Effects of Storage Time and Condition on Mineral Contents of Grape Pekmez Produced by Vacuum and Classical Methods[1]

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This study was conducted to investigate the effect of storage period and conditions on chemical properties of boiled grape juice (pekmez) produced from the grape variety of Kınalı Yapıncak using classical and vacuum methods. Pekmez samples were stored in 250 cc volumed jars. Products obtained using two different production methods were stored for 10 months in room conditions and at +4 ºC temperature. Starting from the beginning of the storage, mineral analyses were repeated in every two months. Average copper, manganese, phosphorus, and sodium contents in pekmez samples produced by vacuum method were higher than by classical method at the end of storage period. But, calcium content in pekmez samples produced by classical method was higher than that of the other. Zinc, iron, and potassium contents in either vacuum method or classical method were not significantly different. In conclusion; in general, mineral contents were better in pekmez produced by vacuum method than classical method.

Phosphor, sodium, potassium, calcium, copper, zinc and manganese contents were affected significantly by storage period, but iron was not. In addition, storage condition did not affect sodium, zinc and iron contents.

Keywords: Pekmez production, grape Pekmez, Mineral matter

Vakum ve Klasik Yöntemle Üretilen Pekmezlerin Kimyasal Özellikleri Üzerine Depolama Zamanı ve Koşullarinin Etkisinin Saptanması

Çalışmada Kınalı Yapıncak çeşidi üzümden vakum ve klasik metodla üretilen üzüm pekmezlerinin mineral içerikleri üzerinde depolama süresi ve koşullarının etkisi araştırılmıştır. Pekmez örnekleri 250 cc hacimli kavanozlarda ambalajlanmıştır. İki farklı üretim yöntemiyle elde edilen ürünler +4 ^{o}C de ve oda koşullarında 10 ay süreyle depolanmıştır. Depolamanın başlangıcından itibaren iki ayda bir kimyasal analizleri yapılmıştır. Vakum yöntemi ile üretilen pekmez örneklerinde ortalama bakır, mangan, fosfor ve sodyum miktarları klasik yöntemle üretilenden yüksek bulunmuştur. Fakat kalsiyum miktarı klasik yöntemle yapılan üretimden yüksek olmuştur. Çinko, demir, potasyum miktarları bakımından iki yöntem arasında önemli fark görülmemiştir.

Fosfor, sodyum, potasyum, kalsiyum, bakır, çinko, mangan miktarları depolama süresinden önemli ölçüde etkilenirken, demir miktarındaki değişim önemli bulunmamıştır. Ayrıca, depolama koşulları sodyum, çinko ve demir miktarlarındaki değişimi önemli ölçüde etkilememiştir.

Anahtar Kelimeler: Pekmez Üretimi, Üzüm Pekmezi, Mineral Madde

[1]This paper consists of a part of the Ph.D. thesis of Serap KAYIŞOĞLU

Introduction

Boiled grape juice is named as "pekmez" in Turkey. When heat is applied to grape juice, it is thickened then pekmez is produced. Pekmez includes nourishment as in fresh grape and doesn't include any additives. Approximately 37% of grapes produced in Turkey is used in pekmez production every year. This content refers to about 250.000 tones/year pekmez *(*Köylü,1997). Pekmez is produced in all regions of Turkey but varieties of grapes and techniques used in pekmez production are different. Pekmez products of good quality are produced in Zile, Kırşehir, Kastamonu, Sivrihisar, Afyon, Kahramanmaraş, Gaziantep and Hatay in Turkey. These products are called according to produced regions, for example zile pekmez (Tekeli, 1965).

Pekmez is a good source of energy and carbohydcontent source due to its high sugar content ranges betwen 50%-80%. Average energy value is 280 kcal/100g (Güven,1982). Pekmez is nutritious food. Specially, pekmez is rich in iron, phosphor, calcium, and potassium minerals (Ekşi and Artık,1984).

(Kavas, 1990) stated that iron in dried grape and pekmez is absorbed easily by digestive system and these products can satisfy 37% of daily iron requirement. Researcher notified that glucose and fructose in pekmez bound easily with phosphor and turn into energy. Additionally, calcium and phosphor content are in desired degree for children.

