



Plant-based milks: the dental perspective

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Oliver Sumner¹ and **Lucy Burbridge**² look at the differences in the vitamin and mineral content of plant-based milk compared to cow's milk, and outline the potential dental implications.

Abstract

Background Consumption of plant-based milk in the UK is increasing at the expense of cow's milk. Cow's milk consumption has traditionally been advocated by the dental profession as 'good for teeth'.

Aims To identify the range of plant-based milks available in the UK and compare their nutritional benefits with cow's milk. A secondary aim was to explore reasons behind the increase in popularity of plant-based milks and discuss dental relevance.

Methods Branded plant-based milks available in UK supermarkets were identified and nutritional data collected. Data were obtained from product labelling and manufacturer websites. The sample was collected in December 2019.

Results Eighty-two products were identified. Differences were observed between plant-based and cow's milk, in particular regarding calcium, iodine, vitamin B12 and sugar content. Sugar content varied from 0–7.6 g/100 ml.

Conclusions Dairy is a key source of dietary iodine and many plant-based milks contain much lower levels. Many plant-based milks contain free sugars which are cariogenic. Dentists should be aware of this emerging market and be able to advise patients accordingly.

Introduction

Consumption of plant-based milk in the UK is increasing.

Mintel research shows a quarter of people (23%) used plant-based milks in 2019, an increase on previous years. This trend is driven by the 16–24 age group.¹ Sales of hot drinks made with plant-based milk have seen four-times year-on-year growth in UK coffee shops over recent years, and these are now available in chain coffee stores. It is estimated that 21 million plant-based coffees are served every week in the UK.²

This may be part of wider changes in UK diets. Vegetarian, vegan, non-meat and 'flexitarian' (an individual who eats plant-based meals without completely excluding meat from the diet) diets are increasingly popular and will make up an estimated 65% of the UK population by 2025.³ 'Veganuary' is an annual campaign encouraging people to adopt a vegan diet during January, which has been running since 2014 but has received more media attention in recent years. Vegan fast food options are booming, as shown by the recent proliferation of vegan products in high-profile high-street chains such as Greggs and Subway, among others.

Consumers may be choosing plant-based milks if they – or a member of their household – are unable to drink cow's milk, due to lactose intolerance or cow's milk protein allergy (CMPA). Alternatively, they may be chosen for ethical, environmental or perceived health reasons.

This paper aims to inform dental professionals of the reasons why people might be choosing plant-based milks and the range of the market in the UK, and to discuss the potential effects on dental and general health.

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CMPA

CMPA is an immune-mediated response to proteins found in cow's milk. Although rare, it is one of the most common food allergies in early life, with an estimated prevalence in developed countries of 0.5–5% by age one. In children, males are more commonly affected (this is the reverse in adulthood). CMPA tends to resolve with age, with half of children 'outgrowing' their allergy by five years old.⁴ Children with CMPA are commonly prescribed a hydrolysed formula milk by their general medical practitioner (GMP) or are advised to use a plant-based alternative depending on their age. This is discussed at length later.

Most cases of CMPA (60%) are IgE-mediated, a type I hypersensitivity reaction whereby IgE antibodies to cow's milk proteins bind to mast cells. Subsequent exposure to the proteins triggers mast cell degranulation and release of inflammatory mediators, which can cause gastrointestinal symptoms (pain, vomiting, diarrhoea), urticaria, angioedema, hypotension and respiratory distress. Symptoms usually occur within minutes. Cow's milk can cause anaphylaxis and can be fatal.⁴

Non-IgE-mediated reactions are a T-cell response and are more delayed. Symptoms manifest up to 48 hours (or even one week) after ingestion and include an itchy skin rash (atopic dermatitis), abdominal pain, reflux, bloating, diarrhoea and vomiting.⁴

Lactose intolerance and lactase deficiency

Lactose is a carbohydrate found in all mammalian milk and is the main carbohydrate in dairy products. It helps absorption of magnesium and zinc. Lactose is metabolised by the enzyme lactase, forming galactose and glucose. Lactose intolerance is a consequence of insufficient endogenous lactase production. Global prevalence is estimated at 68%, but this is much lower in Northern European countries. It generally develops between 20–40 years of age, although is seen in childhood. Undigested lactose passes into the colon where it is fermented by bacteria, producing gases as well as short-chain fatty acids. This can result in abdominal pains, cramps, flatulence and diarrhoea.⁵

