UNIVERSITY OF COPENHAGEN

Innovative Education towards Sustainable Food Systems

# Sustainable Nutrition - In cooperation with Unilever Food Solutions

## Project in Practice on MSc level in Human Nutrition

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# Table of Contents

# Abstract

**Introduction:** The purpose of this review is to examine and improve sustainability for Unilever by implementing vegetarian- and vegan diet with focus on possible deficient nutrients and how to improve the environment. One way to make a difference in the burden on the environment, could be through a sustainable diet such as vegetarian- or vegan diets. These diets are shown to have less environmental impact compared with carnivore based diet. Furthermore, some limitation of nutrients in the diets are detected. These includes vitamin $B_{12}$, calcium, vitamin D, some long chain ω-3 fatty acids, iron and zinc.

**Methods:** Through a literature review study, vegetarian- and vegan diets have been examined to the extent of nutrients limitation. Further improvement of Unilever's recipes has been made by adding food to improve the recipes and obtain the Nordic recommendations. Calculation of the recipes were made in Vitakost.

**Results:** The review showed that the six selected recipes did not obtain the recommended intake and therefore specific food such as dried dill, poppy seed, coriander and eggs were added. Furthermore, not all selected nutrients can be implemented in vegan diet by food such as vitamin $B_{12}$, vitamin D and docosahexaenoic acid (DHA), since these are limited to a carnivore food intake. However, these results are not conclusive. Some research show that mushrooms and algae might contain some of these. Lastly the results show that when improving the recipes, the nutritional value enhance in most of the commonly missing nutrients. The enhancements were greater for vegetarians than for vegans due to the additional foods added.

**Conclusion**: changing dietary habits to a more vegetarian- or vegan diet, could improve the environment. However, exclusion of animal origin can lead to limited nutrients and potentially lead to deficiency and can influence the health. There are other actions, such as replacing meat with alternatives, eat less meat or change the frequency of meat consumption, that can improve the environmental concern while remaining within the nutritional recommendations.

# Background

The world's population is expanding and this trend seems to continue. It is expected that by 2050 the world population will reach 9 billion (54). Not only the population growth but also the wealth of the population has a changing effect on the ecosystem and increased demands for especially water, energy resources and food supply (1; 4; 73). These projections are geographic determined and some countries' development has a larger increase in natural resources usage. However, this will affect the whole planet and has led to one of the major threats humanity is facing, global warming (35). It has been suggested that since passing 387 ppm $CO_2$ in the atmosphere the world has trespassed the carrying capacity of the Earth and demanding over 20% more biological capacity than the Earth can regenerate in a year (38; 43). This means that the world is using resources than one single Earth can generate. The Earths biocapacity have been exceeded by the activity of humans (54). This current situation request changes to ensure the future generations. Sustainability is a key element to ensure this. (1). But can it be done without compromising on the current lifestyle? A possible method is to obtain a more sustainable diet. The implementation of a sustainable diet might ensure the growing population in the future. Since the production of animal products uses a huge share of natural resources, the implementation of vegetarian- or vegan diets could have a positive effect on the environment (1). However, a lot of considerations needs to be put in thoughts before such claims can be validated. Furthermore, there are some concerns about the nutrients limitation in the diets that exclude a food group and might lead to nutritional deficiency (53). This makes it relevant to clarify the potential limited nutrients for a vegan- and vegetarian diet and improve the recipes from Unilever to become more sustainable while remaining healthy.

## Sustainability

Sustainability is defined to ensure that developments meet the needs of the present while not compromising the ability of the future generations (1).

#### The triple bottom line: the 3 P's

Sustainability can be described by the 3 *p's*: *People*, *Profit* and *Planet* as the goal of sustainability. They present the pillars of sustainability. They all need to be present to ensure sustainability and are therefore equally important (1; 25).

**People** covers the social aspect. It pertains a fair and beneficial business practice towards the local community and region. It assures that labour rights and social equity such as fair salaries, tolerable working hours, safe work environment and access to water and toilet are present (18; 41; 54).

**Profit** includes the economical part (54), the fair and beneficial business practice toward labour and the community and region. A cooperation still needs to be productive and competitive to ensure sustainable food production, economic growth and profit (18; 41; 54).

**Planet** embraces the environmental aspect (54). The food production needs to be protective of the environment regarding climate change, but also create awareness of energy, water and biodiversity in production. The ecological footprint can be reduced by controlling the use of energy especially non-renewable while reducing manufactured waste especially toxic waste, emission and water (18; 41; 54). This means that the food productions can benefit from the nature but still minimising the environmental impact and still assure that the future generation can benefit from it too. Environmental food consumption usually focus on the environmental impact and less on the effect of biodiversity, land use, water use, social aspect etc. (16; 41; 54) and so a sustainable production is not achieved.

