Optimization of Some Process Parameters to Produce Raisin Concentrate in Khorasan Region of Iran

Peiman Ariaii, Hamid Tavakolipour, Mohsen Pirdashti, and Rabehe Izadi Amoli

Abstract**—**Raisin Concentrate (RC) are the most important products obtained in the raisin processing industries. These RC products are now used to make the syrups, drinks and confectionery productions and introduced as natural substitute for sugar in food applications. Iran is a one of the biggest raisin exporter in the world but unfortunately despite a good raw material, no serious effort to extract the RC has been taken in Iran. Therefore, in this paper, we determined and analyzed affected parameters on extracting RC process and then optimizing these parameters for design the extracting RC process in two types of raisin (round and long) produced in Khorasan region. Two levels of solvent (1:1 and 2:1), three levels of extraction temperature (60°C, 70°C and 80°C), and three levels of concentration temperature (50°C, 60°C and 70°C) were the treatments. Finally physicochemical characteristics of the obtained concentrate such as color, viscosity, percentage of reduction sugar, acidity and the microbial tests (mould and yeast) were counted. The analysis was performed on the basis of factorial in the form of completely randomized design (CRD) and Duncan's multiple range test (DMRT) was used for the comparison of the means. Statistical analysis of results showed that optimal conditions for production of concentrate is round raisins when the solvent ratio was 2:1 with extraction temperature of 60°C and then concentration temperature of 50°C. Round raisin is cheaper than the long one, and it is more economical to concentrate production. Furthermore, round raisin has more aromas and the less color degree with increasing the temperature of concentration and extraction. Finally, according to mentioned factors the concentrate of round raisin is recommended.

Keywords**—**Raisin concentrate, optimization, process parameters, round raisin, Iran.

I. INTRODUCTION

RAISINS have been a favorite food since 1490 BC due to their nutritive value and high micronutrients content [1]. Raisins are a nutritious snack, containing dietary fiber, antioxidants, potassium, and iron. Raisins are also a concentrated source of carbohydrate (a 2-tablespoon, or 18- g, portion counts as a fruit exchange in the Exchange Lists for Meal Planning) [2], [3]. Raisin juice is pure extract of dry raisins in a form of dark brown syrup, produced by boiling without the addition of sugar or other food additives. Because of its high content in trace elements (K, Na, P, Mg, Ca) and vitamins (C, B_3, and A), its incorporation into foods satisfies the consumers' needs and desires for healthier foods. Because raisin juice's carbohydrates are in the form of glucose and fructose, it easily passes into the blood without digestion. This is of nutritional importance, especially for babies, children, coeliac disease patients, sportsmen, and in situations demanding immediate energy [4], [5]. Raisin Concentrate (RC) also are the most important products obtained in the raisin processing industries. These RC products are now used to make the syrups, drinks and confectionery productions and introduced as natural substitute for sugar in food applications. Iran country has a best ecological condition for grape agriculture and grape is one of the major fruits in Iran and is mainly grown in the provinces of Khorasan, Azerbaijan, Hamedan, Qazvin, Fars, Zanjan, and Tehran provinces. Khorasan province is a biggest raisin producer in Iran. Iran hasn't any retreat in raisin for different product such as RC and only exports as a raw material to global market [6], [7]. As the top raisin exporters are typically Turkey, Iran and the United States [8].

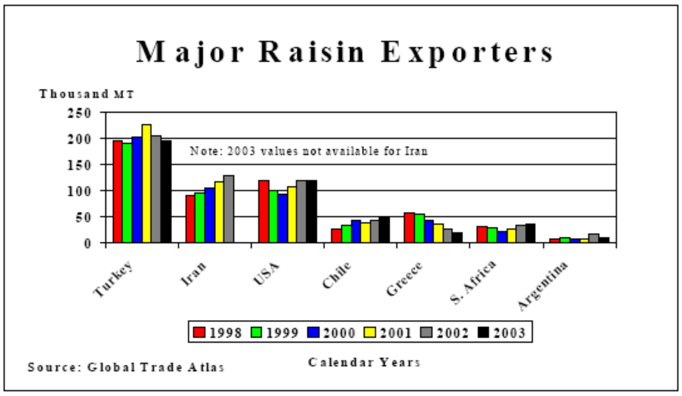

Fig. 1 Major raisin exporters

Unfortunately, at present due to technological backwardness, lack of modern agricultural method, lacks of suitable processing and unsuitable packaging Iran dispose of part of this raisin as a waste material. Because of the

Piman Ariaii is with the Food Science and Technology Department of Islamic Azad University-Ayatollah Amoli Branch, Amol, P.O. Box 678 Iran (corresponding author to provide phone: +98-121-2552150-3; fax: +98-121-2552789; e-mail: p.aryaye@yahoo.com).

