Nestlé & CPA Submission

Consultation Paper - W1109

Consultation about beta-glucan and blood cholesterol health claims

Sept 2017

Acknowledgment

Nestlé Australia Ltd and Nestle New Zealand Limited (Nestle) & Cereal Partners Australia (CPA) is pleased to be able to respond to the Consultation Paper on beta-glucan and blood cholesterol health claims.

Related submissions

Nestlé has had involvement with, and supports, the comments made in the submission of the Australian Food and Grocery Council, and New Zealand Food and Grocery Council.

Submission to FSANZ Consultation Paper

W1109

Sept 2017

Overview

CPA is a joint business venture between Nestlé and General Mills. CPA manufactures all but one of their 70 SKUs in Wahgunyah, Victoria. CPA produces and sells oats, oat-based cereals and ready to eat breakfast cereals under the brand names UNCLE TOBYS, NESTLE, O&G, PURINA and Morning Sun. The outcome of the systematic review conducted by FSANZ is of great interest to CPA, as it does sell oat and oat-based products carrying claims in relation to beta-glucan and cholesterol lowering. The potential outcome of this systematic review, if regulated, is likely to impact CPA product labels, as well as other communication touchpoints such as website, TVC, print and media.

Nestlé & CPA considers that the systematic literature review needs further assessment and clarification based on the material provided in this submission, and therefore does not support an automatic move to start the regulatory process to change the existing pre-approved food-health relationship for the GLHC about beta-glucan.

Overarching Comments on the Systematic Literature Review conducted by FSANZ

We wish to acknowledge the significant work FSANZ have conducted on the systematic literature review. We have a number of comments and questions relating to the evidence used in the '*beta-glucan from oats on blood cholesterol'* review for consideration. We also seek clarification on the methodology used in this review, as it appears that conclusions may be based on the *a priori* criteria chosen for the selection of included studies.

- Although it is acknowledged that no human intervention studies have been conducted on the effects of 100% pure beta-glucan, this sets a difficult precedent for foods and food-based ingredients where the total weight of evidence of studies support the lowering cholesterol effects of beta-glucan oats. As a point of consideration, in the paper by He et. al. 2016 (*The difference between oats and beta-glucan extract intake in the management of HbA1c, fasting glucose and insulin sensitivity: a meta-analysis of randomised controlled trials*), it was noted that the process of extracting beta-glucan from oats might change the properties of the beta-glucan. In particular, it was considered to degrade the beta-glucan quality and therefore, decrease the viscosity and/or molecular weight of the beta-glucan. In the study, it was demonstrated that extracted beta-glucan could not achieve the same effects of beta-glucan in whole oats.

- While no randomised controlled trials have been conducted on pure beta-glucan extract, there is robust evidence from studies that have investigated a range of beta-glucan doses (Tiwari and Cummins 2011; Behall et. al. 1997), molecular weights and viscosities (Wang et. al. 2015, Tosh et. al. 2010, Wolever et. al. 2010a) that support a plausible mechanism for oats beta-glucan

and cholesterol lowering. When beta-glucan was tested in a dose-dependent manner, significantly greater reductions in blood cholesterol were observed as the beta-glucan content increased (shown in the Figure below). Furthermore, research on oats (and barley) were often standardized by their beta-glucan content thus leading to the minimum quantity necessary for the health claim from multiple regulatory authorities.

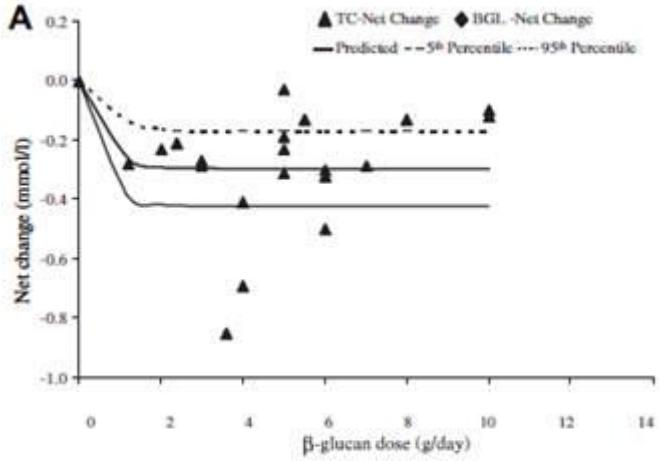

Fig. 4. Net change in (A) TC and (B) BGL with corresponding β-glucan dose. BGL, blood glucose level; TC, total cholesterol.

• An important mechanism for the action of oat beta-glucan on plasma cholesterol is through the impact of viscous soluble fibres, which slow digestion and increase cholesterol excretion, thereby reducing blood cholesterol levels (Bazzano 2008). Viscosity interferes with the reabsorption of bile acids, where the beta-glucan in oats binds with bile acids and increases their excretion in the faeces (Gunness and Gidley 2010; Martlett et al. 1994). The greater the amount and solubility of beta-glucan, the greater the extent of bile acid binding. In light of the overall body of evidence, there is a strong argument in support of causality of beta-glucan from oats consumption and reduced blood cholesterol concentration.

<u>Questions related to Methodology:</u>

• In Section 2.1.1 Search Strategy, it is stated that the literature search was only conducted up to 12 Dec 2014. We note that additional studies have been published since this date that would provide a more updated body of evidence, which could potentially influence the result outcomes. One such paper is a systematic literature review and meta-analysis by Ho et. al. (2016), along with a randomised controlled trial by Wang et. al. (2015).

• In Section 2.1.3 Study Selection, Data Extraction and Quality Assessment, it stated that the data was extracted by one investigator and then cross-checked by a second researcher. It is accepted scientific best practice to have two investigators conducting the search in parallel from the very beginning, followed by a comparison of extracted data by the two investigators – with a third involved in the case of disagreement.

- In Section 2.2.3 Extracted Data, it states that "*where the interventions involved different quantities or molecular weights of beta-glucan assaying in the food, the quantity closest to 3g, or with highest molecular weight, was selected for inclusion in the review. The value of 3g was selected as that is the daily intake required to be stated in claims by Std 1.2.7*". Although it appears that studies with differing beta-glucan levels were included in the systematic review, it is unclear from this statement whether the full breadth of literature of ranging doses was included in the extracted data in order to provide a complete overview of the evidence-base - or whether it was limited to papers only investigating 3g beta-glucan or "closest to 3g".

- Furthermore, in Section 2.2.1 Search Results in Appendix 2, 11 studies have been excluded on the basis of "*insufficient dietary intake information*". We note in the subgroup analyses related to background diet that, even when the data was poorly matched – the influence of background diet on total or LDL-cholesterol seemed to be minimal as highlighted below (from Table 3).

Sub-group		No. strata	Total cholesterol Mean difference [95% CI]	*P*	Total cholesterol *P*-value Sub-group difference	LDL cholesterol Mean difference (95% CI)	*P*	LDL cholesterol *P*-value Sub-group difference	HDL cholesterol Mean difference (95% CI)	*P*	HDL cholesterol *P*-value Sub-group difference
Overall		33/31/30[1]	-0.22 [-0.27, -0.17] I^2 = 52%	<0.00001	n/a	-0.20 [-0.24, -0.17] I^2 = 16%	<0.00001	n/a	0.00 [-0.01, 0.00] I^2 = 36%	0.32	n/a
Back-ground diet	Provided	4/4/4	-0.38 [-0.52, -0.24] I^2 = 13%	<0.00001	0.06	-0.29 [-0.41, -0.18] I^2 = 0%	<0.00001	0.46	0.02 [-0.06, 0.10] I^2 = 72%	0.62	0.83
	Well matched	20/19/18	-0.20 [-0.25, -0.15] I^2 = 34%	<0.00001		-0.21 [-0.26, -0.17] I^2 = 0%	<0.00001		-0.01 [-0.03, 0.01] I^2 = 45%	0.57	
	Poorly matched	9/8/8	-0.23 [-0.37, -0.09] I^2 = 71%	0.001		-0.22 [-0.34, -0.10] I^2 = 67%	0.0002		-0.01 [-0.03, 0.02] I^2 = 0%	0.81	

- Finally, for your reference, we have attached a report compiled by Peter Williams PhD FDAA (*Oats for Cholesterol Lowering: A research summary for health care professionals*) which collated an extensive body of scientific research that established the ability of the beta-glucan in oats to lower total and LDL cholesterol. In addition, it has incorporated four additional studies that were not included in the FSANZ review (Jenkins et. al. 2002, Maier et. al. 2000, Reyna-Villasmil et. al. 2007 and Tighe et. al. 2010).

