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Effects of Different Dipping Solutions and Storage Conditions on the Color Properties of Raisin

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Abstract: In this study, we study the effect of pretreatment on the sultana (Raisin) color. We used 0, 5 and 10% potassium carbonate salt solutions and 5 % Paksan oil for pre treatment. Dried grapes were stored at three levels of temperature (4, 18 and 32°C) with three relative humidity levels. Relative humidity was prepared from saturated solution of potassium carbonate salt, potassium acetate and sodium chloride salt. We assessed the color of samples in (2, 5 and 8 months storage) by Hanter L ab units. Color analysis indicated that the studied factors (chemical pretreatment, temperature, keeping time) affected color of raisins indexes. During keeping time the lowest index *L* pertained to those samples which were kept at 4°C and by increasing keeping temperature index *L* decreased and index *a*/*b* increaseds. *a*/*b* index decreased when the concentration of potassium carbonate in emulsion increased and therefore color would be brighter.

Key words: Chemical Pretreatment · Storage Conditions · Raisin · Color

INTRODUCTION

Color is one of the important qualitative aspects of processed and non-processed foods and plays an important role in acceptance of that product. In addition it may show the chemical changes that happen during production and keeping period. Most of researchers defined product color as important change in dried grapes quality that changes during drying and keeping period for some chemical and biochemical actions [1]. Product color will affect a lot factors that some of them are attendance before drying and housing situation and lightening [2].

Among other foodstuffs, color changes in raisin are easier and this fact is for brownish action whether with enzyme or without it, warehousing and product distribution [3-5]. Brownish actions that are without enzymes can be defined as a hierarchy of phenomena that start with the reaction of acid amino (peptide amino) or protein group with glycoside hydroxyl of sugar and finish by formation of nitrogen polymers. In normal form consumers prefer grapes or raisins with brighter colors so avoidance of their brownish that lead to darkness and bad favor in raisin has significant importance [6]. In order to decrease the ratio of fruit darkness during drying and warehousing periods, control of sulfur dioxide has wide application in food industry and acts as an anti-oxidation and save the color and favor of dried fruits [7]. Also preparing with alkali emulsion leads to production with bright color. Alkali environment prevents raisin color from darkening by controlling oxidase polyphenol and decreasing drying time [1].

Esmaili *et al*. [1] studied the effect of different preparing methods on raisin color and reported that prepared samples with alkali emulsion have brighter color rather than prepared samples with hot water and pretreatment with chemical solutions affect evaluating factors dramatically [1]. Also Simal *et al*. [2] Introduced keeping temperature as the main factor on raisin color changes and reported that increase in keeping temperature severe the brownish reaction [2]. Canellas *et al*. [5] studied the effect of keeping temperature on samples color. Tarr and Clingeleffer [8] who studied keeping and packing situations on color of dried fruit reported that keeping temperature and amount of oxygen in keeping environment have a great effect on color. They also mentioned that high temperature and keeping time have a negative impact on the color of dried fruits. Modifying conventional methods to optimize

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preparing and keeping situation have an important priority. Unfortunately there isn't enough information about relation of biophysical features of dried grapes with preparing methods up to now, the effect of basic factors such as amount of alkali in emulsion and keeping situation on qualitative indexes aren't taken into consideration. In this paper, the effects of alkali emulsion on preparing grapes and the effect of temperature and relative humidity in keeping environment on the color during keeping period were studied.

MATERIALS AND METHODS

Seedless grapes prepared from Urmia gardens Iran**.** Grapes primary humidity is about 74-75 % based on the weight of grapes and mean Brix of grapes was 25°. A table refractometer (Erma-Optical, Works, LTD, JAPAN) was used to measure Brix of grapes. A sensitive balance (Ohaus, AS200, USA, ±0.0001g) was used to weight samples and chemical material. A Hunter-Lab colorimeter (Hunter Lab DP-9000 color, Virginia, USA) was used to evaluate colors of samples in environment temperature. Color was expressed in Hunter Lab units *L* (lightness) and chromaticity parameters *b* (yellow–blue) and *a* (red–green). An incubator with a refrigerator was used to keep samples in temperature 18°C and also a refrigerator was used to keep samples in 4°C. In order to dry samples that were in a tray and covered by argent grid a mortar with compulsory air flow (Heraeus, W. Germany) was used. Harvested samples have been kept at 4°C temperature. After measuring humidity. The safe seeds were separated from their cluster. Then 4.5 Kg of them were divided into 9 equal groups that each of them was 500 gm and each one was pretreated separately.

