

Physico-Chemical, Thermal and Molecular Characteristics of Date-Pits Digested by *Trichoderma reesei* at High Moisture

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Abstract

Date-pits are by-products of date-processing factories and these contain a high amount of indigestible carbohydrates (i.e. fibers). Their utilization could bring economic gain and environmental benefits. The whole and defatted date-pits were treated by autoclaved followed by digestion with *Trichoderma reesei*. Control was considered as treatment in pure water. The defatted date-pits showed higher growth of molds as compared to the whole date-pits. The untreated samples of whole and defatted date-pits showed higher solubility and water absorption; and lower hygroscopicity as compared to the autoclaved samples. In general, the digested whole and defatted date-pits samples showed an increase in water solubility, water absorption and hygroscopicity as compared to the autoclaved samples.

Three pools of protons were identified in whole and defatted date-pits assigned to rigid (T_{2b}), semi-rigid (T_{21}) and mobile (T_{22}) protons. The relaxation time of T_{2b} and T_{22} were higher in the case of untreated whole date-pits as compared to the autoclaved treatment, while T_{21} showed no significant change. The untreated defatted date-pits showed lower T_{2b} and T_{21} and higher T_{22} as compared to the autoclaved samples. The T_{2b} , T_{21} , and T_{22} of whole date-pits decreased as compared to the autoclaved samples. This decrease indicated that digestion transformed these protons to low mobile due to structural damage that interfered with the mobility of the neighboring protons, thus reduced their mobility.

Thermal analysis of the untreated whole date-pits showed a structural change at -3.2°C followed by a glass transition shift, onset at 138°C with a specific heat change as $295\text{ J/kg }^{\circ}\text{C}$ and solids melting-decomposition endothermic peak at 196°C with enthalpy of 68 J/g . In addition, an exothermic increase was observed after glass transition. Thermal analysis showed that treatment produced structural damage and formed high amorphous phases in the treated date-pits. Fourier Transform Infrared (FTIR) spectra of untreated sample showed lower absorption for all selected functional group as compared to the autoclaved sample. Lower absorption in the digested samples indicated that bonds in the functional groups became more-stiff. The spectrum of digested defatted date-pits showed higher absorption for hydroxyl group as compared to autoclave treatment, while it showed lower absorption for other selected functional group.