How You Cook Rice Influences the Arsenic Level

Lilianne Abramsson-Zetterberg1*, Birgitta Sundström1 and Barbro Kollander1

1Department of Science, The Swedish National Food Agency, Box 622, 751 26 Uppsala, Sweden.

Authors’ contributions
Contributions to NFA reports are carried out in collaboration between all authors. Author LAZ initiated the work and headed the writing. Author BS headed the analyses and contributed to the writing and performed the analyses. All authors read and approved the final manuscript.

Article Information
DOI: 10.9734/EJNFS/2016/28191
Received 7th July 2016
Accepted 16th November 2016
Published 12th January 2017

ABSTRACT

Inorganic Arsenic, iAs, is a well-known carcinogenic compound. It is therefore important to decrease the exposure of iAs as much as possible. In this work the levels of iAs and total arsenic (totAs) are determined in twelve samples of common rice brands, before and after cooking: i) in a recommended volume of water, and ii) in an extra volume of water which is poured off when the rice is ready to eat. The study mimics the way of cooking rice in the house holds; Ordinary pan has been used, salt has been added, and the tap water at hand has been used. The mean levels of iAs and totAs in unboiled rice were 110 µg/kg and 133 µg/kg respectively. The corresponding mean iAs level in the boiled rice, prepared as recommended with cooking to dryness, was about the same as in the unboiled rice. The mean levels, of iAs and totAs in the rice boiled in an excess amount of water was significantly reduced, between 40-70 percent. Furthermore, also other metals were analysed at the same time, e.g. nickel decreased and uranium increased significantly in the rice boiled in excess of water.

Keywords: Food; rice; arsenic; cooking.

1. INTRODUCTION

Inorganic Arsenic, iAs, is a well-known toxic compound with both carcinogenic and genotoxic properties and it is therefore important to decrease the intake as much as possible (WHO/IARC, 2012). Arsenic is naturally occurring in the bed rock and thereby in ground water and soil. As a result of this, elevated arsenic level is found in rice growing in some regions.

Rice is a staple food and is much consumed globally, especially by certain population groups. Therefore it is of great importance to decrease the iAs level in often-consumed rice products. There are different ways of reducing the arsenic level in cooked rice. For people living in regions

*Corresponding author: Email: liab@slv.se;
with low levels of As in water, one way is to boil the rice in excess volume of water which after boiling is discarded. How the way of boiling influences the As levels in rice has been studied and published by others, and from these studies it is clear that an excess volume of water, containing low levels of As, that are discarded after completed boiling time decreases the As level in rice. In this study we have also analysed and compared As levels in rice that have been boiled in two ways; i) in a volume water adjusted to be totally absorbed after the recommended cooking time, and ii) boiling the rice grains in an extra volume of water which is poured off when the rice is ready to eat. Furthermore, to mimic the cooking procedure in an ordinary kitchen we have used; ordinary tap water salted in the recommended way, an ordinary pan, and simply poured off the extra water after completed boiling time. Both iAs and also totAs (total amount of arsenic) have been analysed. Also the effects on the levels of some other metals in the boiled rice are presented.

2. METHODS

Twelve different brands of rice, of the most common in Sweden, were purchased in some major retailers in the city of Uppsala in Sweden. The tap water used for rinsing and cooking were produced in Uppsala municipality. From each of the rice packages, three samples were analysed upon the level of iAs, and totAs; a) one sample of raw rice without any further preparation, b) one sample, washed in tap water during 10 seconds, and then boiled in the recommended volume of water plus a recommended amount of salt added until all water was absorbed into the rice, and c) one sample, washed and boiled in extra much tap water, 100 gram rice corresponding to 1 litre of water. After the boiling the remaining water was discarded by simply tilting the pan.

3. RESULTS AND DISCUSSION

The levels of iAs in the twelve samples of unboiled rice ranged from 35 to 270 (mean 110) µg/kg and the levels of totAs from 50 to 274 (mean 133) µg/kg. The corresponding mean iAs level in the boiled rice, prepared as recommended with cooking to dryness, was as expected about the same as in the unboiled rice after correction of the increase in weight from absorbed water. The mean levels, of iAs and totAs in the rice boiled in an excess amount of water was, however, significantly reduced, p<0.001. In all rice the reduction was between 40-70% for both iAs and totAs.

![Figure 1. iAs in rice, before and after boiling](image)

Fig. 1. The concentrations of inorganic arsenic, iAs, in different brands of rice (A – L); Unboiled, boiled to dryness, and boiled in excess of water that was discarded after cooking

* The concentrations are adjusted for the increase in weight after boiling, i.e. corrected to give the concentrations in dry unboiled rice
The rice samples were also analysed regarding other toxic elements, e.g. nickel (Ni) and uranium (U). When boiling the rice in an excess of water the levels of Ni decreased significantly. The original level of Ni varied between 250 and 460 µg/kg in unboiled rice and after the boiling in excess of water the level was reduced 70%. On the contrary the levels of U increased in the rice after boiling. The tap water used in the study has a documented high level of U, about 30-40 µg/L, which was reflected in the boiled rice. The U-level in the boiled rice increased from below 1 µg/kg to the same level as in the tap water.

Our results and data from other published studies show, irrespective of the content of other metals present in tap water, that boiling rice in water reduces the As content. The tap water used in our study contained low levels of As and therefore it was possible to get rid of a great part of As in the rice.

In comparison with other carcinogenic compounds that we are exposed to via food, the health risk of inorganic arsenic is high. Among average and high level consumers in Europe the extra cancer risk is calculated to 1% (EFSA, 2009). Therefore it is recommended that dietary exposure to inorganic arsenic should be reduced. Our study demonstrates that the way of cooking rice in the house hold could easily decrease our exposure of As.

http://www.livsmedelsverket.se/globalassets/rapport/2016/how-you-cook-rice-influence-rapport-7-2016.pdf

ACKNOWLEDGEMENT AND ADDITIONAL INFORMATION

The project was funded by the Swedish National Food Agency and was performed in 2015.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

EFSA. Scientific Opinion on Arsenic in Food. EFSA panel on contaminants in the food chain (CONTAM). EFSA J. 2009;7(10):1351.

WHO/IARC. Monographs on the evaluation of carcinogenic risks to humans. 2012;100C.