

# PLANT ATTITUDE

Mind the nutritional gap



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**A GIVAUDAN WHITE PAPER,  
IN COLLABORATION WITH THE  
UNIVERSITY OF CALIFORNIA,  
BERKELEY.**

This paper summarises the key findings of a research report prepared by students of the University of California (UC) Berkeley Product Development Program (PDP) on behalf of Givaudan.

It explores micronutrients in plant-based meat and dairy, analyses market data in this space, and considers challenges and opportunities for future market development.

With special thanks to UC Berkeley's PDP Director, Keith Alexander, PDP Coach, Sudhir Joshi, and the field project team that conducted the research.

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# 01

## WHY NUTRITION IN PLANT-BASED PRODUCTS MATTERS

Once considered a niche dietary choice, plant-based eating has firmly cemented its place in modern mainstream diets. Whether opting for vegetarian, vegan or flexitarian (semi-vegetarian) diets, consumers have changed their eating behaviours, citing health, environmental and ethical benefits, as well as the cachet that comes with being perceived as 'doing good' for their health and the planet with their food choices<sup>1</sup>.

In response, the plant-based sector has boomed to comprise a previously unimaginable range of meat and dairy alternatives, from plant-based milk and cheeses to patties and sausages that look, cook and taste as good as meat. This innovation shows no signs of slowing down, with a recent report<sup>2</sup> estimating that the plant-based market will exceed \$480 billion by 2024, with a projected compound annual growth rate (CAGR) of nearly 14% from 2019 to 2024.

Typically made of soy, rice, almond, peas and lentils, among other plant sources, meat and dairy alternatives are starting to gain traction in the market. But, what does this increase in the consumption of plant-based foods mean for nutrition and public health? Although animal foods can be a source

of saturated fat and salt, nutrients considered unhealthy if consumed without moderation, they are also important sources for vital nutrients, such as protein and essential vitamins like B12.

Although the goal is not necessarily to replicate all of the (good) nutrients derived from animal products, it is interesting to explore what happens when consumption of meat and dairy products is reduced or cut out completely. Can plant based products bring equivalent nutritional benefits as the referents of the market (animal derived) and if so, how?

Our research project set out to answer such questions by exploring the nutritional gap between meat and dairy products and their plant-based alternatives to offer insight into nutrient supplementation and the importance of fortification. Although proteins and fats are essential for human nutrition and health, they were not considered for the scope of this specific research, which focused instead on the common micronutrients (minerals and vitamins) that are provided in important amounts by meat and dairy foods.

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<sup>1</sup> See page 6

<sup>2</sup> Plant-based Food and Beverage Alternatives: The Revolutionary Trend in the Food-Tech Industry, BIS Research, <https://bisresearch.com/industry-report/plant-based-food-beverages-alternatives-market.html>

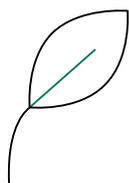
# CONSUMER EXPECTATIONS ARE CHANGING

Across much of the world, a flexitarian diet is both recommended and very much in trend: 65% of Gen Z say they want a more 'plant-forward' diet and 42% of consumers globally are restricting animal-based products<sup>3</sup>. Key drivers for this change include:



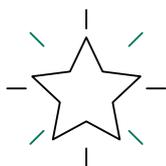
## GOOD FOR HEALTH

- As many as 60%<sup>4</sup> of people in Asia, Africa, Latin America and the Middle East could suffer from lactose intolerance.
- 40%<sup>5</sup> of global consumers say dairy products are high in sugar and a key reason for them to avoid it.
- Most people consume too much salt: on average 9–12 grams per day<sup>6</sup>, or around twice the recommended maximum level of intake according to the World Health Organization (WHO).



## GOOD FOR NATURE

- Food of animal origin is seen as a high source of environmental destruction, both because of the production of greenhouse effect gases and the huge demand on the soil and water needed for their production. Improvements in the economic status of populations also lead to a rise in demand for animal products, which is adding to these environmental concerns.
- As a part of the solution, plant-based foods such as dairy and meat alternatives have shown<sup>7</sup> to generate significantly less environmental impacts than their animal-based counterparts.



## TRENDY

- 40% of younger consumers say they tried plant-based milks as it is trendy<sup>8</sup>.
- Caring for animal welfare makes them feel good, and look good in society<sup>9</sup>.

