

Supporting document 1

Technical and nutrition assessment – Application A1104

Voluntary Addition of Vitamins & Minerals to Nut- and Seed-based Beverages

Executive summary

Nut- and seed-based beverages are relatively new to the Australian and New Zealand markets and there has been steady growth in the nut- and seed-based beverage market over the past few years. Recent national nutrition survey information indicates that nut- and cereal-based beverages are consumed by less than 1% of the population. Nut- and seed-based beverages were consumed in similar quantities and ways to milk, with around 83% of eating occasions involving consumption with breakfast cereal or use in a beverage such as in tea or coffee and, to a lesser extent, as a beverage in its own right. Little research is available on how consumers perceive nut- and seed-based beverages. However, it is reasonable to assume that consumers perceive nut- and seed-based beverages as a milk substitute, similar to soy-based beverages, which is another milk substitute. Consumer research from two 2002 studies on the perceptions of unfortified soy-based beverage indicates that this beverage may be viewed as healthier than milk, which may also be the case for unfortified nut- and seed-based beverages.

In all the available national nutrition surveys, milk is reported to be an important contributor ($\geq 20\%$) to the intakes of many vitamins and minerals, particularly calcium, phosphorus, retinol equivalents, riboflavin, vitamins B₆ and B₁₂ and iodine; particularly for young children. Milk is also an important source of energy (13–14%) and protein (18–19%) for young children aged 2-3 years.

The concentrations of vitamins, minerals and protein currently in nut- and seed-based beverages are generally lower than those present naturally in full cream cow's milk. With the exception of coconut-based milk substitutes, nut- and seed-based beverages have a lower fat and energy content than full cream cow's milk. The protein content of nut- and seed-based beverages is comparable to cereal-based beverages, but is lower than that in full cream cow's milk and legume-based beverages.

Nut- and seed-based beverages are manufactured in a similar way to beverages derived from cereals or legumes including the process of vitamin and mineral addition. Up to 95% of anti-nutritional factors (for example phytates, oxalate) present in nuts and seeds are likely to be removed during manufacture of nut- and seed-based beverages. Therefore, it is unlikely that any residual constituents would impact appreciably on the absorption of added vitamins and minerals from nut- and seed-based beverages.

In relation to population nutrient intakes, the estimated mean intakes of calcium, magnesium, phosphorus, zinc, vitamin A, riboflavin, thiamin, vitamins B₆, B₁₂ and D were in the same range in recent surveys as those reported in the 1995 AusNNS and 1997 NZNNS.

In the A500 assessment, estimated nutrient intakes from the 1995 and 1997 surveys were lower for non-dairy consumers than for the general population; the greatest difference being for calcium intakes (59–66% lower). Estimated mean protein and fat intakes were 17–22% lower and 21–25% lower, respectively. Based on the A500 Assessment and the fact that overall nutrient intakes from more recent surveys are similar to those in 1995 and 1997, it is assumed that those non-dairy consumers using unfortified nut- and seed-based beverages as a complete milk replacement may be at a similar level of risk of reduced nutrient intakes as the non-dairy consumers previously assessed (i.e. cereal-based beverage non-dairy consumers). The A500 Assessment indicated that children were likely to be at greater risk of impaired normal growth and development from inadequate nutrient intakes.

Fortification of nut- and seed-based beverages will raise the micronutrient profile of nut- and seed-based beverages closer to that of full cream cow's milk. Consumption of these fortified beverages is expected to increase vitamin and mineral intake by those who do not consume dairy foods or other fortified plant-based milk substitutes. Such fortification may also accord more closely with consumer assumptions around their nutritional value. Consumption of nut- and seed-based beverages as a milk substitute, with fortification at similar levels of vitamins and minerals to those found in full cream milk, is not considered to pose any additional risk with respect to excess intake of vitamins and minerals compared to consumption of milk itself.

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Glossary of terms

This report contains a number of terms that describe milk or plant-based milk substitute beverages. The table below provides some definitions of these terms to assist the reader in interpreting the content of the report as a mixture of text from the 'Term' or the 'Includes' columns may be used in the report. Based on the table, where the term 'milk' is used in this report, it refers to any source of milk as outlined in the 'Includes' column'. Likewise where the specific 'Include' of 'soy-based beverages' is used in this report, this is one of the group of 'Analogues derived from legumes' group of beverages as noted in the 'Term' column.

Table 1: Glossary of terms

Term	Definition/Sub-category	Includes
Analogues derived from legumes	Beverages containing no less than 3% m/m protein derived from legumes ¹	Legume-based beverages
		Soy-based beverages
Analogues derived from cereals	Beverages containing no less than 0.3% m/m protein derived from cereals ¹	Cereal-based beverages
		Rice-based beverages
		Oat-based beverages
Analogues derived from nuts and seeds		Almond-based beverages
		Coconut-based milk substitutes
		Hazelnut-based beverages
		Macadamia-based beverages
		Nut- and seed-based beverages
		Nut-based beverages
		Sesame-based beverages
Sunflower-based beverages		
Milk	Fluid milk, evaporated milk, condensed milk and milk powder (including undiluted and dry forms) from cows, sheep and goats, irrespective of fat content.	
Full cream cow's milk	Fluid milk of approximately 3.5% fat content from cattle only.	
Milk consumer	Respondent who reported consuming milk in a national nutrition survey. For example, in the comparative analysis across surveys this included consumption of plain milk only or plain milk / flavoured milk / milkshakes / hot chocolate. It did not include milk used in recipes.	

¹ As per categories in Section S17-4 of the revised Code

Term	Definition/Sub-category	Includes
Soy-based beverage consumer	<p>Respondent who reported consuming soy-based beverages in a national nutrition survey.</p> <p>For example, in the comparative analysis across surveys this included plain soy-based beverages or plain soy-based beverage / flavoured soy-based beverage / soy 'milkshakes' / soy hot chocolate. It did not include soy-based beverage used in recipes.</p>	
Nut-based beverage consumer	<p>Respondent who reported consuming a nut-based beverage in a national nutrition survey.</p> <p>For example, in the comparative analysis across surveys this included all almond-based beverages and coconut-based milk substitutes.</p>	
Cereal-based beverage consumer	<p>Respondent who reported consuming a cereal-based beverage in a national nutrition survey.</p> <p>For example, in the comparative analysis across surveys this included consumption of all rice-, oat- and other cereal-based beverages</p>	
Coconut-based milk substitute	<p>Milk substitute derived from coconut. It specifically excludes coconut milk and coconut cream (i.e. those products used to make dishes such as curries), coconut water and coconut water-based beverages.</p>	
Non-dairy consumer	<p>Respondent who did not report consuming products containing dairy ingredients in a national nutrition survey.</p> <p>For example, in the FSANZ assessment of A500 – Fortification of Cereal-Based Beverages, the 1995 Australian National Nutrition Survey or 1997 New Zealand National Nutrition Survey non-dairy consumers did not report consuming milk, milk yoghurt, cream, milk cheese, frozen and unfrozen milk desserts, dairy spreads, butter, oil/cream base sauces or pizza. Additionally, for Australian survey respondents, a 'non-dairy consumer' did not eat milk-based meal replacements, infant custards or yoghurts or relevant dairy-based sauces.</p> <p>Non-dairy consumers may or may not have consumed a plant-based milk substitute. Where a plant-based milk substitute was consumed, it was assumed to be unfortified unless otherwise stated.</p>	
General population	<p>The general population includes all survey respondents, irrespective of whether they consumed dairy products or plant-based milk alternatives or not.</p>	

1 Objectives of the assessment

The objective of this technical and nutrition assessment was to evaluate the potential public health and safety risks that may arise from the voluntary fortification of nut- and seed-based beverages with specific vitamins and minerals, as requested by Application A1104.

1.1 Introduction

Nut- and seed-based beverages are intended to be consumed as milk substitutes. The Applicant has requested that nut- and seed-based beverages be fortified on a voluntary basis on the principle of nutritional equivalence of a counterpart food. In this respect, the findings of A500 – Fortification of Cereal-Based Beverages (FSANZ 2005b) are relevant to this assessment, where milk was considered as the regular counterpart food in the context of nutritional equivalence for milk substitutes.

FSANZ assessed food consumption patterns of milk and milk substitutes (Section 0) and the intakes of the nutrients requested by the Applicant across all available surveys (see Section 0); for Australian populations, the 1995 National Nutrition Survey (AusNNS), the 2007 Children's Nutrition and Physical Activity Survey (ANCNAPS) and the Australian 2011-12 National Nutrition and Physical Activity Survey (NNPAS); for New Zealand, the 1997 New Zealand National Nutrition Survey (NZNNS), the 2002 New Zealand Children's Nutrition Survey (NZCNS) and the 2008 New Zealand Adult Nutrition Survey (NZANS).

FSANZ also referred to the previous evaluation of the safety of fortification of cereal-based beverages with vitamins and minerals on the basis of nutritional equivalence in the A500 assessment. An extensive nutritional, safety and dietary intake assessment was undertaken for A500, including assessment of nutrient intakes for non-dairy consumers². The A500 assessment used food consumption data from the 1995 AusNNS and 1997 adults NZNNS, as the best available data at that time. The comparative analysis across all the surveys was used to determine the validity of using the A500 assessment of nutrient intakes for non-dairy consumers versus the general population for this application. The more recent Australian 2011-12 National Nutrition and Physical Activity Survey (NNPAS) data are not currently available to FSANZ in a format that would allow a similar detailed analysis of nutrient intakes.

1.2 Scope of this assessment

The assessment of nutrient intakes is limited to those vitamins and minerals requested for voluntary fortification in this Application and to the macronutrients discussed in A500 (i.e. energy, protein and fat). Reviewing the existing vitamin and mineral fortification profile of milk substitutes is outside the scope of this assessment.

FSANZ completed a review of the Code in 2015 and the revised Code will commence on 1 March 2016. Since the draft variations arising from this Application are likely to take effect around that date, draft amendments are proposed for the revised Code only. All references to Standards or Schedules in this assessment refer to the revised Code requirements only.

² For A500, a 'non-dairy' consumer was defined as a 1995 AusNNS or 1997 NZNNS survey respondent who did not eat milk, milk yoghurt, cream, milk cheese, frozen and unfrozen milk desserts, dairy spreads, butter, oil/cream base sauces or pizza. Additionally, for Australian respondents, a 'non-dairy consumer' did not eat milk-based meal replacements, infant custards or yoghurts or relevant dairy-based sauces.

1.3 Risk assessment questions

To assist in the evaluation of this Application, the following risk assessment questions were posed:

1.3.1 Consumption patterns and market share

- How do the usage patterns of nut- and seed-based beverages compare to usage patterns of milk by discrete consumers of these two foods in all population groups? For example, what proportions of total milk or nut- and seed-based beverages are consumed as a beverage, used on breakfast cereal, and for other uses?
- What proportion of individuals who report consuming nut- and seed-based beverages also consume milk?
- What impact on market share of the different types of milk analogues has the emergence and growth of nut- and seed-based beverages had over the past 5 years?

1.3.2 Consumer perceptions

- What are consumer perceptions around nut- and seed-based beverages?
- Why are people purchasing and consuming the products? How are consumer perceptions linked to these two outcomes?

1.3.3 Effects of processing and storage on the added vitamins and minerals

- What is the likely effect of processing and storage on the lability of the requested vitamin and minerals in nut- and seed-based beverages?

1.3.4 Bioavailability of the added vitamins and minerals

- Are there any constituents in nut- and seed-based beverages that could bind the added vitamins and minerals and prevent or reduce their absorption?

1.3.5 Dietary intakes of the requested vitamins and minerals

- What are the differences in the dietary intakes of the requested vitamins and minerals between milk consumers and unfortified nut- and seed-based beverage consumers for all population groups?
- What is the difference in the dietary intake of macronutrients of young children (aged 2-5 years) consuming nut- and seed-based beverages without milk or legume-based beverages, compared to those consuming milk?
- What is the risk of excess dietary intake of the requested vitamins and minerals for all population groups if added to nut- and seed-based beverages?

Each of these questions is addressed in the assessment below.

2 Market share of nut-, seed- and other plant-based milk substitutes

Nut- and seed-based beverages are relatively new to the Australian and New Zealand markets giving additional options to consumers who are unable to, or choose not to, consume milk on all or some occasions.

Australian supermarket market share data indicate that, within the UHT/long life non-dairy segment of the 'non-dairy milk'³ market, brands such as Almond Breeze™ was first reported as having a market share in 2012 (Retail World Pty Ltd 2012). There has been steady growth in the nut- and seed-based beverage market over the past few years with sales volumes of the Almond Breeze™ brand increasing from 1.3 million litres (Retail World Pty Ltd 2012) to 7.8 million litres (Retail World Pty Ltd 2014) between 2012 and 2014. Over this same period, the total market volume of plant-based milk substitutes has increased from 65 million litres to approximately 69 million litres, with UHT/long life plant-based milk substitutes making up about 80% of the volume sold. The increase in market share of nut- and seed-based beverages appears to have contributed to the steady decline of soy-based beverages and resulted in leading brands such as So Good™ and Vitasoy™ introducing nut- and seed-based beverages such as almond-based beverage and coconut-based milk substitutes to their ranges.

3 Consumption of nut- and seed-based beverages and other plant-based milk substitutes

3.1 Nutrition survey data used for the risk assessment

FSANZ uses detailed food consumption data from national nutrition surveys to derive data on food consumption and estimated dietary intakes of nutrients for Australians and New Zealanders. The most recent detailed survey data available to FSANZ for these purposes are outlined below.

- 1995 Australian National Nutrition Survey (AusNNS) is a one day 24-hour recall survey of 13,858 respondents aged 2 years and above (with 10% of respondents undertaking a second 24-hour recall on a non-consecutive day). Results in this assessment are for Day 1 only. A respondent was counted as a consumer of a food if the food was consumed on Day 1 only.
- 2007 Australian National Children's Nutrition and Physical Activity Survey (ANCNPAS) is a 24-hour recall survey of 4,487 respondents aged 2-16 years, with all respondents undertaking a second 24 hour recall on a non-consecutive day. A respondent is counted as a consumer of a food in this assessment if the food was consumed on either Day 1 or Day 2, or both days.
- 2002 New Zealand Children's Nutrition Survey (2002 NZCNS) is a one day 24-hour recall survey of 3,275 respondents aged 5-14 years (with 15% of respondents undertaking a second 24-hour recall on a non-consecutive day). The results in this assessment are for Day 1 only. A respondent is counted as a consumer of a food if the food was consumed on Day 1 only.
- 2008-09 New Zealand Adult Nutrition Survey (2008 NZANS) is a one day 24-hour recall survey of 4,721 respondents aged 15 years and above (with 25% of respondents undertaking a second 24-hour recall on a non-consecutive day). The results in this assessment are for Day 1 only. A respondent is counted as a consumer of a food if the food was consumed on Day 1 only.

³ Terminology as per Retail World Pty Ltd publication

The 1997 New Zealand National Nutrition Survey (NZNNS) is a one day 24-hour recall survey of 4,636 respondents aged 15 years and above (with approximately 15% of respondents undertaking a second 24-hour recall on a non-consecutive day). Generally, this survey is no longer used by FSANZ since it has been superseded by the 2008 NZANS.

Data from the Australian 2011-12 National Nutrition and Physical Activity Survey (NNPAS) has recently become available (ABS 2014a). Summary food and nutrient intake reports have been published by the Australian Bureau of Statistics (ABS) and some additional analyses of these raw data files have been undertaken by FSANZ. However, not all detailed analysis is available yet to include in this report because the data set is not yet included in our custom computer modelling system. Consequently, FSANZ compared the summary nutrient intake data from 1995 AusNNS, 2007 ANCNAPS and 2011-12 NNPAS for Australia, and from the 1997 NZNNS, 2002 NZCNS and the 2008 NZANS for New Zealand (see Sections 0, 0, 0, 0 and 0 for the detailed analyses) to determine the validity of using the A500 assessment for comparison of nutrient intake estimates for non-dairy consumers and the general populations in Australian and New Zealand.

In general, the contribution of milk to vitamin and mineral intakes and the mean vitamin and mineral intakes from the more recent Australian and New Zealand national nutrition surveys were similar to those from the older 1995 AusNNS and 1997 NZNNS, the surveys used in the assessment of A500. Therefore the results shown in A500 (and the 1995 AusNNS and 1997 NZ NNS) were still considered relevant for assessing the current Application, except for iodine, total folates, dietary folate equivalents and folic acid owing to fortification initiatives in the intervening period.

From the recent surveys, the proportion of the population consuming milk and plant-based milk substitutes can be estimated. These estimations include where milk and plant-based milk substitutes were reported as consumed as a beverage or on breakfast cereal. The consumption figures do not include where milk or plant-based milk substitutes have been used in a recipe, such as flat white coffee, cakes or cheese sauce.

