

Mineral contents of several corn and potato chips

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Abstract

Plasma Atomic Emission Spectrometry (ICP-AES). Cd, Cr, Mo, Ni and Pb contents of all chips were found at the low levels. B content of all chips was determined between 2.75 mg/Kg to 8.49 mg /Kg. Cu contents of chips ranged from 0.31 mg/Kg (corn chips with cheese) to 5.42 mg/Kg (potato chips). Fe contents of chips ranged from 1.57 mg/Kg (potato chips) to 13.03 mg/Kg (corn chips with cheese). While manganese contents change between 0.78 mg/Kg to 5.72 mg/Kg, zinc contents of all chips were found between 2.71 mg/Kg (corn chips with cheese) to 14.48 mg/Kg (corn chips with cheese). Generally, iron and zinc contents of corn chip were found high compared with potato chips.

Keywords: corn, potato, chips, heavy metal, ICP-AES

1. Introduction

The effect of environmental pollution on contamination of foods and on their safety for human consumption is a serious global public issue and widely addressed [1,2,8]. Heavy metals of several foods are of interest due to essential or toxic nature [5]. Iron, zinc, copper, chromium, cobalt, and manganese are essential while lead, cadmium, nickel and mercury are toxic at certain levels [13,15]. Metals such as lead, mercury, cadmium, and copper are cumulative poisons, which cause environmental hazards and are reported to be exceptionally toxic [4]. Many metals have therapeutic applications and some of them are essential nutrients on the positive side [6,7,10,12]. On consumption of food in the diet, the trace metal contents of food are directly taken into the body [9,17,18]. Potato and corn chips are common in our diet.

Therefore the trace heavy metals in potato and corn chips are very important. Moreover, the daily intake of these metals, based on chip consumption was ascertained.

The aim of present study is to determine the levels of micro element, heavy metal and macro elements

in selected potato and corn chips with several additive and ingredients by ICP-AES.

2. Materials and Methods

Material. Each chip sample (about 200g) was purchased from several markets in Konya in Turkey.

Determination of mineral contents. Collected chips samples were dried at 70 °C in a drying cabinet with air-circulation until they reached constant weight. Later, about 0.5 g dried and ground sample was digested by using 5ml of 65% HNO₃ and 2 ml of 35% H₂O₂ in a closed microwave system (Cem-MARS Xpress) at 200 °C. The volumes of the digested samples were completed to 20 ml with ultra-deionized water and mineral concentrations were determined by inductively coupled plasma-optical emission spectroscopy (ICP AES; (Varian-Vista, Australia).

Measurement of mineral concentrations was checked using the certified values of the related minerals in the reference samples received from the National Institute of Standards and Technology (NIST; Gaithersburg, MD, USA). Distilled deionized water and ultrahigh-purity commercial acids were used to prepare all reagents, standards, and samples.

After digestion treatment, samples were filtrated through whatman No 42. The filtrates were collected in 50 ml flasks and analysed by ICP-AES. The mineral contents of the samples were quantified against standard solutions of known concentrations which were analysed concurrently [16].

Working conditions of ICP-AES:

Instrument: ICP-AES (Varian-Vista)

RF Power: 0.7-1.5 kw (1.2-1.3 kw for Axial)

Plasma gas flow rate (Ar): 10.5-15 L/min. (radial) 15 “ (axial)

Auxiliary gas flow rate (Ar) : 1.5 “

Viewing height: 5-12 mm

Copy and reading time: 1-5 s (max. 60 s)

Copy time: 3 s (max. 100 s)

Statistical analyses. Results of the research were analysed for statistical significance by analysis of variance [14].

3. Results and Discussion

Micro element and heavy metal contents of several corn and potato chips purchased from local markets were determined by ICP-AES. While B levels of potato chips range between 5.63 mg/Kg to 8.49 mg/Kg, these values in corn chips changed between 2.75 mg/Kg to 6.03 mg /Kg (Table 1). Cd, Cr, Mo, Ni and Pb contents of all chips were found at the low levels. Cu contents of chips were found between 0.31 mg/Kg (corn chips with cheese) to 5.42 mg/Kg (potato chips) (Table 1). Iron contents of chips ranged between 1.57 mg/Kg (potato chips) to 13.03 mg/Kg (corn chips with cheese). Manganese contents changed between 0.78 mg/Kg to 5.72 mg/Kg. Zinc contents of all chips were found between 2.71 mg/Kg (corn chips with cheese) to 14.48 mg/Kg (corn chips with cheese). Generally, iron and zinc contents of corn chips were found high compared with potato chips.

In addition, Cu contents of potato chips were found high than those of corn chips values.

