Nutrition Guideline

For Professional Reference Only

Healthy Infants and Young Children
Plant-based Beverages

Applicable to: Nurses, Physicians and Other Health Professionals

Summary of Key Recommendations

For the purpose of this guideline, when referring to age in months this will be chronological age for term infants and corrected age for preterm infants.

Birth to Age 24 months

- Soy, rice, almond, coconut, pea, and other plant-based beverages (fortified or non-fortified) are not appropriate alternatives to human milk, infant formula, or 3.25% (homogenized) cow's milk in the first 24 months of life as they do not provide adequate calories or fat, for appropriate growth and development.
- Human milk is the healthiest option for infant feeding, when available, and is recommended for up to 24 months or longer.
- If an infant is partially fed with human milk or not fed human milk, infant formula is recommended until 9–12 months of age, unless an infant is drinking soy formula.
- If infants are drinking a soy formula, continue to offer this formula until 24 months of age along with calcium-rich complementary foods. In previous years, follow-up soy formula was recommended between 12–24 months of age; however, they are no longer available.
- Pasteurized 3.25% cow's milk may be introduced at 9–12 months of age to healthy term infants and continue until 24 months of age.
- Most plant-based beverages are generally lower in protein (other than soy and pea) and fat compared to 3.25% cow's milk. Due to this, children 12–24 months drinking plant-based beverages as their main milk source may need more fat and protein from food to meet their nutritional requirements. A referral to a dietitian may also be considered.
- A child under 24 months of age who is not drinking human milk, infant formula, or 3.25% cow's milk, may benefit from a referral to a dietitian.

Ages 24 months and Older

- For children 24 months of age and older, human milk, skim, 1%, or 2% cow's milk can be offered. If a child is still drinking human milk, human milk feeding can continue.
- If cow's milk is not consumed for vegetarian, vegan or cultural reasons, Canada's food guide recommends offering fortified soy beverages. Unsweetened fortified soy beverage is preferred over those with added sugar.

- If parents or caregivers choose another plant-based beverage as a milk alternative for their child, recommend they look for a product that:
  - is labelled as fortified or enriched. Fortified products will provide at least 23% daily value of calcium (300 mg) and 10% daily value of vitamin D (80 IU = 2 mcg) per 1 cup (250 mL);
  - provides at least 6 g of protein per 1 cup (250 mL); and
  - contains less than 15% daily value of sugar (<15 g) per 1 cup (250 mL).

Introduction

The purpose of the Plant-Based Beverages Nutrition Guideline is to provide health professionals with an overview of evidence-based nutrition recommendations on appropriate plant-based beverages for healthy infants and young children to help support healthy growth and development. When referring to age in months, this will be chronological age for term infants and corrected age for preterm infants.

It will also provide answers to commonly asked questions (See Key Questions List).

This information is intended as a general resource only and is not meant to replace the medical counsel of a physician or individual consultation with a Registered Dietitian (RD). It is the responsibility of the health professional to evaluate the situation of each patient in their care and apply the nutrition guideline appropriately. Individuals who are at high risk of malnutrition or who have a medical condition that is impacted by nutrition should receive RD intervention. See Nutrition Guideline: Referral to a Registered Dietitian for more information.

Background

This nutrition guideline (NG) was developed by the 0–6 Target Population Provincial Working Group and is based on scientific evidence and best practice.

The original guideline was created based on the need for information regarding the appropriate usage of plant-based beverages in healthy infants and young children. Growing consumer interest in plant-based beverages and the increasing availability of plant-based beverages on the market have prompted updates to the NG.

With the growth of the plant-based beverage market, research has revealed there to be a corresponding rise in parents and caregivers offering plant-based beverages to infants and young children.[1] Current evidence has shown that growing interest in plant-based beverages may be driven by multiple factors. This includes the perception that plant-based beverages are healthier than traditional cow's milk, environmental concerns, personal health beliefs, and religious and cultural values resulting in the desire to avoid cow's milk.[1] Inappropriate use of plant-based beverages in young children can result in serious adverse health effects, which this NG aims to address.