The types of plant-based milk substitutes, excluding soy-based beverages, that were reported as consumed in the more recent Australian and New Zealand nutrition surveys are provided in Table 2. No nut, seed or cereal-based beverages were reported as being consumed in the 1995 AusNNS. No seed-based beverages were reported as consumed in any of the surveys.

A range of soy-based beverages were consumed across all nutrition surveys. Soy-based beverages were also reported as consumed as coffee with soy-based beverage (e.g. flat white, cappuccino, latte etc.). In the 2011-12 NNPAS, smoothies and milkshakes/iced coffees were also prepared with soy-based beverages.

3.2 Proportion of the Australian and New Zealand populations consuming plant-based milk substitutes

Generally, the proportion of the Australian and New Zealand populations consuming plant-based milk substitutes was small, with soy-based beverages being consumed by approximately 2% and other plant-based beverages being consumed by <1% of survey respondents in the most recent Australian (2007 ANCNPAS and 2011-12 NNPAS) and New Zealand (2002 CNS and 2008-09 ANS) nutrition surveys (Table A1.2 in Appendix 1). No survey respondents reported consuming cereal-, nut- or seed-based beverages in the 1995 AusNNS, with <0.1% of 1997 NZNNS respondents consuming a cereal-based beverage.

In the 2011-12 NNPAS, the proportion of the population aged 2 years and above consuming cereal- or nut-based beverages was 0.7% (noting that no seed-based beverages were reported as consumed in this survey). Of the consumers of cereal- or nut-based beverages, 27% also consumed fluid milk (plain/ flavoured/ milkshake/ hot chocolate). Similarly, there were consumers of soy-based beverages (plain or flavoured), who also consumed fluid milk (29%). The age range of consumers of nut- or cereal-based beverages was from very young (2 years) up to 85 years and over. However, across all products in this group, 68% of consumers were aged 30 years and over, with only 8% of consumers aged 10 years or under. In terms of gender, 59% of consumers of any nut- or cereal-based beverages were females and 41% were males. In the 2011-12 NNPAS, respondents were also asked if they avoided any foods for any reason. Of the nut- and cereal-based beverages consumers, 36% reported avoiding cow's milk/dairy due to allergy or intolerance (despite this, 25% of these avoiders actually reported consuming some form of plain fluid milk). None of the consumers of nut- or cereal-based beverages said they avoided dairy due to religious or cultural reasons.

In the 2011-12 NNPAS, most cereal- or nut-based beverage consumers (78%) consumed the beverage once per day. Twenty-two (22%) percent of consumers had more than one eating occasion in the day, with the highest number of eating occasions of any one of the identified products being 4 times over the day. Of the cereal- or nut-based beverage consumers, approximately 5% also consumed soy-beverages. No respondents consumed more than one of the cereal- or nut-based product types listed in Table 2 on Day 1.

For consumers only, mean consumption of plain fluid milks, plain soy-based beverages and other plain plant-based milk substitutes (only cereal- and nut-based products were consumed) appeared to be in the same range, at around 130–400 grams/day (see Figure 1, Figure 2 and Table A1.3 in Appendix 1), with children generally consuming more than adults or the general population.

Table 2: Types of plant-based milk substitutes (excluding soy beverages) reported as consumed in the more recent Australian and New Zealand nutrition surveys

Milk Substitute Type	Sub-type	Australia		New Zealand	
		2007 ANCNPAS	2011-12 NNPAS	2002 NZCNS	2008-09 NZANS
Almond-based	Almond-based beverage	✓	✓		
Oat-based	Oat-based beverage	✓	✓		
	Oat-based beverage, fortified		✓		
Rice-based	Rice-based beverage	✓			✓
	Rice-based beverage, fortified	✓	✓		✓
	Rice-based beverage, flavoured			✓	
	Rice-based beverage, flavoured, fortified				✓
	Rice-based beverage, protein enriched, fortified	✓	✓		✓

Milk Substitute Type	Sub-type	Australia		New Zealand	
		2007 ANCNPAS	2011-12 NNPAS	2002 NZCNS	2008-09 NZANS
Other-base	Milk, other kind (not coconut)			✓	

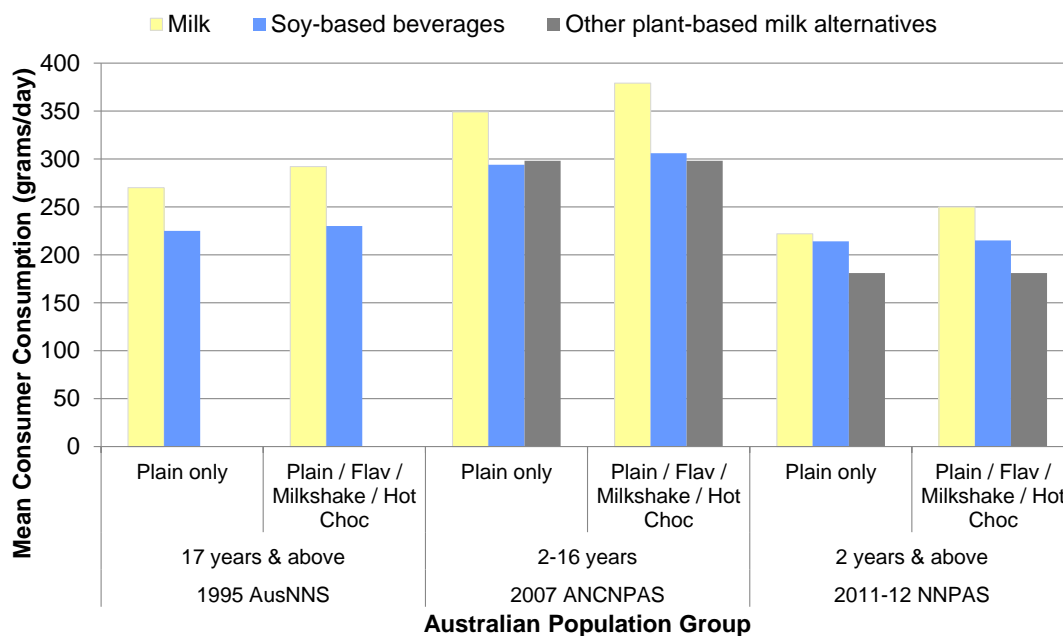


Figure 1: Mean consumption of plain fluid milk and plant-based milk substitutes for Australian consumers (Day 1 only)

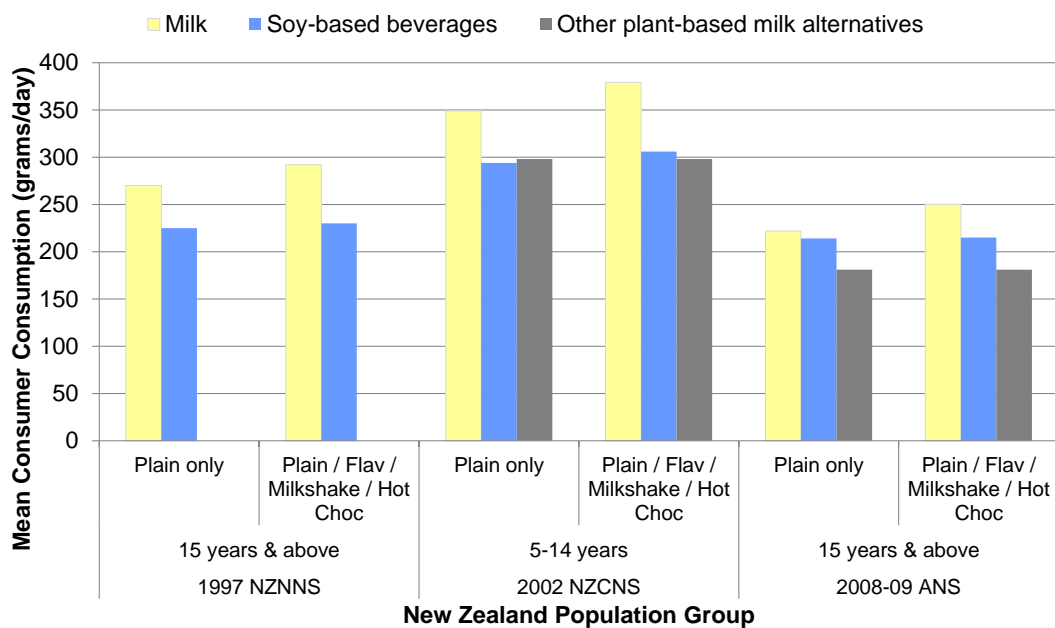


Figure 2: Mean consumption of plain fluid milk and plant-based milk substitutes for New Zealand consumers (Day 1 only)

3.3 How nut-based beverages and other plant-based milk substitutes are consumed

In the 2011-12 NNPAS raw data files (ABS 2014a), a 'combination code' is used to identify mixed foods whose ingredients were collected and coded separately, but were consumed together. This includes such foods as milk and coffee, where the same combination code would be given to indicate they were consumed as one. These data were evaluated to determine whether cereal- and nut-based beverages were consumed in the same way as milk, and therefore can be considered as a plant-based milk substitute.

The highest number of reported eating occasions of plain cereal- and nut-based beverages in the 2011-12 NNPAS was for use with breakfast cereal (48%), followed by in a beverage such as coffee or tea etc. (35%), and consumed on its own (16%) (Table 3). There was very little use of cereal- and nut-based beverages in other types of mixed dishes. In the 2011-12 NNPAS, 13% of the eating occasions for plain fluid milk was for milk consumed on its own, similar to the proportion for plain cereal- and nut-based beverages (16%). However, for milk, there was a greater proportion consumed in beverages with additions (60%) compared to cereal- and nut-based beverages (35%) and a lower proportion in cereals with additions (24%) than for cereal- and nut-based beverages (48%).

Table 3: How plain cereal- and nut-based beverages were consumed by eating occasion in the 2011-12 NNPAS compared to plain fluid milk

Combination code	Combination code descriptor	Cereal and nut-based beverages		Plain fluid milk
		Number of occurrences in the data ⁺	Proportion (%) ⁺	Proportion (%) ⁺
0	Food consumed on its own, no combination	23	16	13
1	Beverage with additions (e.g. coffee, tea)	52	35	60
2	Cereal with additions	71	48	24
Various	Other	2 ⁺⁺	1	3
Total		148	100	100

⁺ Day 1 and day 2

⁺⁺ Other mixtures - one for mixed dish (scrambled egg); one for millet porridge

4 Consumer perceptions of nut-and seed-based beverages

4.1 Literature search overview

Using FSANZ subscriptions to EBSCO databases, five searches were conducted to locate research into consumer understanding of nut- and seed-based beverages. No consumer-related literature was identified where the terms 'nut milk', 'seed milk', or 'almond milk' were used. The searches relating to milk analogue/substitute/alternative located research relating to soy-based beverage only (i.e. soy 'milk'). The IBISWorld Industry Report OD5256 *Soy and Almond Milk Production in Australia*, dated June 2014, was examined for content relating to consumer attitudes towards nut- and seed-based beverages. No relevant content was found.

Mintel were contacted about their report *Dairy Drinks, Milk and Cream – UK – 2014*, however this report also did not contain information suitable for assessing consumer attitudes toward nut- and seed-based beverages.

4.2 What are consumer perceptions around nut- and seed-based beverages?

The literature search did not locate research into general consumer perceptions around nut- and seed-based beverages or whether they were viewed as milk substitutes. It is assumed that consumer perceptions of nut- and seed-based beverages will be similar to consumer perceptions of soy-based beverages, which are also a plant-based milk substitute. This is supported to a certain extent by information on how nut-based beverages were consumed in the 2011-12 NNPAS (refer to Sections 0 and 0).

If this assumption is true, then familiarity with the nut- and seed-based beverages may not influence consumer understanding of the beverages as the following study suggests. A 2002 study of shoppers purposively sampled from a high socio-economic area (HSEA) and a low socio-economic area (LSEA) of Cape Town, South Africa, found that the HSEA consumers were significantly more likely to correctly answer questions testing basic knowledge of soy milk⁴ (Hinze et al. 2005). While significantly more HSEA consumers had ever tasted soy milk compared to LSEA consumers (42% and 17%, respectively), there was no significant difference in the proportions who reported current use of soy milk with relatively few of either group consuming this product.

5 Nutrient composition of nut- and seed-based beverages and other plant-based milk substitutes

The types of nut- and seed-based beverages being manufactured are increasing. Almond-based beverages are now commonly available in Australia and New Zealand. Other beverages, such as coconut-based milk substitutes and sesame-, sunflower-, macadamia- and hazelnut-based beverages, are manufactured in Australia and overseas (see Section 0 for details on market share) and are now being sold in Australia and New Zealand. Both sweetened and unsweetened varieties of nut- and seed-based beverages are available.

Generally, nut- and seed-based beverages differ greatly in composition compared to full cream cow's milk, particularly in relation to total fat, energy and protein content. Table A1.1 in Appendix 1 details examples of a range of available nut- and seed-based beverages and compares their nutrient profiles to full cream cow's milk, soy- and cereal-based beverages. The similarities and differences between full cream cow's milk and the plant-based milk substitutes are discussed in further detail below. In this report 'coconut-based milk substitutes' specifically excludes coconut milk and coconut cream (i.e. those products used in dishes such as curries), coconut water and coconut water-based drinks.

⁴ Four questions were asked, relating to: the cholesterol content of soy milk; soy milk as a reasonable alternative to cow's milk for people allergic to cow's milk; nutritional content of soy milk compared to cow's milk; health benefits of soy milk compared to cow's milk.

5.1 Comparison of vitamin, mineral and macronutrient concentrations in nut- and seed-based beverages currently on the market with full cream cow's milk

The concentrations of vitamins, minerals and protein in nut- and seed-based beverages currently on the market are generally lower than those present naturally in full cream cow's milk (see Table 4 **Error! Reference source not found.** and Table A1.1 in Appendix 1). The majority of nut- and seed-based beverages have lower energy contents than full cream cow's milk. Many nut- and seed-based beverages have a similar amount of fat to that of reduced fat cow's milk with the exception of coconut-based milk substitutes which generally contain a significant amount of saturated fat, similar to that of full cream cow's milk.

The protein content of nut- and seed-based beverages (0–1.2 grams per 200 mL) is comparable to that of cereal-based beverages (0.6–3.0 grams per 200 mL), although lower than that of full cream cow's milk (approximately 6.8 grams per 200 mL) and soy-based beverages (5.4–8.2 grams per 200 mL) (see Table A1.1 in Appendix 1 for details). Milk contains a complete protein⁵ which consists of 80% casein and 20% whey protein, and has the highest bioavailability of any protein source (Baste *et al.* 2011). Soy-based beverages are the only type of plant-based milk substitute that contains a comparable amount of protein. Soy protein is also a complete protein.

The currently available nut- and seed-based beverages contain similar concentrations of magnesium and thiamin to full cream cow's milk.

Table 4: Comparison of the nutrient content per reference quantity of nut- and seed-based beverages currently on the market with skim and full cream cow's milks and unfortified cereal-based beverages

Nutrient	Concentration per reference quantity (200 mL) ^Δ			
	Full cream cow's milk ^ψ	Skim cow's milk ^ψ	Unfortified cereal-based beverages ^ψ	Nut- and seed-based beverages currently on the market ^γ
Energy (kJ)	562	284	444	134 – 544
Protein (g)	6.8	7.2	3.0	0 – 1.2
Fat (g)	6.8	0.2	4.2	0.8 – 6.8
Calcium (mg)	208	236	10	86 – 240 [*]
Folate, naturally occurring (µg)	28	14	2	2 [*]
Iodine (µg)	44.6	28.8	1.2	0.4
Magnesium (mg)	20	24	34	26 [*]
Phosphorus (mg)	176	194	78	28 – 122
Riboflavin (mg)	0.40	0.36	0	0.052 [*]
Thiamin (mg)	0.01	0.07	0.06	0.008 [*]
Vitamin A (µg)	102	0	0	0 [*]
Vitamin B ₁₂ (µg)	1.2	1.2	0	0 [*]
Vitamin B ₆ (mg)	0.14	0.06	0	0 [*]

⁵ Milk is regarded as a complete protein as it contains all essential amino acids. Whey protein is more soluble than casein and is highly bioavailable. Whey protein has the highest biological value of all protein sources.

