Effect of Microwaves on the pH and °Brix value of Cranberry, Grape, Blackberry and Lemon

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Abstract

The microwaves find the potential capability in variety of applications, however the effects of microwaves on the materials plays an important role. It is often discussed about the adverse effects of microwaves on the fruits however this can be verified by considering two characteristics of fruits such as °Brix and pH value.This paper focuses on the effect of microwaves exposure on some fruits. It aims to explain the effect of microwave heating on °Brix and pH value of the Cranberry, Grape, Blackberry and Lemon fruits. Two basic sections are considered here, one without exposure and other with exposure to microwaves.◦Brix and pH values of Cranberry, Grape, Blackberry and Lemon are measured before exposure to microwaves. Brix measurement is done by the Aichose Refractometer &pH value is measured by AMT28F pH meter.The change in pH and °Brix value was noted for Cranberry, Grape, Blackberry and Lemon after exposure to microwaves for given time intervals of 5, 10, 15 and 20 seconds of heating at 700 W power. With graphical analysis, USDAstandards(United States Department of Agriculture) are utilized to validate the results.The °Brix and pH values for all fruits have shown the variation when exposed to microwaveshowever the °Brix and pH value were lying in the permissible limits referred by USDA standards after exposure to the microwaves.

Keywords: °Brix, pH, Refractometer, Microwave heating, Circuit & systems.

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1. Introduction

Two basic sections are considered as without exposure and with exposure of microwaves. °Brix measurement is done by the Aichose Refractometer which is capable of measuring sugar content in fruit, honey, maple syrup and other sugary drink. In a given solution level of soluble solids are expressed as °Brix. Sugar, pectin, organic acids, and amino acids are dominant soluble solids in fruits contributes to °Brix value. However, sugar is the most abundant soluble solid in many fruit and vegetable juices. So, primarily estimation of sugar content in fruits and vegetables is given by °Brix value. In the mid-1800s the °Brix scale was developed by Adolf Brix& the scale is equal to the percent of dissolved solids in a solution.100 gm sample of a solution that measures 50° Brix has 50 g of sugar and other dissolved solids and 50 g of water at reference temperature of temperature of 20°C[1]. In simple words Brix content in fruit is the most important factor that determines fruit quality [2]. The pH value is measured by AMT28F pH meter is flat sensor, which can test pH values of skin and fruits. pH has an important effect on pigments (e.g. chlorophyll, carotenoids, anthocyanins, etc.) responsible for fruits color. Altering the natural qualities, jellification, enzymatic activities, growth and mortality of microorganisms, germinating or inactivation of bacterial spores and chemical reactions are the phenomena which are affected by the pH value during the processing of the food [3]. In order to produce safe, high-quality and value-added products it very important to have information about pH effects while microwave heating process [4]. Novel approach for estimating sugar in wines using Refractometer was rapid, easy, and practical for use in routine analyses or for monitoring quality of must during fermentation and final wine products in a winery and laboratory[5]. pH influences quality of the food product so monitoring of pH becomes vital part in food safety. While considering the tool for pH measurement the accuracy, precision, sensitivity of instrument is important. The effect of temperature, probe handling, cleaning procedures, type of the sample can yield significant difference in the results of pH measurement [6].

2. Methodology

This section comprises of sample preparation & experimental procedure of the experimentation.

I. Sample Preparation:

The all fruits were kept at identical temperature conditions to avoid errors due to temperature variations. Cleaning of fruits, equipment and vessels given most importance to minimize the deviation in the measurement. From all the fruits the seeds were removed, and uniform liquid samples were prepared. For the same fruit multiple sample were prepared so that more readings can be taken to get more accuracy.

