The Role of Plant-based Drinks in the British and Irish Diet

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Summary

- Soya and other plant-based drinks provide many of the nutrients found in cow's milk and can contribute positively to overall nutritional intakes.
- In the main, plant-based drinks have energy levels that are comparable to semi-skimmed milk, with low levels of total fats that are predominantly unsaturated.
- With the notable exception of soya, plant-based drinks are typically lower in protein than cow's milk, however this is not an issue for the general adult population in the UK or Ireland, with current protein intakes in excess of requirements.
- Plain soya and other plant-based drinks are readily available as unsweetened or sweetened. Plain sweetened variants provide on average 2.8g sugars per 100ml (range 1.2g–3.8g). Flavoured soya and other plant-based drinks have sugar levels comparable to flavoured cow's milk.
- With the exception of organic variants, the majority of plant-based drinks are fortified with calcium to a level comparable to that found in cow's milk and with a similar bioavailability. Moreover, many are fortified with vitamin D, which further supports calcium absorption. Likewise, with the exception of organic variants, most soya and other plant-based drinks are fortified with vitamin B12.
- Those who completely replace cow's milk with plant-based drinks that are not fortified with iodine should ensure adequate iodine is consumed from other food sources or as a supplement.
- Plant-based diets support better population health outcomes for cardiovascular health, body weight and blood glucose control. Furthermore, all the nutrients needed for optimal bone health are also readily available in plant foods.
- Plant foods in general, make more efficient use of the earth's resources – a key point which should not be overlooked in light of global population growth and climate change.

Introduction

Soya and other plant-based drinks made from nuts, seeds and grains have been used for centuries in many traditional cultures, but relatively recent commercialisation over the past 50 years has seen their consumption grow exponentially.[1,2]

This growth comes in response to increased consumer demand for alternatives to cow's milk, whether it be clinically indicated such as with lactose intolerance, because of lifestyle choices concerned with reducing the consumption of or eliminating altogether animal origin foods (veganism) or to simply introduce more variety into the diet. There is also increasing consumer and scientific interest in the positive role that plant-based diets can play in improving health outcomes and reducing the environmental footprint of the food supply.

This review focuses on the contribution made by soya and other plant-based drinks to a varied healthy diet.

"A plant-based dietary pattern does not necessarily exclude all animal origin foods, rather emphasis is placed on the ascendancy of plant foods such as fruit, vegetables, whole grains, legumes, nuts and seeds in the overall diet."

Plant-based Drinks and Dietary Guidelines

Following updated dietary reference values to reduce free sugars and increase fibre intakes, new food-based dietary guidelines were released by Public Health England in 2016.[3] Under the revised Eatwell Guide, dairy products and unsweetened/low sugars, calcium-fortified plant-based drinks, continue to be grouped together. In a similar manner, the Irish Healthy Eating Guidelines include calcium-fortified soya drinks.[4]

"Internationally, dietary guidelines are increasingly focusing on plant-based dietary patterns."

Important to note, however, is the shift towards the inclusion of more plant foods in the UK Eatwell Guide: with an increase in the proportion that grains, potatoes, vegetables and fruit make up in the diet, as well as a change in emphasis on the protein food group, now titled 'beans, pulses, fish, eggs, meat and other proteins'. In order to accommodate these changes, corresponding falls in the latter and all other groups are presented, resulting in the dairy and dairy alternatives group moving from providing 15% to 8% as a percentage weight of food.

This change in focus of dietary guidelines placing stronger emphasis on plant foods is not unique to the UK. More recently, the draft of the Canadian dietary guidelines echoed the sentiment of the Eatwell Guide, arguing that an increase in plant foods can help increase the consumption of fibre-rich foods, reduce red meat consumption and replace foods that contain mostly saturated fat with foods that contain mostly unsaturated fat.[5] A similar sentiment is echoed in updated versions of Belgium's and the Netherlands' dietary guidelines.[6,7]

Modelling of the Eatwell Guide against current consumption patterns is suggestive of substantial health benefits, including averting 17.9 million disability-adjusted life years over the lifetime of the current population and increasing life expectancy by 5.4 months in men and 4.0 months in women.[8] A large proportion of these health gains are from the prevention of type 2 diabetes with nearly 800,000 fewer cases predicted over the next decade if the guidelines are met.