The main concentrations of Fe levels in potato with flavor, corn chip with spice, corn chip with cheese and corn chip with poppy seed were 12.68, 11.63, 13.03 and 12.61 mg/Kg dry weight, respectively. Also, the mean concentrations of Cd levels at these chips were 0.038, 0.005, 0.019 and 0.007 ppm dry weight, respectively.

Macro element contents of chips are given in Table 2. K and P contents of chips were found high compared with results of Ca and Mg of chips (Table 2). K contents of chips changed between 1341 mg/Kg (corn chips with cheese) to 11671 mg/Kg (potato chips). Phosphorus contents of chips ranged from 930 mg/Kg (corn chips with cheese) to 3111 mg/Kg (corn chips with cheese). Generally, K, Mg and P contents of potato chips were found at the high levels than those of corn chips. The highest Ca content (1610 mg/Kg) was established in corn chips with poppy seed. Cu contents of chips changed between 0.31 mg/Kg (corn chips with cheese) to 5.42 mg/Kg (potato chips). Iron contents of chips ranged between 1.57 mg/Kg (potato chips) to 13.03 mg/Kg (corn chips with cheese). Zinc contents of all chips were found between 2.71 mg/Kg (corn chips with cheese) to 14.48 mg/Kg (corn chips with cheese). Generally, iron and zinc contents of corn chips were found high compared with potato chips. In previous study, the investigated element concentrations in the analysed potato chip samples ranged from ND (not detectable) to 15.5 µg/g for zinc, ND to 0.13 µg/g for lead, 3.05 to 10.5 µg/g for nickel, ND to 1.85 µg/g for cobalt, 0.5 to 8.25 µg/g for manganese, ND to 36.25 µg/g for iron, ND to 1.6 µg/g for chromium, 4.1 to 126.5 µg/g for aluminium and ND to 4.7 µg/g for copper respectively, while cadmium was not present in any of the samples [5]. The metal contents of corn and potato samples have been reported as 0.28-1.26 µg/g for iron, 3.50-2.52 µg/g for zinc and 0.884-8.40 µg/g for manganese, respectively [3]. Narin et al., (2005) reported that copper concentrations were found to be <1 µg/g in the chip samples [11]. Our results shown differences compared with literature values. These differences may be probably due to raw material and analytical procedures.

Table 1. Micro element and heavy metal concentrations of corn and potato chips (Data are presented as means±SD, n = 3 replicates; mg/kg; dry matter)

	B		Cd		Cr		Cu	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Classic potato	8.49 ± 0.49		0.012 ± 0.004		0.392 ± 0.007		4.46 ± 0.05	
Potato with Party ketchup flavor	6.36 ± 0.37		0.038 ± 0.004		0.398 ± 0.015		1.57 ± 0.00	
Pure potato chip	5.63 ± 0.11		0.023 ± 0.004		0.380 ± 0.006		3.99 ± 0.22	
Potato chip with spices	7.63 ± 0.17		0.028 ± 0.005		0.366 ± 0.014		3.21 ± 0.15	
Potato chip with ketchup condiment	6.36 ± 0.05		0.021 ± 0.003		0.351 ± 0.022		3.16 ± 0.04	
Classic pure potato chip	6.51 ± 0.19		0.024 ± 0.007		0.451 ± 0.018		5.42 ± 0.04	
Corn chip	6.03 ± 0.24		0.009 ± 0.002		0.374 ± 0.003		0.79 ± 0.02	
Patotes corn chip with pungent spice	4.32 ± 0.20		0.005 ± 0.001		0.386 ± 0.002		1.17 ± 0.07	
Corn chip with roasted nut	5.85 ± 0.06		0.002 ± 0.003		0.373 ± 0.007		1.05 ± 0.02	
Corn chip with cheese	3.49 ± 0.07		0.019 ± 0.002		0.430 ± 0.020		1.00 ± 0.02	
Corn chip with onion condiment	3.47 ± 0.15		0.015 ± 0.002		0.419 ± 0.031		0.34 ± 0.02	
Milk corn	3.36 ± 0.06		0.016 ± 0.001		0.434 ± 0.021		0.35 ± 0.01	
party taco corn chip with spice condiment	3.21 ± 0.25		0.008 ± 0.000		0.367 ± 0.012		0.78 ± 0.00	
Corn chip with poppy condiment	4.13 ± 0.21		0.007 ± 0.001		0.373 ± 0.012		1.50 ± 0.15	
Corn chip with spice flavor	4.36 ± 0.14		0.012 ± 0.003		0.387 ± 0.034		0.86 ± 0.01	
Corn chip with cheese	2.75 ± 0.10		0.009 ± 0.001		0.338 ± 0.026		0.31 ± 0.01	