II. Experimental procedure:

Aichose Refractometer and AMT28F pH meter which are used in the experimentation are shown in Figure 1. Firstly, for ◦Brix value measurement two drops of well mixed fruit sample are placed on Aichose Refractometer’s prism and the lid closed. Then looked through the lens and seen internal scale by holding the device perpendicular to a light source. The light and dark areas meet on the scale is the ◦Brix reading. Figure 2 shows the actual reading on Aichose Refractometer for blackberry fruit with microwave exposure. Secondly, pH value is measured by AMT28F pH meter. Immersing the standardized electrode tip into the well mixed fruits sample untilreading stabilizes on pH meter. Figure 3 shows the actual reading on the AMT28F pH meter for lemon fruit with microwave exposure.

The change in pH and °Brix value was noted for Cranberry, Grape, Blackberry and Lemon after exposure to microwaves for given time intervals of 5, 10, 15 and 20 seconds. Table 1 shows °Brix value as 6.70 and pH value as 2.70 for cranberry. These values are without exposure to the microwave. Table 2 shows the °Brix value and pH value for certain time interval of microwave exposure. °Brix value reaches to 9.00 whereas pH value reaches to 2.69 after 20 seconds of heating at 700 W.

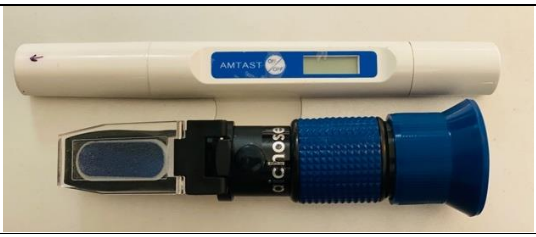

Figure 1: AMT28F pH Meter & Aichose Refractometer

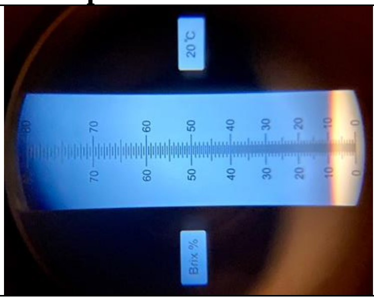

Figure 2: °Brix measurement on Aichose Refractometer's scale
(Actual reading for blackberry fruit, with exposure, Time interval of 10 seconds)

Figure 3: pH measurement on AMT28F pH meter
(Actual reading for lemon fruit, with exposure, Time interval of 10 seconds)

Table 1: Cranberry: without Exposure

°Brix	pH
6.70	2.70

Table 2:Cranberry: with Exposure

Time	°Brix	pH
5	6.83	2.51
10	7.00	2.53
15	8.00	2.45
20	9.00	2.69

Table 3 shows the °Brix value as 18.40 and pH value as 3.67 for Grape. These values are without exposure to the microwave. Table 4 shows the °Brix value and pH value for certain time interval of microwave exposure. °Brix value reaches to 27.00 whereas pH value reaches to 3.48 after 20 seconds of heating at 700 W.

Table 3: Grape: without Exposure

°Brix	pH
18.40	3.67

Table 4:Grape: with Exposure

Time	°Brix	pH
5	20.00	3.61
10	20.60	3.57
15	22.75	3.64
20	27.00	3.48

Table 5 shows the °Brix value as 9.62 and pH value as 3.59 for Blackberry. These values are without exposure to the microwave. Table 6 shows the °Brix value and pH value for certain time interval of microwave exposure. °Brix value reaches to 13.00 whereas pH value reaches to 3.72 after 20 seconds of heating at 700 W.

Table 5:Blackberry: without Exposure

°Brix	pH
9.62	3.59

Table 6:Blackberry: with Exposure

Time	°Brix	pH
5	10.25	3.65
10	10.00	3.68
15	13.00	3.61
20	13.00	3.72

Table 7 shows the °Brix value as 9.00 and pH value as 2.37 for Blackberry. These values are without exposure to the microwave. Table 8 shows the °Brix value and pH value for certain time interval of microwave exposure. °Brix value reaches to 8.50 whereas pH value reaches to 2.46 after 20 seconds of heating at 700 W.

