Proximate and Mineral profile of Quinoa (*Chenopodium quinoa*), and kiwicha (*Amaranthus caudatus*) consumed in north of Argentina

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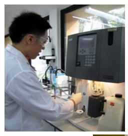
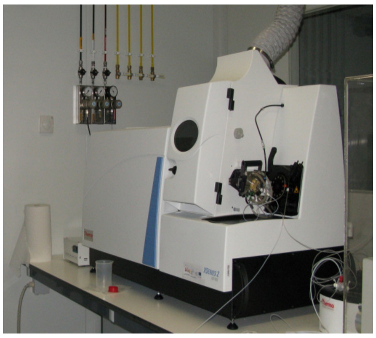
Introduction



Quinoa (*Chenopodium quinoa*) and kiwicha (Amaranthus caudatus) are pseudocereals of Andean origin that have been cultivated in Argentina for thousands of years. They are prepared in the same manner as cereals like wheat and rice(1). These pseudocereals gained special attention by the scientific community in part due to their high nutritional value and also because they can be consumed by persons who are not gluten tolerant such as babies up to six months or those who suffer from celiac disease. Therefore the nutrient analysis with the purpose of including these foodstuffs in the Argentinean Food Composition Databank is of uttermost importance.

Materials and Methods

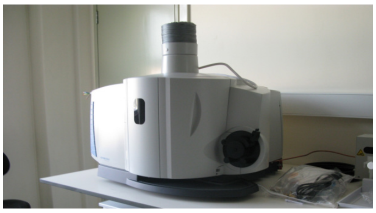
Ash, Moisture, Dietary Fibre, Protein, and Fat content were determined by AOAC methods. Calcium, Copper, Iron, Potassium, Phosphorus, Magnesium, Zinc and Manganese were analyzed by ICP-OES and trace elements by ICP-MS (^{7}Li, ^{9}Be, ^{51}V, ^{52}Cr, ^{59}Co, ^{60}Ni, ^{75}As, ^{82}Se, ^{88}Sr, ^{95}Mo, ^{121}Sb, ^{205}Tl, ^{208}Pb). The values were obtained applying quality criteria as defined by EuroFIR guidelines for laboratory analysis (2). This included criteria on sample handling, an appropriate analytical method in terms of precision and accuracy, limit of quantification, selectivity, and an effective internal and external quality control program including appropriate use of Certified Reference Materials (CRM) and participation in adequate Proficiency Testing Schemes carried out by laboratories ISO/EN 17025. Values published in EuroFIR platform for rice and wheat are used for comparison. Each analysis was performed in triplicate, by two operators, and for all determinations coefficient of variation were under repeatability conditions was evaluated and accepted only if lower than 10%.



ICP-MS

Thermo X series II

Operating Conditions	
Extraction	-113,7
Focus	10,0
Pole Bias	-0,1
Hexapole Bias	-3,0
Nebulizer flow rate (L min^{-1})	0,87
Forward Power (W)	1404
Cool gas flow rate (L min^{-1})	13,0
Auxiliary gas flow rate (L min^{-1})	0,90
Sampling Depth	120
Standard Resolution	135
High Resolution	150
Analogue Detector	1902
PC Detector	3353



ICP-OES

Thermo ICAP 6000 Series

Operating Conditions	
Auxiliary Flow (l/min)	0,5
RF power (W)	1200
Nebulization Pressure (psi)	on
Speed peristaltic pump - Flush pump rate and Analysis pump rate (rpm)	50
Speed peristaltic pump - Analysis pump rate (rpm)	50
Pump stabilization time (seg)	5
Integration Time in the UV and visible	15 e 10

Results and Discussion

Table 1 - Concentration of trace elements found in pseudocereals, compared with cereals values published in EuroFIR platform* (ug/ kg)

	Cr	Ni	Mo	Sr	V	Li
Quinoa flour	184,9 (170,5-199,2)	162,5 (155,3-169,7)	234,3 (225,5-243,2)	1661,3 (1655,2-1667,3)	66,6 (6170,1-6341,6)	85,7 (81,3-90,2)
Amaranthus flour	582,5 (538,7-626,4)	137,6	<LQ	<LQ	71,9 (69,7-74,2)	<LQ
Rice, polished, raw*	4.2	35.6	n.a	n.a	n.a	n.a
Wheat flour*	1.8	3.8	n.a	n.a	n.a	n.a