Nutrient	Concentration per reference quantity (200 mL) ^Δ			
	Full cream cow's milk ^Ψ	Skim cow's milk ^Ψ	Unfortified cereal-based beverages ^Ψ	Nut- and seed-based beverages currently on the market ^Υ
Vitamin D (µg)	Data not available	Data not available	Data not available	Data not available
Zinc (mg)	0.68	0.64	0.56	0.2 [☆]

- Δ Refer to Table A1.1 in Appendix 1 for further details on the nutrient composition of full cream cow's milk, unfortified cereal-based beverages and nut- and seed-based beverages (note that the nutrient profiles in Table A1.1 are presented per 100 mL whereas this table is per reference quantity of 200 mL)
- Ψ Nutrient profiles from *AUSNUT 2011-13 Australian Health Survey Food Nutrient Database* (FSANZ 2014)
- Υ Data on the nutrient content of nut- and seed-based beverages that are currently on the market is derived, in most cases, from product label data
- ☆ Nutrient profile for nut-based beverage from *AUSNUT 2011-13 Australian Health Survey Food Nutrient Database* (FSANZ 2014)
- ◆ As noted in Section 0, tricalcium phosphate and calcium carbonate can be used in nut- and seed-based beverages for technological purposes but are also calcium sources for fortification purposes.

5.2 Comparison of proposed levels of vitamin/mineral fortification of nut- and seed based beverages with full cream cow's milk

In general, the concentrations of vitamins and minerals requested to be permitted for voluntary fortification of nut- and seed-based beverages are similar to the concentrations naturally present in full cream cow's milk (see Table 5). The thiamin concentration in full cream cow's milk is 10 times lower than that already permitted to be added to cereal- and legume-based beverages, and therefore requested for nut- and seed-beverage fortification; folate (naturally occurring) is 2 times higher in full cream cow's milk; and iodine is 3 times higher in full cream cow's milk.

Table 5: Comparison of vitamin/mineral content of nut- and seed-based beverages with full cream cow's milk

Vitamin/ Mineral	Concentration per reference quantity (200 mL)			
	Full cream cow's milk ^Δ	Nut- and seed-based beverages currently on the market	Requested concentration for voluntary fortification of nut- and seed-based beverages	
			Maximum claim	Maximum permitted quantity
Vitamin A (µg)	102	0 [☆]	110	125
Thiamin (mg)	0.01	0.008 [☆]	no claim permitted	0.10
Riboflavin (mg)	0.40	0.052 [☆]	0.43	Not specified
Vitamin B ₆ (mg)	0.14	0 [☆]	no claim permitted	0.12
Vitamin B ₁₂ (µg)	1.2	0 [☆]	0.8	Not specified
Vitamin D (µg)	Data not available	Data not available	1.0	1.6
Folate, naturally occurring (µg)	28	2 [☆]		
Folate (naturally occurring plus added forms) (µg)			no claim permitted	12
Calcium (mg)	208	86 – 152 [◆]	240	Not specified
Magnesium (mg)	20	26 [☆]	no claim permitted	22
Phosphorus (mg)	176	28 – 88	200	Not specified
Zinc (mg)	0.68	0.2 [☆]	no claim permitted	0.8
Iodine (µg)	44.6	0.4	15	Not specified

Δ refer to Table A1.1 in Appendix 1 for further details on the nutrient composition of full cream cow's milk (note that the nutrient profiles in Table A1.1 are presented per 100 mL whereas this table is per reference quantity of 200 mL)

☆ nutrient profile from one product

◆ excludes fortified products

5.3 Why are people purchasing and consuming the products?

The literature search did not locate research into the reasons why consumers purchase and consume these products.

6 Food Technology Assessment

6.1 How are nut- and seed-based beverages produced?

Nut- and seed-based beverages are produced in a similar way to beverages derived from cereals (e.g. rice-based beverages) and legumes (e.g. soy-based beverages). They are all based on the same five step process (grinding, water extraction, filtration, homogenisation and microbial stabilisation (pathogen removal)).

Figure 3 is a schematic taken from a US patent (No. 2011/0064862 A1; “Non-dairy, nut-based milk and method of production”) that provides information on the production of nut-based beverages and which is assumed to be similar to those derived from seeds. Figure 4 and Figure 5 are schematics taken from Bernat et al. (2014) showing typical production processes for cereal-based and nut-based beverages respectively.

From the patent and figures, it is apparent that the nuts or seeds are ground into a fine powder, paste or butter which is then dispersed into water (dry milling). Alternatively, the initial nut or seed can be soaked and then wet milled to extract the constituents from the slurry (wet milling). Removal of coarse particles is performed by filtration, decanting or centrifugation. Various processes or additional substances may need to be added to ensure an acceptable appearance, organoleptic characteristics and shelf life for commercialisation of the products. This means that the fine particles of the ground nut or seed are blended homogeneously in the beverage and the resultant drink has an acceptable mouthfeel that is not too ‘gritty’ but also not too ‘thin’. The resulting beverages have an appearance and texture that are similar to those of milk and other plant-based milk substitutes. Various heat treatments are used to ensure all components are homogenised and maintained in suspension in the beverage and to also ensure good microbial stability and shelf life.

The US patent (number 2011/0064862 A1) (McCreedy 2011) provides some information on how nut-based beverages are produced. It involves mixing nut butter (produced by grinding the nut) with water and a dry blend of hydrocolloids and salts and various added nutrients (vitamins and minerals) to fortify the beverage. Sweeteners, flavours and emulsifiers (lecithins) may also be added as required.

The US patent (No. 2011/0064862 A1) as outlined in Figure 3 also provides some further explanation of the various steps in the production process for nut-based beverages. The step listed as ‘Likwifier’ is a high-shear blender used to dissolve or disperse solids into the liquid. Heating by direct steam injection or by indirect heat exchange plates is used to help with blending and mixing. The further homogenisation step is explained as forcing the blend under high pressure through a small orifice (Ultra High Pressure (UHP) treatment). Due to the expense, UHP treatment is not commonly used commercially so emulsifiers and hydrocolloids are frequently used to ensure homogeneity. Final products are usually pasteurised or UHT (Ultra High Temperature) treated (or undergo some other equivalent treatment) to ensure good microbial stability and so extend their shelf life by reducing or eliminating microbial load in the beverage.

Hydrocolloids (such as gellan gum) and emulsifiers are added to the product to assist in producing a homogeneous suspension of any insoluble material from the ground nut or seed, and so limit fine particles coming out of suspension and settling on the bottom of the product, as well as preventing phase separation. The suspension formed when gellan gum is used does not add substantially to the mouthfeel of the beverage. Therefore, other food additives such as thickeners or stabilisers are needed to address this issue.

Food additives, such as the salt tricalcium phosphate (INS 341 (iii)), can be used to produce a fuller mouthfeel of the beverage. The technological purpose of tricalcium phosphate includes texturizing agent and stabiliser according to the Codex Standard CAC/GL 36-1989 (Class Names and the International Numbering System for Food Additives). Calcium carbonate is another stabilising agent. Both substances can also be calcium sources for fortification purposes.

In relation to the current application, the Applicant has advised FSANZ that the various vitamin and minerals will be added at the appropriate stage during the production process to ensure they are mixed homogeneously into the beverages and that losses during subsequent processing are minimised. Appropriate equipment (dosing and metering pumps) will be required, as well as technical expertise. However, similar products have been produced for a number of years in other countries so appropriate knowledge and expertise is available to assist in setting up of the plant and processes, including quality assurance practices to ensure the appropriate amounts will be present in the final products. The technology, equipment and expertise for producing these products are similar to those used to produce cereal-based beverages, both of which are well known to, and understood by, the Applicant.

6.2 Stability of added vitamins and minerals in nut- and seed-based beverages

It is important to understand what impact processing has on the stability and bioavailability of added vitamins and minerals in the product and during its shelf life. The stability is influenced by a variety of food processing factors. Excessive heat and oxygen exposure will reduce the amounts of added nutrients. The addition of added minerals is complicated by their reactivity to other food components, including metal ions, so the use of added sequestrants (such as citric acid) may be necessary.

The Application describes the use of stabilised forms of vitamins and minerals to reduce losses due to processing and storage conditions. For example, vitamin A complexed with cyclodextrin inhibits photoisomerisation and photodegradation. As well, gum arabic also acts as a suitable vehicle for encapsulation. Commercially available permitted forms of the micronutrients may also use various permitted carriers and stabilising agents to stabilise them before they are added to the beverage. These are permitted processing aids that do not have any technological function in the final beverage.

The Application contains some stability data for levels of various added vitamins and minerals for the company's plant-based milk substitutes (including soy-based beverages). Quality assurance testing is conducted by the company to ensure products meet their Nutritional Information Panel (NIP) statements. Data supporting the company's claim that the added micronutrients (vitamin A, riboflavin, vitamin B₁₂, calcium, phosphorus, thiamin, vitamin B₆ and folate) for soy-based beverages are consistent with the NIP statements were provided as Confidential Commercial Information (CCI). Results were also provided for levels of added calcium and phosphorus for a rice-based beverage which showed average results close to the NIP statements.

These products are outside the scope of this Application but they do provide some assurance that manufacturers will be able to successfully add these vitamins and minerals to nut- and seed-based beverages and the vitamins and minerals will be stable since it is understood that the production processes are quite similar.

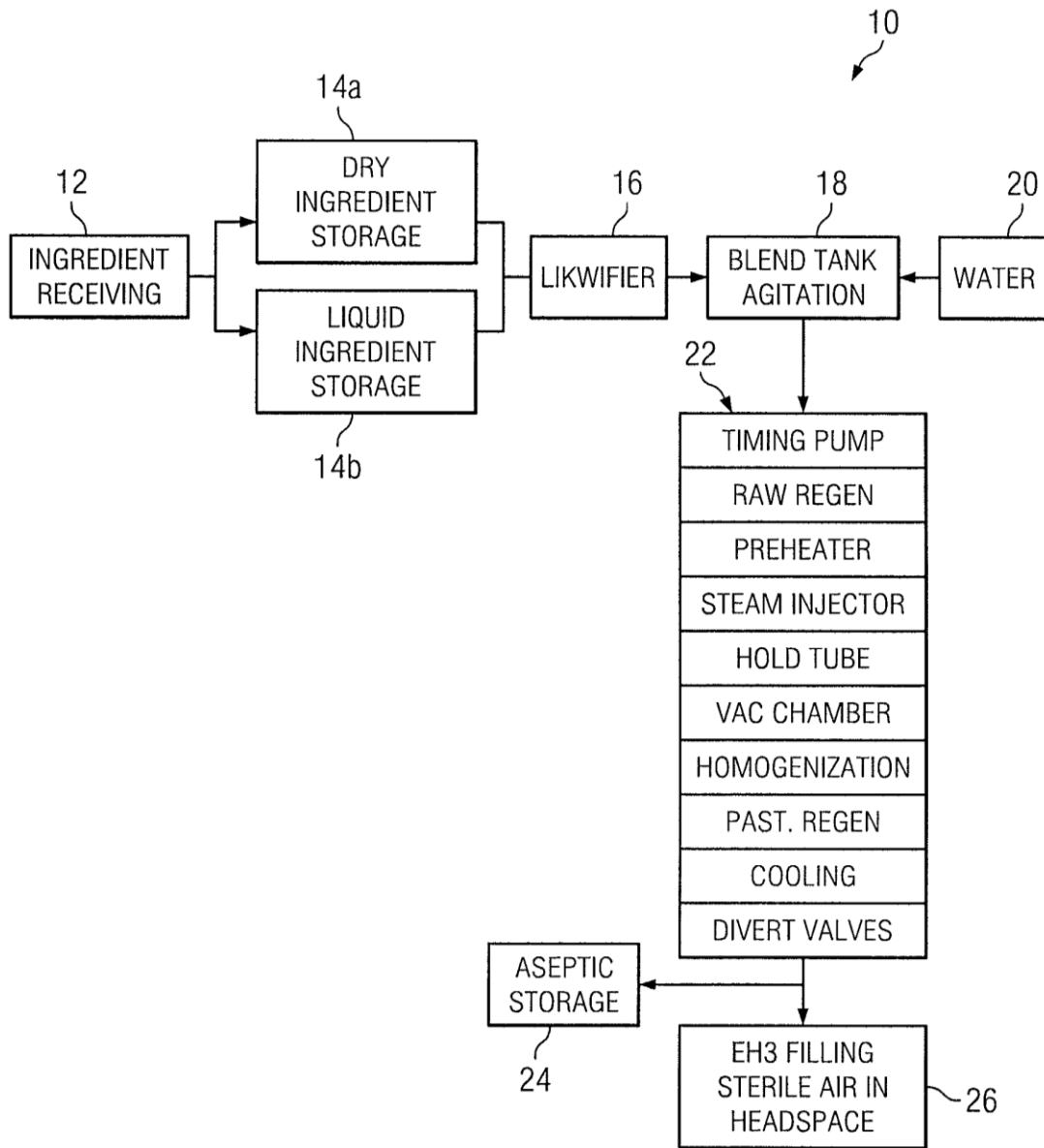


Figure 3: Schematic of nut-based beverage production, taken from US Patent No. 2011/0064862 A1 (McCready 2011)

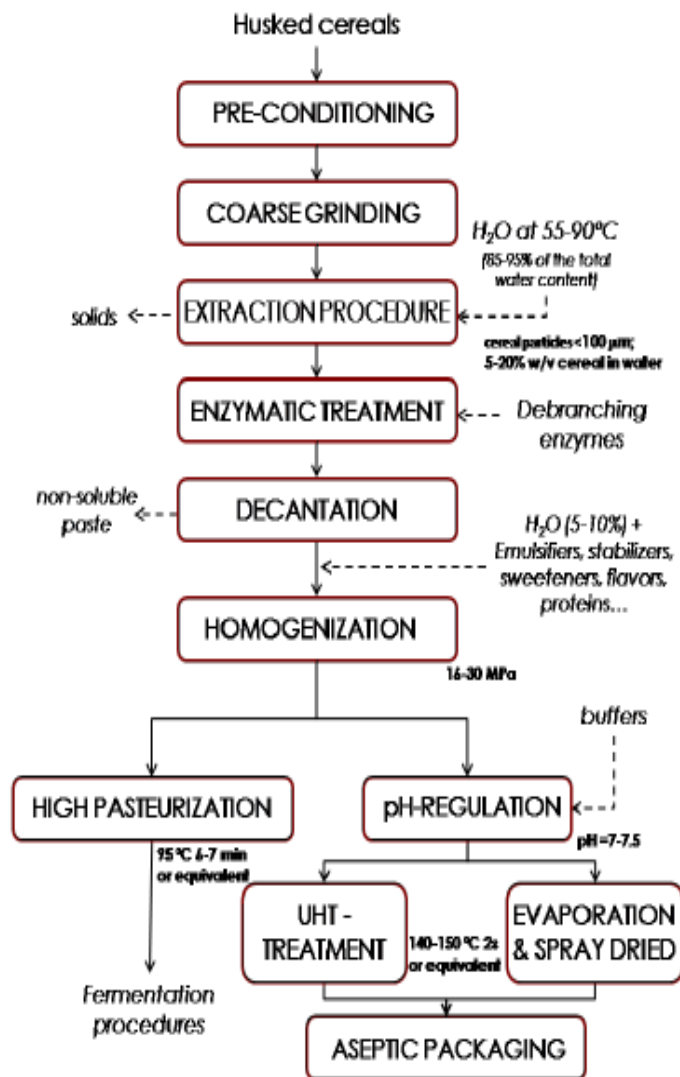


Figure 4: Schematic of typical cereal-based beverage production processes, reproduced from an open access, online source (Bernat et al. 2014).

