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AIR DRYING KINETICS ON THE VARIETY OF CAPSICUM

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ABSTRACT

The quality of different dried chilli (*Capsicum annuum* .L) (green, yellow and red) in terms of colour attributes and nutrients was studied using a Microwave oven dryer, in order to determine the quality loss caused by drying. Different drying temperatures from 50-100 degree celsius, were used to find out the difference in quality loss at various temperatures.Browning colour of dried chilli was observed due to non-enzymatic browning reaction as reducing sugar was decreased. Not only did the Maillard reaction provide a dark-brown colour, but thermal degradation and oxidation of total ascorbic acid also provided an unacceptable colour of dried capsicum. It was found that, when there is a increase in the temperature there is decrease in the moisture and the nutritional quality. The kinetics was implemented using the rate constant and the order of reaction followed by this dried capsicums (green, yellow and red) were First order rate of kinetics respectively.

INTRODUCTION

Capsicum has been known since the beginning of civilization in the Western Hemisphere. It has been a part of the human diet since about 7500 BC (Mac Neish, 1964). Hot pepper is produced in all the continents except Antarctica, and historically associated with the voyage of Columbus (Heiser, 1976). Pepper, chilli, chile, or chili belongs to the Solanaceae family genus *Capsicum* and is closely related to tomato, eggplant, potato and tobacco. The genus *Capsicum* represents a diverse plant group and includes twenty seven species; five domesticated and twenty two un-domesticated (Bosland, 1993). *Capsicum annuum*, *C. frutescens*, *C. chinense*, *C. baccatum* and *C. pubescens* are considered domesticated species of peppers. The use and uses of the numerous cultivars within the five domesticated species have grown exponentially.

Despite their vast trait differences, virtually all commercially cultivated *Capsicum* cultivars in the world belong to *C. annuum.* Peppers are quite diverse and may be classified by the trade according to the end use. Peppers grown for their characteristics hot flavor are of genus *Capsicum*, *C. annuum* L. var. *annuum* principally and *C. frutescens* L. to a lesser extent. A second pepper type valued for its brilliant deep red color is paprika, evoking none or only negligible pungency. Both types have a distinct aroma, valuable in certain formulations. A third pepper type classified according to end use is *C. annuum* L. var. *annuum*, the large sized fleshy bell pepper used as fresh vegetable and valued for its aroma, color and crisp texture, but evokes no pungency (Govindarajan and Sathyanarayana, 1991). A powerful compound called *capsaicin* is what gives Capsicum its bite and is also responsible for most of its beneficial effects on human physiology. (G.A. Cordell and O.E. Araujo). The hotter the pepper, the higher its content of capsaicin. (A.Y. Leung)The remarkable properties of capsaicin will be discussed and documented clinical evidence supporting the use of capsaicin will be delineated. Only ionic conduction and dipolar rotation are of primary interest in microwave heating of foods (Owusu-Ansah, 1991). The basic premise associated with microwave heating is that it involves the interaction of microwaves with a non-homogeneous food product, which contains materials which are highly affected by the electrical component of the electromagnetic field. In foods, it is the polar molecules that for the most part interact with microwaves to produce heat. Water is the most common polar molecule and is a major component in most foods.

In the case of dipolar rotation, due to having a strong dipole or non-uniform charge distribution, water molecule attempts to line up with the field in much the same manner iron fillings line up with the field of a magnet in the presence of a microwave electric field. Since the microwave field is reversing its polarity, millions of times each second, the water molecule, because it is constrained by the nature of the food of which it is a part, only begins to move in one direction when it must reverse itself and move in the other direction. In doing so, kinetic energy is extracted from the microwave field and heating occurs by

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internal molecular friction. In addition, the contribution of microwave absorbing components is also a function of their state, i.e., whether they are "free" or "bound". Consequently, bound water exhibits much lower microwave absorptivities. (Decaurau, 1992; Ramaswamy and Van de Voort 1990).