<sup>3</sup> Innova Market Insights

<sup>4</sup> Mintel

<sup>5</sup> How has COVID-19 changed consumer behaviour, FMCG Gurus, 2020, <https://fmcggurus.com/reports/fmcg-gurus-how-has-covid-19-changed-consumer-behaviour>

<sup>6</sup> 'Healthy diet fact sheet', WHO, 2020, [www.who.int/news-room/fact-sheets/detail/healthy-diet](http://www.who.int/news-room/fact-sheets/detail/healthy-diet)

<sup>7</sup> 'Life cycle assessment of animal-based foods and plant-based protein-rich alternatives: An environmental perspective', Journal of the Science of Food and Agriculture, 2021,

<sup>8,9</sup> Ethical Consumer, [www.ethicalconsumer.org/food-drink/shopping-guide/milk](http://www.ethicalconsumer.org/food-drink/shopping-guide/milk)

# 02

## UNDERSTANDING MICRONUTRIENTS IN MEAT, DAIRY AND THE PLANT-BASED MARKET

Although plant-based eating carries a health and environmental 'halo' for many consumers, meat and dairy products are significant sources of vitamins and minerals (micronutrients), as well as fat, protein and carbohydrates (macronutrients). The challenge is that most people consume too many animal derived products that bring along higher levels of saturated fat and salt versus recommended guidelines by national food safety authorities. Nonetheless, if choosing plant-based foods over animal products, it's important to ensure that the intake of vital nutrients is not compromised.

### MICRONUTRIENTS AND THEIR BENEFITS

Minerals and vitamins are essential to the survival and normal function of our bodies, from energy production to immune function, blood clotting, bone health, growth and a host of other processes.

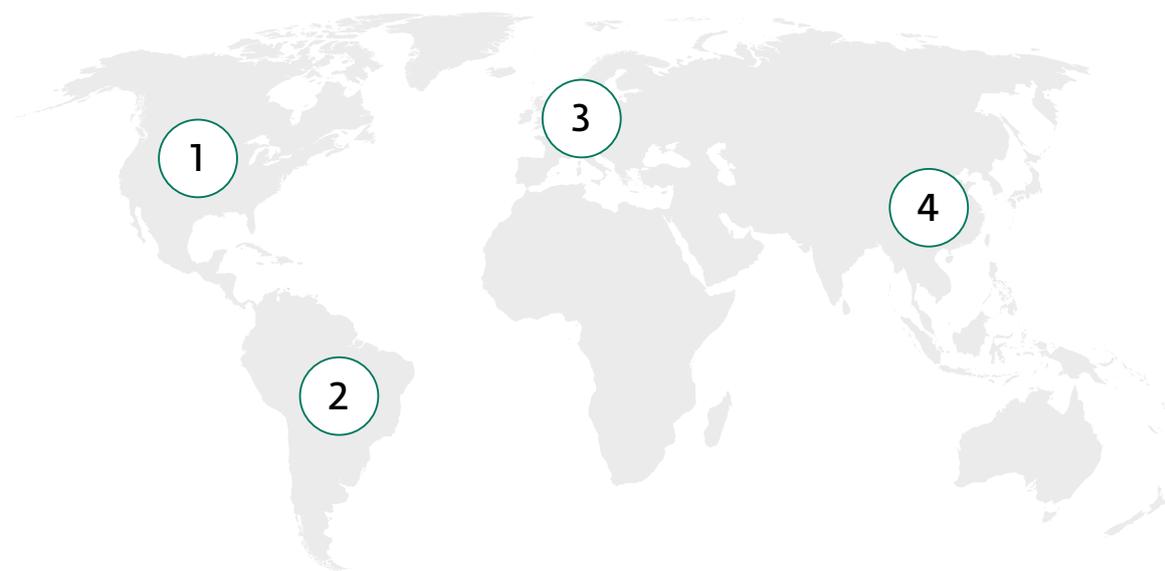
Many of these micronutrients are well known to, and highly prized by, consumers and many are associated specifically with meat and dairy products. If the appeal of plant-based alternatives is to be widened outside the vegetarian and vegan markets, those products need to be recognised for the same high level of nutritional content, therefore, considering fortifications of the following vitamins and minerals.

- **Vitamin B6** – helps to maintain the central nervous system. It is acquired from fish, poultry, potatoes and nuts, among other sources.
- **Vitamin B12** – helps to maintain the nerve and blood cells. It is acquired mostly from meat products.
- **Other B vitamins** – includes thiamine (B1), riboflavin (B2), Niacin (B3), pantothenic acid (B5), biotin (B7) and folic acid (B9). Deficiencies can cause many health issues and are particularly detrimental for mental health.
- **Vitamin D** – keeps bones healthy and is acquired from exposure of the skin to the sunlight, as well as from fish and fortified foods, such as eggs and dairy products.
- **Vitamin A** – keeps eyes healthy. Preformed vitamin A occurs in meat and dairy products while beta-carotene, the principal plant precursor of vitamin A, occurs in oranges, carrots and sweet potatoes, as well as in green leafy plants such as spinach.
- **Iron** – crucial for transporting oxygen around the body. Although abundant in many plants and legumes, such as pulses, the bioavailability of meat iron is essentially higher.
- **Zinc** – keeps the immune system strong. Sources include oysters, meats and nuts. Zinc is also abundant in some vegetable products.
- **Calcium** – maintains strong bones and is also important for the nervous system. Calcium is plentiful in dairy products but also exists in grains, leafy green, some fish and fruits.