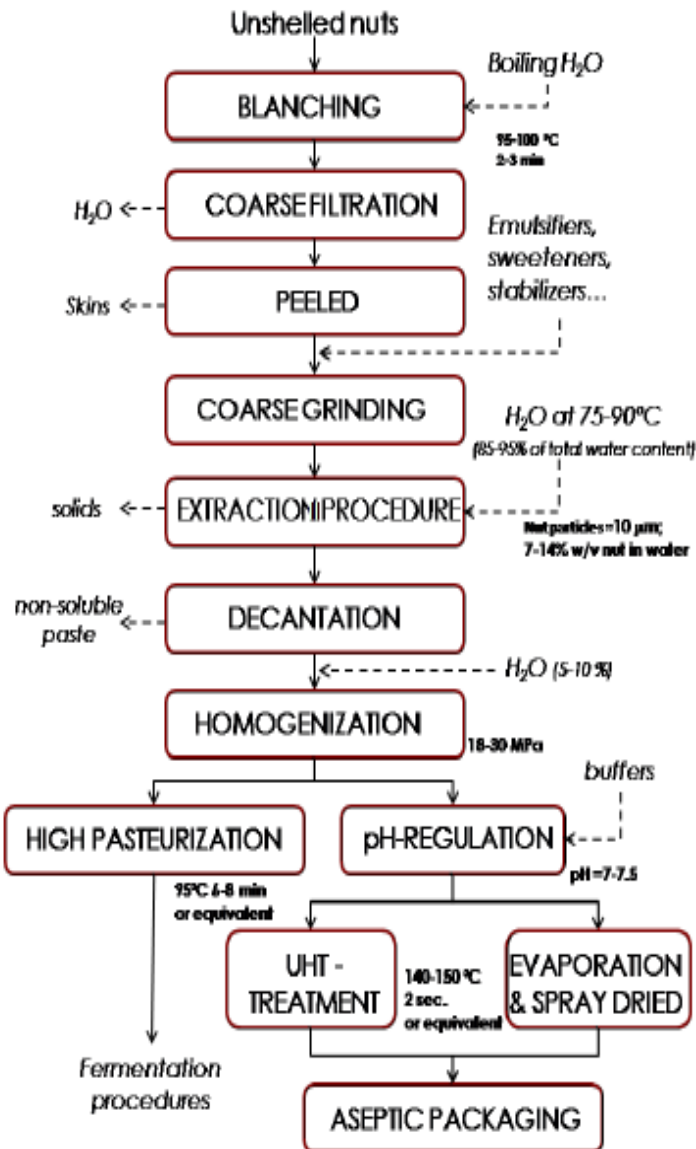


Figure 5: Schematic of typical nut-based beverage production processes, reproduced from an open access, online source (Bernat et al. 2014)

A limited number of analytical results for the presence of calcium in almond-based beverages were also provided as CCI. The only conclusion that can be made from this is that they are consistent with the NIP label statement.

The Application contained more CCI stability data on results of added vitamins and minerals to commercial almond-based beverages sourced from overseas. Extra micronutrients were added to the base almond beverage and used for further forced stability testing. It was estimated that these samples were several months old when initially received. Fortified samples were then stored for 2 and 4 months at 30°C (equivalent to 4 and 8 months at room temperature) and compared to the initial results. Testing found that negligible losses were observed over this shelf life period for the four micronutrients tested: phosphorus, vitamin A, riboflavin and iodine. These results support the Applicant's claim that very little of the added nutrients are lost over an extended shelf life period and that they can be assured to be comparable to NIP label statements.

6.3 Analytical methods

The Application contains a table of various AOAC International (formerly the Association of Official Analytical Chemists) analytical methods that can be used for the quantitative detection of the various vitamins and minerals proposed to be added to nut- and seed-based beverages. The Applicant analyses for these micronutrients as part of its quality assurance testing in their commercial soy-based beverage products. It is understood and expected that analysts experienced in such work would be able to use or adapt such methods.

6.4 Specifications of proposed added vitamins and minerals

All vitamins and minerals proposed to be permitted addition to nut- and seed-based beverages are already permitted to be added to cereal- and legume-based beverages. They all have appropriate specifications within the various monographs in Schedule 3 – Identity and Purity. The permitted forms of the nutrients are listed in section S17-3 and S17-4 of Schedule 17- Vitamins and minerals.

6.5 Food technology conclusion

The food technology assessment concludes that there is current technology available commercially to manufacture and fortify nut- and seed-based beverages with vitamins and minerals in a similar manner to the fortification of soy-based beverages. The losses of these nutrients during processing and over similar products' shelf lives are known and appropriate strategies are available to ensure their levels reflect the NIP label statements.

7 Absorption of added vitamins and minerals from plant-based milk substitutes

7.1 Previous FSANZ Assessments on bioavailability of vitamins and minerals added to beverages

Bioavailability of vitamins and minerals is defined as the amount of the ingested nutrient that is absorbed in the gastrointestinal tract and either stored or utilised for metabolism. Bioavailability is influenced by numerous factors including release of nutrient from the food matrix during digestion, physical interactions between constituents within a food or between other foods or meal components during digestion, the form of the nutrient, as well as host-related modifiers, such as the host's nutritional status or developmental state.

FSANZ has previously assessed two Applications in which bioavailability of vitamins and minerals added to beverages were examined (FSANZ 2005a; FSANZ 2005b). The Assessments covered the bioavailability of various vitamins and minerals (including calcium, iodine, iron, magnesium, phosphorus, selenium, zinc, folate, niacin, pantothenic acid, riboflavin, thiamin, and vitamins A, D, E, B₁₂, B₆ and C) added to formulated beverages or to cereal-based beverages.

Both Assessments determined that gastrointestinal absorption rates of vitamins and minerals, as an indicator of bioavailability, show wide variation irrespective of whether the vitamin or mineral is present endogenously in food or in supplemental form. Therefore, it was not possible to draw definitive conclusions on the bioavailability of vitamins and minerals as it applies to any individual food product.

Because bioavailability is likely to be more influenced by other meal components or the consumer's nutritional status, it was expected that the added vitamins and minerals in the fortified beverages would be comparable to the bioavailability of these nutrients obtained from other food sources.

7.2 Anti-nutritional factors – approach for this Assessment

Approval has been sought to permit addition of vitamin A, thiamin, riboflavin, vitamin B₆, vitamin B₁₂, vitamin D, folate, calcium, magnesium, phosphorus, zinc and iodine to nut- and seed-based beverages. Since these beverages can be derived from either single or combinations of commonly consumed nuts and seeds, including coconut, an examination of the main constituents in almond, sesame, sunflower, coconut and hazelnut was undertaken to consider the levels of any anti-nutritional factors (ANFs).

ANFs are substances in food that act to reduce nutrient intake, digestion, absorption and utilization and may produce other adverse effects. They, *inter alia*, include: toxic amino acids, saponins, cyanogenic glycosides, polyphenols (tannins), phytic acid, gossypol, oxalates, goitrogens, lectins (e.g. phytohaemagglutinins), protease inhibitors (e.g. antitrypsin), chlorogenic acid, and amylase inhibitors (Table 6). ANFs in nut- and seed-based beverages are important if they bind to the added vitamins and minerals and prevent their absorption. Because phytate and oxalate are the only ANFs potentially present in nuts or seeds that can affect absorption of the requested micronutrients, only these ANFs need to be considered further for this Assessment.

Table 6: ANFs in plant-derived foods and their potential effects on nutrients

ANF	Effect	Present in
Phytic acid	Binds minerals (Zn, Cu, Fe, Ca, Mg, Mn)	Widely distributed in plant seeds and grains
Oxalate	Binds minerals (Na, K, Ca, Mg) reducing nutrient availability and forming insoluble complexes	Widely distributed in all plants
Polyphenols (Tannins)	Decreases protein digestibility and Fe absorption	Widely distributed in the hulls of plant seeds and grains
Gossypol	Polyphenol compound that binds to essential amino acids and interferes with their metabolism	Cotton seeds and cotton seed meal
Toxic amino acids	Structurally similar to essential amino acids and interfere with their metabolism	Present in the foliage and seeds of plants
Saponin	Irritating taste, reduces nutrient bioavailability, inhibits digestive enzymes activities	Common in legumes, oilseeds and cereal grains
Lectins	Carbohydrate-binding proteins that have haemagglutinating activity and allergenic properties	Common in legumes, oilseeds, cereal grains, nuts
Cyanogenic glycosides	Breaks down during digestion to produce hydrogen cyanide	Legumes
Goitrogens	Inhibit synthesis and secretion of thyroid hormones	Legumes
Chlorogenic acid	Tannin-like compound that inhibits digestive enzyme activities	Present in relatively high levels in meals derived from sunflower seeds
Amylase inhibitors	Inhibit digestion of dietary starches and prevent their absorption	Widely distributed in plants particularly beans and legumes
Protease inhibitors	Inhibits digestive enzyme activities preventing protein digestion	Common in most plant, mainly raw legume seeds and soybean

References: (Akande et al. 2010; Raes et al. 2014; Bernat et al. 2014)

7.3 Amounts of phytate and oxalate in nuts and seeds

The phytate and oxalate content of the nuts and seeds relevant to the Application was obtained from reported experimental studies or review papers (Table 7). In general the tree nuts (almond, hazelnut, and coconut) contain higher amounts of phytate and oxalate than sesame and sunflower seeds.

Table 7: Reported phytate and oxalate content in nuts and seeds

Source	Phytate mg/100 g	Oxalate mg/100 g	Reference
Almond (unprocessed)	1,138	469	(Macfarlane <i>et al.</i> 1988; Chai and Liebman 2005)
Hazelnut (unprocessed)	648	222	(Macfarlane <i>et al.</i> 1988; Chai and Liebman 2005)
Coconut (unprocessed)	357	N.A.	(Macfarlane <i>et al.</i> 1988)
Sesame (unprocessed) Sesame (processed) ¹	25* 12*	16* 5*	(Jimoh <i>et al.</i> 2011)
Sunflower (unprocessed) Sunflower (processed) ¹	13* 4*	16* 7*	(Fagbenro <i>et al.</i> 2010)

* Concentrations rounded to nearest whole number

¹ Processing consists of cooking for 30 minutes at 100°C then dried and ground.

N.A. not reported in this reference

7.4 Effects of processing on ANF in nuts and seeds

No data were found that quantified the ANFs in beverages derived from the nuts and seeds listed in Table 7, however, phytate and oxalate quantities in processed forms of sesame and sunflower seeds have been reported. In these studies, seeds were processed into a seed meal by cooking for 30 minutes at 100°C followed by drying and grinding. For both sesame and sunflower seeds, processing removed 50–95% of phytate and oxalate. Reduction in the phytate and oxalate content has similarly been reported for soy beans processed to soy-based beverages and cereal grains processed to breakfast cereals (Hurrell 2003). It can be concluded, therefore, that the maximum content of phytate and oxalate in beverages derived from nuts and seeds would be lower than that present in the unprocessed forms.

7.5 Estimated intake of phytate and oxalate from nut-based beverages

Of the nuts and seeds in Table 7, the phytate content of almonds represents the source with the highest potential ANF content that may affect mineral absorption. The phytate intake from an almond-based beverage was therefore estimated using (1) the reported phytate content in almonds, (2) the weight percentage of almond contained in nut-based beverage (McCready 2011), and (3) the mean consumption of almond-based beverage as reported in the 2011-12 NNPAS component of the Australian Health Survey (ABS 2014a) (Box 1 below). As shown, the approximated phytate intake was calculated to be 36 mg/day.

To indicate how this amount compares to potential phytate intakes from other foods, Box 1 also shows the estimated phytate intake from consumption of high fibre breakfast cereals. Using (1) the reported phytate content of high-fibre (40% bran) breakfast cereals (Reddy and Sathe 2001), and (2) the mean breakfast cereal consumption as reported in recent Australian and New Zealand nutritional nutrition surveys, the approximate phytate intake from high fibre breakfast cereals was determined to be 515 mg/day.

Not taking into account any reduction that is likely to occur because of heat-processing, the intake of phytate from an almond-based beverage is estimated to be less than one-fourteenth of that obtained from a high-fibre breakfast cereal. In the context of a normal diet, almond-based beverages make a relatively small contribution to phytate intakes.

Box 1: Comparison of estimated phytate intakes from two dietary sources

<i>Estimated phytate intake from almond based-beverage:</i>	
(1) Almond phytate content (from Table 7)	1,138 mg phytate /100 g almond
(2) Percentage of almond in almond-based beverage (McCready 2011)	2%
(3) Estimated phytate in almond-based beverage = (1) x (2)/100	22.8 mg phytate /100 g
(4) Mean consumption almond-based beverage ¹	159 g /day
(5) Estimated phytate intake from almond-based beverage = (3) x (4)	36 mg phytate/day
<i>Estimated phytate intake from high fibre breakfast cereal</i>	
(1) Phytate in 40% bran breakfast cereal (Reddy and Sathe 2001)	1,120 mg phytate /100 g cereal
(2) Mean breakfast cereal consumption ²	46 g cereal/ day
(3) Estimated phytate intake from breakfast cereal = (1) x (2)	515 mg phytate/day

¹ Consumers only, 2011-12 NNPAS (ABS 2014a).

² Averaged from several Australian and New Zealand surveys, as reported in FSANZ 2015, where range of breakfast cereal consumption was 26-59 g/day.

Using a similar calculation and the reported almond oxalate content in Table 7, oxalate content of almond-based beverage was estimated to be 9.4 mg/100 g (see Step 3 in Box 2 below).

Box 2: Estimation of oxalate content of almond-based beverage

<i>Estimated oxalate intake from almond based-beverage:</i>	
(1) Almond oxalate content (from Table 7)	469 mg oxalate /100 g almond
(2) Percentage of almond in almond-based beverage (w/w) (McCready 2011)	2%
(3) Estimated oxalate in almond-based beverage = (1) x (2)/100	9.4 mg oxalate /100 g
	0.11 mmol oxalate /100 g
(4) Mean consumption almond-based beverage ¹	159 g /day
(5) Estimated oxalate intake from almond-based beverage = (3) x (4)	15 mg oxalate/day

¹ Consumers only, 2011-12 NNPAS (ABS 2014a).

² Averaged from several Australian and New Zealand surveys, as reported in FSANZ 2015, where range of breakfast cereal consumption was 26-59 g/day.

7.6 Amount of phytate and oxalate needed to impact on nutritional status

Because of the relatively large amounts of phytate in plant-based foods that are fed to production animals (e.g. pigs and chickens), the anti-nutritive effects of phytate have been studied to a great extent. These studies have shown that anti-nutritive effects of phytate involves strong sequestering of minerals to form insoluble complexes which are poorly absorbed in the gastrointestinal tract, as well as unavailability of phosphorus contained in phytate⁶. High phytate, as a result, has been associated with mineral deficiencies, poor growth, and bone defects such as rickets (Reddy et al. 1982). It is important to note that these anti-nutritive effects represent extreme conditions since production animals are likely to receive the phytate-containing food as a single source of nutrients.

⁶ Phytate is the salt form of phytic acid, also known as inositol hexakisphosphate. Phosphorous contained in phytic acid can be released by hydrolysis under certain processing conditions or in digestion by the enzyme phytase.

Reduced mineral absorption and phosphorus unavailability has also been reported in humans consuming diets that include a significant proportion of phytate-containing food (Reinhold 1971; Reinhold *et al.* 1973; Reddy *et al.* 1982). For example, wholemeal unleavened flat bread (e.g. lavosh, chapatti) consumed by people living in Iran has been reported to have a mean phytate concentration of 300–650 mg per 100 g (Reinhold 1971; Reinhold *et al.* 1973). At least 50% of their energy requirement was met by consumption of the unleavened bread. Assuming the average adult energy intake was 8,700 kJ/day (section S12-4 of Schedule 4 – Nutrition Information Panels) and the energy density of chapatti bread of 906 kJ/100 g (FSANZ 2010), their potential phytate intake was approximately 1.4–3.4 g of phytate per day, which is higher than the estimated phytate intakes shown in Box 1 from an almond-based beverage or from a high fibre breakfast cereal. Daily intakes of phytate in this range has been shown to lead to imbalanced calcium and zinc absorption, although the effect is reversible by reducing phytate in the diet (Reinhold 1971; Reinhold *et al.* 1973).

Anti-nutritional effects of phytate in populations consuming balanced diets containing relatively small amounts of phytate have not been reported. Most experimental studies in humans indicate that phytate has only minor effects on nutritional status because mineral requirements are readily met from other food sources (such as meat) (Liener 1994). For the same reason, it is likely that the amounts of oxalate needed to affect the nutritional status (e.g. calcium bioavailability) would be very high compared to the amount potentially present in a nut- or seed-based beverage.

Calcium can bind to oxalate and make it unavailable for absorption. Oxalate, at a maximum, binds in an equal molar ratio with calcium. Thus, the estimated molar content of oxalate in an almond-based beverage (0.11 mmol/100 g (see Box 2)), corresponds to 4.3 mg calcium/100 g (0.11 mmol calcium/100 g). This amount represents less than 2% of the proposed amount of calcium (240 mg/100 mL) to be contained in almond-based beverage following fortification (see Section C.2 on page 30 of Application). Therefore, it can be concluded that oxalate in nut- and seed-based beverages will have negligible impact on calcium bioavailability.

7.7 Studies on absorption of added vitamins and minerals from plant-derived beverages

The Applicant provided two studies on nutrient absorption for soy-based beverage as evidence that added vitamins and minerals are effectively absorbed.

7.7.1 Calcium absorption

The first study (Tang *et al.* 2010) examined the absorption of calcium from fortified soy-based beverages relative to cow's milk in osteopenic post-menopausal women. This was a small study (12 participants) using a commercially available fortified soy-based beverage which contained calcium at the same level as that in cow's milk but did not indicate the form of the calcium fortificant. The study determined that the average calcium absorption rate (as measured hourly in plasma after ingestion of radiolabelled calcium) was the same for cow's milk versus fortified soy milk.

