Characterization of phenolics extracted from Amla (Emblica officinalis) and its processing waste and development of Amla-lemon based RTS drink

ABSTRACT

The thesis includes extraction, characterization and isolation of phenolic compounds from Amla powder, Amla pomace powder and Amla seed coat powder. The present investigation deals with the efficacy of different solvents, temperature and pH on recovery of total phenolic content. It focuses on optimum conditions for highest recovery of phenolics from Amla and its processing waste. The study also evaluated the retention of antioxidant properties in isolated components from Amla pomace powder. The thesis describes the procedure for the development of Amla-lemon based RTS as a functional food.

The thesis is divided into eight chapters which are briefly discussed below.

Chapter-1 presents the general introduction about Amla, its production, morphology, composition, functional and medicinal properties. This chapter also reviews the bioactive components extracted from Amla till now. Different methods for the extraction of phenolics from plant sources are emphasised. It also focuses on commercially available Amla products. Finally the scope and objectives of the present investigation are included.

Chapter-2 deals with the physicochemical properties of different Amla varieties. Various physicochemical properties like size, shape, weight, proximate and total phenolic content of different Amla varieties were investigated. Amla variety selected on the basis of physicochemical properties and availability along with its seed and seed coat were investigated for their proximate composition, mineral analysis, functional properties (total phenolic content, water holding capacity, and swelling capacity). Total phenolic content was compared by both FCR (Folin-Ciocalteu reagent) and reverse phase high performance liquid chromatography (HPLC). The presence of functional groups in Amla fruit, seed and seed coat were also investigated by Fourier transform infrared spectroscopy (FTIR).
Chapter-3 reports the efficacy of different solvents on recovery of total phenolic content from Amla powder. The best optimum conditions for recovery of total phenolics with potent 2,2-diphenyl-1-picrylhydrazyl free radical (DPPH*) scavenging activity from Amla powder through response surface methodology are reported. This chapter also deals with further purification of phenolics using different solvents and by column chromatography. Different fractions from different solvents and column chromatography of the ethyl acetate fraction were characterized by reverse phase HPLC and FTIR. The recovery and DPPH* scavenging activity of the different fractions of Amla powder were also studied.

Chapter-4 presents extraction, isolation, and characterization of phenolics and analyses of the antioxidant properties of Amla pomace powder. In this chapter total phenolics were extracted with a mixture of ethanol and water and the obtained extract was concentrated and freeze dried under vacuum. Obtained powder was partitioned with different solvents and each extract was freeze dried separately. Recovery, DPPH* scavenging activity, total phenolic content and characterization of phenolics (by HPLC and FTIR) in different solvents were studied. Powder of ethyl acetate fraction was further purified by column chromatography. Different fractions from column chromatography were investigated for their total phenolic content and recovery, and characterized by HPLC and FTIR. Phenolic components were isolated from selected fractions through preparatory HPLC. Isolated compounds were identified by HPLC, GC-MS and FTIR. DPPH and ABTS free radical scavenging activity of isolated components were also investigated.

Chapter-5 includes the optimization of extraction of total phenolic content from Amla seed coat powder using Response Surface Methodology. Further, extraction and purification of phenolics were carried out. The characterization of phenolics present in seed coat powder was carried out by HPLC and FTIR. Phenolics were identified by GC-MS after converting them into TMS (Tri methyl silyl) derivatives.

Chapter-6 discusses the effect of different concentrations of maltodextrin and inlet temperatures on physicochemical properties of spray dried Amla powder. Various parameters like moisture content, bulk density, water solubility index, hygroscopicity, particle morphology using SEM and color value were investigated. Effect of inlet
temperature and maltodextrin level on total phenolic content and DPPH* scavenging activity of powder was also investigated.

Chapter-7 describes the effect of different concentration of maltodextrin and inlet temperature on physicochemical properties of spray dried lemon powder. Parameters like moisture content, bulk density, water solubility index, hygroscopicity, particle morphology using SEM and color value of spray dried lemon were investigated. It also deals with optimization of Amla-lemon based RTS (prepared from spray dried Amla and lemon powders) by response surface methodology. Compositional analysis, mineral analysis, color ($L$, $a$ and $b$) values were also analyzed for the optimum product. Effect of storage on retention of color, phenolic content and DPPH* scavenging activity was also investigated. Amla-lemon based RTS was acceptable by the sensory panellists.

Chapter-8 presents the salient findings of the present investigation. It concludes that the major fraction of vital bioactive constituents of Amla is present in the Amla pomace powder which can be exploited after extraction of the juice. Seed coat powder has a huge potential for exploitation as a good source of antioxidant or bioactive components. However, solvent extraction method is not suitable for the extraction of phenolics from seed coat powder; hence alternative methods like supercritical fluid extraction or pressurized extraction need to be tried in future. Amla juice and lemon powder can be effectively spray dried by encapsulation with maltodextrin and may have lot of future as a commercial functional drink in the market.