#### Ecological- and carbon footprint

The footprint refers to measure the ‘marks’ humans make on the planet (27). Carbon footprint is the amount of carbon gas emission per land caused by humans either by individuals or production of product (46; 28). A more broader term that includes a larger amount of data and take more into account is the ecological footprint (46). The ecological footprint is the amount of biologically productive land and sea area needed to regenerate the resources a population uses. It estimates the environmental impact and is measured by comparing the possible supply from Earth with the demand from humans (70). This also means that a larger footprint correlates with a greater land required (38). However, this is a still simplified calculation estimate due to the overextending capacity of consumption, production and transportation. An accurate measurement is very complex and many factors need to be put into consideration. It is estimated that there are 1,8 hectares of biologically productive area per person available (65). The average hectares decrease per person as the population increases. Usually in developed countries a higher footprint is seen due to the increase use of goods, products, foods and services (28). Many companies can have a high footprint when producing products. However, for some companies it is even possible to become ‘carbon

positive' by generating less carbon than needed for the production, for example by planting more trees than harvested or using renewable energy sources (63).

#### The three levels of sustainability

To be able to maintain the future, sustainable actions must be made. This can be done in different levels of sustainability. In the wheel of sustainability, there are three levels; civil society, corporations, and governments. Within these different levels of addressing a problem, different strategies can be implemented to limit the negative impact of humans and improve the situation for the environment (16).

**Civil society** is the level of responsibility where individuals can have an impact. There are three different levels of which an individual can interact and influence a change; individuals, household and community. There are multiple different actions to help the environment for all these levels such as buy local grown products, reduce waste and create awareness of renewable energy and sustainability (16; 64).

**Corporation**, especially larger ones, can potentially have a great influence on the environment. Large corporations usually have higher economically profit to engage in important projects such as the environment. This might further create awareness in the population about sustainability. The population can to some extent set the agenda for cooperation since they are dependent on the economic support from the consumers. The corporations can further set the standards for the smaller companies and force them to follow their lead (16; 41).

**Government** has the greatest power to made changes in favour of the environment. Government can set up policies and laws which the population and corporations are required to follow. Government can therefore decide where the main resources will be allocated. This could affect a larger group of people and thus impact the environment more (9; 16).

The greater number of people involved in the change, could lead to a larger impact on the ecological footprint. The concern and commitment for the environment is not shared by every country. Sustainability is not mentioned in all the countries' national dietary guidelines, only 4 out of 215 countries' national dietary guidelines have implemented environmental impact of diets in their official guidelines (48). This is still an increase compared to previous years, but still awareness is needed (48).

## Unilever

Unilever operates in 190 countries (19). This makes Unilever a large company and thus has a big influence on the current situation of sustainability. This also means that Unilever can make some advantageous choices for sustainability and change the current view for responsibility for a better environmental future. Unilever have workplaces all over the world and in Denmark both the Danish and some of the Swedish department are located. Since 1997 by legal requirement every child, in compulsory public school have the right to a warm meal a day in Sweden. This is part of a meal programme that every Swedish municipalities and regions finance. The largest clients for the Swedish department are the municipalities, which select the products for meals in schools, and regions which decide the products for meals in hospitals and nursing homes (55). The municipalities and regions sign a contract with different brands or companies, such as Unilever, and negotiate which products are within their demands. The municipalities and regions can thus set high standards and demands for companies such as fair trade, ecology or nutritional values.

### Sustainable Living Plan

Unilever launched in 2010 a new vision for the company, Sustainable Living Plan to create focus on sustainability (58; 34). This concept applies for every value chain and brand in the company. This includes the raw materials used and the amount of electricity and water consumed when using their products. These actions has been taking into considerations and if possible improved. Sustainable Living Plan can be divided into three major sections: 1) Reducing environmental impact by looking at greenhouse gases, water use, sustainable sourcing, waste and packaging, 2) Enchanting livelihoods by changing the fairness in workplace, opportunities for women and business and finally, 3) Improving health and well-being, which includes health, hygiene and improving nutrition. Improving nutrition includes having products that might be better than national nutritional recommendations which could help the millions of consumers to achieve a healthier diet and simultaneously being more sustainable (33). A part of the Sustainability Living Plan is also to become carbon positive by 2030. This includes generating less carbon than needed and can be done by having 100% of their energy as renewable energy, plant trees and maintain forests (63).

### Recipenet

Unilever have provided recipes in Recipenet on their website as inspiration for the usage of their products. Simultaneously supply the option for more sustainable alternatives in their recipes such as replace cow or lamb with other meat products that are more sustainable such as poultry or fish.

Another option is to replace meat products with vegetarian alternative or choose the vegetarian recipes provided. Further vegetarian- and vegan recipes are in high demand from the industry and municipalities. Therefore, more and more vegetarian recipes are represented on their website.

## Potential sustainable diets

As previously mentioned actions for a more sustainable future can be done with different impact and levels. The whole production of a product; from the growing production, harvesting, collection, production including the processing of a product, to transport to the store, have an influence on the environment (5; 54). It is estimated that more than one-third of the waste are from the food production (54). Sustainability also includes staying within the limit of natural resources of the Earth (43).

There are multiple ways to become more sustainable and implement a more sustainable diet. Sustainable diets are defined as including food products that consider three pillars of sustainability when producing products (54). Sustainable diets have a low environmental impact which contribute to food and nutrition security and ensures a healthy life for present and future. Additionally, sustainable diets protect and are respectful of the biodiversity and ecosystems of the planet (57). Lastly water, waste and pollution needs to be reduced to ensure sustainable living. However, the term of sustainable diets is hard to implement and thus the term sustainable diets has also been used as diets having small environmental impact (43).