Related to the improvement in health outcomes with plant-based diets is the associated cost savings to society – both direct in terms of reduced healthcare costs for diagnosis and treatment, and indirect in terms of employment costs such as sickness and absenteeism. Recent economic modelling has estimated that if just 10% of society ate according to a plant-based dietary pattern akin to a Mediterranean-style diet, then savings over 20 years could amount to £5.21 billion.[9] Savings were even more pronounced if soya was included, with estimates rising to £7.54 billion.[9]

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Nutritional Composition of Plant-based Drinks

The move towards diets that rely more heavily on plants, does not inevitably lead to the complete exclusion of all animal origin foods. Indeed, consumer research has reported that 90% of people surveyed who had consumed plant-based drinks had also continued to consume cow's milk.[10] Here we consider how the main nutrients of interest shift when plant-based drinks partly or wholly replace cow's milk.

Energy

Soya and other plant-based drinks are generally lower in energy than whole cow's milk, but can be on par with semi-skimmed or skimmed, which provide 64kcal, 47kcal and 35kcal per 100ml respectively (Table 1). Unsweetened plain soya drinks provide 29kcal per 100ml and other plant-based drinks range from 13kcal to 63kcal per 100ml depending on the base ingredient. The main macronutrients contributing to these energy contents vary according to the primary plant ingredient from which the drinks are made. In soya drinks, unsaturated fats and protein mainly provide energy, in coconut drinks it is saturated fat, and in grain/cereal drinks – such as oat and rice – it is carbohydrates.

Saturated Fat

In a recent and very comprehensive review from the American Heart Association (AHA), Harvard researchers concluded that although there are small differences between saturated fats, these are insignificant when the total diet is considered, and broadly speaking, high intakes of saturated fats irrespective of food source can increase the risk of cardiovascular disease.[11]

The UK National Diet and Nutrition Survey (NDNS) reports mean saturated fat intakes in excess of the Reference Nutrient Intake (RNI) of 11% of food energy across all age/sex groups.[12,13] In adults aged 19-64 years, mean saturated fat intakes sit at 12.7% food energy (25.2g per day), with cereals and cereal products, milk and milk products, and meat and meat products each contributing 22% to overall saturated fat intakes.[13] Similarly, the Irish National Adult Nutrition Survey (NANS) finds consumption in excess of requirements, increasing to 14.3% total energy (30.7g per day) in adults 65+ years.[14]

Soya and other plant-based drinks are generally lower in saturated fat than cow's milk, providing 0.1-0.6%, with coconut drinks being a notable exception at 0.9-1.9% (Table 1). At 2.4% saturated fat, whole cow's milk isn't particularly high in saturated fat, however due to the volume with which it is consumed,

it ultimately contributes appreciable amounts to diets – 6% in adults aged 19-64 in the UK NDNS, and 7% in adults aged 18-64 years in the Irish NANS.[13,15] Importantly however, the AHA's statement emphasises a food-based approach, whereby populations are encouraged to minimise and replace foods high in saturated fat, namely butter, lard, beef fat, palm oil, palm kernel oil and coconut oil, with foods high in unsaturated fats, preferably polyunsaturated oils such as soya bean, sunflower or rapeseed oil (marketed as vegetable oil).[11] As such, the focus on reducing and/or replacing food sources of saturated fats in the diet should come at the expense of energy dense, nutrient poor foods such as biscuits, buns, cakes and pastries.

Table 1: Macronutrient content per 100ml of plain plant-based drinks* (excluding organic & specialised variants) and pasteurised cow's milk.[16-18]