<u>Whole Grain Barley Effect</u>

- There appeared to be inconsistency between the FSANZ conclusion and the systematic literature review regarding the effect of barley. The review states "*The relationship between barley and blood total and LDL cholesterol concentrations was shown to be consistent, with plausible mechanisms to explain the observed effect*". However, the conclusion indicates the confidence in the evidence was downgraded to "*Moderate*" degree of certainty because of low test subject numbers.

- In the included studies, significance was consistently reached with a smaller number of subjects indicating the effect size was sufficiently large to be detected in any case. Adding more subjects would therefore increase the level of significance or narrow the confidence interval. Regardless,

more subjects would not reverse the strong statistical association between barley and lower blood cholesterol. Typically, low subject/participant numbers is attributed to the failure to demonstrate statistical significance. This is not a reason to downgrade consistent, significant findings to "*Moderate*".

- In Section 2.5.1, Figure 9, the Forest plot showed that the effect of barley on total cholesterol was both consistently favourable and also significant. Increasing the number of subjects would be expected to increase confidence / significance, not change direction of the relationship.

- In Section 2.5.2, Figure 10, the Forest plot also showed a consistently favourable effect of barley on LDL-cholesterol reduction that was highly significant.

- In Section 2.5.4, Table 4 reports statistical significance for barley in the reduction of both total and LDL cholesterol.

  Nestlé & CPA considers that the systematic literature review needs further assessment and clarification based on the above material, and therefore does not support an automatic move to start the regulatory process to change the existing pre-approved food-health relationship for the GLHC about beta-glucan.

Response to the Consultation Paper Questions

FSANZ needs to determine how best to manage the existing pre-approved food-health relationship for the GLHC about beta glucan.

1. What do you consider to be the best approach for managing this food-health relationship in the Code, given the outcomes of the systematic review for the food-health relationship for a HLHC about beta-glucan? (See Section 7.1) Please give reasons for your response.

The outcome of the systematic review has shown a consistent and significant effect of oats and barley on reduced blood cholesterol concentrations. Each has a plausible mechanism of action established and is recognized by other global regulatory authorities. Based on the systematic literature review by FSANZ it is logical that the findings be extended to other (i.e. general) health claims describing the relationship.

Nestlé & CPA considers that, if the food-health relationship for the HLHC about beta-glucan and cholesterol lowering is to change (which we do not believe should occur pending the further assessment and clarification of the systematic literature review, as identified above), then the GLHC about beta-glucan and cholesterol reabsorption also needs to be updated. It would not be practical or logical to change the HLHC to replace beta-glucan with oat bran or whole grain oats, and to remove barley, when claims about beta-glucan and barley and cholesterol reabsorption can still be made as a GLHC.

Nestlé & CPA recommends that FSANZ review the science for the GLHC in light of the additional information provided in this submission. Any changes to the HLHC should be consistent with the GLHC.

The following three questions are in the context of amending the Code to align the pre-approved food-health relationship for a HLHC about beta-glucan and blood cholesterol with the outcomes of the systematic review, i.e. the food-health relationship between wholegrain oats or oat bran and the reduction of blood total and LDL cholesterol concentrations is substantiated.

2. What do you consider to be the impacts of amending the Code for consumer understanding about beta-glucan, oats and barley and blood cholesterol?

Quantitative consumer research that CPA have conducted over the past eight years has shown that beta-glucan is an unfamiliar term with no inherent meaning for consumers. While it does sound science based and elevate uniqueness, it also brings a medicinal tone for some consumers and reduces claim credibility. When beta-glucan from oats is the sole support for a cholesterol lowering claim it is less relevant and persuasive than other claims.

Our view is that consumers would not be significantly impacted by amending the code around beta-glucan and oats. However, we have not tested, and we cannot anticipate what the impact would be on consumers by removing the permitted claim on beta-glucan from barley and cholesterol lowering. This may cause misunderstanding as barley is considered an inherently healthy whole grain with health benefits, as described in the dietary guidelines.

3. Do you consider that such amendments to the Code would be consistent with dietary guidelines and other relevant public health messages? Why/why not?

If the Code is amended to align the pre-approved food-health relationship for a HLHC about beta-glucan and blood cholesterol with the outcomes of the systematic review, the Australian and the New Zealand dietary guidelines would potentially be mis-aligned.

These dietary guidelines use barley as an example of a whole grain, and whole grain intake consistently has been associated with improved cardiovascular disease outcomes, and also with healthy lifestyles, in large observational studies.

Due to the varying nutrient compositions of different whole grains, each could potentially affect CHD risk via different mechanisms. Whole grains high in viscous fibre (oats, barley) decrease serum low-density lipoprotein cholesterol and blood pressure and improve glucose and insulin responses (1).

(1) Harris KA, Kris-Etherton PM. Effects of whole grains on coronary heart disease risk. Curr Atheroscler Rep. 2010 Nov; 12 (6):368-76.

4. What do you consider to be the impacts on the food industry of such an amendment?

The following are potential impacts to Nestlé & CPA:

Cost

Cost of label changes required to products currently making claims about beta-glucan and reduces blood cholesterol, to change the reference to oats instead, and to remove the dietary context statement.

Impact of additional criteria that maybe introduced

Nestlé & CPA questions whether there will be another dietary context statement required to take its place. There is uncertainty as to whether it is the only the wording that would need to change to maintain the claim, or if additional criterion will be introduced. Without this information, it is not possible to comment exhaustively on the impacts to our business of such an amendment.

Nestlé & CPA has a cereal product making a HLHC about beta-glucan and cholesterol lowering, which contains the required levels of minimum of 1g beta-glucan per serve. It also contains 24g whole grain oats plus oat bran in a serve. If additional criterion was introduced, which set a minimum whole grain oat or oat bran content, for a product to carry the HLHC, this may introduce barriers for these types of products making these claim.

Question on evidence for the effect of dietary intake of oats on blood cholesterol

Nestlé & CPA seek clarification on what FSANZ would consider to be the appropriate scientific dose parameters for general oats consumption i.e - if the claim changes from beta-glucan to wholegrain oats and oat bran. In Section 2.4 it states that the "*quantity of wholegrain oat products (other than bran) consumed ranged between 45-109 g per day, whereas the quantity of oat bran consumed ranged between 20-150 g per day. There was no apparent dose-response effect across these intake ranges*". Would the minimum dose criteria for a claim be 45g per day for wholegrain oats? We would like to understand whether the full range of literature was reviewed for all available wholegrain oat and oat bran dose ranges, or whether only papers based on the *a priori* criteria were included.

Potential changes to beta-glucan content of oats over time – impact on research programmes

If beta-glucan criterion were to be removed from S4-4 and S4-5 of Schedule 4, this will remove the requirement for manufacturer's making claims about oat beta-glucan and cholesterol for ensuring the beta-glucan is maintained at the required levels. This may result in lost investment into research programs on beta-glucan and oats, as well as loss of incentive to continue with any such program. For example, the South Australian Research and Development Institute (SARDI) and UNCLE TOBYS have collaborated to develop a new oat breed 'Kowari' with higher beta-glucan content that will be planted by farmers in 2018. This was the result of a 14 years of research as part of the National Oat Breeding program. If beta-glucan criteria was removed then this type of research may be discontinued resulting in less focus on beta-glucan content as other nutritional parameters are focussed on.

International Regulatory Inconsistency

Removing reference to beta-glucan from whole grain oats, oat bran and whole grain barley and cholesterol reduction from the HLHC will be inconsistent with other recognised regulatory authorities such as EFSA. It could also adversely impact other jurisdictions that look to FSANZ for guidance. Ideally the strength of the science on a particular food health relationship is the same globally. Inconsistent health claims create trade barriers, cause consumer confusion impair regulator credibility in a global market and can have other unintended consequences where products and labels are shared between different markets.

Please provide documented evidence to support your views where possible.