One way of becoming more sustainable can be to change diet habits which can be replacing food with a high ecological footprint with low ecological footprint. This could be if a vegetarian- or vegan diets were to replace a meat based diet. Plant-based diets are known to be more sustainable due to the large effect meat- and dairy products have on the environment. Meat- and dairy products use more natural resources to be produced than vegetables (43; 54).

### Vegetarian- and vegan diet

Vegetarian diet is defined as not containing meat, including fish (36; 50; 53). There are different sub-classifications of vegetarians, that define the specific inclusion of food sources (43). This report will focus on lacto-ovo vegetarian. Vegetarians who eat dairy products and eggs, but no fish or other meat products. They also do not consume animal bi-products if an animal that has been killed for it. This includes roe from lump-sucker (43; 50). Lacto-ovo vegetarian is the most commonly known classification of vegetarian since this is the most abundant (43).

A stricter version of vegetarians is veganism. Veganism is defined as individuals who do not consume any animal products or food products of animal origin. This excludes dairy products and eggs besides fish and other meat products as for vegetarian (43). For all diets, there are an optimal range of intake, that means for the extreme strict diets there are increased risk of nutrient malnutrition. For a western diet, there is an increased risk of excess nutrients whereas for a plant based diet there is an increased risk of deficiency (53). A western diet is typically consumed in industrialized countries and is defined by the high consumption of processed meat, red meat and high content of added sugar, fat and salt (43).

An estimation made in 2003 establishes that 2 billion people live primarily on meat-based diet and 4 billion on plant-based diet (47). There are multiple reasons for why people are adopting a vegetarian- or vegan diet such as health, animal rights, religious, philosophical, environmental and economic concerns (50). However still more people are converting to meat based diets due to the increase wealth in some countries (54).

All types of diets, especially when dealing with restrictive diets, are associated with potential deficiency and excess of specific nutrients (53). This is also true when excluding animal products in plant-based diet. A risk of lacking some nutrient may be present and result in a nutrient imbalance and potentially deficiency (43). It is also noteworthy to mention that for vegetarian- and vegan diets some nutrients will be increased compared to a typical western diet and some nutrients might be closer to the current Nordic recommendation (43) Additionally, health effect of a plant-based diet is also seen (53). Some of the health benefits includes the reduced risk of chronic diseases such as obesity, coronary disease and diabetes and might prolonged life expectancy (22; 36; 49). Possible explanations of this beneficial effect can be the absence of meat as well as the increased variety of vegetables (71).

Table 1 shows an overview the potential risk of typically lacking nutrients for vegetarian. The table compares these plant-based diets with a western diet.

**Table 1: Overview of nutrient deficiency for vegetarian-, and vegan diet compared to typical western diet.**

| | Western based diet* | Vegetarian diet | Vegan diet |
|---|---|---|---|
| Vitamin $B_{12}$ | + | ÷ | ÷ |
| Calcium | + | + | ÷ |
| Vitamin D | + | ÷ | ÷ |
| Long chain ω-3 FA | + | ÷ | ÷ |
| Iron | (+) | (÷) | (÷) |
| Zinc | + | (÷) | (÷) LD |

*Table 1: shows the typical insufficient nutrient for a typical western-, vegetarian- and vegan diet.*
*+ indicates a typical sufficient content when comparing to national nutritional recommendation*
*÷ indicates a typical lack of nutrient when comparing to national nutritional recommendation*
*(÷) the content might be sufficient however due to the low bioavailability, zinc and iron is typically insufficient for a plant-based diet.*
*(+) the content has shown to be sufficient for women in childbearing age*
** In some articles characterised as a meat diet.*
*Source: 2; 12; 13*

The table shows that vegetarians and vegans need to be conscious about some nutrients and insure consuming of food that contains these nutrients. However, still some supplements might be needed to ensure a sufficient diet for plant-based diet if no foods can provide it. Supplements are not unique for plant-based diets. People on a western diet might also be need supplements such as vitamin D (43). The nutrients (table 1) are essential for the body to function properly and each have their own mechanism in the body.

## Further elaboration of nutrients in relation to a plant-based diet.

Some accessibility of nutrients will vary depending on the geographic region due to the different fortification laws in different countries (12). When eliminating all animal products from the meals, it increases the risk of certain nutritional deficiencies (43). In the following section a further elaboration of these nutrients are elaborated: their food origins and some of the mechanism in the body.

### Vitamin $B_{12}$

Vitamin $B_{12}$ is the common term for a group of chemical complicated tetrapyrroles, also known as cobalamin. These are necessary for the activities of multiple enzymes (43).

Vitamin $B_{12}$ can be found in animals, some fortified cereals and animal products such as milk and cheese (66). Some plant-based products are enriched with vitamin $B_{12}$ and thus can be very important sources of vitamin $B_{12}$ for vegetarian and vegans (68). The bioavailability of vitamin $B_{12}$ depends on the food source. Chicken have an absorption of 61-66 %, fish and eggs have 42 % and <9% respectively and thus a different amount is absorbed in the body than the content in the food (14; 15; 56).
Bacterial contamination or fermentation might be found in traces in some plant foods and have content of vitamin $B_{12}$ (43). It has been suggested that seaweed and tempeh (product made of naturally fermented soya beans, originates from Indonesia) can provide vitamin $B_{12}$ or analogues from a plant-based diet. However, the vitamin $B_{12}$ analogues might be inactive or inhibit the true vitamin $B_{12}$ (36).