# MICRONUTRIENTS IN THE PLANT-BASED MARKET

National health and food safety authorities issue daily recommended intake values to promote and control the intake of micronutrients. However, mandatory declaration of micronutrients on food labels can vary between

countries, even within the same geographical regions, and what is declared is also heavily influenced by regional food regulations.



**1) NOAM** Declaration of calcium, iron and potassium is mandatory in the US and Canada, but declaration of Vitamin D is only mandatory in the US.

**2) LATAM** In Latin America, the declaration of micronutrients is not generally mandatory, unless vitamins and minerals are added to foods and beverages, at which point their declaration becomes compulsory.

**3) EUROPE** In the European Union, it is only mandatory to label energy and macronutrients<sup>10</sup>. Labelling of vitamins and minerals is required once the amount surpasses a certain amount.

**4) APAC** In Asia Pacific, the situation varies from one country to another: For example, in China<sup>11</sup> and Korea<sup>12</sup>, it is mandatory to label energy and macronutrients, while micronutrients must be declared if the amount surpasses a certain percentage of the recommended daily value. In Japan<sup>13</sup>, it is completely voluntary to declare vitamins and minerals.

One exception to this regional variation is the mandatory declaration of sodium content. This is now compulsory in all regions because sodium has been linked to health problems, particularly hypertension.

<sup>10</sup> Regulation (EU) No 1169/2011, European Commission, [https://ec.europa.eu/food/safety/labelling\\_nutrition/labelling\\_legislation/nutrition-labelling\\_en](https://ec.europa.eu/food/safety/labelling_nutrition/labelling_legislation/nutrition-labelling_en)

<sup>11</sup> 'China: General Rules for Nutrition Labeling of Prepackaged Foods', USDA Foreign Agricultural Service, [https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=General%20Rules%20for%20Nutrition%20Labeling%20of%20Prepackaged%20Foods%20\\_Beijing\\_China%20-%20Peoples%20Republic%20of\\_1-9-2013.pdf](https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=General%20Rules%20for%20Nutrition%20Labeling%20of%20Prepackaged%20Foods%20_Beijing_China%20-%20Peoples%20Republic%20of_1-9-2013.pdf)

<sup>12</sup> 'Foods Labelling Standards', Ministry of Food and Drug Safety, Foods Labelling Standards(No.2016-45).hwp

<sup>13</sup> 'Japan: An Overview of the Food Labeling Standard', USDA Foreign Agricultural Service, [https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=An%20Overview%20of%20the%20Food%20Labeling%20Standard\\_Tokyo\\_Japan\\_5-26-2017.pdf](https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=An%20Overview%20of%20the%20Food%20Labeling%20Standard_Tokyo_Japan_5-26-2017.pdf)



# 03

## MINDING THE NUTRITION GAP IN PLANT-BASED MEAT ALTERNATIVES

For this research, we compared the nutritional information available on labels for meat and dairy alternatives (or 'analogues') with the labelling information on meat and dairy products. It should be noted, however, that such comparisons have their limitations. Nutritional information is not always available for plant-based alternatives and, when it does exist, it is often because micronutrients have been supplemented in order to address the nutritional concerns of conscious consumers.

From the market data that was analysed<sup>14</sup>, the percentage of detailed labelling was low, with the exception of the North American (US and Canada) region, which has more stringent labelling regulations. For example, while iron is declared in most meat analogues in North America, it is only declared in 10% of European products, and 30% of Asian or Latin American products.

There may be a good reason for this lack of labelling. For example, when it became compulsory to declare vitamin D in North America in 2020, we found that it only appeared on 10% of meat analogues. This amount will likely grow in the near future as more regulations come into place. Manufacturers might choose to add vitamin D as a means to differentiate their products, for example. The same may apply to vitamin A, which is also compulsory for labels in North America.

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<sup>14</sup> New product launches between 2018 and 2021, Mintel database, [www.mintel.com/global-new-products-database](http://www.mintel.com/global-new-products-database)

<sup>15</sup> Plant-based Meat Market Size, Share & Trends Analysis Report 2020-2027, Grand View Research, [www.grandviewresearch.com/industry-analysis/plant-based-meat-market](http://www.grandviewresearch.com/industry-analysis/plant-based-meat-market)

# THE NUTRITIONAL PROFILE OF MEAT PRODUCTS

Meat products are important sources of micronutrients, such as heme iron (particularly red meat<sup>16</sup>), as well as vitamin B12, B6, zinc<sup>17</sup>, D and A. How does the nutritional profile of meat analogues compare?