Questions for the food industry

5. What foods do you sell that currently carry health claims (GLHC or HLHC) about beta-glucan? Please provide the following information for these foods:

- **the name of the food**
- **the wording of the health claim**
- **the total number of foods and SKUs currently carrying health claims about beta-glucan.**

Name of the food	Total Number of SKU carrying claim	Wording of the health claim
UNCLE TOBYS HEALTHWISE	1	**with beta glucan, a soluble fibre naturally occurring in oats which helps lower cholesterol for heart wellbeing. **As part of a healthy diet low in saturated fat, 3g of beta glucan every day is required to help lower cholesterol For Heart Wellbeing. Contains oat fibre to helps lower cholesterol**
UNCLE TOBYS OATS TRADITIONAL	2	Helps lower cholesterol re-absorption As part of a healthy diet low in saturated fat, 3g of beta glucan each day is required to help lower cholesterol re-absorption
MILK OATIES (NZ) NZ Flemings Rolled Oats	2 2	Contains beta-glucan, which helps lower cholesterol re-absorption^ ^As part of a healthy diet low in saturated fat, 3g beta-glucan each day is required to help lower cholesterol re-absorption
UNCLE TOBYS OATS QUICK (loose and sachets)	2 loose format 2 sachet format	contains beta glucan, which helps lower cholesterol re-absorption^ As part of a healthy diet low in saturated fat, 3g of beta glucan each day is required to help lower cholesterol re-absorption HELPS LOWER CHOLESTEROL^ Contains Beta Glucan, Which helps lower Cholesterol ^As part of a healthy diet low in saturated fat, 3g of beta glucan every day is required to help lower cholesterol ^
UNCLE TOBYS QUICK Sac High Fibre (sachets)	1	Beta glucan helps lower cholesterol^ ^As part of a healthy diet low in saturated fat, 3g of beta glucan every day is required to help lower cholesterol
UNCLE TOBYS MUESLI NATURAL STL Swiss	2	Contains beta glucan to help lower cholesterol ^ ^ As part of a healthy diet low in saturated fat, 3g of beta glucan every day is required to help lower cholesterol

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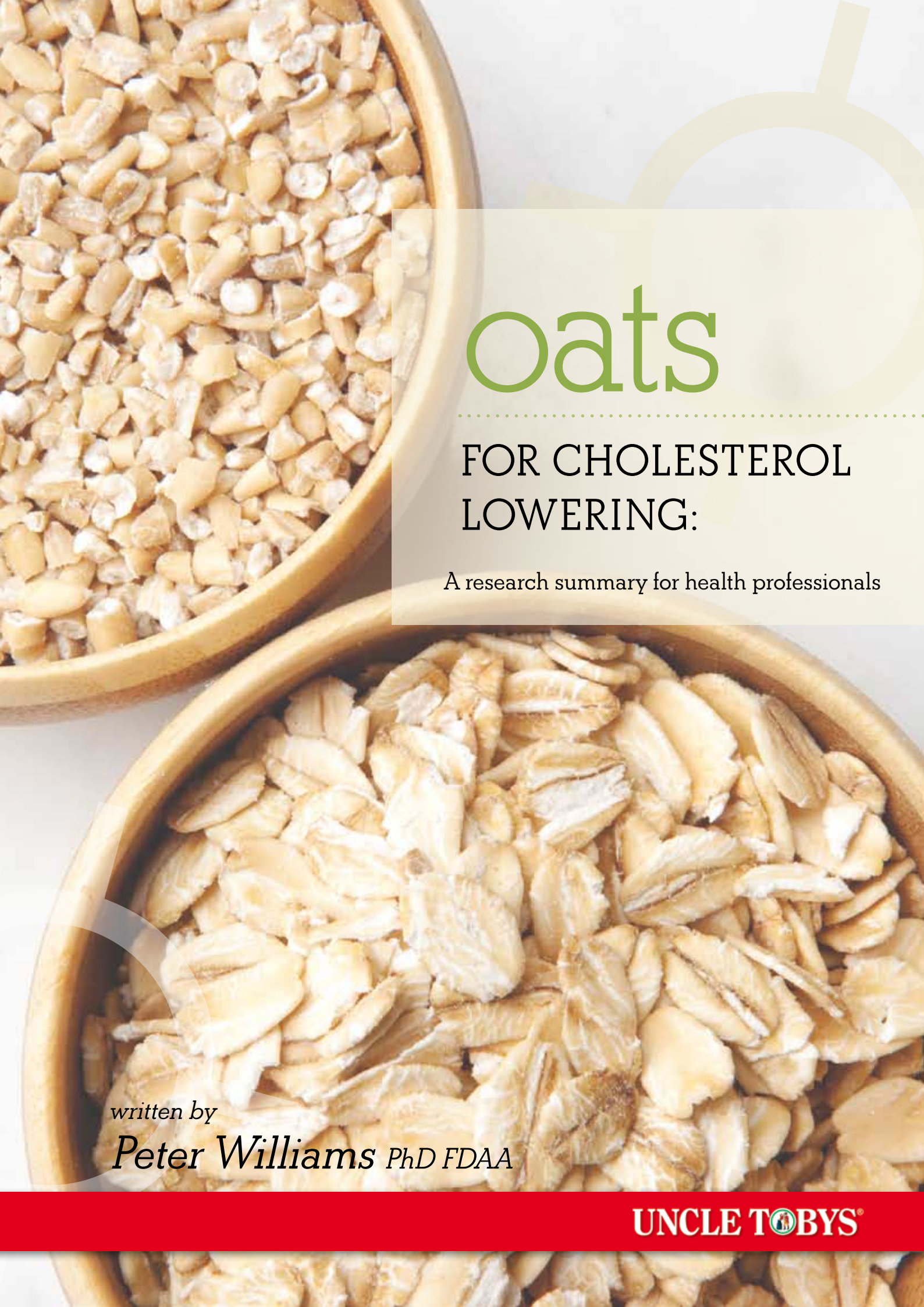

oats

FOR CHOLESTEROL LOWERING:

A research summary for health professionals

written by
Peter Williams PhD FDAA

UNCLE TOBYS®

FOREWORD

This important report gives a comprehensive overview of the science behind current recommendations to include more whole grain oat products in our diets, to reduce the risk of one of our most serious and costly diseases –coronary heart disease.

It collates the very extensive body of scientific research that has convincingly established the ability of the beta-glucan in oats to lower total and LDL cholesterol, and thereby reduce the risk of cardiovascular disease. Research started on this topic almost 40 years ago and meta-analyses and reviews conducted 10 years ago demonstrated the consistency of the findings and supported the first health claim for oats in the US in 1997.

Since then the body of research has continued to grow. This report summarises 22 key studies conducted in the last decade, and explains important new information about the effect that variations in the molecular weight of ß-glucans can have on their measured hypercholesterolemic effectiveness.

The clear conclusion is still that oats can help lower cholesterol and should be an important component of heart healthy diets.

Importantly it shows that the recommended intake of 3g ß-glucan per day can be achieved by a variety of simple changes to normal recipes and menus and with foods readily available at the supermarket.

Peter Williams

Smart Foods Centre. University of Wollongong

AUGUST | 2011

SUMMARY

- Cardiovascular disease remains the leading cause of death in Australia.
- Whole grains, including oats, protect against coronary heart disease, with 3 or more serves per day reducing risk by at least 20%.
- Over 60 scientific studies show viscous soluble fibres such as oat ß-glucan can reduce cholesterol reabsorption and lead to reductions in serum, total and LDL cholesterol by around 4-8% and up to 19% in some studies.
- Oats are one of the richest natural sources of ß-glucan.
- The efficacy of ß-glucan on cholesterol lowering is not just dependent on dose. The solubility and molecular weight of ß-glucan varies with the grain source, processing and food matrix. Cholesterol-lowering is greatest when the MW is >500 kDaltons (as in whole oats and oat bran).
- Intakes of at least 3g ß-glucan per day significantly lower the risk of heart disease and health claims are now approved in the US, Canada, UK and Europe.
- The Heart Foundation of Australia recommends consumption of oats as one strategy to help reduce LDL cholesterol.
- Patients should be encouraged to include a range of oat-based products to meet the recommended target of 3g ß-glucan per day, including rolled oats or oat bran in porridge, muesli, or incorporated into other dishes; oat-based ready-to-eat breakfast cereals; muesli bar snacks; and oat biscuits and breads.

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INTRODUCTION

Diet and cardiovascular disease

Cardiovascular disease (CVD)–including heart and blood vessel disease and stroke–is the leading cause of death in Australia, accounting for 34% of all deaths in 2005 (Australian Bureau of Statistics 2006). The estimated cost of treatment is over $5 billion per annum (Australian Institute of Health and Welfare 2008), of which over $2 billion is for medicines (Ademi et al. 2009).