Definitions

Arsenic: Arsenic is a naturally occurring element found in trace amounts in rock, soil, water, and air.[2] Human exposure to arsenic can be through drinking water and food.[3] Chronic exposure (over many years or decades) to certain forms of arsenic has been associated with a variety of negative health effects impacting the gastrointestinal tract, kidneys, liver, lungs, and skin, as well as contributing to the risk of certain cancers.[2,3]

Complete protein: A term used to describe the protein characteristics in a food; refers to the food containing all essential amino acids the human body needs.[4]

Essential amino acids: These are amino acids which cannot be produced in the body, and therefore, need to be obtained from food.[5]

Follow-up formula: Follow-up or second-stage formulas are intended for infants six months of age and older who are consuming solid foods.[6]

Fortified: Fortification refers to "the addition of one or more vitamins or minerals to a food product".[7]

Galactosemia: A rare genetic condition of carbohydrate metabolism in which a blocked or inactive enzyme does not allow the breakdown of galactose. It can cause serious illness if not identified and treated soon after birth.[7]

Kwashiorkor: A severe form of protein malnutrition in young children.[8,9]

Main milk source: The primary beverage a child drinks when they transition from human milk or infant formula to another beverage that is nutrient-rich, which is traditionally/often cow's milk.

Manganese: A trace mineral involved in the formation of bone and in amino acid, lipid, and carbohydrate metabolism.[10]

Marasmus: A severe form of protein-energy malnutrition involving chronic wasting of fat, muscle, and other tissues.[11]

Plant-based beverage: A beverage derived from legumes, nuts, seeds, grains, or potatoes.[12]

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Key Questions List

Key nutrition questions related to plant-based beverages addressed in this Nutrition Guideline are listed below.

Answers to Key Questions

What are plant-based beverages?

Plant-based beverages are beverages derived from legumes, nuts, seeds, and grains.[12] Beverages included below were those available in Alberta in November 2021:

Legume Based	Nut Based	Seed Based	Grain Based
Soy	Almond	Flax seeds	Oat
Pea	Cashew	Hemp seeds	Rice
	Coconut		
	Macadamia		

How do plant-based beverages compare nutritionally to breastmilk and cow's milk?

Human milk is the normal and unequalled method of feeding infants and is recommended for up to 24 months of age or longer.[13,14] It is recommended for children under 24 months of age to drink human milk or infant formula and 3.25% (homogenized) milk after 9–12 months of age.[6,13,14] Compared to these milks, plant-based beverages are generally lower in protein, fat, and calories.[6,15,16] Furthermore, nutrients in human milk such as protein and iron are more readily absorbed and efficiently utilized compared to other milks, including plant-based beverages.[17,18]

Because of their nutrient profile, plant-based beverages will not meet calorie or fat needs even with the consumption of solid foods[19,20] if they are used in the first 24 months of life as a substitute for human milk, infant formula, or 3.25% cow's milk. This may contribute to growth faltering.[21] If unfortified plant-based beverages are used as a whole or major source of nutrition, a child may be at risk of growth faltering,[13,21,22] marasmus (protein-calorie),[11] kwashiorkor (protein malnutrition),[8,9,19,23] and/or severe nutritional deficiencies.[8,9,19,21–25]

If parents or caregivers choose a plant-based beverage as a milk alternative for their child aged 24 months of age and older, recommend they look for a product that:

- is labelled as fortified or enriched;[12]
- provides at least 6 g of protein per 1 cup (250 mL);[12]
- provides at least 23% daily value of calcium (300 mg) and 10% daily value of vitamin D (80 IU = 2 mcg) per 1 cup (250 mL) ; and
- contains less than 15% daily value (<15 g) of sugar per 1 cup (250mL).

Note: Calcium and vitamin D recommendations for DV were previously 30% DV (based on 1100 mg calcium and 200 IU vitamin D), however, with updated Health Canada interim marketing authorization to permit the optional addition of vitamins and minerals to plant-based beverages, this has been recalculated to 23% DV for calcium (based on1300 mg calcium) and 10% DV for vitamin D (800 IU = 20 mcg vitamin D).[12]

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Table 1. Nutrient Comparison of Human milk, Cow's Milk, and Plant-based Beverages (per 250 mL or 8 oz) Based on Ranges From Various Products on the Market

This table represents some common plant-based beverage products available for purchase but is not a complete representation of all products. Considering the variability in nutrient composition of different products, this table illustrates the importance of checking the Nutrition Facts Table of each product.

