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

A THESIS PRESENTED IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
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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. Thiolsulphinates loss in onion flakes, nonenzymic browning in apricot, and SO₂ 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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TABLE OF CONTENTS

	PAGE
ABSTRACT	ii
ACKNOWLEDGEMENTS	v
LIST OF TABLES	ix
LIST OF FIGURES	xv
CHAPTERS	
1. INTRODUCTION	1
2. MOISTURE SORPTION ISOTHERMS OF DRIED FOODS	
2.1 Introduction	8
2.2 Literature Review	9
2.2.1 Sorption Isotherm Models	11
2.2.2 Effect of Temperature	15
2.2.3 Moisture Sorption Isotherms of Dried Onion, Green Beans, and Apricot	17
2.3 Methodology	18
2.3.1 Background	18
2.3.2 Materials	19
2.3.3 Reliability of the Method	21
2.3.4 Sample Preparation	21
2.4 Experimental	22
2.5 Results and Discussion	24
2.5.1 General Observations	24
2.5.2 Sorption Isotherm Equation	34
2.5.3 Fit of the GAB Model	43
2.6 Conclusion	48
3. WATER VAPOUR PERMEABILITY OF PACKAGING FILMS	
3.1 Introduction	51
3.2 Literature Review	52
3.2.1 Effect of Relative Humidity	55
3.2.2 Effect of Temperature	56

3.2.3 Effect of Pinholes	57
3.2.4 Other Factors	58
3.3 Methodology	59
3.3.1 Background	59
3.3.2 Procedure	59
3.3.3 Calculations	62
3.3.4 Materials	62
3.4 Experimental	62
3.5 Results and Discussion	65
3.5.1 WVTR and Permeance	65
3.5.2 Development of the Permeability Model	79
3.6 Conclusion	82
4. KINETICS OF DETERIORATIVE REACTIONS IN DRIED FOODS	
4.1 Introduction	84
4.2 Literature Review	84
4.2.1 Background	84
4.2.2 Factors Affecting the Kinetics of Reactions	86
4.2.3 Modes of Deterioration	93
4.3 Materials and Methods	99
4.3.1 Moisture Content	99
4.3.2 Onion	100
4.3.2.1 Material	100
4.3.2.2 Thiolsulphinate Determination	100
4.3.2.3 Browning Measurement	104
4.3.3 Green Beans	105
4.3.3.1 Material	105
4.3.3.2 Chlorophyll Determination	106
4.3.3.3 Sulphur Dioxide Determination	108
4.3.4 Apricot	111
4.3.4.1 Material	111
4.3.4.2 Browning Measurement	111
4.3.4.3 Sensory Evaluation	115
4.3.4.4 Sulphur Dioxide Determination	116
4.4 Experimental	117
4.5 Results and Discussion	121

4.5.1	Onion	121
4.5.1.1	Nonenzymic Browning	121
4.5.1.2	Thiolsulphinates Loss	133
4.5.1.3	Shelf Life of the Dried Onion Flakes	139
4.5.2	Green Beans	142
4.5.2.1	Chlorophyll Loss	142
4.5.2.2	Sulphur Dioxide Loss	151
4.5.3	Apricot	155
4.5.3.1	Nonenzymic Browning	156
4.5.3.2	Sulphur Dioxide Loss	165
4.6	Conclusion	171
5.	DEVELOPMENT AND EVALUATION OF SHELF LIFE PREDICTION MODELS	
5.1	Introduction	173
5.2	Experimental	175
5.2.1	Calculation and Program Development	175
5.2.2	Storage Trials	175
5.3	Development of Models for Quality Deterioration in Dried Foods	176
5.4	Prediction of Moisture Transfer and Shelf Life of Packaged Dried Foods	191
5.5	Conclusion	215
6.	SUMMARY AND CONCLUSIONS	216
	BIBLIOGRAPHY	220
	APPENDICES	245