The Tang *et al.* study is consistent with previous studies that showed that fortification of soy milk with calcium carbonate showed the same absorption rate in healthy subjects as cow's milk containing the same level of calcium (Heaney *et al.* 2000; Zhao *et al.* 2005). Both studies confirmed that, due to the very large difference in aqueous solubility, the calcium from tricalcium phosphate fortified soy -based beverage was at least 25% less bioavailable compared to calcium carbonate fortified soy -based beverage or the calcium naturally present in cow's milk (Reinwald and Weaver 2010).

A recent review of 55 studies concluded that, aside from tricalcium phosphate, calcium from most calcium salts included in a food matrix were considered to have comparable absorbability as calcium present in cow's milk (Rafferty *et al.* 2007).

7.7.2 Vitamin B₁₂ absorption

The second study (Hokin, 2003) provided by the Applicant measured serum B₁₂ concentrations in 67 vegetarian subjects with low (<200 pmol/L) baseline serum B₁₂ and treated according to one of the following six groups: control (no B₁₂ - placebo), 2 µg/day from a commercially available B₁₂ fortified soy-based beverage; 2 µg/day B₁₂ in a tablet, 50 µg/week B₁₂ in a multivitamin, 0.8 µg/day B₁₂ from fortified meat analogues or 100 µg/month as an intra-muscular injection. The study methods do not describe randomisation. After three months, all intervention groups, except those receiving meat analogues, had significantly increased serum B₁₂ compared to the control group. The soy-based beverage group had the greatest increase (32%) although it is not clear whether this was result was tested statistically against the other intervention group results.

FSANZ was unable to identify any additional human studies demonstrating the absorption of added vitamins and minerals from soy-, cereal-, or nut- and seed-based beverages.

7.8 Conclusions regarding the absorption of added vitamins and minerals to plant-based milk substitutes

The conclusion of this assessment is that there are unlikely to be any constituents present in nut- or seed-based beverages that will impact appreciably on the absorption of added vitamins and minerals. A number of anti-nutritive substances may be present in plant-derived foods but only phytate and oxalate are known to interfere with the minerals that are proposed to be added to nut- and seed-based beverages. Of the proposed added nutrients, phytate and oxalate are known to inhibit the absorption of calcium, zinc, and magnesium but only when consumed in higher amounts than found in nut- and seed-based beverages.

Of the nuts and seeds considered in this assessment, almonds were determined to contain the highest concentrations of phytate and oxalate (Table 7). Using the phytate concentration in almonds (1,138 mg/100 g almonds), the potential phytate content of an almond-based beverage was estimated to be considerably less than that present in commonly consumed foods such as high fibre breakfast cereal. The estimated phytate intakes were much less than the intake reported for people in Iran consuming a high phytate food (wholemeal unleavened bread) in which zinc and calcium absorption metabolism was negatively affected (Reinhold 1971). Therefore, phytate intakes from almond-based beverages, as an illustration of a worst-case scenario for nut- and seed-based beverages, are unlikely to cause negative nutritional effects. Similarly, oxalate was also considered to have a minimal impact on calcium bioavailability. The estimated oxalate content in an almond-based beverage is much less than the amount that would be required to bind to the added calcium and substantially reduce absorption.

Beverages derived from plant-based sources such as nuts and seeds, cereal grains (oats and rice) or legumes (soy) are produced through of series of steps that includes dehulling, filtration and heat treatment (see Section 0). Cereal grains and legumes contain various types of ANF but most of these (up 95%) are removed during the production process (Raes *et al.* 2014). It is likely that ANF present in nuts and seeds will be removed to the same extent and so the calculations presented have overestimated the quantity of these ANFs in the beverages. In addition, nutrient absorption is largely influenced by interactions with other food components during digestion or the nutritional status of the consumer.

8 Comparison of estimated dietary intake of nutrients across national nutrition surveys

As discussed in Section 0, food consumption data are available from recent national nutrition surveys (2002 NZCNS, 2007 ANCNPAS, 2008 NZANS and 2011-12 NNPAS). The A500 assessment used the 1995 AusNNS and 1997 NZNNS food consumption data and, where relevant, it is included in the discussion below.

8.1 Contribution of milk to nutrient intakes

8.1.1 Findings from the cereal-beverage assessment (A500 (FSANZ 2005b))

Milk⁷ is a nutritious food and, in the A500 Assessment, was noted as an important contributor ($\geq 20\%$) to the total estimated intakes of many vitamins and minerals, particularly calcium, phosphorus, retinol equivalents, riboflavin, vitamins B₆ and B₁₂ and iodine; and particularly for children 2–3 years of age. Milk was an important source of energy for Australian children (25% for children aged 2–3 years, 16% for children aged 8–11 years) and New Zealand children (6% for children aged 5–15 years)⁸.

8.1.2 Findings from more recent Australian and New Zealand national nutrition surveys

8.1.2.1 Australian national nutrition surveys

In the 2007 ANCNPAS, milk contributed 6–14% of the energy intake for children aged 2-16 years. This is a smaller contribution than that reported for the same age groups in the 1995 AusNNS. Milk contributed 8–19% of the protein intake for children aged 2-16 years in the 2007 ANCNPAS, a level similar to that in the 1995 AusNNS (13-22% for children aged 2-14 years). In the 2007 ANCNPAS, milk was a major contributor ($\geq 20\%$) to calcium, iodine, phosphorus, retinol equivalents, riboflavin and vitamin D intakes for one or more population groups assessed (Table A1.4 in Appendix 1).

In the 2011-12 NNPAS (ABS 2014a), milk contributed 4–13% of the energy intake for 2-18 year old children. This is a smaller contribution than that reported for the 1995 AusNNS but similar to the 2007 ANCNPAS. Milk contributed 6–18% of protein intakes in the 2011-2012 NNPAS, with a similar contribution being seen in the 2007 ANCNPAS. In the 2011-12 NNPAS milk was a major contributor ($\geq 20\%$) to calcium, iodine, phosphorus, retinol equivalents, riboflavin, vitamin B₆ and vitamin B₁₂ intakes for one or more population groups assessed (Table A1.4 in Appendix 1).

The contribution of milk to iodine intakes for respondents aged 2 years and above was lower in the 2011-12 NNPAS (19%) compared with the 1995 AusNNS (68%). It is also important to note that mandatory fortification of bread with iodine (by the use of iodised salt) was introduced in 2009, contributing to the reduction in the relative contribution of milk to total iodine intakes. Different methodologies were also used to assess iodine intakes in the two surveys. The contribution of milk to calcium intakes was also lower in the 2011-12 NNPAS (21%) compared with the 1995 AusNNS (33%).

⁷ 'Milk' includes fluid milk, evaporated milk, condensed milk and milk powder (including undiluted and dry forms) from cows, sheep and goats, irrespective of fat content. Milkshakes, flavoured milks and milk used in recipes are not included.

⁸ These age groups are different to those listed in Table A1.4. These are groups as per the A500 report on cereal-based beverages.

The contribution of milk to riboflavin intakes was also lower in the 2011-12 NNPAS (16%) compared with the 1995 AusNNS (23%). These differences could be a result of differences in survey methodology or changes in food consumption over time, or both.

8.1.2.2 New Zealand national nutrition surveys

Milk was a major contributor to calcium, iodine and riboflavin intakes for children aged 5-14 years in the 2002 NZCNS and for New Zealanders aged 15 years and above in the 1997 NZNNS. Milk was a major contributor to calcium and riboflavin intakes for the population aged 15 years and above in the 2008 NZANS (see Table A1.5 in Appendix 1).

The contribution of milk to iodine intakes for respondents aged 15 years and above was lower in the 2008 NZANS (17%) compared with the 1997 NZNNS (31%)⁹. As for Australia, the mandatory fortification of bread with iodised salt was introduced in 2009, contributing to the reduction in the relative contribution of milk to total iodine intakes. The contribution of milk to calcium intakes was also lower in the 2008 NZANS (28%) compared with the 1997 NZNNS (38%). Similar results were found for the Australian surveys. Again, these differences could be a result of differences in survey methodology or changes in food consumption over time, or both.

8.2 Comparison of mean nutrient intakes between the general population and non-dairy consumers, based on the A500 assessment (FSANZ 2005b)

8.2.1 Vitamin and mineral intakes

8.2.1.1 Vitamin and mineral dietary intake assessments for non-dairy consumers, based on the cereal-based beverages assessment (A500)

In A500, mean vitamin and mineral intakes were estimated for Australians aged 2-4 years, 5-14 years, 15 years and above and 2 years and above. Mean intakes were also estimated for New Zealanders aged 15 years and above (see Table A1.6 in Appendix 1).

The dietary intake assessment for A500 found that the mean intakes of calcium, naturally occurring folates, magnesium, phosphorus, zinc, retinol equivalents, riboflavin, thiamin, vitamins B₆, B₁₂ and D were lower for non-dairy consumers compared to the general population. Due to the low number of Australian non-dairy consumers aged 2-4 years, the difference in nutrient intakes between the general population and non-dairy consumers for this age group should be interpreted as a guide only. All vitamin and mineral intakes were lower for non-dairy consumers aged 2-4 years compared to the general population, with calcium, riboflavin and retinol equivalents showing the greatest difference (see Table A1.6 in Appendix 1).

Table 8 provides a summary of the difference in mean nutrient intakes for the Australian and New Zealand populations assessed, excluding Australian children aged 2-4 years. It indicates that the difference in mean nutrient intakes for non-dairy consumers compared to the general population was similar between the two countries.

⁹ This assessment (A1104) used a revised methodology for assessing iodine intakes for the 1997 NZNNS to allow a comparison between the 2008 NZANS and the 1997 NZ NNS. The A500 assessment of iodine intakes used a different methodology for assessing iodine intakes for the 1997 NZNNS.

8.2.1.2 Vitamin and mineral intakes for the general population, using the more recent Australian and New Zealand national nutrition surveys

Australia

For the general population of Australians aged 2 years and above and for the majority of nutrients considered in A500, mean nutrient intakes from the more recent 2011-12 NNPAS were similar to those from the 1995 AusNNS, as estimated in the assessment of cereal-based beverages (A500) (refer to Table A1.7 in Appendix 1). However, iodine intakes were approximately 69% higher in the 2011-12 NNPAS, likely due to the introduction of mandatory iodine fortification of bread in 2009. Mean intakes of total folates (naturally occurring folates plus folic acid) and folic acid in the 2011-12 NNPAS were also higher, most likely due to the introduction of mandatory folic acid fortification of bread-making flour in Australia in 2009. Retinol equivalents intakes were approximately 27% lower in the 2011-12 NNPAS compared to the 1995 AusNNS.

Table 8: Comparison between the vitamin and mineral intakes of non-dairy consumers and the general population

Vitamin/ Mineral	Approximate difference in mean nutrient intakes for 'non-dairy' consumers compared to the general population	
	1995 AusNNS [▽]	1997 NZNNS [♦]
Calcium	59-66% lower	58% lower
Folates (naturally occurring)	Not available	23% lower
Iodine	Not available	Not available
Magnesium	20-27% lower	21% lower
Phosphorus	27-37% lower	31% lower
Retinol equivalents	6-42% lower	31% lower
Riboflavin	35-55% lower	44% lower
Thiamin	13-29% lower	29% lower
Vitamin B ₆	19-40% lower	21% lower
Vitamin B ₁₂	2-35% lower	23% lower
Vitamin D	16-28% lower	13% lower
Zinc	14-24% lower	18% lower

[▽] The lower end of the range is for Australians aged 15 years and above; the higher end of the range is for Australians aged 5–14 years. The percentage difference for Australians aged 2 years and above is within the range.

[♦] For New Zealanders aged 15 years and above.

New Zealand

For New Zealanders aged 15 years and above, mean intakes of magnesium, naturally occurring folates, phosphorus, riboflavin, thiamin, vitamin B₁₂ and zinc from the more recent 2008 NZANS were similar to those from the 1997 NZNNS, as estimated in the assessment of cereal-based beverages (A500) (refer to Table A1.8 in Appendix 1).

Calcium intakes were approximately 10% higher in the 2008 NZANS compared to the 1997 NZNNS, with vitamin B₆ intakes being approximately 50% higher in the 2008 NZANS and vitamin D intakes approximately 100% higher. Some of these differences could be due to differences in the methods of nutrient analysis.

Iodine intakes were approximately 14% lower in the 2008 NZANS than in the 1997 NZNNS, noting the 2008 NZANS was conducted prior to the introduction of mandatory iodine fortification of salt used to make bread. Retinol equivalents intakes were approximately 20% lower in the 2008 NZANS compared to the 1997 NZNNS. This is similar to that seen in the 1995 AusNNS and 2011-12 NNPAS comparison.

8.2.1.3 Summary

In general, the contribution of milk to vitamin and mineral intakes and the mean vitamin and mineral intakes from the more recent Australian and New Zealand national nutrition surveys were similar to those from the older 1995 AusNNS and 1997 NZNNS, as estimated in the assessment of cereal-based beverages (A500). In addition, mean intakes for a range of vitamin and minerals were similar between 1995/1997, as described in A500, compared with estimates of mean intake from more recent nutrition surveys, except for iodine and dietary folate equivalents owing to fortification initiatives in the intervening period. Therefore the results shown in A500 for assessing the differences in nutrient intakes between non-dairy consumers and the general population were still considered relevant for assessing the current Application. Therefore, these comparisons were not repeated for the newer surveys.

Unfortified nut- and seed-based beverages are a poor source of vitamins and minerals. Therefore, the conclusions from dietary vitamin/mineral intake assessments for unfortified cereal-based beverages (A500), that non-dairy consumers are likely to have reduced nutrient intakes for a range of nutrients compared to the general population (see Section 0 above), may apply to non-dairy consumers who choose to consume unfortified nut- and seed-based beverages as a complete milk replacement.

8.2.3 Protein intakes

8.2.3.1 Protein dietary intake assessment for non-dairy consumers based on the cereal-based beverages assessment (A500)

The findings from the A500 assessment indicated that estimated protein intakes were 17-22% lower in non-dairy consumers compared to the general population (see Table A1.9 in Appendix 1).

8.2.3.2 Protein dietary intakes for the general population using the more recent Australian and New Zealand national nutrition surveys

The mean protein intake for the general population of Australians aged 2 years and above was similar for the 1995 AusNNS (86 grams/day) that was used in the A500 assessment and for the more recent 2011-12 NNPAS (88 grams/day) (refer to Table A1.10 in Appendix 1).

The mean protein intake for the general population of New Zealanders aged 15 years and above was similar in the 1997 NZNNS that was used in the cereal-based beverages assessment (87 grams/day) and in the more recent 2008 NZANS (88 grams/day) (refer to Table A1.11 in Appendix 1). Therefore, the conclusions from the dietary protein intakes assessment for non-dairy consumers and the general population for the cereal-based beverages assessment (A500) were assumed to be relevant to the assessment of nut- and seed-based beverages.

8.2.4 Fat intakes

8.2.4.1 Fat intake assessment for non-dairy consumers based on the cereal-based beverages assessment (A500)

In the A500 assessment estimated fat intakes were approximately 21–25% lower in non-dairy consumers compared to the general population (see Table A1.12 in Appendix 1).

8.2.4.2 Fat intakes for the general population using the more recent Australian and New Zealand national nutrition surveys

The mean fat intake for the general population of Australians aged 2 years and above was slightly higher in the 1995 AusNNS (81 grams/day) compared to the more recent 2011-12 NNPAS (73 grams/day) (refer to Table A1.13 in Appendix 1).

The mean fat intake for the general population of New Zealanders aged 15 years and above was similar in the 1997 NZNNS (89 grams/day) and the more recent 2008 NZANS (83 grams/day) (refer to Table A1.11 in Appendix 1). Therefore, the conclusions from the dietary fat intake assessment for non-dairy consumers and the general population for the cereal-based beverages assessment (A500) were assumed to be relevant to the assessment of nut- and seed-based beverages. The A500 assessment of cereal-based beverages indicated that consumers of cereal-based beverages were not at risk of inadequate fat intakes. Consequently, the same conclusion can be made for nut- and seed-based beverages.

8.2.5 Energy intakes

The estimated mean energy (including energy from dietary fibre) intake for the general population of Australians aged 2 years and above was in the same range in the 1995 AusNNS (9,185 kJ/day) compared to the more recent 2011-12 NNPAS (8,520 kJ/day) (refer to Table A1.15 in Appendix 1). For children aged 2-4 years, there was also little difference in mean energy intakes: 6,595 kJ/day for the 1995 NNS and 6,470 kJ/day for the 2007 ANCPAS.

The estimated mean energy (not including dietary fibre) intake for the general population of New Zealanders aged 15 years and above was similar in the 1997 NZNNS (9,375 kJ/day) and the more recent 2008 NZANS (9,105 kJ/day) (refer to Table A1.16 in Appendix 1).