Primary lactase deficiency is an inherited, age-related decrease in lactase activity, normally presenting between 5–20 years of age, and is a permanent reduction in enzyme activity of approximately 10–30%. Secondary lactase deficiency generally affects adults and is a transient consequence of damage to the lactase-producing cells in the intestine, as a

result of gastroenteritis, uncontrolled coeliac disease, inflammatory bowel disease (IBS), toxins and cancers. Symptoms commonly improve following cell healing.⁵

Management of CMPA, lactose intolerance and lactase deficiency is primarily by avoidance of lactose-containing food/drink – including dairy milk.

any decision to introduce plant-based milks into young children's diets. Discussion with local dietitians has revealed a preference for Koko Super (coconut) and Alpro Growing Up (soya). The latter contains 2.7 g sugar/100 ml, which dentists should be aware of.

UK guidance is that infants should be exclusively breastfed until six months old.

'Plant-based milks are not recommended for exclusive use until two years of age because they do not contain sufficient vitamins and nutrients required for healthy growth.'

Milk alternatives in the management of CMPA

Any parent or individual with concerns regarding feeding and potential CMPA should be signposted to their GMP and/or health visitor.

Prescription 'hypoallergenic' formula milks (referred to as hydrolysed formulas) are recommended for infants with CMPA or lactose intolerance/lactase deficiency.⁶ These products are based on cow's milk, but the proteins have been hydrolysed, to minimise risk of causing an allergic reaction. They are also lactose-free. They should be used following consultation with a GMP, dietitian and, possibly, medical specialist advice.

Partially hydrolysed formula is suitable for those with lactose intolerance and can be bought 'over the counter'. Extensively hydrolysed formula products are widely available, only on prescription from a GMP, for individuals with CMPA. Amino acid-based formulas are used for those not tolerating extensively hydrolysed formulas; however, these are less widely available globally. In the UK, the cost is two and a half times more: £5+/100 g compared to £2.36/100 g. For reference, 'regular' formula milk is approximately £1.70/100 g.⁷ Some formulas contain added sugars and syrups.⁸

Children and milks

Plant-based milks are not recommended for exclusive use until two years of age as they do not contain sufficient vitamins and nutrients required for healthy growth.⁹ Health visitors, GMPs and dietitians should be consulted in

Where this is not possible, formula (based on dairy milk) is the only suitable alternative under 12 months of age; alternative formula should only be given following medical advice.¹⁰

Cow's milk should not be given before one year of age as it does not contain sufficient iron compared to breast or formula milk. Whole milk can be given from one, semi-skimmed milk from two and skimmed milk after five years old.¹⁰

Rice milks should not be given to children under five years old due to concerns over the amount of arsenic that is present in rice and rice products.¹¹

The UK market: data collection

The online grocery stores of four major UK supermarkets (Asda, Sainsbury's, Tesco, Waitrose) were used to gather all branded plant-based milk products available as of December 2019. Supermarket 'own-brand' products were excluded. Products available only online or in health food stores were also excluded for convenience. Nutritional data of these products were obtained from supermarket and manufacturers' websites, and milk data from Dairy UK.^{12,13,14,15,16,17,18} These are presented in Table 1 allowing a comprehensive overview of the nutritional information of these products. However, it must be pointed out that this is a current snapshot of products at the time of writing (December 2019).

Price data presented are mean price per litre, calculated from non-promotional prices on the supermarkets' online grocery stores.

