



# Putting protein transitions into perspective



*The Dutch food-based dietary guidelines are called the Wheel of Five. It represents a science-based healthy and more sustainable diet. At present, the government aims to make the food system even more sustainable and is therefore targeting a protein transition: less protein in the diet and more plant proteins overall. However, this may have implications for public health, particularly for vulnerable populations.*

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One of the best-known recommendations for a healthier and more sustainable diet is to eat more plant-based and fewer animal-based food products. This guideline has also been included in the development of the Wheel of Five, a representation of the Dutch food-based dietary guidelines. The Wheel of Five is developed by the Netherlands Nutrition Centre. In addition to the Wheel of Five advice, the Dutch government has also committed to a protein transition to encourage people to eat even more sustainably. However, a protein transition is not the same as a food transition. This article discusses the differences between a protein transition and a food transition, and the possible health limitations associated with a transition based solely on protein.

### Food transition

The Dutch food-based dietary guidelines recommend eating more fruit and vegetables: i.e., 2 pieces of fruit and 250 grams of vegetables per day. A diet that follows



## A sustainable and healthy diet

this fruit and vegetable guideline is considered healthier and generally more sustainable, because current average consumption of fruit and vegetables is significantly lower. In the Netherlands, we eat an average of approximately 130 grams of fruit per day (just over 1 piece)<sup>1</sup> and 145 grams of vegetables. The Dutch food-based dietary guidelines also recommend, among other things, eating less meat, maintaining the current dairy intake levels, including more legumes in the diet and eating a handful of nuts every day. In short, a healthier and more sustainable diet, according to the Wheel of Five, is based on foods.

### Protein transition

The Dutch government is also tackling the sustainability of the food system and our consumption in other ways. The 2018 Biomass and Food Transition Agenda proposes several solutions, including making agriculture more circular, reducing food waste, and a protein transition to more plant proteins or new sources of protein.<sup>2</sup>

In 2020, the Dutch government will present the National Protein Strategy to increase the production of plant proteins as well as how proteins and waste streams are utilized.



The protein transition is viewed from two perspectives: the production perspective and the consumption perspective. On the production side, there is a call for more innovation and development of plant proteins and new alternative proteins, such as those from insects. When it comes to the “plant-based consumption transition”, two aspects are addressed:

1. Reduction of total protein consumption by 10-15%.
2. Reversal of the animal-to-plant protein ratio from 60/40 to 40/60.<sup>2</sup>

In the short term, the Dutch food-based dietary guidelines are targeting a 50/50

ratio for animal and plant protein. This already requires considerable behavioral change for many people. About this shift, the Netherlands Nutrition Centre says: “If everyone followed a diet of 50% animal protein and 50% plant protein, in line with the Dutch food-based dietary guidelines, then the environmental impact of our diet in terms of greenhouse gas emissions would drop by about 10 to 13%”. For the Nutrition Centre, going beyond a 50/50 ratio is not yet up for discussion from a health point of view. According to the Netherlands Nutrition Centre, this requires more insight into potential effects on our health and the environment.<sup>3</sup> This article discusses the various health aspects of a protein transition.

### Sustainable versus healthy

The Dutch government’s protein transition agenda comes mainly from the Ministry of Agriculture, Nature and Food Quality and focuses on reducing total protein intake and on a transition to the intake of more plant proteins. This vision focuses solely on protein and is therefore fundamentally different from the vision defined in the Dutch food-based dietary guidelines, which turns to food products rather than macronutrients like protein to address each transition. The Dutch health policy is based on a comprehensive and holistic view of nutrition, one that, in turn, is based on food products, not on its nutrients. For this reason, the protein transition agenda should be reviewed by the Dutch Health Council, the independent scientific advisory board for the Dutch government. It should look at whether a policy aimed at reducing protein intake could pose health risks. In the following paragraphs, we zoom in on relevant factors in a protein transition, such as protein quality and replacement.