The protective effect of whole grains for coronary heart disease has been suggested for almost 40 years (Kushi et al. 1999) and all recent reviews have been strongly consistent in supporting the protective effect of whole grains against coronary heart disease (CHD). In the last ten years there have now been five meta-analyses (Anderson et al. 2000; Anderson & Anderson 2003; Pereira et al. 2004; Kelly et al. 2007; Mellen et al. 2008) and at least four systematic literature reviews (Jacobs et al. 2004; Flight & Clifton 2006; Mente et al. 2009; Harris & Kris-Etherton 2010) which have all reported an association of reduced risk of CHD, ranging from 19-30% reductions with the highest intakes of 3 or more serves of whole grain foods per day.

There are many mechanisms by which whole grain foods may influence CHD risk including lower glycemic index levels and the provision of nutrients such as magnesium, folate, alpha-tocotrienol and a variety of other phytochemicals such as avenathramides that might inhibit oxidative stress, inflammation and modulate endothelial function (Katz et al. 2001; Slavin 2003; Slavin 2004; Jensen et al. 2006; Nie et al. 2006; Qi et al. 2006; Jacobs et al. 2007; Ryan et al. 2007; Peterson & Dimberg 2008). The ratio of arginine to lysine in whole grain oats is also associated with cholesterol-lowering in animals (Slavin et al. 2001).

However, probably the most important mechanism is through the impact of viscous soluble fibres, which slow digestion and increase cholesterol excretion, thereby reducing blood cholesterol levels (Bazzano 2008). It has been estimated that each 10g increment in total cereal fibre per day is associated with a 25% reduction in risk of coronary death (Pereira et al. 2004).

Health claims and clinical guidelines

Table 1 below summarises the health claims and clinical guidelines about oats and cholesterol reduction that have been approved internationally.

TABLE 1: APPROVED HEALTH CLAIMS AND RECOMMENDATIONS ABOUT OATS

ORGANISATION	CLAIM
US Food and Drug Administration (1997)	Soluble fibre from foods such as oats, as part of diet low in saturated fat and cholesterol, may reduce the risk of health disease. A serving of rolled oats supplies X grams of the 3g of soluble fibre necessary per day to have this effect
Swedish Nutrition Foundation (2004)	Soluble fibre from oat bran may reduce cholesterol
UK Joint Health Claims Initiative (2004)	The inclusion of oats as part of a diet low in saturated fat and a healthy lifestyle can help reduce blood cholesterol
National Heart Foundation of Australia (2006)	There is good evidence that soluble fibre lowers plasma low density lipoprotein (LDL) cholesterol which lowers the risk of cardiovascular disease
American Heart Association (2006)	Soluble or viscous fibres (notable ß-glucan and pectin) modestly reduce LDL cholesterol levels beyond those achieved by a diet low in saturated and trans fatty acids and cholesterol alone
European Food Safety Authority (2009)	Regular consumption of beta-glucans contributes to maintenance of normal blood cholesterol concentrations
Health Canada (2010)	Oat fibre helps reduce cholesterol, which is a risk factor for heart disease
European Food Safety Authority (2010)	Oat beta-glucan has been shown to lower/ reduce blood cholesterol. Blood cholesterol lowering may reduce the risk of heart disease

After the establishment in 1993 of a process by which the US Food and Drug Administration (FDA) could approve health claims for food, the oat-heart disease health claim was the first petition from a food company to be approved by the FDA in 1997. The scientific review included 41 clinical trials, as well as epidemiological and animal studies, and the model health claim allowed was as follows: *"Soluble fibre from foods such as oats, as part of diet low in saturated fat and cholesterol, may reduce the risk of health disease. A serving of rolled oats supplies X grams of the 3g of soluble fibre necessary per day to have this effect"* (US Food and Drug Administration 1997).

A similar claim about beta-glucan (the viscous soluble fibre in oats) has been in place in Sweden since 2002 (Swedish Nutrition Foundation 2004), and in 2004 the UK Joint Health Claims Initiative approved a health claim for oat products containing at least 0.75g ß-glucan per serving (Joint Health Claims Initiative 2004).

More recently in 2009, the European Food Safety Authority (EFSA) also published a scientific opinion on the substantiation of health claims related to oat ß-glucans (European Food Safety Authority 2009). For foods providing at least 3g per day, EFSA has approved the general function health claim (article 13.1) that regular consumption of beta-glucan contributes to maintenance of normal blood cholesterol concentrations.

They relied primarily on the conclusion of two meta-analyses of randomised controlled clinical trials (Ripsin et al. 1992; Brown et al. 1999), plus eight other clinical trials published more recently. An article 14 claim (disease risk reduction) on oat beta-glucan was also approved by EFSA in 2010.

In November 2010, Health Canada issued a new report summarising their assessment of the evidence supporting a disease reduction claim on oat products (Health Canada 2010). They approved the use of a cholesterol reduction claim, provided that a serve of the food contains at least 0.75g of beta-glucan from oat bran, rolled oats or whole oat flour.

In Australia and New Zealand, health claims for foods are not yet permitted. However, the National Heart Foundation acknowledges the role of soluble fibre from foods such as oats in the treatment of raised cholesterol. In its position paper on carbohydrates and cardiovascular disease it concluded that there is good evidence that soluble fibre lowers plasma low density lipoprotein (LDL) cholesterol, and consumption of oats is recommended to health professionals as one strategy to lower LDL cholesterol in the blood (National Heart Foundation of Australia 2006). These recommendations are also supported by the American Heart Association (American Heart Association Nutrition Committee 2006).

OATS AND BETA-GLUCAN – THE FACTS

Grain and composition

Oats (Avena sativa L.) originated from the Asian wild red oat, which grew as a weed amongst other cultivated cereals. From 1000BC in Europe there are records of oat cultivation, but it was mostly used as animal food in classical times. Later it became a staple human cereal for populations in colder climates such as Germany, Scandinavia, Ireland and Scotland (Davidson 1999).

Oat grain has a soft kernel and the lipids are distributed throughout the seed. The protective inedible hull (husk) makes up about 25% of the seed (Figure 1) and the grain is dehulled before use. The resulting whole oat (groat) contains high amounts of protein, soluble dietary fibre and unsaturated fatty acids, as well as being a source of several vitamin and minerals (Table 2).

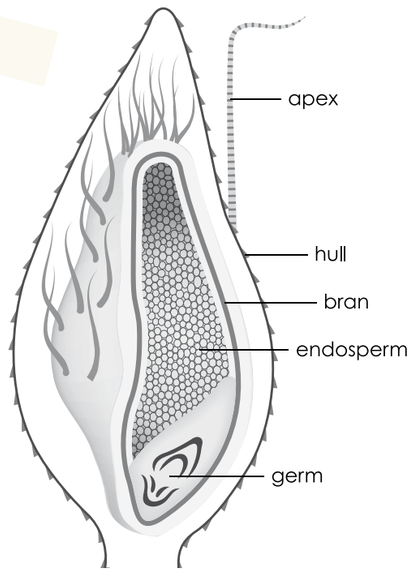

Fig.1 Cross section of oat grain
Adapted from Encyclopedia Britannica

Oats and Barley are naturally rich in beta-glucan

TABLE 2: TYPICAL RAW GRAIN COMPOSITION PER 100g

COMPONENT	OATS	WHOLE WHEAT	BROWN RICE	PEARLED BARLEY
Energy (kJ)	1572	1471	1537	1358
Available carbohydrate (%)	58.1	65.3	76.5	61.2
Moisture (%)	9.3	11.0	12.1	11.4
Protein	11.0	11.4	7.2	8.0
Total dietary fibre (g)†	9.5	11.3	3.2	11.7
Insoluble fibre (g)†	6	10.6	1.6	5.2
Soluble fibre (g)	5	1.6	<0.1	5.4
Beta-glucan (%)*	4.5	0.7	0.1	3.5
Total fat (%)	8.7	2.1	2.4	2.4
Poly- and mono-unsaturated fat (%)	6.6	1.0	0.8	1.1
Calcium (mg)	45	30	11	22
Iron (mg)	3.7	3.0	1.2	2.7
Zinc (mg)	1.9	1.3	2.1	0.9
Phosphorus (mg)	411	222	310	266
Magnesium (mg)	131	103	119	90
Sodium (mg)	7	5	5	15
Thiamin (mg)	0.54	0.42	0.35	0.68
Riboflavin (mg)	0.14	0.11	0.05	0.06
Niacin (mg)	1.0	5.5	4.5	5.5
Vitamin E (mg)	0.4	0.8	1.2	0.3

Source: Food Standards Australia New Zealand 2010 and USDA National Nutrient Database for Standard Reference, Release 23 (2010).

