

# S2

## Using Hyperspectral Imaging Combined with 1D-CNN to Evaluate Quality of Mānuka Honey Before Extraction

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New Zealand mānuka honey is mainly derived from *Leptospermum scoparium* nectar. The potent antibacterial activity of mānuka honey comes principally from methylglyoxal (MGO), in addition to the hydrogen peroxide and other lesser activities present in all honeys. MGO is formed from dihydroxyacetone (DHA) unique to *L. scoparium* nectar. Mānuka honey also has an idiosyncratic phenolic profile useful as a chemical marker. Authentic mānuka honey is highly valuable but almost all honeys are formed from natural mixtures of nectars harvested by a hive over a time period. Once diluted by other nectars, mānuka honey irrevocably loses value. We aimed to apply hyperspectral imaging to honey frames before bulk extraction to minimise dilution of genuine mānuka by other honeys and ensure authenticity at source. This technology is non-destructive and suitable for an industrial setting. Partial Least Squares and Support Vector Machine showed limited efficacy in interpreting chemical footprints due to large non-linear relationships between predictor and predictand in a large sample set, likely due to honey quality variability across geographic regions. Therefore, one-dimensional convolutional neural networks (1D-CNN) were investigated for analysing hyperspectral data for extraction of biochemical information from honeys. The 1D-CNN model showed superior prediction of honey quality ( $R^2 = 0.74$ , RMSE = 2.201) to PLS ( $R^2 = 0.66$ , RMSE = 2.607) and SVM ( $R^2 = 0.67$ , RMSE = 2.559). Classification of mono-floral manuka honeys from multi-floral and non-manuka honeys exceeded 90 % accuracy for all models tried. This study reveals the potential of 1D-CNN modelling for evaluating honey authenticity.

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