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# **FRYING OF POTATO CRISPS – AN INVESTIGATION AIMING AT REDUCTION OIL CONTENT AND ACRYLAMIDE FORMATION**

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**A thesis submitted for the fulfillment of the requirements of the degree of  
Doctor of Philosophy  
in Department of Chemical and Materials Engineering**



By

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## **Abstract**

Reducing oil content, minimizing any carcinogenic acrylamide in the high temperature frying process for potato crisps, and producing good products with considerable crispiness and acceptable color were the objectives of this research. Vacuum frying with pre-treatment of potato crisps was investigated as an effective process for oil content reduction. Pre-drying and subsequent dipping (PSSD) in a sugar solution ('sugar dipping') were considered as an advantageous procedure for the treatment of potato crisps before frying in order to reduce oil uptake during frying. Vacuum frying was observed as an excellent process to decrease significantly the acrylamide formation at low temperature frying of potato crisps. In this study, potato crisps were respectively blanched, pre-dried, and dipped in a solution of sugar (23.07 wt %) for two seconds, before vacuum frying at 120°C, 110°C under different vacuum pressures (170mbars, 150mbars, 100mbars and 50mbars in separate experiments). Conventional frying at 180°C was also used as the control to benchmark the reductions in the oil contents and acrylamide formation among various techniques. There was a significant reduction in oil content of the potato crisps observed when the new techniques were applied. The crisps that had been pre-treated and fried with conventional frying have given the result of 30 wt % reduction. The crisps that were fried under vacuum frying achieved greater oil reduction with varying percentages when applying different pretreatments. The lowest oil content was achieved when the potato crisps were fried at 110°C and 150 mbars giving 58 % reduction on the dry basis compared with control samples. There are various advantages of the technique with PSSD as we have discovered: it is simple and can be applied in potato crisp industries in continuous mode in both vacuum and conventional frying systems. The crisps that had been treated with pre-drying and subsequent sugar solution dipping and then fried were crunchier and possibly had better perceived taste to the consumer, due to the small sugar addition.

Pre-drying and vacuum frying have all turned out to be excellent techniques to reduce acrylamide formation in potato crisps as we have found in this study. Vacuum frying at 120°C and 150 mbars reduced acrylamide formation by 80 to 85%. The 95% reduction was obtained when the crisps had been pre-dried. Acrylamide was undetectable when crisps were pre-dried and vacuum fried at 110°C, 150 mbars. The crisps with pre-drying subsequent sugar dipping and vacuum fried at low temperature had improved color compared with the control samples, which were produced by conventional frying at high temperatures.

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## Table of Contents

<b>ABSTRACT.....</b>	<b>III</b>
<b>ACKNOWLEDGMENTS .....</b>	<b>VI</b>
<b>TABLE OF CONTENTS .....</b>	<b>VIII</b>
<b>LISTS OF FIGURES .....</b>	<b>XVI</b>
<b>LISTS OF TABLES .....</b>	<b>XXV</b>
<b>ABBREVIATIONS.....</b>	<b>XXIX</b>
<b>1. GENERAL INTRODUCTION.....</b>	<b>1</b>
<b>2. REDUCING OIL CONTENT OF FRIED POTATO CRISPS CONSIDERABLY USING A ‘SWEET’ PRE-TREATMENT TECHNIQUES .....</b>	<b>6</b>
<b>2.1 INTRODUCTION.....</b>	<b>6</b>
<b>2.2 MATERIALS AND METHODS .....</b>	<b>8</b>
<b>2.2.1 Materials.....</b>	<b>8</b>
<b>2.2.2 Methods .....</b>	<b>9</b>
2.2.2.1 Potato crisp preparation .....	9
2.2.2.2 Dipping and frying process.....	9
2.2.2.3 Analysis .....	10
<i>Oil content analysis .....</i>	<i>10</i>

<i>Moisture content analysis</i> .....	13
<i>Sugar content analysis</i> .....	14
<i>Shrinkage analysis</i> .....	14
<i>Scanning Electron Microscopy</i> .....	15
<b>2.3 RESULTS AND DISCUSSION</b> .....	<b>15</b>
<b>2.3.1 Oil uptake</b> .....	<b>15</b>
<b>2.3.2 Sugar content in potato crisps- the mechanism of oil reduction with pre-drying and sugar solution dipping technique</b> .....	<b>17</b>
<b>2.3.3 Moisture loss during frying</b> .....	<b>21</b>
<b>2.3.4 The relationship of oil uptake and moisture loss</b> .....	<b>23</b>
<b>2.3.5 Effect of pre-treatment on shrinkage</b> .....	<b>25</b>
<b>2.3.6 Sensory analysis</b> .....	<b>25</b>
<b>2.4 CONCLUSIONS</b> .....	<b>26</b>
<b>2.5 REFERENCES</b> .....	<b>26</b>
<b>3. REDUCING OIL CONTENT OF FRIED POTATO CRISPS USING SOME PRE-TREATMENTS FOLLOWED BY VACUUM FRYING</b> .....	<b>32</b>
<b>3.1 INTRODUCTION</b> .....	<b>32</b>
<b>3.2 MATERIALS AND METHODS</b> .....	<b>32</b>
<b>3.2.1 Materials</b> .....	<b>33</b>
<b>3.2.2. Methods</b> .....	<b>33</b>
3.2.2.1 Potato crisp preparation (before frying).....	33
3.2.2.2 Vacuum frying setup.....	33
3.2.2.3 Experimental conditions for the vacuum frying process .....	35