*Data based on analysis of 1 sample of each grain, sourced from Australia. These figures are only indicative of beta-glucan content. Average levels may vary from one grain species to another.

†Data courtesy of Go Grains Health and Nutrition, various sources.

Oats provide beta-glucan

(1-3),(1-4)-ß-D-glucan is a water-soluble gum, generally referred to as beta-glucan (ß-glucan). It is found in the cell walls of seeds of the Gramineae family and oats are one of the richest sources. Purified oat ß-glucan is a linear unbranched polysaccharide composed of 1-4-O-linked (70%) and 1-3-O-linked (30%) ß-glucopyranosyl units (Figure 2).

ß-glucans belong to the group of indigestible carbohydrates, which include non-starch polysaccharides, resistant starch and oligosaccharides. These are not digested or absorbed in the small intestine but are partially or completely fermented to short chain fatty acids in the large intestine.

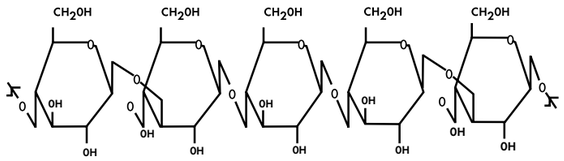

Fig.2 Structure of ß-glucan

ß-glucan exhibits high viscosities at concentrations as low as 1% and this viscosity is stable over a wide range of pH. However, molecular weight (MW) and concentration have a great influence on the rheological behaviour of ß-glucans in solution and in the intestinal tract. ß-glucans extracted from oat bran have a higher viscosity than those from oat endosperm (Wikstrom et al. 1994).

It had been suggested that in order to be physiologically active and form viscous solutions in the gut, ß-glucan should be soluble with a molecular weight between 2000-3000 kDa (Doublier & Wood 1995; Aman et al. 2004). But these publications were based on very limited data. More recent data indicates that medium molecular weight sources of ß-glucan may also be effective at cholesterol lowering (Wolever et al 2010a).

Different oat varieties, endogenous ß-glucanase activity, processing and storage conditions (such as freezing) can all affect the amount, solubility, molecular weight and structure of ß-glucan in processed food products (Beer et al. 1997; Wood 2007). Furthermore, treatment of oats with enzymes that destroy ß-glucan results in a loss of cholesterol lowering potential (Shinnick & Marlett 1993).

The importance of molecular weight

Two recent studies have directly demonstrated the importance of molecular weight on the viscosity of ß-glucans and their cholesterol lowering effectiveness. In the first, a series of extruded oat bran cereals, all containing around 14% ß-glucan, were prepared under different temperature and shear conditions so that their MW varied from 251 to 1930 kDa. The viscosity, measured after in vitro digestion, increased exponentially with increasing MW, with a 20-fold difference between the products of lowest and highest MW (Tosh et al. 2010).

Secondly, these same products were tested in a clinical trial conducted with 345 hypercholesterolemic subjects who were provided with two serves of ready-to-eat breakfast cereal to be consumed daily for four weeks. Subjects consumed 3g oat ß-glucan/d of four different MWs that varied 10-fold. The high-MW (2210 kDa) and medium MW (530 kDa) cereals lowered LDL cholesterol levels similarly (by around 5%), but efficacy was reduced by 50% when MW was reduced to 210 kDa (Wolever et al. 2010a).

This study concluded that the maximal cholesterol lowering effect would be gained from oat products where the ß-glucan has a MW of approximately 2000 kDa (such as found in whole oats or oat bran). It is very likely that this finding explains some of the heterogeneity found in the meta-analyses of the cholesterol-lowering effect of oats (Ripsin et al. 1992; Brown et al. 1999), since the MW of some commercial preparations of ß-glucans, whose effects on LDL cholesterol have been tested, ranged from only 40-80 kDa. However large doses of low MW ß-glucan may still have a hypocholesterolemic effect. Wolever et al (2010b) have suggested that serum cholesterol is proportional to log (MW x amount), indicating that the reduced effect of low MW can be overcome by increasing the dose.

TABLE 3: PHYSICOCHEMICAL PROPERTIES OF SELECTED UNCLE TOBYS OAT FOODS

The solubility and the molecular weight of the beta-glucan in oat foods are both important for cholesterol lowering.

	UNCLE TOBYS TRADITIONAL OATS	UNCLE TOBYS OAT CRISP HONEY
Serving size (g)	40	40
Beta-Glucan content (%)	4.17	2.42
Beta-Glucan content (g/serve)	1.4	0.9
Soluble dose Beta-Glucan (g soluble ß-glucan)	0.6	0.9
Molecular Weight (kDa)	2,100 ± 23	760 ± 9.2

Data courtesy of Dr Susan Tosh, Guelph Food Research Centre, Agriculture and Agri-Food, Ontario, Canada

Variation in beta-glucan levels between oat varieties

There is substantial intraspecific variation in the ß-glucan content of different oat genotypes, ranging from 1.7-8.5%, which can be manipulated by breeding, and some rarer varieties can have levels up to 11.3% (Welch & Lloyd 1989; Wood et al. 1991; Welch et al. 2000; Cevantes-Martinez et al. 2001; Havrlentova & Kraic 2006). Environmental factors such as temperature, the availability of water during grain maturation and the use of nitrogen fertilisers can also affect ß-glucan levels in oats (Brennan & Cleary 2005).

Oat bran is the outermost layer of the oat kernel, produced by grinding clean dehulled rolled oats and separating bran from the resulting flour by sieving. It is the richest source of ß-glucan (particularly in the nutrient rich aleurone, a single layer of cells found under the bran), having a typical total dietary fibre content of 22%, and a ß-glucan content of 10.4% (Butt et al. 2008).

Beta-glucan lowers cholesterol

Several systematic reviews have examined the relationship between consumption of oats and cardiovascular risk factors. Truswell summarised the results of 38 studies published from 1963 to 1994, reporting percentage reductions in total cholesterol from 0-18% in subjects receiving rolled oats or oat bran, with an unweighted mean reduction of 5.5% with intakes of around 50g of oat bran (Truswell 2002). However he noted that very few of the publications reported the fibre content of the foods used in the studies.

A Cochrane review of whole grain cereals and coronary heart disease found only 10 studies from 11 publications suitable for inclusion, and eight of those studies were with oats. It concluded there was a weighted mean difference in total cholesterol of -0.19 mmol/L for oatmeal diets compared with refined grain diets, and a similar reduction of LDL-cholesterol (-0.18mmol/L), but no effect on HDL cholesterol (Kelly et al. 2007).

The most recent systematic review of 21 studies published between 1990 and 2008 did not attempt to estimate the overall cholesterol changes, but reported that only two studies found no evidence of an association between oats and cholesterol and these were studies with small numbers of subjects or unreported levels of subject compliance (Ruxton & Derbyshire 2008).

Two meta-analyses have estimated the likely effect sizes on cholesterol levels. Ripsin et al reviewed 20 trials of rolled oats or oat bran published between 1984 and 1991, and calculated a change in blood total cholesterol of -0.13mmol/L, which was larger than would be predicted from calculation of Keyes scores, demonstrating that the effect was not due to substitution of dietary carbohydrates for fat (Ripsin et al. 1992).

Importantly the authors noted that trials enrolling subjects with higher initial cholesterol levels (>5.8 mmol/L) and employing a dose of 3 or more grams of soluble fibre, demonstrated a five-fold greater reduction in total cholesterol than those whose subjects had lower initial cholesterol levels or those that employed lower doses of fibre.

A later meta-analysis published in 1999 reviewed 25 controlled trials with oat products and concluded that 3g soluble fibre from oats can decrease total and LDL cholesterol by approximately 0.13mmol/L (2-2.5%) (Brown et al. 1999).

Table 4 summarises the findings of all the 22 further studies examining the effect of oat beta-glucan on plasma cholesterol levels, which have been published between 2000 and 2010, since the last meta-analysis (arranged in order of decreasing impact on cholesterol levels). All of these studies report falls in LDL cholesterol (ranging from -27.3% to -1.7%) at different doses of oat ß-glucan, although in 6 studies these changes were not statistically significant. It is worth noting that three of those six studies used normolipidemic subjects, and in the other three the ß-glucan was incorporated into ready-to-eat cereal, bread or cookies and the molecular weight of the ß-glucan was not reported. If only the results from studies in subjects with elevated cholesterol levels are considered, the unweighted simple mean reduction in LDL cholesterol from these 19 recent studies is 7.9%, slightly higher than that reported by Truswell in his earlier review (Truswell 2002).