Nutrient per 250 mL (8oz)	Human milk* (whole, mature)	Soy infant formula	Cow's milk (3.25%)	Note: Ranges in the chart below represent a variety of products that vary in nutrient composition with higher levels reflective of fortification. Even though some products contain higher amounts of certain nutrients (e.g., fortified products), most plant-based beverages do not contain the right amount of protein, calcium, vitamin D, fat, etc. to be considered as a replacement for cow's milk.									
				Legume		**Nut**				**Seed**	**Grain**		**RDA (children 1-3 years old)**
				Soy	**Pea**	**Almond**	**Cashew**	**Coconut**	**Blend (e.g. almond/ cashew, almond/ coconut)**	**Hemp**	**Oat**	**Rice**	
Energy (kcal)	182	169	155	70–160	60–146	30–130	25–130	45–80	35–90	50–80	70–160	120–130	Varies
Fat (g)	11	8.9	8	3–6	2.5–8	1.5–11	2–10	4.5–5	3–6	5	1.5–8	2.5–3	Varies
Carbohydrate (g)	18	17.9	12	3–23	1–17	0–22	1–7	1–8	1–2	1–7	1–26	25–26	130
Protein (g)	3*	4.2	8	5–12	4–8.3	1–5	1–4	0–0.5	1–8	2	1–4	0.2–2	1.05 g/kg/day
Vitamin A (mcg RE)	159	150	117	0–153	0–90	0–99	NA–99	NA–99	99	99	0–99	0–99	300
Calcium (mg)	83	174	286	26–325	0–351	0–442	26–325	0–299	299–325	299	13–494	0–325	700
Iron (mg)	0.08*	2.7	0	0.9–3.06	0–1.44	0.18–1.44	0.54–1.44	0.18–1.08	0.036–1.98	0.18	0–1.44	0–0.18	7
Vitamin D (IU)	10	101	104	0–120	0–200	0–88	0–88	0–80	80–88	80	0–88	0–88	600
Riboflavin (mg)	0.09	0.153	0.442	0.065–0.169	NA–0.39	NA–0.403	NA–0.403	NA–0.403	0.403	0.403	NA–0.403	NA–0.403	0.5
Vitamin B_{12} (mcg)	0.13	0.46	1.15	0.792–3.12	0.6–0.84	NA–1	NA–0.1	NA–1	1	1	NA–1	NA–1.056	0.9
Potassium (mg)	133	79	340	200–480	600–950	30–260	30–150	NA–40	30–250	100	0–400	NA–50	3000 (AI)
Manganese (mg)	0.068	0.049	0.010	NA	NA	NA	NA	NA	NA	NA	NA	NA	

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Nutrient per 250 mL (8oz)	Human milk* (whole, mature)	Soy infant formula	Cow's milk (3.25%)	Note: Ranges in the chart below represent a variety of products that vary in nutrient composition with higher levels reflective of fortification. Even though some products contain higher amounts of certain nutrients (e.g., fortified products), most plant-based beverages do not contain the right amount of protein, calcium, vitamin D, fat, etc. to be considered as a replacement for cow's milk.									
				Legume		**Nut**				**Seed**	**Grain**		**RDA (children 1-3 years old)**
				Soy	**Pea**	**Almond**	**Cashew**	**Coconut**	**Blend (e.g. almond/ cashew, almond/ coconut)**	**Hemp**	**Oat**	**Rice**	
Data Source	CNF #73 (milk, fluid, human [breast milk], whole, mature)[6]	Product labels 2021	CNF #113 (milk, fluid, whole, pasteurized, homogenized3 .3% M.F.)[6]	Product labels 2021	Product labels 2021	Product labels 2021	Product labels 2021	Product labels 2021 **Note:** This does not include canned coconut milk	Product labels 2021	Product labels 2021	Product labels 2021	Product labels 2021	

*__Human milk__ also contains anti-inflammatory factors, digestive enzymes, growth factors, and immunoglobulins.[5] Furthermore, nutrients such as **protein and iron** are more readily absorbed and efficiently utilized compared to other milks.[14,15]

NA = Information not available from source

CNF = Canadian Nutrient File

RDA = Recommended dietary allowance. The average daily dietary intake that is sufficient to meet the nutrient requirements of 97–98% of healthy individuals in a particular life-stage and gender group[26]

AI = Adequate intake. The recommended average daily intake of a nutrient estimated to meet the nutrient needs of healthy individuals. Used when an RDA is unavailable due to limited evidence[26]

Nutrition Facts Table Values were calculated using the Canadian Food Inspection Agency Chapter 7: Nutrient Content Claims, 7.25.4 Claims on foods for adults and children two years of age or over.