To pretreatment, grapes were saturated during 30 seconds into three solutions (5% Paksan oil that is without potassium carbonate, 5% potassium carbonate salt and 5% Paksan oil and 10% potassium carbonate salt and 5% Paksan oil). This work was done at 40°C temperature. Then each group was spread in separate trays and dried at 50±0.2°C. After drying process and keeping 48 hours in environment temperature, dried samples were poured in polyethylene bags that were shallow and open and then were placed on a glass trivet in the glass container including saturated salt (saturated solution of sodium chloride salts, potassium carbonate and potassium acetate that are prepared at 80°C) with standard humidity (Table 1) and after that container's door was closed tightly. Also containers were kept at three temperatures 4°, 8° and 32° for 2, 5 and 8 months. These samples were analyzed after passing this time. The results obtained were analyzed statistically using SAS software and figures were plotted in Microsoft Excel 2003.

Table 1: The relative humidity that has been created by saturated salts in temperature of storage

	Temperature (°C)		
Chemical treatment	4	18	32
Potassium acetate	29.51	25.41	22.18
Potassium carbonate	46	44.85	43.84
Sodium chloride	80.77	77.62	74.87

RESULTS AND DISCUSSION

In order to study the effect of pretreatment and storage conditions on dried grapes texture, some of the prepared samples were evaluated by using texture device (Table 2).

Color is a main qualitative feature of dried fruits and changes during keeping time for some chemical and biochemical reactions. In general two kinds of browning reactions lead to color change, enzyme kind and non-enzyme kind. Some effective features on occurrences of browning reactions are temperature, sugar concentration and its nature. As temperature increases, the rate of browning reaction and as a result the severity of color increase [9]. The judgment index to determine the best color for grapes is the highest number of (*L*) and the lowest number of ratio (*a*/*b*) [1].

Results showed that keeping temperature has negative impact on *L* value. Fig. 1 shows that as the environment temperature increases, the amount of *L* decreases. Decrease of *L* in raisin samples through

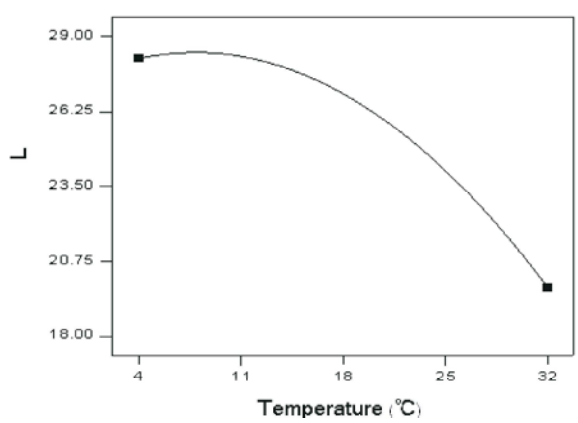

Fig. 1: The relationship between storage temperature and lightness " L"

Table 2: Experimental design for investigated parameters including alkaline pretreatment, temperature, relative humidity on raisin textural properties

NO.	Temperature	K2CO3%	Relative humidity	NO.	Temperature	K2CO3%	Relative humidity
1	4	0	80.77	24	4	10	46
2	32	0	22.18	25	32	10	74.87
3	32	0	74.87	26	4	5	46
4	32	0	22.18	27	32	5	22.18
5	4	0	29.51	28	18	5	77.62
6	32	10	74.87	29	4	5	29.51
7	4	10	80.77	30	18	5	44.85
8	32	10	74.87	31	32	0	74.87
9	32	10	22.18	32	18	0	25.41
10	4	10	29.51	33	4	0	80.77
11	4	0	80.77	34	4	0	80.77
12	32	0	22.18	35	18	0	44.85
13	4	0	29.51	36	32	5	22.18
14	32	0	74.87	37	32	5	43.84
15	32	0	74.87	38	4	5	29.51
16	4	10	29.51	39	18	5	77.62
17	32	10	22.18	40	4	5	46
18	32	10	74.87	41	18	5	44.85
19	32	10	29.51	42	18	5	44.85
20	4	10	80.77	43	18	5	44.85
21	32	10	22.18	44	18	5	44.85
22	18	10	25.41	45	18	5	44.85
23	4	10	80.77	-	-	-	-