It appears that oats are consistently hypocholesterolemic, regardless of whether they are incorporated in an ad libitum diet or an energy- and fat-restricted diet.

Oats do not reduce cholesterol by simply displacing fat and cholesterol intake (Ripsin et al. 1992) and they reduce cholesterol levels even when a baseline diet is low in fat (Van Horn et al. 1988) and independent of weight loss (Maki et al. 2010).

In most studies, oats reduced LDL-cholesterol without affecting HDL-cholesterol levels, although in some studies there were improvements in the profiles of HDL-cholesterol and apolipoprotein A-1 (an important independent risk factor for CVD) (Turnbull & Reeds 1989; Bremer et al. 1991; Robitaille et al. 2005; Reyna-Villasmil et al. 2007).

When ß-glucan is fed in a dose-dependent manner, significantly greater reductions in blood cholesterol are observed as the ß-glucan content increases (Behall et al. 1997). One dose-controlled study, using doses ranging from 1.2-6.0g/d ß-glucan, predicted a linear relationship in reductions in LDL cholesterol from -5% at 1 g/day to around -15% at 6 g/day (Davidson et al. 1991). A study with very high doses of oat products (100 g oat bran/d, which would provide around 10 g/d of ß-glucan) found that in hypercholesterolemic men serum cholesterol could be reduced by as much as 19% and LDL-cholesterol by 23% (Anderson et al. 1990).

However, the food matrix in which the ß-glucan is delivered can also significantly affect its physiological action. The process of enrichment may affect efficacy (Poppitt 2007). For example, structural changes can occur to ß-glucan during commercial extraction, including depolymerisation of the linear structure, resulting in decreasing molecular weight and viscosity (Wursch & Pi-Sunyer 1997). Cooking processes may decrease molecular weight and freezing and storage can reduce the extractability of ß-glucan in the intestine (Beer et al. 1997). Thus in one recent study, oat bran ß-glucan consumed with orange juice was more effective in lowering total and LDL-cholesterol than the same preparation administered in bread or cookies, indicating that it is difficult to predict the effect in processed foods without direct clinical studies (Kerckhoffs et al. 2003).

TABLE 4: SUMMARY OF 22 STUDIES PUBLISHED BETWEEN 2000-2010 EXAMINING THE EFFECT OF OAT BETA-GLUCAN ON PLASMA CHOLESTEROL.

STUDY	SUBJECTS	DESIGN	INGREDIENT	DURATION	TOTAL CHOLESTEROL	LDL-C	HDL-C	LDL:HDL-C
Amundsen et al (2003)	16 hypercholesterolemic men and women (mean age 57y) Sweden	Randomised single blind cross-over study with oat bran in various products (muesli, cereal, bread, cakes, muffins, pastas and juice)	Oat bran concentrate (15% ß-glucan) providing 5g ß-glucan/d	2 x 3 weeks	-6.0%	-9.0%	-3.4% NS	n/a
Berg et al (2003)	235 hypercholesterolemic men (mean age 53y) Germany	Randomised parallel group trial of lifestyle program with increased activity, NCEP step 2 diet +/-oat bran supplementation	35-50g /d oat bran incorporated into bread, sauces and desserts	4 weeks	-8.4%	-9.4%	-3% NS	n/a
Biorklund et al (2005)	89 hypercholesterolemic men and women (mean age 59y) Netherlands & Sweden	Single blind randomised dose controlled trial (rice starch control)	5 or 10g/d oat ß-glucan (MW 70 kDa) in two 250mL serves of fruit beverage	5 weeks	-7.4% (5g) -4.5% (10g) NS	-6.7% (5g) -3.7% (10g) NS	-0.6% (5g) NS +4.8% (10g) NS	n/a
Bioklund et al (2008)	43 hypercholesterolemic men and women (mean age 58y) Sweden	Randomised, parallel placebo controlled trial (maltodextrin and oil control)	4g/d oat ß-glucan (MW 80 kDa) in one 400g portion of soup	5 weeks	-2.9%	-3.7%	-2.3% NS	n/a
Chen et al (2006)	110 normolipidemic men and women (mean age 48y) USA	Randomised controlled trial (wheat and corn control)	7.3g/d oat ß-glucan from 60g oat bran muffin and 84g Quaker oatmeal squares	12 weeks	-1.2% NS	-1.6% NS	-0.5% NS	n/a
Davy et al (2002)	36 overweight hyperlipidemic men (mean age 57y) USA	Randomised controlled parallel trial (wheat fibre control)	5.5g/d oat ß-glucan in 2 serves/d of cooked oatmeal or ready-to-eat oat bran cereal	12 weeks	-2.5% NS	-2.5%	-1.1% NS	-6.3%
Frank et al (2004)	22 hypercholesterolemic men and women (mean age 49y) Sweden	Randomised double blind cross-over trial (low MW ß-glucan control)	4 bread rolls/d providing 6 g high MW oat ß-glucan (797kDa)	2 x 3 weeks	-6.3% (women) No significant change in men	-8.9% (women) No significant change in men	0% NS	n/a
Jenkins et al (2002)	68 hyperlipidemic men and women (mean age 60y) Canada	Randomised cross-over study NCEP Step 2 diet + oat or psyllium (diet only control)	3g/d oat ß-glucan from 4 serves/d of fibre enriched cereals, breads, dinners cookies, chips, pasta, beverages – each with 0.75g -glucan	4 weeks	-2.1%	-1.7% NS	+1.3% NS	-2.4%
Karmally et al (2005)	152 hypercholesterolemic Hispanic men and women (mean age 49y) USA	Randomised controlled trial NCEP Step 1 diet + oat bran cereal (corn control)	3g/d oat ß-glucan in 2 serves/d of ready-to-eat oat bran cereal (Cheerios)	6 weeks	-4.5%	-5.3%	0% NS	n/a
Kerkhoffs et al (2003)	25 hypercholesterolemic men and women (mean age 53y) Netherlands	Randomised controlled parallel group trial (wheat fibre control)	5.0g ß-glucan/d from oat bran in 2 serves of orange juice	2 weeks	-3.8%	-6.7%	-2.0% NS	5.4%
Kerkhoffs et al (2003)	48 hypercholesterolemic men and women (mean age 52y) Netherlands	Randomised controlled parallel group trial (wheat fibre control)	5.9g ß-glucan/d from oat bran incorporated in 5 slices of bread + cookies	4 weeks	-2.1% NS	-2.5% NS	-2.0% NS	n/a
Lovegrove et al (2000)	62 hyperlipidemic men and women (mean age 56y) Switzerland	Randomised, double blind placebo controlled, parallel trial (wheat bran control)	3g/d oat ß-glucan in breakfast cereal with 20g oat bran concentrate	12 weeks	-1.6% NS	-2.3% NS	-6.6% NS	+4.6% NS
Maki et al (2010)	204 hyperlipidemic men and women (mean age 49y) USA	Randomised controlled parallel trial of 500kcal hypocaloric diet +/- 2 serves RTE oat (corn cereal control)	3g oat ß-glucan/d from whole grain oat cereal (Cheerios)	12 weeks	-5.4%	-8.7%	0% NS	n/a
Maier et al (2000)	180 hypercholesterolemic men and women (mean age 48y) USA	Randomised controlled parallel group trial with NCEP Step 1 diet +/- 5 treatment groups (oats & amaranth)	50g/d oat bran in two ready to eat cereals: (A: "flakes" or B: "Os")	4 weeks	A: -13.1% B: -9.1%	A: -11.8% B: -8.7%	A: -21.6% B:-21.1%	n/a
Naumann et al (2006)	47 hyperlipidemic men (mean age 56y) and women (mean age 49y) Netherlands	Placebo controlled double blind parallel trial (rice starch control)	5g oat ß-glucan/d (MW 80 kDa) consumed in 2 serves of fruit drink.	5 weeks	-4.8%	-7.7%	+1.6% NS	-4.9% NS
Pins et al (2002)	88 hypertensive men and women (mean 48y) USA	Randomised controlled parallel trial with isocaloric diets (wheat fibre control)	60g oatmeal (2.83g ß-glucan) + 77g Oat squares (2.59g ß-glucan)	12 weeks	-14.9%	16.0%	+3.4% NS	-18.8%
Queenan et al (2007)	75 hypercholesterolemic men and women (mean age 45y) USA	Randomised double blind parallel group trial (dextrose control)	6g ß-glucan/d from oat bran concentrate, consumed in 2 serves of beverages	6 weeks	-4.8%	-7.3%	-1.4% NS	-6.0%
Reyna-Villasmil et al (2007)	38 hypercholesterolemic men (mean 60y) Venezuela	Randomised controlled trial NCEP Step 1 diet + bread (wheat fibre control)	6g oat ß-glucan (Nutrim OB)	8 weeks	-15.9%	-27.3%	+27.8%	-42.1%
Robitaille et al (2005)	34 normolipemic pre-menopausal women (mean age 39y) Canada	Randomised double blind parallel group trial. NCEP step 1 diet +/- muffins	2.3g ß-glucan/d provided in 2 muffins enriched with 28 g/d oat bran)	4 weeks	-2.5% NS	0%	+11.2%	-10.5%
Tighe et al (2010)	186 healthy overweight men and women (mean age 52y) Scotland	Randomised controlled single blind trial of 3 serves per day of whole grain (WG) foods (refined wheat cereal control)	2 serves per day oat based WG foods, (foods and ß-glucan content unspecified) WG diet had 16.8g/d NSP vs 11.3g in control	12 weeks	-0.9% NS	-2.8% NS	+1.2% NS	-1.7% NS
Van Horn et al (2001)	127 hypercholesterolemic postmenopausal women (mean age 67y) USA	Randomised controlled parallel trial of NCEP Step 1 diet + oats/soy, oats/milk, wheat/soy, or wheat/milk, (diet only control)	2 serves/d of cooked oatmeal or RTE oat bran cereal , providing 1.7g soluble fibre (ß-glucan not reported)	6 weeks	-3.0%	-6.5%	-1.7% NS	n/a
Wolever et al (2010a)	345 hyperlipidemic (mean age 52y) Canada, Australia, UK & Switzerland	Double blind randomised parallel controlled trial (wheat control)	3g/d high MW (2100 kDa) or 4 g/d medium MW (850 kDa) oat ß-glucan in 2 daily serves of RTE cereals	4 weeks	-3.9% (3g) -3.9% (4g) NS	-5.5% (3g) -6.5% (4g)	n/a (3g) NS n/a (4g) NS	n/a (3g) n/a (4g)

