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PHYSIOLOGICAL MEASURES RELATED TO CRISPNESS PERCEPTION OF EXTRUDED SNACKS

A thesis presented in partial fulfilment of the requirements for the degree

of

Doctor of Philosophy
in
Food Technology

At Massey University, Albany,
New Zealand.

Lisa Marjorie Duizer
2003

ABSTRACT

Published research for understanding crispness perception has relied on correlations of sensory results to objective measurements. This research was undertaken to evaluate the contribution of physiological responses to the perception of crispness of corn based puffed snacks.

Predictive models published in literature relate crispness perception to instrumental force and sounds produced during biting and compression. These models were used as the basis for this research. Air-conducted and bone-conducted sounds were measured using both consumer and trained panelists. A novel analysis technique, fractal analysis, was used to analyse the jagged sound wave patterns produced during biting into extruded snacks. A specialised bite force apparatus was designed for measuring bite forces produced by the incisors. All physiological results were then related to panelists' perception of crispness. To minimise sample variability, extruded snack samples were prepared and used throughout the entire trial. A range of crispness levels were achieved by equilibrating the extrudates over various water activities.

Consumer panelists and trained panelists consistently agreed on the relative crispness of the extruded snacks. Air-conducted sounds and bite force showed significant correlations with crispness, while bone-conducted sounds did not. Bite force measures were also shown to relate to instrumental measures of force. For statistical validity, the physiological data from the 39 consumers were used to develop predictive equations for crispness. Analysis of the data showed no significant correlation between the physiological data and crispness. Therefore, it was not possible to develop a predictive equation for crispness based on the physiological measures collected from consumers.

While there are reports linking crispness to various instrumental measures, this is the first time in-vivo physiological measures have been collected from a large group of individuals for development of statistically viable models for crispness. The lack of a relationship between crispness and physiological measures indicates that crispness perception across consumers is complex and not adequately explained by bite force and sounds alone.

ACKNOWLEDGEMENTS

I would like to sincerely acknowledge the support and assistance provided to me by Professor Ray Winger. Without his help, this PhD would never have been completed. I would also like to thank Dr. Osvaldo Campanella, Dr. Geoff Barnes, and Dr. Chris Findlay each of whom provided me with support in different ways throughout the course of this research.

Thanks go to Crop and Food Research Ltd., who provided seed funding for this research, Bluebird Foods Ltd. for the use of their single-screw extruder and HortResearch and Dr. Shafiur Rahman (formerly of HortResearch) for the use of the helium pycnometer. Also, Dr. Patrick Li of Crop and Food Research Ltd. is thanked for assistance with extruding and answering all of my questions about extrudates.

Massey University is gratefully acknowledged for assistance throughout this project. The Institute of Food, Nutrition and Human Health (formerly the Department of Food Technology) provided me with time and support to carry out this research while working as a lecturer. Financial assistance from the Massey University Research Fund helped fund this research. The Academic Women's Award allowed me to take time off from lecturing to start writing this thesis.

I would like to thank Garry Radford and Steve Glasgow for help while extruding and Byron McKillop and Bruce Rapley for building equipment. I would in particular like to thank Kevin Pedley who was a great source of information and assistance with physiological measurements and equipment for measuring bite forces. Dr. Denny Meyer and Duncan Hedderley are gratefully acknowledged for answering all my questions on statistics.

This research was conducted with approval from the Massey University human ethics committee. I'd like to thank all of those panelists who gave up their time to bite samples and make noises during this project. A sensory evaluation research project without panelists would not be possible.

A special thank you to my parents, as well as to friends, Carol and Michael Pound, for support in various ways throughout the years that it took to complete this research. And lastly, I'd like to thank my husband, Shane for his continued patience and encouragement throughout the entire process of completing this research.

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LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviations:

ANOVA	-	analysis of variance
a_w	-	water activity
df	-	degrees of freedom
D_{fk}	-	Kolmogorov fractal dimension
EMG	-	electromyography
F	-	feed rate
FCA	-	factorial correspondence analysis
FFT	-	fast fourier transformation
mhp	-	mean height of peaks
np	-	number of peaks
PCA	-	principal components analysis
PCO	-	principal coordinates analysis
QDA	-	quantitative descriptive analysis
TPA	-	texture profile analysis
TSE	-	twin-screw extrusion
Tukey's HSD	-	Tukey's honestly significant difference
r	-	correlation coefficient
r^2	-	coefficient of determination
RPM	-	rotations per minute
SAS	-	statistical analysis software
SSE	-	single-screw extrusion
vs.	-	versus
W	-	water flow rate
W_f/W_t	-	ratio of work during fracture to total work done
X_f	-	moisture content of the feed
X_p	-	product moisture during extrusion

Symbols:

ε_{app}	-	apparent porosity
ε_{op}	-	open porosity
ε_{cp}	-	closed porosity
ρ_{part}	-	particle density
ρ_s	-	substance density
ρ_{app}	-	apparent density