Table 1 Nutritional data of each milk product (where no nutritional data could be obtained, a '#' symbol is recorded) (cont. on next page)

Manufacturer	Product name	Mean price (£/litre)	Nutritional values (per 100 ml)							
			Energy (kcal)	Fat (g)	Saturated fat (g)	Sugars (g)	Vitamin B12 (mcg)	Calcium (mg)	Vitamin D (mcg)	Iodine (mcg)
-	Cow's milk organic skimmed	0.94	37	<0.5	0.1	5.0	0.4	128	0	15-25
	Cow's milk skimmed	0.73	37	<0.5	0.1	5.0	0.83	124	0	30-43
	Cow's milk organic semi-skimmed	0.94	50	1.8	1.1	4.8	0.93	120	0	15-25
	Cow's milk semi-skimmed	0.73	50	1.8	1.1	4.8	0.93	124	0	30-43
	Cow's milk organic whole	0.94	67	4.0	2.6	4.5	0.93	121	0	15-25
	Cow's milk whole	0.73	67	3.7	2.4	4.7	0.93	124	0	30-43
St Helen's farm	Goat milk skimmed	1.78	30	0.1	0.07	4.3	#	120	#	#
	Goat milk semi-skimmed	1.71	44	1.6	1.1	4.3	#	120	#	#
	Goat milk whole	1.71	61	3.5	2.4	4.3	#	120	#	#
Chilled shelf										
Alpro	Almond	1.80	22	1.1	0.1	2.4	0.38	120	0.75	0
	Almond Unsweetened	1.81	13	1.1	0.1	0	0.38	120	0.75	0
	Cashew	1.80	23	1.1	0.2	2	0.38	120	0.75	0
	Coconut	1.80	20	0.9	0.9	1.9	0.38	120	0.75	0
	Coconut Unsweetened	1.80	14	1.2	1.1	0	0.38	120	0.75	0
	Coconut & almond	1.82	23	1.3	0.6	2.5	0.38	120	0.75	0
	Hazelnut	1.80	29	1.6	0.2	3.1	0.38	120	0.75	0
	Oat	1.60	44	1.5	0.1	3.3	0.38	120	0.75	0
	Oat Unsweetened	1.28	40	1.5	0.2	0	0.38	120	0.75	0
	Soya Original	1.43	39	1.8	0.3	2.5	0.38	120	0.75	0
	Soya Unsweetened	1.43	33	1.8	0.3	0	0.38	120	0.75	0
	Soya Light	1.43	39	1.8	0.3	2.5	0.38	120	0.75	0
	Soya Organic	1.75	39	1.8	0.3	2.5	#	9.71	0	0
	Soya Chocolate	1.62	68	2.1	0.6	6.4	#	120	0.75	0
Blue Diamond	Almond Breeze	1.52	13	1.1	0.1	0	0.38	120	0.75	0
Califa	Almond Drink	3.57	16	1.3	0.1	0.1	#	189	#	0
	Almond Vanilla	3.30	17	1.3	0.1	0.1	#	190	#	0
	Chocolate Coconut Almond	3.30	38	1.9	0.7	4.2	#	192	#	0
Good Hemp	Seed Milk	2.00	26	2.7	0.3	0	#	0	0	0
Innocent	Almond	2.66	37	3.4	0.3	0	#	0	0	0
	Coconut	2.66	52	2.1	1.9	3.1	#	0	0	0
	Hazelnut	2.66	72	3.9	0.3	2.9	#	0	0	0
	Oat	2.66	49	0.8	0.1	4.8	#	0	0	0
Koko	Coconut Original	1.54	28	1.9	1.7	2.1	0.75	0.37	120	0
	Coconut Unsweetened	1.54	15	1.3	1.1	0.2	0.75	0.38	120	0
Oatly	Oat Drink Semi	1.80	46	1.5	0.2	4.1	0.38	120	1.5	5
	Whole Oat	1.80	57	2.8	0.3	4.1	0.38	120	1.5	5
	Barista Oat	1.82	59	3	0.3	4	0.38	120	1.5	5
	Skinny Oat	1.80	37	0.5	0.1	4.1	0.38	120	1.5	5
	Chocolate Deluxe	2.00	69	2.5	0.3	7.1	0.38	120	1.1	22.5

Table 1 Nutritional data of each milk product (where no nutritional data could be obtained, a '#' symbol is recorded) (cont. from previous page)