Grape pekmez is produced with classical and vacuum (modern) methods in Turkey. Content of production by classical method is higher than vacuum method. Specially, in rural regions pekmez is produced by classical method (Batu et al., 1992)

(Üstün and Tosun,1997) investigated the composition of 11 pekmez samples. The ranges of average values obtained from 11 pekmez samples were as follows; total dry matter 71.9 - 84.4%; total sugar 49.8 - 76.8; invert sugar 16.8 - 67.9%; sakkaroz 0 - 32.4%; ash 0.41 - 2.44%; HMF content 7,38 -166,05 mg/kg; calcium 50.9 - 206.1 mg/100g; sodium 25.4 - 83.2 mg/100g; manganesse 11.03 - 68.31 mg/100g; phosphorus 0 - 95.06 mg/100g; iron 2.62 - 16.30 mg/100g; copper 0.29 - 0.94 mg/100g; zinc 0.18 - 0.74 mg/100g.

The aim of this study was to investigate the effect of storage period and conditions on mineral contents of pekmez produced by classical and vacuum methods.

Materials and Methods

Materials

In this research, pekmez was produced from the grape variety of Kınalı Yapıncak using vacuum and classical methods. 500 kg of grape were used for pekmez production. Pekmez samples were stored in 250 cc volume jars. In addition, Grape mill, basket press, and evaporator were used in pekmez production.

Methods

Pekmez production schemes produced by vacuum and classical methods were given in Figure 1 and Figure 2, respectively.

Pekmez products that were produced by vacuum and classical medhods, stored for ten months under following conditions:

CMCR : Classical method in room condition; CMCC : Classical method in +4 °C condition; VMRC : Vacuum method in room condition;

VMCC : Vacuum method in +4 °C condition.Analysis with tree replications before the storage and every two months during 10 months period after the storage were done.

Phosphor content was determined by spectrometric method (Turkish Standard No:10949) (Anonymous,1993). Sodium, potassium, and calcium contents were determined by flame photometer (Pomeranz et al.,1977) Copper, zinc, manganese, and iron contents were determined by atomic absorption spectrometer (Gökalp et al.,1993). All samples were prepared according to dry firing method.

Samples were established in two factor factorial treatment. And the results were tested by variance analysis using LSD method at $p<0.05$ significant level (Düzgüneş et al.,1987); (Soysal, 2000).

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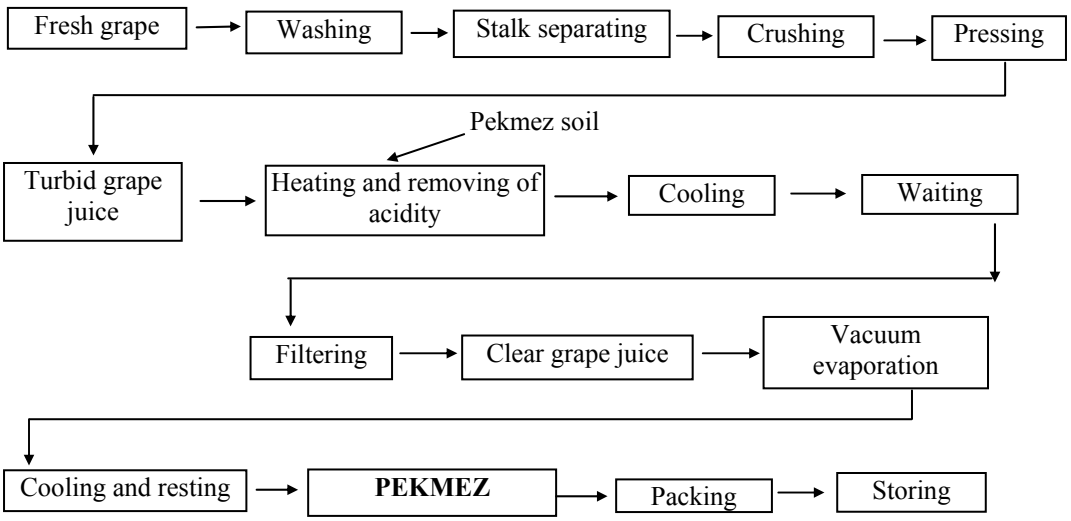