3.2.2.4 Conventional deep frying experiments .....	35
3.2.2.5 Analysis .....	37
3.2.2.6 Statistical analysis.....	37
<b>3.2.3 Kinetics of oil uptake and moisture loss.....</b>	<b>38</b>
3.2.3.1 Oil uptake kinetics .....	38
3.2.3.2 Moisture loss kinetics .....	38
<b>3.3 RESULTS AND DISCUSSION.....</b>	<b>39</b>
<b>3.3.1 Oil uptake of Potato crisps.....</b>	<b>39</b>
3.3.1.1 Effect of pretreatment techniques (PSSD) on the oil reduction of the fried potato chips under vacuum frying.....	39
3.3.1.3 Effect of frying oil temperatures on the oil reduction of the PSSD potato crisps with vacuum frying.....	41
3.3.1.4 Effect of pre-drying technique on the oil reduction of potato chips under vacuum frying.....	45
<b>3.3.2 Kinetics of oil uptake .....</b>	<b>50</b>
<b>3.3.3 Moisture loss .....</b>	<b>56</b>
3.3.3.1 Effect of pretreatment PSSD on the moisture content of fried potato crisps under vacuum frying conditions .....	56
3.3.3.2 Effect of pressure on the moisture content of PSSD treated potato chips under vacuum frying conditions .....	58
3.3.3.3 Effect of low temperature on the moisture content of the PSSD treated potato chips under vacuum frying conditions.....	59
<b>3.3.4 Kinetics of moisture loss .....</b>	<b>62</b>

3.3.5 <i>Shrinkage</i> .....	66
3.4 CONCLUSIONS.....	67
3.5 REFERENCES.....	67
<b>4. COLOUR CHANGES OF POTATO CRISPS DURING DEEP FAT FRYING- EFFECTS OF PRETREATMENT TECHNIQUES AND VACUUM FRYING.....</b>	<b>69</b>
4.1. INTRODUCTION.....	69
4.2. MATERIALS AND METHODS .....	71
4.2.1 <i>General view</i> .....	71
4.2.2 <i>Colour measurement and evaluation</i> .....	72
4.2.3 <i>Kinetics of colour change</i> .....	74
4.3 RESULTS AND DISCUSSIONS .....	74
4.3.1 <i>Effects of sugar concentrations on the colour of pre-drying potato crisps under conventional frying conditions</i> .....	74
4.3.1.1 Effect of sugar concentration on the lightness of pre-dried and fried potato crisps .....	75
4.3.1.2 Effect of sugar concentration on the redness of pre-dried and fried potato crisps .....	76
4.3.1.3 Effect of sugar concentration on the yellowness of pre-dried and fried potato crisps .....	78
4.3.1.4 Effect of sugar concentration on the total colour change of pre-dried and fried potato crisps.....	80
4.3.2 <i>Colour changes of potato crisps under conventional frying</i> .....	81
4.3.3. <i>Colour changes of potato crisps under vacuum frying</i> .....	83

4.3.3.1 Colour of potato crisps with vacuum frying- Effects of sugar dipping .....	83
4.3.3.2 Effect of vacuum pressure on the colour of pre-dried and sugar solution dipped, vacuum fried potato slices .....	93
<b>4.3.4 Colour changes of potato crisps presented using colour photos.....</b>	<b>99</b>
4.3.4.1 Conventional frying .....	99
<i>Conventional frying at the start (0 frying time)</i> .....	99
<i>Conventional frying for 1 minute</i> .....	100
<i>Conventional frying for 2 minutes</i> .....	102
<i>Conventional frying for 3 minutes</i> .....	103
<i>Conventional frying for 4 minutes</i> .....	105
<i>Conventional frying for 5 minutes</i> .....	106
4.3.4.2 Vacuum frying .....	108
<i>Vacuum frying for 1 minute</i> .....	108
<i>Vacuum frying for 2 minutes</i> .....	109
<i>Vacuum frying for 3 minutes</i> .....	110
<i>Vacuum frying for 4 minutes</i> .....	111
<i>Vacuum frying for 5 minutes</i> .....	112
4.3.4.3 Vacuum frying for 5 minutes under different vacuum pressures .....	113
<b>4.3.5 Kinetics of the colour changes .....</b>	<b>114</b>
<b>4.4 CONCLUSIONS.....</b>	<b>116</b>
<b>4.5 REFERENCES.....</b>	<b>117</b>

