

# Heavy elements in chestnuts



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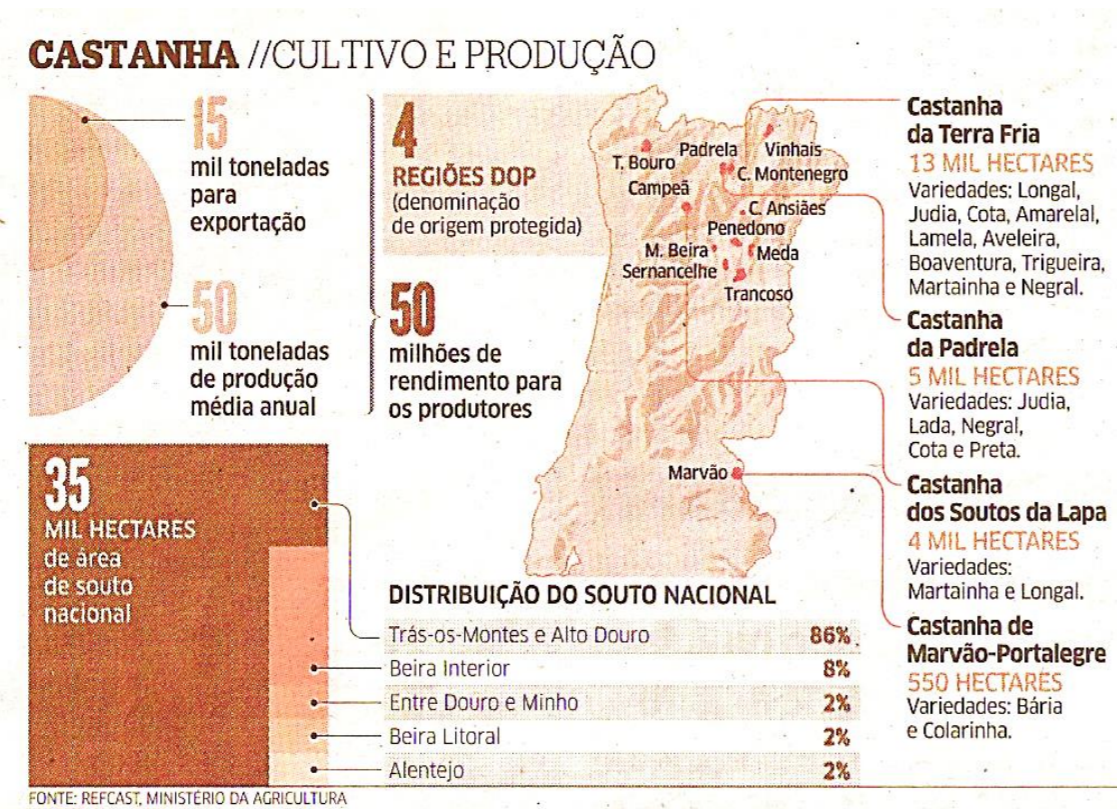
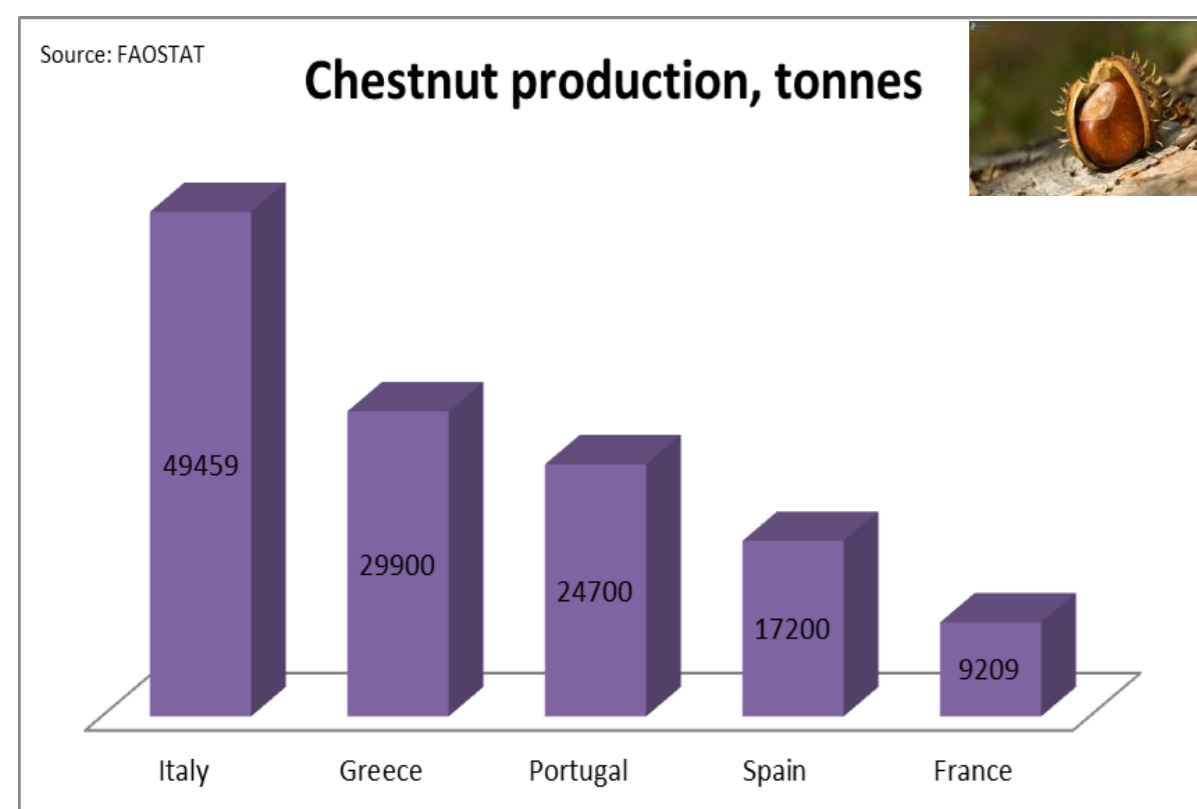
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## Introduction