Edible algae such as green and purple lavers (nori) have demonstrated to contain vitamin $B_{12}$. A study in rat shows that vitamin $B_{12}$ from purple lavers is bioavailable (60) and in vegans an improvement of serum vitamin $B_{12}$ level after intake of nori is found. Further dried chlorella and nori is believed to contain substantial amount of vitamin $B_{12}$ and increase the concentration of serum $B_{12}$ (17; 37; 67). Over time the status of vitamin $B_{12}$ seems to decrease (52). However high serum $B_{12}$ concentration and bioavailability in rats, is not the equal to a high level of bioavailability of vitamin $B_{12}$ in humans and so it can be pseudo vitamin $B_{12}$ that is detected (26; 59; 69). Different methods have been used to detect vitamin $B_{12}$. A study in women shows that when given raw nori, no change in the urinary methylmalonic acid excretion is detected (74). This indicates that these algae might contain pseudo vitamin $B_{12}$. Algal health food includes chlorella and spirulina (68). Spirulina is believed to contain a large amount of vitamin $B_{12}$ (51) however other studies show that vitamin $B_{12}$ might not be bioavailable for humans (26; 69). Other edible algae such as Kombu, duce and arame have shown to contain none or only traces of vitamin $B_{12}$ and thus is not bioavailable (68; 69). Although studies in humans shows a high concentration of vitamin $B_{12}$ from algae, it appears not to be bioavailable for humans and effect the physiological sign. This effect is so far only seen in rats.

The main functions for vitamin $B_{12}$ are to help release energy from macronutrients, activating folic acid, forming of red blood cells, synthesizing new cells and maintaining nerve cells (66). The

recommended intake of vitamin $B_{12}$ is ranged from 0.5-2 μg/day (43). For a more details overview of the Nordic recommendations see appendix 2.

#### Calcium

A major source of calcium is dairy products and for vegan whole grain cereals, nuts seeds and dark-green vegetables are calcium-rich plants (2; 36; 66).

Calcium plays a role in multiple essential processes such as blood coagulation, growth and maintenance of the skeleton (2). The absorption of calcium is promoted by some of the active vitamins D and thus vitamin D is important for calcium absorption.

It has been suggested that plant-based diets might be beneficial for bone health due to the reduced acid load since the low pH stimulates bone resorption (3). However, this is not clearly understood which diet is better for bone health (42). The recommended intake of calcium is ranged from 540-800 mg/day (43). For a more details overview of the Nordic recommendations see appendix 2.

#### Vitamin D

There are different isomers of vitamin D. Vitamin $D_1$ is a mixture of multiple vitamins D. Vitamin $D_2$ exists mainly in plants and vitamin $D_3$ is mainly in animal products (2). Vitamin $D_2$ is less bioavailable than the animal derived vitamin $D_3$ (61). Vitamin $D_3$ can also be generated, when the skin is exposed to the UV-light from the sun (66). The exposure to the sun have shown to cover the basic requirement for vitamin D. The population of some countries might not receive adequate amount of vitamin D and so supplement might be necessary. This especially applies for the Nordic countries, where sun exposure is low during the winter period (43). However, vitamin D can be converted to a hormone in the body and might help decrease the risk of vitamin D deficiency during these months (66). Especially if a diet also has a low intake of vitamin D it can increase the risk of deficiency (43).

The main food sources of vitamin D are oily fish, milk product enriched by vitamin D or edible fats (66). A study indicates that mushrooms grown in nature can have a large content of vitamin D due to the sun exposure, however the vitamin D content does not last for long. Mushrooms have a rapidly growth and thus the content of vitamin D thins dramatically every day. The photochemical process in the mushrooms increases the vitamin D content and due to the speed of the photochemical process, only a couple of minutes seems to be enough to increase the content of vitamin D (39). Further research is needed to confirm this finding.

The main function for vitamin D is to stimulate calcium absorption from the intestine and hence has a great influence on the normal mineralization of the skeleton (66). The recommended intake of vitamin D is ranged from 10-20 μg/day (43). For a more details overview of the Nordic recommendations see appendix 2.

#### Long chain ω-3 fatty acids: EPA and DHA

Long chain ω-3 fatty acids usually come from diets including fish or eggs (12). The content of long chain ω-3 fatty acid varies in the feeding of the animal (36).

Fat is important to provide the body with energy and obtain the body with essential fatty acids and fat-soluble vitamins (66). Different types of fats are essential such as α-linolenic and must be provided through the diet since it cannot be synthesized in the body (43). α-linolenic can be converted into eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) but with a low efficiency (10). Vegetarian who eats eggs and dairy products, get some long chain ω-3 fatty acid such as EPA and DHA but it only contains low or none levels (36). This means that they might have insufficient amount of EPA and DHA in their diet.