Figure 1. Pekmez production schemes of vacuum method

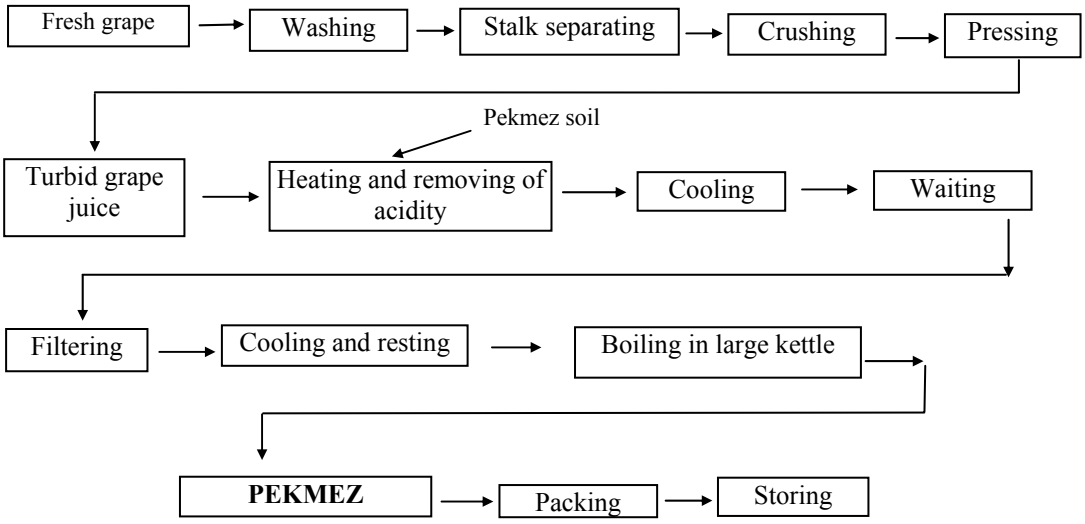

Figure 2. Pekmez production schemes of classical method

Results and Discussion

Micro mineral contents of pekmez samples including zinc, copper, magnesium and iron were given in Table 1. Methods of production did not significantly effect zinc content of the samples (F=0.01). But, period of storage significantly affected zinc content (F=93.88**; LSD=11.761). Zinc content decreased rapidly in all treatments until the sixth month, than there was not noteworthy decrease in the content of zinc. Besides, storage conditions did not have significantly effect on zinc content (F=2.19). (Köylü,1997) founded that the content of zinc in classical and vacuum pekmez as 3.3 mg/kg and 17.3 mg/kg, respectively. In this research, content of zinc in vacuum pekmez was also found to be higher than the classical pekmez. However zinc contents of the samples produced with both methods were greater than that of *Koylu*'s.

Table 1. Changes of microelement contents of pekmez samples produced by vacuum and classical methods during the storage period (mg/kg) [z]

Storage Time (Months)	CMRC	CMCC	VMRC	VMCC	Average
			Zinc		
0	142.0	142.0	150.3	150.3	**146.1 a**
2	120.3	128.4	99.2	122.5	**117.6 *b***
4	95.5	118.7	97.0	98.2	**102.3 *c***
6	56.6	56.4	67.1	62.2	**60.6 *d***
8	54.8	53.5	57.2	61.9	**56.9 *d***
10	54.5	55.3	57.5	59.2	**56.6 *d***
Average	**87.3**	**92.4**	**88.1**	**92.4**	
			Copper		
0	12.267	12.267	12.516	12.516	**12.392 a**
2	12.133	12.223	12.256	12.400	**12.253 *a***
4	11.158	11.954	11.584	11.854	**11.637 *b***
6	10.605	10.730	10.582	10.744	**10.665 *c***
8	9.522	9.868	9.803	10.184	**9.844 *d***
10	9.395	9.472	9.763	10.083	**9.678 *d***
Average	**10.847 *c***	**11.086 *b***	**11.084 *b***	**11.297 *a***	
			Manganese		
0	10.248	10.248	12.769	12.769	**11.509 a**
2	9.452	9.966	11.601	12.002	**10.755 *b***
4	9.354	9.738	11.340	11.414	**10.461 *b***
6	8.546	9.283	10.839	10.889	**9.889 *c***
8	7.740	9.197	10.475	10.695	**9.527 *c***
10	7.414	8.161	8.429	9.872	**8.469 *d***
Average	**8.792 *c***	**9.432 *b***	**10.909 *a***	**11.273 *a***	
			Iron		
0	113.9	113.9	116.4	116.4	**115.1 a**
2	115.0	112.5	102.6	98.4	**107.1 *a***
4	104.2	94.1	95.9	96.0	**97.5 *b***
6	78.3	82.1	86.1	89.5	**84.0 *c***
8	77.1	80.6	86.1	88.1	**83.0 *c***
10	76.5	80.7	86.5	87.3	**82.8 *c***
Average	**94.2**	**94.0**	**95.6**	**95.9**	

