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Optimization of raisin extract concentration

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ABSTRACT

The aim of this study was to optimize raisin concentration process. For this purpose the concentration process conducted in three different extraction temperature (40, 60, and 80 ºC), three water/raisin ratios (1:1, 2:1, and 3:1) and three evaporation temperatures (65, 75, and 85ºC). The physiochemical properties of obtained concentrate (color, sugar, recovery percentage and production efficiency) were studied. Results showed that concentration under conditions: extraction temperature of 80 ºC, evaporation temperature of 75 ºC and solvent proportion of 2:1and 3:1 led to better results.

KEYWORDS

Raisin;
Extraction;
Raisin concentrate.

INTRODUCTION

Raisin concentrate is a valuable product in manufacturing different kinds of syrups, sweet drinks[1-3], confectionary industries as well as a natural alternative for sugar[4-6]. Considering high raisin production in Iran, raisin concentrate is one of the most important products among grape goods[7-10].

Statistics show that about 15-20% of grape produced has internal usage while, the remaining is exported or left useless. Non-petroleum exports especially agricultural products can play a significant role in employing economical strategies[7,11-13]. Dried fruits especially raisin have been important agricultural export materials and for two decades Iran has been among the most important countries in exporting raisin to Asian, European, and Persian golf countries[13-15]. 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 with respect to Iran. Because of these reasons we tried to introduce a long life raisin product and optimize the production parameters in laboratory scale. The results of this study might be used by industrial plants producing different fruit concentrate[14,16].

MATERIALS AND METHODS

Materials

Tampson raisin was purchased from local market in Quchan-Iran. All chemical purchased from Merck.

Method

Fresh raisin transformed to the lab and allowed to be stiffened and then washed and consequently dried. After weighing, the samples scratched slightly by Mulinex mixture to penetrate water within their crust. Samples were soaked in water with different ratios including 1:1, 2:1 and 3:1. These mixtures kept in Ben Mary in three different extraction temperatures including 40, 60, 80ºC and analyzed once an hour for Brix

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until a constant level. The resultant extract was filtered through Bookhner funnel using Diatoms soil as filtering aid. This extract evaporated by rotary evaporator (Azma Teb Company-Iran) in at three different temperatures including 65, 75, 85ºC to reach a brix about 70º. Finally the extracts were analyzed for mould, total microbial count, glucose content (Line and Ainon method), color (lovibond system) and also extraction yield (w/w%).

Statistical analysis

For analyzing the obtained data a design of factorial examinations in the format of completely random was used. The M-Stat software was used to determine the significant of differences between experiments. Then by using the least different significant test, those experiments which brought about the significant were identified.

RESULTS AND DISCUSSION

Statistical analysis of results

The obtained means for all observations via Dunkan multi-domain test were compared with each other and the amount of the least statistical significant difference at the level P≤ 0.05 was determined and the results was summarized in TABLE 1.

According to TABLE 1, at all levels of interactions there are no significant differences. But at the efficiency levels, and yellow color a significant difference is observed at the level of P≤ 0.01. However there is no significant difference on color of red and blue at any level. 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) on the amount of sugar recovery a highly significant difference is observable. Of course here there is no significant difference of the effect of extraction temperature and solvent proportion.

TABLE 1 : Statistical analysis of data obtained through conducting experiments

Color			Sugar Recovery	Efficiency	Degree of freedom	Observation levels of experiments
Blue	yellow	Red				
$0.003^{n.s}$	$0.120^{n.s}$	$1.059^{n.s}$	$194.84^{n.s}$	$4.664^{n.s}$	2	levels of interactions
7.159^{**}	$1.239^{n.s}$	277.402^{**}	$6711.68^{n.s}$	2121.84^{**}	2	Levels of extraction temperature
0.365^{**}	$8.810^{n.s}$	30.429^{**}	$4368.407^{n.s}$	2304.66^{**}	2	Levels of water ratio
0.564^{**}	$2.173^{n.s}$	12.993**	22581.49^{**}	143.48^{**}	4	Levels of interactional effect of extraction temperature and water ratio on concentration
0.281^{**}	$4.943^{n.s}$	16.485^{**}	11092.97^{*}	361.878^{**}	2	Levels of concentration
0.119^{**}	$1.514^{n.s}$	11.167^{**}	10902.97^{**}	624.715^{**}	4	The interact ional effect of extraction and concentrated temperature on concentration
0.110^{**}	$1.370^{n.s}$	20.309^{**}	8417.915^{*}	94.632^{**}	4	The interact ional effect of concentrated temperature and water ratio on concentration
0.175^{**}	$3.047^{n.s}$	10.811^{**}	27944.223^{**}	229.752^{**}	8	The interact ional effect of concentrated and extraction temperature plus solvent ratio on concentration