LIST OF TABLES

TABLE	PAGE
2.1 Water activity of the saturated salt solutions at different temperatures.	20
2.2 Equilibrium moisture contents of dried onion at different water activities and temperatures.	25
2.3 Equilibrium moisture contents of dried green beans at different a_w s and temperatures.	26
2.4 Equilibrium moisture contents of dried apricot at different a_w s and temperatures.	27
2.5 Results of the transformed, polynomial regression analysis.	37
2.6 Results of the weighted, nonlinear, three parameter GAB equation.	38
2.7 Estimates of the six parameters for the nonlinear GAB equation.	39
2.8 Calculated isotherm constants based on the nonlinear, six parameter GAB equations.	40
2.9 Results of the BET analysis.	42
2.10 Experimental and calculated mean moisture content values for dried onion.	44
2.11 Experimental and calculated mean moisture content values for dried green beans.	45
2.12 Experimental and calculated mean moisture content values for dried apricot.	46
3.1a Saturated salt solutions and their corresponding RH at different temperatures.	64
3.1b Assumed internal relative humidities for PET film.	64
3.2 Change in absorbance of the detector film as a function of time.	66
3.3 Results of the regression equations for WVTR as a function of Δp .	68
3.4 WVTR at constant external RH.	70

3.5	Regression equations for \ln WVTR versus T^{-1} .	71
3.6	Water vapour permeance.	74
3.7	Water vapour permeability constants.	74
3.8	Summary of published results of permeability constants.	75
3.9	Results of the Arrhenius equations for permeance.	77
3.10	Results of the regression equations describing $\ln (P/X)_0$ as a function of external RH.	81
3.11	Results of the regression equations describing E_p as a function of RH.	81
3.12	Estimates of the parameter constants of the permeability model.	82
4.1	Thiolsulphinat content of dried onions.	103
4.2	Optical index of dried onion.	105
4.3	Chlorophyll content of dried green beans.	108
4.4	Sulphur dioxide content of dried green beans.	111
4.5	Browning measurements for dried apricot.	113
4.6	Browning measurements of apricot samples of varying browning intensities.	114
4.7	Sulphur dioxide content of dried apricot.	117
4.8	The salts used in preparing the saturated salt slurries and their corresponding relative humidities.	118
4.9	Results of the regression analysis for browning in onion flakes based on a zero-order reaction model.	124
4.10	Results of the regression analysis for browning in onion flakes based on a first-order reaction model.	124
4.11	Errors in calculated rate constants caused by analytical errors.	127
4.12	Equations describing the relationship between rate constant (k) and a_w for browning in dried onion flakes.	129

4.13	Results of the Arrhenius equations and Q_{10} values for browning in dried onion flakes.	131
4.14	Results of the regression analysis for thiol sulphinate loss in onion flakes based on a zero-order reaction model.	135
4.15	Results of the regression analysis for thiol sulphinate loss in onion flakes based on a first-order reaction model.	135
4.16	Equations describing the relationship between k and a_w for thiol sulphinate loss in dried onion flakes.	137
4.17	Results of the Arrhenius equations and Q_{10} values for thiol sulphinate loss in dried onion flakes.	139
4.18	Shelf life of dried onion flakes based on browning and thiol sulphinate loss.	140
4.19	Results of the regression analysis for chlorophyll <u>a</u> loss in green beans based on a zero-order reaction model.	144
4.20	Results of the regression analysis for chlorophyll <u>a</u> loss in green beans on a first-order reaction model.	144
4.21	Results of the regression analysis for chlorophyll <u>b</u> loss in green beans based on a zero-order reaction model.	145
4.22	Results of the regression analysis for chlorophyll <u>b</u> loss in green beans based on a first-order reaction model.	145
4.23	Results of the regression analysis for total chlorophyll loss in green beans based on a zero-order reaction model.	146
4.24	Results of the regression analysis for total chlorophyll loss in green beans based on a first-order reaction model.	146
4.25	Equations describing the relationship between k and a_w for chlorophyll <u>a</u> loss in dried green beans.	148
4.26	Results of the Arrhenius equation and Q_{10} values for chlorophyll <u>a</u> loss in dried green beans.	150

