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Effect of % solution concentration pretreatment on weight loss of Thompson seedless grapes

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Abstract- ***Drying process is one of the thermal processes that are time and energy consuming in the industry. That's why new methods are aimed to decrease drying time and energy consumption without reduction in quality. Pre-treatment solutions contained different alkaline materials in different concentrations and air temperatures were used. Dipping grapes in an alkaline solution increased the drying rate substantially. Grapes dried in 450– 900 min depending on pre-treatment and air temperature. The shortest drying time and best quality dried product were obtained with grapes dipped in a solution of potassium carbonate of 5% at 42 ^{0}C. When grapes are dipped into an alkaline solution containing, for instance, ethyl oleate, this component penetrates into the waxy layer and causes the formation of many small pores. As a consequence, the drying time of pretreated grapes is up to four times shorter than the drying time of untreated grapes.***

***Index Terms*— Grapes, Pretreatment solutions, Weight loss.**

I. INTRODUCTION

Research has shown that grape skin is main barrier to mass transfer. this finding led to the application of method of dipping the grapes in a hot emulsion of ethyl oleate so as to reduce skin resistance and further increase in drying rate. Raisin is produced by pre-treating with hot alkali and ethyl oleate to quicken the drying process. Sulphuring imparts a light color to the raisins. The wax cuticle plays an important role in retarding water loss from grapes. The wax cuticle is made up of wax platelets that slow moisture loss from the fruit tissue. The fruit is treated with 82_C water containing 0.25% NaOH for 5–10 s to bring about cracking in the skin of the fruit, which vents the fruit tissue and reduces drying time. Petrucci et al. found that the oleate emulsion reduced drying time of sundried raisins to 5–10 days. Ethyl or methyl oleate is mixed with water and potassium carbonate to form an emulsion that dissolves the wax cuticle. The potassium carbonate serves as an emulsifier to maintain the ethyl or methyl oleate in suspension. This oleate emulsion reduces the drying time by physically cracking the grape skin.

In a study by Tulasidas et al. pretreatment with 2% ethyl oleate in 0.5% NaOH resulted in good quality raisins and shorter drying times. Raisins are then dried mechanically or sun dried.

With organic foods becoming popular, use of chemical additives in foods is being discouraged from the health point of view. Consumers demand foods that are natural and safe for consumption with less or no chemicals in them. Besides the health concern, handling and disposal of large quantities of corrosive chemicals could lead to safety issues.

According to Tulasidas et al. microwave processing is an energy-efficient drying technique for raisin production. Due to their high moisture content, heat absorption is very effective.

Krokida and Maroulis mentioned the use of dielectric heating as pretreatment to reduce drying time of agricultural products in conventional drying. Yen and Clary state that once moisture in the berry is heated to a saturation temperature, the temperature rises with pressure, resulting in volume expansion, causing the berry to rupture. If the rate of vaporization is controlled.

II. MATERIALS AND METHODS

A. Preparation of Grapes

Grapes (Thompson seedless) were purchased from the local market. They were washed, and surface dried. Berries of uniform size (17 _ 2mm in diameter) were chosen for the study.

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Fig.1. Grapes after dipping in solution

B. Principles o f Fruit Dehydration

The outer layers and surface of grape berries have physical and chemical mechanisms to resist water loss—nature's way of keeping the berry hydrated and turgid. The principal barrier is the berry cuticle, which includes the outer layer of epicuticular wax or *bloom.* This wax consists of partially overlapping flat platelets that are irregular or lacelike in texture (Figure 2). Their orderly spacing and arrangement and the chemical characteristics of the wax provide water repellence and vapor loss resistance.

Fig. 2 scanning electron micrograph of the 'Thompson Seedless' berry surface showing the typical arrangement and appearance of the cuticular wax platelets

During drying, water in the grape berry moves in the liquid phase through the cells to the cuticle. It must then pass as vapor through the wax platelets and evaporate from the outside surface (Figure 2). Water movement within the grape is speedy in comparison to the slow transfer of water through the cuticle. The rate of water loss from the berry is dependent on the water's rate of transfer and availability at the berry surface. The transfer rate is governed by differences between the vapor pressure of the fruit and that of the surrounding air, referred to as *vapor pressure deficit* or *evaporative potential.* Vapor pressure deficits are greatest with a high berry temperature and a low relative humidity. High air temperatures and rapid air movement contribute to low relative humilities. Of these factors, berry temperature is the most important driving force in field drying.

