Effect of Boiled Fruit Juices on Mineral Contents of Traditional Bread Produced in Turkey

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ABSTRACT: *In this study, the mineral contents of bread with boiled grape, date, carob, and mulberry fruit juices at five different concentrations were determined. The fluctuations of B and Cu contents in bread with pekmez (molasses) were determined between 4.10 to 4.49 mg/kg and 2.74 and 3.34 mg/kg respectively. Ca, Mg, K, P, and S were the main macro-elements of bread samples. The highest values of Ca were observed in samples with mulberry molasses (421 mg/kg - 826 mg/kg). The Ca content of bread with grape molasses ranged from 360 to 520 mg/kg, while Ca content of bread with carob molasses change between 396 and 582 mg/kg ($p<0.05$). K content of samples with carob molasses was higher than the others and ranged from 2321 mg/kg to 4719 mg/kg, followed by samples with mulberry, grape, and date palm molasses in descending order. The P content of the samples with carob molasses changed from 1249 to 1313 mg/kg. Results have exhibited the potential for the production of bread with boiled fruit juices of acceptable quality.*

KEYWORDS: *Concentrated juices; Bread, Elements; ICP-AES.*

INTRODUCTION

Bread is an essential food in human nutrition. It is a good source of energy and contains groups of vitamin B, proteins, and minerals which are essential in our diet. Bread is present at the table during all three main meals of the day as the main diet consumed either with fish, meat, mixed vegetables, and legumes [1,2]. Bread in human nutrition is not only a source of energy but also a supplier of irreplaceable nutrients for the human body [2-4]. There may be several types of bread called with different names in different locations, according to the ingredients used or baking techniques [2]. Besides, it contains vitamins of the B group and minerals, mostly Mg, Ca, and Fe [5]. There has been an increased bread consumption worldwide; in Turkey, with the progressive increase of bread consumption and other baked products, there is an emergent need for natural product ingredients for bread and bakery products. Therefore, the current study aimed to determine the mineral contents of bread with boiled grape, date, carob, and mulberry fruit juices at five different concentrations.

EXPERIMENTAL SECTION

Materials

Wheat white flour (ash content 0.60%, moisture 14.5%, protein 10.5%) used in this study was provided

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Table 1: Parameters of bread making procedure with boiled grape, date, carob, and mulberry juices.

Steps	Time (min.)	Temperature (ºC)
Mixing	5.0	28.0
Maturing	90.0	30.0
Proofing	28.0	32.0
Baking	20.0	220.0

from Selva Company of Konya, Turkey. Boiled concentrated grape, carob, and mulberry juices were obtained from the market, while date juices were provided from Gesaş Food Company in Konya, Turkey.

Methods

On a basis of 50 g flour containing 30 ml water and 1% salt, flour was added at the rates of 5%, 10%, 15%, 20%, and 25% to each pekmez (molasses) sample. Each dough sample obtained from the mixture was baked in the oven at 220° C, for 20 min. For control, Pekmez samples were not the only material used. The parameters of the bread-making procedure with concentrated fruit juice are given in Table 1.

Determination of Mineral Contents

Bread samples were dried at 70 ºC in a drying cabinet with air-circulation until they reached a constant weight. Dried samples (about 0.5 g) were digested by using 5mL of 65% HNO_3 and 2 ml of 35% H_2O_2 in a closed microwave system (Cem-MARS Xpress). Once the volume reached 20 ml with the addition of ultra-deionized water, mineral contents were determined by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP AES) (Varian-Vista, Australia). The heavy metal contents of the samples were quantified against standard solutions of known concentrations which were analyzed concurrently [6].

Statistical Analysis

A complete randomized split-plot block design was used analysis of variance （ANOVA）was performed by using JMP version 9.0（SAS Inst. Inc., Cary, N.C.U.S.A. Analysis of variance was used to determine the statistical significance of the results. All analyses were carried out three times and the results are mean± standard deviation MSTAT C）of bread with independent boiled juices [7].

