Abstract

The thesis was initiated through an exhaustive review of research conducted worldwide towards application of enzymes and membrane technology in the production of ready-to-drink (RTD) black tea beverages. To begin with, the influence of extraction conditions on polyphenols content and tea cream constituents in black tea extracts was investigated, which revealed that it is desirable to optimize the extraction conditions in terms of polyphenols recovery rather than merely on extractable-solids-yield (ESY), more precisely on polyphenols content in extracted-solids (PES) with an equal focus on the important quality parameter, Theaflavins-to-thearubigins (TF/TR) ratio. However, the conditions standardized also co-extracted other tea components (proteins, calcium and pectin) responsible for various interactions leading to tea cream formation. Subsequent attempts were made using enzyme assisted extraction to enhance the recovery of polyphenols (besides ESY) and clarity using a cell-wall digesting enzyme (pectinase) and a tannin hydrolysing enzyme (tannase). The results revealed that tannase, hitherto considered only as a tannin hydrolyzing enzyme, displayed not only improvements in polyphenols recovery but also nearly a matching performance to pectinase in terms of ESY. Single enzyme treatment with only tannase could achieve similar performance to that of combined enzyme treatments, proposed earlier by several researchers. The results also revealed enzymatic extraction may be preferred over enzymatic clarification as it not only displayed reduction in tea cream and turbidity but also improved the recovery of polyphenols and ESY.

Membrane technology was assessed as a clarification method for black tea extract employing various microfiltration (MF) and ultrafiltration (UF) membranes with a focus on higher yield and greater retention of polyphenols.
Clarity of membrane processed extracts was excellent (~4 NTU) even after 30 days of refrigerated storage. UF (500 kDa) and MF (200 and 450 nm) membranes resulted in greater retention of original colour, besides higher and polyphenols-to-pectin ratios in the clarified extract. Accordingly, subsequent studies were planned with these membranes at various higher feed concentrations to improve the recovery and productivity under diafiltration (DF) mode of operation. Increase in feed concentration affected the recovery. DF was effective in improving solids recovery including polyphenols and theaflavins but suggested a limit (100-150%) so that elimination of hostile components such as pectins is not dropped below 50%. Assessment of primary quality criteria, turbidity and tea cream contents as well as PPS (polyphenols-in-permeated solids) supported processing at low feed concentrations. Solids and polyphenols recoveries obtained with 0.6% feed concentration and MF-450 membrane combination were unmatched with any other combination employed. The study asserted that MF is preferred over UF membranes for clarification of tea extracts. Further, the antioxidant potential (DPPH) of reject stream of membrane process was comparable to the original tea solids of the crude extract, despite significant differences in their phenolic contents owing to contributions from other non-phenolic tea components. The results suggested that the final retentate stream containing a substantial amount of tea solids (~24%) could be used as a tea conserve in functional foods. The study revealed that membrane clarification of tea extracts offers the possibility of reducing tea cream formation and haze in RTD tea beverages and improve its stability during refrigerated storage while retaining most of the natural quality characteristics of tea.