Biological Forum – An International Journal ***(Special Issue 2015)*** **7**(2): 11-14(2015)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Enrichment of Calcium Content of Kiwi Fruit by Osmotic Dehydration Method

Farid Amidi-Fazli* and Neda Amidi-Fazli**
**Department of Food Science and Technology, Soofian Branch, Islamic Azad University, Soofian, Iran*
**Young Researchers and Elite Club, Tabriz Branch, Islamic Azad University, Tabriz, Iran*

(Corresponding author: Farid Amid-Fazli)
(Received 09 May, 2015, Accepted 12 July, 2015)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Calcium is an important mineral in the formation of bones, teeth, growth, blood clotting and many other actions deficiency of calcium causes osteoporosis and high blood pressure. The process of osmosis is based on placing of the food in hypertonic solutions (concentrate) of sugar or salt. In this study the osmosis solution was made by sucrose dissolved in deionized water and the concentration of 55% (w/w) by adding calcium in specified concentrations in the range of 0- 5% the solution making was completed. Based on central composite design and response surface method dehydration process took 0- 120 minutes while the amount of solution was 5 times the weight of the fruit. The moisture content, weight loss, sugar uptake and loss of water samples from the process was determined. According to the results it can be stated the amount of absorption of sugar and dehydration of kiwi fruit in the presence of calcium ions is considerable and maximum weight loss was 8.02% while using calcium as osmosis agent. When the concentration of calcium in the solution is the 5% the solid gain and water loss would be minimal. Factors influencing the rate of weight loss during the process of osmosis of kiwi fruit in a solution containing calcium were concentration and square of time at the levels of 95% and 99%, respectively.

Keywords: Kiwi fruit, enrichment, osmosis, calcium

INTRODUCTION

Like vitamins, minerals are needed to improve the functioning of the body and vice versa vitamins, minerals are inorganic materials which existed in the soil and water absorbed by plants or are consumed by animals. To ensure the proper functioning of the body organs, bones, tissues and immune system the body should get a lot of minerals daily. Minerals in our body have different activities, including the regulation of enzyme activity, helping to transfer material from the cell wall, balancing acidic the body, bones strength, muscles and the nervous system as well as the transmission of messages. Minerals can prevent the disease caused by environmental pollutions and increase the human abilities for corporal as well as mental activities. Also minerals can reduce the toxic effects of other minerals which entered the body (Agheli, 2006).

Minerals are needed to improve the functioning of the body, to ensure the proper functioning of organs, bones, tissues and your immune system the human body needs to get a lot of minerals on a daily basis (FAO, 2004). Due to the lack of minerals in the diet the body is subjected of serious damage in terms of health and also economic and social consequences lies there. Among the elements that have frequently been deficiencies are elements such as iron, calcium, phosphorus and potassium. All the minerals needed by the human body must be supplied by the food sources since the body can not make them and only can keep the level of minerals in balance for a short time. If the body's absorption of nutrients from food reduce then body compensate for this deficiency by removing the minerals from the muscles, liver and bone that adverse effects will follow. Calcium is an important mineral in the formation of bones, teeth, growth, blood clotting and many other actions; its deficiency causes osteoporosis and blood hypo pressure. In addition calcium helps proper function of the hands, heart, nerves, muscles and other body systems.

Dehydration of food products through osmosis that is the emerging of the food materials in concentrated solution is an old treatment which is regarded as a pretreatment in recent years for subsequent processing of food products (Raoult, 1994). The osmosis is based on placing the food at hypertonic solution (concentrate) of sugar or salt in order to achieve some change in concentration, drying and spontaneous food formulation due to the immersion of the food in solution and interacts with components of their solution. During osmotic dehydration water of food flows into the solution while the soluble components used in the solution flows at the opposite direction. The main phenomenon of osmosis is diluting of osmosis solution with weight gain and reduction in dehydration ability of osmosis agent (Torreggiani, 1995).

Fruit texture modification agents can be added to the solution promotes mass transfer characteristics and affect nutritional and stability of aromatic substances during processing (Ferrando, 1998).

In recent decades osmotic drying processes has been regarded as a pretreatment in complex processes. During this process by using different and sequential technologies, controlled changes in the food properties can be achieved. While some processes such as freezing has their main role in the preservation of foods other processes such as osmosis dehydration can modify structural characteristics, nutritional, sensory and functional properties of the used raw materials (Maguer, 1998).

MATERIALS AND METHODS

In this study osmosis solution was prepared by sucrose solving in deionized water at the concentration of 55% (w/w) by addition of the calcium in specified concentrations (0- 5%) to the solution the osmosis solution preparation was completed. In this experiment, the kiwi was cut in circular pieces after washing and was immersed in a solution containing sucrose and mineral for the period of 0-120 minutes. The fruit to solution ratio was 1:5. After the specified emerging time is passed fruits were take away of the syrup and the extra water was eliminated of the surface of fruit samples. Osmosis process took place at a constant temperature (25°C) and without stirring and without subsequent drying process. Fruits were weighed before and after the process and their dry matter were measured before and after the process.

