and safe commodities have recently extents its application in the food processing. RF heating in current scenario is the preferred method in modern industries for product cooking, baking, drying, pasteurization and other applications.

7. Conclusion

This paper presented an overview on design of RF based dryer for leafy vegetables.

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