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Variation of Copper, Iron, and Zinc Levels in Pekmez Products

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Pekmez is a very popular and traditional food products in Turkey and it is produced in almost every region of the country. Fruits containing high sugar like mulberry, plum, apple, and mainly grape are used as raw material in the production of Pekmez. According to investigations in Turkey, about 20% of all growth grapes were used in Pekmez production in 1982, this ratio was about 18% in 1992 (Nas and Nas, 1987; Batu and Aktan, 1992; Batu, 1993). Pekmez has been produced since ancient but its production technique has not been developed. Fruit-juice, which was obtained with different techniques, used in producing Pekmez, is boiled with the Pekmez soil (this soil is added to the grape-juice in order to neutralize its acidity and contains 50-90% of $CaCO_3$, and it has various colors from white to light brown). After than, it is concentrated in the boiler on naked flame after filtration. This concentrated fruit-juice is a very clear and brownish product (Batu and Aktan, 1992; Batu and Yurdagel, 1993). Consumption of Pekmez has decreased by the time nowadays although Pekmez was one of the basic food materials for human in previous years. However, its importance in human nutrition has never decreased. Nevertheless, it was determined that 60% of people in social living areas did not consume any Pekmez according to a research results in 1984 (Batu, 1993). As Pekmez contains high mineral contents and gives energy, it is important in human nutrition. Pekmez contains copper and zinc at definite levels especially it is very rich for iron. As it is known, iron, copper, and zinc are essential minerals for human health.

Trace elements are important both toxicological and nutritional viewpoints. Iron, copper and zinc are essential, while their ingestion at excessive levels result in toxicological effects in body. Human takes these elements from numerous sources, including food, drinks and water. Dietary intake is considered to be the major supplier of these elements for body (Hallberg et al., 1993; Miller, 1996). Therefore, the levels of consumed food products should be investigated. For this reason, in this research, it was aimed to determine the levels of iron, copper and zinc in the marketed Pekmez products which made from grape-juice and known as a rich source of minerals.

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MATERIALS AND METHODS

The Pekmez samples collected from markets in Samsun, İzmir, and Konya were used in this study. After mixing the samples very well to obtain homogeneity, 10g were weighed in a borosilicate glass beaker, and the dry ashing method advised by Jorhem (1993) was applied. Later, ash was diluted to 10 ml with 10% of nitric acid (Merck).

All equipment used for sample treatment and storage were prepared for the analysis by washing (Jorhem 1993), and tested for contamination by leaching with 5% nitric acid (Merck).

The flame atomic absorption spectrophotometry (AAS) method was used for determination of the iron, copper, and zinc levels in the digested samples (Jorhem, 1993). The Varian SpectrAA-880 model and Perkin Elmer- Model flame AAS systems were used for measuring. The measurements were made using the iron, copper and zinc hollow cathode lamps with slit intervals and at the wavelengths of 0.2 nm and 248.3 nm, 0.5 nm and 324.7 nm, 1.0 nm and 213.9 nm, 0.5 nm and 283.3 nm, 0.5 nm and 228.8 nm, respectively. Three replicate readings were taken for each sample, and the mean values of these figures were used to calculate the concentrations. The detection limits for each metal were calculated as three fold of the standard deviation of the mean blank concentrations, and the values for iron, copper, and zinc were found to be 6 μg/kg, 5 μg/kg, and 1 μg/kg, respectively.

The one-way analysis of variance and the *Tukey* pairwise comparison test were applied in statistical evaluation of the results. They were designed by using the program of the Minitab-12. The first type α=5% of error tolerance was used in the tests.

RESULTS AND DISCUSSION

The results obtained from the study on the quantities of iron, copper and zinc are given in Table 1, 2, and 3.

Table 1. Iron in Pekmez (mg/kg)

City Name	No. of Samples	Mean±SD	Median	Range	95th % value
Samsun	36	19.46±14.00	16.00	6.38-80.00	44.00
Konya	36	33.67±29.87	18.85	5.50-110.20	93.11
İzmir	36	25.83±25.00	19.40	5.90-130.00	74.25
Total	108	26.32±24.38	17.80	5.50-130.00	85.66

As shown in Table 1, the iron values of 108 Pekmez samples varied between 5.50 mg/kg and 130.00 mg/kg in all cases. The mean and 95th % values differed from each other among the cities. Statistically important differences in iron levels were found ($p<0.05$) among cities. It was determined that the results of Samsun and Konya have great role on these differences with using the *Tukey* pairwise comparison test.