[z] means are different at .05 level (LSD)

CMCR : Classical method in room condition CMCC : Classical method at +4 °C condition
VMRC : Vacuum method in room condition VMCC : Vacuum method at +4 °C condition

Methods of production (F=11.15**) and storage period (F=11.31**) significantly affected copper contents. Average copper contents of all treatments at the end of the tenth month decreased 21.9% in comparison to the initial contents. Conditions of storage significantly affected copper contents (F=208.97**; LSD=0.248). (Üstün *and Tosun,1997)* studied on 11 pekmez samples and they founded that the level of copper varied between 2.9 - 9.4 mg/kg. These values were in accordance with our values.

Iron contents in both, conventional and vacuum, methods were only affected by storage periods significantly (F=780.1**; LSD=8.366). Iron contents decreased sharply until the sixth month, than a small decrease was obsarved. (Artık and Velioğlu,1993) stated that iron content in pekmez was 100 mg/kg. (Üstün and Tosun,1997) studied on pekmez and they founded content of iron in pekmez varied between 26.2 - 163.0 mg/kg. In this research, the values of iron contents were in accordance with their values.

Changes of content of macro elements in pekmez which was produced by using conventional and vacuum methods during the storage period were given in Table 2. Methods of pekmez production (F=71.99**) and storage condition (F=32.29**) significantly affected sodium contents. While sodium content in classical method was slightly higher when compare to the vacuum method. The storage period significantly affected sodium content (F=37.49**; LSD=2.361). *Kavas* [6] stated that content of sodium in pekmez was 96 mg/100g. (Batu et al.,1992)investigated that there was no differences between conventional and vacuum method in respect sodium content. These researchers determined sodium content of the pekmez samples between 336.9 - 386.3 mg/kg. In this research sodium content of the pekmez samples were in accordance with related articles but some were not.

Methods of pekmez production (F=1.91) and storage period (F=0.61) did not effect content of potassium. But, storage conditions significantly affected potassium content (F=23.75**; LSD=1100.5). Content of potassium in classical method was more than in vacuum method in early period. After the second month, values of potassium content in each method were almost same. At the end of storage period, average content of potassium in all treatments was decreased by about 7%.(Batu et al.,1992) stated that pekmez produced by classical method contained more potassium than produced by vacuum method, varying between 13078 - 56505 mg/kg which were consistent with our values.

Content of calcium in conventional method was twice more than in vacuum method. There was differences between two methods according to statical analyses (F=39.53**) . On the other hand, storage conditions did not effect calcium content (F=0.53). Storage period significantly affected calcium content (F=6.69**; LSD=716.6). Calcium content in Pekmez produced by vacuum method decreased slightly until the sixth month. Whereas, in classical method, after sixth month, it decreased sharply and reached to the level of vacuum method. Average calcium content in all treatments decreased by about 65% according to beginning values. (Artık and Velioğlu,1993) stated that average calcium content in pekmez was 4000 mg/kg.(Köylü,1997) determined that content of calcium in classical method was 1365.2 mg/kg and 1051.6 mg/kg for vacuum method. In this research, calcium contents of the samples were similar to the *Koylu*'s values.