The health effect of lacking long chain ω-3 fatty acids is not fully understood. However, a study shows that giving supplement of long chain ω-3 fatty acids increased the plasma levels and reduced platelet aggregation (40). These are possible risk factors of cardiovascular disease and thus ω-3 fatty acids might reduce the risk of cardiovascular disease. Other reports indicate that ω-3 fatty acids are important for various cell membranes characteristics and functions (43). DHA have an essential function in the body and large concentrations are found in the central nervous system and thus it can influence the mental development and visual function. The latter also applies for EPA (2; 43). The recommended intake of EPA and DHA are ≥1% energy/day (43). For a more details overview of the Nordic recommendations see appendix 2.

#### Iron

Whole grains cereal, nuts, seeds and dark leaves have a high content of iron (66).

The iron content in plant-based diets are typically similar to a western diet, but due to the absence of haem-iron, the bioavailability of iron is lower (12; 36) and thus a plant-based diets might still have iron deficiency.

Iron from foods is either haem-iron which is found in animal or animal products or non-haem iron which is found in vegetable food sources (43). The absorption depends on the composition of the dietary meal and amount of the two different types of haem. The absorption of haem-iron has a low

dependency of the dietary food composition. Whereas the absorption of non-haem-iron is highly dependent of the dietary food composition (43). There is further a difference between the different iron absorption. Haem iron is better absorbed (15-40%) compared to non-haem iron (1-15%) (29). However, the body might be able to compensate if the iron status is low by increasing the effectiveness of iron absorption (43).

Iron deficiency is moderately common among premenopausal women. This also applies to women on a western diet (36).

Iron has many essential functions in the body such as enable transport of oxygen from the lungs to tissue via the red blood cells (2). Additionally, transfer oxygen and electrons in a variety of metabolic pathways in the liver, brain and endocrine organs (43). The recommended intake of iron is ranged from 8-15 mg/day. This range differs between men and women (43). For a more details overview of the Nordic recommendations see appendix 2.

#### Zinc

Some good sources of zinc in plant-based diets are grains cereal, sea foods, nuts and seeds (66). However, plant-based zinc has a lower bioavailability than zinc originated from animal sources and thus deficiency might still be a problem for vegetarians and vegans (29).

Their diets usually have a high intake of grains, seeds and legumes. These food sources usually have a high content of phytates and can affect the absorption of zinc. Phytates might decrease zinc bioavailability by binding to zinc (2; 30). However, the body might have compensatory mechanisms to adapt to a lower intake of zinc when eating plant-based (23).

Zinc is essential for multiple important function such as the function of the immune system, normal DNA syntheses and cell division. Further zinc protects proteins and lipids from oxidative damage and is essential for many enzymes involving in different important mechanism (43). The recommended intake of zinc is ranged from 5-12 mg/day. This range differs between men and women (43; 66). For a more details overview of the Nordic recommendations see appendix 2.

#### High content of nutrient in plant-based diet

When eating plant-based diet, and having meals based on legumes, fruits and vegetables, there are some nutrients that a typical vegetarian- and vegan diet has a high content of. Among those nutrients are fibre, folic acid, vitamin C, potassium and magnesium (12).

Folic acids are essential for synthesis of DNA and the formation of new cells however requires vitamin $B_{12}$ to become activated (66). Vitamin C is important for the skin, bones, infection and

helps to form connective tissue (66). Potassium maintains the normal body fluid and electrolyte balance, and assists in nerve impulse transmission and muscle (66). Lastly magnesium's function is bone mineralisation, building protein, enzyme action and nerve impulse transmission (66). These nutrients also have an essential effect on the body and some are shown to further enhance or reduce the absorption of other nutrients (table 1).

Table 2 gives a quick overview of some of the nutrients that might inhibit the absorption of the typically lacking nutrients in a plant-based diets (table 1). The arrows indicate whether the different nutrient inhibits (↓) or activates (↑) the absorption of the nutrients according to table 1. In the following text, some of these nutrients are elaborated.

**Table 2: Overview of some nutrients that might decrease the absorption of the nutrient**

| Absorption of: | Fibres | Phytate | Oxalates/ Oxalic acid | Vitamins | Minerals | Surgery (gastric bypass) | others |
|---|---|---|---|---|---|---|---|
| Vitamin $B_{12}$ | | | | | ↑[e] | ↓[h] | |
| Calcium | ↓ | ↓ | ↓ | ↑[b]↓[c] | ↓[f] | | ↑[i] |
| Vitamin D | | | | | | ↓[h] | |
| Long chain ω-3 FA | | | | | | | |
| Iron | ↓ | ↓[a] | | ↑[d] | ↓[g] | | ↓[j] |
| Zinc | ↓ | ↓ | | | | | ↑[k] |

[a] The inhibition only account for the non-haem, [b] Vitamin C increases the absorption,
[c] Vitamin D deficiency, [d] Vitamin D increases the absorption, [e] Calcium
[f] Potassium and magnesium, [g] Calcium and phosphate, [h] Due to loss of stomach to absorption
[I] Lactose, [j] Tannic acid and protein from vegetable, [k] Animal protein
sources: (2; 36; 43; 62; 66)

Vitamin C is known to improve the absorption of non-haem iron and thus will enhance the iron uptake. The same applies for meat and fish (2; 36; 43). However, some of the food sources also contains different components that show to have an undesirable effect in vegetarian- or vegan diet.