Drink	Unsweetened / Sweetened	n	Energy kcal mean (range)	Fat g mean (range)	Saturates g mean (range)	Total sugars g mean (range)	Protein g mean (range)
Soya	Unsweetened	4	29 (22-33)	1.5 (1.2-1.8)	0.3 (0.2-0.3)	0.5 (0.1-1.4)	2.7 (2.0-3.3)
	Sweetened	3	42 (39-44)	1.8 (1.7-1.9)	0.3 (0.2-0.3)	2.8 (2.5-3.3)	3.1 (3.0-3.3)
Almond	Unsweetened	4	13 (13)	1.1 (1.1)	0.1 (0.1)	0.1 (0.1)	0.5 (0.4-0.5)
	Sweetened	5	24 (18-36)	(1.1-1.3)	0.1 (0.1)	2.7 (1.3-3.8)	0.5 (0.4-0.6)
Oat	Unsweetened	5	40 (28-50)	1.0 (0.7-1.5)	0.1 (0.1-0.2)	3.7 (2.8-4.5)**	0.7 (0.4-1.0)
	Sweetened	2	44 (44)	1.5 (1.5)	0.1 (0.1)	3.3 (3.3)	0.3 (0.3)
Rice	Unsweetened	3	47 (42-50)	1.0 (0.9-1.0)	0.2 (0.1-0.4)	6.2 (5.6-7.1)**	0.1 (0.1-0.2)
	Sweetened	1	47 (47)	1.0 (1.0)	0.1 (0.1)	3.3 (3.3)	0.1 (0.1)
Cashew	Unsweetened	1	26 (26)	1.0 (1.0)	0.2 (0.2)	1.7 (1.7)	0.5 (0.5)
	Sweetened	2	23 (23)	1.1 (1.1)	0.2 (0.2)	2.0 (2.0)	0.5 (0.5)
Hazelnut	Unsweetened	0	na	na	na	na	na
	Sweetened	2	29 (29)	1.6 (1.6)	0.2 (0.2)	3.2 (3.1-3.2)	0.4 (0.4)
Coconut Almond	Unsweetened	0	na	na	na	na	na
	Sweetened	2	24 (24)	1.3 (1.3)	0.6 (0.6)	2.5 (2.5)	0.3 (0.3)
Coconut	Unsweetened	4	36 (16-63)	1.5 (1.1-1.8)	1.4 (0.9-1.7)	3.3 (0.2-7.3)	0.2 (0.2)
	Sweetened	6	23 (20-28)	1.3 (0.9-2.0)	1.2 (0.9-1.9)	1.8 (1.2-2.1)	0.2 (0.1-0.3)
Whole milk		2	64	3.7	2.4	4.7	3.5
Semi-skimmed milk		2	47	1.8	1.1	4.8	3.6
Skimmed milk		2	35	0.3	0.1	4.9	3.6

*A range of plant-based drinks currently on the market excluding organic (n=12) and specially formulated variants: drinks formulated to meet the nutrition needs of 1-3 year olds (n=1), drinks with enhanced protein, fibre or calcium content (n=3). **Unsweetened Rice and Oat drinks: total sugars levels range from 2.8-7.1g. The total sugars value is from naturally occurring sugars within the rice or oat ingredients.

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Protein

The UK RNI and Irish Recommended Dietary Allowance (RDA) for protein for the adult population is set at 0.75g/kg/day, which equates to approximately 9-10% energy, meaning an adult male of 74kg would need 55.5g protein and an adult female of 60kg would need 45.0g protein per day.[12,19] Other population groups need proportionately more protein such as children, women during pregnancy and lactation, older adults and people participating in intensive sports activities.[20]

Dietary surveys for both the UK and Ireland indicate that typical protein intakes are in excess of requirements. The UK NDNS shows that mean protein intakes are 14.9-15.2% food energy (54.1-67.1g/d) for children aged 4-18 years and 17.2-17.8% food energy (68.8-74.4g/d) for adults aged 19-65+ years.[13]

Data from the Irish NANS tells a similar story, with mean protein intake in adults aged 18-64 years at 18% food energy (85.2g/d) and 18.5% (76.8g/d) in older adults 65+ years.[15] Pointedly cow's milk provides only 7-8% of protein intakes in 11-65+ years in the UK NDNS.[13] In the Irish NANS, milk and yogurt provide 10% of protein intakes in 18-64 years and 11% in 65+ years.[15] With the exception of toddlers, cow's milk is not a crucial provider of protein in UK or Irish diets.

With the notable exception of soya drinks, which provide comparable amounts of protein to cow's milk, plant-based drinks are generally lower in protein on a weight-for-weight basis than cow's milk, typically under 1% (Table 1). However, given there are plenty of other protein-containing foods consumed in a varied diet, a reduction in protein from liquid sources through substitution to plant-based drinks (other than soya) should not pose an issue for the general adult population.