8.3 Conclusions from the dietary intake assessment

The conclusion from the assessment of nutrient intakes in this Application is the same as that reached for A500: non-dairy consumers are likely to be at risk of much lower intakes of a range of vitamins and minerals, protein, and fat in comparison to the general population. Children have been identified as having a greater risk to health from inadequate vitamin and mineral and protein intakes. An optimal nutrient intake, including protein and fat, is very important for infants and toddlers under two years of age because of growth and developmental needs. There are potentially serious consequences from inadequate nutrient intakes since adequate intakes are required to support growth and development.

As for cereal-based beverages (A500, (FSANZ 2005b)), unfortified nut- and seed-based beverages are a poor source of fat, protein, vitamins and minerals whereas milk and other dairy foods are very important contributors of many nutrients to the diet. The proposed levels of voluntary fortification of nut- and seed-beverages with the selected vitamins and minerals would bring these types of beverages closer nutritionally to the micronutrient profile of milk.

Permitting the addition of a variety of vitamins and minerals in order to achieve micronutrient equivalence with milk would not alter the protein and fat content of the product.

The fortification of nut- and seed-based beverages with vitamins and minerals similar to the profile of milk or the currently available fortified plant-based milk substitutes will provide individual consumers with a more nutritious milk replacement than a non-fortified nut- or seed-based beverage. It will not address the potentially lower protein or fat intakes for non-dairy consumers compared to the general population.

9 Risk of excess nutrient intakes

In general, the concentrations of vitamins and minerals requested to be permitted for voluntary fortification of nut- and seed-based beverages are similar to the concentrations that are present naturally in full cream cow's milk, with the exception of thiamin (lower in full cream cow's milk), folate (higher in full cream cow's milk) and iodine (higher in full cream cow's milk). A comparison between the level of vitamins/mineral proposed to be voluntarily added to nut- and seed-based beverages and in full cream cow's milk is provided in Table 5 (see Section 0 above).

Fortification of nut- and seed-based beverages to similar levels of vitamins and minerals found naturally in full cream milk will not pose any additional risk with respect to excess intake of vitamins and minerals over milk itself. The fortification of nut- and seed-based beverages is unlikely to cause excess consumption of these micronutrients for regular consumers of nut- and seed-based beverages who are non-dairy consumers as this population group tends to have lower intakes of vitamins and minerals in comparison to the general population. The fortification of nut- and seed-based beverages to 0.1 mg thiamin per reference quantity (200 mL) is consistent with the current thiamin fortification permissions for cereal- and legume-based milk substitutes. The safety of this level of thiamin fortification for cereal-based milk substitutes was considered in A500 (FSANZ 2005b). Additionally, there is no Upper Level of Intake¹⁰ (UL) set for thiamin for Australian and New Zealand population groups (NHMRC and NZ MOH 2006).

Since the requested levels of voluntary fortification are similar to milk, it is expected that there will not be an exacerbation of the proportion of Australian population groups with usual nutrient intakes above their respective ULs (ABS and FSANZ 2015). An evaluation of the exceedances of the ULs was conducted as a part of the 2011-12 NNPAS (ABS and FSANZ 2015). The findings were that the iodine intakes of young children were "...below a level at which adverse effects may be observed, though a reduced margin of safety exists...". The usual zinc intakes of young children were considered in the report to be not excessive and, after comparison with the Provisional Tolerable Daily Intake (PTDI)¹¹ (1 mg/kg bw/day), intakes were within the PTDI. The findings for children aged 2-18 years are summarised in Table 9.

There were no exceedances of the ULs for Australian adults for calcium, iodine, iron, phosphorus, zinc, pre-formed vitamin A (retinol equivalents) and folic acid, with the exception of adult males aged 71 years and above where 0.9% of population was above the UL for phosphorus.

¹⁰ The Upper Level is defined as "...The highest average daily nutrient intake level likely to pose no adverse health effects to almost all individuals in the general population...." (NHMRC and NZ MOH 2006)

¹¹ The Provisional Maximum Tolerable Daily Intake is an indication of "...the safe level of intake of a contaminant with no cumulative properties..." (WHO 2009).

Table 9: Proportion (%) of Australian population groups with usual nutrient intakes above the Upper Level (ABS 2015)

Nutrient	Proportion of population with usual intakes > Upper Level							
	2-3 yrs		4-8 yrs		9-13 yrs		14-18 yrs	
	Male	Female	Male	Female	Male	Female	Male	Female
Calcium	-	-	-	-	-	-	-	-
Iodine	12.9	5.6	0.1	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-
Phosphorus	-	-	-	-	-	-	-	-
Zinc	62.7 [^]	39.8 [^]	2.9	0.7	-	-	-	-
Preformed Vitamin A (retinol equivalents)	0.5	0.1	-	-	-	-	-	-
Folic acid	3.6	2.3	3.6	2.0	0.7	0.1	0.1	-

- nil or rounded to zero

[^] proportion has a margin of error >10 percentage points

10 How would consumers perceive fortified nut- and seed-based beverages?

The literature search did not locate information on the effect of fortification on consumer perceptions of nut- and seed-based beverages. However, Australian research in 2002 into consumer perceptions of the nutritional quality of unfortified soy-based beverages suggests that fortification of nut- and seed-based beverages may lift the nutritional profile of these beverages closer to consumer assumptions around their nutritional value. In the two consumer studies outlined below, Australian consumers appeared to have misperceptions that unfortified soy-based beverages were a good source of fibre, iron, and vitamin C, and health benefits that were similar to, if not better than, cow's milk.

A 2002 study of 361 Queensland shoppers asked a subset of respondents for their views on soy milk (soy-based beverage) (Bus & Worsley 2003b). Because respondents were asked for their views on only one of whole milk, reduced-fat milk, or soy-based beverage, and not all three types, this is a between-subjects design. Compared to the other two milks, a significantly greater percentage of respondents answering about soy-based beverage thought it:

- was a good source of fibre (33% agreed and 53% 'didn't know'; soy-based beverage is not a good source of fibre)
- contains phyto-oestrogens (35% agreed and 61% 'didn't know'; soy-based beverage contains phyto-oestrogens).

While not significantly different to beliefs about the other two milks, some results indicated that respondents may have an overly positive view about the nutritional quality of soy-based beverage in some areas (Bus & Worsley 2003b). Of the respondents who were asked about soy-based beverage, the most commonly held beliefs were:

- 77% agreed soy-based beverage was a good source of vitamins (incorrect at time of study)
- 78% agreed soy-based beverage was a good source of calcium (incorrect at time of study)
- 71% agreed soy-based beverage was a good source of protein (correct).

A relatively large subsample of respondents who were asked about soy-based beverage had incorrect views about other nutrients (Bus & Worsley 2003b):

- 35% agreed that a soy-based beverage was a good source of iron (incorrect at time of study, similar misperception for both cow's milks) and 58% 'didn't know'
- 21% agreed that a soy-based beverage was a good source of vitamin C (incorrect at time of study, similar misperception for both cow's milks) and 66% 'didn't know'.

These 2002 results suggest that a reasonably large proportion of Australian shoppers held overly positive views of soy-based beverages. In addition, a soy-based beverage was viewed as 'natural' by 78% of respondents asked about soy-based beverage, compared to the 86% who viewed whole milk as natural and the 58% who believed reduced-fat milk was natural,¹² another statistically significant result (Bus & Worsley 2003b).

In a related 2002 study of Melbourne shoppers, the same authors looked at consumer health perceptions of the three different kinds of milk/ milk substitute (Bus & Worsley 2003a). Again, respondents were asked for their views on only one of whole milk, reduced-fat milk, or soy milk (soy-based beverage), and not all three types. There were statistically significant differences in health perceptions between the milks/milk substitute, with consumers tending to provide very positive assessments of soy-based beverage compared to cow's milk. Overall, a soy-based beverage was perceived to be least likely to cause serious diseases¹³ and allergies¹⁴ and better than dairy milks to help prevent disease.¹⁵ Additionally, a soy-based beverage was believed to have "strong bones" and anti-osteoporosis effects equivalent to those associated with dairy milk. With respect to healthiness, a soy-based beverage was viewed as significantly healthier than whole milk (88% compared to 68%, respectively), and similar to reduced fat milk (87%). There was no effect of sex, age, or education level on the results with respect to the soy-based beverage results.

11 Conclusions of the risk and technical assessment

Nut- and seed-based beverages are relatively new to the Australian and New Zealand markets and there has been steady growth in the nut- and seed-based beverage market over the past few years.

In general, the concentrations of vitamins and minerals requested to be permitted for voluntary fortification of nut- and seed-based beverages are similar to the concentrations that are present naturally in full cream cow's milk. Thiamin is lower in full cream cow's milk and folate and iodine are higher in full cream cow's milk compared to the requested permissions for nut- and seed-based beverages. The energy content of nut- and seed-based beverages is lower compared to full cream milk and legume and cereal-based beverages. The protein content of nut- and seed-based beverages is comparable to cereal-based beverages, although lower than in milk and soy-based beverages. The Application does not seek to address the energy or protein differences between nut- and seed-based beverages and full cream cow's milk. Calcium is much lower in unfortified nut- and seed-based beverages compared with milk.

¹² Of the respondents who were asked about whole milk, and of the respondents who were asked about reduced-fat milk, respectively.

¹³ There were nine diseases examined in the study: blindness; diabetes; kidney stones; high blood pressure; heart problems; cancer; high cholesterol; obesity; asthma.

¹⁴ There were five allergy-type factors examined in the study: allergy; mucus; asthma; hay fever; lactose intolerance.

¹⁵ There were four diseases examined in the study: cancer; blindness; menopausal problems; anaemia.

There is technology available commercially to fortify nut- and seed-based beverages with vitamins and minerals in a similar manner to the fortification of soy-based beverages. The losses of these nutrients during processing and over the product's shelf life are known in other comparable plant based products and appropriate strategies are used to ensure their levels reflect the NIP label statements.

There are unlikely to be any constituents present in nut- or seed-based beverages that will impact appreciably on the absorption of the added vitamins and minerals. It is likely that up to 95% of anti-nutritional factors present in nuts and seeds will be removed during production of the nut- and seed-based beverages.

Recent national nutrition survey information shows that nut- and cereal-based beverages are consumed in similar ways to milk. Around 83% of eating occasions of nut- and cereal-based beverages are from use with breakfast cereal or in a beverage and, to a lesser extent, as a beverage in its own right.

A comparative analysis across all available national nutrition surveys indicates that milk is a nutritious food and important contributor ($\geq 20\%$) to the intakes of many vitamins and minerals, particularly calcium, phosphorus, retinol equivalents, riboflavin, vitamins B₆ and B₁₂ and iodine; and particularly so for young children. Milk is also an important source of energy for children.

A previous assessment based on the 1995 AusNNS and 1997 NZNNS indicates that mean intakes of calcium, naturally occurring folates, magnesium, phosphorus, zinc, retinol equivalents, riboflavin, thiamin, vitamins B₆, B₁₂ and D were lower for non-dairy consumers compared to the general population. Of the vitamins and minerals, the greatest magnitude of difference between the general population and non-dairy consumers was for calcium (non-dairy consumers had mean calcium intakes approximately 60-70% lower than the general population). Estimated mean protein intakes were 17–22% lower in non-dairy consumers compared to the general population, with estimated mean fat intakes being 21–25% lower. As vitamin and mineral intakes were similar in the more recent surveys to those reported in the 1995 and 1997 surveys, it is assumed that non-dairy consumers are likely to continue to have lower micronutrient intakes compared to the general population.

The fortification of nut- and seed-based beverages to levels equivalent to milk (and already permitted in soy- and cereal-based beverages) would give consumers of nut- and seed-based beverages the same opportunities for vitamin and mineral intake from this beverage source as for consumers of milk and fortified soy and cereal-based beverages. The risk from fortification of nut- and seed-based beverages to similar levels of vitamins and minerals found naturally in milk poses the same risk as milk itself.

Industry uptake of a voluntary permission to fortify nut- and seed-based beverages will help increase the intake of a variety of vitamins and minerals by those individuals who do not consume dairy foods or soy-based beverages.

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Appendix 1 – Additional nutrient composition, nutrient intake and food consumption information

Table A1.1: Nutrient content of cow's milk, coconut-based milk substitutes and soy-, oat-, rice-, almond-, almond blend- and other nut-based beverages

Nutrients per 100 mL	Cow's Milk	Soy Beverages		Oat –Based Beverages		Rice-Based Beverages		Almond-Based Beverages											
	Milk, cow, fluid, regular fat (~3.5%) †	Soy beverage, regular fat (~3%), unfortified †	Soy beverage, regular fat (~3%), added Ca & vitamins A, B1, B2 & B12 †	Milk, oat, fluid, unfortified †	Milk, oat, fluid, added calcium †	Milk, rice, fluid, added calcium †	Milk, rice, fluid, protein enriched, added calcium †	Milk, almond, fluid, unfortified †	So Good™ Almond Milk Regular #	So Good™ Almond Milk Unsweetened #	So Good™ Almond Milk Vanilla Flavoured #	Almond Breeze™ Original Almond Milk #	Almond Breeze™ Original Unsweetened Almond Milk #	Almond Breeze™ Almond Milk with a Hint of Honey #	Australia's Own™ Almond Milk #	Pure Harvest™ Almond Milk Original #	Coles™ Sweetened Almond Milk #	Woolworths™ Original Almond Milk #	Woolworths™ Unsweetened Almond Milk #
Energy (kJ)	281	246	251	222	220	225	159	143	126	70	142	105	67	85	150	175	130	104	68
Protein (g)	3.4	3.7	4.1	1.5	1.5	0.3	1.5*	0.6	0.6	0.6	0.5	0.4	0.5	0.5	0.6	0.3	0.6	0.6	0.6
Total fat (g)	3.4	2.7	2.7	2.1	2	1	1.1	2.7	1.4	1.4	1.3	1.1	1.2	1.1	2.7	0.4	1.5	1.2	1.3
Saturated fat (g)	2.19	0.43	0.43	0.29	0.29	0.16	0.18	0.21	0.1	0.1	0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.1	0.1	0.1
Monounsaturated fat (g)	0.89	0.56	0.56	0.7	0.69	0.47	0.52	1.34	0.9	0.9	0.9	0.7	0.8	0.7	1.8	0.3	0.8	ns	ns
Polyunsaturated fat (g)	0.09	1.49	1.49	0.96	0.94	0.31	0.34	1	0.4	0.4	0.4	0.3	0.3	0.3	0.7	0.1	0.3	ns	ns
Trans fatty acids (g)	0.11	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	<0.1	<0.1
Cholesterol (mg)	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbohydrates (g)	6	4.6	4.6	6.5	6.5	12.7	5.6	2	3.6	0.3	4.9	3.2	0.7	2.2	2.4	9.1	3.5	3	0.5
Total sugars (g)	6	2.6	2.6	0.1	0.1	3.7	2.8	1.9	3.4	0.1	4.8	2.8	0.1	1.5	1.9	6.3	2.2	2.8	0.1
Dietary fibre (g)	0	0.6	0.6	1.2	1.1	0	0	0.3	0.3	0.3	0.3	0.2	0.3	0.3	ns	ns	0.6	ns	ns
Calcium (Ca) (mg)	104	13	115*	5	124*	70*	120*	67	75	75	75	75	75	76	ns	ns	70	43	48
Sodium (Na) (mg)	35	44	44	59	58	62	55	59	30	35	35	52	51.6	50	60	56	45	56	59

Nutrients	Cow's Milk	Soy Beverages		Oat –Based Beverages		Rice-Based Beverages		Almond-Based Beverages													
		per 100 mL	Milk, cow, fluid, regular fat (~3.5%) †	Soy beverage, regular fat (~3%), unfortified †	Soy beverage, regular fat (~3%), added Ca & vitamins A, B1, B2 & B12 †	Milk, oat, fluid, unfortified †	Milk, oat, fluid, added calcium †	Milk, rice, fluid, added calcium †	Milk, rice, fluid, protein enriched, added calcium †	Milk, almond, fluid, unfortified †	So Good™ Almond Milk Regular #	So Good™ Almond Milk Unsweetened #	So Good™ Almond Milk Vanilla Flavoured #	Almond Breeze™ Original Almond Milk #	Almond Breeze™ Original Unsweetened Almond Milk #	Almond Breeze™ Almond Milk with a Hint of Honey #	Australia's Own™ Almond Milk #	Pure Harvest™ Almond Milk Original #	Coles™ Sweetened Almond Milk #	Woolworths™ Original Almond Milk #	Woolworths™ Unsweetened Almond Milk #
Phosphorus (P) (mg)	88	69	69	39	38	18	18	14	56	58	61	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Vitamin A (µg)	51	7	80*	0	0	0	0	0	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Thiamin (B₁) (mg)	0.005	0.02	0.04*	0.03	0.02 ₉	0.02	0.02	0.004	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Riboflavin (B₂) (mg)	0.201	0.03	0.41*	0	0	0	0	0.026	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Vitamin B₆ (mg)	0.07	0.03	0	0	0	0	0	0	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Vitamin B₁₂ (µg)	0.6	0	0.9*	0	0	0	0	0	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Folate, natural (µg)	14	14	14	1	1	0	0	1	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Magnesium (Mg) (mg)	10	21	21	17	17	10	10	13	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Zinc (Zn) (mg)	0.34	0.15	0.15	0.28	0.27	0.07	0.07	0.1	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Iodine (I) (µg)	22.3	1.3	1.3	0.6	0.6	3.5	3.5	0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