Methods of pekmez production (F=54.61**) and storage period (F=43.35**; LSD=16.024) significantly affected content of phosphor. Storage conditions did not affected content of phosphor content (F=0.35). Content of phosphor in vacuum method was higher than conventional method. According to beginning values, it decreased 15.2% at the end of tenth month. (Batu et al., 1992) reported that there was no differences between vacuum and classical methods in respect to phosphor content. They revealed that phosphor values ranged between 155.6 - 1541.1 mg/kg. These values were similar to our values.

Table 2. Changes of macro element contents of pekmez samples produced by vacuum and classical methods during the storage period (mg/kg)[z]

Storage Time (Months)	CMRC	CMCC	VMRC	VMCC	Average
			Sodium		
0	11149.9	11149.9	9341.3	9341.3	**10245.6 a**
2	9039.5	9095.7	9067.1	9144.5	**9086.7 *b***
4	7793.7	7953.2	7811.9	8099.6	**7914.6 *bc***
6	7689.7	7725.9	7716.1	7970.5	**7775.5 *cd***
8	7510.8	7713.3	7395.7	7766.2	**7596.5 *d***
10	7473.5	7494.6	7434.0	7676.6	**7519.7 *e***
Average	**8442.8**	**8522.1**	**8127.7**	**8333.1**	
			Potassium		
0	682.6	682.6	698.0	698.0	**690.3 a**
2	639.1	665.7	662.0	689.1	**663.9 *b***
4	632.1	653.4	673.4	687.2	**661.5 *c***
6	627.6	642.3	649.5	680.1	**649.9 *c***
8	620.4	635.4	646.4	664.4	**641.6 *c***
10	581.6	611.7	618.1	649.2	**615.1 *c***
Average	**630.6 *c***	**648.5 *b***	**657.9 *b***	**678.0 *a***	
			Calcium		
0	2946.3	2946.3	1340.4	1340.4	**2143.4 a**
2	2916.2	2921.6	874.4	1223.3	**1983.8 *a***
4	2574.4	2675.6	812.2	1078.9	**1785.3 *a***
6	2510.0	2586.0	715.7	836.1	**1661.9 *a***
8	1099.8	1266.9	598.6	800.1	**1191.3 *b***
10	468.2	625.9	510.5	760.2	**941.2 *b***
Average	**2085.8 *a***	**2570.4 *a***	**808.6 *b***	**1006.5 *b***	
			Phosphor		
0	660.8	660.8	677.0	677.0	**668.9 a**
2	622.8	640.3	657.4	643.1	**640.9 *b***
4	608.9	626.1	655.2	637.3	**631.9 *b***
6	596.7	598.1	620.7	631.7	**611.8 *c***
8	581.6	578.2	627.6	625.7	**603.3 *c***
10	535.3	545.4	588.1	599.1	**567.0 *d***
Average	**601.0 *b***	**608.1 *b***	**637.7 *a***	**635.6 *a***	

[z] means are different at .05 level (LSD)

CMCR : Classical method in room condition CMCC : Classical method at +4 °C condition
VMRC : Vacuum method in room condition VMCC : Vacuum method at +4 °C condition

Conclusion

Because of decrease in ash content, mineral content of pekmez produced by vacuum and classical methods decreased during the storage period (Batu et al.,1992). Average copper, manganese, phosphorus, and sodium contents in pekmez samples produced by vacuum method were higher than by classical method at the end of storage period. But, calcium contents of pekmez samples produced by classical method were higher than that of the other. Zinc, iron, and potassium contents in either vacuum method or classical method were not significantly different. Especially, decrease in copper, zinc, and potassium contents during the storage period in all treatments were very high until the sixth month. Except manganese and sodium, the other minerals were not affected significantly by storage conditions of pekmez. Results showed that, in general, mineral contents were higher in pekmez produced by vacuum method than classical method. But, sedimentation in vacuum pekmez is an important problem. Therefore refining process in vacuum pekmez should be made. In addition, the color of vacuum pekmez is not preferred much in market by Turkish People. In reality, the color has not effect on the nutrient contents; vacuum pekmez should be well presented.

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