Machine vision to reduce nut loss

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Introduction

One third of food produced for human consumption is presently being lost or wasted. Nut losses due to high moisture content and rancidity is a significant issue (Bai et al. 2018). However, current methods to detect nut-in-shell moisture content and kernel rancidity are destructive. Hyperspectral imaging has the potential to decrease nut loss by predicting rancidity and shelf life in a rapid and non-destructive manner.
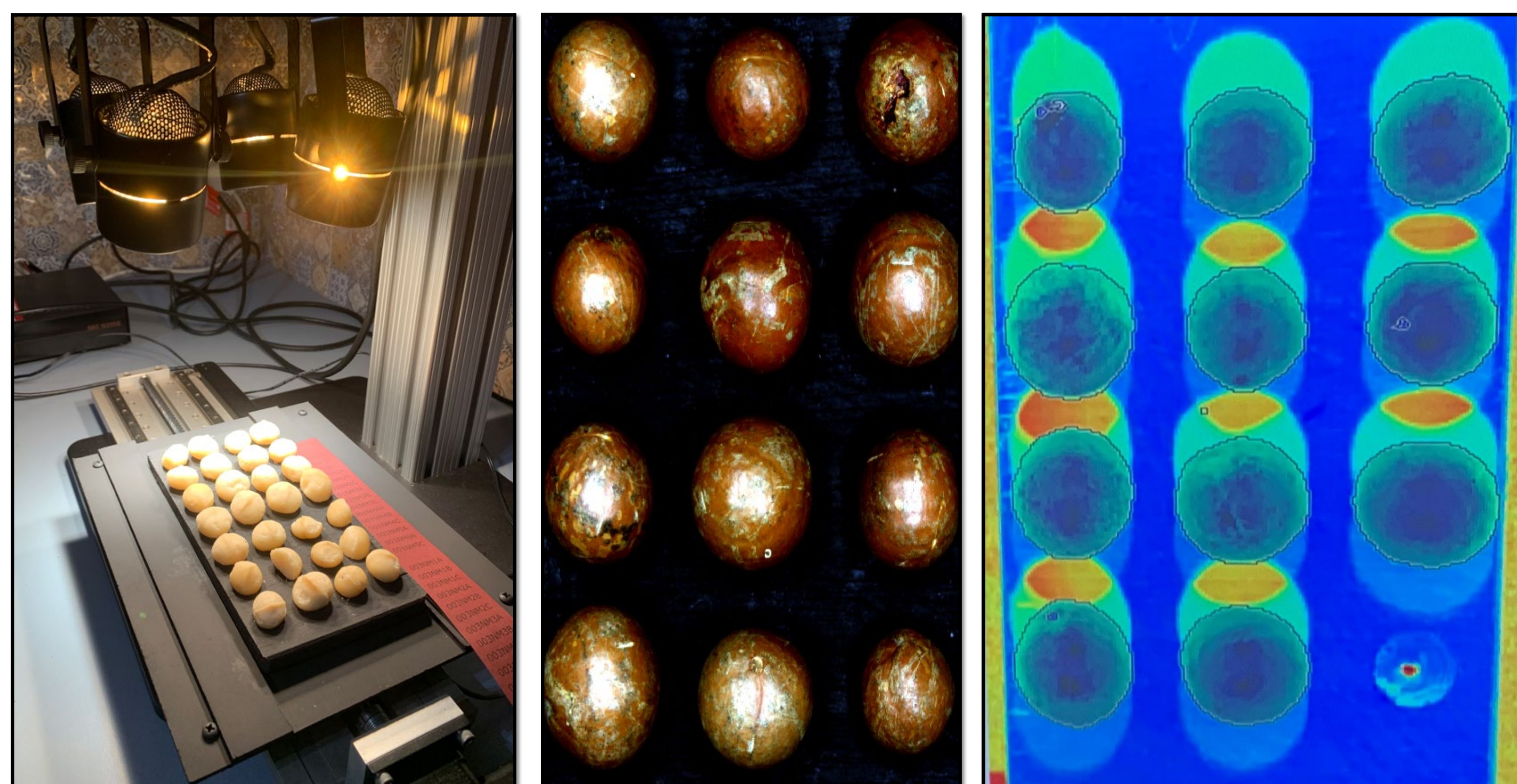
Material & Methods

Fig. 1 Hyperspectral imaging of macadamia kernels (left), nut-in-shell macadamia samples (center) and object segmentation using SWIR (900-2500nm) (right)

- Hyperspectral images were collected for 437 nut-in-shell macadamias, 240 macadamia kernels and 120 canarium kernels (Fig. 1).
- Nut-in-shell macadamia samples were analyzed for moisture (%) content.
- Macadamia and canarium kernels were analysed for peroxide values (PV)
- We then developed partial least squares regression (PLSR) models to predict moisture content of nut in shell macadamia and rancidity (PV) of both macadamia and canarium kernels.