† Data from AUSNUT 2011-13 Australian Health Survey Food Nutrient Database (FSANZ 2014)

Data from product Nutrition Information Panels (NIPs)

* Fortified

ns not specified

Table A1.1 (cont'd): Nutrient content of cow's milk, coconut-based milk substitutes and soy-, oat-, rice-, almond-, almond blend- and other nut-based beverages

Nutrients	Cow's Milk	Almond-Based Beverage blends					Coconut-Based Milk Substitutes				Other Nut-Based Beverages			
		per 100 mL	Milk, cow, fluid, regular fat (~3.5%) †	Vitasoy™ Soy & Almond Milk #	Vitasoy™ Oat & Almond Milk #	So Good™ Almond & Coconut Milk Original #	So Good™ Almond & Coconut Milk Unsweetened #	Australia's Own™ Almond & Coconut Milk #	So Good™ Coconut Milk Original #	Vitasoy™ Coconut Milk, added calcium #	Pure Harvest™ Coco Quench Coconut Milk #	Silk™ Original Coconut Milk (non-Australian/NZ) #	Australia's Own™ Macadamia Milk #	EcoMil™ Sesame Milk (non-Australian/NZ) #
Energy (kJ)	281	256	332	113	70	272	183	124	262	140	121	214	122	121
Protein (g)	3.4	3.0	1.0	0.5	0.6	0.6	0.2	0.15	0.6	0	0.2	0.6	0.4	0.4
Total fat (g)	3.4	3.0	2.8	1.5	1.4	1.9	3.4	2	3.2	2.1	1.8	2.4	1.7	1.6
Saturated fat (g)	2.19	0.4	0.4	0.3	0.1	0.5	2.2	2	2.3	2.1	0.3	0.5	0.2	0.2
Monounsaturated fat (g)	0.89	2.8	1.6	0.8	0.9	1.3	0.5	0	0.8	0	1.4	1.4	ns	1.3
Polyunsaturated fat (g)	0.09	3.3	0.8	0.4	0.4	0.4	0.7	0	0.1	0	0.03	0.5	ns	0.1
Trans fatty acids (g)	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	ns	0.00
Cholesterol (mg)	10	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbohydrates (g)	6	5.1	11.5	2.7	0.3	2.7	3.1	2.7	7.8	2.9	2.8	6.7	3.8	3.1
Total sugars (g)	6	3.8	2.8	2.5	0.1	2.7	2.9	2.5	3.8	2.5	0.2	3.4	2.9	3.1
Dietary fibre (g)	0	0.6	2	0.4	0.3	ns	0.1	0.2	ns	0	ns	0.2	0.4	0.3
Calcium (Ca) (mg)	104	120*	120*	75	75	ns	75	120*	ns	*	ns	ns	*	120*
Sodium (Na) (mg)	35	34	40	30	35	39	25	26	55	20	75	10	50	50
Phosphorus (P) (mg)	88	ns	ns	58	58	ns	44	ns	ns	ns	ns	ns	*	ns

Nutrients per 100 mL	Cow's Milk	Almond-Based Beverage blends					Coconut-Based Milk Substitutes				Other Nut-Based Beverages			
		Vitasoy™ Soy & Almond Milk #	Vitasoy™ Oat & Almond Milk #	So Good™ Almond & Coconut Milk Original #	So Good™ Almond & Coconut Milk Unsweetened #	Australia's Own™ Almond & Coconut Milk #	So Good™ Coconut Milk Original #	Vitasoy™ Coconut Milk, added calcium #	Pure Harvest™ Coco Quench Coconut Milk #	Silk™ Original Coconut Milk (non- Australian/NZ) #	Australia's Own™ Macadamia Milk #	EcoMil™ Sesame Milk (non- Australian/NZ) #	SoL™ Sunflower Beverage (non- Australian/NZ) #	Alpro™ Hazelnut Drink (non- Australian/NZ) #
Vitamin A (µg)	51	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	*	ns
Thiamin (B₁) (mg)	0.005	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Riboflavin (B₂) (mg)	0.201	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	ns	0.21*
Vitamin B₆ (mg)	0.07	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Vitamin B₁₂ (µg)	0.6	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	ns	0.38*
Folate, natural (µg)	14	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns
Magnesium (Mg) (mg)	10	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Zinc (Zn) (mg)	0.34	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	ns	ns
Iodine (I) (µg)	22.3	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

† Data from AUSNUT 2011-13 Australian Health Survey Food Nutrient Database (FSANZ 2014)

Data from product Nutrition Information Panels (NIPs)

* Fortified

ns not specified

Table A1.2: Proportion of population groups consuming milk and plant-based milk substitutes in Australian and New Zealand national nutrition surveys^{*}

Nutrition Survey	Age	Plain or flavoured beverage	Milk		Soy-based beverages		Other plant-based milk substitutes	
			Number of consumers	% consumers to respondents	Number of consumers	% consumers to respondents	Number of consumers	% consumers to respondents
1995 AusNNS	17 years & above	Plain only	11,441	83	289	2.1	NC	NC
		Plain / flavoured / milkshakes / milk hot chocolate	11,594	84	297 [^]	2.1	NC	NC
2007 ANCNPAS	2-16 years	Plain only	3,285	73	86	1.9	26	0.6
		Plain / flavoured / milkshakes / milk hot chocolate	3,434	77	101	2.3	26	0.6
2011-12 NNPAS ^{**}	2 years & above	Plain only	8,302	68	312	2.6	85	0.7
		Plain / flavoured / milkshakes / milk hot chocolate	8,556	70	316 [^]	2.6 [^]	85	0.7
1997 NZNNS	15 years and above	Plain only	3,978	86	27	0.6	NC	NC
		Plain / flavoured / milkshakes / milk hot chocolate	3,999	86	29	0.6	1	<0.1
2002 NZCNS	5-14 years	Plain only	2,266	69	27	0.8	4	0.1
		Plain / flavoured / milkshakes / milk hot chocolate	2,335	71	29	0.9	6	0.2
2008 NZANS	15 years & above	Plain only	3,574	75	109	2.3	13	0.3
		Plain / flavoured / milkshakes / milk hot chocolate	3,635	77	110	2.3	21	0.4

^{*} Based on consumption from Day 1 only

^{**} Derived from CURF raw data (ABS, 2014a))

Table A1.3: Consumer consumption of milk and plant-based milk substitutes in Australian and New Zealand national nutrition surveys^{*}

Country	Nutrition Survey	Age	Plain or flavoured	Consumer consumption (grams per day)					
				Milk		Soy-based beverages		Other plant-based milk substitutes	
				Median	Mean	Median	Mean	Median	Mean
Australia	1995 AusNNS	17 years & above	Plain only	208	270	199	225	NC	NC
			Plain / flavoured / milkshakes / milk hot chocolate	232	292	199	230	NC	NC
	2007 ANCNPAS	2-16 years	Plain only	258	349	232	294	258	298
			Plain / flavoured / milkshakes / milk hot chocolate	304	379	258	306	258	298
	2011-12 NNPAS ^{**}	2 years & above	Plain only	156	222	193	214	158	181
			Plain / flavoured / milkshakes / milk hot chocolate	185	250	196	215	158	181
New Zealand	1997 NZNNS	15 years & above	Plain only	186	244	155	189	n/a ^u	n/a ^u
			Plain / flavoured / milkshakes / milk hot chocolate	191	252	207	205	n/a ^u	n/a ^u
	2002 CNS	5-14 years	Plain only	212	270	130	223	n/a ^u	136
			Plain / flavoured / milkshakes / milk hot chocolate	233	288	130	235	258	200
	2008-09 ANS	15 years & above	Plain only	180	228	146	215	135	247
			Plain / flavoured / milkshakes / milk hot chocolate	191	240	146	214	135	250

^{*} Based on consumption from Day 1 only

^{**} Derived from CURF raw data (ABS, 2014a))

^u Insufficient consumers to derive statistics

Table A1.4: Percentage contribution of milk¹⁶ to estimated nutrient intakes for Australia

Nutrient	Percent contribution of milk (%) [♦]													
	A500				More recent data									
	1995 AusNNS				2007 ANCPAS [♣]				2011-12 NNPAS*					
	2 years and above	2-4 years	5-14 years	15 years and above	2-3 years	4-8 years	9-13 years	14-16 years	2-3 years	4-8 years	9-13 years	14-18 years	19 years and above	2 years and above
	(n=13,858)	(n=583)	(n=1,844)	(n=11,431)	(n=552)	(n=1,520)	(n=1,493)	(n=922)	(n=317)	(n=775)	(n=862)	(n=740)	(n=9,460)	(n=12,153)
Calcium	33	51	38	31	41	32	30	25	41	28	26	21	20	21
Energy					14	9	7	6	13	7	6	4	4	4
Fat					19	11	9	7	18	9	7	5	4	5
Folate, naturally occurring	4	11	6	4										
Dietary folate equivalents [§]					11	8	8	7	9	5	5	4	4	4
Iodine	68 [^]	77 [^]	74 [^]	66 [^]	57	45	40	35	43	27	25	20	17	19
Magnesium	9	20	13	8	15	10	9	7	14	9	8	6	5	5
Phosphorus	15	32	21	14	26	18	16	13	26	16	14	10	9	10
Protein	9	22	13	8	19	12	10	8	18	10	9	6	5	6
Riboflavin	23	38	26	21	30	21	20	15	33	21	21	17	14	16
Thiamin	6	13	7	5	<1	<1	<1	<1	2	1	1	<1	1	1
Vitamin A (Retinol equivalents)	7	22	12	6	23	15	13	12	22	12	11	9	5	6
Vitamin B ₁₂	16	41	25	14					49	35	30	22	18	21
Vitamin B ₆	7	13	8	6	0	0	0	0	20	12	10	7	5	6
Vitamin D	3	8	4	2	44	29	23	25	NA	NA	NA	NA	NA	NA
Zinc	8	20	12	7	15	10	8	7	14	9	8	5	5	5

[♦] All percentage contributions have been rounded to the nearest whole number.

[♣] Day 1 and 2 average.

¹⁶ 'Milk' includes fluid milk, evaporated milk, condensed milk and milk powder (including undiluted and dry forms) from cows, sheep and goats, irrespective of fat content. Milkshakes, flavoured milks and milk used in recipes are not included.

* Source: (ABS 2014b)

φ Dietary folate equivalents recognise a differential bioavailability between folate and folic acid. Dietary folate equivalents = naturally occurring folates + (1.67 x folic acid). Currently the Code treats folic acid and folate as having equivalent bioavailability; this applies to reference amounts for nutrition labelling and the derivative criteria for health and nutrition claims as well as indirectly controlling voluntary fortification.

^ For Iodine in the 1995 AusNNS, 'Milk' includes all milks, yoghurts, cheese, ice cream, butter and their use in recipes.

Notes:

- Grey shading indicates that milk is a major contributing food ($\geq 20\%$) to the intake of the nutrient for the population group listed.
- For all other vitamins and minerals and for iodine in the 2007 ANCNPAS and 2011-12 NNPAS, milk includes fluid milk, evaporated milk, condensed milk and milk powder (including undiluted and dry forms). Milkshakes, flavoured milks and milk used in recipes are not included.

Table A1.5: Percentage contribution of milk¹⁷ to estimated nutrient intakes for New Zealand

Nutrient	Percent contribution of milk (%)						
		More recent data					
	1997 NZNNS	2002 NZCNS			2008 NZANS		
	15 years and above (n=4,636)	5-8 years (n=1,286)	9-13 years (n=1,675)	5-14 years (n=3,275)	15-18 years (n=347)	19 years and above (n=4,374)	15 years and above (n=4,721)
Calcium	38	33	32	33	22	28	28
Energy	6	6	5	6	3	4	4
Fat	6	8	7	7	4	4	4
Folate, naturally occurring	4						
Dietary folate equivalents ^φ	3				5	6	5
Iodine	31	31	29	30	16	17	17
Magnesium	8	9	8	9	6	7	7
Phosphorus	16	17	16	17	10	13	13
Protein	10	11	10	10	6	8	8
Retinol equivalents	6	13	11	12	5	4	4
Riboflavin	27	23	21	22	20	24	24
Thiamin	5	4	3	4	3	4	4
Vitamin A	6						
Vitamin B ₁₂	15	19	17	18	11	14	13
Vitamin B ₆	7	6	6	6	2	3	3
Vitamin D	2				17	17	17
Zinc	8	8	8	8	5	6	6

♦ All percentage contributions have been rounded to the nearest whole number.

φ Dietary folate equivalents recognise a differential bioavailability between folate and folic acid. Dietary folate equivalents = naturally occurring folates + (1.67 x folic acid). Currently the Code treats folic acid and folate as having equivalent bioavailability; this applies to reference amounts for nutrition labelling and the derivative criteria for health and nutrition claims as well as indirectly controlling voluntary fortification.

¹⁷ 'Milk' includes fluid milk, evaporated milk, condensed milk and milk powder (including undiluted and dry forms) from cows, sheep and goats, irrespective of fat content. Milkshakes, flavoured milks and milk used in recipes are not included.

Notes:

- Grey shading indicates that milk is a major contributing food ($\geq 20\%$) to the intake of the nutrient for the population group listed.
- For all other vitamins and minerals and for iodine in the 2002 NZCNS, milk includes fluid milk, evaporated milk, condensed milk and milk powder (including undiluted and dry forms). Milkshakes, flavoured milks and milk used in recipes are not included.

Table A1.6: Estimated mean intakes (per day) of vitamins and minerals for Australia and New Zealand, based on cereal-based beverage assessment (A500)

Vitamin/ Mineral	Country	Population Group [^]	Estimated mean intake per day			
			General population		Non-dairy consumers	
			(includes dairy and non-dairy consumers)	(with or without consumption of unfortified plant- based milk substitutes)	(with consumption of plant-based milk substitutes only)	
					Unfortified	Fortified
Calcium (mg)	Australia	2 years and above	847	337	407	690
		2–4 years	808	231 ^Δ		
		5–14 years	870	296		
		15 years and above	845	346		
	New Zealand	15 years and above	788	329		
Folate, naturally occurring (μg)	Australia	2 years and above	n/a	240	411	333
		2–4 years	n/a	160 ^Δ		
		5–14 years	n/a	181		
		15 years and above	n/a	251		
	New Zealand	15 years and above	243	187		
Iodine (μg) (NB: pre- mandatory fortification data)	Australia	2 years and above	n/a	50	43	46
		2-4 years	n/a	48 ^Δ		
		5–14 years	n/a	46		
		15 years and above	n/a	50		
	New Zealand	15 years and above	n/a	44		

Vitamin/ Mineral	Country	Population Group [^]	Estimated mean intake per day			
			General population	Non-dairy consumers		
			(includes dairy and non-dairy consumers)	(with or without consumption of unfortified plant- based milk substitutes)	(with consumption of plant-based milk substitutes only)	
				Unfortified	Fortified	
Magnesium (mg)	Australia	2 years and above	314	251	347	364
		2–4 years	202	144 ^Δ		
		5–14 years	256	186		
		15 years and above	329	264		
	New Zealand	15 years and above	310	245		
Phosphorus (mg)	Australia	2 years and above	1,451	1,045	1,208	1,426
		2–4 years	1,047	643 ^Δ		
		5–14 years	1,304	823		
		15 years and above	1,495	1,088		
	New Zealand	15 years and above	1,468	1,008		
Riboflavin (mg)	Australia	2 years and above	2.1	1.2	1.3	1.8
		2–4 years	1.9	0.8 ^Δ		
		5–14 years	2.2	1.0		
		15 years and above	2.0	1.3		
	New Zealand	15 years and above	1.8	1.0		
Thiamin (mg)	Australia	2 years and above	1.6	1.3	1.7	1.7
		2–4 years	1.3	1.0 ^Δ		
		5–14 years	1.7	1.2		
		15 years and above	1.6	1.4		
	New Zealand	15 years and above	1.4	1.0		

Vitamin/ Mineral	Country	Population Group [^]	Estimated mean intake per day			
			General population	Non-dairy consumers		
			(includes dairy and non-dairy consumers)	(with or without consumption of unfortified plant- based milk substitutes)	(with consumption of plant-based milk substitutes only)	
				Unfortified	Fortified	
Vitamin A (retinol equivalents) (µg)	Australia	2 years and above	1,123	1,010	1,012	1,170
		2–4 years	714	326 ^Δ		
		5–14 years	956	553		
		15 years and above	1,171	1,095		
	New Zealand	15 years and above	1,105	759		
Vitamin B ₆ (mg)	Australia	2 years and above	1.5	1.2	1.7	1.8
		2–4 years	1.1	0.9 ^Δ		
		5–14 years	1.5	0.9		
		15 years and above	1.6	1.3		
	New Zealand	15 years and above	1.4	1.1		
Vitamin B ₁₂ (µg)	Australia	2 years and above	4.3	4.1	2.1	3.2
		2–4 years	2.8	2.2 ^Δ		
		5-14 years	3.7	2.4		
		15 years and above	4.5	4.4		
	New Zealand	15 years and above	4.8	3.7		
Vitamin D (µg)	Australia	2 years and above	1.9	1.6	1.5	3.5
		2–4 years	1.2	0.7 ^Δ		
		5-14 years	1.8	1.3		
		15 years and above	2.0	1.6		
	New Zealand	15 years and above	2.3	2.0		

Vitamin/ Mineral	Country	Population Group [^]	Estimated mean intake per day			
			General population	Non-dairy consumers		
			(includes dairy and non-dairy consumers)	(with or without consumption of unfortified plant- based milk substitutes)	(with consumption of plant-based milk substitutes only)	
				Unfortified	Fortified	
Zinc (mg)	Australia	2 years and above	11.4	9.7	9.6	10.4
		2–4 years	7.2	4.9 ^Δ		
		5–14 years	9.9	7.5		
		15 years and above	11.8	10.1		
	New Zealand	15 years and above	12.2	10.0		

Consumers only – This includes only the people who have not consumed any 'dairy products'.