Chestnut fruits (*Castanea sativa* Miller) are an important food resource in several countries. Earlier studies on chestnuts elemental composition were performed by atomic absorption to detect Ca, Mg, Na, K, Cu, Fe, Mn and Zn or by UV-VIS spectrophotometry to detect P [1-2].

Portugal is the third largest European producer, with an average production of 25 thousand tons [3], being mainly produced in the North region of Trás-os-Montes.



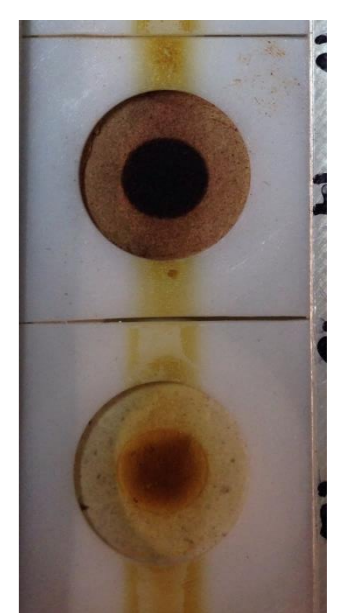
## Experimental

Random chestnut fruits from different varieties (Judia and Longal) were selected, manually peeled (inner and outer skins), dried and grinded to obtain a fine dried powder.



For PIXE experiments, several pellets (fruit, inner and outer skins) were done.