Support for this can be found in studies of vegan populations who consume no animal products and therefore no cow's milk, but may or may not consume plant-based drinks. For example, a recent cross-sectional analysis of the EPIC-Oxford cohort comprising 18,244 meat eaters, 4,531 fish eaters, 6,673 vegetarians and 803 vegans aged 30 to 90 years, found mean daily protein intakes of 1.14g/kg, 1.06g/kg, 0.95g/kg and 0.91g/kg respectively, suggesting that even a diet completely devoid of animal products could meet the general population protein RNI of 0.75g/kg/day.[21]

Sugars

The UK RNI for sugars has recently been updated following the publication of the Scientific Advisory Committee on Nutrition's review into carbohydrates and health.[28] Free sugars, that is those that are added to food and drinks, or found naturally in honey, syrups and unsweetened fruit juices, should now compromise no more that 5% of energy, equivalent to a maximum daily intake of 19g for 4-6 year olds, 24g for 7-10 year olds and 30g for older children and adults.[12]

Dietary surveys currently report mean intakes of non-milk extrinsic sugars (NMES) – a similar categorisation to free sugars but also capturing 50% of the sugars found in dried, stewed or canned fruit – in the UK population are of concern.[28] The UK NDNS reports that mean NMES intakes exceed 10% of energy in all age/sex groups and intakes are especially high during childhood and adolescence. Adults consume on average 59.9g NMES per day (12.3% food energy), however, teenagers have the highest daily intakes at 73.2g (15.2% food energy) whilst younger children consume between 37g and 54g (12.2-13.4% food energy).[13] Leading contributors include fruit juice and soft drinks, confectionary, buns, cakes, pastries, fruit pies and sugar preserves.

In Ireland, the goal of <10% energy from added sugars (classified as NMES) has been adopted for the purposes of supporting dietary guideline development.[29] The Irish NANS shows consumption of added sugars is similarly more of a concern in younger age groups, with mean intakes in children aged 5-12 years of 14.6% energy (65.2g/d) and in teenagers aged 13-17 years of 12.4% (65.5g/d) versus 9.4% (61.0g/d) in adults 18-64 years.[30]

Plain soya and other plain plant-based drinks are available with and without added sugars. Unsweetened soya drinks and other plant-based drinks contain naturally occurring sugars depending on the base ingredients: soya drinks 0.1-1.4%, almond and cashew drinks 0.1-1.7%, coconut, rice and oat drinks 0.2-7.3%.

Sweetened plain soya drinks provide between 2.5% and 3.3% total sugars and other sweetened plain plant-based drinks provide between 1.3% and 2.8% total sugars.

Protein Quality

"Plants contain all essential amino acids and it is important to note that single food scores of protein quality such as PDCAAS do not provide an assessment of the overall ability of a diet to meet EAA requirements."

Of the 20 amino acids supplied through our diet, humans require nine of these, termed essential amino acids (EAAs), in differing amounts, to support protein synthesis. It is commonplace to see foods referred to as being complete, meaning providing all EAAs or incomplete, meaning one or more EAA is missing. However, the careless use of such terminology to suggest plant proteins are nutritionally inferior can be misleading, as all plant food sources of protein contain all nine EAAs and they are not 'lacking' or 'missing' an EAA in the sense that the word 'incomplete' implies.

What the terms complete and incomplete actually pertain to, but is very often unclear in discussion on protein quality, is a food possessing an EAA composition closely related to human amino acid requirements. Protein 'completeness', which forms part of an assessment of protein quality, can be determined through various scoring systems; the most readily used of which is the Protein Digestibility-Corrected Amino Acid Score (PDCAAS).

Whole cow's milk and soya drinks have relatively comparable PDCAAS scores of 1.0 and 0.9 respectively.[22,23] Importantly however, single food scores of protein quality such as PDCAAS do not provide an assessment of the overall ability of a diet to meet EAA requirements. It has been repeatedly argued that a varied diet that meets energy needs, even one based entirely on plants, can meet all EAA requirements.[24] This is because the body maintains a pool of EAAs that it can call upon to 'complete' dietary proteins that may be lower in one or more EAAs in relation to requirements.[25-27]

Table 2: Calcium, iodine, and vitamin B12 and D content per 100ml of plain plant-based drinks* (excluding organic & specialised variants) and pasteurised cow's milk.[16-18]

Drink	Unsweetened / Sweetened	n	Vit. B12 µg mean (range)	Vit. D2 µg mean (range)	Calcium mg mean (range)	Iodine µg mean (range)
Soya	Unsweetened	4	0.38 (0.38)	0.75 (0.75)	120 (120)	0
	Sweetened	3	0.67 (0.38-1.25)	0.75 (0.75)	120 (120)	0
Nut, oat & rice plant-based drinks	Unsweetened	13	0.38 (0.38)	0.89 (0.75-1.50)	120 (120)	0
	Sweetened	14	0.38 (0.38)	0.75 (0.75)	120 (120)	0
Coconut	Unsweetened	4	0.38 (0.38)	0.75 (0.75)	120 (120)	0
	Sweetened	6	0.38 (0.38)	0.75 (0.75)	120 (120)	0
Whole milk		2	0.91	0.00	123	32
Semi-skimmed milk		2	0.91	0.00	123	31
Skimmed milk		2	0.81	0.00	128	31

