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The Effect Of Depectinization & Clarification On Sour Cherry Juice Quality

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SUMMARY

In this research, the effects of depectinization and clarification on sour cherry juice quality were evaluated. Some quality tests were done on sour cherry juice produced by filtration of raw juice, depectinized juice and depectinized plus clarified juice. In the present study, all the experiments were performed by using the sour cherries harvested in 1990 and 1991.

Some losses in chemical composition of sour cherry juice was observed through processing. However, the lightness, taste and clearness of the products were the best in the case of depectinized plus clarified juice.

VİŞNE SUYU ÜRETİMİNDE DEPEKTİNİZASYON VE DURULTMA İŞLEMİNİN KALİTESİYE ETKİSİ

ÖZET

Bu araştırmada, depektinizasyon ve durultmanın vişne suyu kalitesine etkisi incelenmiştir. Sadece preslenmiş, depektinize edilmiş ve depektinizasyon ile birlikte durultulmuş vişne suları üzerinde bazı kalite kontrol analizleri yapılmıştır. Bu araştırma 1990 ve 1991 yıllarında hasat edilen vişnelerden elde edilen örneklerle yürütülmüştür.

İşlemler sırasında vişne suyunun kimyasal bileşiminde bazı kayıplar ortaya çıkmıştır. Buna rağmen ışık geçirgenliği, tat ve berraklık açısından en iyi ürünün depektinizasyona uğratılmış ve durultulmuş vişne suyu olduğu belirlenmiştir.

INTRODUCTION

In the production of sour cherry juice, the major steps involve: washing, sorting, mash treatment, pressing, screening, depectinization, clarification, filtration and parsteurization. The quality of the final products in believed to depend on raw material quality, storage conditions and produrtion stages (Poll, 1986).

Type of the press used affect the yield and the composition of fruit juice, especially pectin that leaves the pulp and passes to the juice (Eksi, 1988).

Since sour cherry juice is categorized in clear fruit juices, destabilization of the colloidal particles such as cellulose, hemicellulose, starch, araban, protein, polyphenol, metal ions and pectic substances is necessary.

The pectic substances located primarily in the middle lamella between the cells in higher plant tissues, are complex polysaccharides. The pectic substances and the enzymes which degrade them are of the major importance to the fruit juice production industry because of their effect on texture. During depectinization, pectin is hydrolyzed by the action of pectolytic enzymes and so the viscosity of the juice decreases. It is necessary for better clarification and filtration. Also as the pectin is a high molecular weight colloid that acts as a protective colloid in suspending the particles in sour cherry juice, when it is hydrolyzed these particles are released and settle out of the juice leaving the supernatant juice clear (Tressler and Joslyn, 1971).

For clarification, gelatin, kieselsol, bentonite, clays, etc. may be added. This results in settling out of the fine juice, which makes the filtration moıe effective. The reason for this precipitating action of these agents is the charge difference between the colloidal materials and flocculants.

The amount of gelatin used is very important in the clarification of sour cherry juice. It shouldn't be used or should be used in low quantity since it may cause color loss (Cemeroğlu, 1982).

Color of the product is affected by the operations in fruit juice production line. Mash heating before pressing yields more intensely red color. With diatomite filtration, anthocyanin pigments are adsorbed, decreasing the color of the juice. No significant color loss is observed following a treatment with pectolytic enzyme to clarify the juice (Tressler & Joslyn, 1971).

Each stage in sour cherry juice production line affects the quality of the juice. The purpose of this study was to observe the effects of depectinization and clarification on product quality.

MATERIAL AND METHODS

MATERIAL :

Sour cherries (**Prunus cerasus**, L.) from a local variety (Afyon) harvested in 1990 and 1991 were used in the experiments. The fabric filter medium which was tightly woven synthetic cloth manufactured locally and used in beet sugar production industry was employed. For filter aid dose, 0.005 g/cm^3 juice and for precoating 0.10 g/cm^2 filter area, diatomaceous earth with 20 μm average particle size were used (purchased from Turkish Sugar Factories Inc., Ankara).