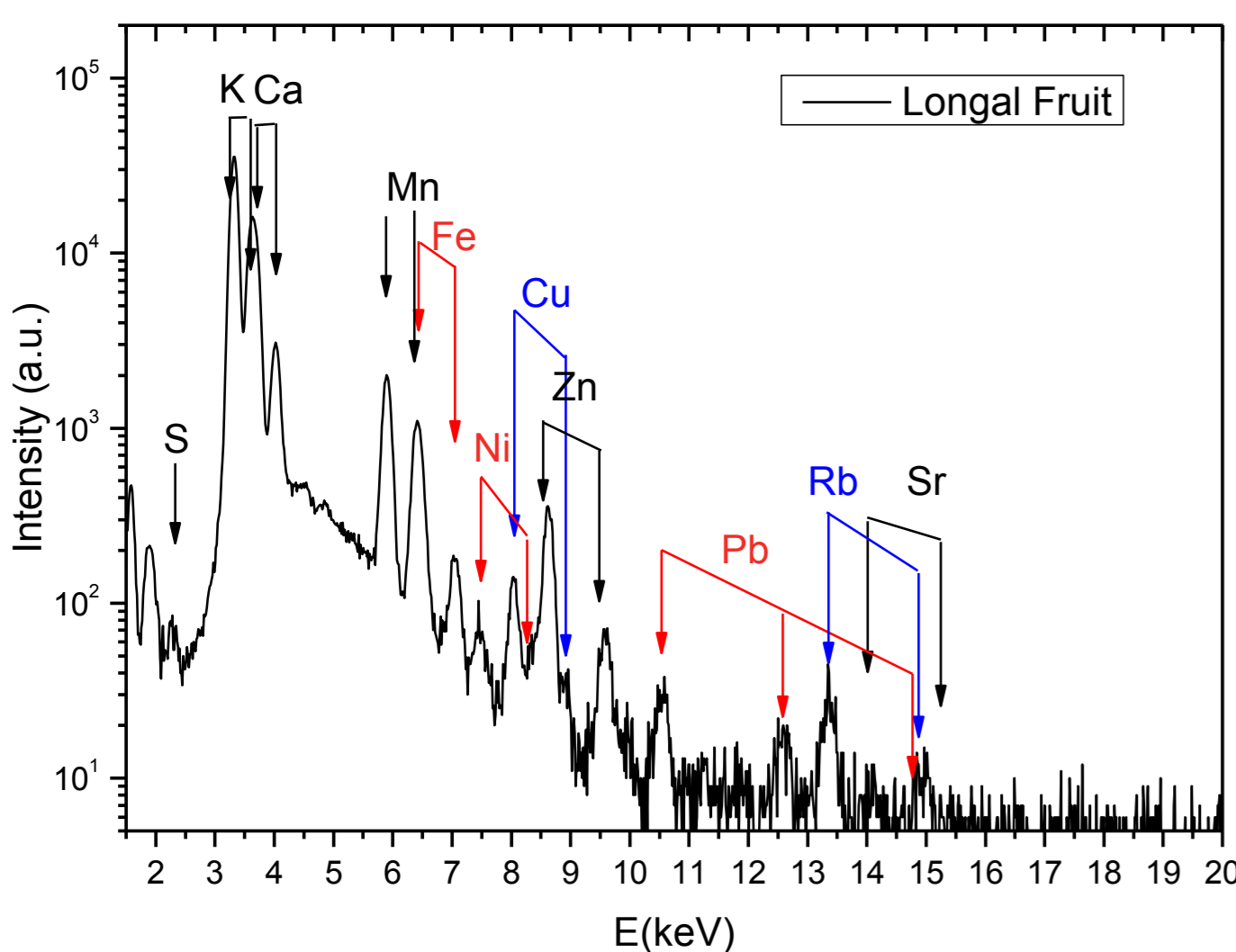
The samples were analyzed at CTN using two proton beam energies (1,000 and 2,100 MeV). AXIL software was used to fit the PIXE spectra and DATPIXE code to calculate the elemental concentrations for each spectrum.