Table 7: Lemon: without Exposure.

°Brix	pH
9.00	2.37

Table 8: Lemon: with Exposure.

Time	°Brix	pH
5	9.00	2.37
10	8.50	2.45
15	8.50	2.58
20	8.50	2.46

Table 9: Standard pH and Brix values as per USDA

Fruit	°Brix (Minimum required value)	pH (Permissible range)
Cranberry	06	1.9 to 3.1
Grape	14	2.7 to 4.1
Blackberry	10	2.9 to 3.6
Lemon	07	2.2 to 2.5

3. Results and Discussions

Change in the °Brix and pH values observed and plotted in two conditions namely without exposure and with exposure of microwaves. From the Fig. 4, Fig. 6, Fig. 8 and Fig.10, it is seen that the °Brix value increased with exposure to microwaves for cranberry, grape and blackberry however for lemon it was observed to be decreased with exposure time interval of 5, 10, 15 and 20 seconds. ThepH value increased with exposure to microwaves for blackberry and lemon whereas it decreased for the cranberry and grape which can be observed in the Fig.5, Fig.7, Fig.9 and Fig.11.

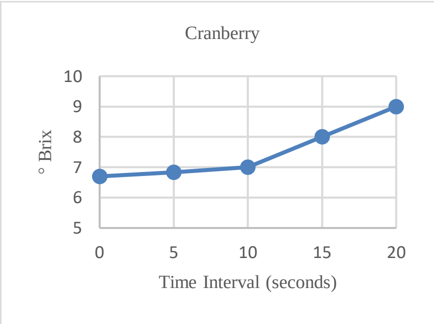

Fig. 4: Change in the °Brix value for Cranberry

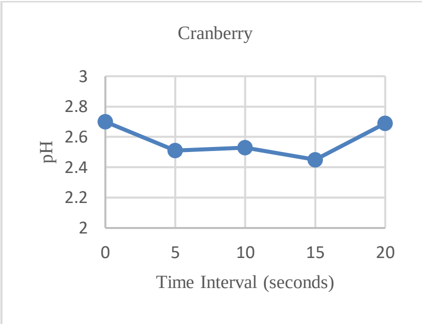

Fig. 5: Change in the pH value for Cranberry

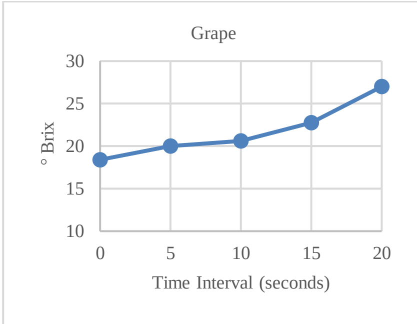

Fig. 6: Change in the °Brix value for Grape

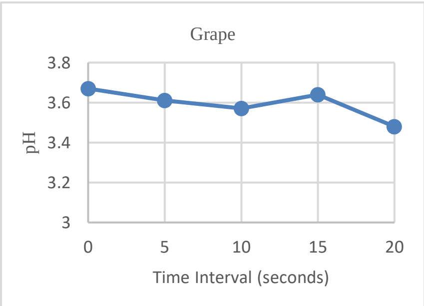

Fig. 7: Change in the pH value for Grape

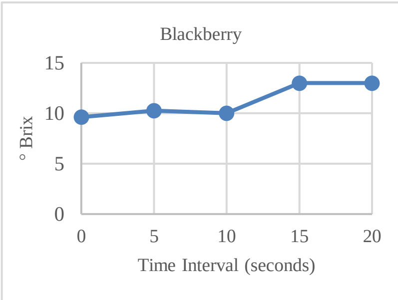

Fig. 8: Change in the °Brix value for Blackberry

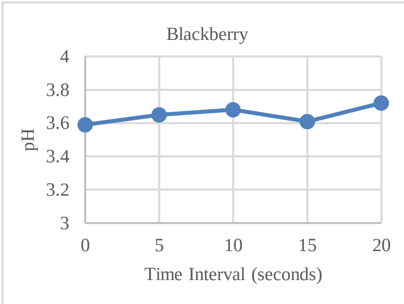

Fig. 9: Change in the pH value for Blackberry

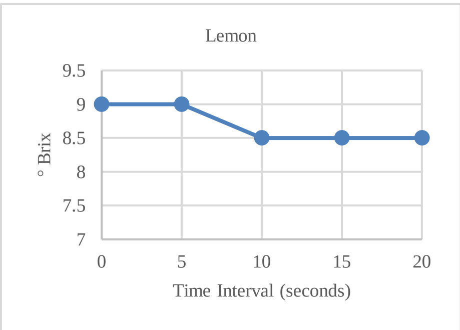

Fig. 10: Change in the °Brix value for Lemon

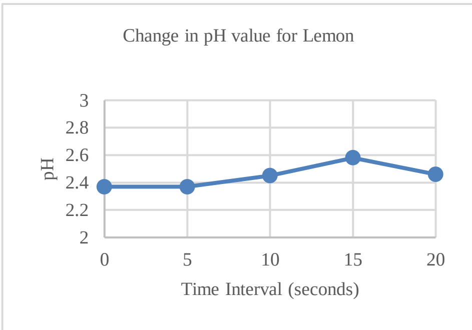

Fig. 11: Change in the pH value for Lemon

Without microwave exposure °Brix value of cranberry was 6.70 whereas after exposure it was 9. As per Table 9 the minimum required percent soluble solids (°Brix) as per USDA standards is 6. [7], which concludes that °Brix value after the microwave exposure is above minimumrequired value. Without microwave exposure pH value of cranberry was 2.7 whereas the value reached to 2.69 after exposure. The permissible pH range as per USDA standards is 1.9 to 3.1 which concludes that the pH value after the microwave exposure falls in the permissible range [8].Without microwave exposure °Brix value of grape was 18.40 whereas after exposure it was 27. As per Table 9the minimum required percent soluble solids (°Brix) as per USDA standards is 14.