40 IU = 1 mcg vitamin D

What are the concerns with children under 24 months of age drinking a plant-based beverage as their main milk source?

Potential Nutrient Deficiencies

Plant-based beverages do not provide the calorie and fat content that infants require from beverages for growth and development.[21] Many plant-based beverages are lower in protein compared to cow's milk and therefore are less likely to meet the protein needs for appropriate growth and development.[20] Infants and young children drinking a plant-based beverage as their main milk source would be at risk of growth faltering,[13,21,22] marasmus (protein-calorie),[11] kwashiorkor (protein malnutrition),[8,9,19,23] and/or severe nutritional deficiencies.[8,9,19,21–25]

As noted in Table 1, many plant-based beverages are not a source of protein. Those beverages that are labelled as fortified but do not have the minimum amount of 6 g per 1 cup (250 mL) (or 2.5 g protein per 100 mL), must have the statement "not a source of protein" on the product label.[1]

Plant-based beverages also do not contain many of the vitamins and minerals that are naturally present in cow's milk such as vitamin B_{12}, riboflavin, and zinc.[21] Currently, there are no regulations that require plant-based beverages to be fortified.[12] However, if fortified, these beverages are required to be fortified with vitamin A, vitamin D, vitamin B_{12}, riboflavin, calcium, and zinc.[12] It is voluntary to add vitamin B_6, vitamin C, thiamine, niacin, folic acid, pantothenic acid, phosphorus, potassium, and magnesium.[12]

Potential Nutrient Toxicities

Plants such as coconut, soy, rice, oats, and nuts are naturally rich in manganese.[26] Nutrition labelling of plant-based beverages does not require manganese to be listed, so it is difficult to determine the exposure to manganese from these products. Several recent studies in school-aged children have reported deleterious cognitive and behavioural effects following excessive manganese exposure, primarily through drinking water.[26–28] There is presently no evidence of toxicity occurring directly from food sources, including plant-based beverages.[26,27]

Both canned coconut milk and coconut beverages are not suitable milk alternatives for young children, however, may be used in cooking or baking. Canned coconut milk (1.835 mg manganese per 250 mL) has the potential to exceed the upper limit (UL) of 2 mg per day for manganese in infants and toddlers.[15,29] Including canned coconut milk in cooking and baking is less likely to reach the UL as smaller amounts are used.

Are there any plant-based beverages appropriate for children under 24 months of age who are not drinking human milk, infant formula, or 3.25% cow's milk (after 9–12 months of age)?

No. Currently, there are no plant-based beverages on the market that are similar in nutrient composition to 3.25% cow's milk. Plant-based beverages are not appropriate alternatives to human milk, infant formula, or 3.25% milk for children under 24 months of age.[6,24]

Fortified soy beverages can be offered occasionally as a complementary food, in addition to human milk, formula, or cow's milk as the main milk source; in such cases ensure it is an unflavoured, full-fat, fortified soy beverage.[6]

Although plant-based beverages are not recommended as a main milk source until after 24 months of age,[6] some parents or caregivers may have received individual assessments and recommendations from a physician or dietitian to give a plant-based beverage. These individuals are recommended to continue follow-up with that physician or dietitian, so that intake of nutrients including protein, fat and calories, commonly obtained from 3.25% cow's milk can be considered in dietary planning.[21] Those who have not received individual assessment and wish to give a plant-based beverage as the child's main milk source may benefit from a referral to a dietitian or seek advice from their physician. Alternatively, encourage clients to call 811 (Health Link) to speak with an RD for further information.

For infants drinking a soy formula, what beverage is appropriate from 12 to 24 months of age?