## BEEF 80/20

Relevant micronutrients include: iron, zinc, vitamins B12, D, A and other B vitamins. Our comparisons of beef (80 protein/20 fat) to beef analogue products in all regions based on new product launches from 2018 to 2021<sup>18</sup>, found little difference in nutritional value, aside from certain macronutrients (carbohydrates). However, meat is an excellent source of vitamins and minerals, as they are present in biochemical forms that make them easily absorbed. In other words, while some micronutrient content might seem similar in plant-based alternatives and meat, the actual bioavailability may differ. For example, proteins can increase the bioavailability of certain minerals such as zinc, while lipids can improve the absorption of vitamin A. In the case of red meat, 100 grams provides around 25% of the recommended daily allowance (RDA) for riboflavin, niacin, vitamin B6 and pantothenic acid, and two-thirds of vitamin B12<sup>19</sup>. Lean red meat, in particular, contains a number of vitamins and minerals that are considered important for all stages of life.



## CHICKEN

Relevant micronutrients include: niacin, iron, zinc, vitamins B12, D, A and other B vitamins. In general, the micronutrient content reported in chicken analogues is higher than that found in chicken breast. This is not surprising as chicken breast is not a major source of iron, zinc, vitamin B12 or vitamin A. That being said, it's important to note that those plant-based analogues that label their micronutrient content tend to do so because they have been supplemented with the relevant vitamins and/or minerals. Fortification is an important strategy in this respect.



## PORK

Relevant micronutrients include: iron, zinc, vitamins B12, D, A and other B vitamins. Pork is an important source of nutrients for many global consumers. In particular, it's an excellent source of B vitamins, which are important for our overall health. Currently, there are fewer plant-based pork products on the market than beef and chicken (not including sausages).

<sup>16</sup> 'Dietary Micronutrient and Mineral Intake in the Mediterranean Healthy Eating, Ageing, and Lifestyle (MEAL) Study', 2018

<sup>17</sup> Ibid

<sup>18</sup> New product launches between 2018 and 2021, Mintel database, [www.mintel.com/global-new-products-database](http://www.mintel.com/global-new-products-database)

<sup>19</sup> The Sustainable Meat Project, [www.carnisostenibili.it/en](http://www.carnisostenibili.it/en)

## Comparison of meat analogues by source of protein

Nutritional value of different type of meat analogues products by source of protein, per 100g (mean  $\pm$  SD)

	 WHEAT	 SOY	 WHEAT/SOY	 NUTS	VALUE*
Number of products (n)	32	7	10	7	–
Kcal	176.52 $\pm$ 36.79	234.62 $\pm$ 67.21	185.52 $\pm$ 30.53	204.60 $\pm$ 43.63	0.01
Protein (g)	21.68 $\pm$ 2.96	24.96 $\pm$ 17.19	21.44 $\pm$ 2.90	18.12 $\pm$ 5.03	0.30
Total fat (g)	5.68 $\pm$ 4.00	6.63 $\pm$ 4.14	5.64 $\pm$ 3.06	11.59 $\pm$ 8.33	0.03
Saturated fatty acids (g)	0.77 $\pm$ 0.54	0.94 $\pm$ 0.62	0.75 $\pm$ 0.39	1.70 $\pm$ 1.30	0.01
Monounsaturated fatty acids (g)	1.44 $\pm$ 1.08	1.64 $\pm$ 1.08	1.47 $\pm$ 0.85	5.13 $\pm$ 4.51	0.00
Polyunsaturated fatty acids (g)	3.05 $\pm$ 2.20	3.63 $\pm$ 2.34	3.01 $\pm$ 1.68	4.11 $\pm$ 2.46	0.64
Omega 3 (g)	0.11 $\pm$ 0.12	0.24 $\pm$ 0.27	0.08 $\pm$ 0.04	0.04 $\pm$ 0.05	0.04
Carbohydrates (g)	10.95 $\pm$ 3.18	20.31 $\pm$ 8.22	13.94 $\pm$ 2.90	9.63 $\pm$ 3.70	0.00
Fiber (g)	1.35 $\pm$ 0.65	6.35 $\pm$ 5.70	2.71 $\pm$ 0.58	3.01 $\pm$ 0.89	0.01
Cholesterol (mg)	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	–
Iron (mg)	2.38 $\pm$ 0.69	6.05 $\pm$ 3.03	3.06 $\pm$ 0.99	3.62 $\pm$ 1.70	0.00
Zinc (mg)	0.88 $\pm$ 0.89	4.29 $\pm$ 2.02	1.24 $\pm$ 0.61	3.18 $\pm$ 1.83	0.00
Sodium (mg)	251.20 $\pm$ 163.50	267.06 $\pm$ 186.00	189.65 $\pm$ 162.30	162.18 $\pm$ 157.51	0.46
Vitamin A ( $\mu$ g)	9.91 $\pm$ 9.26	7.30 $\pm$ 6.80	13.87 $\pm$ 13.43	17.08 $\pm$ 20.54	0.34
Vitamin B1 ( $\mu$ g)	0.05 $\pm$ 0.03	0.26 $\pm$ 0.23	0.09 $\pm$ 0.02	0.13 $\pm$ 0.09	0.00
Riboflavin ( $\mu$ g)	0.04 $\pm$ 0.05	0.15 $\pm$ 0.11	0.07 $\pm$ 0.03	0.05 $\pm$ 0.01	0.00
Niacin ( $\mu$ g)	0.32 $\pm$ 0.21	0.87 $\pm$ 0.71	0.35 $\pm$ 0.07	2.47 $\pm$ 2.43	0.00
Vitamin B6 ( $\mu$ g)	0.06 $\pm$ 0.03	0.24 $\pm$ 0.20	0.12 $\pm$ 0.02	0.13 $\pm$ 0.04	0.00
Vitamin B12 ( $\mu$ g)	1.10 $\pm$ 1.16	0.87 $\pm$ 1.08	2.24 $\pm$ 1.51	1.02 $\pm$ 0.72	0.17
Folic acid ( $\mu$ g)	20.37 $\pm$ 14.02	121.33 $\pm$ 123.37	40.33 $\pm$ 7.00	56.54 $\pm$ 26.62	0.00