Which concludes that °Brix value after the microwave exposure is above minimumrequired value. Without microwave exposure pH value of grape was 3.67 whereas value reached to 3.48 after exposure. The permissiblepH range as per USDA standards is 2.7 to 4.1 which conclude that the pH value after the microwave exposure falls in the permissible range. Without microwave exposure °Brix value of blackberry was 9.62 whereas after exposure it was 13. As per Table 9 the minimum required percent soluble solids (°Brix) as per USDA standards is 10. Which concludes that °Brix value after the microwave exposure is above minimum required value.Without microwave exposure pH value of grape was 3.59 whereas value reached to 3.72 after exposure. The pH range as per USDA standards is 2.9 to 3.6 which conclude that the pH value after the microwave exposure falls in the permissible range. Without microwave exposure °Brix value of lemon was 9 whereas it was 8.50 after exposure. As per Table 9 the minimum required percent soluble solids (°Brix) as per USDA standards is 7. Which concludes that °Brix value after the microwave exposure is above minimum required value.Without microwave exposure pH value of lemon was 2.37 whereas value reached to 2.46 after exposure. The pH range as per USDA standards is 2.2 to 2.5 which conclude that the pH value after the microwave exposure falls in the permissible range.

Conclusion:

The °Brix and pH values ofCranberry, Grape, Blackberry & Lemon have shown the variations when they were exposed to microwaves as °Brix value increased for cranberry, grape and blackberry & for lemon it was observed to be decreased. The pH value increased for blackberry and lemon whereas it decreased for the cranberry and grapehowever the °Brix and pH value were lying in the given permissible limits referred by USDA (United States Agriculture Department) standards.

Conflict of interest: The authors declare that they have no known competing financialinterests or personal relationships that could have appearedto influence the work reported in this paper.

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