METHODS :

Sour cherry juice production was done in three different ways to observe the effects of the previous units on product quality : Raw juice, depectinized juice, depectinized plus clarified juice.

For the production of raw juice, sour cherries harvested in 1990 had been stored in polyethylene bags at about —18°C. For the experiment, they were thawed by placing them in a water bath at about 70°C, held at temperature for 5 minutes and then cooled to room temperature. After cooling, pressing was applied manually. After that, filtration was done.

In the case of depectinized and depectinized plus clarified juice productions, first sour cherries were washed and sorted to remove the spoiled and damaged fruits and leaves. Then, these were elevated to the fruit mill that reduced them to a pulp suitable for juice extraction. Next, mash was heated to 65-70°C in a tubular heater. After that, sour cherry juice extraction was done for 20 minutes by using hydraulic press (Bucher-Guyer AG, Switzerland). Then, the juice was screened to remove the coarse particles. After that, enzyme treatment was done at about 50°C for 2 hours by using Pectinex 3XL (Rohm) which is a highly purified pectolytic enzyme preparation containing mainly polygalacturonase, pectinesterase, hemicellulase and pectintranseliminase. After depectinization was completed, this juice was stored in plastic bottles in deep-freeze at about — 18°C. For the second and third set of the experiments this stored ju'ce was thawed by placing the bottle in the running cold water and shaking it from time to time. In the case of depectinized juice, this thawed juice was filtered directly. For the production of depectinized plus clarified juice, on the other hand, clarification was also done before filtration. For clarification, gelatin, kieselsol and bentonite were used. Finally, filtration was performed.

When the sour cherries harvested in 1991 were used, all the procedure was the same except deep-freeze storage.

For all the three cases, filtration procedure was the same. The experimental set up was composed of three major parts: Pressure supply which was nitrogen gas, reservoir which was 2.5 L stainless steel storage vessel and a standard filtration cell holder (Spectra/Por, Spectrum Medical Ind, NY). Storage vesselsei had been placed on top of a magnetic stirrer to prevent settling. Filtration cell holder was originally manufactured for ultrafiltration studies but instead of ultrafiltration membranes filter media was employed for this study. Filtration area of the cell holder was 30.2 cm^2. Experiments were performed at 21°C under 0.65 atm. gauge pressure.

Some quality analysis were done on sour cherry juices produced in three different ways by using the sour cherries harvested in 1990 and 1991 to observe the effects of pretreatment steps on product quality.

Density measurements was done by using pycnometer. Viscosity measurements were done with Cannon - Fenske capillary viscometer (Schott and Gen., Mainz, Germany). Total titratable acidity was determined by titrating with 0.1 N NaOH to a pH end point of 8.1. The results were expressed as g malic acid/L juice (Poll, 1986; Pilando et al., 1985). pH was measured with a pH meter (Corning Model 10, England).

Soluble solids were determined with a refractometer (Tajiri Ind. Co. Ltd., Japan). Alcohol insoluble solids, ascorbic acid, ash and protein determinations were done according to the A.O.A.C. methods. Mineral content of sour cherry juice was also determined by using atomic absorption spectrofotometer (Varian - Techtron AA 175). Formol number was determined by using IFJU method.

Invert sugar content was determined by using Lane and Eynon method (AOAC, 1975). In addition, alcohol test was done to evaluate the presence of pectin in the product (Eksi, 1988).

For color analysis, UV Spectrophotometer (Shimadzu, UV - 2100//2100 S; Japan) was used. The absorption maxima was at 515.6 nm for sour cherry juice in aqueous medium. The following measurements were made as described Fuleki & Francis (1968); Markakis, (1979); Poll (1986); Pilando et al. (1985); Rommel et al. (1990); Somers & Evans (1977) and Wrolstad (1976): total monomeric anathocyanin pigment by both pH differential and single pH methods (as mg cyanidin - 3 - glucoside/L juice which is the major anthocyanin found in sour cherry juice, using extinction coefficient, $\epsilon = 29600$); anthocyanin degradation index (Total anthocyanin by single pH determination/total anthocyanin by pH differential method); color density and polymeric color $(((Abs_{420} + Abs_{515.6}) - 2\,(Abs_{700}))\,DF)$ before and after bisulfite bleaching respectively, Abs_{700} value was the correction factor for turbidity since at this wavelength absorbance approaches to zero as turbidity decreases and DF is the dilution factor; percentage polymeric color ((polymeric color/color density) *100); browning (absorbance at 420 nm after bisulfite bleaching); turbidity (absorbance at 700 nm by assuming zero absorbance is obtained for zero turbidity at this wavelength) and Hunter L, a and b color analysis. All the analysis were done in duplicate and average values were taken.