RESULTS AND DISCUSSION

The micro-element contents of bread with boiled fruit juices added at the different concentrations (molasses) are illustrated in Table 2. Generally, Mo, Cd, Cu, Ni, and Zn contents were found to be partly similar depending on pekmez (molasses) concentrations. However, values of B content in pekmez doped bread (4.10 mg/kg to 4.49 mg/kg) were found higher than the others. In descending order followed bread with mulberry, carob, date and palm molasses. B content of bread with carob and date palm molasses increased by increasing their concentration. Mo, Cd, Cr (except for bread 20% date palm molasses and 20% carob molasses) and Ni (except for bread with 20% and 25% carob and 10% mulberry molasses) content in bread were observed to be generally below 1 mg/kg. Cu contents of bread were determined to be between 2.74 and 3.34 mg/kg and generally Cu contents of each sample with pekmez (molasses) were found to be close.

Ca and K contents of bread increased together with the addition of pekmez concentrations (Table 3). This increase was also observed for Fe and Mg. Macro-element contents of samples were determined as Ca, Mg, K, P, and S. The highest values for Ca were determined in samples with mulberry molasses (from 421 to 826 mg/kg). Ca content in bread with grape molasses ranged from 360 to 520 mg/kg, with carob molasses from 396 to 582 mg/kg, and with date palm from 292 mg/kg and 379 mg/kg ($p<0.05$). Fe content in doped bread partly increased and decreased, depending on addition of pekmez (molasses). Fe content of samples with grape and carob molasses were found to be higher than the others. Fe content of bread with grape molasses ranged between 38.1 mg/kg to 50.5 mg/kg, and with carob molasses between 38 mg/kg and 46.7 mg/kg ($p<0.05$). All the above results were found higher than the control sample. In all bread samples, K was found to be in the highest concentration. K content of samples with carob molasses was found to be higher than the others, between 2321 mg/kg and 4719 mg/kg, followed by samples with mulberry, grape, and date palm molasses in descending order. Mg contents of bread ranged from 510 mg/kg (in date palm molasses) to 690 mg/kg (in carob molasses). Mg content of the control sample was determined as 585 mg/kg ($p<0.05$).

According to the control group, the low element content of some bread samples may have been because the elements were oxidized during the heat treatment.

Table 2: Microelement contents of breads produced by boiled grape, date, carob and mulberry juices (mg/Kg).