\* Differences between means assessed through ANOVA, followed by Turkey adjustment  $p < 0.05$  was considered statistically significant  
Results of a 2019 study<sup>20</sup> comparing the nutritional properties of 56 meat analogues with beef meat.

<sup>20</sup> 'Meat Analogs from Different Protein Sources: A Comparison of Their Sustainability and Nutritional Content', Sustainability, 2019  
<https://doi.org/10.3390/su11123231>

## Comparison of micronutrients by type of meat



	<b>BEEF 80/20 RAW</b>	<b>CHICKEN MEAT RAW</b>	<b>PORK HAM RAW</b>
	VALUE	VALUE	VALUE
Calcium (mg/100g)	12.7	11	6.39
Chloride (mg/100g)	-	-	75.7
Copper (mg/100g)	0.061	0.044	0.08
Iron (mg/100g)	1.94	0.77	0.6
Iodine (µg/100g)	6.8	0.4	
Magnesium (mg/100g)	17	24.1	27
Manganese (mg/100g)	0.01	0.016	0.01
Phosphorus (mg/100g)	158	179	510
Potassium (mg/100g)	270	257	392
Selenium (µg/100g)	12.7	12.4	< 40
Sodium (mg/100g)	64	81	49.2
Zinc (mg/100g)	4.18	1.17	1.66
Retinol (µg/100g)	4	15.3	2
Beta-carotene (µg/100g)	0	0	0
Vitamin D (µg/100g)	0.1	0.15	0.3
Vitamin E (mg/100g)	0.17	0.25	0.16
Vitamin C (mg/100g)	0	2.3	0
Vitamin B1 or Thiamin (mg/100g)	0.043	0.084	0.82
Vitamin B2 or Riboflavin (mg/100g)	0.15	0.15	0.18
Vitamin B3 or Niacin (mg/100g)	4.23	8.15	6.39
Vitamin B5 or Pantothenic acid (mg/100g)	0.5	1.05	0.66
Vitamin B6 (mg/100g)	0.32	0.41	0.51
Vitamin B9 or Folate (µg/100g)	7	14.1	0
Vitamin B12 (µg/100g)	2.14	0.39	0.28

Comparison of micronutrient content by raw meat source<sup>21</sup>

<sup>21</sup> Ciqua (ANSES), <https://ciqua.anses.fr>

# 04

## GOING NUTS FOR PLANT-BASED DAIRY ALTERNATIVES

Dairy products have long been considered an important source of nutrition in many national diets, particularly for intake of calcium, vitamin D and amino acids from caseins and whey proteins. Nonetheless, consumption of milk has decreased across North America and Europe in recent years<sup>22</sup>. In turn, there has been a corresponding spike in the consumption of plant-based alternatives and innovation in the category. Concerns regarding the environmental impact of dairy production, growing recognition of lactose intolerance and milk allergies, and shifts towards a sustainable and healthier diet have driven a boom in plant-based milk alternatives. The plant-based dairy market reached US\$21 billion in the US alone in 2020 with an estimated CAGR of 14%<sup>23</sup>.

