polyphenols). Maltodextrin (MD) is the most common carbohydrate matrix used for encapsulation stability, i.e., protecting against undesirable physical (stickiness and collapse) and/or chemical changes, such as oxidation of encapsulated material (Roos 1995; Galmarini et al. 2009).

Present work reports preliminary results on the freeze-drying encapsulation of red wine's dry extract (which contains its polyphenols) in an amorphous MD matrix, while simultaneously eliminating the water and alcohol. Some physical characteristics and polyphenol content of the dry powder so obtained were determined.

Materials and Methods

Materials

The wine used was Cabernet Sauvignon, "Postales del Fin del Mundo" (*Bodega Fin del Mundo*) from a cold climate wine growing region (Neuquén, Argentina); alcohol content was 13.7% (*v*/*v*) (10.29 g ethanol/100 g wine). Maltodextrin DE $_{10}$ was from Productos de Maíz S.A., Buenos Aires, Argentina.

Wine's dry extract was determined by evaporation of a thin layer of wine in a forced air circulation oven at 97–102 °C during 2.5 h: four replicates were made and the average is reported. The pH of the wine was measured using a previously calibrated glass electrode.

Encapsulation Procedure

Maltodextrin DE $_{10}$ was dissolved in wine to 20% concentration (total weight basis) and freeze-dried to encapsulate the polyphenols (and associated constituents of the wine's dry solids) in an amorphous microstructure of MD. The wine containing the dissolved MD was poured into a stainless steel tray (round tray of 20 cm diameter; depth of sample 1 cm), and freeze-dried at room temperature in a FIC Ll-I-E300-CRT freeze dryer (Buenos Aires, Argentina) operated with a freezing plate and condenser at −40 °C and a vacuum below 200 μmHg. Freeze-drying time was of 40 h at room temperature (22±3 °C).

The freeze-dried sample of glassy aspect, was milled in a domestic grain coffee grinder, resulting in a free-flowing powder (i.e., "wine powder") resembling red wine's color. This powder was placed in a hermetically sealed opaque plastic flask and stored up to 15 days in a constant temperature oven at 38±0.2 °C representative of an accelerated storage test.

Moisture Content

Moisture content of the "wine powder" was determined using the Karl Fischer (KF) method. KF titration was carried out at 25±1 °C with a Karl Fischer titrator DL 31 from Mettler-Toledo, applying the one-component technique with Hydranal Titrant Composite 5 (from Riedel-de Haën, Germany). A methanol/formamide mixture (1:1) was used as solvent (purchased from Merck, Darmstadt, Germany). Standard deviation for moisture determination using KF titration was determined to be about ±0.04% moisture.

Water Activity

Water activity (a_w) was determined using an electronic dew-point water activity meter Aqualab series 3 (Decagon Devices, Pullman, Washington, USA). The equipment was calibrated with saturated salt solutions in the water activity range of interest (Favetto et al. 1983). The error in a_w measurement was found to be about ±0.004.

Determination of Thermal Transitions

Glass transition of MD-added wine powder and regular red wine were determined by differential scanning calorimetry (DSC; onset values) using a DSC 822e 104 Mettler Toledo calorimeter (Schwerzenbach, Switzerland). The instrument was calibrated with indium (156.6 °C), lead (327.5 °C), and zinc (419.6 °C). All measurements were performed at a heating rate of 10 °C⁄min. Hermetically sealed 40-μL medium pressure pans were used (an empty pan served as a reference). In order to obtain the glass transition temperature (T_g), the thermograms were evaluated using Mettler Stare program; the onset temperature of the T_g was reported (Roos and Karel 1991).

Determination of Residual Ethanol in Wine Powder

A sample of MD-added freeze-dried "wine powder" was dissolved in water (20 g of powder with 80 g of distilled water). This solution was then distilled (simple distillation) and water added to the distillate to restore the original volume; a solution containing only volatile compounds from the wine was obtained in this way. The ethanol concentration in this solution was determined using an enzymatic kit provided by Cobas Roche, Argentina, based on Bucher and Redetzki (1951). The resulting ethanol concentration was then expressed as gram ethanol/100 g powder. Determination was done in duplicate.

Total Polyphenols

Total polyphenols of red wine and carbohydrate-added freeze-dried "wine powder" were determined by the Folin–Ciocalteau method (Cioroi and Musat 2007; Camussoni and Carnevali 2004). The Folin–Ciocalteau reagent was from Merck KgaA Darmstadt, Germany, and concentrations were