The results were used to characterize of the osmotic dehydration process such solid gain, water loss and weight reduction. In the next step the amount of mineral in the fruit measured before and after the process. And the net absorbed amount and the percentage of increase was calculated and was compared by the amount of mineral in the fruit before process.

To determine the moisture content of osmosis treated and non treated fruit AOAC method was used. In this method, a certain amount of sample were placed in oven at 100 °C until the sample reaches the constant weight after that the sample weights again and moisture content and dry matter of the sample was calculated.

Dry matter = $(W_f/W_0) \times 100$ … (1)

Moisture content = 100- dry matter … (2)

Where, W_f : final weight and W_0 : initial weight

Solid gain, water loss and weight reduction of the samples was determined using the following equations (Mavroudis, 1998):

$WR = (W_0-W)/W_0$ … (3)

$SG = (S-S_0)/W_0$ … (4)

$WL = WR + SG$ … (5)

Where, WR: weight reduction, SG: solid gain, WL: water loss, W_0: initial weight, W: final weight, S_0: initial dry matter and S: final dry matter.

Research based on central composite design according to response surface method. Duncan test was performed to compare means and analysis of variance.

RESULTS AND DISCUSSION

According to obtained results it can be concluded that the amount of solid gain and water loss in kiwi fruit is regardable especially when the calcium ion is existed in the osmotic dehydration solution. The maximum weight reduction while using calcium as an osmotic agent was 8.02%. Also the amount of solid gain and water loss are considerable. High amounts of solid gain or high amounts of water loss are appreciated when the purpose of osmotic dehydration is regarded as a pre treatment for further freezing or drying processes.

The time of further dehydration process will be decreased if the higher levels of solid gain as well as higher levels of water loss be obtained during osmotic dehydration step. Then this can reduce the amount of consumed energy during drying process. On the other hand during freezing process the freezing damage will be reduced as the free water of fruit is reduced according to high levels of water loss or high levels of solid gain.

Solid gain and water loss would be minimal when the concentration of calcium in the solution is up to the 5%. This may be due to higher levels of ion concentration which causes less freedom of movement and then solutes can not easily move in the solution and they can not be absorbed by the fruit. Related osmotic parameters as of weight reduction, solid gain and water loss were increased when lower concentrations of minerals used in the osmosis solution. By reducing the concentration of the minerals in solution the problem of mineral density and movement is solved.

Fig. 1-3 are shown the results of osmotic dehydration parameters (Solid gain, water loss and weight reduction) of kiwi fruit. Sugar solution containing different concentrations of calcium and the treatment is performed during different process times.

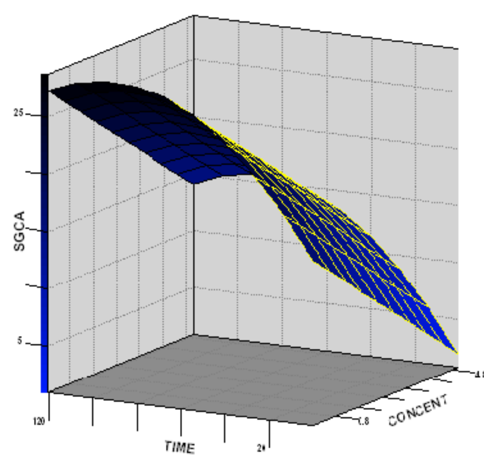

Fig. 1. Surface plot of solid gain (SG) for kiwi fruit.

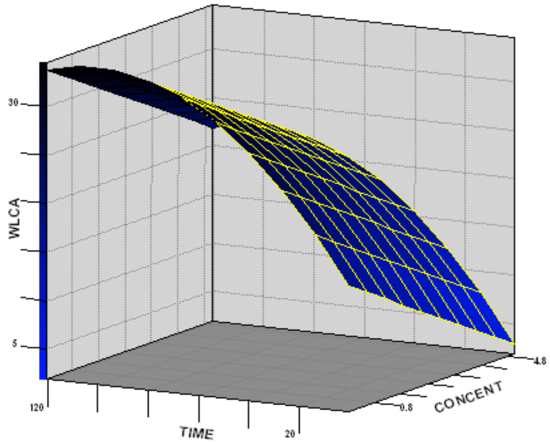

Fig. 2. Surface plot of water lose (WL) for kiwi fruit.