### DAIRY AND ITS NUTRITIONAL PROFILE – WHOLE

**MILK** Relevant micronutrients: vitamins A, D, B6, B12 and calcium. For a long time marketed by manufacturers as the best source of vitamin D and calcium, the 'healthy halo'

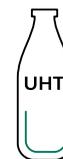
surrounding milk does have a scientific basis. One serving of whole milk contains on average 2 micrograms (mcg) and 293 milligram (mg) of vitamin D and calcium respectively (see table). However, it would be incorrect to assume that all of these nutrients are characteristics inherent to the milk itself as some, such as vitamin D, are added. Milk was one of the first products to be standardised in the market (to have a consistent taste and nutritional level), and its composition is fairly stable through markets and seasons. As a result, fortification with vitamins is necessary not just to remain competitive in terms of the nutritional value of plant-based products, but also to fulfil expectations for the nutritional content of milk. In particular, whole (or full fat) milk is an excellent source of hydrosoluble vitamins (with the exception of vitamin C) and liposoluble vitamins (with the exception of vitamin E).

<sup>22</sup> 'Global Dairy Industry and Trends', Feed Additive, [www.feedandadditive.com/global-dairy-industry-and-trends](http://www.feedandadditive.com/global-dairy-industry-and-trends)

<sup>23</sup> Euromonitor/GFI



## Micronutrient content in cow's milk



### PASTURISED MILK

### UHT STERILISED MILK

Other minerals and trace elements (/100g)	PASTURISED MILK			UHT STERILISED MILK		
	Full	Semi-skimmed	Skimmed	Full	Semi-skimmed	Skimmed
Iron (mg)	0.05	0.05	0.13	0.05	0.05	0.05
Copper (mg)	<0.22	<0.0042	traces	<0.01	0.01	0.00
Zinc (mg)	0.38	0.41	0.4	0.38	0.39	0.41
Selenium (µg)	<3	1	0.8	1	0.94	0.8
Calcium (mg)	117	119	121	112	116.9	113
Retinol (µg)	37.5	15.7	1	47	20	0.5
Beta-carotene (µg)	16.7	7.88	13.5	19.9	9.45	traces
Vitamin D (µg)	0.03	0.01	traces	0.03	0.01	traces
Thiamine (B1) (mg)	0.04	0.04	0.04	0.04	0.04	0.05
Riboflavin (B2) (mg)	0.17	0.18	0.18	0.18	0.18	0.17
Vitamin B6 (mg)	0.06	0.06	0.06	0.04	0.02	0.03
Vitamin B12 (µg)	0.4	0.4	0.4	0.2	0.2	0.27
Vitamin B5 (µg)	0.35	0.32	0.32	0.32	0.33	0.38

Micronutrient content of milk per 100 grams<sup>24</sup>

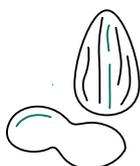


### DAIRY YOGHURTS

Relevant micronutrients: vitamins A, D, B6, B12 and calcium. Rising consumer desire for healthy snacks has led to an increase in the consumption of dairy yoghurts (and probiotics), as well as their plant-based alternatives. Today, yoghurt is a highly competitive and differentiated category with various flavours and packaging sizes. Most products are sold directly to consumers based on fat content, from 'whole' to low or no-fat options. As with the dairy milk used to make it, yoghurt does not naturally contain appreciable levels of vitamins A, D and B6, however. In fact, unlike milk, which is regulated to be fortified by various government agencies, yoghurt is not fortified and the same regulations do not apply.

<sup>24</sup> Ciqual (ANSES), <https://ciqual.anses.fr/#/aliments/19024/milk-whole-pasteurised>

# NUTRITION AND PLANT-BASED ALTERNATIVES



## WHOLE MILK ALTERNATIVES

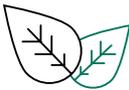
Our research assessed the top plant-based milk products from last year's market launches<sup>25</sup>, taking into account the vitamin A, D, B6, B12 and calcium content, as compared to dairy milk, as well as regional market popularity. As noted earlier, regional labelling regulations have a strong influence on the amount of information available on the label. However, of those assessed, no significant differences were found in the micronutrients listed by the different types of plant-based milk alternatives. Indeed, the level of micronutrients identified suggested that they were all supplemented at a higher or lower level depending on the region and market positioning. In other words, plant-based dairy alternative companies have actively pursued fortification in their products to either match the nutritional profiles of milk and yoghurts, or exceed them. Their goal is to meet consumer expectations for nutrition and the associated health benefits; particularly when it comes to calcium and vitamin D.



