Extraction of Raisin Concentrate from Raisin

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Abstract

Raisin concentrate extraction is studied in this paper since raisin concentration posses many properties as well as getting varieties of by-products which are used in different industries. In order to extract it, the experiments were conducted in three different extraction temperature (40, 60, and 80 °C) and three different solvent values (1:1, 2:1, and 3:1) as well as three different evaporation temperature (65, 75, and 85 °C). Finally, the physiochemical properties of obtained concentrate (color, sugar, and recovery percentage and production efficiency) were studied; additionally microbial experimentation (mould, fermentation and total count) was performed. Statistical analysis is conducted after 81 experimental iterations. The outcomes show that iterations under the conditions of extraction temperature of 80 °C, evaporation temperature of 75 °C and solvent proportion of 2:1 and 3:1 led to better resultants.

Key words: Raisin, Extraction, Raisin concentrate

Introduction

Nowadays raisin concentration is introduced as a valuable product for producing different kinds of syrups, sweet drinks, confectionary industries as well as a natural alternative for sugar. In this paper its laboratory’s procedures is studied; whereas its results in the form of technical information and production technology can be a great help for industrial plants producing concentrate which in turn leads to reduction of sustain toward the farmers who produce raisin. Considering high raisin production in Iran raisin concentration is in fact one of the most important products among grapes various productions. This is supported by having partial exporting 20% to 15% interior usage of, where the remaining grapes are left useless.

Exports especially agricultural productions can play a significant role in employing economical strategies. Long since in Iran, dried fruits especially raisins was considered of export materials; and till two decades ago Iran was among the most important countries in exporting raisin to Asian, European, and Persian golf countries. Unfortunately these markets were missed for two major reasons: a) weakness in production and packaging b) the superiority of market searching of other countries such as America, Australia, Turkey and Greece over Iran. These markets were captured by such countries which were at a time importing raisin products. While in Iran, not only producing raisin has not been
decreased but also shows an increase of 72-82% during a
decade of farming dried; and since just 15% to 20% of
produced raisin is used inside the country where as the
remaining raisin should be exported, varieties in production
seem to be essential.

Materials and Methods: Reagents and Materials

Raw material, Tampson raisin (types 2 and 3), Diatoms
Soil, Copper Sulfide, Sodium Potassium, Mattilan blue,
Chloride Acid and Nutrint Agar (N.A) were obtained from
Merck.

Apparatus: Rotary evaporator, Poor, Auto close, Grinder
and Mixture (Mulinex type), Vacuum Pump and Refracto-
meter. Rotational iscometer, Microscope. Refrigerator (an 8
feet Azmayesh set) and Lovibond.

Methodology: After selecting and transforming the samples
to the lab they are allowed to be stiffened, washed, and dried.
A slight scratch by Mulinex mixture is done on samples for
penetrating water within their crust. Here definite proportion
of 1:1, 2:1 and 3:1 of water and solvent is used. Then those
Bashers containing raisin and solvent are kept in Ben Mary in
three different extracted temperatures 40 °C, 60 °C, and 80 °C.
Brix is measured one time per hour, the performing point is
determined by Brix stability which is lasted for 24 hours.
Then produced extraction is filtered and passed through
Bookner funnel again, using Diatoms soil as filtering aid.
The extraction then evaporated in the evaporator under
vacuum in three different temperatures 65 °C, 75 °C, and 85
°C. Since the time needed for each evaporation are 2 to 3 hours,
before evaporating, the samples are heated for 5 minutes. To
avoid fermentation during evaporation, every half an hour
Brix is measured to control the operation; the process is
continued to get the Brix of 70. At the end the microbial
experiments including mould, fermentation and total count as
well as experiments for determining quality characteristics
such as efficiency. Glucose, and color are performed.

Extraction Efficiency: Considering the sample weight
and using 300 grams raisin for each experiment, the optimal
percentage of concentration is estimated.

