EVALUATION OF THE LEVELS OF ARSENIC IN CHILEAN RICE ACORDING TO THE AGRONOMIC MANAGEMENT

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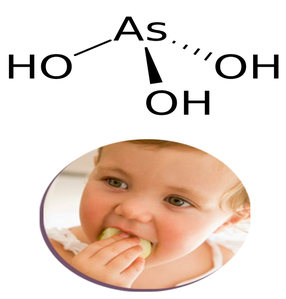
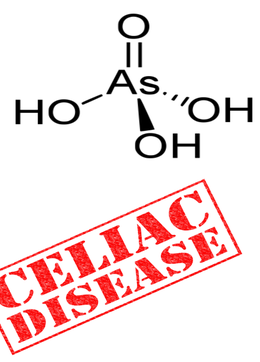
1. Abstract

This summary incorporates the most relevant results of this study. These correspond to the concentration of total and inorganic arsenic (As) in rice samples, which were validated by using certified reference material for rice flour. The rice samples (n=144) were divided into 72 polished rice samples with an average total As concentration of 159 ± 87 µg kg^{-1} and inorganic As concentration of 74 ± 27 µg kg^{-1}. For brown rice (n=72) an average total As concentration of 250 ± 107 µg kg^{-1} and for inorganic As 143 ± 517 µg kg^{-1} was found. From these average values for the 2021 harvest, it is concluded that the concentrations of total and inorganic As in polished and brown rice comply with national and international regulations, not exceeding the maximum permitted limits of 200 µg kg^{-1} and 400 µg kg^{-1}, respectively.

2. Introduction





CELIAC DISEASE

Norm/ Country	Polished rice	Brown rice	Infant rice
FAO/WHO	0,20 mg kg^{-1}	0,40 mg kg^{-1}	0,10 mg kg^{-1}
EFSA/EC	0,20 mg kg^{-1}	0,25 mg kg^{-1}	0,10 mg kg^{-1}
FDA/EEUU	0,10 mg kg^{-1}	-	0,10 mg kg^{-1}
*MINSAL/Chile	0,20 mg kg^{-1}	-	-

3. Methodology

HPLC/IC/ICP-MS

SRM 1568b Rice Flour

Settings HPLC (As-speciation análisis)	
Colum	PRP-X100, 5 µm, 250 × 4.6 mm
Mobile phase flow	0,8 mL min^{-1}
Mobile phase	$NH_4H_2PO_4$ / NH_4NO_3 6,66 mM pH 6.2 using 3% ammonia
Settings ICP-MS	**(Total As)**
Gas Flow rate plasma	13.9 L min^{-1}
Gas Flow rate nebulizer	1.1 L min^{-1}
Gas Flow rate auxiliary	0.8 L min^{-1}

4. Results

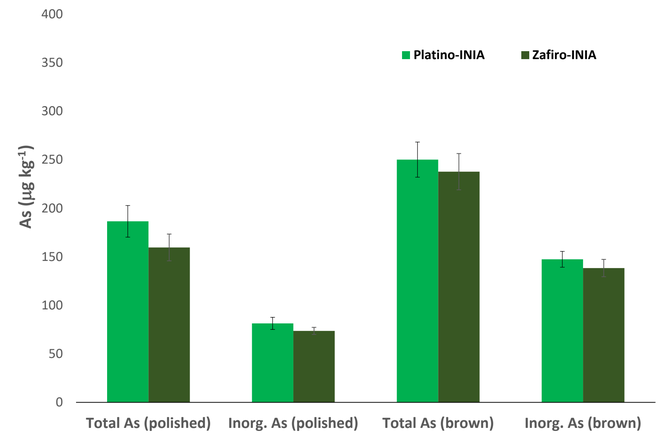
Total and Inorganic Arsenic in Polished Rice

Parámetro	As t (µg Kg^{-1})	As i (µg Kg^{-1})	% As i (µg Kg^{-1})
Promedio	173 ± 91	78 ± 31	50 ± 17
Distribución Normal	No	No	No
Rango Concentración mín-máx	52 – 408	15 – 176	20 – 98
Mediana	146	72	48

