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Physicochemical characterisation of kafirins extracted from sorghum grain and dried distillers grain with solubles related to their biomaterial functionality

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Kafrin, the hydrophobic prolamin storage protein in sorghum grain is enriched when the grain is used for bioethanol production to give dried distillers grain with solubles (DDGS) as a by-product. There is great interest in DDGS kafrin as a new source for biomaterials. There is however a lack of fundamental understanding of how the physicochemical properties of DDGS kafrin having been exposed to the high temperature conditions during ethanol production, compare to kafrin made directly from the grain. An understanding of these properties is required to catalyse the utilisation of DDGS kafrin for biomaterial applications. The aim of this study was to extract kafrin directly from sorghum grain and from DDGS derived from the same grain and, then perform a comparative investigation of the physicochemical properties of these kafirins in terms of: polypeptide profile by sodium-dodecyl sulphate polyacrylamide gel electrophoresis; secondary structure by Fourier transform infra-red spectroscopy and x-ray diffraction, self-assembly behaviour by small-angle x-ray scattering, surface morphology by scanning electron microscopy and surface chemical properties by energy dispersive x-ray spectroscopy. DDGS kafrin was found to have very similar polypeptide profile as grain kafrin but contained altered secondary structure with increased levels of β -sheets. The structure morphology showed surface fractals and surface elemental composition suggesting enhanced reactivity with possibility to endow interfacial wettability. These properties of DDGS kafrin may provide it with unique functionality and thus open up opportunities for it to be used as a novel food grade biomaterial.

The production of alcohol from grains such as maize and sorghum for use as biofuel is a current topic of commercial interest. Increased biofuel needs are predicted to occur over the next decade as reported by the EU Regulatory Framework for Biofuels¹. Dried distillers grain with solubles (DDGS) is a protein enriched by-product from this industry, that remains after fermentation and distillation by heat treatment². At present, some DDGS may be used as an animal feed supplement, but the rest is considered waste and may be dumped in sewers and rivers³. Unlocking value from unwanted DDGS is an important step to reduce this current environmental burden. Globally, several Authorities have identified priorities for the value-added utilisation of DDGS.

Kafrin is a hydrophobic storage protein found in sorghum grain. In the grain it contributes 65–75% of the total protein and it contains more than 50% hydrophobic amino acids. Efficient techniques for extraction and

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