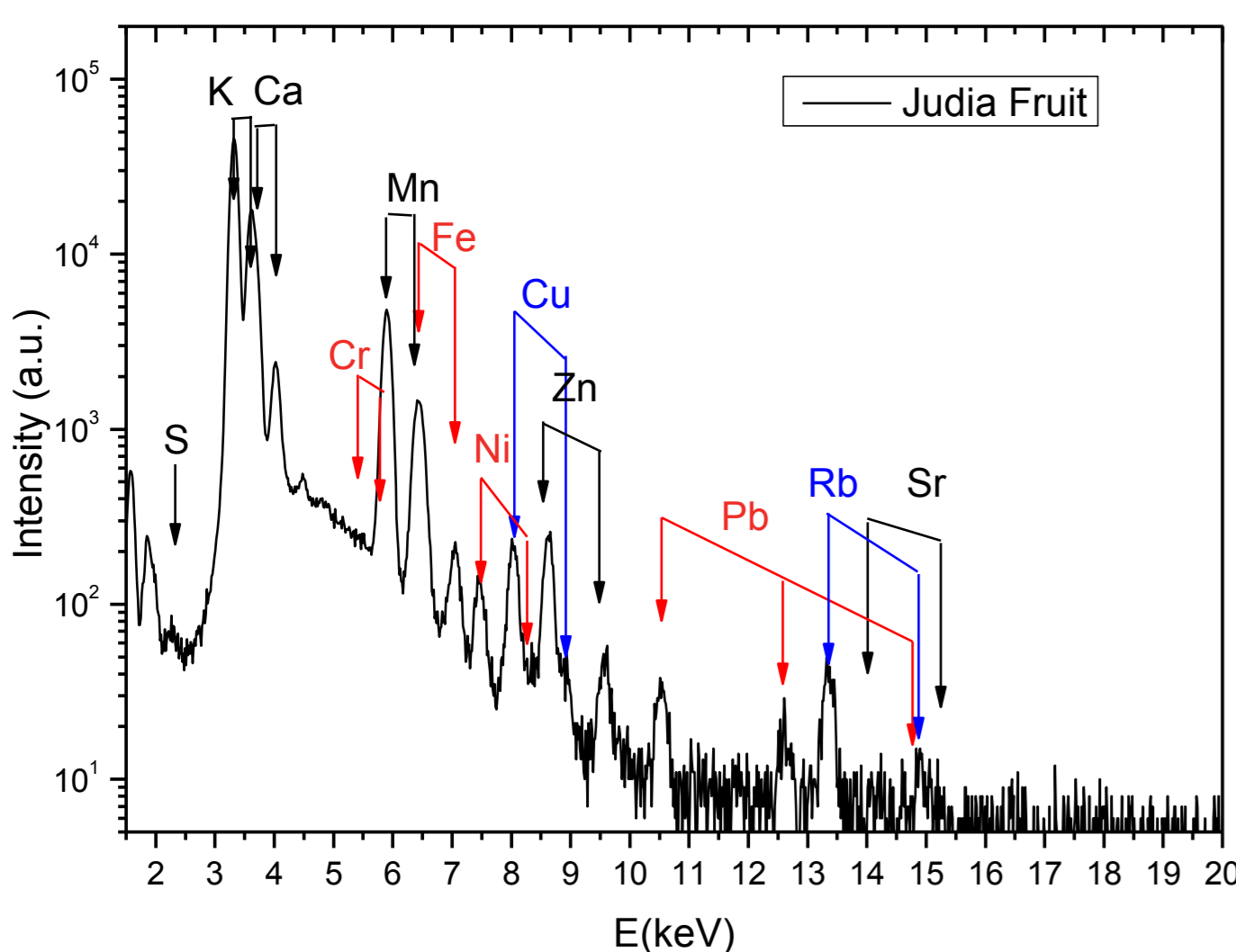
Skin (up) and fruit (down) pellets after beam irradiation