Ionic conduction is another important microwave heating mechanism. Ions, being electrically charged, are influenced by microwave fields. Ions present in a solution flow first in one direction then in the opposite direction as the field is reversed and ionized compounds randomly collide with non-ionized groups when subjected to an electric field. The kinetic energy of these ions is transmitted as heat during such collisions. Ionic conduction occurs in cellular fluids when animal or vegetable tissues are exposed to microwave energy (Decaurau, 1992; Owusu-Ansah, 1991).

The present paper aims at predicting the air drying kinetics on the variety of Capsicum using various theoretical models and rate constant reactions.

MATERIALS AND METHODS

Drying behavior

To determine the drying kinetics, the capsicum was dried using Microwave oven at various temperatures at a range from 50 to 100 degree Celsius. The dryer was set at the required air temperature. It was run without load for 0.5 hour to stabilize the drying conditions. The treated samples were uniformly spread in a thin layer on the perforated tray, which ensured a cross flow of air. The loss in weight of the sample during experimentation was measured at an interval of 30 minutes.

Determination of moisture content and water activity (aw)

The moisture content was determined using the hot air oven at temperatures from 50 to 100 degree Celsius at a time interval of 0.5 hour. Water Activity of Capsicum was measured using Karl Fischer method. The experiment was calibrated using the standard sample.

Reducing sugar analysis

Reducing sugar was analyzed using the Nelson-Somogyi method, which is suitable for food with low reducing sugar (Low, 1994). The concentration of reducing sugar was obtained using a spectrophotometer at 520 nm and a standard curve of glucose at 0-200 µg/ml was used. The method of extraction followed the Lane- Eynon method (AOAC, 1990) using 1 g of chilli. Three replications were conducted.

Ascorbic acid analysis

L-ascorbic acid was analyzed using the 2,6-dichlorophenol indohenol titrimetric method (AOAC, 1990). Five grams of both fresh and dried chilli were mixed with 5% dichloroacetic acid. In addition, 0.1 mg/ml of ascorbic acid solution was used as the standard. The analysis was conducted in three replications.

Determining the Rate of Reaction using Kinetics

The rate constant is also determined using the k value in which the percentage of moisture, percentage of Ascorbic Acid and the amount of reducing sugar decreases by the increase of the rate constant, i.e. rate of drying increases with the decrease in Nutritional quality of the sample (capsicum).

The First Order Reaction of Kinetics:

$$r = -\frac{d[A]}{dt} = k[A]$$

k is the first order rate constant, which has units of 1/s
The integrated first-order rate law is

$$\ln [A] = -kt + \ln [A]_0$$

RESULTS AND DISCUSSION

Drying behaviour

The moisture content on the variety of capsicum was observed in order to study the drying behaviour. Its drying time under different temperatures of drying is shown in Figure 1. The moisture content decreased exponentially with drying time. The total required time for moisture took place nearly 3 hours, since the drying temperature was from 50-100 degree Celsius with the time interval of 0.5 hour. Similar observations were reported for garlic (Madamba et al., 1996) and mushrooms (Arora et al., 2003). All the drying process took place in falling rate period, starting from the initial moisture content to the final moisture content.

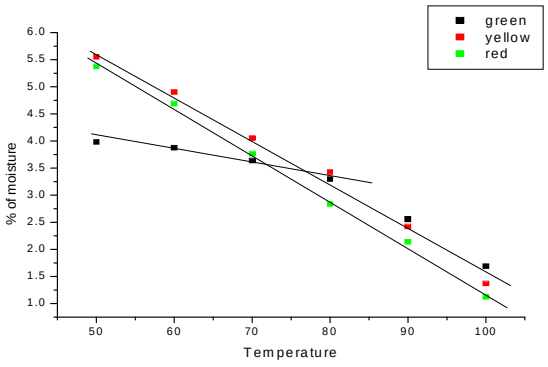

Fig. 1 Variation in moisture content on the variety of Capsicum

The drying rate on the variety of capsicum (green, yellow and red) was determined using the graph. The k value (rate constant) of green is 0.00194, yellow 0.001898 and red 0.001959. The k value was calculated in finding out the ratio of the percentage of moisture. It shows that as the temperature increases the percentage of moisture gradually decreases. The graph was expressed in a straight line which resulted in a negative slope and came to know that it follows the First order reaction kinetics.