RESULTS AND DISCUSSION

Changes in chemical composition of sour cherry juice through processing are listed in Table 1 for all the three cases in two different harvesting times. The values reported are means of duplicate analysis.

No significant change in density was observed (Fig. 1). Raw juice contained the highest amount of soluble solids (Fig. 2). Depectinization caused some decrease in viscosity due to the hydrolyzation of pectin. Clarification, on the other hand, did not give any additional effect to the viscosity (Fig. 3). Change in pH was not significant (Fig. 4). Decrease in total titratable acidity due to usage of alkaline material in clarification and invert sugar are shown in Figures 5 & 6.

In addition, protective action of pectin for suspending particles were removed as a result of depectinization. Clarification also resulted in settling of colloidal particles. So, alcohol insoluble solids content of juice decreased through depectinization and clarification (Fig. 7).

Decrease in protein content and formol number which is related with the free amino acid content are shown in Figures 8 & 9. Protein and peptides form complexes with heavy metal ions. During depectinization and clarification metal ions sediment together with peptides and proteins. Decrease in ash content of sour cherry juice during processing is shown in Figure 10. Change in mineral content of product through processing is given in Table 2. Decrease in copper, zinc, manganase and iron are shown together in Figure 11. Ascorbic acid content is lower in depectinized and depectinized plus clarified juices. This may be due to their storage after depectinization since the surface area which is in contact with oxygen is larger as compared to the storage of sour cherries directly in the case of raw juice production. For clarification, juice is waited for overnight after thawing. This cause additional decrease in ascorbic acid content (Fig. 12). Alcohol test confirmed the presence of pectin in the case of raw juice and hydrolyzation of pectin completely in the case of depectinized plus clarified juice. The results of color analysis of sour cherry juice were summarized in Table 3.

Total monomeric anthocyanin was the highest in the case of raw juice and decreased through processing (Fig. 13). Decrease in pH due to galacturonic acid production during depectinization may be the reason for anthocyanin loss. Even in the case of raw juice, total monomeric anthocyanin content was quite lower as compared to the values mentioned in literature which is in the range of 500-700 mg/L (Poll, 1986). This may be due to the variety, degree of ripeness and anthocyanin loss during frozen storage of raw material or due to the adsorption of anthocyanin pigments during diatomite filtration.

Browning which is proportional with anthocyanin degradation decreased (Fig. 14). The results of color, density and polymeric color were given in Fig. 15 & 16. Color density is proportional with anthocyanin, anthocyanin degradation and browning.

Decrease in turbidity through depectinization and clarification was observed as expected due to the removal of pectin and other collodial particles (Fig. 17).

Raw juice was the darkest one in all the three samples in both 1990 and 1991 as shown by the lowest «L» value and highest color density (Fig. 18). Lightness, redness and yellowness indices of Hunter measurements increased through processing.

The results obtained from the sour cherries harvested in 1990 and 1991 was not compared since storage time, maturity, variety were not the same but in both year's production similar trends were observed.