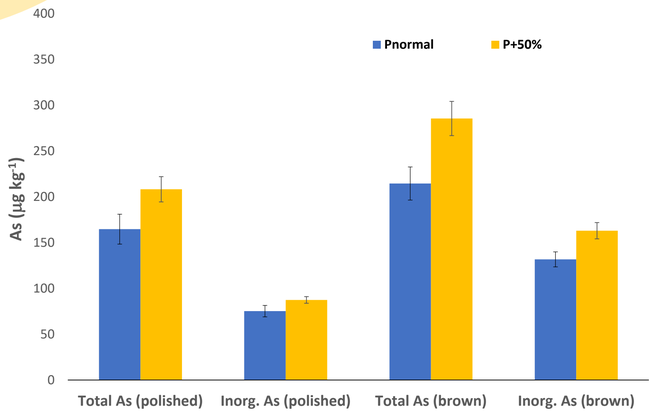
Total and Inorganic Arsenic in Brown Rice

Parámetro	As t (µg Kg^{-1})	As i (µg Kg^{-1})	% As i (µg Kg^{-1})
Promedio	244 ± 110	143 ± 51	63 ± 16
Distribución Normal	No	No	No
Rango Concentración mín-máx	95 – 513	54 – 257	23 – 142
Mediana	201	135	63

Genetic variety

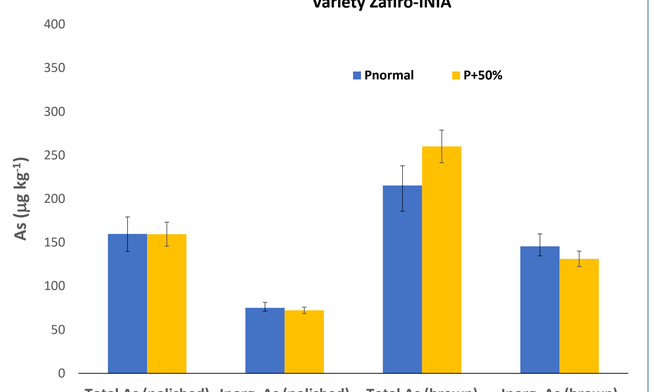


Variety Platino-INIA



Fertilizer doses

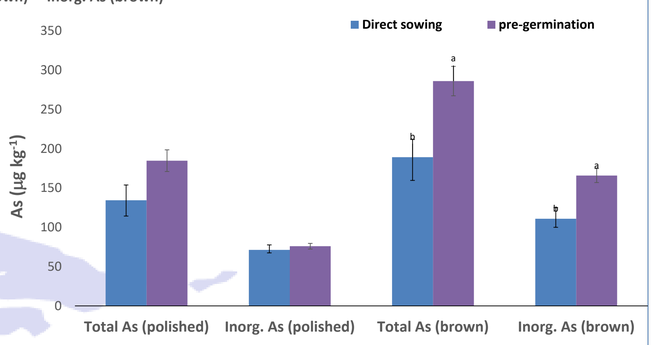
Variety Zafiro-INIA



Platino-INIA

Sowing system

Zafiro-INIA



5. Discussion and conclusions

1. The total and inorganic arsenic levels in polished and brown rice found in this study comply with the international regulations of WHO.
2. Agricultural practices such as increasing the dose of fertilizer (phosphorus) could increase the arsenic concentration in rice grain. However, the genetic variety and the type of sowing (direct sowing and pre-germination) influence arsenic uptake in the plant and grain.

References

[1] Tuli R., Chakrabarty D., Trivedi P. K., Tripathi R.D., Recent advances in arsenic accumulation and metabolism in rice. Mol. Breed. 26 (2010) 307-323.

[2] Kumarathilaka P., Seneweera S., Meharg A., Bundschuh J., Arsenic accumulation in rice (Oryza sativa L.) is influenced by environment and genetic factors. Sci. Total Environ. 642 (2018) 485–496.

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