Hamid Tavakolipour is with the Food Science and Technology Department of Islamic Azad University-Sabzevar Branch, Sabzevar, Iran.

Mohsen Pirdashti is with the Department of Chemical Engineering, Shomal University, Amol, P.O. Box 731 Iran and He is now with the Department of Chemical Engineering, Islamic Azad University, Ayatollah Amoli Branch, Amol, P.O. Box 678 Iran (e-mail: Pirdashti@ Yahoo.com).

Rabehe Izadi Amoli is with the Food Science and Technology Department of Islamic Azad University-Ayatollah Amoli Branch, Amol, P.O. Box 678 Iran.

environmental problems of waste raisin disposal, these facilities invest in technologies to reduce the environmental problems without treating it as a valuable product. To avoid the environmental problems of raisin disposal and the inefficient capital investment associated with treating raisin as a waste product; this study suggests establishing an RC factory to process the raisin of the in Iran. Consequently, there is a need for an appropriate research to assist in determining the relative importance of the parameters for evaluating type of raisin and the priority of the raisin considering the parameters. Therefore, in this paper, we determined and analyzed affected parameters on extracting RC process and then optimizing these parameters for design the extracting RC process in two types of raisin (round and long) produced in Khorasan province.

II. Experimental Section

A. Materials

Two type of Raisin (round and long) produced in Kashmar zone of Khorasan province. Cupper sulfate, di sodium tartarat, potassium, sodium hydroxide, methylene blue indicator were of analytical grade (Merck) and were used without future purification. Subro dextrose agar and nutrient agar were purchased from Merck. Distilled water was used in all experiments.

B. Apparatus and Procedure

Raisin concentrate is mostly manufactured in industrial conditions although traditionally and still today, farmers produce small amounts of raisin concentrate in order to supply their own requirements and the market. Production of raisin concentrate is illustrated in Fig. 2.

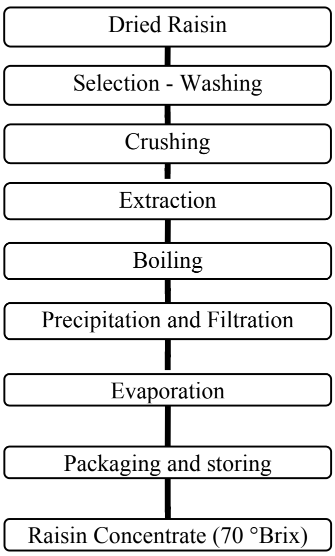

Fig. 2 Manufacture method for raisin concentrates [9]

In this work for preparation of RC the manufacture method reported by Şimşek et al. [9] were used. After selection of 1 kg raisin (round or long) at first, raisin were detailing and washing, then dried and weighted. Then, raisins were milled (Molinex, China) and scarified to better absorption of water. Finally, 1:1 and 2:1 of solvents mixed into raisins and then extracted (at 60, 70 and 80°C). For extraction, benmary (LAUDR-E 2000, Germany) within 2 hours was used. Then extract was filtered and raisin residual infiltrated by passing from Boehner funnel curtain cloth. In order to filtration of extract a filter enriched by diatom's soil was used. This extract was ready for concentration. Concentration continued by increasing of temperature until boiling. Necessary time was applied at boiling temperature until mentioned concentration (brix). At this research, for ensuring of extracted brix to 70, the extracted concentrated by rotary evaporator (LABORTA-4001, Germany) containing a chiller and automatic control for temperature in which 50, 60 and 70°C were imposed on samples. After product preparation microbial experiments including total count of mould, yeast and chemical tests were used to determine quality characteristics of extract such as viscosity, acidity, color and reduced sugar.

C. Physicochemical Test

Physicochemical characteristics of the obtained concentrate such as color, viscosity, percentage of reduction sugar, acidity and the microbial tests (mould and yeast) were counted. The concentration (Brix) of samples was determined by refractive index measurements at 298.15K using an ATAGO-DTM1 model in two steps. First step executed simultaneously after concentrate extraction and next step executed during samples concentration to brix of 70 and the final step carry out on ready treatment [10]. The stability and solidity of extraction samples was determined by viscosity measurements using rotary viscometer (DV3 model, Germany). According to sample viscosity the different spindles with different rounds could apply but a paper spindle and round must have been monitoring capability of 15 to 90%. This rate was applied for any repetition and viscosity number was counted. Or determination of reduced sugars in sample Lyn-Aynon method [11], [12] was used.

