SHELF LIFE PREDICTION
OF DRIED FRUIT AND VEGETABLES:
A QUANTITATIVE APPROACH

A THESIS PRESENTED IN PARTIAL FULFILMENT
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CHRISTINE MARIE SAMANIEGO-ESGUERRA
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ABSTRACT

The quantitative approach to shelf life prediction of foods is a relatively new field of food technology and the paucity of published studies in this area indicates a need for further research. The present study was undertaken to develop and evaluate a methodology for the shelf life prediction of packaged dried foods using a quantitative approach.

The development of a technique for the shelf life prediction of packaged dried foods, specifically onion flakes, sliced green beans, and apricot halves, involved the mathematical modelling of product and package characteristics as functions of environmental conditions, i.e. temperature and humidity.

The WVTR and permeability constants of LDPE (60 μm), PET (12 μm) and a laminate of both films (30 μm LDPE and 12 μm PET) were determined at different temperatures and humidities. A general model was developed which satisfactorily predicted permeances of the three films as a function of external relative humidity and temperature.

The moisture sorption isotherms of the three products were determined at 20, 30, and 40°C. The GAB model adequately described the isotherms using a direct nonlinear regression analysis.

The kinetics of the deteriorative reactions limiting the shelf life of the three dried products and their acceptable limits were determined. Storage trials were conducted on the three products under different relative humidity (32% to 59% RH for dried onion flakes and green beans; 59% to

81% RH for dried apricot) and temperature (20°C to 40°C) conditions.

Nonenzymic browning in onion flakes and chlorophyll a loss in green beans were better described by a zero-order reaction model. Thiolsulphinate loss in onion flakes, nonenzymic browning in apricot, and SO_2 loss in both green beans and apricots were better described by a first-order reaction model. For onion flakes and green beans, the rates of reactions were found to increase with an increase in the water activity of the products. Empirical equations were derived describing the relationship between the rates of reactions and water activity. The Arrhenius equation satisfactorily described the relationship between rate constants and temperature.

Nonenzymic browning and sulphur dioxide loss in dried apricots exhibited a trend wherein the rate increased with water activity until a maximum was reached and then decreased with a further increase in water activity. The reactions followed the Arrhenius equation at all three water activity levels.

Mathematical models of quality deterioration in the dried foods were developed based on the theoretical and empirical equations obtained on the kinetics of the deteriorative reactions as functions of storage time, water activity and temperature. There was close agreement between the actual and predicted shelf lives of the unpackaged dried foods stored under variable temperature and relative humidity conditions.

In order to predict the shelf life of the dried products packaged in polymeric films, a computer iterative technique was developed which combined the models describing the permeability characteristics of the packaging films, the sorption properties of the product, the kinetics of

deterioration in the products and the mass transport equation. By solving these equations numerically with the aid of a computer, moisture gain, quality loss and shelf life of the products were satisfactorily predicted under various storage conditions.

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