## THE NEED FOR FORTIFICATION

Improvements in plant-processing technology have fueled the explosive growth of the plant alternatives market. This is especially true for the plant-based milk market, as product sources have significantly expanded from the use of almonds and soybeans to include a plethora of other plant ingredients, such as oats, rice and coconuts.

## Micronutrients in the source ingredients

	 ALMOND	 SOY	 COCONUT	 OAT	 RICE
Vit A µg	0	6	0	0	0
Vit D µg	0	0	0	0	0
Vit B6 mg	0.137	0.461	0.054	0.119	0.16
Vit B12 µg	0	0	0	0	0
Calcium mg	269	206	14	54	28

Micronutrient content of ingredients used for the production of plant-based milks (per 100 grams)<sup>26</sup>

<sup>25</sup> New product launches between 2018 and 2021, Mintel database, [www.mintel.com/global-new-products-database](http://www.mintel.com/global-new-products-database)

<sup>26</sup> FoodData Central USDA: oats NBD 20038, Rice NBD 20044, soy (flour) NBD 16115, Coconut (meat) NBD 12104, <https://fdc.nal.usda.gov/index.html>

Compared to dairy milk, the grains and seeds used for the manufacture of plant-based dairy foods do not contain the micronutrients that could reach and guarantee the nutrient content of the milk produced. As a result, fortification has been used to differentiate and improve the nutritional profile of products. Across the dairy alternatives we examined, Vitamin D was the most common vitamin to be labelled and at a level higher than in dairy milk. Levels of calcium, vitamin B12 and A were also more or less equivalent to dairy milk, with oat milk tending to have slightly higher levels of calcium and vitamin A on labels than dairy milk. Vitamin B6 was

not reported on plant-based alternatives, perhaps because dairy milk is not known to be naturally a good source of this vitamin.

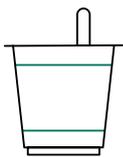
In a recent study<sup>27</sup> of the nutrient density of plant-based milk alternatives versus cow's milk, the authors compared the protein content of 17 plant-based products. These ranged from 5 to 100% (48% when averaged) of the protein content of whole cow's milk. This may also be one of the reasons why some consumers do not recognise the same nutritional qualities in plant-based milks as dairy milk.



### ON THE UP: AN OPPORTUNITY FOR PLANT-BASED MILKS

The plant sources for dairy alternatives hold their own nutritional content, which can provide producers with additional marketing benefits:

- **Almonds** – Known to be a good source of vitamin E, an antioxidant vitamin that helps prevent cardiovascular diseases which can drive value and differentiation for almond milk.
- **Coconut** – Medium Chain Triglycerides (MCT) is gaining traction at the moment for properties related to lipid metabolism. MCT is a component of coconut oil that comprises an interesting group of nutrients and could help add value and differentiate coconut milk.
- **Oats** – Beta-glucan, the soluble fibre found in oats, has been shown to lower cholesterol among other health benefits.
- **Soy** – A plant-based milk pioneer, soy milk has the highest quantity and quality of proteins<sup>28</sup>.



### YOGHURTS

As with whole milk, dairy alternatives have started to gain a foothold in the global yoghurt market due to the rise of dairy-associated allergies, such as lactose intolerance, and the popularity of veganism among younger populations. While alternative yoghurts currently only hold around 2% of the market share, the plant-based dairy market is expected to grow at nearly twice the rate of the dairy-based market (11.39% CAGR) between 2020 and 2025<sup>29</sup>. While the nutritional content of plant-based yoghurt varies by region, one common thread is in the area of calcium. As there are currently no mandatory fortification guidelines in place for yoghurt or its plant-based counterparts, some micronutrients are more likely to be fortified than others. However, based on our study of new product launches<sup>30</sup>, we can say that plant-based yoghurts generally contain lower amounts of calcium than their dairy counterparts, but are usually well supplemented in vitamins D, A and B12. (As was the case with dairy milk alternatives, data was not largely reported for B6.)

<sup>27</sup> Reference: Chalupa-Krebzdak, S., Long, C.J., Bohrer, B.M., Nutrient density and nutritional value of milk and plant-based milk alternatives, *International Dairy Journal* (2018), doi: 10.1016/j.idairyj.2018.07.018.