### Protein quality

The nutritional quality of proteins varies and depends on the source. Animal proteins often contain more essential amino acids and in a more beneficial ratio than plant proteins. Animal proteins are also often digested more efficiently.<sup>4</sup> This should be taken into account when considering changing a diet to a more plant-based diet. However, according to the





	10 gr milk protein (279 ml milk or 100 gr quark)	10 gr rice protein (313 gr cooked rice)	10 gr lentil protein (130 gr cooked lentils)	5 gr lentil protein and 5 gr rice protein
	% of FAO/WHO recommendation	% of FAO/WHO recommendation	% of FAO/WHO recommendation	% of FAO/WHO recommendation
Histidine	38.6	33.6	42.3	37.9
Isoleucine	37.8	30.9	28.3	29.6
Leucine	37.8	30.3	30.9	30.6
Lysine	41.1	<u>18.1</u>	33.5	<u>25.8</u>
Methionine + cysteine	32.6	41.9	<u>15.8</u>	28.8
Phenylalanine + tyrosine	57.3	49.7	47.0	48.3
Threonine	45.1	34.1	33.3	33.7
Tryptophan	48.7	41.4	30.2	35.8
Valine	33.7	33.5	25.6	29.5
<b>Quality</b>	<b>32.6</b>	<b>18.1</b>	<b>15.8</b>	<b>25.8</b>

Table 1. Contribution of milk, rice and lentils to the FAO/WHO-recommended essential amino acid allowance. The limiting amino acid is underlined. See text for further explanation.

Netherlands Nutrition Centre, if you eat according to the Wheel of Five and replace meat, for example, with nuts, legumes, dairy and eggs, you will get enough protein. But further moves towards a more plant-based diet can cause problems. The most extreme example of such a change is a vegan diet. According to the Netherlands Nutrition Centre, vegans need to consume more protein to meet protein requirements, i.e., 20-30% more.<sup>3</sup> And keep in mind: a vegan diet requires more points of attention than just getting enough protein, like taking dietary supplements. For more information for Dutch vegans, please refer to the Netherlands Nutrition Centre's website. As mentioned above, to assess protein quality two different aspects have to be considered: the composition of a protein in terms of essential amino acids, and the digestive efficiency. In digestion, proteins from foods are digested to amino acids. These amino acids are absorbed into the body where they can be used for many bodily functions, including muscle/tissue maintenance and growth, the production of proteins and several metabolic functions. Plant proteins generally contain less essential amino acids and are, in most cases less digested, with a lower efficiency. Anyone who wants to replace animal proteins and products with plant proteins will have to take this into account.



### Protein substitution

Determining protein quality based on amino acid composition looks at the limiting essential amino acids in the food. For a protein with a sub-optimal amino acid composition, one or more amino acids are limiting and, consequently, only part of the protein can be utilized in the body. As far as essential amino acids are concerned, animal proteins are superior to plant proteins. It is possible to improve the amino acid composition of plant-based products by mixing different protein sources (see next paragraph).

That mixture, however, must be consumed in a single meal, because the amino acids released by the protein are used within a few hours.

### Mixing proteins

The protein quality of plant proteins can be improved by mixing them. An example of a plant protein mix is shown in Table 1. In this example, rice protein is mixed with lentil protein. A mixture of rice protein and lentil protein ensures that the limiting amino acid lysine in rice is compensated by lentil protein and, conversely, the limiting sulfur-containing amino acids cysteine and methionine in lentil protein are compensated by rice protein. In the table, the limiting amino acid is underlined for each protein. The percentage represents what the limiting amino acid from 10 grams

of that protein provides compared to the FAO/WHO recommendations for amino acids.<sup>5</sup> In rice protein, for example, lysine is the limiting amino acid. Ten grams of rice protein provides only 18.1% of the recommended lysine. The bottom row in the table shows the protein quality as a percentage of the limiting amino acid in the protein or mixture. From this we can conclude that protein quality is significantly improved when lentils and rice are mixed. However, the quality of the mixture still does not match that of milk protein. Furthermore, it should be noted that values in Table 1 assume 100% digestibility of the protein sources, whereas studies have shown that the digestion efficiency of plant-based proteins is also lower than that of animal proteins.<sup>3</sup> In short, it is quite challenging to replace proteins of animal origin with proteins of equal quality from plant-based mixtures.

