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Milk Alternative Beverages

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Summary

Cow's milk provides an important source of energy, protein, fat, vitamins and minerals to the diets of Canadian children. For individuals who do not tolerate cow's milk, there are a variety of milk alternatives available. The use of these products in children, however, does pose several concerns. Many of the milk alternatives do not provide adequate macronutrients and micronutrients required for children during periods of rapid growth and development, and may contain harmful ingredients. Current guidelines suggest these alternatives are unsafe for children aged 2 and under, and for those over 2, products should be selected based on advice from a Registered Dietitian or other health care provider.

Introduction

The term 'milk alternatives' is used to describe beverages intended to substitute for cow's milk. Many plant-based milk alternatives can easily be found, sourced from various ingredients such as almonds, coconut, hemp, oat, rice, soy, among others. These products are appealing for individuals who are unable to consume cow's milk, due to allergy or intolerance, eat a vegetarian/vegan diet or for personal preference. Animal-based milk alternatives are also available, such as goat milk or kefir, a fermented milk product made from cow, sheep, or goat milk. Animal-based milk alternatives however, are not recommended for consumption for treatment of allergy or intolerance, due to high cross-reactivity to cow's milk.

Some of the appeal of plant-based milk alternatives is that products are advertised or perceived as being healthier options. They are typically lower in fat, cholesterol-free, and lactose-free, however, tend to have increased amounts of added sugar, especially in flavoured varieties, and lower protein content, when compared to whole cow's milk. See **Table 1** for more detailed summary and nutrient comparison. As well, there is no standard of fortification for these products, and fortification is voluntary [1]; not all beverages contain the same level of essential nutrients typically found in dairy products.

Nutrient Considerations

Milk is an important food for growing children. It provides them with important micronutrients, such as calcium and vitamin D, to help build strong bones and teeth. Dietary Reference Intake (DRI) for each nutrient is summarized in **Table 2**. Milk is also an excellent source of protein and fat, necessary for growth, development, and energy.

Editor's Note
Summer Newsletter #2

Greetings! I hope all of you have had a fantastic summer. As summer ends, a new school year begins, it means back to school shopping, packing lunches and sending off little ones to school. Our feature article for this summer was an idea from one of our DCPPN members. With milk allergies and intolerance rising, many parents are turning to alternative milks to provide their children with a healthy alternative. Are these milks a safe and healthy substitute for young children? Andrea Carpenter provides us with a fantastic article about Milk Alternatives. This article will help guide you with the concerns surrounding Milk Alternatives and allow you to educate families who are considering Milk Alternatives.

Remember that we are always looking for new topics and authors. If you have an idea about an article or are willing to write about your area of expertise, please contact me.

Sincerely,
Andrea Young
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Table 1: Milk Comparison Chart

Milk / Milk Alternative	Serving Size (mL)	Calories (kcal)	Protein (g)	Fat (g)	Carbo-hydrate (g)	Calcium (mg)	Vitamin D (IU)
Almond beverage [2]*	250	91	1.0	2.5	15.8	451	101
Breast milk [1]	250	182	2.7	11.4	17.9	83	10
Coconut beverage [3]*	250	73	0	4.7	8.3	110**	180**
Cow's (whole) milk [1]	250	157	8.1	8.4	12.4	291	102
Goat (whole) milk [1]*	250	178	9.2	10.7	11.5	345	100
Goat (whole) milk [1]	250	178	9.2	10.7	11.5	345	100
Hemp beverage [4]*	250	146	3.1	5.2	20.1	550**	180**
Oat beverage [5]*	250	125	4.2	3.1	20.1	330**	150**
Rice beverage [1]*	250	127	0.4	2.1	26.3	315	88
Soy beverage [1]	250	140	8.5	4.5	16.3	65	0
Soy beverage [1]*	250	110	6.7	3.8	12.6	321	88

*Enriched
**Calculated Calcium (mg) and Vitamin D (IU) based on %DV

Table 2: DRI for Calcium and Vitamin D [6]

Age group	RDA for Calcium (mg)	UL for Calcium (mg)	RDA for Vitamin D (IU)	UL for Vitamin D (IU)
Infants 0-6 months	200	1000	400	1000
Infants 7-12 months	260	1500	400	1500
Children 1-3 years	700	2500	600	2500
Children 4-8 years	1000	2500	600	3000
Children 9-18 years	1300	3000	600	4000