One undesirable effect is phytates and their metabolites which inhibits absorption of non-haem (43). The same applies for spinach and rhubarb that contains oxalates and inhibits calcium absorption (43). Oxalic acid found in spinach and other dark leaves vegetables can also inhibit calcium absorption (43). This means that eating dark leaves, like spinach to gain enough iron, might cause calcium deficiency due to oxalates and oxalic acids. Another food source that has a high content of iron is cereals, however the phytic acid in cereals inhibits iron and zinc absorption (2;43). The absorption of iron can be further inhibited by vegetable protein, tannic acid found in e.g. tea and coffee (66). Potassium and magnesium have shown to inhibit bone resorption and so with a low calcium intake in plant-based diets, this might further lead to deficiency of calcium (62). Lastly surgery such as gastric bypass which removes a part of the intestine where some nutrients are mainly being absorbed can lead to malabsorption (66).

### Vegetarian- and vegan diets in a sustainable content

The implementation of a more environmental diet is one option to ensure a more sustainable future. The population in the world is estimated to increase by 50% in just 50 years, where meat- and dairy products have been projected to grow by 70 % in 2050 (1; 8).

The amount of feed grains to produce eggs and milk products for a vegetarian diet are estimated to use about half of the amount of feed grains fed to the livestock to produce the animal products (47). It is projected that about 40 % of the world grain production is fed to livestock (70) and that approximately 6 kg vegetable protein is needed to produce 1 kg animal protein (24). When taking a closer look on some of the animal products, there is a difference between the amount of grain required for the animals. Cattle require approximately 7 kg of grains to generate 1 kg beef, pigs must consume about 4 kg grains per kg meat and poultry requires about 2 kg per kg meat generated (70) and therefore cattle leave a larger ecological footprint than other type meats mentioned (47). When comparing vegetarian- and vegan diets with typically a western diet, a reduction in carbon footprint of 22 % and 26% respectively can be detected (6). Further an increased factory farming might lead to biodiversity loss, freshwater loss and eventually change of the climate (1; 5).

# Methods

## Literature study

### Web based review

A literature study created on a web based review was conducted to cover the current situation of sustainability, possible sustainable diets such as vegetarian- and vegan diets. To investigate their nutrition composition and thus possible lacking nutrients.

### Selection of recipes

The selection of recipes is executed by focusing on the largest client for Swedish department of Unilever A/S, which is, as mentioned earlier, the municipalities and the regions. Further only the newest inspiration recipes from Unilever are taken into consideration, that includes recipes from the concept “Around the world in 80 dishes”. It contains 80 recipes inspired from all over the world. These recipes have a focus on being more sustainable by looking at the $CO_2$ and implemented more vegetarian dishes (32). To further refine the recipes only vegan recipes are included and dishes that are not included consist of desserts or other side dishes. The approach for selection of the recipes were as followed: 1) recipes from “Around the world in 80 dishes, 2) Selection of vegan recipes excluding recipes with animal traces such as animal bouillon, fish sauce and vegetable margarine enriched with vitamin $D_3$, 3) Deselection of dressings and desserts. This exclusion ends up with six recipes to improve in this report.

### Selection of nutrients and food sources

The literature study is further used to select the most significant deficient nutrients detected in plant-based diets and choose three food sources with the highest content of the given nutrient from Foodcomp (21). This needs to be done while staying within the limits of a vegetarian- or vegan diet. However, some food sources did not contain any of the nutrients when looking at a vegan diet and therefore less than three or none is noted in appendix 3. The highest content is modified so that only food sources that can be added to a recipe is noted, i.e. chewing gum, baking powder and already made meals, such as fast food sandwiches, are not included in the table (appendix 3). In the results section, the typical lacking nutrients are listed with the six vegan recipes from Unilever (table 3). None of the nutrients are close to NNR and thus all the nutritional value is improved by adding foods. The foods added to each recipe are for vegans dried dill, frozen broccoli, coriander and poppy seed and additional for vegetarian duck egg and egg yolk were added to the recipes seen in

vegetarian or vegan diets and the food sources added to the recipes are those that have the highest content of each nutrient. These foods are marked with thick letters in appendix 3. Further the nutritional value from the original recipes (table 3) and the updated recipes (table 4) are compared to NNR to show the improvement.

#### Vitakost

All the recipes are evaluated by calculation of the different nutrients in Vitakost (45). Vitakost is a web based nutrition program that includes many foods with their corresponding nutritional values. Vitakost was used to upload the original recipes from Unilever (appendix 1) and calculate the nutritional values for the nutrients according to table 1 for each recipe. This also applies for each group of original-, vegan- and vegetarian recipes, where a mean was calculated for the recipes to be able to compare these groups (appendix 4). This can improve the nutrition status of the recipes from Unilever's recipenet while remaining vegetarian or vegan and thus improving the sustainable option for the recipes.