Boiled Juices	Mo	B	Cd	Cr	Cu	Ni	Zn
Grape (5%)	0.54 ± 0.02*b	4.26 ± 0.28c	0.049 ± 0.003a	0.78 ± 0.05d	2.85 ± 0.14bc	0.687 ± 0.064b	9.94 ± 0.10c
Grape (10%)	0.55 ± 0.02a**	4.10 ± 0.07d	0.033 ± 0.002d	0.83 ± 0.06c	3.13 ± 0.31ab	0.783 ± 0.016a	9.78 ± 0.41cd
Grape (15%)	0.55 ± 0.03a	4.49 ± 0.23a	0.041 ± 0.003bc	0.83 ± 0.06c	3.14 ± 0.23ab	0.486 ± 0.063d	12.57 ± 0.18a
Grape (20%)	0.51 ± 0.03c	4.25 ± 0.14cd	0.040 ± 0.004c	1.92 ± 0.22a	3.34 ± 0.21a	0.621 ± 0.048c	10.06 ± 0.25b
Grape (25%)	0.47 ± 0.03d	4.39 ± 0.08ab	0.043 ± 0.003b	0.98 ± 0.08b	2.77 ± 0.01c	0.382 ± 0.017e	9.08 ± 0.29d
Date (5%)	0.49 ± 0.05d	2.94 ± 0.04a	0.018 ± 0.003cd	0.43 ± 0.03d	2.66 ± 0.03cd	0.391 ± 0.053e	9.11 ± 0.37c
Date (10%)	0.55 ± 0.02a	2.91 ± 0.01ab	0.045 ± 0.002ab	0.61 ± 0.04cc	3.02 ± 0.12a	0.869 ± 0.040a	9.48 ± 0.13bc
Date (15%)	0.49 ± 0.00d	2.89 ± 0.13bc	0.024 ± 0.004c	0.68 ± 0.05ab	2.74 ± 0.12c	0.632 ± 0.038c	9.52 ± 0.43b
Date (20%)	0.54 ± 0.02b	2.84 ± 0.01c	0.054 ± 0.002a	1.16 ± 0.14a	2.85 ± 0.15b	0.673 ± 0.056b	10.15 ± 0.05a
Date (25%)	0.52 ± 0.05c	2.89 ± 0.05bc	0.035 ± 0.004b	0.64 ± 0.01bc	2.79 ± 0.10bc	0.611 ± 0.039d	8.91 ± 0.15d
Carob (5%)	0.58 ± 0.02a	2.59 ± 0.03c	0.064 ± 0.002a	0.59 ± 0.07e	3.09 ± 0.13b	0.805 ± 0.072cd	10.25 ± 0.60a
Carob (10%)	0.54 ± 0.03b	2.61 ± 0.02bc	0.051 ± 0.006b	0.79 ± 0.06c	3.12 ± 0.33ab	0.842 ± 0.020c	9.97 ± 0.24bb
Carob (15%)	0.49 ± 0.01d	3.08 ± 0.16ab	0.036 ± 0.004de	0.68 ± 0.03cd	3.02 ± 0.04b	0.783 ± 0.013d	9.55 ± 0.09c
Carob (20%)	0.58 ± 0.04a	3.09 ± 0.07ab	0.042 ± 0.003c	1.46 ± 0.16aa	3.20 ± 0.29a	1.791 ± 0.152b	9.53 ± 0.16c
Carob (25%)	0.50 ± 0.05c	3.25 ± 0.19a	0.041 ± 0.002cd	1.26 ± 0.21b	2.96 ± 0.07c	1.837 ± 0.323a	9.63 ± 0.49c
Mulberry (5%)	0.54 ± 0.01a	2.90± 0.05de	0.044 ± 0.003bc	0.99 ± 0.08a	3.23 ± 0.27a	1.209 ± 0.095a	9.77 ± 0.20b
Mulberry (10%)	0.53 ± 0.02b	3.11 ± 0.17d	0.048 ± 0.005ab	0.77 ± 0.06cd	3.00 ± 0.17ab	1.207 ± 0.152a	9.29 ± 0.19b
Mulberry (15%)	0.42 ± 0.02e	3.20 ± 0.09cd	0.029 ± 0.004e	0.69 ± 0.10e	3.08 ± 0.08ab	0.817 ± 0.056c	9.09 ± 0.10bc
Mulberry (20%)	0.49 ± 0.05d	3.56 ± 0.09c	0.029 ± 0.005e	0.83 ± 0.05b	3.16 ± 0.17ab	0.819 ± 0.067c	9.10 ± 0.38bc
Mulberry (25%)	0.52 ± 0.04bc	4.02 ± 0.15ab	0.041 ± 0.005cd	0.77 ± 0.13cd	2.96 ± 0.18c	0.910 ± 0.076b	8.80 ± 0.61d
Control	0.54 ± 0.02ab	4.26 ± 0.28a	0.049 ± 0.003a	0.78 ± 0.05c	2.85 ± 0.14cd	0.687 ± 0.064d	9.94 ± 0.10a

**mean±standard deviation; **Values within each column followed by different letters are significantly different (p < 0.05)*

P contents of some bread samples were found to be close. The highest P content was observed in samples with carob molasses, with a range from 1249 mg/kg to 1313 mg/kg. Regarding the control sample, P value was found to be 1246 mg/kg ($p<0.05$). In terms of values of P content, bread sample with carob molasses was followed by samples with grape and mulberry molasses in descending order. The highest S content was observed in bread samples with carob molasses. S content in bread was found between 1326 and 1419 mg/kg, followed by bread samples with grape, mulberry molasses. It was observed statistically significant differences among macro and microelement contents of breads with boiled fruit juices added at the different concentration ($p<0.05$)

Isserliyska et al. [2] determined values of 0.023 Ca, 0.027 Mg, 0.001 Fe, and 0.001 g/100 g Zn in Bulgarian wheat bread. In another study, bread samples contained 257.68-885.32 Na, 32.05-112.59 Ca, 92.88-404.49 K and 0.32-4.14 mg/100 g Fe [8]. In a previous study, *Iskendar* and *Davis* [9] reported that the overall average concentrations of elements in the investigated bread samples were the following (in µg/g): 5.06 B, 326 Ca, 2062 Cl, 0.95 Cr, 0.044 Co, 54.0 Fe, 2086 K, 692 Mg, 11.6 Mn, 1709 Na, 0.28 Se, and 11.5 Zn. The iron content in Egyptian bread samples was higher than what reported for some American baked bread (15-38 µg Fe/g) [10]. The concentrations of Zn in several breads were reported in other studies to range from 5.7 to 13.4 µg /g [11] and 7.5-17 µg /g µg [10]. The Ca and Mg concentrations in wheat bread were reported by Gormican [10] as 740 µg/g and 590 µg/g on wet weight bases, respectively. The average K content of Egyptian breads is within

