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Rice and nutritional quality: Grain quality of highland rice genotypes cultivated in Jumla, Nepal

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Abstract

The cultivation of highland rice relies on cold-tolerant *Oryza sativa* japonica landrace, and is directly associated with an ample availability of water combined with low and often highly fluctuating temperatures and very high solar radiation depending on altitude, latitude, and topography. Particularly low (night) temperatures delay the phenological development of highland rice and increase spikelet sterility, affecting the production and productivity of landraces and resulting in relatively low grain yields as compared to the national average. Thus, food insecurity prevails in much of the highland regions, especially in Karnali, where food shortages shape the vulnerability of rural livelihood since decades. On the other hand, low temperatures combined with high UV radiation at high altitudes may enhance antioxidants and phenolic compounds in the grain, thus positively affecting grain quality. However, the morphological and nutritional quality may vary between rice genotypes and across altitudinal gradients. We collected grain samples at rice harvest of seven genotypes including three parental lines including local and improved cultivars grown at Agricultural Research Station, Bijayanagar, Jumla (2300 masl) and from other three altitudinal gradients, namely Tatopani (2200 masl), Sinja (2300 masl) and Chhumchaur (2900 masl) from farmers' field during the harvesting period. Grain morphological traits (grain weight, shape, size) was analysed using scanning electron microscope coupled with energy disperse X-ray (ESEM-EDX) and mineral composition of grain samples was analysed using Inductively Coupled Plasma – Optical Emission Spectroscopy (ICP-OES) in the lab at the University of Bonn. Larger grain was observed for improved genotypes Chandanath 1, Chandanath 3 and Lekali 1 than local cultivar Jumli Marshi, and the 1000 grain weight was higher for Chandanath 3 (31.3 g). Interestingly, mineral contents (Fe, Zn, P) was significantly higher in local cultivar Marshi, whereas Ca was found higher in Black rice. Our results suggest that local cultivar Marshi has superior mineral nutrients quality even though the grain morphology associated yield seems to be relatively low. Our study reports for the first time on the associated change trends in grain morphological and nutritional quality attributes across altitudinal gradients of Nepal.

Keywords: Agronomic traits, grain morphology, Karnali, *Oryza sativa*