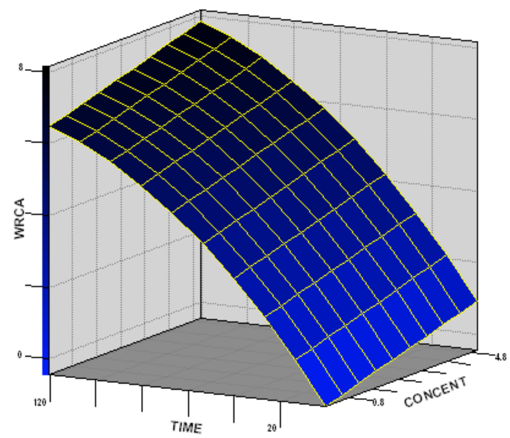

Fig. 3. Surface plot of weight reduction (WR) for kiwi fruit.

Table 1: ANOVA table for treatment factors and their effects on weight reduction.

Source	DF	SS	MS	F	Pr > F
CONCENT	1	2.205322	2.205322	6.762228	0.0406
TIME	1	50.90782	50.90782	156.0998	<.0001
CONCENT*CONCENT	1	0.596805	0.596805	1.829996	0.2249
CONCENT*TIME	1	0.497495	0.497495	1.525479	0.263
TIME*TIME	1	2.122475	2.122475	6.508192	0.0434

According to the ANOVA table (Table 1) affecting factors of treatment on weight reduction during the process of osmosis of kiwi fruit in concentrated solution of sucrose containing calcium are ion concentration and square of time at the level of 95% and 99%, respectively. The factors influencing the solid gain of kiwi fruit during osmosis process in concentrated solution of sucrose containing calcium is ion concentration at level of 90%.

Factors affecting the level of water loss during the process of osmosis of kiwi fruit in concentrated solution of sucrose containing calcium is time of treatment at the level of 90%. A solution containing calcium at the surface is 90%. The below equations are related the independent variables of the experiment with the osmotic dehydration parameters of kiwi fruit in concentrated solution at the presence of calcium ion at different concentration over period of time.

$$WR = -0.50254 + 0.299168*concent + 0.102024*time - 0.000353*time*time \quad \dots (6)$$
$$SG = 15.2243 - 2.904624*concent + 0.329973*time - 0.001982*time*time \quad \dots (7)$$
$$WL = 14.72176 - 2.605456*concent + 0.431998*time - 0.002335*time*time \quad \dots (8)$$

The equation 1 obtained to represent the relation between independent variables of treatment and weight reduction with a correlation coefficient of 96.68%. On the other hand equations 2 and 3 were obtained to correlate the amount of solid gain and water loss during osmotic dehydration treatment of kiwi fruit with independent variables of treatment. Osmosis with correlation coefficients were as 57.45% and 65.88% for solid gain and water loss respectively.

CONCLUSION

Since the adult body needs 1000 mg of calcium per day then through the obtained results it can be concluded that consumption of one serve (100 g) of enriched kiwi fruit each day can provide one third of body need to the calcium. On the other hand the other samples with low solid gain or with lower amount of calcium content after enrichment process can provide one sixth of total body need to calcium. The osmosis pretreatment can advised to enriching of fruits to provide essential minerals for body. Further research is needed to calculate the amount of absorbed different minerals in different fruits.

REFERENCES

Agheli, N. (2006). Food composition and food requirements. Marz danesh publication, Tehran, p. 64-65.

Ferrando, M. & Spiess, W.E.L. (1998). Lose of cellular systems to characterize plant tissue behavior. In: proceeding of the fourth plenary meeting Eu-FAIR concertedation CT96-1118. Improvement of overall food quality by application of osmotic treatment in conventional and new processes, 1998, 1-4.

Le Maguer, M., Shi, J., Ferandez, C. & Mazzamti, G. (1998). Study of mass transfer, structural changes and material properties. In proceeding of the fourth plenary meeting Eu-FAIR concertedation CT96-1118. Improvement of overall food quality by application of osmotic treatment in conventional and new processes, 1998, 68-71.

Mavroudis, N.M., Gekas, V. & Sjoholm, I. (1998). Osmotic dehydration of apples _ effect of agitation and row material characteristics. *Journal of Food Engineering*. **35**: 191-209.

Najafi, Gh, (1996). Agricultural business management, *Journal of Agricultural Economics and Development*, No. **16.**

Raoult Wack, A.L. (1994). Recent advances in the osmotic dehydration of foods. *Trends in Food Science and Technology*. **5**(8): 255-260.

Report of a joint FAO/WHO expert consultation. (2004). Vitamin and mineral requirements in human nutrition. Bangkok, Thailand, 1998, p. 338.

Torreggiani, D. (1995). Technological aspects of osmotic dehydration in foods. food preservationby moisture control: fundamentals and applications. *ISOPAW Practicum II* p. 281-304.