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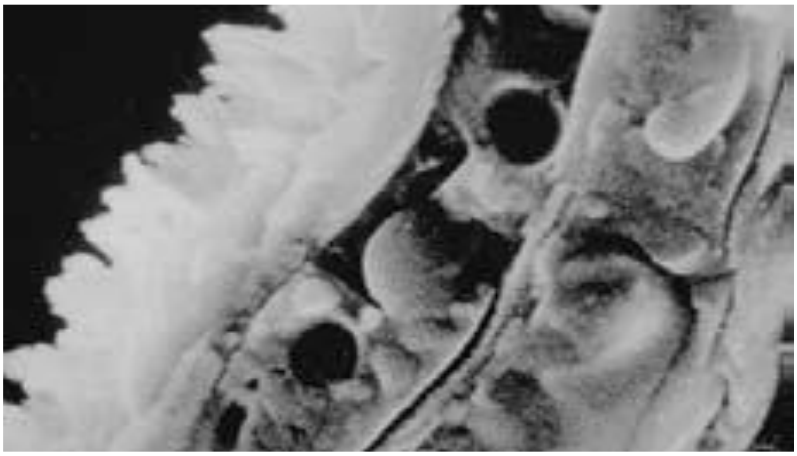

Fig.3. Scanning electron micrograph of a fracture through a frozen hydrated cuticle and epidermis of a 'Thompson Seedless' berry. The upper white layer is the epicuticular wax that is underlain by the cuticle and the cells with their wall structures

C. Chemical Treatment

For dipping process the solution of ethyl oleate and potassium carbonate is done.
For 5 liter of water 90 ml of ethyl oleate is taken and 120 gm potassium carbonate powder is mixed. This mixture is 100% solution.

Raisin making time under various solution concentrations

Now the samples of various concentrations are prepared with 80 ml of water and above 100% solution.

Table 1 - % solution concentration

Sr no.	Water quantity(ml)	Solution quantity(ml)	% concentration
1	80	24	30
2	80	32	40
3	80	40	50
4	80	48	60
5	80	56	70
6	80	64	80
7	80	72	90
8	80	80	100

Now each sample is taken with 20 gm of grapes. The grapes are dipped in the solution till 5 minutes. This sample put in the microwave oven for moisture removal. The microwave oven was set for 100 Watt and the reading after an interval of each 3 minute is taken.

Table 2 Weight loss in each solution concentration

% concentration	Initial weight (gm)	Weight loss after 3 min	Weight loss after 6 min	Weight loss after 9 min	Weight loss after 12 min	Weight loss after 15 min
30	20	5.2	9.44	11.4	13.86	14.93
40	20	4.73	9.32	11.7	13.57	14.77
50	20	4.31	8.39	11.43	13.35	14,5
60	20	4.36	8.63	11.4	13.67	14,4
70	20	6.1	9.21	11.35	13.41	14.36

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80	20	5.44	9.31	11.81	13.48	14.67
90	20	5.87	9.89	12.65	14.21	15.23
100	20	5.53	9.64	11.78	14	14.83

Weight reduction of 20 gm grapes is done up to 6 gm i.e. 80% moisture is removed.

Table 3 Weight loss as per time

% concentration	Initial weight (gm)	%Weight loss after 3 min	%Weight loss after 6 min	%Weight loss after 9 min	%Weight loss after 12 min	%Weight loss after 15 min
30	20	26	47.2	57	69.3	74.6
40	20	23.65	46.6	58.5	67.8	73.8
50	20	21.55	41.95	57.15	66.75	72.5
60	20	21.8	43.15	57	68.35	72
70	20	30.5	46.5	56.75	67.05	71.8
80	20	27.2	46.55	57.05	67.4	73.35
90	20	29.35	49.45	63.25	71.5	76.15
100	20	27.65	48.2	58.9	70	74.5

Table 4 % weight loss as per time

% concentration	Initial weight(gm)	%Weight loss after 3 min	%Weight loss in next 3 min	%Weight loss in next 3 min	%Weight loss in next 3 min	%Weight loss in next 3 min
30	20	26	21.2	9.8	12.3	5.3
40	20	23.65	22.95	11.9	9.3	6
50	20	21.55	20.4	15.2	9.6	5.75
60	20	21.8	21.35	13.85	11.35	3.65
70	20	30.5	16	10.25	10.3	4.75
80	20	27.2	19.35	10.5	10.36	5.95
90	20	29.35	20.1	13.8	8.25	4.65
100	20	27.65	20.55	10.7	11.1	4.5