Mechanisms of action

The most plausible explanation for the action of oat ß-glucan on plasma cholesterol is that its viscosity interferes with the reabsorption of bile acids (BA) (Gunness and Gidley 2010). The ß-glucan in oats binds with BA and increases their excretion in the faeces (Marlett et al. 1994). In oat fibre trials, BA have been reported in faeces (Judd & Truswell 1981; Kirby et al. 1981), and in ileostomy effluent (Zhang et al. 1992). In one ileostomy study, oat bran cereal providing 11.6 g/day ß-glucans increased excretion of BA by 144% and cholesterol absorption decreased by 19% (Ellegard & Andersson 2007). Removing BA from circulation stimulates the conversion of serum and liver cholesterol to form additional BA, with a concomitant drop in serum cholesterol (Anderssen et al. 2002; Jenkins et al. 2004).

Two mechanisms have been proposed for BA binding to dietary fibre. One theory suggests that they are chemically bound to the fibre and the other suggests that BA may be physically trapped in a ß-glucan mesh within the fecal milieu. Whatever the mechanism, it appear the greater the amount and solubility of the ß-glucan, the greater the extent of BA binding (Yao et al. 2008).

However there may be additional ways in which oat fibre might lower cholesterol. Bacterial fermentation of the ß-glucans increases the release of short-chain fatty acids, which may reduce cholesterol synthesis, possibly through inhibition of the enzyme HMG-CoA reductase (Ink & Matthews 1997; Chen & Huang 2009; Chen et al 2010). In animal studies, high MW ß-glucans increase the ratio of propionate+butyrate/acetate, which is associated with lower serum cholesterol levels (Wolever et al. 1996). Oat fibre may also directly reduce intestinal cholesterol absorption (Shinnick & Marlett 1993; Drozdowski et al 2010).

Furthermore, although the effect of oat ß-glucan on cholesterol reabsorption is likely to be the primary mechanism by which oats affect CHD risk, newer research suggests oats also affect gut hormones associated with satiety (Beck et al. 2009), modulate immune function (Volman et al. 2008), blood glucose reduction (Wood 2010) and can lower blood pressure (Tighe et al 2010).

Clinical efficacy versus other treatments

The FDA oat claim determined that an effective daily intake of ß-glucan is 3g. The 1999 meta-analysis concluded that 3g soluble fibre per day from oatmeal could decrease total cholesterol by 2%, but this effect was calculated after excluding 23 studies that used doses of >10 g per day because the response appeared to be non-linear (Brown et al. 1999). If these studies were included, there was an average cholesterol reduction per oat study of 4% (Wood 2007).

Dietary changes are recommended as the first line treatment for mild to moderate hyperlipidemia (American Heart Association Nutrition Committee 2006). These include changes to reduce saturated fat, and increase intakes of soy foods and soluble fibres such as ß-glucans (Buckley et al. 2007). It is difficult to be precise about the magnitude of impact of each of the different recommended dietary changes, but at least one recent study found the impact of oats was greater than that of soy when both were compared in a clinical trial with hypercholesterolemic women (Van Horn et al. 2001).

What is known is that when all these changes are combined in a "portfolio diet" for hyperlipidemic subjects, along with the inclusion of plant sterols and nuts, the magnitude of LDL-cholesterol reduction (29%) can equal that achieved using statin therapy (Jenkins et al. 2003).

Because oat beta-glucans and plant sterols work by different mechanisms, they have an additive effect so that a diet including both is likely to be more effective than either alone.

Dietary sources beta-glucan

Beta-glucans are found in a range of other cereal foods besides oats- including barley (Delaney et al. 2003; Keenan et al. 2007) and to a small extent in rye, and wheat (Henry 1987)–and are also found in some mushrooms (Pancheco-Sanchez et al. 2006), yeasts (Lehne et al. 2006) and seaweeds (Teas 1983).

However, the fungal sources of beta-glucan are structurally very different from cereal-sources of beta-glucan and, as such, have very different properties. Wheat and rye sources have also been shown to have a low molecular weight and low solubility compared to other, more effective sources of beta-glucan (Tosh 2010; Ragaee 2008).

Only oats and barley contain significant levels of ß-glucans and they are the only foods that have been approved for a health claim about heart health. The levels in the other foods are likely to be too low to be useful sources in the normal Australian diet, and the chemical forms of some of the other ß-glucans are also different to those in oats.

Since oats have a long history of consumption in Australia, they are the dietary source of ß-glucans most easily recommended for people wanting to increase their intake. Table 5 lists the ß-glucan content of some common oat-based foods available in the Australian market.

TABLE 5: BETA-GLUCAN CONTENT OF TYPICAL OAT BASED FOODS

TYPICAL SERVE SIZE	BETA-GLUCAN CONTENT (g)
30g Oat Bran	3.0
40g Rolled Oats	1.4
45g Natural Style Muesli	1.0
45g Uncle Tobys® Healthwise for Heart Wellbeing	1.0
30g Uncle Tobys® Oat Crisp	0.9
Uncle Tobys® Oat Brits (2 biscuits)	0.8
2 slices Burgen™ Whole grain and Oats bread	0.75
Uncle Tobys® Muesli bar	0.35*

*product average

THE UNCLE TOBYS OAT RANGE

ESTIMATED BETA GLUCAN CONTENT OF SELECTED UNCLE TOBYS PRODUCTS

UNCLE TOBYS OAT RANGE	ESTIMATED BETA GLUCAN CONTENT		
	serve size (g)	per serve (g)	per 100g
UNCLE TOBYS OATBRITS (2 Biscuits)	41.7	0.93	2.24
UNCLE TOBYS OAT FLAKES	30	0.48	1.58
UNCLE TOBYS OAT CRISP HONEY	30	0.75	2.50
UNCLE TOBYS OAT CRISP ALMOND	30	0.70	2.34
UNCLE TOBYS OATS TRADITIONAL	40	1.60	4.00
UNCLE TOBYS QUICK OATS	40	1.44	3.60
UNCLE TOBYS QUICK SACHETS ORIGINAL	34	1.22	3.60
UNCLE TOBYS QUICK SACHETS CREAMY HONEY	35	0.81	2.30
UNCLE TOBYS QUICK SACHETS GOLDEN SYRUP	35	0.89	2.56
UNCLE TOBYS QUICK CUPS BROWN SUGAR & CINNAMON	35	0.98	2.81
UNCLE TOBYS GOURMET SELECTIONS SULTANAS, APPLE & HONEY	35	0.76	2.16
UNCLE TOBYS GOURMET SELECTIONS REALLY NUTTY	35	0.92	2.63
UNCLE TOBYS SO TASTY HONEY	30	0.79	2.63
UNCLE TOBYS SO TASTY VARIETY	30	0.80	2.67
UNCLE TOBYS WEIGHT WISE ORIGINAL	40	1.15	2.88
UNCLE TOBYS BODY WISE OMEGA 3 BOOST BAR	30	0.48	1.60
UNCLE TOBYS MUESLI BAR CHEWY CHOC CHIP	31.5	0.35	1.11
UNCLE TOBYS CRUNCHY NUT CRUMBLE BAR	20	0.3	1.50