Table 2 – Mineral composition of pseudocereals (mg/100g) determined by ICP-OES. Values from rice and wheat belong to Danish Food Composition Databank and are linked to EuroFIR platform*

	Ca	Mg	P	Fe	Cu	Zn	Mn	K
Quinoa flour	43.8 (42.0-45.7)	196.7 (187.5-205.9)	468.1 (451.5-484.6)	5.46 (5.44-5.48)	0.59 (0.56-0.63)	2.91 (2.83-2.99)	1.95 (1.84-2.07)	664 (645-681)
Amaranthus flour	166.7 (156.8-176.4)	231.4 (223.8-239.0)	527.0 (512.4-541.6)	9.62 (9.49-9.76)	0.51 (0.50-0.52)	5.55 (5.15-5.94)	1.51 (1.46-1.56)	530 (508 -552)
Rice, polished, raw*	52.7 (6.09-158)	35 (31.2-40.6)	130 (117-141)	1.2 (0.35-2.5)	0.2 (0.10-0.29)	1.7 (1.10-2.10)	0.9 (0.530-1.5)	150 (118-172)
Wheat flour*	17.4 (14.6-21)	25 (17.3-32)	117 (89-142)	1.18 (0.1-2.55)	0.133 (0.088-0.33)	0.758 (0.45-1.10)	0.51 (0.299-0.77)	155 (124-181)

Table 3 - Elements determined by ICP-MS below the limit of quantification in both pseudocereals

	Element	LoQ (ug/ kg)
Quinoa and Amaranthus flour	Be, As, Cd, Tl	62,5
	Co, Se, Sb, Pb	125

Table 4 – Proximate composition expressed in g/100g

	Quinoa	Amaranthus	Rice**	Wheat**
Protein	12.06	13.37	8.4	9.6
Fat	6.34	6.35	1.2	1.6
Ash	2.01	2.89	0.6	0.7
D. Fiber	6.89	15.93	0.7	3.7
HC	62.18	50.59	78.3	72
Amylose*	9.4	1.45	n.a	n.a

*% Starch
* * Danish Food Composition Databank

Results obtained for inorganic components are presented in tables 1 to 3. The optimization of analytical conditions in particularly for sample digestion were carried out under an Internal Quality Control procedure implemented in the laboratory in accordance with EuroFIR guidelines. Laboratory performance was guaranteed by regular participation in PT schemes launched by PT providers such as FAPAS, Z<2 were obtained in participation programmes. Results obtained for CRMs in the assays were in accordance with certified values.

Analyzed samples contained higher amount of minerals than values published for rice and wheat. Since this values are obtained under IQC conditions, as described in EuroFIR guidelines, we can conclude that Quinoa and Amarathus from Argentina are a good source of minerals.

Data on trace elements, under IQC conditions, are published in Tables 2 and 3. Higher values for Chromium were obtained in Amaranthus. When compared these values with data from rice and wheat it can be concluded that Amaranthus and Quinoa are a good source of this trace elements. Heavy metals do not represent a health hazard in these food matrices since values found were very low or even below the limit of quantification.

Proximate values are presented in table 3 Quinoa and Amaranthus are rich in Fiber. Amylose content in this Quinoa variety is higher than Amaranthus.

Conclusions

The observed values, obtained in laboratory analysis, are in agreement with literature. The quality control procedures implemented in this work are a guarantee of reliability of the work. The main purpose of the data obtained is to be included in National Food Composition Databanks to guarantee that data on food consumed in local place are used to implement national public nutrition health. This are crucial to identify food /health disease relationship. Guidelines for laboratory performance are paramount to enhance the acceptability of values in LATIN FOODS and other Food Data regional organizations. This provides the necessary information to the users of Food Composition Databanks who wish to have an overview of the parameters, which influence the estimation of nutrient intake, and may affect the diet-disease relationship.

References

(1) L. Alvarez-Jubete, E.K. Arendt, E. Gallagher. Nutritive value of pseudocereals and their increasing use as functional gluten-free ingredients *Trends in Food Science & Technology, Volume 21, Issue 2, February 2010, Pages 106-113*

(2) www.eurofir.net

(3) www.danishfoodcompositiondatabank.com

Acknowledgements

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