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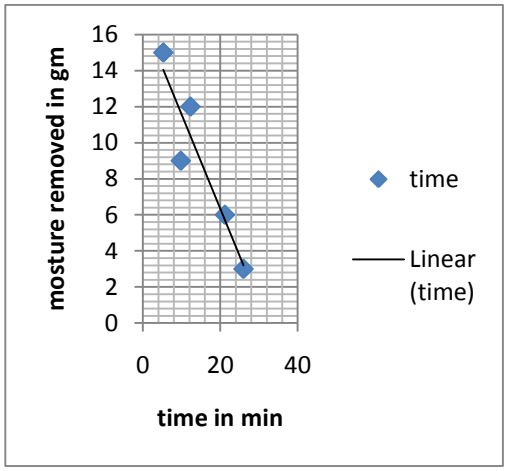
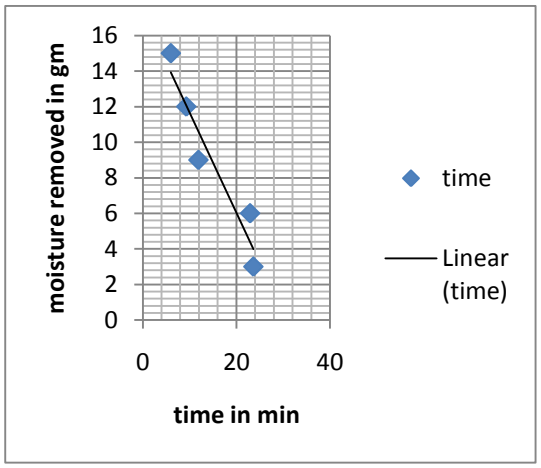
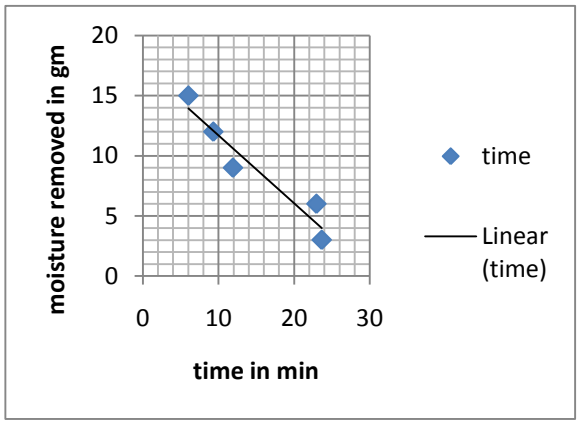
D. Results and discussion- Following are the graph of moisture removal in gm verses time in minute for various concentration levels



