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A Feasibility Study on Date Honey Production Using Composite Design Pattern

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ABSTRACT

In recent decades, there has been an increasing demand for the products containing safe sweeteners such as date syrup and date honey in food products; in this regard, the present paper tries to investigate the optimization of date syrup decolorization conditions using composite design in order to find the most appropriate dose of decolonization materials such as active carbon, calcium carbonate, and decolorizing soil. So, producing the dates honey with the best physical and rheological properties is effective in its marketability and consequently an increase in the Iran's contribution to its export and also improves its competitiveness with other sweeteners used by the food industry. Findings revealed that the use of decolorization materials mixture with the diffident percentage can noticeably effect on decolorization and decolorized syrup properties (p<0/05), especially turbidity and color. Activated carbon and decolorizing soil had the maximum impact and while calcium carbonate did not show a positive effect so that the increase in the use of activated carbon could definitely reduce the NTU and a* index and increase L and b* indices. Decolorizing soli also showed the same results but with less favorable percentage. Yet, Brix and Viscosity factors were not influenced by decolorization materials. Finally, it could be identified the optimal combination of decolorization materials usage for the most efficient decolorization of date syrup.

KEY WORDS: date, date syrup, decolorization, activated carbon, decolorizing soil, calcium carbonate

1. INTRODUCTION

Iran is one of the top dates producers so that in 2003, it produced approximately 875 thousand tons of dates, which was ranked third in the world (Zare & et al. 2006). Since the low quality dates production is about 60% and usually suggested not to use in terms of size and good taste and also with regard to their high levels of sugar, so producing dates syrup from them is economically beneficial (Alfarsi, 2003). Date honey is indeed the concentrate resulted from date extract and concentration which has a high functional and nutritional value as the most common products of date that containing 67%-72% of solids (includes 85% of reducing sugars). Studying the combinations of different types of dates syrup revealed that this product is rich in mineral salts and sugar compounds (mostly glucose and fructose) so that its usage as a source of natural sugar in food products can attracts the consumers attentions (Al-Farsi & et al. 2007, Al-Hooti & et al. 2002). Although, the date syrup has been used in types of bread, cakes and biscuits, fermented dairy products, and soft drinks, some combination with special flavor and particularly inappropriate colors is the limiting factor in its application; so, identifying and removing them can prevent the waste and leads to achieving a product that can be used in many foods and competitive with other sweeteners (Pareek and Rajendra, 1985;Al-ogaidi and Rasheed, 1986; Al-Zubaydi et al.1983). Based on findings and color combination of date syrup and also considering the operating conditions of industrial units, this research tries to investigate the methods applicable in Iran’s factories in order to omit the color from date syrup and produce liquid sugar.

MATERIALS AND METHODOLOGY

1. Materials

Date syrup samples produces by Tabriz Be Baharin company and chemical materials produced by Merck company with analytical grade were considered as the proper materials in order to achieve the aim of this research.

2. Methodology

Decolorizing soil, activated charcoal, and calcium carbonate (with mixing percentages of 0, 16/66, 50, 66/66, and 100 and the amounts of 50, 67/5, 85, 102/5, and 120 kg in 100 hectoliter) were added to the date syrup at 50 ° C. Decolorizing soil was dissolved in 20 mL of deionized water12 hours before use and the suspension with different percentages were added. In this regard, 20ml of water was also added to all samples without decolorizing soil. In all treatments the contact duration of syrup with decolorization mixture was considered 60 min; then, 7% bentonite was added to it. Next, the dates syrup under vacuum was passed through Whatman No. 42 filter paper.

2.1. Color Parameters Measurement

Hunter Lab Color Flex was used in order to measure the parameters of samples’ colors (a*, b*, and l*).Three axial system was used to express color:

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1. Axis L which consists of two complementary colors, black and white and gray between them. Rich white with No.100 and rich black with No. 0 are indicated respectively at the top and bottom of the axis.
2. Axis a with the right end of rich red and No. +60 and the left end of green with No. -60.
3. Axis b consists of two complementary colors of yellow (+60) and blue (-60) at both of its ends (Kraumer, 1966).