Manufacturer	Product name	Mean price (£/litre)	Nutritional values (per 100 ml)							
			Energy (kcal)	Fat (g)	Saturated fat (g)	Sugars (g)	Vitamin B12 (mcg)	Calcium (mg)	Vitamin D (mcg)	Iodine (mcg)
Long-life shelf										
Alpro	Almond	1.68	22	1.1	0.1	2.4	0.38	120	0.75	0
	Unsweetened Almond	1.73	13	1.1	0.1	0	0.38	120	0.75	0
	Almond Unroasted Unsweetened	1.50	13	1.1	0.1	0	0.38	120	0.75	0
	Barista Almond	2.00	24	1.2	0.1	2.5	0	120	0	0
	Cashew	1.70	23	1.1	0.2	2	0.21	120	0.75	0
	Chocolate Almond	1.70	47	1.3	0.2	6.9	0	120	0.75	0
	Coconut Organic	1.70	20	0.9	0.9	1.9	0	10	0	0
	Coconut	1.67	20	0.9	0.9	1.9	0.38	120	0.75	0
	Coconut Unsweetened	1.65	14	1.2	1.1	0	0.38	120	0.75	0
	Hazelnut	1.68	29	1.6	0.2	3.1	0.38	120	0.75	0
	Oat	1.44	44	1.5	0.1	3.3	0.38	120	0.75	0
	Oat Unsweetened	1.47	40	1.5	0.2	0	0.38	120	0.75	0
	Barista Oat	1.75	43	1.5	0.1	3.2	0.38	120	0.75	0
	Rice	1.43	46	1	0.1	3.2	0.38	120	0.75	0
	Soya	1.37	42	1.9	0.3	2.5	0.38	120	0.75	0
	Soya Unsweetened	1.37	33	1.8	0.3	0	0.38	120	0.75	0
	Soya Light Longlife	1.37	27	1.2	0.2	1.4	0.38	120	0.75	0
	Soya Organic Unsweetened	1.45	32	1.9	0.3	0	0	0	0	0
	Soya Growing Up	1.60	65	2.1	0.3	2.7	0.38	120	1.5	24
	Soya Chocolate	1.40	61	1.8	0.4	7.6	0	120	0.75	0
Soya Vanilla Drink	1.45	57	1.8	0.3	6.7	0.38	120	0.75	0	
Barista Soya	1.97	33	1.8	0.3	1	0.38	120	0.75	0	
Blue Diamond	Unsweetened Almond	1.58	13	1.1	<0.1	0	0.38	120	0	#
	Almond Breeze Original	1.55	24	1.1	<0.1	2.8	0.38	120	0	#
Dream	Rice	1.58	50	1	0.1	7.1	0.38	120	0.75	#
Koko Original	Coconut	1.51	27	1	1.9	1.6	0.38	120	0.75	0
	Coconut Unsweetened	1.50	15	1.3	1.1	0.2	0.38	120	0.75	0
	Super	2.10	44	2.9	2.3	2.5	0.2	170	1.2	13
Lucy Bee	Organic Coconut Milk	2.50	36	2.3	2.1	1.8	#	#	#	#
Mighty Society	Unsweetened Pea Mylk	1.50	33	2	0.3	0.2	0.94	186	0.78	31.2
	Original Pea Mylk	1.50	39	1.9	0.3	1.8	0.94	186	0.78	31.2
Oatly	Oat Drink	1.52	46	1.5	0.2	4.1		120	1.1	22.5
	Organic	1.73	37	0.5	0.1	4.1	0	0	0	0
	Chocolate Oat Drink	1.61	61	1.5	0.2	7.5	0.38	120	1.5	#
Plenish	Almond Organic	2.53	34	3.1	0.2	0.2	#	13	#	#
	Cashew Organic	2.53	34	2.9	0.6	0.3	#	7	#	#
	Oat Organic	2.03	41	0.6	0.1	1.2	#	0	#	#
	Soya	2.00	32	1.6	0.3	0.5	#	0	#	#
Provitamil	Oat Drink	1.50	40	1.2	0.1	8.7	0.38	120	0.75	