D. Microbial Test

For microbial experiments of samples, total count of mould and yeast conducted as follows: total count of aerobic microbes done by nutrient media. Subro dextrose media also was used for mould and yeast count in samples, in which 20% glucose, neopeptun 10%, agar 17% and distillated water (100 cc) used for 1 liter media preparation. Selectivity of their media based on low pH and low nutrient. Meanwhile for suppressing of bacteria different antibiotic such as chloramephnicolf and tetracycline was added to media. Then steriled by autoclave and applied for determination of mould and yeast. For counting of mould and yeast the following formula was used as fallow:

Fungi number = dilution reverse × 10 × yeast and mould number (1)

E. *Statistical Analysis*

The analysis was performed on the basis of factorial in the form of completely randomized design (CRD) and Duncan's multiple range test (DMRT) was used for the comparison of the means. Meanwhile, SAS 96 soft ware was used for data analysis.

III. RESULTS AND DISCUSSION

In this research, some process parameters were treat on two type of raisin (round and long) produced in Khorasan region and two levels of solvent (1:1 and 2:1), three levels of extraction temperature (60, 70 and 80°C), and three levels of concentration temperature (50, 60 and 70°C) as shown in table 1 were used.

TABLE I
VARIOUS PARAMETERS DURING THE EXPERIMENTS

A	L	B	b_1	C	c_1	D	d_1	R	r_1
					c_2		d_2		r_2
	R		b_2		c_3		d_3		r_3

A: type of raisin, R: Round, L: Long
B: levels of solvent, b_1=1:1, b_2=2:1
C: extraction temperature, c_1= 60^{oC}, c_2= 70^{oC}, c_3= 80^{oC}
D: concentration temperature, d_1=50^{oC}, d_2= 60^{oC}, d_3= 70^{oC}
R: reiterate number, r_1= first reiterate, r_2= second reiterate, r_3= three reiterate
Number of experiment= A× B × C × D× R: 108 =3 × 3 × 3 × 2 × 2

A. *Effect of Level of Solvent, Extraction and Concentration Temperature on Percentage of Reduction Sugar*

Fig. 3 shown, according to Millard reaction, percentage of reduction sugar in two type of raisin, decreased with increasing concentration temperature. Maximum percentage of reduction sugar was recorded at 50 °C and minimum at 70°C. Also, significantly difference was observed among all mentioned treatments (P<0.05).

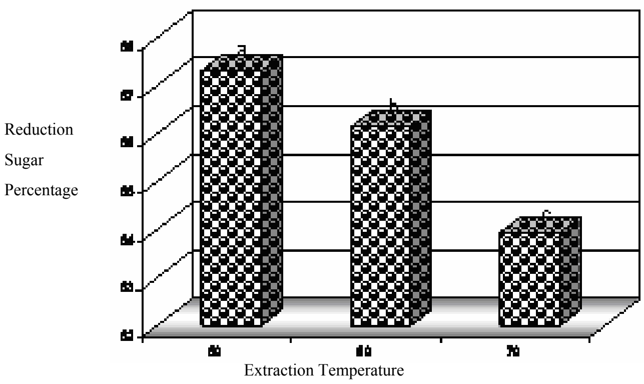

Fig. 3 Effect of concentration temperature on reduction sugar

According to Fig. 4, diffusion rate of reduced sugars in solvent was increased due to their rapid solubility and thus the range of extraction was high. Furthermore, the level of used solvent in 2:1 ratio was more than 1:1; therefore, percentage of reduction sugar reduced more based on Millard reaction. Results indicated that in 2:1 and 1:1 ratio, maximum percentage of reduced sugar and minimum sugar percentage were recorded at extraction temperature of 60 and 80°C, respectively.