*A range of plant-based drinks currently on the market excluding organic (n=12) and specially formulated variants: drinks formulated to meet the nutrition needs of 1-3 year olds (n=1), drinks with enhanced protein, fibre or calcium content (n=3).

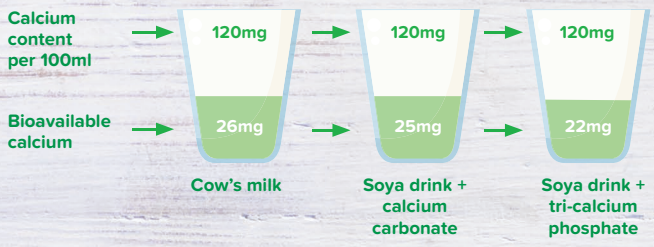
Calcium and Vitamin D

The UK RNIs for calcium is highest for the 11-18 years age group, a period during which peak bone mass is accrued; where it is set at 1000mg/d for males and 800mg/d for females.[12] Younger age groups require proportionately less. Requirements then drop to 700mg/day for adults aged 19-75 years. The Irish RDAs share a similar pattern, but recommended levels are generally higher at 800mg/d for 1-10 year olds, 1200mg/d for 11-18 year olds and during pregnancy and lactation, with the remainder of adulthood 18-65+ years set at 800mg/d.[19]

In the UK mean calcium intakes are reasonably well above RNIs for all age groups except 11-18 year olds, for whom intakes are at 89% RNI.[13] Cow's milk contributes significantly to calcium intakes, ranging from 26% in 4-10 year olds to 18% in 11-18 year olds. For adults (19-64 years), milk contributes 19% of calcium intakes.[13] In Ireland, milk and yogurt provide about a third of calcium intakes in adults aged 18-65+ years, followed by bread which contributes roughly 21%.[15] The latter is similar for the UK, where the other food group that significantly contributes to calcium intakes is cereal and cereal products, which provide 30-38% of intakes for 11-65+ year olds.[13] This is predominantly as a consequence of wheat flours used in the UK (except wholemeal) being fortified with calcium carbonate.[31]

The vast majority of soya and other plant-based drinks (except organic versions) are fortified to provide an amount of calcium comparable to cow's milk (120mg per 100ml) (Table 2). Moreover, calcium fortificants are typically absorbed at a rate similar to cow's milk. For example, a study comparing the bioavailability of calcium in cow's milk to two soya drinks, fortified with either calcium carbonate or tri-calcium phosphate, found that they had bioavailabilities of 21.7%, 21.1% and 18.1% respectively.[32] Based on typical calcium levels of cow's milk, soya and other plant-based drinks of 120mg per 100ml, this would provide 26mg, 25mg and 22mg of absorbable calcium per 100ml respectively.

Figure 1: Amount of calcium that is bioavailable from cow's milk and soya drinks with a calcium content of 120mg per 100ml.[32]



"Calcium from fortified plant-based drinks is typically absorbed at a rate similar to cow's milk.[32]"

It is prudent that consumers of soya and other plant-based drinks, particularly those with heightened calcium needs (such as during adolescence), select those that have been fortified with calcium, as recommended in both the UK Eatwell Guide and the Irish Food Pyramid.[33,34] However, it is worth noting that even consumers of cow's milk rely on other foods for the majority of their calcium intake.[13,15] Plenty of other foods provide calcium; in particular, leafy greens, such as broccoli, kale and bok choy, have calcium that is absorbed at almost twice the rate of cow's milk.[35]

It is also worth noting that the majority of soya and other plant-based drinks (except organic versions) are fortified with vitamin D, further supporting calcium absorption and bone health.