****Highly statistical significant differences at the level of P≤ 0.01; *Statistical significant differences at the level of P≤ 0.05; n.s: No statistical significant differences.**

Effect of extraction temperature on yield, sugar recovery and color

Concentrate production yield is increased by increasing the extraction temperature (Figure 1). But the extraction temperature did not have any significant effect on sugar recovery. Non-sugar substances may cause increasing the efficiency. Also by increasing the extraction temperature especially at 80ºC the color of produced concentrate increased. As increasing the color specially red and blue brings about darkness and reduces appearance properties, extracting operation under 80ºC seems suitable for obtaining desirable color.

Effect of water ratio on concentrate production yield, sugar recovery and color

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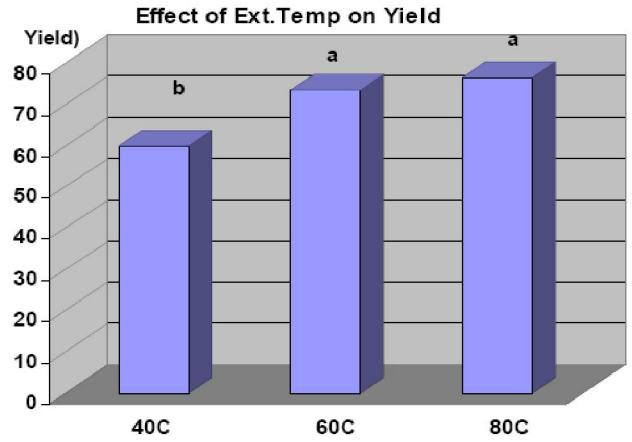

Figure 1 : Effect of extraction temperature on concentrate production yield

By increasing the amount of water/raw material, the concentrate production efficiency also increased. Results are shown in Figure 2. But the water ratio to raw material had no significant effect on the amount of sugar recovery. The amount of color is more in higher water proportion because other substances except sugar diffuse to the concentrate, i.e. the most and the least amount of color belonged to the ratios 1:3 and 1:1 respectively.

Interactional effect of water/raisin ratio and extraction temperature on production yield, sugar

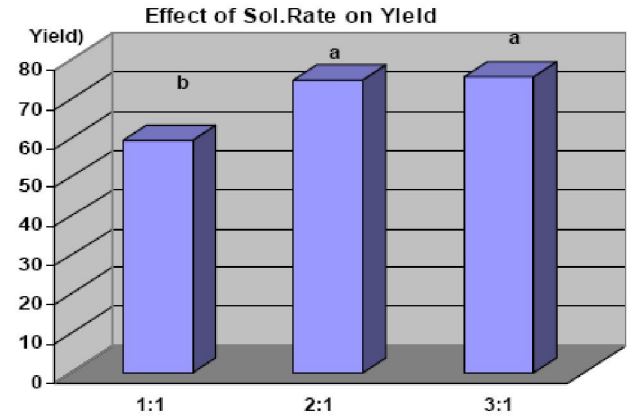

Figure 2 : Effect of solvent ratio on concentrate production yield

recovery and color

Concentrate production efficiency like weight increases by increasing extraction temperature and water/raisin ratio (Figure 3). It seems that the effect of water/raisin ratio and extraction temperature on the efficiency is equal. There is no significant difference in the amount of sugar recovery within the interactional effect of extraction temperature and water/raisin ratio (Figure 4). However it seems that the highest percentage of sugar recovery is obtained in 80 ºC and water/raisin