# Results

## Vegetarian -and/or vegan recipes

Table 3 shows the six vegan recipes from Unilever database and the selected nutrients that are typically missing in a vegan and vegetarian diets (table 1). See appendix 1 to see the complete recipes. When comparing these nutritional values with Nordic Nutrition Recommendation (NNR) (see appendix 2). All the nutrients are lower than recommended and thus all need to increase. This can be done by adding foods to the recipes

**Table 3: Selected recipes and their nutrients status***

| Recipes name | Vitamin $B_{12}$ (µg) | Calcium (mg) | Vitamin D (µg) | Long chain ω-3 (g) | Iron (mg) | Zinc (mg) |
|---|---|---|---|---|---|---|
| Beets with toasted buckwheat, celery and apple | 0[c] | 15[c] | 0[c] | 0[d] | 0,3[c] | 0,3[c] |
| Broccoli with sesame seeds, coriander and miso | 0[c] | 39[c] | 0[c] | 0[d] | 1[c] | 0,4[c] |
| Fruity white cabbage salad | 0[b] | 41[b] | 0[b] | 0[d] | 0,6[b] | 0,4[b] |
| Caramelized pineapple salad | 0[b] | 24[b] | 0[b] | 0[d] | 0,6[b] | 0,5[b] |
| Korean turnip salad | 0[c] | 81[b] | 0[c] | 0[d] | 1[b] | 0,5[b] |
| Roasted cabbage with lemon and thyme | 0[b] | 35[b] | 0[b] | 0[d] | 0,5[b] | 0,2[b] |

The data is registered by 100 g recipes. The recipes are vegan diets that are selected from Unilever data base. The nutrients content is based on Foodcomp and Vitakost (21, 45).

[a] data basic for 95-99 % of the foods in the recipe

[b] data basic for 75-94 % of the food in the recipe

[c] data basic for 50-74 % of the food in the recipe

[d] data basic for 0-49 % of the food in the recipe

Not all foods have all the data for the nutrient (21; 45). The data basic is based on the percentages of foods with data is part of the total recipe. That means that the percentages indicate the data basic of the foods in the recipe. This means that the data shown is not always 100% accurate (45).

* the data is rounded

Table 4. shows the recipes with the selected foods provided to improve the nutritional value. The grey area represents vegan recipes where the original recipe (table 3) is modified after adding food sources which includes dried dill, coriander, poppy seed and frozen broccoli to increase the nutrients from table 1 while remaining vegan. The white area is the recipes where the same food sources is added as for vegan and including duck egg and egg yolk to remain vegetarian and increase the nutrients content (table 1). See appendix 3 to see the complete selection of food sources.

**Table 4: Recipes improved by selected food sources for vegan and vegetarian***

| Recipes name | Vitamin $B_{12}$ (µg) | Calcium (mg) | Vitamin D (µg) | Long chain ω-3 (g) | | Iron (mg) | Zinc (mg) |
|---|---|---|---|---|---|---|---|
| | | | | EPA | DHA | | |
| Beets with toasted buckwheat, celery and apple | 0 [c] | 99 [c] | 0 [d] | 0,04 [d] | 0 [d] | 1,9 [c] | 0,7 [c] |
| Beets with toasted buckwheat, celery and apple | 1,7 [b] | 90 [b] | 0,3 [d] | 0,02 [c] | 0,03 [c] | 2,7[b] | 1,1 [b] |
| Broccoli with sesame seeds, coriander and miso | 0 [b] | 120 [b] | 0 [c] | 0,05 [d] | 0 [d] | 2,3 [b] | 0,75 [b] |
| Broccoli with sesame seeds, coriander and miso | 2,1 [b] | 100 [b] | 0,4 [d] | 0,03 [c] | 0,04 [c] | 3,1 [b] | 1,2 [b] |
| Fruity white cabbage salad | 0 [b] | 106 [b] | 0 [c] | 0,04 [d] | 0 [d] | 1,8 [b] | 0,6 [b] |
| Fruity white cabbage salad | 4,7[a] | 93 [a] | 0,3 [c] | 0,03 [c] | 0,04 [c] | 2,7 [b] | 1,1 [b] |
| Caramelized pineapple salad | 0 [b] | 75[b] | 0 [c] | 0,03 [d] | 0 [d] | 1,4 [b] | 0,6 [b] |
| Caramelized pineapple salad | 1,5 [b] | 74[b] | 0,3 [c] | 0,02 [c] | 0,03 [c] | 2,3 [b] | 1 [b] |
| Korean turnip salad | 0 [b] | 137 [b] | 0 [c] | 0,04 [d] | 0 [d] | 2,1 [b] | 0,8 [b] |
| Korean turnip salad | 1,9 [b] | 113 [b] | 0,3 [d] | 0,03 [c] | 0,04[c] | 2,9 [b] | 1,2[b] |
| Roasted cabbage with lemon and thyme | 0[a] | 77 [a] | 0[b] | 0,03[d] | 0[d] | 1,3 [a] | 0,5[a] |
| Roasted cabbage with lemon and thyme | 1,3 [a] | 75 [a] | 0,2 [c] | 0,02 [d] | 0,03[d] | 2,1 [a] | 0,8 [a] |