4.27	Results of the regression analysis for SO ₂ loss in green beans based on a zero-order reaction model.	153
4.28	Results of the regression analysis for SO ₂ loss in green beans based on a first-order reaction model.	153
4.29	Equations describing the relationship between k and a _w for SO ₂ loss in dried green beans.	151
4.30	Results of the Arrhenius equation and Q ₁₀ values for SO ₂ loss in dried green beans.	155
4.31	Results of the regression analysis for browning in dried apricot based on a zero-order reaction model.	158
4.32	Results of the regression analysis for browning in dried apricot based on a first-order reaction model.	158
4.33	Equations describing the relationship between k and a _w for browning in dried apricot.	160
4.34	Results of the Arrhenius equations and Q ₁₀ values for browning in dried apricot.	164
4.35	Results of the regression analysis for SO ₂ loss in dried apricot based on a zero-order reaction model.	166
4.36	Results of the regression analysis for SO ₂ loss in dried apricot based on a first-order reaction model.	166
4.37	Equations describing the relationship between k and a _w for SO ₂ loss in dried apricot.	169
4.38	Results of the Arrhenius equations and Q ₁₀ values for SO ₂ loss in dried apricots.	169
5.1	Results of the nonlinear regression analysis of the deterioration model for nonenzymic browning in onion flakes.	183
5.2	Results of the nonlinear regression analysis of the deterioration model for thiolsulphinate loss in onion flakes.	183
5.3	Results of the nonlinear regression analysis for chlorophyll <u>a</u> loss in onion flakes.	184

5.4	Results of the nonlinear regression analysis for the deterioration model for browning in dried apricots.	184
5.5	Actual and predicted shelf life of dried onion flakes based on browning.	189
5.6	Actual and predicted shelf life of dried onion flakes based on thiolsulphinat loss.	189
5.7	Actual and predicted shelf life of dried green beans based on chlorophyll <u>a</u> loss.	190
5.8	Actual and predicted shelf life of dried apricot halves based on browning.	190
5.9	Actual and predicted results for dried onion flakes packaged in LDPE and stored at 30°C/75%RH.	198
5.10	Actual and predicted results for dried onion flakes packaged in laminate film and stored at 30°C/75%RH.	199
5.11	Actual and predicted results for dried onion flakes packaged in LDPE film and stored at 40°C/90%RH.	200
5.12	Actual and predicted results for dried onion packaged in laminate film and stored at 40°C/90%RH.	201
5.13	Actual and predicted values for dried green beans packaged in LDPE film and stored at 30°C/75%RH.	202
5.14	Actual and predicted values for dried green beans packaged in laminate film and stored at 30°C/75%RH.	203
5.15	Actual and predicted values for dried green beans packaged in LDPE film and stored at 40°C/90%RH.	204
5.16	Actual and predicted values for dried green beans packaged in laminate film and stored at 40°C/90%RH.	205
5.17	Predicted results for browning in dried onion flakes stored at 20°C/55%RH.	210
5.18	Actual and predicted shelf lives for dried onion flakes based on nonenzymic browning.	213

5.19 Actual and predicted shelf lives for green
beans based on chlorophyll a loss.

213

LIST OF FIGURES

FIGURE	PAGE
2.1 Schematic sorption isotherms with typical marking points.	10
2.2 Schematic diagram of the proximity equilibration cell.	19
2.3 Moisture sorption isotherms of dried onion.	29
2.4 Moisture sorption isotherms of dried green beans.	30
2.5 Moisture sorption isotherms of dried apricot.	31
2.6 Residual plots for the weighted regression analysis of the GAB equations.	49
3.1 Diagram of the microcell used for the determination of the WVTR of packaging films.	61
3.2 Relationship between WVTR and vapour pressure difference (Δp) for LDPE.	67
3.3 Relationship between WVTR and Δp for PET.	67
3.4 Relationship between WVTR and Δp for laminate film.	67
3.5 Plot of \ln WVTR against T^{-1} for LDPE film.	72
3.6 Plot of \ln WVTR against T^{-1} for PET film.	72
3.7 Plot of \ln WVTR against T^{-1} for laminate film.	72
3.8 Plot of $\ln P/X$ against T^{-1} for LDPE film.	76
3.9 Plot of $\ln P/X$ against T^{-1} for PET film.	76
3.10 Plot of $\ln P/X$ against T^{-1} for laminate film.	76
4.1 Diagrammatic representation of the influence of water activity on chemical, enzymatic and microbiological changes.	90
4.2 Semi-micro apparatus for SO_2 determination by aeration-oxidation.	109
4.3 The container set-up used in the storage trials.	119