The iron values of analyzed Pekmez samples varied between 33.80 mg/kg and 169.90 mg/kg, and the mean iron value was found to be 73.10 mg/kg in a research (Ayaz, 1996). In another research, the iron values varied between 41.70 mg/kg and 178.00 mg/kg, and the mean iron value was determined as 89.30 mg/kg (Yazıcıoğlu and Gökçen, 1986). It was shown that the values of both investigations were higher than the values of our research. Several factors have effect on differences between these studies. The iron level in a product must primarily depends on the raw material. In Pekmez production, rate of dry material in grape-juice containing 3-6 mg iron/kg is increased from 17% to 70% by vaporizing (Nas and Nas, 1987; Ayaz, 1996). After this step, it is expected that iron content of the product should be 12-25 mg/kg. However, commercial pekmez production has different conditions. Equipments used in production and inputs have more significant effect on the iron content of the product. The pH of grape-juice is about 4.0. It has a corrosive effect on the equipment and resistance of the equipment material to corrosion affects the iron level in Pekmez. The composition of Pekmez soil is also one of the factors influencing the iron level. The amount of soil added may vary depending on the pH of the raw material and producer experience (Nas and Nas, 1987). Therefore, all discussed factors cause significant differences in the iron levels in the end product Pekmez.

Table 2. Copper in Pekmez (mg/kg)

City Name	No. of Samples	Mean±SD	Median	Range	95th % value
Samsun	36	3.91±2.58	3.42	0.06-10.04	8.75
Konya	36	1.58±1.62	0.98	0.26-8.95	3.55
İzmir	36	3.21±3.64	2.00	1.10-18.00	8.08
Total	108	2.90±2.88	2.00	0.06-18.00	8.53

As shown in Table 2, the copper contents of Pekmez samples in this research varied between 0.06 mg/kg and 18.00 mg/kg. The mean copper values and 95th % values of Pekmez samples taken from Samsun and İzmir (3.91±2.58 mg/kg and 8.75 mg/kg for Samsun, and 3.21±3.64 mg/kg and 8.08 mg/kg for İzmir) were similar, but the values belonging to Konya (1.58±1.62 mg/kg and 3.55 mg/kg) were lower than the others. These values were statistically examined, it was found that the differences of copper levels were important ($p<0.05$) among cities and the results obtained from Konya acted on these differences.

In a research (1996), Ayaz determined that the copper levels varied between 3.30 mg/kg and 21.80 mg/kg (the mean value was 9.2 mg/kg) in some Pekmez samples. It was clear that our results were lower than the values determined by Ayaz. It may be thought that the differences of the processing inputs and equipment in addition to the raw material had effect on this difference.

Grape-juice contains aproximately 0.2 mg/kg copper (Ayaz, 1996). If Pekmez is produced from a raw material containing that amount the copper level should be aproximately 0.8 mg/kg in the product. But, if our values (the mean copper value was 2.90±2.88 mg/kg for 108 samples)were considered it may be thought that the inputs and equipment used in production line may affect on the copper values as similarly as on the iron values. However, this increase was not determined as clearly as in the iron level.

Table 3. Zinc in Pekmez (mg/kg)

City Name	No. of Samples	Mean±SD	Median	Range	95th % value
Samsun	36	4.86±2.54	4.50	1.40-11.20	10.00
Konya	36	2.46±1.89	2.15	0.12-7.12	6.54
İzmir	36	3.75±2.20	2.85	1.00-8.50	7.98
Total	108	3.69±2.42	3.04	0.12-11.20	7.95

The zinc levels varied between 0.12 mg/kg and 11.20 mg/kg in analyzed Pekmez samples, as shown in Table 3. The mean zinc values belonging to Konya, İzmir, and Samsun were found to be 2.46±1.89 mg/kg, 3.75±2.20 mg/kg, and 4.86±2.54 mg/kg, respectively. According to statistical evaluation, it was found that the differences were important ($p<0.05$) among cities. These differences of the mean values were not significant between Samsun and İzmir, but the values obtained from Konya differed significantly from the values obtained from the other cities according to the *Tukey* pairwise comparison test.

A trace amount of zinc is found in grape-juice (Ayaz, 1996). Because of this, the raw material has no important effect on the zinc content of Pekmez. As a result of this, it is clear that only inputs and equipment materials are effective on the zinc contamination. In a research, the zinc values varied between 13.40 mg/kg and 85.30 mg/kg (the mean value was 28.40 mg/kg) in some analyzed Pekmez samples (Ayaz, 1996). When these values and the values in Table 3 were compared, zinc levels of samples analyzed by Ayaz were higher than the samples analyzed in our research. It may be also thought that the soil, equipment used in production and environment conditions acted on the differences.

There is no limit value in Turkish Food Codex for Pekmez. However, in Pekmez Standard published by Turkish Standards Institution (TSE), the iron, copper, and zinc levels were limited to be 20 mg/kg, 5 mg/kg, and 5 mg/kg, respectively (Anonymous, 1989). Respectively, 60%, 88%, and 77% of the iron, copper, and zinc values found in this research were under the limit values given by TSE.

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