3. RESULTS AND DISCUSSION

3.1. Data Analysis

After conducting the test and recording data for the relationship between mentioned parameters and decolorization desirability conducted on the date syrup, the model was designed by one-way ANOVA and the results were analyzed separately. Data were analyzed by Minitab software. The tests consisted of analysis of the relationship between the different materials used together in the date syrup decolonization. In this regard, the colors indices (a*, b*, and l*) were studied in terms of correlation by Stepwise method and in the case of the lack of correlation the variable will remove from the model; below are the results:

3.2. The Effect of the Studied Factors on the Color Indices

3.2.1. The Effect of the Studied Factor on the IndexL

A noticeable relationship was revealed between L and different mixture percentage of three decolorizing materials, level of (α =0.05), by using the analysis of variance and leads to the following model to predict the index L:

$$y = (19.28 * A) + (18.83 * B) + (17.43 * C) + \mathcal{E}_L$$

In this model, y is the amount of L, A the amount of activated carbon, B the amount of calcium carbonate, C the amount of decolorizing soil, and $\mathcal{E}_L$ is random term model which contains other factors effective on L. Figure 1 shows the relation between index L and the studied factors.

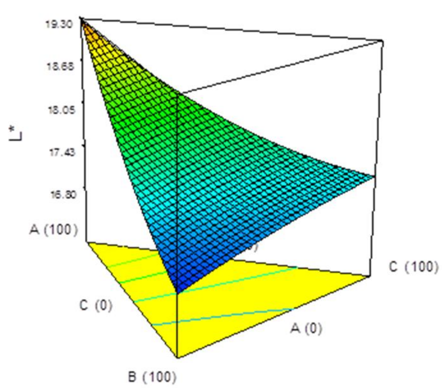

Figure 1. three-dimensional graph of the relation between index L and three decolorizing materials

3.2.2. Investigating the Effects of Calcium Carbonate and Activated Carbon and Their Mutual Influence and the Effect of Applied Dosage on the Index L

The highest amount of index L belonged to the treatments with activated carbon decolorization of 100% and the lowest amount was for consumption of 100% calcium carbonate. Moreover, the change of applied dosage, in a constant mixing ratio of both decolorizations, did not show a noticeable effect on index L.

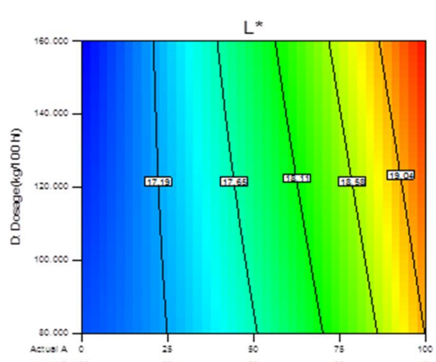

Figure 2. The effect of activated carbon, calcium carbonate, and applied dosage on the index L

3.2.3. The Features of the Optimal Point of Index L, Using the unt of Activated Carbon

It was tried to find the point indicate the most amount of L with the least amount of activated carbon. Table 1 shows the dosage and the mixture percentage of docolorization substances in order to achieve this result.

Table 1. The features of the optimal point of the index L with the least use of activated carbon

A	B	C	Dosage	L	Desirability
0	0	100	160	17.54	0.537

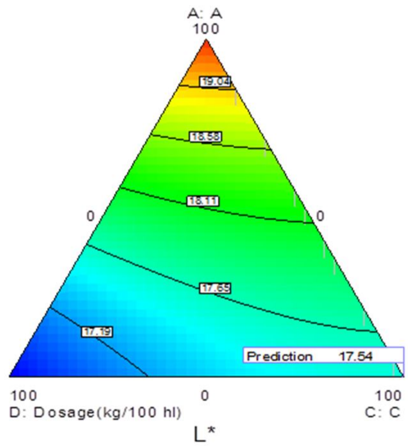

Figure 3. The optimal point with the use of the least amount of activated carbon

3.3. The Effect of the Studied Factors on the Index b*

A noticeable relationship was found between b* and different mixture percentage of three decolorizing materials, level of (05/0=α), by using the analysis of variance. R^2 was also 0/9984 which indicate the model significant contribution of the population variance. Based on the following equation, finding b* is possible for every model:

$$y = (5.7 * A) + (-20.6 * B) + (3.26 * C) + (29.16 * A * B) + (0.61 * A * D) + (34.35 * B * C) + (-9.94 * B * D) + (0.3 * C * D) + (18.83 * A * B * D) + (19.16 * B * C * D) + (0.42 * A * D^2) + (-7.52 * B * D^2) + (0.17 * C * D^2) + (15.41 * A * B * D^2) + (14.99 * B * C * D^2)$$

In this regard y refers to the amount of b*, A is the amount of activated carbon, B is the amount of calcium carbonate, C is the amount of decolorizing soil, and D is the applied dosage. Figure 4 also indicates the relationship between the index b* and decolorization substances by contour plot triangular graphs.