## Results

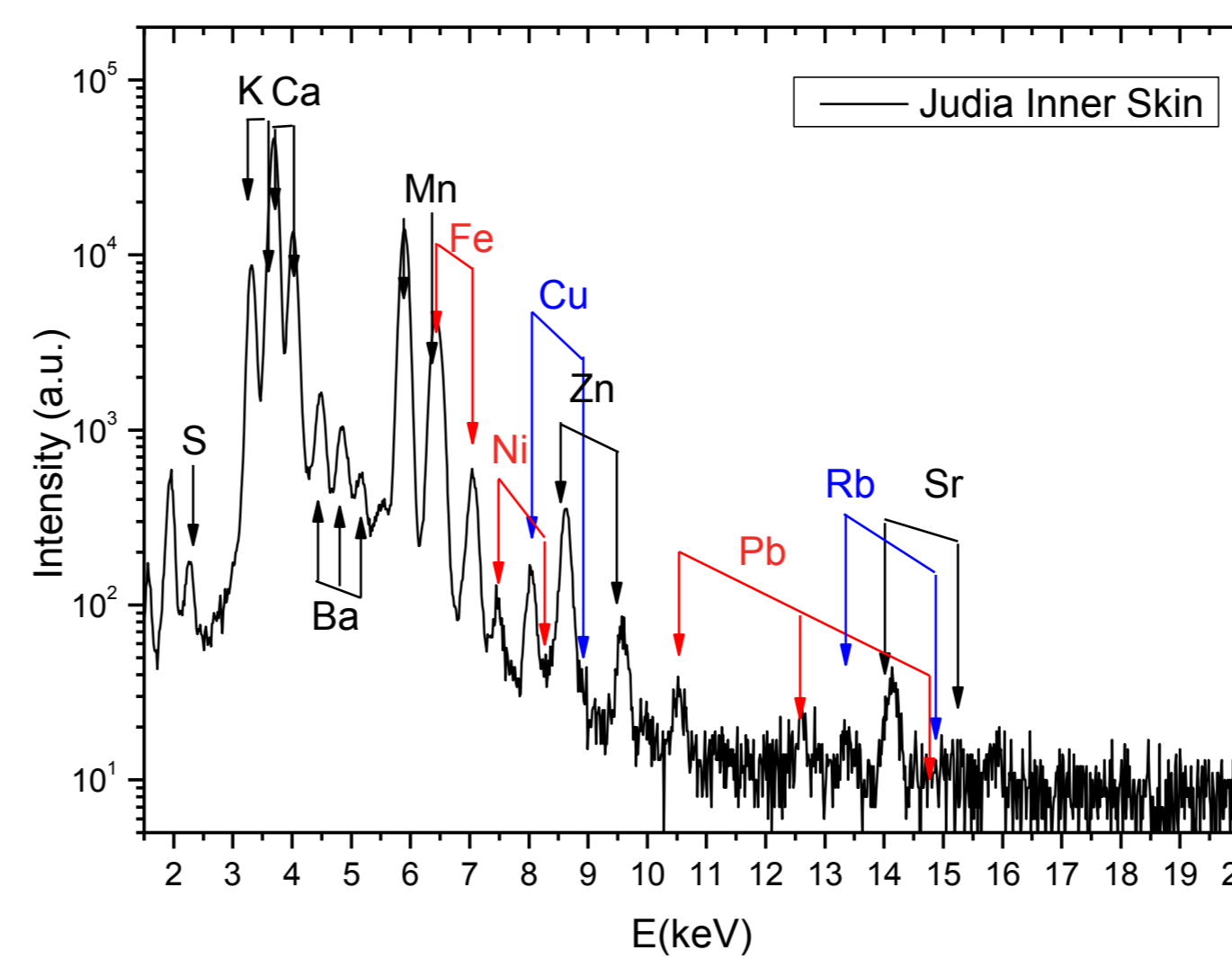
Preliminary results show different composition according with the varieties, not only in the major and minor elements (as it is described in the bibliography) but also in the trace elements, which includes the presence of Pb.



