Plant Cell Reports
Vol. 33/ PP 521-537

Co-suppression of synthesis of major a-kafirin sub-class together with c-kafirin-1 and c-kafirin-2 required for substantially improved protein digestibility in transgenic sorghum

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Abstract

Key message Co-suppressing major kafirin sub-classes is fundamental to improved protein digestibility and nutritional value of sorghum. The improvement is linked to an irregularly invaginated phenotype of protein bodies. The combined suppression of only two genes, c kafirin-1 (25 kDa) and c-kafirin-2 (50 kDa), significantly increases sorghum kafirin in vitro digestibility. Co-suppression of a third gene, a-kafirin A1 (25 kDa), in addition to the two genes increases the digestibility further. The high-digestibility trait has previously only been obtained either through the co-suppression of six kafirin genes (a-A1, 25 kDa; a-B1, 19 kDa; a-B2, 22 kDa; c-kaf1, 27 kDa; c-kaf 2, 50 kDa; and d-kaf 2, 18 kDa) or through random chemical-induced mutations (for example, the high protein digestibility mutant). We present further evidence that suppressing just three of these genes alters kafirin protein cross-linking and protein body microstructure to an irregularly invaginated phenotype. The irregular invaginations are consistent with high pepsin enzyme accessibility and hence high digestibility. The approach we adopted towards increasing sorghum protein digestibility appears to be an effective tool in improving the status of sorghum as a principal supplier of energy and protein in poor communities residing in marginal agro-ecological zones of Africa.