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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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## 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 ( $\text{kg. kg}^{-1}$ )