Percent of Sugar Recover: Using Line and Ainon method,
the samples were studied and after titration operation by
referring to Line and Ainon chart the percentage of sugar
recovery were recorded for all samples.

Color: In order to perform color experimentation lovibond
machine is used. In this system the extract sample color is
compared with standard color palates which are composed of
a few series of moveable and colored glamour palates in red,
yellow, and blue (each of which is consisted of a series of
palate from light to dark color). So the desirable sample color
can be determined by comparing with one of the palates
combining with few palates. For measuring the color,
containers of 0.25, 1, and 5.25 inches can be used.

Mould and Fermentation

The total samples were cultivated within three different
concentrations of 0.1, 0.01 and 0.001 M then the operation
was studied after putting in Ben Mary.

Total count: All samples were studied and cultivated
within three different concentrations of 0.1, 0.01 and 0.001
M then total count was handled after predetermined time.

Statistical Relationship for Analyzing the Results

For analyzing the obtained data from aforementioned
experiments such as efficiency, color and percentage of sugar
recovery, by considering the 81 times iterations, a design of
factorial examinations in the format of completely random was used. The M-Stat software was employed to determine the significant of differences between experiments and their interactions, experiments which brought about the significant were identified using the least different significant test.

Results and Discussions: Statistical analysis of results

The obtained means for all observations via Danken multi-domain test were compared with each other and the amount of the least statistical significant difference at the level P ≤ 0.05 were determined. The results are summarized in Table 1. As Table 1 indicates, there is no significant differences at all levels of iterations. However considering it, a significant difference is observable at the level of P ≤ 0.01. But there is no significant difference on color of red and blue at any levels. At the levels of evaporating temperature; effects and interact ional effect of solvent proportion and evaporated temperature on the amount of recovery sugar a statistical significant difference is observable. Also there is a highly significant difference at the level of interact ional effect of three parameters (extracting temperature, solvent ratio, and evaporated temperature). Of course here there is no significant difference of the effect of extraction temperature and solvent proportion.

Comparing the means: All of the obtained means from statistical analyses based on Danken multi-domain test, compared with each other and their least amount of the statistical significant difference (LSD) was determined.

The effect of extracting temperature on efficiency

Concentrate producing efficiency has also been increased with increasing the extracting temperature. This effect is indicated in Figure 1.

![Fig. 1. The effect of extracting temperature on concentrate production efficiency](image)

The effect of extracting temperature on sugar recovery percentage

The extracting temperature did not have any significant effect on existing sugar recovery on final concentration. Non-sugar substances or non-recovery sugar may cause efficiency increasing. Extracting temperature has also had no effect on increasing or decreasing of the amount of recovery sugar.

The effect of extracting temperature on color

By increasing the extracting temperature especially in 80 °C the color of produced concentration has been increased. As increasing the color specially red and blue brings about darkness and reduces appearance properties on the production; extracting operation under 80 °C seems suitable for obtaining desirable color.

The effect of solvent production on concentrate production efficiency: By increasing the amount of solvent to the proportion of raw material, the concentrate production efficiency also increases. The results are shown in Figure 2 considering the ratio of 2:1 and 3:1, the efficiency increases comparing with the proportion 1:1; however, the Brix is 70 for all samples.
The effect of solvent proportion on sugar recovery percentage: Varying the solvent proportion has no significant effect on the amount of sugar recovery.

The effect of solvent proportion on color

The amount of color is more in higher solvent proportion because of the solvable and insolvable solid substances, i.e. the most and the least amount of color is in the proportion of 3:1, and 1:1 respectively.

Interactional-effect of solvent proportion and extracting temperature on observed properties

Like weight concentrate producing efficiency increases by increasing extracting temperature and solvent proportion (Figure 3). It seems that the effect of solvent proportion and extracting temperature on efficiency is equal.