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Manufacturer	Product name	Mean price (£/litre)	Nutritional values (per 100 ml)							
			Energy (kcal)	Fat (g)	Saturated fat (g)	Sugars (g)	Vitamin B12 (mcg)	Calcium (mg)	Vitamin D (mcg)	Iodine (mcg)
Rebel Kitchen	Organic Mylk Whole	2.50	75	5.5	4.5	4.6	#	0	#	#
	Organic Mylk Semi-Skimmed	2.50	60	3.9	3.2	4.9	#	0	#	#
	Chocolate Hazelnut	1.60	73	4.7	3.3	5.4	#	0	#	#
Rude Health	Almond Drink	2.03	56	1.49	0.3	4.7	#	4.14	#	#
	Ultimate Almond	3.50	38	3.2	0.3	0	#	8.33	#	#
	Coconut Organic	2.50	53	1.2	1	4.2	#	1.3	#	#
	Oat Organic	2.03	43	1.6	0.4	4.1	#	0.67	#	#
	Hazelnut Organic	2.55	69	1.3	0.1	4.1	#	5.16	#	#
	Brown Rice Organic	2.03	60	1.4	0.4	4.8	#	1.08	#	#
	Tiger Nut Organic	2.50	56	2	0.3	5	#	#	#	#
Sproud	Pea	1.80	34	2.1	0.2	2	0.38	120	1	0
Vita	Coconut	2.65	19	1.4	1.3	1.4	#	#	#	#

The price per litre for cow’s milk is the mean price, calculated from supermarkets’ own label two-pint (1.13 l) bottles.

As can be seen from Table 1, there is a wide range of plant-based milks available in the UK. These are derived from soya, oat, pea protein, rice, hemp seed, coconut, almond, cashew nut and hazelnut. The nutritional content varies considerably and this will be considered in more detail below. Price point also varies considerably; however, most plant-based milks are two or more times as expensive to buy as cow’s milk.

Discussion

Sugars

Lactose is a naturally occurring sugar found in mammalian milk. Lactose in milk is not classified as a ‘free sugar’.¹⁹ Cow’s milk contains 4–5% lactose, but is accepted to have low/negligible cariogenic potential²⁰ and to be ‘tooth-safe’.²¹

Free sugars are ‘monosaccharides and disaccharides added to foods and beverages by the manufacturer, cook, or consumer, plus sugars naturally present in fruit juices.’²² Whether as a monosaccharide (for example, glucose or fructose) or disaccharide (for example, sucrose), they act as a source of fermentable carbohydrate which can be metabolised by oral bacteria in the plaque biofilm, leading to the production of acids, causing enamel demineralisation. It is this bacterial-driven process of enamel demineralisation which we call caries.

Whereas cow’s milk is considered of negligible cariogenicity, the same cannot be said for most plant-based milks due to the presence of free sugars. Animal milks also contain the protein casein, which is thought to form a layer on the teeth, acting as a physical barrier and inhibiting enamel demineralisation.^{20,21}

Sugar content of the plant-based milks ranges from 0–8.7 mg/100 ml. For reference, Coca-Cola contains approximately 10.6 g/100 ml.²³ Unsweetened varieties contain no sugar; however, claims such as ‘no added sugars’ or ‘natural sugars’ are frequent and this may be to appeal to the health-conscious consumer. However, the sugars in these products are free sugars and have cariogenic potential. A number of products would contain more than 1 teaspoon (5 g) of sugar per 200 ml glass (the recommended ‘serving’ size).

Current World Health Organisation (WHO)²² guidelines recommend free sugars contribute no more than 10% of total energy intake and recommend this should be reduced to 5%. The UK has adopted this lower 5% as their recommendation.¹⁹ This is equivalent to approximately 30 g/day for anyone over 11 years of age.¹⁹ One glass of some plant-based milks could be providing up to a third of an adult’s recommended daily sugar intake.

Drinks with free sugars have been associated with increased risk of cardiovascular disease, stroke and type II diabetes.²⁴ Dental professionals have a role in providing dietary counselling to reduce free

sugars and promote a healthy diet, as part of a holistic health message, not just oral health.