<b>5. THE TEXTURE PROPERTIES OF POTATO CRISPS WITH DIFFERENT PRE-TREATMENTS- FOLLOWED BY EITHER THE CONVENTIONAL OR THE VACUUM FRYING .....</b>	<b>121</b>
<b>5.1 INTRODUCTION .....</b>	<b>121</b>
<b>5.2 MATERIALS AND METHODS .....</b>	<b>124</b>
<i>5.2.1 Measurement and calculations.....</i>	<i>124</i>
<i>5.2.2 Kinetics of the texture change .....</i>	<i>128</i>
<i>5.2.3 Experimental set up for texture analysis.....</i>	<i>129</i>
Sample preparation .....	131
Statistical analysis.....	131
Calculations .....	131
<b>5.3 RESULTS AND DISCUSSION .....</b>	<b>133</b>
<i>5.3.1 The changing deformation curve with frying time.....</i>	<i>133</i>
<i>5.3.2 Texture parameter analyses.....</i>	<i>137</i>
5.3.2.1 The crunchiness .....	137
5.3.2.2 The surface energy .....	143
5.3.2.3 The hardness .....	144
5.3.2.4 Modulus of elasticity .....	144
<b>5.4 CONCLUSIONS.....</b>	<b>148</b>
<b>5.5. REFERENCES.....</b>	<b>148</b>
<b>6. ACRYLAMIDE FORMATION DURING CONVENTIONAL AND VACUUM FRYING PROCESS-EFFECTS OF PRE-TREATMENTS .....</b>	<b>152</b>
<b>6.1 INTRODUCTION .....</b>	<b>152</b>

<b>6.2 ACRYLAMIDE .....</b>	<b>152</b>
<b>6.2.1 Acrylamide chemical, physical properties and environment effects .....</b>	<b>153</b>
<b>6.2.2 Effect of acrylamide on human .....</b>	<b>154</b>
<b>6.3 ACRYLAMIDE FORMATION DURING FRYING PROCESS.....</b>	<b>155</b>
<b>6.3.1 Pathways for the formation of acrylamide.....</b>	<b>155</b>
<b>6.3.2 Acrylamide in potato chips .....</b>	<b>157</b>
<b>6.3.3 Factors influencing the formation of acrylamide.....</b>	<b>158</b>
Temperature .....	158
Moisture .....	162
Sucrose .....	162
Frying oil and additives .....	163
<b>6.4 MATERIALS AND METHODS .....</b>	<b>167</b>
<b>6.4.1 Materials.....</b>	<b>167</b>
<b>6.4.2 Potato samples.....</b>	<b>167</b>
<b>6.4.3 Acrylamide measurement .....</b>	<b>167</b>
Sample preparation .....	167
GC/MS analysis .....	168
Percentage reduction.....	168
<b>6.5 RESULTS AND DISCUSSION .....</b>	<b>169</b>
<b>6.5.1 Calibration curves .....</b>	<b>169</b>
<b>6.5.2 Effect of vacuum frying on the acrylamide formation of the PNSD treated     potato crisps.....</b>	<b>171</b>

<i>6.5.2 Effect of pre-drying on the acrylamide formation of the vacuum fried potato crisps</i> .....	172
<b>6.6 CONCLUSION</b> .....	175
<b>6.7 REFERENCES</b> .....	175
<b>7. SUMMARY OF THE MAIN CONCLUSIONS</b> .....	180
<b>8. RECOMMENDATIONS FOR FUTURE WORK</b> .....	181
<b>9. PUBLICATION</b> .....	182

<b><u>Lists of Figures</u></b>	<b><u>Page No.</u></b>
Figure 2.1 Potatoes with pre-treatments and fried under conventional conditions.....	11
Figure 2.2 Soxhlet extraction system placed in the fume cupboard, as used in the current study.....	12
Figure 2.3 Effect of pre-drying followed by sugar dipping on the oil content of potato crisps during the frying process.....	17
Figure 2.4 The standard curve of peak area versus sucrose concentration (mg/ml).....	19
Figure 2.5 Fresh potato after pre-drying (to 60% of the initial weight) and no sugar solution dipping (Cryo SEM photo of the potato surface).....	20
Figure 2.6 Fresh potato after pre-drying (to 60% of the initial weight) and after sugar solution dipping (Cryo SEM photo of the potato surface).....	20
Figure 2.7 Fresh potato after drying (to 60% of the initial weigh) and after sugar solution dipping (Cryo SEM photo of the potato surface, scale= 2µm). ....	21
Figure 2.8 Effect of pre-drying followed by sugar solution dipping and frying time .....	23
Figure 2.9 Effect of the pre-treatment on the relationship of the oil uptake and the moisture loss of the same sample. ....	24
Figure 2.10 Effect of pre-drying followed by sugar dipping on shrinkage in potato crisps during frying. ....	26
Figure 3.1 Potato crisps after the pre-treatment and the frying processes. ....	34
Figure 3.2 Schematic illustration of the vacuum frying system used in this study. ....	36
Figure 3.3 Vacuum frying chamber and their components.....	37
Figure 3.4 Effect of pre-drying with and without sugar solution dipping on the oil content of potato crisps during frying process.....	41
Figure 3.5a The oil content of the pre-dried potato slices and followed by sugar solution dipping and frying under different vacuum frying conditions: 170 and 150mbars, respectively at 120°C. ....	42

