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How processing types change the elemental composition of rice?

According to FAO – *Food and Agriculture Organization of the United Nations,* world's rice production reached 501.2 million tonnes in 2016-17 season, which is related to rice being a staple for 7 billion people. Asia is the largest producer continent, and, in Brazil, Rio Grande do Sul is the largest one. After harvesting, rice grains undergo a beneficiation process, resulting in different types, being the most common brown rice (BRO), parboiled (PAR) and white/polished (POL). However, studies reporting elemental composition changes due to rice processing type minimizing geographic origin or climate variables by using grains from the same source are still rare, particularly related to migration of these elements after parboiling and/or polishing process from the same rice origin, that comprehend variations in macro and micronutrients and also in elements with no nutritional value. Elements were determined in rice samples by ICP OES, being them: brown rice (BRO); parboiled rice (PAR); white rice samples (POL) from 5 different brands (ie all five brands produces all three types of rice).

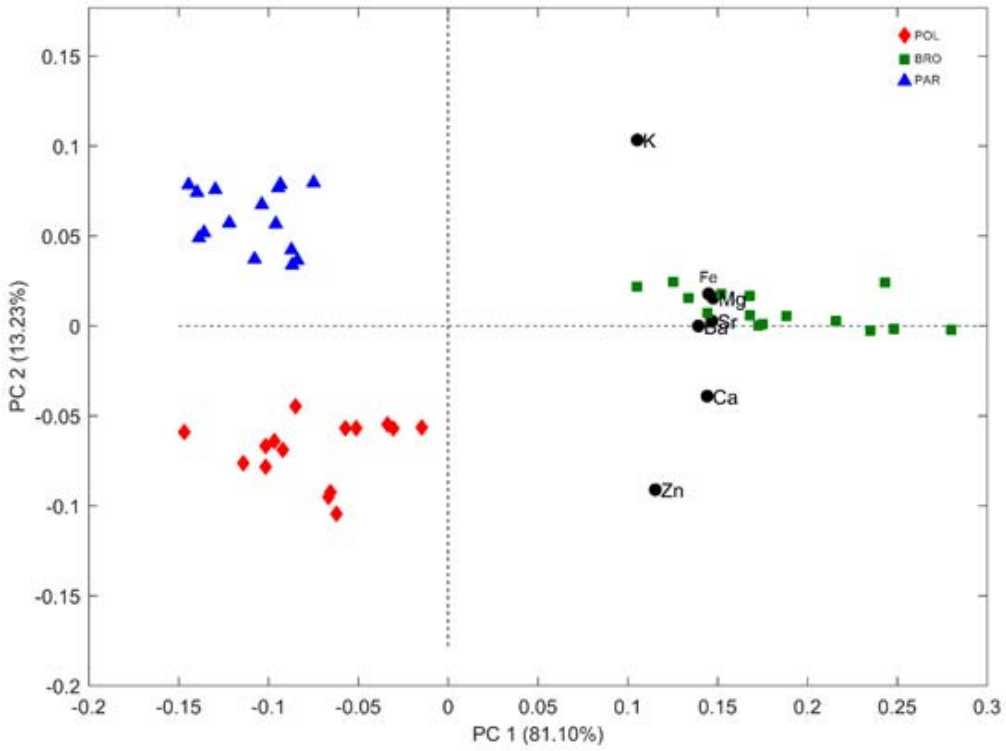

Fig. 1. Scores and loadings of rice samples by different processing types. Brown (■), Parboiled (▲) e White (polished) (♦).

For all brands analyzed, the values found in BRO were equal to or higher than PAR and POL, clearly by keeping most external parts of the grains. It is also possible to notice that the K values decreased as the rice processing removes more components of the grain. However, processing types may also determine different values according to each element. POL had Ca, Mn, Zn and Sr values were higher than PAR,

indicating that retention for these elements after polishing is higher than parboiling process. Mg, Fe, Se and Ba values were not different between PAR and POL groups, thus both processing types are able to reduce these concentrations in comparison to BRO.

Likewise, PCA plot shows natural groupings by rice processing types, indicating strong correlation between elements values regarding to grains layers, namely, processing affects rice grain layers which modulate trace element concentrations. Our findings suggests that K, Mg, Ca, Mn, Zn, Fe, Ba and Sr are reduced by parboiling or polishing, moreover Mg, Ca, Mn, Zn and Sr are more sensitive to parboiling process.

Brown rice does not undergo a polishing process, keeping the external layers, in which the minerals are present in higher concentration. The larger the polishing steps, the greater the number of external layers lost. Thereby, nutrients and fibers concentrations are two to three times higher in brown rice than in white rice. Data previously reported, showed that brown rice nutrients content was 1.7 times higher than parboiled and 3.8 times higher than white rice. However, this behavior was not observed for all the elements, in other words, even with the removal of external layers by the polishing process, concentrations of Ca, Mn, Zn and Sr remained higher than those grains submitted to parboiling process. On the other hand, the higher loss of Ca, Mn, Zn and Sr in parboiled rice suggests that hydrothermal process determines migration of these elements from the inner layers to the outer layers, which are eventually removed, unlike what was observed for the other nutrients like water soluble vitamins. Thus, while parboiled rice contains a larger nutritive value in comparison to white, precisely because of the soluble minerals migration from the outer layers to the endosperm, for Ca, Mn, Zn and Sr our data evidenced that this migration occurs in the opposite direction, or parboiling process itself could contribute to uptake these elements.

Finally, our data suggests that polishing and parboiling determine quantitative and qualitative variations, where Ca, Sr and Zn are more sensitive to parboiling than polishing, Mg, Fe and Ba are more distributed in the outer layers and Cu, Mo, Ni, As, Co and V are not determinants in grouping by processing types.

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Publication

Multi-element rice grains analysis by ICP OES and classification by processing types.
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