Monitoring development and ripeness of oil palm fruit (Elaeis guneensis) by MRI and bulk NMR

Abstract

In this study, magnetic resonance imaging (MRI) and bulk nuclear magnetic resonance (NMR) were used to track the progressive development of intact oil palm fruit (variety Tenera). Fresh fruits were harvested at 4, 12, 16 and 21 weeks after anthesis (WAA) and all measurements of spin-spin relaxation times (T2-values) were performed at 2.35 Tesla and 20°C. MR imaging data were fitted to mono-exponential decay curves, which depicted a progressive increase in the mean T2-values for mesocarp (18-32 ms) and kernel (13-74 ms) with WAA. The same data were also fitted to bi-exponential decay curves for both the mesocarp and kernel, which showed a decrease of the T21-values from 12-10 ms and 10-9 ms, respectively and an increase of the T22-values from 83-118 ms and 129-139 ms, respectively with WAA; those two components are assigned to the protons of water (T21) and to those of the oil (T22). The multi-exponential fitting of the bulk NMR T2 relaxation data for the intact fruit demonstrated three distinct components; T21 (intermediate component, 23-30 ms) and T22 (long component; 64-144 ms), which are assigned to water protons and oil, respectively and T23(short component; 3-6 ms) related to the shell. The bulk NMR T2 relaxation data for the kernel also demonstrated three components; T21(intermediate component, 12-22 ms) and T22(long component, 59-135 ms), which was assigned to water bound in the endosperm (kernel) and oil content respectively, while short component T23(3-2 ms) was associated to the shell.