[^] Information regarding consumer numbers assessed for each population group can be found in Table A1.9.

^Δ These figures are to be used as a guide only due to the small consumers in this population group (n=12).

Table A1.7: Comparison of the estimated mean intakes (per day) of vitamins and minerals, excluding supplements, for the Australian general population using the 1995, 2007 and 2011-12 nutrition surveys

Vitamin/ Mineral	Population Group	Estimated mean dietary intake per day		
		1995 AusNNS*	2007 ANCNPAS*	2011-12 NNPAS ^{▲*}
Calcium (mg)	2 years and above	847		805
	2-4 years	808	808	
	5-14 years	870	859	
	15 years and above	845		
Dietary folate equivalents [♢] (μg)	2 years and above	577		613
	2-4 years	454	445	
	5-14 years	584	471	
	15 years and above	582		
Folates, naturally occurring (μg)	2 years and above	n/a		278
	2-4 years	n/a	n/a	
	5-14 years	n/a	n/a	
	15 years and above	n/a		
Folates, total [♠] (μg)	2 years and above	289		479
	2-4 years	195	n/a	
	5-14 years	256	n/a	
	15 years and above	299		
Folic acid (μg)	2 years and above	129		200
	2-4 years	117	105	
	5-14 years	161	105	
	15 years and above	125		

Vitamin/ Mineral	Population Group	Estimated mean dietary intake per day		
		1995 AusNNS*	2007 ANCNPAS*	2011-12 NNPAS ^{▲*}
Iodine (µg)	2 years and above	102		172
	2-4 years	91	123	
	5-14 years	98	132	
	15 years and above	104		
Magnesium (mg)	2 years and above	314		320
	2-4 years	202	233	
	5-14 years	256	288	
	15 years and above	329		
Phosphorus (mg)	2 years and above	1,451		1,422
	2-4 years	1,047	1,144	
	5-14 years	1,304	1,387	
	15 years and above	1,495		
Retinol equivalents (µg)	2 years and above	1,123		815
	2-4 years	714	668	
	5-14 years	956	736	
	15 years and above	1,171		
Riboflavin (mg)	2 years and above	2.1		1.9
	2-4 years	1.9	2.4	
	5-14 years	2.2	2.5	
	15 years and above	2.0		
Thiamin (mg)	2 years and above	1.6		1.6
	2-4 years	1.3	1.5	
	5-14 years	1.7	1.8	
	15 years and above	1.6		

Vitamin/ Mineral	Population Group	Estimated mean dietary intake per day		
		1995 AusNNS*	2007 ANCNPAS*	2011-12 NNPAS [^] ‡
Vitamin B ₆ (mg)	2 years and above	1.5		1.4
	2–4 years	1.1	n/a	
	5–14 years	1.5	n/a	
	15 years and above	1.6		
Vitamin B ₁₂ (µg)	2 years and above	4.3		4.4
	2–4 years	2.8	n/a	
	5–14 years	3.7	n/a	
	15 years and above	4.5		
Vitamin D (µg)	2 years and above	1.9		n/a
	2–4 years	1.2	3.2	
	5–14 years	1.8	3.0	
	15 years and above	2.0		
Zinc (mg)	2 years and above	11.4		10.6
	2–4 years	7.2	8.2	
	5–14 years	9.9	10.4	
	15 years and above	11.8		

Consumers only – This includes only the people who have not consumed any 'dairy products'.

[^] Information regarding consumer numbers assessed for each population group can be found in Table A1.9.

* Before introduction of mandatory folic acid fortification of bread-making flour and mandatory iodine fortification of salt used for bread-making

[^] Excludes vitamin/mineral intakes from supplements.

‡ Source: (ABS 2014b)

φ Dietary folate equivalents recognise a differential bioavailability between folate and folic acid. Dietary folate equivalents = naturally occurring folates + (1.67 x folic acid). Currently the Code treats folic acid and folate as having equivalent bioavailability; this applies to reference amounts for nutrition labelling and the derivative criteria for health and nutrition claims as well as indirectly controlling voluntary fortification.

λ Total folates = naturally occurring folates + folic acid, as per the Code definition of folates

Table A1.8: Comparison of the estimated mean intakes (per day) of vitamins and minerals, excluding supplements, for the New Zealand general population aged 15 years and above using the 1997 and 2008 nutrition surveys

Vitamin/ Mineral	Estimated mean dietary intake per day [^]	
	1997 NZNNS	2008 NZANS
Calcium (mg)	788	867
Dietary folate equivalents (µg)	n/a	352
Folates, naturally occurring (µg)	243	263
Folic acid (µg)	n/a	53
Iodine (µg)	72 ^υ	62
Magnesium (mg)	310	320
Phosphorus (mg)	1,468	1,427
Retinol equivalents (µg)	1,105	882
Riboflavin (mg)	1.8	2.0
Thiamin (mg)	1.4	1.5
Vitamin B ₆ (mg)	1.4	2.1
Vitamin B ₁₂ (µg)	4.8	4.4
Vitamin D (µg)	2.3	4.6
Zinc (mg)	12.2	11.3

[^] Excludes vitamin/mineral intakes from supplements.

^υ Data as per the P230 – Consideration of Mandatory Fortification with Iodine for New Zealand (FSANZ 2008) dietary iodine intake assessment, excluding discretionary iodised salt intakes. This uses a different methodology to the A500 assessment.

Table A1.9: Estimated mean protein intakes (g/day) for Australian and New Zealand population groups, as per cereal beverage assessment (A500)

Country	Population Group [^]	Number of survey respondents			Estimated mean protein intake (g/day)		
		General population	Non-dairy consumers		General population	Non-dairy consumers	
		Includes dairy and non-dairy consumers	With or without plant-based milk substitutes	With plant-based milk substitutes	Includes dairy and non-dairy consumers	With or without plant-based milk substitutes	With plant-based milk substitutes
Australia [◆]	2 years and above	13,858	734	60	86	71	70
	2–4 years	583	12		54	43 [△]	n/a
	5–14 years	1,844	99		73	57	n/a
	15 years and above	11,431	623		90	74	n/a
New Zealand [△]	15 years and above	4,636	205		87	68	n/a

◆ 1995 AusNNS

△ 1997 NZNNS

△ this figure is to be used as a guide only due to the small consumers in population group (n=12)

Grey shading indicates that data are not available due to low consumer numbers.

Table A1.10: Estimated mean protein intakes (g/day), excluding supplements, for general Australian population groups, including more recent survey data

Population Group	Number of survey respondents			Estimated mean protein intake (g/day)*		
	General population			General population		
	1995 AusNNS	2007 ANCPAS	2011-12 NNPAS	1995 AusNNS	2007 ANCPAS	2011-12 NNPAS**
2 years and above	13,858	n/a	12,153	86	n/a	88
2-4 years	583	911	n/a	54	62	n/a
5-14 years	1,844	2,997	n/a	73	82	n/a
15 years and above	11,431	n/a	n/a	90	n/a	n/a

* All protein intakes have been rounded to the nearest whole number

** Source: (ABS 2014b)

Grey shading indicates that data are not available

Table A1.11: Comparison of estimated mean protein intakes (g/day), excluding supplements, for general New Zealand population groups, for the 1997, 2002 and 2008 nutrition surveys

Population Group	Number of survey respondents			Estimated mean protein intake (g/day)*		
	General population			General population		
	1997 NZNNS	2002 NZCNS	2008 NZANS	1997 NZNNS	2002 NZCNS	2008 NZANS
15 years and above	4,636	n/a	4,721	87	n/a	88
5-14 years	n/a	3,275	n/a	n/a	71	n/a

* All protein intakes have been rounded to the nearest whole number

Grey shading indicates that data are not available

Table A1.12: Estimated mean fat intakes (g/day) for Australian and New Zealand population groups, based on cereal beverage assessment (A500)

Country	Population Group [^]	Number of survey respondents			Estimated mean fat intake (g/day)		
		General population	Non-dairy consumers		General population	Non-dairy consumers	
		Includes dairy and non-dairy consumers	With or without plant-based milk substitutes	With plant-based milk substitutes	Includes dairy and non-dairy consumers	With or without plant-based milk substitutes	With plant-based milk substitutes
Australia [◆]	2 years and above	13,858	734	60	81	64	n/a
	2–4 years	583	12		58	44 [△]	n/a
	5–14 years	1,844	99		79	59	n/a
	15 years and above	11,431	623		82	65	n/a
New Zealand [△]	15 years and above	4,636	205		89	70	n/a

◆ 1995 AusNNS

△ 1997 NZNNS

△ Note: this figure is to be used as a guide only due to the small consumers in population group (n=12)

Grey shading indicates that data are not available due to low consumer numbers.

Table A1.13: Estimated mean fat intakes (g/day), excluding supplements, for general Australian population groups, including more recent survey data

Population Group	Number of survey respondents			Estimated mean fat intake (g/day)*		
	General population			General population		
	1995 AusNNS	2007 ANCNPAS	2011-12 NNPAS	1995 AusNNS	2007 ANCNPAS	2011-12 NNPAS [¶]
2 years and above	13,858	n/a	12,153	81		73
2–4 years	583	911	n/a	58	54	
5–14 years	1,844	2,997	n/a	79	72	
15 years and above	11,431	n/a	n/a	82		

* All fat intakes have been rounded to the nearest whole number

¶ Source: (ABS 2014b)

Grey shading indicates that data are not available

Table A1.14: Comparison of estimated mean fat intakes (g/day) for general New Zealand population groups, for the 1997, 2002 and 2008 nutrition surveys

Population Group	Number of survey respondents			Estimated mean fat intake (g/day)*		
	General population			General population		
	1997 NZNNS	2002 NZCNS	2008 NZANS	1997 NZNNS	2002 NZCNS	2008 NZANS
15 years and above	4,636	n/a	4,721	89	n/a	83
5–14 years	n/a	3,275	n/a	n/a	77	n/a

* All fat intakes have been rounded to the nearest whole number

Grey shading indicates that data are not available

Table A1.15: Estimated mean energy intakes (including dietary fibre) (kJ/day), excluding supplements, for general Australian population groups, including more recent survey data

Population Group	Number of survey respondents			Estimated mean energy intake (kJ/day)*		
	General population			General population		
	1995 AusNNS	2007 ANCNPAS	2011-12 NNPAS	1995 AusNNS	2007 ANCNPAS	2011-12 NNPAS**
2 years and above	13,858	n/a	12,153	9,185		8,520
2–4 years	583	911	n/a	6,595	6,470	
5–14 years	1,844	2,997	n/a	8,940	8,575	
15 years and above	11,431	n/a	n/a	9,355		

* All energy intakes have been rounded to the nearest five kilojoules. Energy intake includes dietary fibre.

** Source: (ABS 2014b)

Grey shading indicates that data are not available

Table A1.16: Comparison of estimated mean energy intakes (without dietary fibre) (kJ/day), excluding supplements, for general New Zealand population groups, for the 1997, 2002 and 2008 nutrition surveys

Population Group	Number of survey respondents			Estimated mean energy intake (kJ/day)*		
	General population			General population		
	1997 NZNNS	2002 NZCNS	2008 NZANS	1997 NZNNS	2002 NZCNS	2008 NZANS
15 years and above	4,636	n/a	4,721	9,375	n/a	9,105
5–14 years	n/a	3,275	n/a	n/a	8,618	n/a

* All energy intakes have been rounded to the nearest five kilojoules. Energy intake does not include dietary fibre.

Grey shading indicates that data are not available

Appendix 2 – Summary of risk assessment questions and answers

Question Type	Question	Location of Response in Report
Consumption patterns and market share	How do the usage patterns of nut- and seed-based beverages compare to usage patterns of milk by discrete consumers of these two foods in all population groups? For example, what proportions of total milk or nut- and seed-based beverages are consumed as a beverage, used on breakfast cereal, and for other uses?	Section 0 – 3.3 How nut-based beverages and other plant-based milk substitutes are consumed
	What proportion of individuals who report consuming nut- and seed-based beverages also consume milk?	Section 0 – 3.2 Proportion of the Australian and New Zealand populations consuming plant-based milk substitutes
	What impact on market share of the different types of milk analogues has the emergence and growth of nut- and seed-based beverages had over the past 5 years?	Section 0 – 2 Market share of nut-, seed- and other plant-based milk substitutes
Consumer behaviour	What are consumer perceptions around nut- and seed-based beverages?	Section 0 – 4 Consumer perceptions of nut- and seed-based beverages Section 0 – 10 How would consumers perceive fortified nut- and seed-based beverages?
	Why are people purchasing and consuming the products? How are consumer perceptions linked to these two outcomes?	Section 0 – 4 Consumer perceptions of nut- and seed-based beverages Section 0 – 10 How would consumers perceive fortified nut- and seed-based beverages?
	How are consumer perceptions affected by fortification of nut- and seed-based beverages, compared to unfortified versions?	Section 0 – 10 How would consumers perceive fortified nut- and seed-based beverages?
Product characteristics	Do nut- and seed-based beverages have similar appearance and texture to cow's milk?	Section 0 – 6.1 How are nut- and seed-based beverages produced?
Effects of processing and storage on the added vitamins and minerals	What is the likely effect of processing and storage on the lability of the requested vitamin and minerals in nut- and seed-based beverages?	Section 0 – 6.1 How are nut- and seed-based beverages produced? Section 0 – 6.2 Stability of added vitamins and minerals in nut- and seed-based beverages

Question Type	Question	Location of Response in Report
Bioavailability of the added vitamins and minerals	Are there any constituents in nut- and seed-based beverages that could bind the added vitamins and minerals and prevent their absorption?	Section 0 – 7 Absorption of added vitamins and minerals from plant-based milk substitutes
Dietary intakes of the requested vitamins and minerals	What are the differences in the dietary intakes of the requested vitamins and minerals between milk consumers and unfortified nut- and seed-based beverages consumers for all population groups?	Differences between the general population (dairy and non-dairy consumers) and non-dairy consumers are provided in Section 0 – 8.2.1 Vitamin and mineral intakes.
	What is the difference in the dietary intake of macronutrients of young children (aged 2-5 years) consuming nut- and seed-based beverages without milk or legume-based beverages, compared to those consuming milk?	Due to the low number of Australian non-dairy consumers aged 2–4 years, nutrient intakes of these consumers should be interpreted as a guide only. See Section 0 – 8.2.1.1 Vitamin and mineral dietary intake assessments for non-dairy consumers, based on the cereal-based beverages assessment (A500).
	What is the risk of excess dietary intake of the requested vitamins and minerals for all population groups if added to nut- and seed-based beverages?	Section 0 – 9 Risk of excess nutrient intakes