temperature domain (4, 11°C) was not meaningful while by increasing of keeping temperature, *L* changes got more. From temperature higher than 20°C decrease in amount of *L* was more and kept samples at 32°C had the lowest amount of *L*.

Fig. 2 illustrates that the amount of *a*/*b* ratio at 4°C have the lowest changes and this amount have low changes between 4-11 temperature domain but its increase is considerable when keeping temperature increases.

In kept samples at temperature higher than 18°C, the increase trend of *a*/*b* is ascendant and this amount at 32°C is maximum.

Color changes depend on occurrences of color changing reactions. In foodstuff keeping, color changes result from enzyme browning reaction, non-enzyme browning reaction and the browning resulted from acid ascorbic oxidation and color changing is related to these reactions [1]. According to given explanations it is determined that kept samples at 4-11°C have the lowest color change in compare to other samples, so they have higher quality.

The research that conducted by Canella *et al*. [5] about raisin color in different situation showed that stored samples at 20-25°C have the lowest amount of *L* rather than other samples and so have darker colors and kept samples at 4 and 11°C have the most amount of *L*, so they have more suitable color. Simal *et al*. [2] reported that

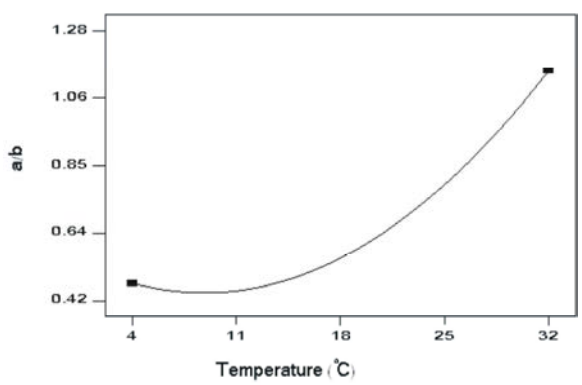

Fig. 2: The relationship between storage temperature and chromaticity parameters " a/b"

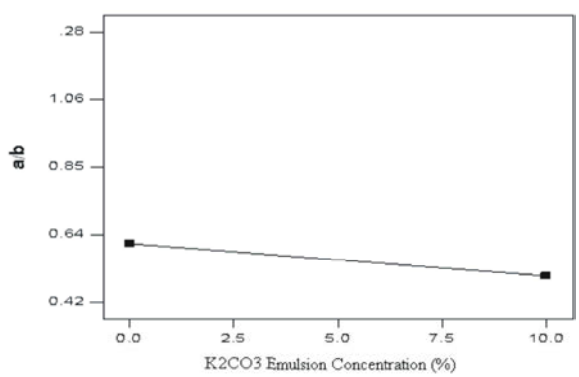

Fig. 3: The relationship between K_2CO_3 emulsion concentration and chromaticity parameters (a/b)

amounts of *L*, *a* and *b* in stored samples at 27°C and 35°C decrease dramatically. And they referred to keeping temperature as an important parameter on the color.

The results of this research are in accordance with Simal *et al*. [2] and canella *et al*. [5]. Keeping temperature is an important factor in relation to increase in changing rate, because as temperature increases in dried production, the browning rate increases and the color of raisin gets undesirable.

In the current work, it was observed that a/b ratio decreases when the concentration of potassium carbonate in emulsion increases, though this decrease is meaningful, when it is between 7.5-10% in potassium carbonate concentration, we can obtain constant *a*/*b* ratio.