Figure 3.5b The oil content of the pre-dried potato slices and followed by sugar solution dipping and frying under different vacuum frying conditions: 150 and 50 mbars, respectively at 120°C.....	43
Figure 3.5c Effect of vacuum pressure on the oil content of potato chips pre-dried and followed by sugar solution dipping and frying under different vacuum conditions 100 and 50 mbars, respectively at 120°C after 5 minutes of frying time.....	43
Figure 3.6 Effect of temperature on the oil content of the PSSD potato chips vacuum-fried at 120 and 110°C with 5 minutes at of frying time. ....	44
Figure 3.7a Effect of pre-drying on the oil content of potato chips vacuum-fried (150mbars) at 120°C (Density of potatoes = $1.1045 \pm 0.0058 \text{ g.ml}^{-1}$ ). ....	46
Figure 3.7b Effects of pre-drying on the oil content of potato chips fried conventionally at 180°C; (Density of potatoes= $D= 1.1056 \pm 0.0062 \text{ g.cm}^{-3}$ ). ....	47
Figure 3.8 Effects of pre-drying and pre-drying & sugar solution dipping on the oil content of potato chips frying under vacuum conditions 150mbars and 110°C after 5 minutes of frying (Density of potatoes= $1.1056 \pm 0.0062 \text{ g.ml}^{-1}$ ).....	48
Figure 3.9a First-order reaction kinetics plots for oil uptake of fried potato crisps with different pre-treatment techniques under conventional and vacuum frying conditions (120°C, 170mbars). ....	51
Figure 3.9b First-order reaction kinetics plots for oil uptake of pre-dried and sugar solution dipped potato crisps with different conditions of vacuum frying and control samples.....	51
Figure 3.10a and 3.10b Experimental and predicted results for the oil uptake of the potato crisps prepared using different conditions. Symbols represent the experimental results and the solid lines represent the predicted results obtained using Equation (1).....	52
Figure 3.11 The final oil content achieved versus the oil uptake rate constant. ....	55
Figure 3.12 Moisture content of the pre-dried potato crisps fried at vacuum conditions (120°C, 170mbars) with different sugar dipping. ....	57

Figure 3.13a First-order reaction kinetics plot for moisture loss of fried potato crisps with different pre-treatment techniques followed by either conventional or vacuum frying processes (120°C, 170mbars). .....	63
Figure 3.13b First-order reaction kinetics plot for moisture loss in pre-dried and sugar solution dipped potato crisps followed by different conditions of vacuum frying compared to control samples.....	64
Figure 3.14a and 3.14b Effects of pre-drying with and without sugar solution dipping on the moisture contents of potato crisps during vacuum and conventional frying processes. Symbols represent the experimental data and the solid lines are the predicted results using equation (3.2).....	65
Figure 3.15 Effect of pre-drying (PNSD) and pre-drying followed by dipping in sugar solution (PSSD) on the shrinkage of potato crisps during vacuum and conventional frying (the control) processes.....	66
Figure 4.1 The colour meter instrument (Minolta Co., Japan). .....	73
Figure 4.2 The lightness of pre-dried potato crisps with different sugar concentrations. ....	76
Figure 4.3 The redness of potato crisps with different sugar concentrations. ....	78
Figure 4.4 The yellowness of pre-dried potato crisps with different sugar concentrations.....	79
Figure 4.5 The total colour change of pre-dried potato crisps with different sugar concentrations .....	81
Figure 4.6 Changes in colour of treated and untreated potato crisps during conventional frying at 180°C. $\Delta E$ value for the total changing in colour.....	82
Figure 4.7a Effects of sugar solution dipping on the lightness of the pre-dried potato crisps vacuum fried at 120°C and 170mbars (Potato density= $1.087 \pm 0.005\text{g.ml}^{-1}$ ).....	86
Figure 4.7b Effects of sugar solution dipping on the redness of pre-dried potato crisps vacuum fried at 120°C, 170mbars (Potato density= $1.087 \pm 0.005\text{g.ml}^{-1}$ ).....	87
Figure 4.7c Effects of sugar solution dipping on the yellowness of pre-dried potato crisps vacuum fried at 120°C, 170mbars (Potato density = $1.087 \pm 0.005\text{g.ml}^{-1}$ ).....	88

