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Maize endosperm density measurement with X-ray micro computed tomography (µCT)

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The staple food of Southern African is milled maize (Zea mays L.). Hard maize is favoured by the milling industry for improved end-product quality and milling yield. Two types of endosperm, vitreous and floury, are present in maize kernel and the predominant type present determines the hardness and milling performance of the maize. A relatively fast and non-destructive method for hardness determination is required. X-ray micro computed tomography (µCT) was used as a non-invasive technique to determine the average densities of the total kernels of maize samples differing in hardness, as well as that of the floury and vitreous endosperm. A linear calibration function was produced using a range of calibration polymers in the range of 0.9 to 2.2 g.cm-3. Different regions of interest (ROI) could be segmented and the average density of each ROI was calculated (total kernel = 1.46 g.cm-3; floury endosperm = 1.28 g.cm-3; vitreous endosperm = 1.51 g.cm-3). These average density values and volumes (mm3) of the whole kernels were subsequently used to calculate the mass of the individual maize kernels; these were within a range of 4.7 to 9.3% of the true masses.
This initial study, using X-ray µCT to determine densities of ROI and whole maize kernels, shows potential of using this technique to distinguish between hard and soft maize kernels. The average densities (1.4 – 1.48 g.cm-3) of the respective kernels ranked them in the same order of increasing kernel hardness as determined earlier by means of a milling index method (34.3 to 21.6% chop).

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