Mahmutoglo *et al*. [10] reported that during warehousing period the amount of *a*/*b* in grapes pretreated by emulsion including potassium carbonate is lower than other methods and the color of non-treatment raisin has lower amount of *L* and they are darker. Finally they concluded that pretreatment has meaningful impact on raisin color and the amount of a/b changes. Simal *et al*. [2] after evaluating the color of samples, reported that primary pretreatment and type of consuming material has considerable effect on three parameters of *a*, *b* and *L*. Esmaili *et al*. [1] reported that the color of those raisins that pretreated by potassium carbonate emulsion and Paksan oil after ethyl oleate has more *L* and the ratio of *a*/*b* is lower. The results of all these researchers agreed that to get bright color, grapes pretreatment is necessary. Not only pretreatment increases drying rate, but also affects color and main parameters. Alkali materials prevent poly phenyl reaction and finally the raisin color gets bright. When the concentration of potassium carbonate is zero, samples color is bright and this point is for oily solution. Oily solution decreases drying time and finally improves the product's color [1, 2, 10, 11].

Fig. 4 shows that the amounts of *L* in pretreated samples by solutions without potassium carbonate decreased after 8 months but the amounts of *L* in samples pretreated with emulsion including 10% potassium carbonate and 5% Paksan oil don't change after 8 months. According to the figure and above definitions we should prepare primary samples with emulsion including potassium carbonate salt till the color of products gets brighter and constant up to the end. Because of polyphenol compounds in the shell, it seems that the high concentration of potassium carbonate controls these compounds and decreases the browning reaction [5].

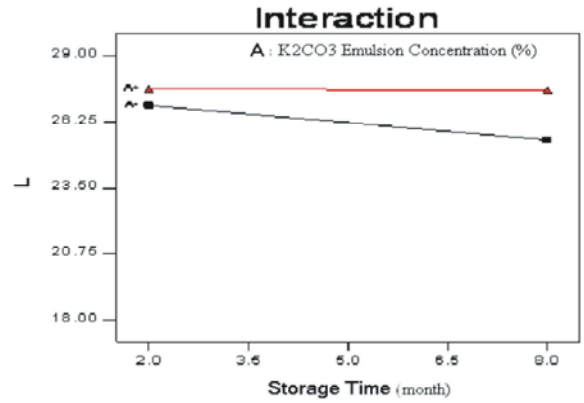

Fig. 4: Effect of Interaction of K_2CO_3 emulsion Concentration and storage time on lightness "L" A+ =10% K_2CO_3, A- = 0% K_2CO_3

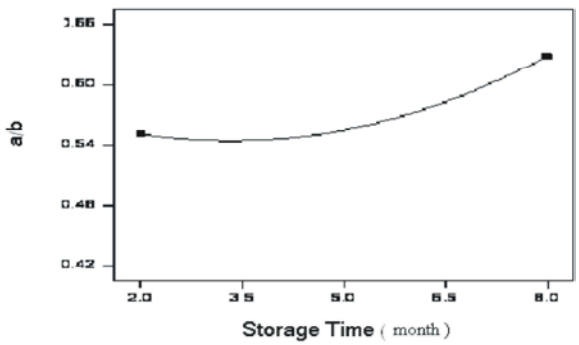

Fig. 5: The relationship between storage time and chromaticity parameters " a/b"

Fig. 5 displays that the decrease of *a*/*b* is ignorable during the first four months and it changes by passing time and after 8 months, it has the highest amount.

The study conducted by canella *et al*. [5] showed that samples have more color changes during the first three months and after this times color change increase. Mahmutoglo *et al*. [10] reported that kept raisins color gets darker by passing time and decrease of *L* is considerable. Simal *et al*. [2] reported that keeping time has meaningful impact on the amounts of *a*, *b* and *L*.

According to the results of this research and other scientific resources, it is defined that produced raisin should be consumed during short time after production and it shouldn't be kept for long time. Raisins can be stored for 5 months in specific situations and after this time they get darker and undesirable.

Results of this study showed that preparing and keeping situations affect the color of raisin samples. Color evaluations showed that keeping temperature

affects the color. As the temperature increased, the amounts of *L* decreased and *a*/*b* ratio increased. Finally the color of samples got darker and the samples color had lower changes at the temperature between 4-11°C.

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