Figure 4.7d Effects of sugar solution dipping on the total colour change of pre-dried potato crisps vacuum fried at 120°C, 170mbars (Potato density = $1.087 \pm 0.005 \text{g.ml}^{-1}$ ).....	88
Figure 4.8a Effects of sugar solution dipping on the lightness of pre-dried potato crisps vacuum fried at 120°C, 170mbars (Potato density = $1.1052 \pm 0.0021 \text{g.ml}^{-1}$ ). .	89
Figure 4.8b Effects of sugar solution dipping on the redness of the pre-dried potato crisps vacuum fried at 120°C and 170mbars (Potato density = $1.1052 \pm 0.0021 \text{g.ml}^{-1}$ ).....	90
Figure 4.8c Effects of sugar solution dipping on the yellowness of the pre-dried potato crisps vacuum fried at 120°C, and 170mbars (Potato density = $1.1052 \pm 0.0021 \text{g.ml}^{-1}$ ).....	91
Figure 4.8d Effects of sugar solution dipping on the total colour change of the pre-dried potato crisps vacuum fried at 120°C and 170mbars (Potato density = $1.1052 \pm 0.0021 \text{g.ml}^{-1}$ ).....	91
Figure 4.9 Colour of potato crisps fried at 5 minutes under either the conventional or the vacuum frying conditions. ....	92
Figure 4.10a Effects of pressure on the lightness of the PSSD potato crisps, followed by vacuum fried at 120°C (Potato density = $1.087 \pm 0.005 \text{g.ml}^{-1}$ ).....	96
Figure 4.10b Effects of pressure on the redness of the PSSD potato crisps followed by vacuum fried at 120°C (Potato density = $1.087 \pm 0.005 \text{g.ml}^{-1}$ ).....	96
Figure 4.10c Effects of pressure on the yellowness of the pre-dried and sugar solution dipped potato crisps followed by vacuum fried at 120°C (Potato density = $1.087 \pm 0.005 \text{g.ml}^{-1}$ ).....	97
Figure 4.10d Effects of pressure on the total colour change of the pre-dried and sugar solution dipped potato crisps followed by vacuum fried at 120°C (Potato density = $1.087 \pm 0.005 \text{g.ml}^{-1}$ ).....	97
Figure 4.11a Colour parameters of the pre-dried and sugar solution dipped potato crisps after 5 minutes of frying time at 120°C and under different pressures 50 , 100 and 150mbars respectively.(Standard number “L”= 96.41, “a”=5.3, “b”= -3.27; Potato density = $1.087 \pm 0.005 \text{g.ml}^{-1}$ ). ....	98

Figure 4.11b Colour parameters “a” of pre-dried and sugar solution dipped potato crisps after 5 minutes of frying time at 120°C and under different pressures 50 , 100 and 150mbars respectively.....	98
Figure 4.12a Photo of potato crisps just after blanching. ....	99
Figure 4.12b Potatoes after drying.....	100
Figure 4.13a Control sample crisps after 1 minute of frying.....	100
Figure 4.13b Potato crisps pre-dried, no-sugar solution dipping, fried for 1 minute.....	101
Figure 4.13c Potato crisps pre-dried and sugar solution dipped after 1 minute of frying.....	101
Figure 4.14a Control sample crisps after 2 minutes of frying. ....	102
Figure 4.14b Potato crisps pre-dried, no sugar solution dipping fried for 2 minutes.....	102
Figure 4.14c Potato crisps pre-dried and sugar solution dipped fried for 2 minutes.....	103
Figure 4.15a Potato crisps (control samples) no pre-dried and no sugar.....	103
Figure 4.15b Potato crisps pre-dried, no sugar solution dipping fried for 3 minutes.....	104
Figure 4.15c Potato crisps pre-dried and sugar solution dipped fried for 3 minutes.....	104
Figure 4.16a Potato crisps (control samples) no pre-dried, no sugar solution dipping, fried for 4 minutes.....	105
Figure 4.16b Potato crisps pre-dried, no sugar solution dipping fried for 4 minutes.....	105
Figure 4.16c Potato crisps pre-dried and sugar solution dipped, fried for 4 minutes.....	106
Figure 4.17a Potato crisps (control samples) no pre-dried, no sugar solution dipping, fried for 5 minutes.....	106