Iodine

Iodine is an essential trace element that is a major component of thyroid hormones, triiodothyronine (T3) and thyroxine (T4). Iodine is especially important during pregnancy, because deficiency during foetal life results in irreversible brain damage.[36] Iodine deficient populations present intelligence quotient (IQ) 13.5 points below iodine replete populations, and the World Health Organisation (WHO) considers iodine deficiency to be the single most important preventable cause of brain damage globally.[37]

The UK RNI for iodine increases progressively from 60µg/d for infants to 140µg/d from 15 years onwards and through adulthood, with no increment for pregnancy or lactation.[12] The Irish RDAs are similar but slightly lower at 130µg/d from 15 years onwards, with no increment for pregnancy but an additional 30µg/d during lactation.[19] However, these recommendations have been criticised as being out-of-date, particularly in relation to pregnant women.[38] The WHO recommends slightly higher levels in all age groups, but during pregnancy and lactation there is a big jump from the adult requirement of 150µg/d to 250µg/d.[37]

The iodine status of a population is best assessed through urinary iodine output rather than dietary intake, due to the variability in the iodine content of foods.[39] Based on such biomarker data, the Global Scorecard of Iodine Nutrition reports that the general population (including school age children) in the UK and Ireland has adequate iodine intakes, but some sub-national data has suggested that women of childbearing age and pregnant women may be at a greater risk of deficiency.[40,41] That said, the most recent, nationally representative data from the UK NDNS looking at urinary iodine output, found that all age/sex groups, including women of childbearing age, met WHO criteria for adequate status.[13]

As a consequence of using iodine-containing sterilisers and iodine-enriched feeds, cow's milk is a substantial source of iodine in UK and Irish diets, providing around 25% and 40% in adults respectively.[13,41] Other iodine contributors include yogurt and cheese, fish and seafood, eggs, meat, and cereal products.

The majority of soya and other plant-based drinks are not fortified with iodine (Table 2). As such, individuals who completely replace their consumption of cow's milk with unfortified plant-based drinks should ensure adequate iodine intake from other sources such as fish, seafood, seaweed, yogurt and eggs. Those that do not consume these foods, such as vegans, may need to consider the use of an iodine-containing supplement – which should not exceed 150µg per day in adults, nor be sourced from kelp or seaweed owing to possible excessive intake.[42]

Table 3: A guide to the iodine content of common foods by recommended serving size.[18]

Food	Serving size	Iodine* µg
Seafood & seaweed		
Seaweed: nori & kelp	30g	1,000-76,000
Haddock	140g	589
Crab meat	140g	305
Cod & coley	140g	211-225
Scampi	170g	156
Mussels	40g (no shells)	99
Cod fish fingers	2	66
Lemon sole & plaice	140g	43-56
Tuna, salmon, mackerel, herring	140g	32-53
Dairy & alternatives		
Low fat yogurt	150g	51-72
Cow's milk: skimmed, semi & whole	200ml	62-64
Soya drink fortified with iodine**	200ml	49
Hard cheese e.g. cheddar, Red Leicester, Edam	40g	18-24
Meat & poultry		
Beef & ham	75g	7-12
Chicken, turkey, pork, lamb	75g	2-6
Other		
Eggs	2 large (134g)	67
Nuts	A handful (30g)	1-6
Bread: white, brown, malted	2 slices - 80g	3-6
Fruit & veg	80g	2-5

*Please note: the iodine content of foods can vary significantly according to the iodine content of the soil, farming practice, fish species & season. **A specialised formula for children aged 1-3 years with added iodine. On-pack nutrition information.

Vitamin B12

Deficiency of vitamin B12 is rare, as the body has an extensive storage capacity that can last for several years. The UK NDNS reports that mean intakes of vitamin B12 from food sources are well above requirements for all age/sex groups, ranging from 776% of the RNI in under 3s to the lowest level of 305% RNI in 11-18 year olds.[43] Adults (19-64 years) have a mean consumption of 342% of the RNI. Similarly, data from the Irish NANS indicates mean vitamin B12 intakes from food sources for adult men and women are 7.3 and 8µg/d, or approximately 550% of the RDA, noting the Irish RDA of 1.4µg/d, compared to the UK RNI of 1.5µg/d.[12,15,19] Leading brands of soya and other plant-based drinks (with the exception of organic variants) are fortified with vitamin B12.

Vitamin B12 is found widely in foods of animal origin and as such, although cow's milk is a significant contributor in the general population, substituting cow's milk for plant-based drinks, even if they are not fortified with vitamin B12, would be unlikely to have a delirious impact on population intakes in general provided other animal foods are included in the diet.