Results 1

The coefficients of determination (R^2) and ratios of prediction to deviation (RPD) of the test set for moisture (%) were $R^2=0.85$; RPD=2.58 for NIS macadamia (Fig. 2).
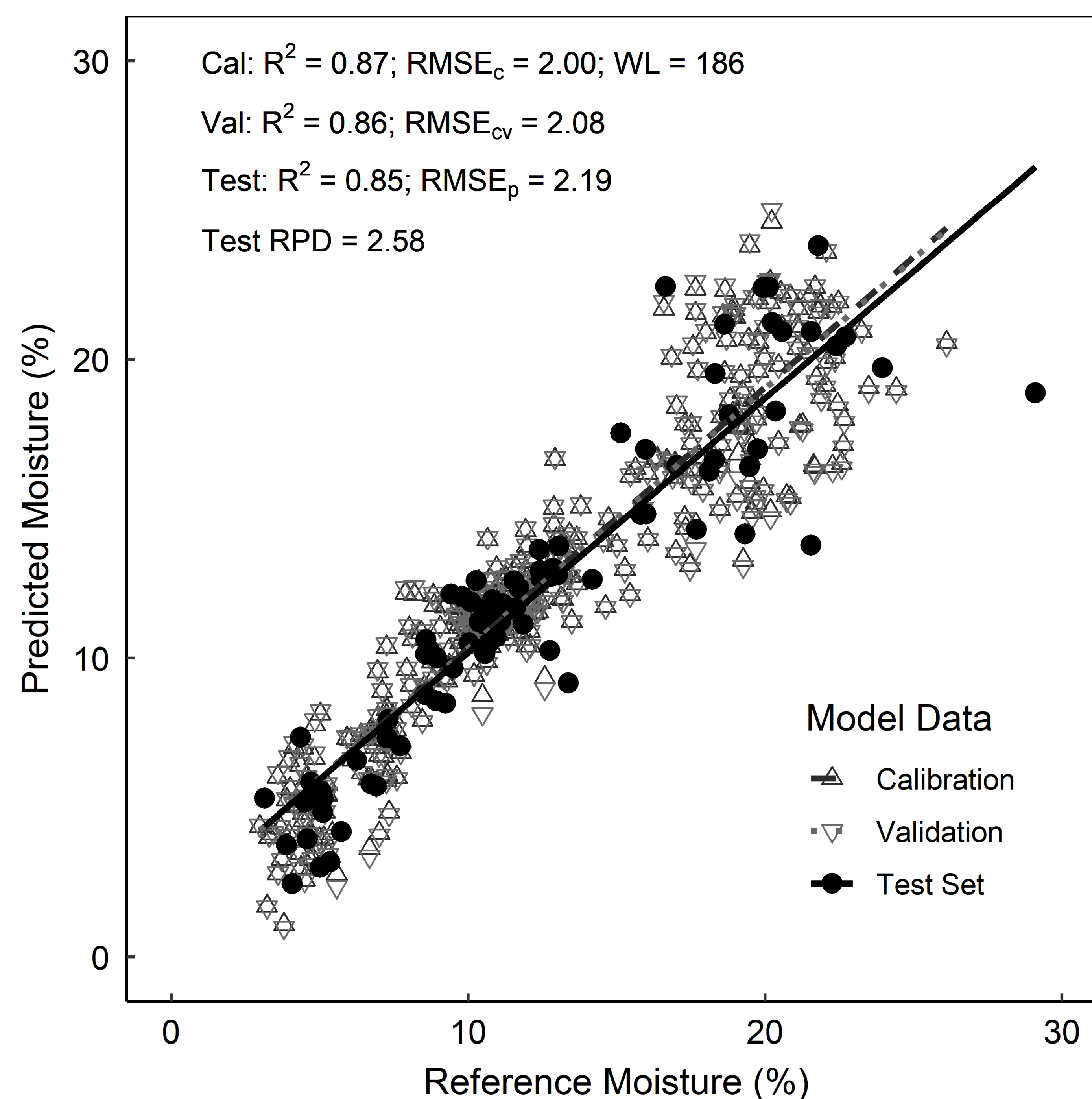

Cal: $R^2 = 0.87$; $RMSE_c = 2.00$; WL = 186

Val: $R^2 = 0.86$; $RMSE_{cv} = 2.08$

Test: $R^2 = 0.85$; $RMSE_p = 2.19$

Test RPD = 2.58

Fig. 2 Measured v predicted nut-in-shell moisture (%) content using V/Nir spectral region (400-1000 nm)

Results 2

Canarium indicum kernels

The coefficients of determination (R^2) and ratios of prediction to deviation (RPD) of the test set for PV were $R^2=0.72$; RPD=1.66 in canarium and $R^2=0.91$; RPD=2.44 in macadamia.

The peak area at 960 nm is usually associated O-H stretches of water and oils (Bai et al. 2018; Panda et al. 2022). Accurate prediction of nut in shell moisture content and rancidity is particularly important which allows developing this technology to accurately scan macadamia nuts in real time and remove spoiled nuts before those become an issue.

Conclusions and perspectives

Hyperspectral imaging has the potential to predict

- moisture content of nut in shell macadamia samples which then reduces nut rejection due to nut spoilage
- nut rancidity which then reduces nut loss.

Fast moisture and rancidity assessment help to reduce post-harvest nut loss

Dr Michael Farrar

References: Bai et al. 2018. Computers and Electronics in Agriculture 151, 492-500; Panda et al. 2022. Journal of Food Engineering, 318, p.110889.

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