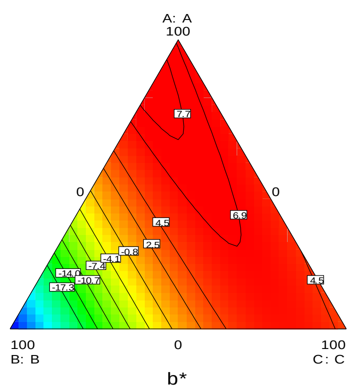

Figure 4. the relationship between index b* and three decolorization materials

The yellow color indicates the greater amount of b* and the more negative b* shows the dominance of blue in the product. the dark red also shows the efficiency of the decolorization process. The same as the results of other factors, this graph also shows the efficiency of deactivated carbon and mostly decolorizing soil; however, it can be concluded that the lowest amount of b* belongs to the use of calcium carbonate which indicates the poor process of decolorization.

3.4. The Relationship Between Index a* and the Studied Factors

A noticeable relationship was observed between a* and different mixture percentage of three decolorizing materials, level of (05/0=α), by using the analysis of variance. R^2 was also 0/9997 which indicate the model significant contribution of the population variance. Based on the following equation, finding b* is possible for every model:

$$y = (0.23 * A) + (58.29 * B) + (7.99 * C) + (-69.43 * A * [illegible]61 * A * C) + (-22.87 * B * C) + (0.39 * B * D) + (-1.25 * C * D)$$

In this regard, y refers to the amount of a*, A shows t [illegible] f activated carbon, B is the amount of calcium carbonate, C is the amount of decolorizing soil, and D is the dosage of decolorizing materials. The points distribution on the line shows not only the linearity of the model but also, its high variance.

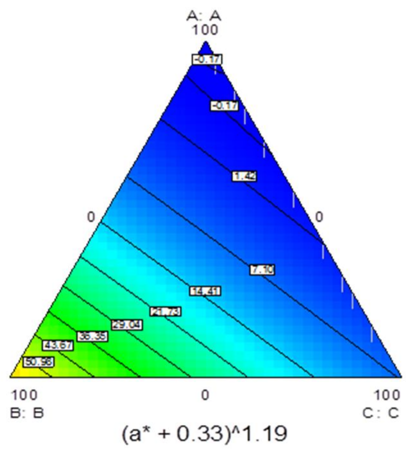

Figure 5. The relationship between index a* and three decolorization materials

Figure 5 also indicates the relationship between the index a* and decolorization substances by contour plot triangular graphs. The red color indicates the high amount of a* and certainly it is not the desired color in the process of decolorization. The lowest amount of a* reveals the dominance of the green and the dark blue indicates the efficiency of the decolorization process. The same as the other factors' results, this graph also shows the efficiency of deactivated carbon and mostly decolorizing soil; however, it can be concluded that the highest amount of a* belongs to the use of calcium carbonate (the head B), which indicates the poor process of decolorization.

4. Conclusion

Based on the findings of the chemical and sensory tests, it can be concluded that the use of appropriate decolorization mixtures with the right concentration leads to the optimal and effective decolorization. It was also revealed that the optimal circumstances is the result of 100% use of activated carbon. However, there were some other models with proper results which provide different percentages of the mixture from all three decolorization materials; so, using them in industrial scale seems applicable. This study was conducted on the industrial dates that are used to produce date syrup; but the type of date is effective on the decolorization quality. So, it should be tried to conduct such an investigation on different types of dates; then, finding the proper type of date, producers can use it as their primary products, which is often a combination of a number of dates; regarding this, they can increase their products quality by using a certain type of date. As a result, the date quality and consequently Iran's contribution to the date market worldwide will be promoted.

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