	Judia Fruit		Longal Fruit	
	Conc. (wt%)	std%	Conc. (wt%)	std%
K	0.9129	13.7%	0.8935	15.9%
P	0.0979	14.7%	0.1470	19.6%
Ca	0.0716	33.0%	0.1663	18.2%
S	0.0620	13.0%	0.0723	19.1%
Si	0.0243	79.8%	N.d.	-
Cl	0.0103	39.8%	0.0123	24.9%

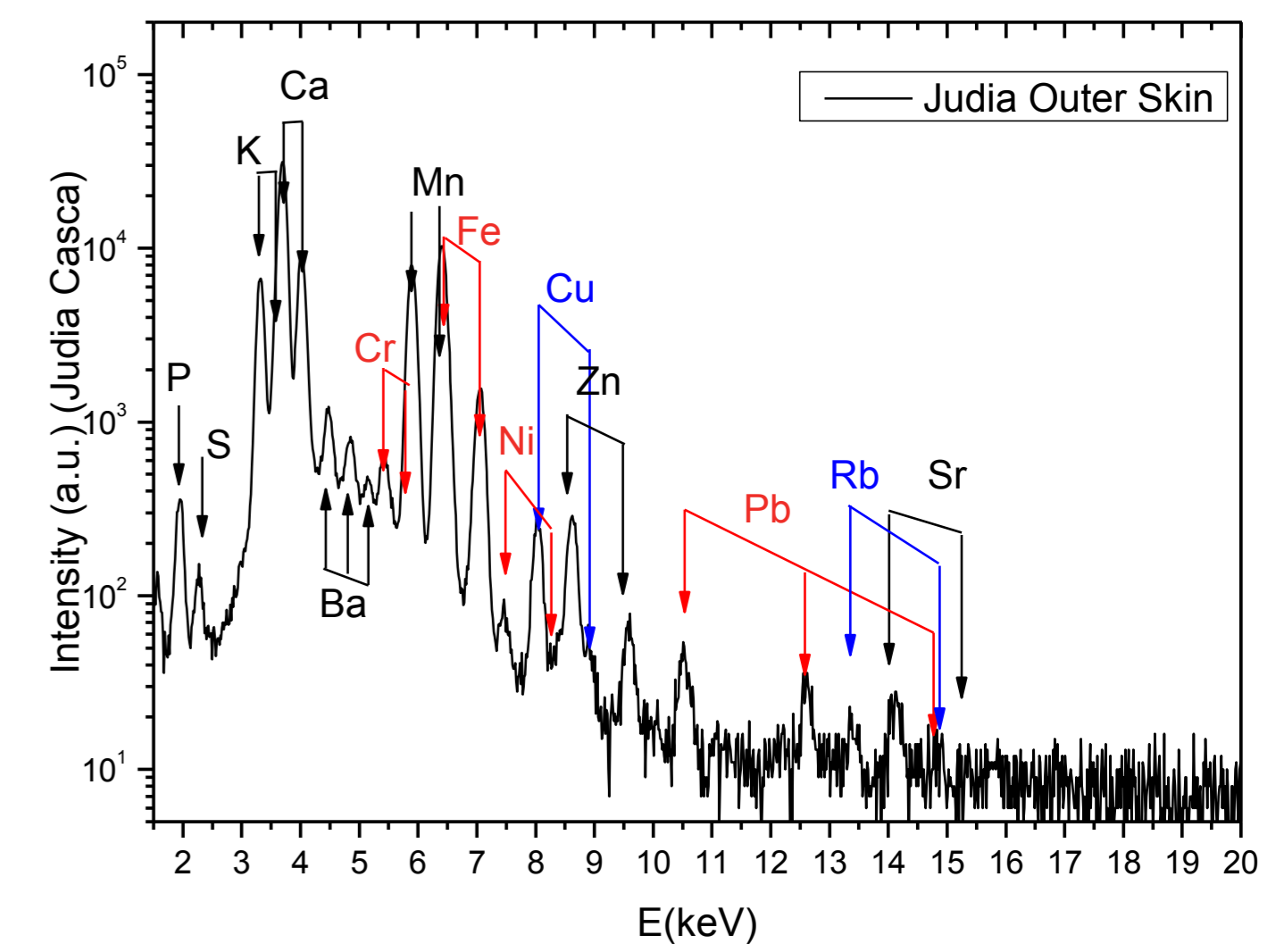


	Judia Fruit		Longal Fruit	
	Conc. (µg/g)	std%	Conc. (µg/g)	std%
Mn	155	39.2%	58	25.3%
Fe	46	27.8%	26	22.2%
Rb	22	37.6%	12	21.9%
Zn	19	39.3%	22	22.3%
Cu	12	41.2%	6	23.0%
Pb	7	59.1%	3	51.7%
Ni	5	39.8%	2	28.1%
Cr	4	121.9%	1	74.3%
Sr	3	43.9%	2	13.0%
As	3	77.0%	2	69.0%



	Judia Inner Skin		Longal Inner Skin	
	Conc. (wt%)	std%	Conc. (wt%)	std%
Ca	0.2457	14.0%	0.3702	5.8%
K	0.1444	10.5%	0.0534	7.2%
S	0.0272	11.2%	0.0229	11.1%
Mn	0.0200	13.0%	0.0072	3.2%
Si	0.0153	36.8%	0.0273	26.2%
P	0.0138	21.3%	0.1126	6.1%

	Judia Inner Skin		Longal Inner Skin	
	Conc. (µg/g)	std%	Conc. (µg/g)	std%
Ba	57	13.9%	30	7.9%
Fe	45	5.1%	59	6.6%
Cl	34	30.5%	57	40.1%
Zn	12	11.5%	13	7.7%
Sr	8	5.5%	11	6.4%
Ti	5	14.3%	6	12.0%
Cu	3	12.9%	2	3.3%
Rb	2	12.2%	1	2.3%
Pb	1	20.0%	1	11.3%



	Judia Outer Skin		Longal Outer Skin	
	Conc. (wt%)	std%	Conc. (wt%)	std%
Ca	0.2492	4.4%	0.1954	0.5%
K	0.1645	2.1%	0.0813	4.3%
Fe	0.0533	51.8%	0.0410	24.5%
S	0.0531	3.1%	0.0588	4.9%*
Mn	0.0522	3.5%	0.0456	0.1%

	Judia Outer Skin		Longal Outer Skin	
	Conc. (mg/g)	std%	Conc. (mg/g)	std%
Ba	155	6.0%	202	2.1%
P	143	4.2%	112	79.6%
Si	96	13.7%	134	18.4%*
Zn	43	8.4%	84	1.6%
Sr	27	11.1%	72	25.3%
Pb	16	93.4%	225	3.9%*
Cr	12	100.7%	4	70.9%
Ti	11	14.4%	39	9.6%*
Rb	8	30.6%	34	51.3%
Ni	3	10.2%	2	30.8%

\* Statistical error. Only one point considered.

## Conclusions

Besides the identification and quantification of macro- and micro-elements reported in the literature for chestnut fruits, it was possible to identify and quantify other elements (to the ppm level) such as Rb, Ni, Sr, Cr, As or Pb.

Different composition according with the varieties were obtained for the fruits and the skins (inner and outer).

The highest Pb content was found in the outer skin, and the lower content in the inner skin of the chestnuts.

The source of the high values obtained for the standard deviation should be further investigated. Specially in what concerns grinding procedures, resulting powder homogenization and number of analyzed samples.

These preliminary results are part of a wider project that aims to evaluate chestnut fruits decontamination treatment with high energy electron beam and X-rays technology.

## Acknowledgments

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## References

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