Figure 4.17b Potato crisps pre-dried, no sugar solution dipping, fried for 5 minutes.....	107
Figure 4.17c Potato crisps pre-dried and sugar solution dipped, fried for 5 minutes.....	107
Figure 4.18a Potato crisps pre-dried, no sugar solution dipping, fried for 1 minute at 120°C and 170mbars.....	108
Figure 4.18b Potato crisps pre-dried and sugar solution dipping, fried for 1 minute at 120°C and 170mbars.....	108
Figure 4.19a Potato crisps pre-dried, no sugar solution dipping, fried for 2 minutes at 170mbars and 120°C.....	109
Figure 4.19b Potato crisps pre-dried, sugar solution dipping, fried for 2 minutes at 170mbars and 120°C.....	109
Figure 4.20a Potato crisps pre-dried, no sugar solution dipping, fried for 3 minutes at 170mbars and 120°C.....	110
Figure 4.20b Potato crisps pre-dried, sugar solution dipping, fried for 3 minutes at 170mbars and 120°C.....	110
Figure 4.21a Potato crisps pre-dried, no sugar solution dipping, fried for 4 minutes at 170mbars and 120°C.....	111
Figure 4.21b Potato crisps pre-dried, sugar solution dipping, fried for 4 minutes at 170mbars and 120°C.....	111
Figure 4.22a Potato crisps pre-dried, no sugar solution dipping, fried for 5 minutes at 120°C and 170mbars.....	112
Figure 4.22b Potato crisps pre-dried, sugar solution dipping, fried for 5 minutes at 120°C and 170mbars.....	112
Figure 4.23a Potato crisps pre-dried, no sugar solution dipping, fried for 5 minutes at 120°C and 170mbars.....	113
Figure 4.23b Potato crisps pre-dried, no sugar solution dipping, fried for 5 minutes at 120°C and 100mbars.....	113
Figure 4.23c Potato crisps pre-dried, no sugar solution dipping, fried for 5 minutes at 120°C and 50mbars.....	114

Figure 4.24 The kinetics of the colour changes of the potato crisps during frying with different pretreatment techniques under conventional frying conditions. ....	116
Figure 5.1 Moisture content versus water activity at 20°C of fried potato chips (adapted from Katz and Labuza, 1981). .....	124
Figure 5.2 Force-deformation curve representing data quantified by the TA.XT2 Texture Analyzer from the fracturing of a potato chip (adapted from Lefort et al., 2003). .....	125
Figure 5.3 Example of a deformation curve obtained in a three-point bending test of a planar fried potato crisp. Determined test parameters: SIT (slope of initial tangent); $F_{\max}$ (maximum force), $x_{\max}$ (maximum deflection) and $W_{\max}$ (total deformation work) (adapted from Blahovec et al., 1999).....	126
Figure 5.4 The texture measurement set-up for the three-point support applied in the current study. ....	130
Figure 5.5 The experimental setup in the Instron testing chamber for texture measurement of the potato crisps.....	131
Figure 5.6 Texture testing in progress .....	132
Figure 5.7 When the crisp is cracked.....	132
Figure 5.8 Force-deformation curve recorded using the Instron Universal Testing Machine at Chemical & Materials Engineering Department.....	133
Figure 5.9 The deformation curve of the control sample before frying (Fresh potato after blanching, NPNS at $t = 0$ min).....	134
Figure 5.10 The deformation curve of the control sample after frying for 1 minute.....	135
Figure 5.11 The deformation curve of the control sample after frying for 2 minutes. ...	135
Figure 5.12 The deformation curve of the control sample after frying for 3 minutes. ...	136
Figure 5.13 The deformation curve of the control sample after frying for 4 minutes. ...	136
Figure 5.14 The deformation curve of control sample after frying for 5 minutes. ....	137
Figure 5.15 The mean values of the hardness, stiffness and firmness ( $H$ , $S_b$ , $F$ ) of the potato crisp samples with different pre-treatment techniques under conventional and vacuum frying conditions. Sample number 2 = PDNS-CF; Sample number 3 = PSSD-CF; Sample number 4 = NPND-VC (120°C, 150mbars); Sample number 5 = PDNS-VC (120°C, 150mbars); Sample	