TABLE 1. Sour Cherry Juice Composition

	1990			1991		
	RJ*	DJ	DCJ	RJ	DJ	DCJ
Density (g/mL)	1.10	1.10	1.09	1.09	1.07	1.07
Soluble solids (°Bx)	21,8	21.2	17.8	18.4	18.0	14.8
Viscosity (g/cm s)	0.020	0.018	0.108	0.108	0.105	0.015
Titratable acidity (% malic acid)	0.82	0.79	0.68	0.82	0.75	0.73
pH (20°C)	3.25	3.20	3.20	3.30	3.20	3.20
Reducing Sugar (mg/mL)	8.17	7.67	6.82	6.82	6.46	6.14
Alcohol Insoluble Solids (%)	0.200	0.150	0.083	0.215	0.157	0.084
Ascorbic acid (mg/100 mL)	16.4	16.0	15.8	13.6	13.5	13.2
Formol number	14	10	7	12	10	8
Protein (%)	0.675	0.487	0.219	0.549	0.392	0.197
Ash (%)	0.63	0.61	0.60	0.53	0.52	0.51

TABLE 2. Mineral Content of Sour Cherry Juice

	1990			1991		
Mineral (mg/kg)	RJ	DJ*	DCJ*	RJ	DJ	DCJ
Potassium (K)	3000	3075	3075	2925	3125	280
Sodium (Na)	3	3	3	3	2	2
Calcium (Ca)	72	69	67	112	100	92
Magnesium (Mg)	216	208	197	164	148	136
Phosphorous (P)	127	112	104	128	89	82
Iron (Fe)	0.800	0.700	0.550	0.871	0.834	0.785
Copper (Cu)	0.15	0.12	0.11	0.171	0.149	0.147
Zinc (Zn)	0.210	0.170	0.140	0.320	0.291	0.282
Manganase (Mn)	0.321	0.305	0.299	0.278	0.257	0.2

Tablo 3. Color Analysis of Sour Cherry Juice

	1990			1991		
	RJ	DJ	DCJ	RJ	DJ	DCJ
Degradation Index	1.17	1.15	1.10	1.17	1.14	1.11
Color Density	9.62	6.60	5.14	12.2	12.64	12.68
Polymeric Color	4.16	2.60	1.98	4.12	1.22	1.08
Polymeric Color (%)	43.24	39.39	38.52	19.43	9.65	8.52
Browning	2.66	1.70	1.30	2.80	0.90	0.78
Hunter L	8.237	9.338	13.405	9.405	14.337	15.556
Hunter a	23.804	27.104	36.398	27.795	37.069	40.467
Hunter b	5.892	6.633	9.473	6.905	10.091	10.953
Hunter a/b	4.040	4.086	3.842	4.025	3.673	3.694
Turbidity (Abs 700)	0.023	0.022	0.013	0.021	0.021	0.007
Tot. mon. anth. (mg/mL)	41.8	32.5	29.5	37.9	29.2	25.1