4.4	Increase in moisture content of dried onion flakes.	122
4.5	Change in colour of dried onion flakes packaged in LDPE film during storage at 40°C/90%RH.	123
4.6	Change in colour of dried green beans packaged in LDPE film during storage at 40°C/90%RH.	123
4.7	Nonenzymic browning in onion flakes during storage at 20°C.	126
4.8	Nonenzymic browning in onion flakes during storage at 30°C.	126
4.9	Nonenzymic browning in onion flakes during storage at 40°C.	126
4.10	Relationship between rate constant (k) and a_w for browning in onion flakes.	128
4.11	Arrhenius relationship between k and T for browning in onion flakes.	128
4.12	Relationship between E_a and a_w for browning in onion flakes.	134
4.13	Thiolsulphinate loss in onion flakes during storage at 20°C.	136
4.14	Thiolsulphinate loss in onion flakes during storage at 30°C.	136
4.15	Thiolsulphinate loss in onion flakes during storage at 40°C.	136
4.16	Relationship between k and a_w for thiolsulphinate loss in onion flakes.	138
4.17	Arrhenius relationship between k and T for thiolsulphinate loss in onion flakes.	138
4.18	Shelf life plots for dried onion flakes.	141
4.19	Plot of the reciprocal of shelf life at 20°C based on browning and thiolsulphinate loss.	141
4.20	Plot of the reciprocal of shelf life at 30°C based on browning and thiolsulphinate loss.	141

4.21	Chlorophyll <u>a</u> loss in dried green beans during storage at 20°C.	147
4.22	Chlorophyll <u>a</u> loss in dried green beans during storage at 30°C.	147
4.23	Chlorophyll <u>a</u> loss in dried green beans during storage at 40°C.	147
4.24	Relationship between k and a_w for chlorophyll <u>a</u> loss in dried green beans.	149
4.25	Arrhenius plot for chlorophyll <u>a</u> loss in dried green beans.	149
4.26	Sulphur dioxide loss in dried green beans during storage at 20°C.	152
4.27	Sulphur dioxide loss in dried green beans during storage at 30°C.	152
4.28	Sulphur dioxide loss in dried green beans during storage at 40°C.	152
4.29	Relationship between k and a_w for SO ₂ loss in dried green beans.	154
4.30	Arrhenius plot for SO ₂ loss in dried green beans.	154
4.31	Change in colour of dried apricot halves packaged in LDPE film during storage at 30°C/75%RH.	157
4.32	Change in colour of dried apricot halves packaged in LDPE film during storage at 40°C/90%RH.	157
4.33	Nonenzymic browning in dried apricots during storage at 20°C.	159
4.34	Nonenzymic browning in dried apricots during storage at 30°C.	159
4.35	Nonenzymic browning in dried apricots during storage at 40°C.	159
4.36	Relationship between k and a_w for browning in dried apricot.	161
4.37	Arrhenius plot for browning in dried apricots.	161
4.38	Sulphur dioxide loss in dried apricots during storage at 20°C.	167

4.39	Sulphur dioxide loss in dried apricots during storage at 30°C.	167
4.40	Sulphur dioxide loss in dried apricots during storage at 40°C.	167
4.41	Relationship between k and a_w for SO_2 loss in dried apricots.	168
4.42	Arrhenius plot for SO_2 loss in dried apricots.	168
5.1	Comparison of the actual and predicted values for nonenzymic browning in onion flakes.	185
5.2	Comparison of the actual and predicted values for thiolsulphinate loss in onion flakes.	186
5.3	Comparison of the actual and predicted values for chlorophyll <u>a</u> loss in green beans.	187
5.4	Comparison of the actual and predicted values for browning in apricots.	188
5.5	Flow diagram of computer iteration.	194
5.6	Sample of the computer program output.	197
5.7	Corrected and uncorrected moisture contents for onion flakes packaged in LDPE film.	207
5.8	Corrected and uncorrected moisture contents for onion flakes packaged in laminate film.	207
5.9	Moisture contents for green beans packaged in LDPE film during storage.	208
5.10	Moisture contents for green beans packaged in laminate film during storage.	208