The interactional-effect of solvent proportion and extracting temperature on sugar recovery percentage

There is no significant difference in the amount of sugar recovery within the interactional-effect of extracting temperature and solvent proportion. The observed difference in different levels shows no statistical differences (Figure 4). However, it seems that the highest percentage of sugar recovery is obtained in 80 °C and solvent proportion of 3:1, which makes different with similar solvent proportion in different temperatures.

Figure 3. The interactional-effect of solvent proportion and extracting temperature on concentrating production efficiency

Figure 4. The bilateral effect of solvent proportion and extracting temperature on sugar recovery percentage

The interactional-effect of solvent proportion and extracting temperature on color

Concentrate color factors by increasing extracting temperature and solvent proportion and in lower temperature together with lesser solvent proportions, the color density was lessened.

The effect of evaporating temperature on raisin concentrates efficiency: Concentrate producing efficiency in 65 and 85 °C shows increasing with respect to the 75 °C. As it is shown in Figure 5 the highest amount of producing efficiency is obtained in 65 °C.
The effect of evaporating temperature on sugar recovery percentage

The effect of evaporating temperature on sugar recovery percentage and the obtained means has no statistical significant differences with each other.

The effect of evaporating temperature on color factor

The highest amount of factors relating to color was obtained in 65 °C evaporated Temperature. However, there are some differences in these amounts which have been obtained in 65 °C but not in 75 °C and 85 °C. The reason of increasing color in 65 °C is, lengthening the evaporated time and appearing the caramelization phenomena.

Interactional-effect of extracting and evaporating temperature on efficiency

Based on obtained results (Figure 6), the concentrate efficiency is increased by increasing the extracting and evaporating temperature. It seems that the effectiveness of extracting temperature on concentrates’ weight is higher than evaporating temperature. Also, the obtained production in 60 °C and 80 °C has the highest volume obtained comparing with 60 °C extraction and 65 °C evaporation, and has no significant differences comparing with those obtained in 80 °C and 75 °C.

Interactional-effect of extracting and evaporating temperature on the sugar recovery percentage

There is no significant difference among the obtained value of most sample iterations. As it is shown by scattered numbers the extracting and evaporating temperature has had no effect on the value of sugar recovery.

The interactional-effect of extracting and evaporating temperature on color factor

The maximum color value which is caused by double heating on color is in the extracting temperature of 75 °C and 80 °C. Since decreasing of red and blue color and increasing of yellow shows the better quality of production, lower temperature of extracting i.e. 40 °C and evaporating in 65 °C is more desirable comparing with other sample iteration.

The interactional-effect of solvent proportion and evaporated temperature on efficiency

The concentrate product efficiency in solvent proportions of 2:1 and 3:1 are higher and highest respectively, which have been increased by increasing the evaporated temperature. This happens because the percentage of extracting substances was higher, and evaporating in higher temperature not only decreases
the production time, but also increases the production efficiency (Figure 7).

![Interaction Effects of Sol Rate and Conc. Temp. on Red. Sugar](image)

**Fig. 7. The interactional-effect of solvent proportion and evaporated temperature on efficiency**

**The interactional-effect of solvent proportion and evaporated temperature on sugar recovery percentage**

Although the existence of statistical differences in lower degrees of evaporation is because of lesser karamelization, these differences are not significant in general. Solvent proportion and evaporating temperature has no effect on sugar recovery percentage (Figure 8).

![Interaction Effects of Conc. Temp. and Sol. Rate on Yield](image)

**Fig. 8. The interactional-effect of solvent proportion and evaporated temperature on sugar recovery percentage**

**The interactional-effect of solvent proportion and evaporated temperature on color factor**

The least amount of color factors that shows the desirable color quality are obtained in solvent proportion 1:1 and evaporated temperature of 75 °C. Increasing in yellow color volume happened in evaporating temperature of 75 °C and solvent proportion of 2:1.