Table 3: Macroelement contents of breads produced by boiled grape, date, carob and mulberry juices (mg/Kg)

Boiled Juices	Ca	K	Mg	Mn	P	S	Fe
Grape (5%)	360 ± 11*e	1809 ± 12e	591 ± 4e	10.8 ± 0.1b	1229 ± 11a	1429 ± 48a	38.1±2.0cd
Grape (10%)	403 ± 13d**	2050 ± 71d	601 ± 19de	10.8 ± 0.4b	1216 ± 44ab	1411 ± 30b	39.7±2.3c
Grape (15%)	462 ± 9c	2248 ± 44c	617 ± 5a	10.9 ± 0.2a	1200 ± 11b	1336 ± 70c	42.7±2.3b
Grape (20%)	492 ± 8b	2290 ± 87b	609 ± 15bc	10.8 ± 0.2b	1144 ± 34c	1292 ± 111d	50.50±0.7a
Grape (25%)	520 ± 5a	2471 ± 16a	614 ± 4ab	10.6 ± 0.0c	1118 ± 3d	1297 ± 67d	42.9±1.6b
Date (5%)	292 ± 11cd	1448 ± 39b	529 ± 15b	9.8 ± 0.3b	1111 ± 35ab	1236 ± 44cd	38.4±1.5b
Date (10%)	296 ± 3c	1523 ± 26a	550 ± 6a	10.2 ± 0.1a	1164 ± 12a	1305 ± 23ab	43.9±1.8a
Date (15%)	313 ± 9b	1403 ± 51d	529 ± 14b	9.8 ± 0.4b	1121 ± 39ab	1244 ± 89d	37.0±1.9c
Date (20%)	346 ± 9a	1371 ± 33e	519 ± 7c	9.7 ± 0.2bc	1086 ± 18c	1327 ± 70a	38.5±1.8b
Date (25%)	279 ± 6d	1425 ± 46c	510 ± 12d	9.4 ± 0.2c	1072 ± 25cd	1254 ± 35c	36.6±1.9d
Carob (5%)	396 ± 27e	2321 ± 95e	602 ± 20e	10.4 ± 0.4a	1249 ± 61cd	1380 ± 131b	38.9±2.3c
Carob (10%)	436 ± 8d	2920 ± 22d	632 ± 9d	10.4 ± 0.1a	1261 ± 12c	1419 ± 16a	39.1±0.6b
Carob (15%)	482 ± 8c	3729 ± 33c	655 ± 3c	10.4 ± 0.1a	1313 ± 9a	1364 ± 9bc	39.7±2.1b
Carob (20%)	539 ± 4b	4210 ± 30b	671 ± 3b	10.2 ± 0.1ab	1296 ± 10b	1340 ± 52c	46.7±0.6a
Carob (25%)	582 ± 8a	4719 ± 53a	690 ± 10a	10.0 ± 0.2c	1298 ± 20b	1326 ± 13cd	38.5±1.1c
Mulberry (5%)	421 ± 4e	1958 ± 27e	589 ± 4a	11.1 ± 0.1a	1260 ± 16aa	1415 ± 18a	37.5±1.0d
Mulberry (10%)	527 ± 12d	2084 ± 55d	580 ± 14bc	10.9 ± 0.3b	1197 ± 27b	1331 ± 41c	39.7±2.0b
Mulberry (15%)	622 ± 5c	2199 ± 34c	580 ± 15bc	10.8 ± 0.2b	1166 ± 12c	1317 ± 16cd	35.6±1.2f
Mulberry (20%)	739 ± 16b	2434 ± 67b	582 ± 10b	10.9 ± 0.3b	1155 ± 32cd	1318 ± 20cd	40.7±3.1a
Mulberry (25%)	826 ± 27a	2597 ± 77a	578 ± 16c	10.8 ± 0.4b	1120 ± 34d	1270 ± 45d	38.3±1.3c
Control	308± 8f	1652± 5f	5785± 6c	10,8 ± 0,3b	1246 ± 24b	1382 ± 55b	36.5±2.7e