Soy infant formula is recommended until 24 months of age for the older infant (6–12 months) and young child (12-24 months) who is no longer fed human milk and is not being introduced to cow's milk.[6] Indications for the use of a soy formula are limited to those who cannot consume dairy-based products for health, cultural, or religious reasons, such as a vegetarian lifestyle or infants who have galactosemia.[30] It should be noted that while Food and Drug Regulations (FDR) approve infant formulas, including soy formulas, to meet the nutrient and ingredient requirements for infants under 12 months,[31] there is currently no stage 2 infant formula on the market that complies with the nutrient and ingredient needs of a child 12–24 months. A child between 12–24 months of age has a calcium DRI of 700 mg,[29] while 2 cups (500 mL) of soy infant formula provide 348 mg calcium.[15] As their calcium needs will likely not be met from 2 cups (500 mL) of soy formula, it is important to offer the child calcium rich complementary foods daily; these include tofu, beans, green leafy vegetables, yogurt, and cheese. Parents or caregivers are advised to consult their family physician or a registered dietitian regarding the need for a liquid or chewable calcium supplement if the child drinking soy infant formula as their main milk source has difficulty consuming calcium rich complementary foods. Similarly, vitamin D requirements are difficult to meet through diet alone and the Nutrition Guideline: Vitamin D recommends all children from birth take a 400 IU vitamin D supplement regardless of milk choice and foods.

Soy beverages are not appropriate substitutes for soy formula as they contain less energy and fat and may not meet the nutritional needs for proper growth and development of a child under 24 months of age.[6,13] These drinks may not be fortified with other nutrients that are naturally present in cow's milk. The vitamins and minerals to be most likely compromised in fortified versions of these drinks include magnesium, zinc, vitamin A, riboflavin, vitamin B_6, and iodine.[21,24]

There are products marketed in Canada as plant-based drinks for infants 12 months and older.[32,33] Consult a dietitian to decide if these are appropriate for the child.

Are plant-based beverages appropriate for a child under 24 months of age who is allergic to cow's or goat's milk and soy?

No. Those who are offering a hypoallergenic formula for allergy (cow, goat, and/or soy) at 12 months can continue to offer this formula until 24 months of age or as directed by their physician. Plant-based beverages are not appropriate replacements for milk for children under 24 months of age with an allergy to cow or goat's milk and soy, as they are nutritionally incomplete. (Refer to Milk Allergy: Birth to 3 Years Nutrition Education Patient Handout)

Plant-based beverages are not recommended as the main milk source unless advised by a dietitian or physician based on individual assessment. These children are recommended to continue follow-up with that physician or dietitian so that intake of nutrients including protein, fat, and calories, commonly obtained from 3.25% cow's milk, can be considered in dietary planning.[21] Those who choose to give a plant-based beverage as the child's main milk source despite advice otherwise may benefit from a referral to a dietitian or advice from their physician to ensure nutritional adequacy of their diet. Alternatively, encourage clients to call 811 (Health Link) to speak with an RD for further information.

For information on appropriate formulas for children under 24 months of age with allergies refer to the Infant Formulas for Healthy Term Infants – Compendium & Summary Sheet. It is important to note that formulas designed for allergies are not considered vegan. Soy formulas contain vitamin D derived from lanolin from sheep's wool with no harm to the animal.

Are there any safety concerns with the use of soy formulas?

No. Current recommendations support the use of soy formulas for healthy term infants when indicated. Indications for the use of soy formula should be limited to those who cannot consume dairy-based products for health, cultural, or religious reasons, such as a vegetarian lifestyle, or infants who have galactosemia.[30]

Soy formulas contain phytoestrogens called isoflavones[6,30] which are non-steroidal chemicals structurally similar to estrogens.[34] In the past, media coverage and medical literature have prompted concerns regarding the phytoestrogens in soy formulas. However, soy formulas in term infants have been documented to support normal growth and development.[35] An expert panel from the National Institute of Environmental Health Sciences (NIEHS) has also expressed minimal concern over the adverse developmental effects in infants fed soy formula.[35]

A lack of sufficient evidence is available to suggest that soy formulas adversely affect endocrine function, development, or reproduction in infants.[31,35] However, further research is warranted, and the use of soy formulas should be limited to the indications noted above. After 24 months of age, Canada's food guide indicates that unsweetened fortified soy beverages can be consumed as part of a healthy diet.[36]

For indications on use and more information on soy formulas refer to the Infant Formulas for Healthy Term Infants – Compendium & Summary Sheet.