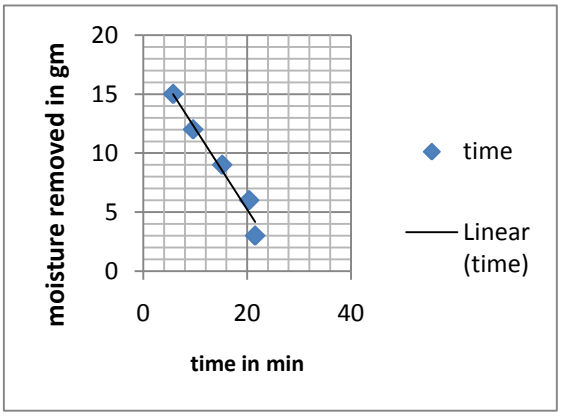
Graph 1 for 30% concentration



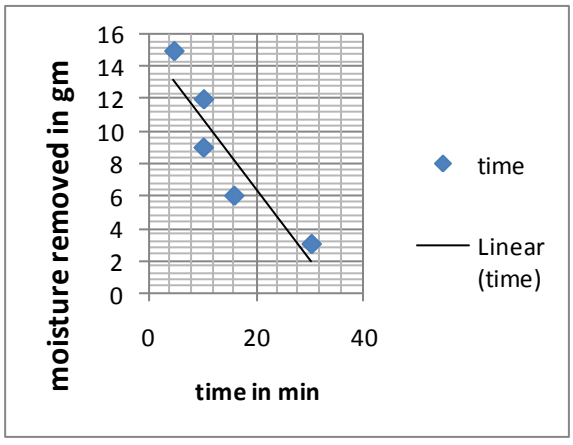
Graph 2 for 40% concentration



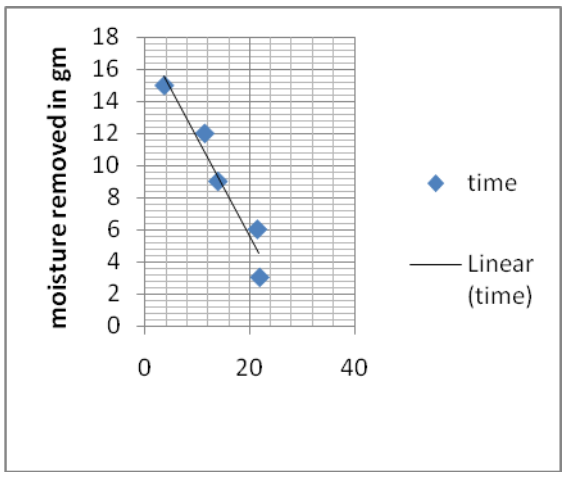
Graph 3 for 50% concentration



Graph 4 for 60% concentration



Graph 5 for 80% concentration



Graph 6 for 70% concentration

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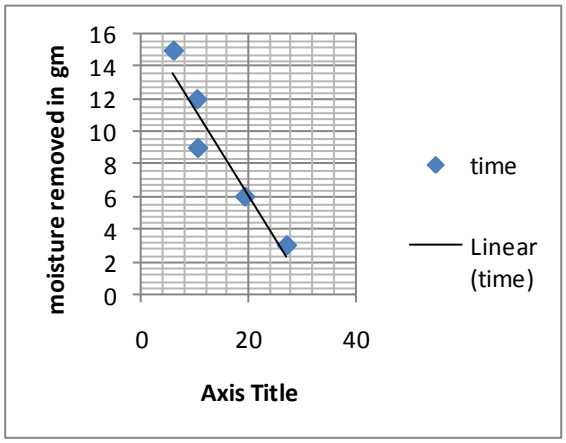
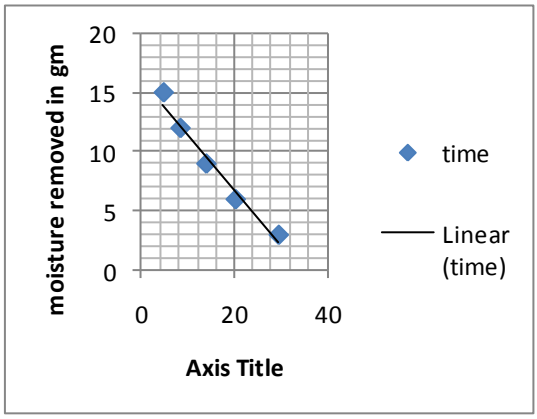
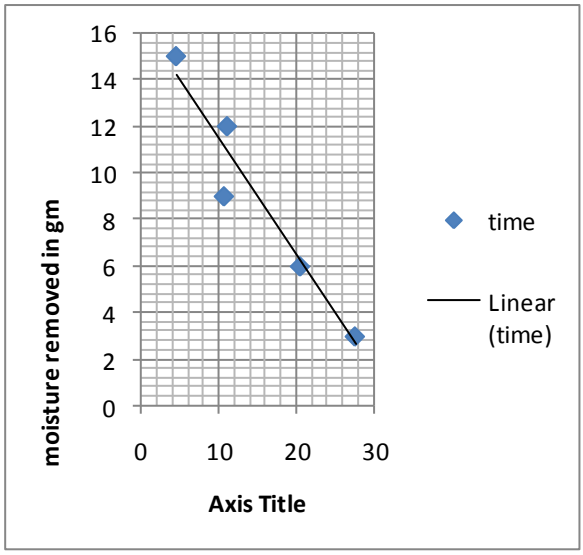


Graph 7 for 90 % concentration



Graph 8 for 100% concentration



Graph 9 for 100 % concentration

% concentration	Initial weight (gm)	Final %Weight loss
30	20	74.6
40	20	73.8
50	20	72.5
60	20	72.00
70	20	71.8
80	20	73.36
90	20	76.15
100	20	74.5

From the study of graphs the 90% concentration solution is efficient to use

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