number 6 = PSSD-VC (120°C, 150mbars); Sample number 7 = PSSD -VC (110°C, 150mbars). .....	145
Figure 6.1 Molecular structure of acrylamide.....	153
Figure 6.2 Previously proposed pathways for the formation of acrylamide after Strecker degradation of the amino acids (e.g. asparagines and methionine) in the presence of dicarbonyl products from the Maillard reaction (adopted from Mottram et al., 2002). .....	156
Figure 6.3 Logarithmic-scale plot of the formation of acrylamide over time in pyrolysates of glucose with glutamine (triangles), asparagines (squares), methionine(circles) (Adopted from Stadler et al., 2002). .....	157
Figure 6.4 Temperature-dependent formation of acrylamide (mg per mol of aminoacid) from asparagine (0.1 mmol) and glucose (0.1 mmol) in 0.5 M phosphate buffer (100µl, pH 5.5) heated in a sealed glass tube for 20 min (adopted from Mottram et al., 2002). .....	159
Figure 6.5 Acrylamide concentrations (micrograms per kilogram), corrected for weight loss, in French fried potatoes heated in a temperature-programmed oven (adopted from Tareke et al., 2002). .....	161
Figure 6.6 Change of acrylamide level in the French fries for different temperatures and heating times (frying oil: rapeseed oil) (Adopted from Gertz et al., 2002). ....	161
Figure 6.7 Chemical structures of the potassium salts, which could be acrylamide precursors in thermal decomposition reactions, of N-(D-glucos-1-yl)-l- asparagine (1), N-(D-fructos-2-yl)-l-asparagine (2), N-(D-glucos-1-yl)-l- glutamine (3) and N-(D-glucos-1-yl)-l-methionine (4) (Adopted from Stadler et al., 2002). .....	163
Figure 6.8 Regression of Acrylamide with Glucose, Fructose, total reducing sugar and saccharose (Adapted from Haase et al., 2003).....	164
Figure 6.9 Change of acrylamide level in French fries after heating in various oils for 3mins and 33 seconds at 170°C and 180°C, respectively (Adopted from Gertz et al., 2002). .....	165

Figure 6.10 A. Forming of acrylamide by hydrolysis of triacylglycerol. B. Forming of acrolein by a cyclic mechanism from monoacylglycerol. C. Forming of acrylic acid from reducing sugar (Adopted from Gertz et al., 2002). .....	166
Figure 6.11 Calibration curve for acrylamide (GC/MS detection). .....	169
Figure 6.12 Gas chromatogram of a potato sample injection with GC-MS detection....	170
Figure 6.13 Chromatograph of acrylamide content analysis with GC/MS detection (SIM mode) of control sample potato crisps. ....	170
Figure 6.14 Acrylamide formation in vacuum frying (120°C, 150 mbars) of PNSD potato crisps and conventionally fried (180°C) control samples. ....	172
Figure 6.15 Effect of pre-drying on the formation of acrylamide in the potato crisps under vacuum frying (120°C, 150 mbars). ....	174
Figure 6.16 Acrylamide content in potato crisps using different treatment and frying methods. ....	174

**Lists of Tables****Page No.**

Table 2.1 The oil content (wt %) of the fried potato crisps with different pre-treatment techniques. ....	16
Table 2.2 The sucrose contents of the pre-dried potato crisps with sugar solution dipping and non-sugar solution dipping frying at conventional conditions (180°C). ....	18
Table 2.3 Water content (wt%) of the potato crisps under conventional frying at 180°C.	22
Table 3.1 The oil content of pre-drying potato crisps with different conditions: (i) pre-dried & no sugar solution dipping (PNSD), and frying conventionally at 180°C; (ii) pre-dried with sugar solution dipping, and vacuum frying at 120°C and 170mbars; and (iii) pre-dried, with sugar solution dipping (PSSD), and vacuum frying at 120°C and 170mbars. ....	40
Table 3.2 Oil contents of the potato crisps at 5 minutes frying with different pre-treatments and frying conditions.....	44
Table 3.3 Oil content of the PSSD potato crisps and vacuum frying at 120°C and 110°C respectively under 150mbars. ....	45
Table 3.4a Oil content (wt%) of the NPND and PNSD potato crisps under vacuum frying at 120°C and 150mbars (Potato density $1.1045 \pm 0.0058 \text{ g.ml}^{-1}$ ). ....	46
Table 3.4b Oil content (wt %) of the potato crisps under conventional fried (180°C).....	47
Table 3.5 Oil content of potato crisps with different pretreatment techniques under vacuum frying at 110° C and 150mbars after frying 5 minutes.....	48
Table 3.6 Statistical analysis on the results of oil contents.....	49
Table 3.7 The parameters for the model equation (3.1) and (3.2) .....	54
Table 3.8 Effect of frying pressure and oil temperature on the oil uptake rate constant ( $k_{oil}$ ) in vacuum frying process.....	55
Table 3.9 Moisture contents of the pre-dried potato crisps fried under vacuum conditions (120°C and 170mbars). ....	57