Groups at higher risk of vitamin B12 deficiency include older adults and the elderly (due to malabsorption), individuals with gastrointestinal disorders and individuals following a vegetarian or vegan diet.[44] For vegans in particular, who are at the greatest risk of deficiency, ensuring a dietary intake of vitamin B12 fortified foods, or more preferably a supplement, is essential to ensure an adequate supply.[45]

Plant-based Diets and Health

A plant-based dietary pattern does not necessarily exclude all animal origin foods, rather emphasis is placed on the ascendancy of plant foods such as fruit, vegetables, whole grains, legumes, nuts and seeds in the overall diet.[46]

The world's leading public health organisations, including the WHO and World Cancer Research Fund promote that diets should be based mostly on plants.[47,48] Plant-based diets confer clear benefits for cardiovascular health, as well as weight management and blood glucose control.[46,49-51] Rather than these health benefits being attributable to single features of including more plants, it is likely that they are the aggregate impact of an overall healthier nutritional profile – a diet that is generally lower in energy density and higher in fibre and with a higher ratio of unsaturated to saturated fats.

For instance, the plant-based portfolio diet, which combines multiple foods, each with cholesterol-lowering efficacy (namely soya, viscous fibres, plant sterols and nuts), has been shown in controlled experiments to significantly reduce LDL-cholesterol by up to 30%.[52,53] Considering also that the wide range of nutrients that contribute to good bone health are all readily available in a plant-based diet, a shift towards including more plants may be of benefit here as well.[54]

Plant-based Diets and Sustainability

Land, Energy and Water

The production of food requires multiple inputs, with land, energy and water being key. The way in which we currently utilize these resources is unsustainable, and at the current rate of usage, we will not be able to produce enough food to meet the needs of a growing population.

Considering just one of these resources as an example – land. Using land to grow crops that are directly consumed by humans, rather than to grow crops that are then fed to animals, that are then consumed by humans, is a much more efficient way of utilising land to produce food. For example, it takes up to 4kg of feed to produce 1kg of chicken and up to 13kg of feed to produce 1kg of beef.[55]

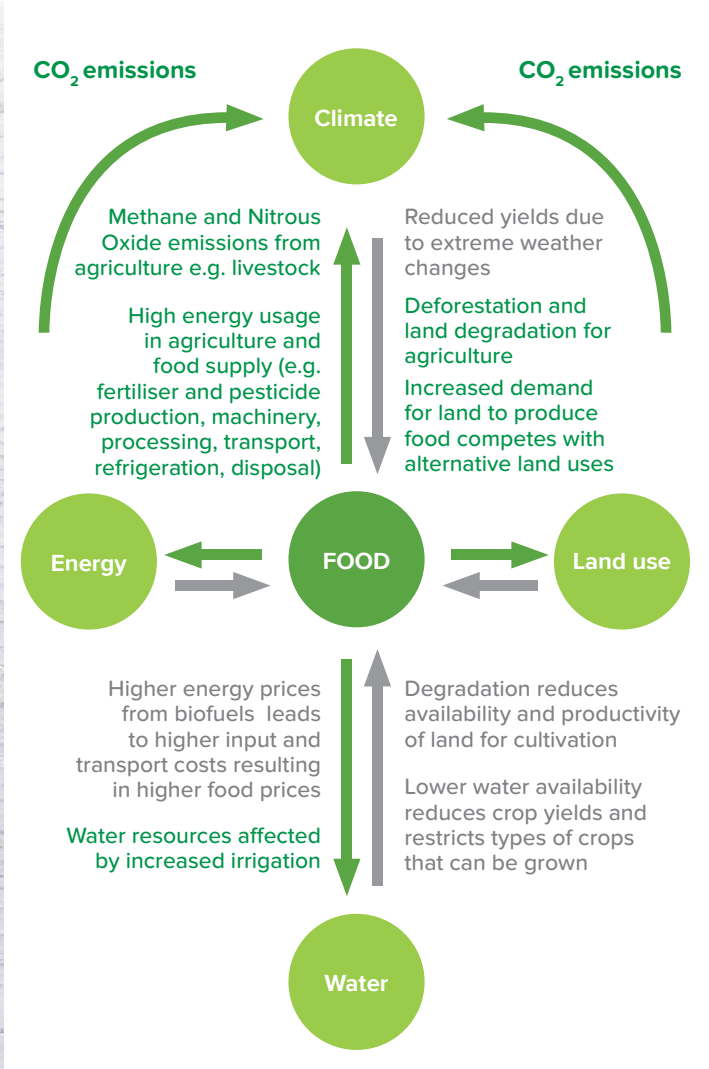
Greenhouse Gases

Another way of looking at the efficiency of food production systems is in terms of the greenhouse gas (GHG) emissions that are generated. Plant foods generally have much lower GHG emissions than animal origin foods per unit weight. This is because plant foods rely much less on inputs (energy, land and water). Animal agriculture is also a primary source of the potent GHGs methane and nitrous oxide, which are 30 and 300 times more potent that carbon dioxide.[56,57]