Are there any safety concerns with the use of rice-based formulas or rice-based beverages?

Possibly. Recent concerns have arisen regarding the consumption of rice and rice-based products, including those labelled as organic, due to high levels of inorganic arsenic relative to other foods. Arsenic is a naturally occurring element found in trace amounts in rock, soil, water, and air.[2] Human exposure to arsenic can be through drinking water and food.[2]

In food, arsenic can exist in both organic and inorganic forms. The organic form of arsenic is generally considered to be non-toxic[2,3,37] and is quickly eliminated by the body.[2,3] Ingested inorganic arsenic is highly bioavailable and is rapidly absorbed in the gastrointestinal tract.[37] For this reason, the inorganic form is considered to be of greater toxicological significance to human health[3,37,38] and has been classified by the International Agency on Research in Cancer as a "group 1 carcinogen".[39]

There is limited evidence to determine a safe daily or weekly intake of inorganic arsenic; however, it is possible that infants and toddlers could be exposed to higher levels of inorganic arsenic from rice-based products[3,39] during complementary feeding. This includes products like rice beverages, rice cereal, rice wafers, rice crackers, cooked rice, and rice cakes. Due to this posed risk of rice beverages being a source of arsenic (in addition to being nutritionally incomplete), the current Nutrition Guideline: Arsenic in Foods advises that they not be offered to children under 24 months of age.

For more information on this, see Nutrition Guideline: Arsenic in Foods.

When can a child be transitioned to a plant-based beverage? What do parents or caregivers look for?

At 24 months of age or older, if parents or caregivers wish to offer plant-based beverages to their child, Canada's food guide recommends it be fortified unsweetened soy beverage.[36] While specific amounts are not provided in Canada's food guide, cow's milk or unsweetened fortified soy beverage can be offered with meals or snacks as a practical way to meet calcium, vitamin D, and protein needs.[36]

Currently, fortification of plant-based beverages is voluntary in Canada.[12] Fortified soy beverage provides protein, vitamin and mineral composition similar to 2% cow's milk.[15,21] Soy protein, provided in soy beverages, is the only plant-based beverage that is a complete protein as it contains all essential amino acids children require for growth.[1,4] Plant-based beverages other than fortified soy may not be similar in vitamin and mineral composition to cow's milk.[21,23,25]

If parents or caregivers choose a plant-based beverage as a milk alternative for their child aged 24 months of age and older, recommend they look for a product that:

- is labelled as fortified or enriched;[12]
- provides at least 6 g of protein per 1 cup (250 mL);[12]
- provides at least 23% daily value of calcium (300 mg) and 10% daily value of vitamin D (80 IU = 2 mcg) per 1 cup (250 mL); and
- contains less than 15% daily value (<15 g) of sugar per 1 cup (250 mL).

If a child is not eating any animal-based protein, the family may benefit from a consultation with an RD to ensure the child is getting an adequate intake of all necessary nutrients.

What are the concerns with children 24 months of age or older drinking sweetened plant-based beverages as their main milk source?

High intake of added sugars can predispose children to increased risk for dental caries, overweight, obesity, and diabetes.[40] Due to these health risks, it is recommended that for children 24 months of age or older who are drinking a plant-based beverage as their main milk source, unsweetened plant-based beverages be chosen most often or choose those that contain less than 15 g of sugar per 1 cup (250 mL).

Sweetened plant-based beverages are not recommended for children as their main milk source due to high levels of added sugar. Sugary drinks include sweetened plant-based beverages that are flavoured e.g., vanilla, strawberry, chocolate, etc. Added sugars are those that are not naturally present in the food source but are added during processing. Current evidence on sugar intake among Canadian children has shown that sugary drinks are one of the top sources of added sugar in their diets.[41]

Are there any resources on plant-based beverages for healthy infants and children that I can use with my patients?

For infant nutrition resources visit Nutrition Education Materials at http://www.albertahealthservices.ca/nutrition/Page11115.aspx and click on **Children/Adolescents** and select **Plant-based beverages for Children**.

For more information related to healthy infants and children see Healthy Parents Healthy Children.

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