RDA: Recommended Dietary Allowance
UL: Tolerable Upper Limit

Calcium

Many milk alternatives, as mentioned above, are fortified with nutrients to make them comparable to cow's milk. The bioavailbility of these added nutrients are influenced by other compounds present in the milk beverages and will affect the body's ability to absorb the calcium. Vitamin D helps promote the absorption of calcium whereas oxalates and phytates present in plant-based milk alternatives bind calcium decreasing its absorption. Some studies have shown that calcium absorption can be reduced by 25% in soy beverages, when fortified with calcium triphosphate, compared to the amount of calcium absorbed from drinking cow's milk [7, 8]. See **Table 3** for summary of calcium absorption. A number of plant-based milk alternatives are fortified with tricalcium phosphate, including oat, hemp, coconut, soy, rice [1-5]. In addition to decreased availability, calcium added to soy beverages can settle and remain at the bottom of the container, regardless of the type of calcium used to fortify the product, despite rigorous shaking, reducing the calcium availability compared to what is stated on the label [9]. Children consuming milk-alternatives should have a comprehensive assessment by a Registered Dietitian to ensure they are meeting their needs for calcium (see **Table 2** for requirements).

Table 3: Equivalencies of Bioavailable Calcium [10,11]

Milk / Milk Alternative	Serving size (mL)	Average calcium content (mg)	Estimated absorption (%)	Calcium absorbed (mg)	Servings required to equal 250 mL of milk
Cow's milk (whole, 2%, 1%, skim)	250	300	32.1	96	1.0
Soy beverage (fortified with tricalcium phosphate)	250	300	24.0	72	1.3
Soy beverage (fortified with calcium carbonate)	250	300	21.1	63	1.5

Vitamin D

There are two forms of vitamin D that are used to fortify cow's milk and commercial milk alternatives: vitamin D_2 (ergocalciferol) and vitamin D_3 (cholecalciferol). Vitamin D_3 is of animal origin and is obtained through the ultraviolet irradiation of 7-dehydrocholesterol from lanolin; vitamin D_2 is produced from the ultraviolet irradiation of ergosterol from yeast making it acceptable to vegans [12]. At supplementation levels within the current recommendations (**Table 2**), the absorption of vitamin D_2 and vitamin D_3 are similar. In Canada, cow's milk must be fortified with vitamin D; since it is such a commonly consumed beverage, milk provides a major dietary source of vitamin D [6]. Cow's milk is fortified with vitamin D and provides approximately 45% of the daily value (DV) whereas fortified plant-based alternatives may only have 10-25% DV of vitamin D [13]. Without vitamin D, calcium absorption is limited, and has been shown to decrease from 30% to 10% [14].

Protein

Canada's Food Guide recommends drinking either cow's milk or a milk alternative derived from soy. No other plant-based milk alternatives are listed as comparable options to cow's milk, due to the lower protein content in the other products. As summarized in **Table 1**, cow's milk and soy beverage have comparable amounts of protein, however all other plant-based alternatives are far lower.

Milk Alternatives in Young Children

The first two years of a child's life is a crucial period with rapid growth and development. Adequate energy and protein provision during this age is crucial. It has been well established in previous studies [15, 16] that inadequate macronutrient and micronutrient delivery are observed in children avoiding milk, due to allergy. This suggests that milk and milk products play an important role in providing adequate energy and protein in a child's diet.

It is estimated that approximately 2-3% of infants and young children have a cow's milk protein allergy (CMPA) and subsequently require an alternative [17]. Additionally, soy-protein allergy affects 1 in 10 infants with an underlying CMPA [18]. In cases of cow's milk allergy, guidance by a Registered Dietitian must be provided not only on avoidance of the allergen but also to ensure that safe alternatives are provided for age-appropriate nutrition. Poor substitution can result in significant health consequences due to a lack of specific and essential nutrients [19]. Additionally, not all alternatives are safe or appropriate substitutes for this young population, due to inadequate protein, fat and/or the potential presence of unsafe ingredients.

Birth to 2 years

Current Canadian guidelines suggest all children ages 2 and under who are not at least partially breastfed should receive either commercial infant formula or whole cow's milk [20]. In cases of confirmed CMPA infants receiving formula should be switched to an extensively hydrolyzed protein formula, such as amino acid-based formulas. In those who are exclusively breastfed and have a confirmed diagnosis of CMPA, the mother should implement a strict cow's milk free diet. Soy-based infant formulas are an option for some infants depending on age and symptoms, however the cross-reactivity to soy-protein in established CMPA is high [20].