* RJ : Raw Juice ; DJ : Depectinized Juice DCJ : Depectinized & Clarified Juice

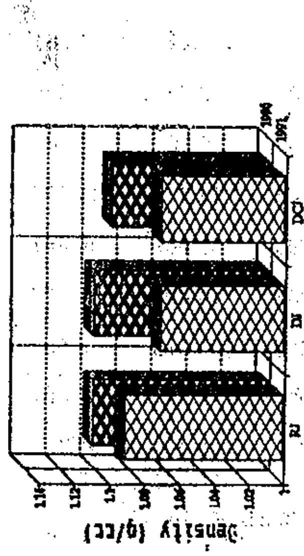
Fig.1.Variation of Density

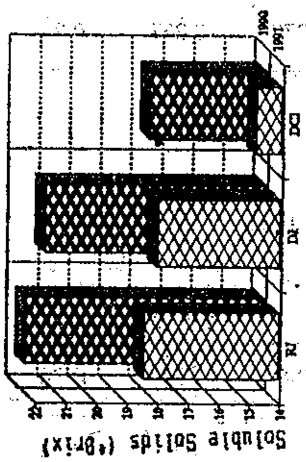
Fig.2.Variation of Soluble Solids

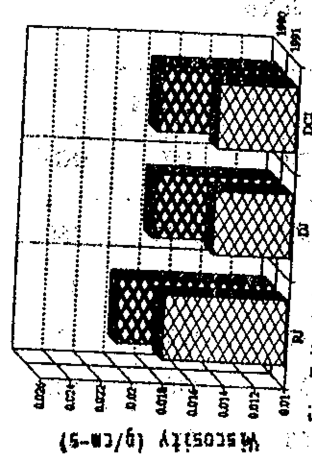
Fig.3.Variation of Viscosity

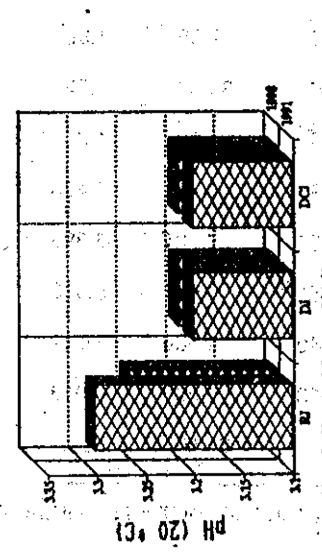
Fig.4.Variation of pH

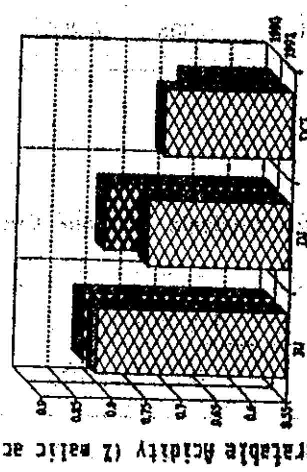
Fig.5.Variation of Titratable Acidity

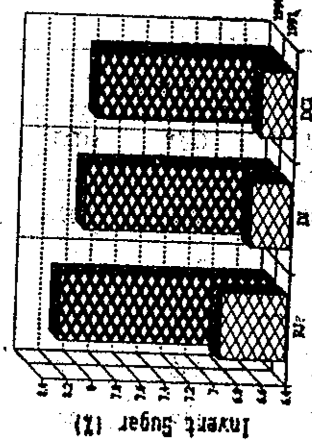
Fig.6.Variation of Invert Sugar

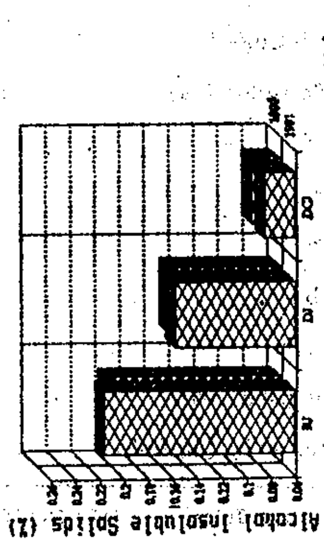
Fig.7.Variation of Alcohol Insoluble Solids