**mean±standard deviation; **Values within each column followed by different letters are significantly different (p < 0.05)*

the concentration range of 850-2330 K/g reported for several other bread types [12]. *Khalil* and *Sawaya* [13] reported that Pearl Millet bread contained 102 Fe, 0.96 Zn, 0.55 Cu, and 1.89 mg/100 g Mn. Results showed partly differences compared to literature values. These differences can be probably due to molasses types and concentrations. Consequently, differences in mineral contents of bread samples may probably result from a combination of flour used in bread, dry matter, and mineral contents of molasses. Also, knowledge of the mineral contents, as an ingredient of various baked and other products such as salad dressing, baby foods, and snack foods is of great interest. The nutritive value of cereal grain depends on the content of minerals and their proportions [14].

CONCLUSIONS

On the whole, it appears that breads with boiled juice can be a good source of some nutrients. It is hoped that if the materials used in samples are standardized and used by being standardized in future studies, they will be more useful. Results have exhibited the potential for the production of bread with boiled fruit juices of acceptable quality. From the current study, it results that boiled fruit juices could be added into bread dough up to 25 % (flour basis).

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REFERENCES

[1] Harmankaya M., Korkmaz A., Özcan M.M., Ceylan D.A., Akköz C., Dursun N., Özcan M.M., Evaluation of the Mineral and Trace Elements of Various Breads, *Arch Lebensmit.* **69**: 10-13 (2018).

[2] Isserliyska D., Karadjov G., Angelow A., Mineral Composition of Bulgarian Wheat Bread, *Eur. Food Res. Technol.*, **213**: 244-245 (2001).

[3] David M.O., "Nigeria, No 1 Market for U.S. Wheat; Potential for Other Grains and Feeds", USAID *Foreign Agric. Serv. Bull.*, pp.1-2, (2006).

[4] Spiekermann U., Brown Bread for Victory: "German and British Whole Meal Politics in The Inter War Period", In: Food and Conflict in Europe in the Age of the Two World Wars, Trentmann F., Just F. (Eds.). Basmastoke, New York, pp 143-171 ( ).

[5] Ranhotra G., Bioavailability of Magnesium in Cereal-Based Foods, *Cereal Foods World*, **28**: 349-351 (1983).

[6] Skujins S., Handbook for ICP-AES (Varıan-Vista). "A Short Guıde To Vista Series ICP-AES Operation", Varian Int. AGşZug. Version 1.0. pp 29. Switzerland, (1998).

[7] Püskülcü H., İkiz F., IntroductionStatistic (İstatistiğe Giriş). Bilgehan Press, Bornova- İzmir, Turkey., (1989) [in Turkish].

[8] Malomo S.A., Eleyinmi A.F., Fashakin J.B., Chemical Composition, Rheological Properties and Bread Making Potentials of Composite Flours From Bread Fruit, Bread Nut and Wheat, *African J. Food Sci.*, **5:** 400-410 (2011).

[9] Iskander F.Y., Davis K.R., Mineral and Traces Element Contents in Bread, *Food Chem.*, **45**: 269-277 (1992).

[10] Osis D., Kramer L., Waitrowski E., Dietary Zinc Intake in Man, *Am. J. Clin. Nutr.*, **25**: 582-588 (1972).

[11] Gormican A., Inorganic Elements in Foods Used in Hospital Menus, *J. Am. Diet. Assoc*., **53**: 397-403 (1970).

[12] Czarnecki S.K., Kritchevsky D., "Trace Elements. In: Nutrition and Adult- Micronutrients" (Ed. Alfin-Slater R.A., Kritchevsky D.), Plenum Press, New York, (1980).

[13] Khalil J.K., Sawaya W.N., Mineral and Vitamin Contents of Saudi Arabian Pearl Millet Flour and bread. *Cereal Chem.*, **61**: 301-304 (1984).

[14] Özcan M.M., Bağcı, A., Dursun, N., Gezgin, S., Hamurcu, M., Dumlupınar, Z., Uslu, N., Macro Andmicro Element Contents of Severaloat (*Avenasativa* L.) Genotype and Variety Grains, *Iran. J. Chem. Chem. Eng. (IJCCE)*, **36**: 73-79 (2017).