Table 1 (continued)

	Mn		Mo		Ni		Pb	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Classic potato	3.35 ± 0.06		0.298 ± 0.006		0.941 ± 0.089		0.072 ± 0.008	
Potato with Party ketchup flavor	2.34 ± 0.03		0.134 ± 0.007		0.142 ± 0.007		0.226 ± 0.039	
Pure potato chip	3.29 ± 0.04		0.060 ± 0.004		1.533 ± 0.107		0.264 ± 0.063	
Potato chip with spices	3.26 ± 0.06		0.303 ± 0.028		0.731 ± 0.051		0.268 ± 0.057	
Potato chip with ketchup condiment	3.47 ± 0.04		0.271 ± 0.017		0.255 ± 0.029		0.184 ± 0.044	
Classic pure potato chip	3.31 ± 0.21		0.123 ± 0.011		2.081 ± 0.265		0.099 ± 0.020	
Corn chip	1.76 ± 0.03		0.054 ± 0.005		0.336 ± 0.020		0.024 ± 0.004	
Patotes corn chip with pungent spice	2.84 ± 0.15		0.145 ± 0.005		0.242 ± 0.023		0.012 ± 0.002	
Corn chip with roasted nut	2.50 ± 0.02		0.573 ± 0.039		0.254 ± 0.018		0.246 ± 0.036	
Corn chip with cheese	4.21 ± 0.15		0.323 ± 0.005		0.298 ± 0.037		0.127 ± 0.014	
Corn chip with onion condiment	1.00 ± 0.01		0.087 ± 0.004		0.172 ± 0.016		0.338 ± 0.030	
Milk corn	0.95 ± 0.03		0.095 ± 0.003		0.259 ± 0.025		0.166 ± 0.019	
party taco corn chip with spice condiment	1.99 ± 0.13		0.119 ± 0.003		0.300 ± 0.022		0.074 ± 0.013	
Corn chip with poppy condiment	5.72 ± 0.31		0.142 ± 0.012		0.350 ± 0.046		0.058 ± 0.015	
Corn chip with spice flavor	2.04 ± 0.06		0.043 ± 0.003		0.382 ± 0.014		0.427 ± 0.108	
Corn chip with cheese	0.78 ± 0.02		0.078 ± 0.006		0.239 ± 0.007		0.108 ± 0.031	

Table 2. Macro element contents of corn and potato chips (Data are presented as means±SD, n = 3 replicates; mg/kg; dry matter)

	Ca		K		Mg		P	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Classic potato	284 ± 10		11671 ± 273		958 ± 13		1881 ± 47	
Potato with Party ketchup flavor	326 ± 1		8318 ± 115		534 ± 7		1505 ± 22	
Pure potato chip	297 ± 12		11154 ± 235		852 ± 17		1515 ± 52	
Potato chip with spices	332 ± 15		10025 ± 423		792 ± 12		1446 ± 33	
Potato chip with ketchup condiment	287 ± 28		9261 ± 381		833 ± 27		1740 ± 120	
Classic pure potato chip	357 ± 37		10989 ± 22		860 ± 66		1724 ± 153	
Corn chip	58 ± 3		1769 ± 38		493 ± 8		1468 ± 26	
Patotes corn chip with pungent spice	1141 ± 6		2189 ± 23		782 ± 16		2034 ± 33	
Corn chip with roasted nut	106 ± 2		2121 ± 20		427 ± 6		1291 ± 15	
Corn chip with cheese	1465 ± 46		2885 ± 42		999 ± 22		3111 ± 61	
Corn chip with onion condiment	92 ± 2		1675 ± 52		244 ± 7		1100 ± 33	
Milk corn	374 ± 17		1359 ± 15		274 ± 5		1130 ± 22	
party taco corn chip with spice condiment	84 ± 3		2022 ± 72		478 ± 11		1509 ± 42	
Corn chip with poppy condiment	1610 ± 70		2456 ± 21		892 ± 14		2315 ± 40	
Corn chip with spice flavor	102 ± 10		1762 ± 40		436 ± 10		1367 ± 22	
Corn chip with cheese	148 ± 14		1341 ± 19		190 ± 9		930 ± 25	

4. Conclusion

Among the chip samples, K and P had the highest mineral content. The highest calcium content was found in corn chips with pungent spice, corn chip with cheese and corn chip poppy seed while lowest Ca was found in corn chip with spice condiment. These differences may be probably due to raw material, process conditions and analytical procedures.

Compliance with Ethics Requirements

Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human and/or animal subjects (if exists) respect the specific regulations and standards.

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