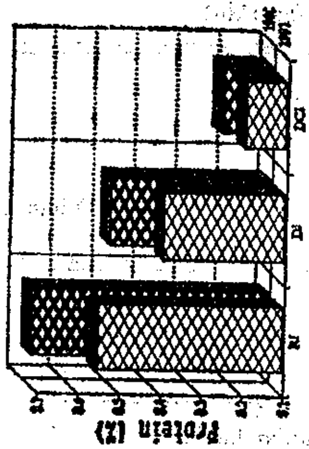
Fig.8.Variation of Protein

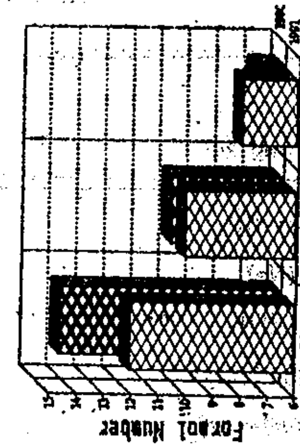
Fig.9.Variation of Formol Number

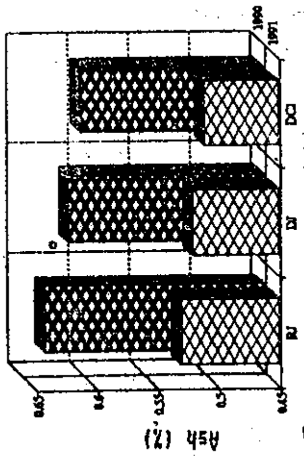

Fig.10.Variation of Ash

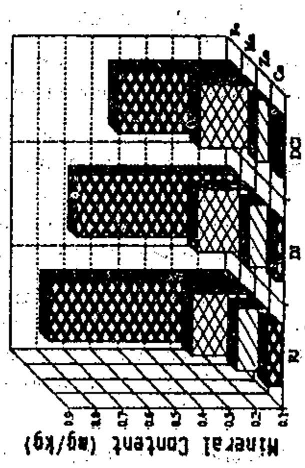

Fig.11.Variation of Mineral Content

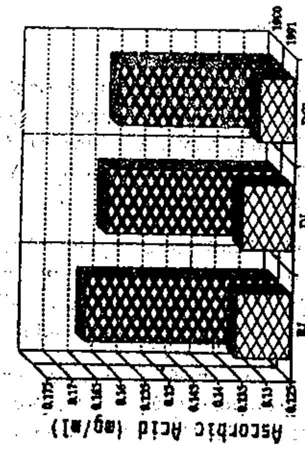

Fig.12.Variation of Ascorbic Acid

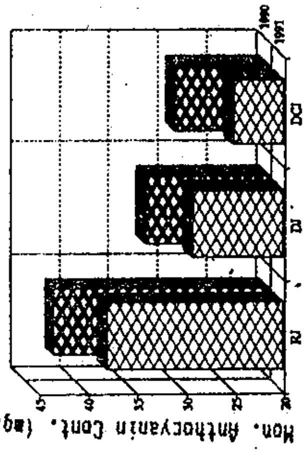

Fig.13.Variation of Anthocyanin

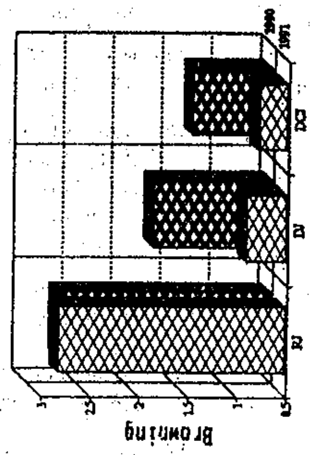

Fig.14.Variation of Browning

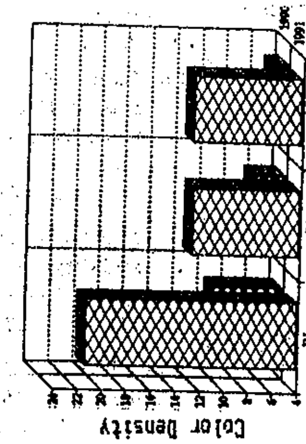

Fig.15.Variation of Color Density

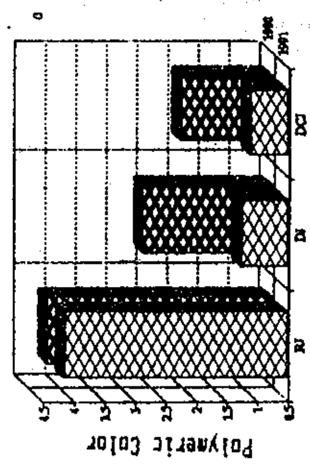

Fig.16.Variation of Polymeric Color

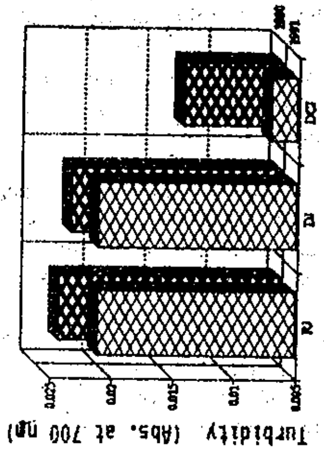

Fig.17.Variation of Turbidity

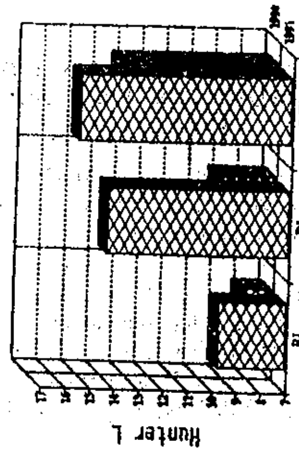

Fig.18.Variation of Hunter L Value

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