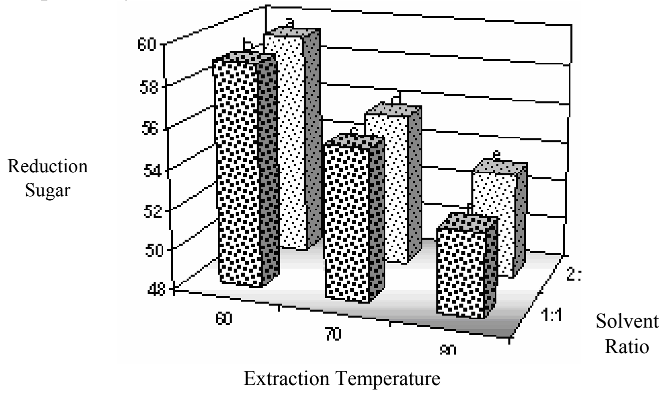

Fig. 4 Interaction effect of solvent ratio and extraction temperature on percentage of reduction sugar

B. *Effect of Solvent Ratio, Type of Raisin and Concentration Temperature on Color*

Data of this parameter was shown in Table II. Results revealed that color intensity in two raisin types increased with increasing of concentration temperature. Color intensity especially red and blue depends on increased temperature (Millard reaction) and these colors caused darkness appearance in raisin product and a reduction for product acceptability.

TABLE II
EFFECT OF SOLVENT RATIO, TYPE OF RAISIN AND CONCENTRATION TEMPERATURE ON COLOR

Solvent ratio, type of raisin	Concentration Temperature		
	d_1	d_2	d_3
Lb_1	^{e} 0.2011	^{g} 0.3150	^{b} 0.5160
Lb_2	^{d} 0.3610	^{b} 0.5532	^{a} 0.7120
Rb_1	^{f} 0.7089	^{e} 0.1863	^{c} 0.4669
Rb_2	^{b} 0.5467	^{b} .0.5644	^{d} 0.6956

C. *Effect of Extraction and Concentration Parameters on Viscosity*

With temperature increasing, solid content diffusion coefficient from raisin to solvent increased and as a result of it, increased viscosity of RC. According to Fig. 5, extracting concentrate at temperature of 80°C more than temperatures of 60 and 70°C, and therefore increasing extract concentrate because increasing viscosity. Also, significantly difference was observed among all mentioned treatments (P<0.05).

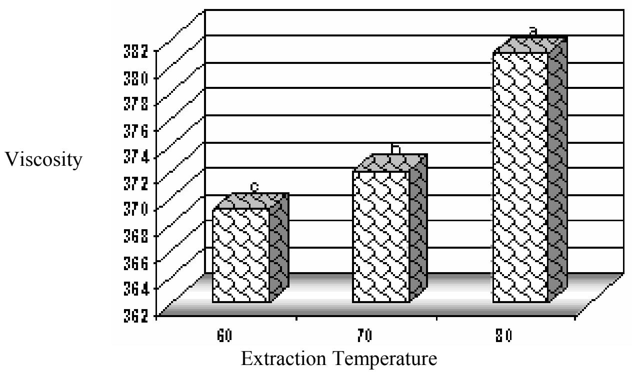

Fig. 5 Effect of extraction temperature on viscosity

According to Fig. 6, RC viscosity increased with increasing concentration and extraction temperature. Results indicated that in extraction temperature of 80°C and concentration temperature of 70°C, maximum percentage of viscosity and minimum viscosity percentage were recorded at extraction temperature of 60 and 70°C and concentration temperature of 50°C, respectively ($P<0.05$).

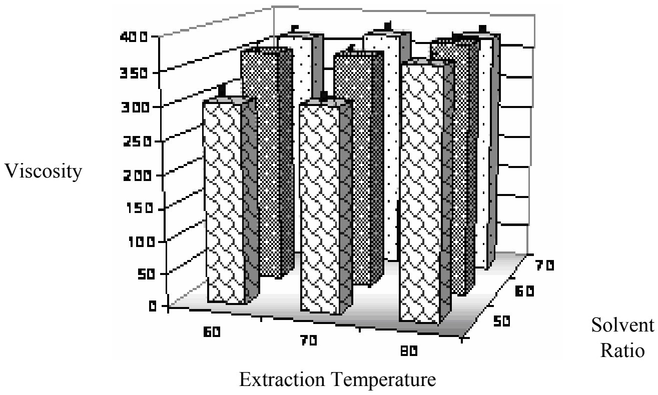

Fig. 6 Interaction effect solvent ratio and extraction temperature on viscosity

D. *Effect of Concentration Temperature on Viscosity*

Solid composition in RC was increased with increasing concentration temperature and as a result of Viscosity increased. The optimum concentration temperatures were found 50, 60 and 70 has been shown in Fig. 7.