### Protein quantity

The average adult in the Netherlands consumes 78 grams of protein per day (88 grams for men and 68 grams for women), 61% of which is from animal origin. The average intake for the whole population per kg of body weight is 1.21 grams per day, while the recommendation is 0.8 grams per kg per day for adults (Dutch National Food Consumption Survey, RIVM). Because the average-protein intake per Dutch person is higher ➤

## Dairy or soy products?

When it comes to dairy substitution, it is important to note that the Health Council of the Netherlands draws a specific connection between the consumption of dairy products and health. It concludes that the consumption of dairy products is associated with a lower risk of colorectal cancer and that the consumption of yogurt is associated with a lower risk of type 2 diabetes.<sup>9</sup> For this reason, the inclusion of dairy products is recommended for the Wheel of Five. The Health Council of the Netherlands also looked extensively into the health effects of soy (and soy products) and came to the conclusion that too little research has been done to draw any similar conclusions.



### Sources of minerals

Food Consumption Survey 2012-2016, ages 1-29

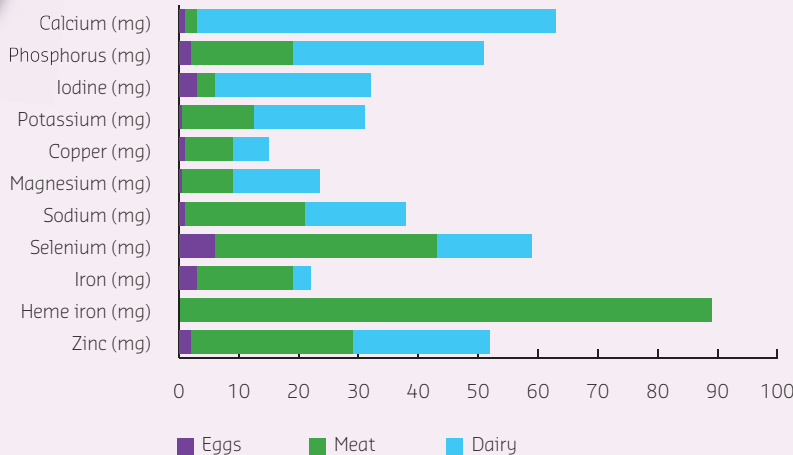


Figure 1a. Share of eggs (green), meat (orange) and dairy (blue) in the average Dutch person's (ages 1-79) mineral intake according to the RIVM Food Consumption Survey, 2012-2016.