Table 3.10 Moisture contents of the conventionally fried potato crisps with different pre-treatment techniques. ....	58
Table 3.11 Moisture contents of the vacuum fried PSSD potato crisps at different frying pressures.....	59
Table 3.12 Moisture contents of the PSSD potato crisps and fried at 110°C and 150mbars.....	60
Table 3.13 Moisture contents of the untreated samples vacuum fried at 110°C and 150mbars.....	60
Table 3.14 Statistical analysis on the results of moisture contents.....	61
Table 3.15 Statistical significance of the results on the moisture contents in untreated samples fried under vacuum conditions and other samples.....	62
Table 4.1 The lightness of the pre-dried potato crisps treated in different sugar solutions.	75
Table 4.2 The redness of the pre-dried potato crisps treated in different sugar solutions.	77
Table 4.3 The yellowness of the pre-dried potato crisps treated in different sugar solutions. ....	79
Table 4.4 The colour changes of the pre-dried potato crisps treated in solutions of different sugar concentrations.....	80
Table 4.5 The colour of the control potato crisps (non pre-dried and non sugar solution treated (NPNS)) during conventional frying process (180°C).....	82
Table 4.6 The colour of the pre-dried and non sugar solution treated (PDNS) potato crisps during vacuum frying process (120°C, 170mbars).....	84
Table 4.7 The colour of the pre-dried and sugar solution treated potato crisps during vacuum frying process (120°C, 170mbars).....	85
Table 4.8 The colour of non pre-drying and non sugar solution treated potato crisps during conventional frying process (180°C).....	85
Table 4.9 The colour changes of the potato crisps treated with different pre-treatments and frying conditions (Potato density=1.087 ± 0.005g.ml <sup>-1</sup> ). ....	87
Table 4.10 The colour of the pre-dried and non-sugar solution treated potato crisps during vacuum frying process (120°C, 170mbars). ....	89

Table 4.11 The colour of the pre-dried and sugar solution treated (PSSD) potato crisps during vacuum frying process (120°C, 170mbars).(Standard colour number $L=96.41$ , $a=0.22$ , $b= 2.04$ and potato density = $1.1052 \pm 0.0021 \text{ g.ml}^{-1}$ ). .....	90
Table 4.12 Colour of the pre-dried and sugar solution treated potato crisps during vacuum frying process (120°C, 50mbars).....	93
Table 4.13 Colour of the pre-dried and sugar solution treated potato crisps during vacuum frying process (120°C, 150mbars).....	94
Table 4.14 Statistical analysis on the results for the colour of the pre-dried and sugar solution treated potato crisps during vacuum frying at 120°C under different pressures (50 and 150 mbars). .....	95
Table 5.1 The percentage of the snapped samples and the mean values of three texture parameters ( $F_{max}$ , $x_{max}$ , $W_{max}$ ) for potato crisps treated with different pre-treatment techniques under conventional and vacuum frying conditions respectively. ....	139
Table 5.2 The statistical analysis on the maximum peak force ( $F_{max}$ ) texture parameter of potato crisps. ....	140
Table 5.3 The mean values of the two texture parameters ( $SIT$ and $SE$ ) of the potato crisps with different pre-treatment techniques under conventional and vacuum frying conditions. ....	141
Table 5.4 The statistical analysis on the slope of initial tangent ( $SIT$ ) of the potato crisps.	142
Table 5.5 The mean values of the three texture parameters hardness, stiffness and firmness ( $H$ , $S_b$ , $F$ ) of potato crisps treated with different pre-treatment techniques under conventional and vacuum frying conditions.....	146
Table 5.6 The mean values of the three texture parameters ( $MRD$ , $EM$ , $MTS$ ) of the potato crisps with different pre-treatment techniques under conventional and vacuum frying conditions. ....	147
Table 6.1 Physical chemical properties of acrylamide .....	153
Table 6.2 Concentrations of sugars and amino acids in a potato cultivar used for chipping (Saturna) (United Biscuits, personal communication).....	158
Table 6.3 Acrylamide concentrations and weight loss in prepared and uncooked french fried potatoes heated in a programmed GC Oven (Total heating time = 21 min).	160

Table 6.4 Acrylamide contents of the PNSD potato crisps fried under vacuum at 120°C, 150 mbars and that of the control samples. ....	171
Table 6.5 Acrylamide contents of the NPNS and PNSD potato crisps frying under vacuum conditions 150mbars and 120°C.....	173

## Abbreviations

CF	Conventional frying
NPNS	No pre-drying no sugar solution dipping (No pre-treatment)
NS	Not significant
PNSD	Pre-dried but with no sugar dipping
PSSD	Pre-dried and subsequently dipped in sugar solution
SN	Significant
VF	Vacuum frying

## LIST OF SYMBOLS

db	Dry basis
$k_{oil}$	Rate constant for oil uptake kinetics ( $\text{min}^{-1}$ )
$k_w$	Rate constant for moisture loss kinetics ( $\text{min}^{-1}$ )
$X_{oil}$	Oil content on dry basis ( $\text{kg. kg}^{-1}$ )
$X_{oil, e}$	Final values of the oil content on dry basis ( $\text{kg. kg}^{-1}$ )
$t$	Time (min)
$S$	Sum of the squares
$X_w$	Moisture content on dry basis ( $\text{kg. kg}^{-1}$ )
wb	Wet basis
wt	Weight (on wet basis)
$X_{w, e}$	Final values of water content on dry basis ( $\text{kg. kg}^{-1}$ )
$X_{w, o}$	Initial moisture content before frying on dry basis ( $\text{kg. kg}^{-1}$ )