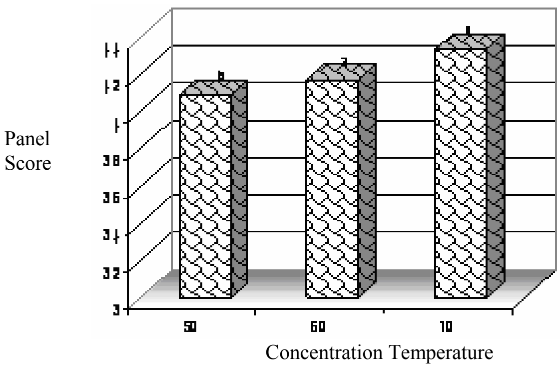

Fig. 7 Effect of concentration temperature on viscosity

E. *Effect of Concentration Temperature on Aroma*

RC Aroma decrease with increasing the concentration temperature. In this case the optimum concentration temperature was 50.

IV. Conclusion

Production of raisin concentrate is one efficient method that carried out at Khorasan region by round and long raisin raisins. This method could be recommended for another region of Iran. For produced of concentrate by this method some parameters such as treatment types, extraction and concentration temperatures for optimization of raisin concentrate were evaluated. The best treatment was recorded when 1:1 and 2:1 ratio of solvent under 60 and 70 °C of extraction temperature and 50 and 60°C concentration temperature were used. The best treatment according to economical aspect was round type of raisin and 2:1 ratio of solvent at 60°C extraction temperature and 50°C concentration temperature. In other words, concentrations from 60°C extraction temperature and 50°C concentration temperature proper in terms of economic criteria. Results also showed that long raisin concentrate has more sugar than round raisin type. By contrast, in cost aspect round raisin was cheaper than the long one therefore round type economically was proper for concentrate production. In terms of mould and yeast count all studied samples were negative. Generally, for concentrate production of raisin with high quality 2:1 ratio of solvent, 60°C extraction temperature and 50°C concentration temperature was recommended. According to this study that focused on industrial view point, a change from traditional method toward industrial methods for raisin concentrate production is necessary to ensure greater production, proper quality and application of raisin concentrate for back way, confectionery and dairy products industry to ensure increasing in storage duration, taste and nutrition property or quality important.

References

[1] L.Saywell, " The effect of figs and small amounts of raisins on urinary acidity by lawewnceg," JN the Journal of Nutrition,1932, pp.518-525.

[2] S.W.Sanders," Using prune juice concentrate in whole wheat bread and other bakery products," Creative Food Consultants Discovery Bay, CA 94514.

[3] D. Sabanis, C. Tzia and S. Papadakis," Effect of Different Raisin Juice Preparations on Selected Properties of Gluten-Free Bread" Food Bioprocess Technol , 2008, pp.374–383.

[4] B. Zhao, C. A. Hall, "Composition and antioxidant activity of raisin extracts obtained from various solvents," Food Chemistry, 2008, pp. 511–518.

[5] Y. Kima, S. R. Hertzlerb, H. K. Byrnec, C. O. Matternc," Raisins are a low to moderate glycemic index food with a correspondingly low insulin index," Nutrition Research, 2008, pp. 304–308.

[6] Jehad-e-Keshavarzi, Agriculture Statistical, 2006, Vol 1,2.

[7] Iranian Standard and Industrial Research Institute, Raisin, Characteristics and Test Methods, 2002, pp.1-18.

[8] USDA FAS Production, Supply, and Distribution Data, 2004.

[9] A. Simsek, N. Artıkb and E. Baspinar," Detection of raisin concentrate (Pekmez) adulteration by regression analysis method", Journal of Food Composition and Analysis, 2004, pp.155–163.

[10] R. Hoseini, "Conventional methods in food stocks analysis," Shiraz University Press, 1999, pp.117-123.
[11] M. Saiedi Asl, "Introduction of Laboratory General and Food Microbiology," Arzhand Press, 2000, pp.10-68.
[12] A. Agah, "Raisin Test; Characteristics and Methods," Standard and Industrial Research Institute of Khorasan, 1997, pp.1-25

Peiman Ariaii has received his undergraduate and graduate degrees in Food Technology from Islamic Azad University, Sabzevar Branch in Iran.. He is currently lectures at the Azad University in Amol. He teaches food analysis, operation at food technology and drying at food technology Department.peiman has been two lectures at the Islamic Azad University, Ghaemshahr Branch and Khazar University. His primary research interests include dairy and canning process, and food process optimization. Peiman has presented his research in numerous national and international conferences.