### Sources of vitamins

Food Consumption Survey 2012-2016, ages 1-29

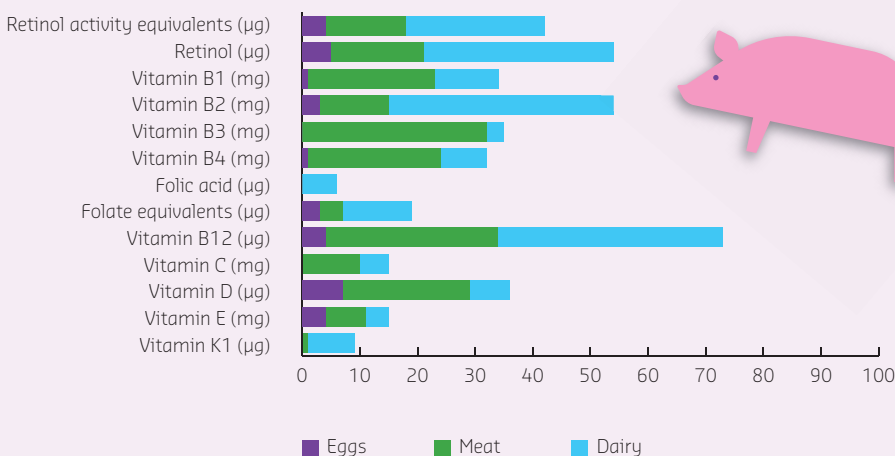


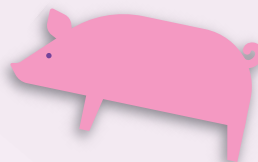
Figure 1b. Share of eggs (green), meat (orange) and dairy (blue) in the average Dutch person's (ages 1-79) vitamin intake according to the RIVM Food Consumption Survey, 2012-2016.

than this recommendation, the Dutch protein transition agenda assumes that the average protein intake can be reduced by 10-15%. However, no distinction is made here between different population groups with different protein needs, nor between protein sources. Looking at the recent Food Consumption Survey, protein intake in the elderly averages under 1 gram per kg, and in women aged 31-50 years 0.89 grams per kg per day. It also reveals that adults consume approximately 60 grams of protein per day on days when they do not eat meat (approximately 0.8 grams of protein per kg body weight per day).<sup>6</sup> These figures suggest that a significant proportion of the population has a relatively low protein intake. It is therefore important to identify the possible health effects of a protein transition agenda which advocates less protein intake overall and increased intake of plant-based proteins in general. This is particularly important for the older adults, for people who are ill or immunocompromised, and for other individuals with a low protein intake.

### Critical nutrients

The transition agenda's one-sided protein approach leads to another potential problem. Our diet not only consists of proteins, but of foods that also contain other nutrients. Meat, for example, is an important source of iron; dairy is an important source of calcium. The Food Consumption Survey shows that animal products (meat, dairy and egg, excluding fish) are responsible for more than 20% of the intake of:

- Minerals: calcium, phosphorus, iodine, potassium, magnesium, selenium, (heme) iron and zinc (figure 1a).



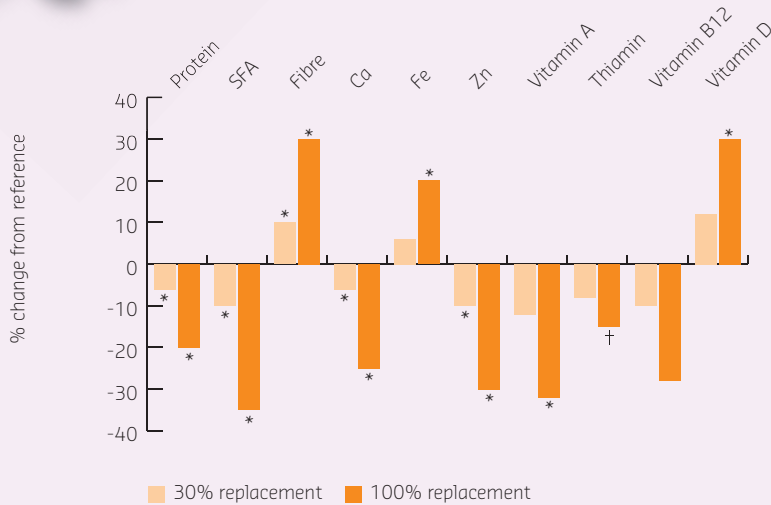
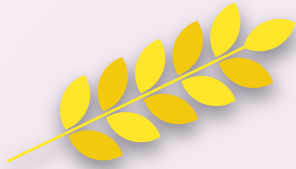


Figure 2. Percentage change in nutrient intake following the replacement of 30% and 100% of meat and dairy with plant-based alternatives. See text for explanation.

- Vitamins: A, B1, B2, B3, B6, B12 and D (figure 1b). It is worth noting that vitamin B12 does not occur naturally in plant-based products.

A food transition based solely on proteins will therefore have major consequences for food quality. In addition to sufficient protein quality and quantity, the foods in the alternative diet should also provide sufficient alternative sources of a large number of vitamins and minerals. The bioavailability of the nutrients should also be taken into account. All in all, this is a major challenge. Moreover, the absorption efficiency of vitamins and minerals also depends on which foods they come from.