Iodine

Iodine is an essential component of thyroid hormones, which are key in brain and neurological function. Iodine deficiency in infancy has significant impact on growth and development, can impair cognitive function and can reduce IQ by 10–15 if severe. In adulthood, goitre and impaired mental function are seen. Maternal thyroxine is crucial for fetal nervous system maturation and even mild deficiency can be harmful to the fetus.^{25,26}

Milk and dairy are one of the main sources of iodine in the UK diet, with cow’s milk containing 30–43 mcg/100 ml (there is seasonal variation).²⁷ The iodine content of organic milk is significantly less (approximately 15–25 mcg/100 ml), due to the differences in cattle feed.²⁸ Many of the plant-based milks do not list any values for iodine content, but previous work has shown most products available in the UK have an iodine concentration of less than 2 mcg/100 ml.²⁷ Oatly are beginning to fortify their oat drinks in early 2020 to 22.5 mcg/100 ml,¹⁷ although this is still less than cow’s milk.

The UK Reference Nutrient Intake (RNI) for an adult is 140 mcg,²⁹ with the WHO³⁰ suggesting an increase to 250 mcg/day during pregnancy.

A recent study found 68% of 737 teenage girls in the UK had iodine deficiency, which

was associated with low dairy milk intake.²⁵ Decreasing milk consumption could therefore have a population-wide impact.

Calcium and phosphorus

Calcium is important for maintaining bone health, including alveolar bone, and some studies have shown calcium has a protective effect for risk of gingivitis and periodontitis.³¹

Calcium, vitamin D and phosphate are essential in early life for tooth development and dentinogenesis. Deficiency at this stage can result in enamel hypoplasia and abnormal development.³² Post-eruption, salivary calcium and phosphate are essential for enamel remineralisation.

As can be seen in Table 1, many of the plant-based milks on sale in the UK are fortified with calcium to a level similar to that found in cow's milk, although many – including organic ranges – are not. However, the actual soluble calcium content in these fortified milks may be lower, as the added calcium is not as bioavailable as in dairy milk.³³ UK RNI for calcium ranges from 525 mg/day in the first year of life to 1,000 mg/day in teenage years, dropping to 700 mg/day for adults.²⁹

The majority of the plant-based milks do not list any nutritional information for phosphorus, but some contain phosphates added as acidity regulators to maintain shelf life. It is unclear what level of phosphate this might be at and therefore uncertain if there will be any dental impact.

Vitamins D and B12

Vitamin D regulates calcium and phosphate balance, enhances calcium absorption and is essential for formation of mineralised tissues. It is also needed for cell development and neuromuscular function, and has a role in the immune system. Vitamin D is important in maintaining periodontal health, and deficiency has been linked to periodontal disease and poorer periodontal outcomes.³¹ There is also some evidence to suggest an association between low serum vitamin D status, caries³⁴ and molar incisor hypomineralisation.³⁵ Furthermore, maternal vitamin D deficiency during pregnancy has been linked with enamel hypoplasia of the child's developing teeth.³⁴

UK cow's milk is not fortified with vitamin D (it is in a number of countries including the USA); however, a number of plant-based milks do contain small amounts. However, to meet the RNI of 10 mcg/day²⁹ would equate to drinking approximately one litre of plant-based milk!

B12 is essential in myelin production and DNA synthesis, and is important for cell

metabolism. Deficiency can lead to lethargy. B12 is present in foods of animal origin, and non-meat-eaters have been shown to have low dietary intake and therefore be at risk of deficiency.³⁶ B12 is naturally found in cow's milk and many of the plant-based milks are fortified with vitamin B12 to a similar level. Plant-based milks could therefore be an important source of B12 to non-meat-eaters.

Environmental impact

It is thought that one factor driving popularity of plant-based milk is environmental concerns.¹ Indeed, producing one 200 ml glass of cow's milk produces more than double the amount of greenhouse gas emissions, uses vastly more land and requires more water than the equivalent glass of plant-based milk.³⁷

However, there is variation in the

Health considerations and concerns

Oat milk contains beta-glucan, a soluble fibre that can reduce blood glucose levels and reduce LDL cholesterol. Many of the plant-based milks contain antioxidants which are thought to be beneficial to health. Almonds are a good source of magnesium, selenium, potassium and zinc. Vitamin E in coconut and almond milk is essential for healthy skin. Coconut milk also contains lauric acid which promotes brain development and maintains a healthy immune system.³⁹

Phytoestrogens are compounds found in plants, particularly soy beans. They are structurally similar to oestrogen. This similarity means they bind to oestrogen receptors and induce agonistic but also antagonistic effects. Some health benefits have been attributed to the agonistic action,

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sugars and have cariogenic potential.

