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**DEVELOPMENT OF A FUNCTIONAL FOOD
INGREDIENT USING EXTRUSION
PROCESSING TECHNOLOGY**

A THESIS

PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

**MASTER OF TECHNOLOGY
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ABSTRACT

This project aimed to develop a puffed “functional food” cereal ingredient that could subsequently be used in muesli bar products and potentially be on sold to breakfast cereal manufacturers. This ingredient was to contain nutrients that provided heart health benefits and also to possess good textural properties and to have an acceptable taste. Extrusion processing was used to produce the ingredient; extrusion processing transformed the raw materials used into a more palatable and texturally acceptable form and changed the nutritional quality.

The decision as to which nutrients to include in the ingredient required consideration of efficacy, regulatory and consumer and market factors. A literature review was undertaken to identify potential nutrients that would have heart health efficacy, meet regulatory guidelines and still be acceptable to consumers. A qualitative consumer study was conducted to gauge consumer awareness of the nutrients investigated and the desirability for these ingredients to be included in a bar benefiting heart health.

The main heart health nutrient selected for use in the puffed muesli ingredient, based on the results of screening, was soluble fibre. The source of soluble fibre selected was oat. The total, soluble and β -glucan (a particular form of soluble fibre) dietary fibre contents and the physical properties were of interest due to their influence on heart health benefits, product claims and sensory characteristics.

The effect of formulation (starch level, starch type), enzyme treatment and extruder processing settings on the fibre content and physical properties of the puffed ingredient was investigated. It was found that soluble fibre increased during the extrusion process, partially at the expense of insoluble dietary fibre. However, β -glucan was found to decrease during processing. The level of starch in the formulation was found to have the most significant effect on both the physical and nutritional properties. Increasing the level of starch had a positive effect on the physical properties, but decreased dietary fibre levels.

The puffed extrusion product contained a low level of β -glucan and a moderate level of total and soluble dietary fibre. A number of recommendations are presented concerning the feasibility of commercialisation, ingredient supplementation requirements and further research associated with the optimisation of the formulation and extrusion processing conditions.

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LIST OF ABBREVIATIONS

AA	Arachidonic acid
ALA	Alpha-linolenic acid
ANZFA	Australia New Zealand Food Safety Authority (renamed FSANZ)
CHD	Coronary Heart Disease
CIAA	Confederation of Food and Drink Industries of the European Union
CMC	Carboxymethyl cellulose
DHA	Docosahexanoic acid
Dwb	Dry Weight Basis
EPA	Eicopentaenoic acid
EU	European Union
FA	Fatty acid
FDA	Food and Drug Administration (food regulatory authority in the United States)
FDAMA	Food and Drug Modernisation Act (in the United States)
Feed rate rpm	is the number of revolutions of the feed conveying screws per minute
FOSHU	Foods for Specified Health Use (a regulatory framework in Japan)
FSANZ	Food Safety Australia New Zealand, (New Zealand and Australian Food Regulation Authority) formerly ANZFA
GE	Genetic Engineering
GM	Genetic Modification
GI	Glycaemic Index
HDL	High density lipoprotein (cholesterol)
ISSFAL	The International Society for the Study of Fatty Acids and Lipids)
LA	Linoleic acid
LDL	Low density lipoprotein (cholesterol)
LFRA	Leatherhead Food Research Association
mm	Millimetres
mmolL ⁻¹	units for blood cholesterol concentration
MUFA	Monounsaturated fatty acid
MUHEC	Massey University Human Ethics Committee
<i>n</i> -3	Omega-3 (polyunsaturated fatty acid)

<i>n-6</i>	Omega-6 (polyunsaturated fatty acid)
NHF Tick	National Heart Foundation approved Tick symbol
NHF	National Heart Foundation
N.I.P	Nutrition Information Panel
NLEA	Nutrition Labelling and Education Act (in the United States)
NZHIS	New Zealand Health Information Service
PUFA	Polyunsaturated fatty acid
rpm	Number of rotations of the screw per minute.
RS	Resistant Starch
RS1	Physically Inaccessible starch (a classification of resistant starch)
RS2	Resistant Starch granules (a classification of resistant starch)
RS3	Retrograded Starch
SFA	Saturated fatty acid
TFA	Trans Fatty Acids
TG	Triglyceride (generally referred to as plasma triglycerides)
UK	United Kingdom
US	United States of America
β -glucan	(1-3)(1-4) β -D-glucan (a form of soluble dietary fibre present in oats)