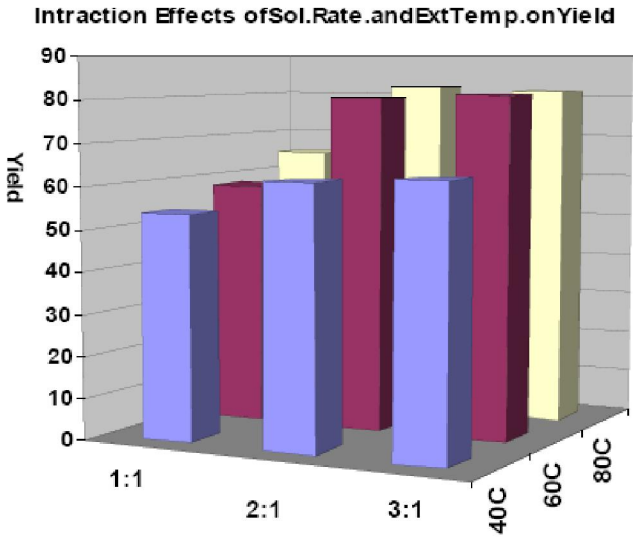

Figure 3 : The interactional effect of water/raisin ratio and extraction temperature on yield of extraction

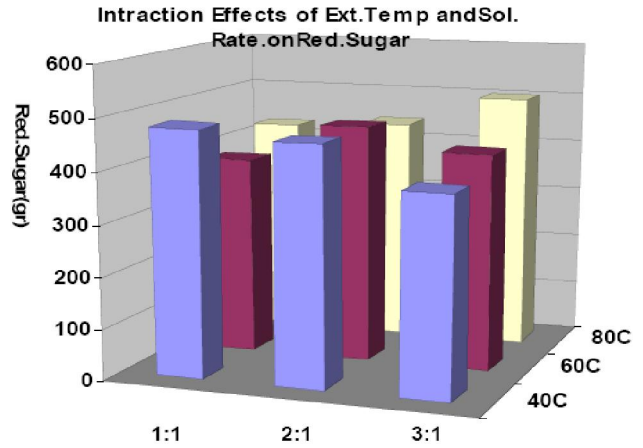

Figure 4 : The interactional effect of water/raisin ratio and extraction temperature on sugar recovery

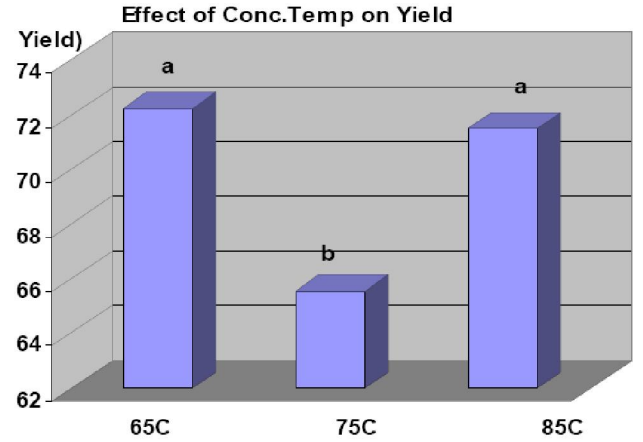

Figure 5 : The effect of evaporation temperature on raisin concentrate yield

ratio of 1:3. The color of concentrate samples increased by increasing extraction temperature and water/raisin ratio and in lower temperature and lower water/raisin ratios, color density decreased. Also the effect of evaporation temperature on raisin concentrate yield is shown in Figure 5. According to this figure concentrate production efficiency was at highest rate at 75 ºC (Figure 5).

CONCLUSION

In this study the effect of extraction temperature, water/raisin ratio and evaporation temperature were studied on the efficiency variables, color and percentage of sugar recovery. Experiment factorial 3*3*3*3 used randomly. Here extracting temperature at three levels 60, 40, and 80 ºC, and water/raisin ratio at three levels 1:2, 1:1, and 3:1 and evaporation temperature at three levels 75, 65, and 85 ºC were tested. Results showed that concentration under conditions: extraction temperature of 80 ºC, evaporation temperature of 75 ºC and solvent proportion of 2:1and 3:1 led to better results.

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