<sup>28</sup> 'Protein – Which is Best?', 2004, [www.ncbi.nlm.nih.gov/pmc/articles/PMC3905294](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3905294)

<sup>29</sup> Source: [https://www-emis-com.libproxy.berkeley.edu/php/search/docpdf?pc=YY&doc\\_id=686932666](https://www-emis-com.libproxy.berkeley.edu/php/search/docpdf?pc=YY&doc_id=686932666)

<sup>30</sup> New product launches between 2018 and 2021, Mintel database, [www.mintel.com/global-new-products-database](http://www.mintel.com/global-new-products-database)

# 05

## FUTURE GAZING: RECOMMENDATIONS FOR INDUSTRY

### FORTIFICATION MAY PROVE THE KEY FOR MEAT ANALOGUES

Our research shows that products with external fortification contain more micronutrients than meats such as chicken and pork, for example, which indicates that there are no technical difficulties to fortification. Nevertheless, there is still a lot of space for the inclusion of essential nutrients in plant-based products, both in terms of nutrients that belong in the plant world and nutrients normally found in meat.

Some opportunities for differentiating products in the plant-based meat market include the addition of:

- **Zinc and vitamin B12** in Asia Pacific, Africa and the Middle East and Europe
- **Iron, zinc and vitamin B12** in chicken analogues (vitamins A and D being less important given they are already low in meats)
- **Zinc, iron, B vitamins and vitamin D** in pork alternatives
- **Iron, zinc, vitamin B12 and D** in sausage alternatives

### TECHNOLOGY WILL CONTINUE TO DRIVE THE PLANT-BASED DAIRY BOOM

Unlike meat analogues, many dairy alternatives already have a good level of supplementation and are usually either equivalent or better than their dairy counterparts. However, as formulation and extraction technologies continue to improve, more plant sources will become available for use as the basis for plant milks and yoghurts.

In some cases, the bioavailability and quality of the micronutrients can be modified by the presence of certain compounds present in the plant source that are called antinutrients. Certain bioprocess such as fermentation can give excellent nutritional results, and even increase in vitamin concentration.



### COMBINING TASTE, TEXTURE AND NUTRITIONAL VALUE

Developing healthy and nutritious dairy and meat alternatives is one key objective, but the sensory characteristics of plant-based products is also a key factor when it comes to the success of these products. Sensory preferences are subjective, however, so it is important to keep in mind that taste preferences across different markets will vary. Combining the right nutritional profile (the right levels of protein, fat, sugar, and vitamins and minerals) while building an appealing sensory experience is not an easy task. To retain the 'health halo', it's also vital to control the amount of and type of fat, and the amount of sodium (salt) used.

# 06

## BECOME PART OF THE FUTURE

In summary, the rise of plant-based meat and dairy alternatives is both significant and poised for strong, continued growth. While providing superior nutrition offers a major opportunity for plant-based meat and dairy alternatives, the main challenges in this sector remain taste and texture. Consumers may be keen to choose products they consider healthier, trendier and better for the planet, but they are not willing to compromise on taste or mouthfeel. We believe the next generation of plant-based foods will increasingly incorporate health benefits such as immunity and gut health or ingredients that contribute to lifestyle elements, such as better sleep, as part of their offering.

Currently, however, successfully addressing the many attributes that are desired at once such as taste, texture, and nutrition to make a “perfect” product, may be seen as a challenge particularly for those entering the space for the first time. Givaudan is here to help.

### **PARTNER WITH GIVAUDAN TODAY**

Givaudan is an experienced partner with a breadth of tools and capabilities designed to unlock new opportunities in plant-based meat and dairy. We bring together a deep understanding of the market, consumers, and ingredients with the best in applications expertise and flavour and taste capabilities to make us your co-creation partner of choice.

From fundamental scientific understanding to holistic product design, our teams in each region of the world are focused on every aspect of the plant-based space. Market by market we study consumer preferences, market drivers and product attributes that are relevant to your targets and business. Our research provides a deep understanding of plant sources and descriptors, real knowledge that is at the fingertips of our creation experts. Our flavourists, application experts and chefs understand the formulation challenges that plant-based products can present and have the insight, skills and tools to perfect the taste that your consumers deserve. And our extensive, broad portfolio of solutions from flavours to ingredients, can be combined and formulated to create differentiating integrated solutions that enable market-winning plant-based food experiences. Givaudan can help you create innovative, indulgent and nutritious plant-based alternatives for a perfect consumer experience. Together, let's drive the global transition to more mindful diets with products that feel good, and do good, for the body and planet.



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## **JOIN THE PLANT ATTITUDE MOVEMENT!**

As tried-and-tested specialists on protein function challenges, Givaudan holds in-depth knowledge and wide-ranging experience of many plant-based dairy alternatives, including beverages, fermented products, yoghurts, frozen desserts, meat alternatives and other high-protein applications. As innovators, we are continually working to build a global community of industry partners, academics and start-ups, as we strive to consolidate our own world-class capabilities for the next generation.

### **Find out more at**

[www.givaudan.com](http://www.givaudan.com)

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