Determination of Ascorbic Acid:

The ascorbic acid content on the variety of capsicum was observed in order to study the nutritional quality of the capsicum. It was dried at different temperatures in a range from 50-100 degree Celsius at a time interval 0.5 hour and allowed for titration. The ascorbic acid content was determined by plotting the graph by temperature versus the percentage of ascorbic acid present in the different types of capsicum is shown in the figure-2.

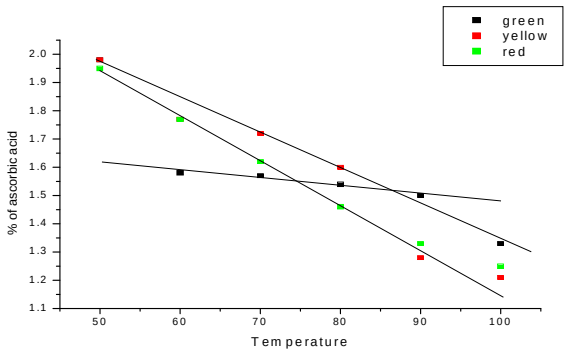

Fig. 2. Variation in Ascorbic acid on the variety of Capsicum

The rate constant was determined using the K value in which as the percentage of ascorbic acid decreases the k value increases. The k value of green capsicum is 0.002308, yellow 0.002308 and red 0.002317. The k value was calculated in finding out the ratio of the percentage of ascorbic acid. It shows that as the temperature increases the percentage of Ascorbic Acid gradually decreases. The graph was expressed in a Straight line which resulted in a negative slope and came to know that it follows the First Order reaction kinetics.

Determination of Reducing Sugar

The Reducing Sugar content on the variety of capsicum was observed in order to study the nutritional quality of the capsicum. It was dried at different temperatures in a range from 50-100 degree Celsius at a time interval 0.5 hour and allowed for analysis. The reducing sugar content was determined by plotting the graph by temperature versus the percentage of ascorbic acid present in the different types of capsicum is shown in the figure-3.

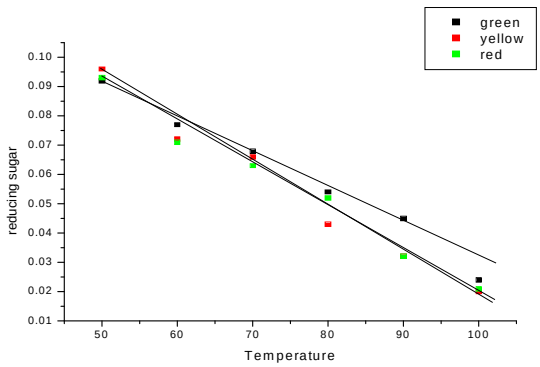

Fig. 3 Variation in Reducing Sugar on the variety of Capsicum

The rate constant was determined using the K value in which as the amount of reducing sugar decreases the k value increases. The k value of green capsicum is 0.004169, yellow 0.004244 and red 0.004230. The k value was calculated in finding out the ratio of the amount of reducing sugar. It shows that as the temperature increases the amount of reducing sugar gradually decreases. The graph was expressed in a Straight line which resulted in a negative slope and came to know that it follows the First Order reaction kinetics.

CONCLUSION

Kinetics is the study of rate of any reaction. Drying of capsicum is a form of a reaction in which the rate of reaction is nothing but the rate of drying. From the graphical representation of Percentage of moisture, percentage of Ascorbic acid and the amount of reducing sugar of all the three varieties of capsicum shows a straight line in the graph which notes that it is a negative slope. Therefore it follows that in the study of drying kinetics it has undergone the First Order reaction of kinetics. Kinetics and food is related by the inactivation of by the inactivation of microorganisms. The inactivation rate of kinetics is nothing but the first order reaction kinetics. The gas permeable membrane of the sample decreases with the increase in the rate constant. When there is a increase in the rate of drying (i.e rate constant), there is a decrease in the nutritional composition of the capsicum. In this sample since in it follows the first order kinetics, which is analysed, cannot form any by-product in it.

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