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than 1 teaspoon (5 g) of sugar per

200ml glass (recommended serving).'

environmental credentials of plant-based milks. Rice plants require large amounts of water to grow and produce more greenhouse gas emissions than any other of the plant-based milks. Almond trees also require large volumes of water to grow. Many of the world's almonds are grown on intensive farms in California, a state which was officially in drought for 376 weeks from December 2011–March 2019. Some almond milk products available in the UK are produced from European almonds, commonly from Spain or Italy, where production is less intensive. Increasing demand for soy beans has been associated with deforestation in developing countries, particularly in the Amazon. Oat milk is regarded to have the lowest environmental impact.^{12,14,37}

What should also be considered is the impact of product transportation – known as 'food miles'. Most fresh milk consumed in the UK is produced and packaged in the UK,³⁸ whereas the ingredients in plant-based milks are produced around the world, often processed and packaged abroad and then imported into the UK.

such as decreased risk of menopausal symptoms, cardiovascular disease, obesity, type II diabetes and cancers, including breast, prostate and bowel. However, the antagonistic (that is, anti-oestrogenic) properties have led some to suggest they could act as endocrine disruptors, causing infertility and increased risk of some cancers, particularly breast. Whether they are beneficial or harmful to human health is an unresolved and controversial question. A recent review concluded that 'the evidence for health benefits is not so obvious to clearly outweigh the possible risks'.⁴⁰

Glyphosphates are a herbicide used in industrial farming and have been found in harvested oats (even organic oats). There is some controversy regarding glyphosphates. They have been classified as 'probably carcinogenic in humans' by the WHO,⁴¹ but found by the European Food Safety Authority to be 'unlikely to be carcinogenic'.⁴² Oatly state that their oats are certified glyphosphate-free.¹⁷

Conclusions

There are a range of reasons why consumers are switching from dairy milk to plant-based alternatives and there are a huge number of different products available in an expanding market. A number of individuals consume these products because of lactose intolerance or CMPA that they or a member of their household are affected by. However, a number of people, particularly younger generations, are choosing them based on perceived health or environmental reasons. This paper aims to provide insight into some of the main differences between cow's milk and plant-based milk, and differences within the plant-based shelf. Some of these key points are given in Boxes 1 and 2. We acknowledge that products may be reformulated over time in a rapidly growing market.

Cow's milk contains a number of vitamins and minerals beneficial to health, not all of which are replaced in plant-based milks. The most important of these would appear to be iodine, and decreasing dairy consumption could have a profound and widespread effect. Iodine supplements could be considered.

Another key difference, and one close

Box 1 Key points for infants and children less than one year of age

- Infants should be breastfed exclusively until six months old
- Milk-based formula milks can be given when breastfeeding is not possible
- 'Non-standard' formulas should only be given following medical advice
- Plant-based milks should not be given exclusively under two years of age
- Dairy milk should not be given before one year of age.

Box 1 references^{9,10}

Box 2 Key points for children more than one year of age and adults

- Whole milk can be given from age one, semi-skimmed from age two and skimmed only from age five
- Rice milk should not be given under five years of age
- Cow's milk contains lactose, but is of negligible cariogenic potential
- Some plant-based milks contain sucrose or glucose; these have much greater cariogenic potential
- Plant-based milks contain added calcium, but this may not be as biologically available as the calcium in dairy milk.

Box 2 references^{11,19,20,21,27,33}

'The fact that many plant-based milks contain free sugars is of concern, particularly in childhood. Claims about containing natural sugars are potentially misleading and confusing.'

to dentists' hearts, is sugar content. The fact that many plant-based milks contain free sugars is of concern, particularly in childhood. Claims about containing natural sugars are potentially misleading and could be confusing. Traditional dental wisdom about consuming 'plain milk or plain water' may not be applicable if talking about plant-based milk.

Little is known about the pH and buffering capacity of plant-based milks and this is an area for future research.

Dental practitioners should be aware of this emerging plant-based 'milk' market and be able to counsel patients about these products, including implications for general health, not just dental health.

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