MOTIVATE YOUR PATIENTS TOWARDS A HEALTHIER HEART

RECIPES

Homemade oat slice

serves 8 preparation time: 15 minutes plus cooling time
cooking time: 25 minutes EASY

Ingredients

2 cups (160g) UNCLE TOBYS Traditional Oats
¼ cup natural almonds (40g), chopped coarsely
⅓ cup (65g) pumpkin seeds
1 cup (140g) dried fruit medley
50g sterol margarine, melted
⅓ cup (80mL) NESTLÉ Skim Sweetened Condensed Milk

Method

1. Preheat oven to 180°C/160°C fan-forced. Grease and line 8cm x 25cm bar pan.
2. Cook UNCLE TOBYS Traditional Oats, almonds and pumpkin seeds in a frying pan over medium heat, stirring, for 8 to 10 minutes or until golden. Transfer to a bowl. Set aside to cool. Stir in fruit medley.
3. Cook margarine, NESTLÉ Skim Sweetened Condensed Milk, in a small saucepan over medium heat, stirring, for 3 to 4 minutes or until smooth. Remove from heat. Add to dry ingredients; stir until combined.
4. Spoon mixture into prepared pan; using wet hands smooth top. Bake for about 20 minutes, or until just firm to touch. Cool on wire rack. Cut into pieces.

Banana & malt oat shake

serves 1 preparation time: 5 minutes EASY

Ingredients

¼ cup (30g) NESTLÉ Malted Milk Drink
1 cup (250mL) skim plant sterol milk
½ medium banana (100g), chopped coarsely
½ cup (40g) UNCLE TOBYS Quick Oats

Method

1. Using a blender or food processor, blend or process NESTLÉ Malted Milk Drink, milk, banana and UNCLE TOBYS Quick Oats. Serve immediately over ice cubes in a chilled glass if desired.

tip

NESTLÉ Malted Milk Drink is available in the beverage isle of your local supermarket, or you can substitute with NESTLÉ MILO.

Crunchy oat crumble with poached pears

serves 4 preparation time: 10 minutes cooking time: 15 minutes

Ingredients

2 pears, halved
2 cups (160g) UNCLE TOBYS Traditional Oats
⅓ cup (80mL) apple juice
2 tbsp honey, plus extra to drizzle over top, if desired
2 tbsp shelled pistachios, chopped finely
½ tsp cinnamon
800g Low fat dairy frozen yoghurt

Method

1. Preheat oven to 180°C/160°C fan forced.
2. Using a metal spoon, scoop out the core, and some surrounding flesh of pear halves, being careful to keep the pear intact.
3. Place pear halves in large saucepan, cover with water. Bring to the boil; reduce heat, simmer for 8 minutes or until just tender.
4. Meanwhile, combine UNCLE TOBYS Traditional Oats, apple juice, honey, pistachios and cinnamon in a bowl; spread mixture in a thin layer onto an oven tray. Bake, stirring once, for 5 to 8 minutes or until golden and toasted.
5. Drain pears and place on serving plates. Top pears evenly with crumble, serve with Low fat frozen dairy yoghurt.

tip

Beurre bosc variety pears work best.

Lemon & dill oat crusted fish

serves 4 preparation time: 10 minutes plus cooling time
cooking time: 20 minutes EASY

Ingredients

2 cups (160g) UNCLE TOBYS Traditional Oats
⅓ cup (100g) low fat mayonnaise
1 tbsp finely grated lemon zest
1 tbsp finely chopped fresh dill
4 x 180g firm white fish fillets
2 cups steamed green beans, to serve

Method

1. Preheat oven to 180°C/160°C fan-forced. Grease and line a baking tray.
2. Cook UNCLE TOBYS Traditional Oats in a frying pan over medium heat, stirring, for 8 to 10 minutes or until golden. Transfer to a bowl. Set aside to cool.
3. Combine UNCLE TOBYS Traditional Oats, mayonnaise, zest and dill in a medium bowl.
4. Divide oat mixture into four equal portions, using wet hands press oat mixture to coat the top of fish fillets. Transfer fillets to prepared tray.
5. Bake 11 minutes or until fish is just cooked through, serve with steamed green beans.

Spiced pumpkin & carrot soup with crunchy oat croutons

serves 4 preparation time: 10 minutes cooking time: 30 minutes EASY

Ingredients

2 tsp olive oil
2 onions (300g), chopped finely
2 cloves garlic, crushed
500g piece pumpkin, peeled, trimmed, chopped coarsely
2 carrots (240g), peeled, chopped coarsely
4 cups (1 L) reduced salt chicken stock or vegetable stock
2 cups (160g) UNCLE TOBYS Quick Oats
1 tbsp Moroccan seasoning, plus 1 tsp extra
2 tbsp water

Method

1. Preheat oven to 180°C/160°C fan forced.
2. Heat oil in large saucepan over medium heat; cook onion and garlic, stirring for 5 minutes or until softened. Add pumpkin, carrot and stock; bring to boil; simmer 20 minutes or until the vegetables are soft.
3. Stir in 1 cup (90g) UNCLE TOBYS Quick Oats and Moroccan seasoning, bring to boil, simmer an extra 2 minutes or until oats are tender. Set aside to cool slightly. Blend or process until smooth.
4. Meanwhile, combine remaining UNCLE TOBYS Quick Oats, extra Moroccan seasoning and water; spread mixture in a thin layer onto an oven tray. Bake, stirring occasionally, for 10 to 15 minutes or until golden and toasted. Serve spiced pumpkin soup topped with croutons.

Lamb, oat & roast capsicum koftas

serves 4 preparation time: 10 minutes (plus 15 minutes refrigeration)
cooking time: 15 minutes EASY

Ingredients

500g lean lamb mince
1 egg, lightly beaten
2 cups (160g) UNCLE TOBYS Traditional Oats
⅓ cup roast capsicum dip
2 tbsp MAGGI Sweet Chilli Sauce
8 bamboo skewers, pre-soaked or metal skewers
Spray oil for cooking

Method

1. Combine mince, egg, UNCLE TOBYS Traditional Oats, dip, and MAGGI Sweet Chilli Sauce, mix well until combined. Divide mixture into eight oval shapes. Thread onto pre-soaked skewers. Cover with plastic wrap and refrigerate for 15 minutes.
2. Heat large pan, spray skewers with oil. Cook for 5 to 6 minutes, turning, or until cooked through. Drain on absorbent paper. Serve with low fat yoghurt with cucumber and mint

CONCLUSION

There is consistent scientific evidence for the protective role of whole grain cereals against cardiovascular disease, and the risk reduction from just three serves per day is at least 20%. Oats are one of the richest sources of ß-glucan and over 60 scientific studies show viscous soluble fibres such as ß-glucan can reduce cholesterol re-absorption and lead to reductions in serum total and LDL cholesterol by around 4-8% and up to 19% in some studies.

Intakes of at least 3g ß-glucan per day significantly lower the risk of heart disease and health claims about this are now approved in the US, Canada, UK and Europe.

Consumption of oats is also recommended by the Heart Foundations of Australia and New Zealand to help reduce serum LDL cholesterol levels.

Unfortunately Australians consume less than one and a half serves of whole grains per day (Go Grains 2010) and the mean daily apparent consumption of oatmeal and rolled oats is only 3g per day (Australian Bureau of Statistics 2000).

Nowadays there is a wide variety of foods that allow people to incorporate oats into their daily diets. Health professionals should be aware that not all oat products provide the high molecular weight ß-glucan that is most effective at reducing cholesterol levels.

Patients should be encouraged to try a range of oat based products to meet the recommended target of 3g ß-glucan per day, including rolled oats or oat bran in porridge, muesli, or incorporated into other dishes; oat-based ready-to-eat breakfast cereals; muesli bar snacks; and oat biscuits and breads.

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