## Plant-based alternatives

The Optimeal® program makes it possible to calculate the consequences on nutrient intake if animal products are avoided. The RIVM has calculated example diets in which animal products are avoided and are replaced by alternatives to meat and dairy products such as those offered in supermarkets. Two scenarios were calculated: a 30% and a 100% replacement of animal products by alternative products. In this scenario, meat as part of the evening meal was replaced by plant-based alternatives and dairy

products by enriched plant-based drinks. The RIVM calculated the effects for adults and children.<sup>7,8</sup> The RIVM came to the following conclusions (figure 2):

- A 30% replacement of animal products leads to a reduction of the CO<sub>2</sub> footprint of approximately 14%.
- 100% replacement leads to a 40% reduction of the CO<sub>2</sub> footprint.
- However, the replacement of animal products with enriched plant-based products leads to insufficient intake of zinc, vitamins A, B1 and B12 and calcium.

This means that in the scenario where consumers replace all meat and dairy with plant-based “alternatives”, the intake of essential nutrients would still be compromised. Moreover, from a health point of view, products offered on the market as alternatives to animal products are not necessarily as healthy as animal products (see box “Dairy or soy products?”).

## Limits to the protein transition

For a protein transition that aims to make food consumption more sustainable, it cannot simply be assumed that this leads to a healthy alternative diet. Changing food consumption with a one-sided

protein-centered approach will lead to a decrease in the quality of proteins and a change in the intake of essential nutrients. In the most optimistic scenario in which meat and dairy are replaced by alternative products, risks of nutrient deficiencies still remain. The consequences of a two-sided protein transition in the Netherlands – a reduction in protein intake and a replacement of animal protein with plant-based protein – will therefore have to be carefully considered. In particular, the consequences for vulnerable groups such as the older adults and the ill, who with their current diet may or may not meet the protein recommendations. For government policy, it is better if the protein transition agenda of the Ministry of Agriculture, Nature and Food Quality is harmonized with the health agenda of the Ministry of Health, Welfare and Sport. When it comes to the health impact of a protein transition, the Health Council of the Netherlands has an important role to play. <



## References

- 1 www.waetnederland.nl
- 2 Transitieteam Biomassa & Voedsel, in: economie, (Ed.) Transitie-agenda circulaire economie, Transitieteam Biomassa en Voeding, 2018.
- 3 RIVM en Voedingscentrum (2019) Brondocument Naar een meer plantaardig voedingspatroon. 2e herziene druk.
- 4 Rutherford, S.M. et al. (2015) Protein digestibility-corrected amino acid scores and digestible indispensable amino acid scores differentially describe protein quality in growing male rats. J Nutr 145 (2), 372-9.
- 5 FAO/WHO/UNU (2007) Joint FAO/WHO/UNU Expert Consultation on Protein and Amino Acid Requirements in Human Nutrition (2002 : Geneva, Switzerland), Food and Agriculture Organization of the United Nations, World Health Organization & United Nations University. (2007). Protein and amino acid requirements in human nutrition : report of a joint FAO/WHO/UNU expert consultation. World Health Organization.
- 6 RIVM (2011) Replacement of meat and dairy by more sustainable protein sources in the Netherlands. RIVM Letter Report 350123001/2011.
- 7 Seves, S.M. et al. (2017) Are more environmentally sustainable diets with less meat and dairy nutritionally adequate? Public Health Nutr 20 (11), 2050-2062.
- 8 Termm, E.H., Bakker, H.M.E., Seves, S.M., Verkaik-Kloosterman, J., Dekkers, A.L., van Raaij, J.M.A., Ocké, M.C. (2015) How may a shift towards a more sustainable food consumption pattern affect nutrient intakes of Dutch children? Public Health Nutr 18 (13), 2468-2478.
- 9 Gezondheidsraad, Richtlijnen goede voeding, 2015.