Globally, the food sector is responsible for 30% of global GHG emissions and the livestock sector accounts for nearly half of this, at just shy of 15%.[56,57]

The production of plant-based drinks compared with cow's milk is typically less resource-intensive (necessitating lower amounts of energy, land and water use), as well as being a significantly less potent source of GHGs which contribute to climate change.[2] For example, the production of soya drinks has been shown to produce two and a half times fewer GHGs, use two times less land and use four times less water than production of cow's milk.[58]

Figure 2: Food's relationship with the environment



Source: Adapted from Oxfam GB Briefing Paper[67]

Improving the Environmental Impact of Our Food System

"Globally, the food sector is responsible for 30% of global GHG emissions and the livestock sector accounts for nearly half of this, at just shy of 15%."[56,57]

Improving the GHG efficiency of livestock systems will make an important contribution to reducing the environmental impact of this sector, especially as global demand for animal origin foods grows. Nevertheless, it has been repeatedly argued that such action will fall far short of the necessary changes needed to make the food system more sustainable, in terms of concomitantly mitigating climate change, while also nourishing a population that is predicted to burgeon to 9 billion by 2050.[59]

Also for consideration, although not discussed here, are the multiple other externalities of livestock systems such as extensive biodiversity loss (30% of which is attributed to livestock) and depleting and polluting the world's scarce freshwater resources.[57] As such, to ensure the sustainability of diets, it is imperative that we look at the consumption end of the equation and understand what movements can occur there, while also ensuring a nutritionally replete diet.

Initial work looking at ways in which the consumption of animal origin foods can be reduced from current levels while ensuring nutritional requirements are met in the general population are promising, although further consideration may need to be given to vulnerable groups.[60,61] Such findings are unsurprising in light of a broader context that acknowledges that vegetarian and vegan diets can meet nutritional requirements.[62,63]

Conclusion

In focusing on the ways in which cow's milk and plant-based drinks can contribute at a nutrient level, we must not lose sight of the total dietary context within which these products are consumed. As we have seen, fortified soya and other plant-based drinks provide many of the nutrients found in cow's milk and can thus contribute positively to overall nutritional intakes. The inclusion of cow's milk in the diet does not guarantee nutritional adequacy, in much the same way that the substitution of cow's milk with soya or other plant-based drinks does not necessarily result in nutritional inadequacy, particularly in adult populations following varied diets.

Plant-based drinks as part of a broader plant-based diet can contribute in myriad positive ways to health outcomes and produce environmental benefits, and in light of the information presented here, healthcare professionals should feel confident in the contribution they can make as part of the whole diet.

Note: Dairy milk, soya and other plant-based drink options for infants and young children.

- 0-6 months: Breast milk or infant formula only.
- 6-12 months: Breast milk or infant formula only in addition to complementary foods. Whole cow's milk and plain unsweetened calcium-fortified soya and other plant-based drinks can be used in cooking but are not suitable as a main drink in the first year.
- 1-2 years: Breast milk or whole cow's milk in addition to water as a main drink. In the UK, unsweetened calcium-fortified soya or other plant-based drinks can also be used as a main drink, however, as they are lower in energy than breast or whole cow's milk, attention needs to be paid to ensure adequate nutrients such as protein (from drinks other than soya) and fat are obtained from other food sources. Alternatively, greater amounts of soya or other plant-based drinks may be consumed as a drink (being careful not to fill up on them at mealtimes) or in cooking.[64,65] A specially-formulated soya drink that contains greater amounts of the nutrients important in the diets of 1-2 year olds – energy, fat, vitamins B2, B12, C and D as well as calcium, iodine and iron – is available.[66]
- 2 years onwards: Breast milk, semi-skimmed milk or plain unsweetened calcium-fortified soya and other plant-based drinks may be offered as a drink in addition to water.
- Rice drinks should not be offered until after 5 years old.

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