**The interactional-effect of three factors, extracting temperature, solvent proportion and evaporation temperature on efficiency**

Extracting temperature higher than 80 °C increases the efficiency. Comparing the means, it is shown that by increasing solvent proportion especially of 3:1 and 2:1 values, causes significant differences on efficiency with respect to other samples iterations.

**The interactional-effect of three factors, extracting temperature, solvent proportion and evaporation temperature on sugar recovery**

The scattering of optimal means indicates that three aforementioned factors have no significant effect on sugar recovery percentage.

**The interactional-effect of three factors, extracting temperature, solvent proportion and evaporation temperature on color factor**

The obtained means from yellow color with respect to red and blue color has higher value and lesser temperature in extracting and evaporating, whereas in higher solvent proportion the obtained color had better quality with respect to the remaining sample repetitions.
Conclusion

In this study the effect of extraction temperature, solvent proportion, and evaporating temperature were studied on the efficiency variables, color and percentage of sugar recovery. Experiment factorial $3^3 \times 3^3$ used randomly. Here extracting temperature at three levels 60 °C, 40 °C, and 80 °C, and solvent proportion at three levels 2:1, 1:1, and 3:1 and evaporating temperature at three levels 75, 65, and 85 °C were tested within three times iterations. The obtained data from experiments was fed to Excel software 97 and analyzed by M-stats software.

The results are as follows; meanwhile in microbial testing everything was alright, only in one case in total count in 0.1 condensed colony was observed which was considered as experimental error. The best sample iterations were obtained in extracting temperature of 80 °C and proportion of 2:1, 3:1 and evaporating temperature of 65 °C and 75 °C.

### Table 1. Statistical analysis of data obtained through conducting experiments

<table>
<thead>
<tr>
<th>Color</th>
<th>Suger Recovery</th>
<th>Efficiency</th>
<th>Degree of freedom</th>
<th>observations</th>
<th>levels of experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>yellow</td>
<td>Red</td>
<td>194.84**</td>
<td>2</td>
<td>levels of iterations</td>
</tr>
<tr>
<td>0.003**</td>
<td>0.120***</td>
<td>1.059***</td>
<td>4.664**</td>
<td>2</td>
<td>Levels of extraction temperature</td>
</tr>
<tr>
<td>7.159***</td>
<td>1.239***</td>
<td>277.402**</td>
<td>671.68***</td>
<td>2</td>
<td>Levels of solvent ratio</td>
</tr>
<tr>
<td>0.365***</td>
<td>8.810***</td>
<td>30.429**</td>
<td>4368.407***</td>
<td>2</td>
<td>Levels of concentration</td>
</tr>
<tr>
<td>0.564**</td>
<td>2.173**</td>
<td>12.993**</td>
<td>22581.49**</td>
<td>4</td>
<td>Levels of interaction effect of extraction temperature and solvent ratio on concentration</td>
</tr>
<tr>
<td>0.281**</td>
<td>4.943**</td>
<td>16.485**</td>
<td>11092.97**</td>
<td>2</td>
<td>The interaction effect of extraction and concentrated temperature on concentration</td>
</tr>
<tr>
<td>0.119**</td>
<td>1.514**</td>
<td>11.167**</td>
<td>10902.97**</td>
<td>4</td>
<td>The interaction effect of concentrated temperature and solvent ratio on concentration</td>
</tr>
<tr>
<td>0.110**</td>
<td>1.370**</td>
<td>20.309**</td>
<td>8417.915**</td>
<td>4</td>
<td>The interaction effect of concentrated and extraction temperature plus solvent ratio on concentration</td>
</tr>
<tr>
<td>0.175**</td>
<td>3.047**</td>
<td>10.811**</td>
<td>27944.223**</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

** Highly statistical significant differences at the level of $P \leq 0.01$.

*Statistical significant differences at the level of $P \leq 0.05$.

n.s.: No statistical significant differences.
2 Topics

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