Preparations other than commercial infant formula, including milk alternatives and homemade formulas, should not be used to replace breast milk or commercial infant formula. Plant-based milk alternatives from any source are not appropriate substitutions for this age group due to the lower content of energy, protein, fat, and iron [22].

2 years and older

Not all plant-based milk alternatives provide comparable nutrients. Eating Well with Canada's Food Guide recommends the use of fortified soy beverages in this age group if traditional cow's milk is not consumed [23]. Most other plant-based milk alternatives are too low in energy, protein, and/or fat, and thus not suitable for young children. Other animal-based milk alternatives are also not recommended due to the similar structure cow's milk; cross-reactivity to goat or sheep milk can be as high as 80%. In instances where cow's milk is restricted and a soy-based alternative is not suitable for a child, due to an allergy or intolerance, efforts should be made to include additional protein and fat sources to their diet. More suitable milk alternatives are those that are fortified and include at least 6 grams of protein per 250 mL serving [22].

Milk Alternative Ingredients: Safety Considerations

Arsenic

Arsenic is a naturally occurring carcinogenic that is found in rice milk and other rice products, and its harmful effects have been well established, however the toxicity depends on its oxidation state and form, either organic or non-organic. It is accepted that the organic form is less toxic and of less concern than the inorganic form, which is a first-level carcinogen [24]. The organic form is found in shellfish and seafood whereas the inorganic form is found in waters where rice and rice products are produced [24].

Small children are at particular risk of arsenic exposure through rice and rice product consumption. Common first foods are rice-based infant cereals; if a child has any food allergies, they may be exposed to additional products made from rice, including rice beverages. Current guidelines from the European Society of Pediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN) recommend arsenic intake via-rice based products be as minimal as possible and that rice-based beverages not be given to infants and young children [25].

Manganese

Plants such as coconut, soy, and rice are rich in manganese. Manganese is an important metal, often found in combination with iron and other minerals, however excessive intakes of this nutrient can lead to neurodegenerative disorders [26]. Coconut beverages are most likely to provide manganese above the UL in young children; drinking 2, 250 ml servings per day provides 232% and 155% of the recommended UL in ages 1-3 years and 4-8 years, respectively [1].

Phytoestrogens

The presence of phytoestrogens in soy milk is one of the main issues of controversy. Phytoestrogens are plant-derived compounds found most commonly in soy that are structurally similar to estrogen. Over the past decade, there has been debate over the use of products containing phytoestrogens. In high quantities, phytoestrogens have been shown to adversely affect the development of reproductive organs and fertility in animal models. However, despite numerous epidemiological and clinical studies, there is no clear consensus on whether consumption of these compounds are harmful in humans. Several studies have shown that soy-based infant formulas support normal growth and development as the sole source of nutrition in healthy infants [27].

Conclusion

Cow's milk is one of the most abundant beverages consumed throughout childhood, however is also one of the most common allergies affecting young children. There are many alternatives available on the Canadian market, but few are appropriate for children. It is important for all children with a suspected or confirmed CMPA to undergo assessment by a Registered Dietitian. The RD will provide education on avoiding the allergen and highlight safety concerns with the use of alternatives. Additionally, the RD can ensure adequate energy, protein, and fat intake for normal growth and development, ensure the child is meeting their micronutrient needs or identify the need for supplementation, and if necessary, prescribe a specialized infant formula.

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Chair Notes Summer #2 2015

Hello DCPNN Members,

In many ways the new year is not January 1st, but the first Tuesday after Labour day. The summer attractions all close down, the kids go back to school, the extracurricular activities start up and we knuckle back down to work again. The projects we have put aside for the summer get put back on the pile. For me that includes:

Submitting pediatric topics and speakers for the 2016 DC conference. If you have any topics or speakers that you think would be suitable for the annual conference please let me know before the deadline of September 15th .

Chairing the annual DCPNN Business meeting. This year the conference will be held via teleconference at noon Central time on Tuesday September 22nd. Please join us if you can. Dial in information is posted on the DCPNN Website (see link below).

Continuing to search out topics for our newsletters and tele-education sessions. Today's article was prompted by a question by one of our members. We are always happy to hear from you with questions or suggestions. You can post a comment on the DCPNN Website or contact me directly.

Happy new (school) year!

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