The data is registered by 100 g recipes. The recipes are vegan diets that are selected from Unilever data base. The nutrients content is based on Foodcomp and Vitakost (21, 45)

[a] data basic for 95-99 % of the foods in the recipe
[b] data basic for 75-94 % of the food in the recipe
[c] data basic for 50-74 % of the food in the recipe
[d] data basic for 0-49 % of the food in the recipe
Not all foods have all the data for the nutrient (21; 45). The data basic is based on the percentages of foods with data is part of the total recipe. That means that the percentages indicate the data basic of the foods in the recipe. This means that the data shown is not always 100% accurate (45).
* the data is rounded

Table 5 gives an overview of the nutrients typically missing in plant-based diets (table 1) in relation to the original recipes, recipes upgraded with vegan- and vegetarian food. This table shows the mean from the recipes presented in table 3 and 4 and comparing it to NNR (appendix 2). See appendix 4 to see complete calculation

**Table 5: Overview of nutrients mean gained from the different recipes***

| | **Original recipes** | **Improved recipes (vegan)** | **Improved recipes (vegetarian)** | **NNR[a]** |
|---|---|---|---|---|
| **Vitamin $B_{12}$ (µg)** | 0 | 0 | 2,2 | [0.5-2] |
| **Calcium (mg)** | 3,9 | 102 | 90 | [540-800] |
| **Vitamin D (µg)** | 0 | 0 | 0,29 | [10-20 µg] |
| **EPA (g)** | 0 | 0,038 | 0,024 | ≥ 1 % E |
| **DHA (g)** | 0 | 0 | 0,033 | ≥ 1 % E |
| **Iron (mg)** | 0,66 | 1,79 | 2,61 | [8-15 mg][b] |
| **Zinc (mg)** | 0,37 | 0,66 | 1,08 | [5-12 mg][b] |

* The data presented is mean per 100 g recipes
[a] The recommendations are unit per day
[b] The recommendation varies between men and women and thus the lowest and highest recommendation is presented here (appendix 2).

# Discussion

## The main results

The results show that it is possible to improve the recipes provided by Unilever, when being aware of foods that have a high content of the required nutrient. Dried dill (added due to calcium), frozen broccoli (added due to EPA), coriander (added due to iron and calcium) and poppy seed (added due to zinc and calcium) were added to the recipes while remaining vegan. Furthermore, the vegetarian recipes had additionally egg yolk (added due to vitamin D) and duck egg (added due to vitamin $B_{12}$) added. It was not possible to add food to improve the vitamin $B_{12}$, vitamin D and DHA status for vegan due to the limited range of food. The remaining nutrients were improved remarkable in the recipes. Vitamin $B_{12}$ exceeds the recommendations for the vegetarian due to the high content from eggs. However, the lower availability from eggs could assure that the whole content of vitamin $B_{12}$ noted is not absorbed.

Some research indicates that there might be some food such as mushrooms that can provide vitamin D, when being exposed to the sun. Scientists are exploring the possibility to actively expose mushroom to the sun in attempt to increase the level of vitamin D. Other food sources are algae that might provide vitamin $B_{12}$. However, whether this is true- or pseudo vitamin $B_{12}$ is not completely known. It appears that algae might not have true vitamin $B_{12}$ and therefore it is not bioavailable and can have a physiological effect on humans. The research is not completely in accordance and more research is needed to provide conclusive results on both vitamins. Further the results have shown that vegetarian and vegans need to be aware of the possible deficiency nutrients in their diet and ensure that all the nutrients are part of their diet. Even though the nutrients have improved remarkable, some are not close to the recommended amount. People on a plant-based diet might get some of nutrients when aware, but it might still not be adequate due to low bioavailability or the inhibition of other nutrients. It is recommended that vegetarian and especially vegans supply their intake with supplements such as vitamin $B_{12}$ and vitamin D. The latter only applies when the vegans and vegetarians is not being exposed enough to the sun.

### Complete diet vs. single meal

The results of this report demonstrate that living strictly on a vegetarian-or vegan diet leaves a risk of developing deficiency in some nutrients over time. These nutrients need extra attention when excluding animal sources. The results are based on a complete vegetarian- or vegan diet and not on

single meals which is the intention of the recipes from Unilever. The recipes are meant to inspire people to eat more vegetarian and simultaneously possible improve the environmental impact. A study has shown that having single meals with similar calorie intake can improve the climate impact by a factor of 2 to 9 in ecological footprint, however a bigger difference is seen when changing the dietary habits or lifestyle (11). Furthermore, after adding foods to the recipes, it could not provide all the nutrients that is typically lacking in vegetarian- or vegan diet. However, by creating awareness for people on a plant-based diet, it might be possible to prevent most of the deficiency. A big goal for Unilever is to create awareness and subsequently provide the population with more sustainable options to implement.

### Sustainable marketing

Awareness of a population is important to ensure a possible future with health and sustainability. Most of the population might achieve their knowledge from the news and internet. This can affect their opinions about health and their choices of consumption. People select and consume products for different reasons such as economic, ecology or sustainable production. When doing grocery shopping some of these reasons might be hard to detect. On the products' labels in the supermarket there are no indication of transportation time, working conditions etc. This means that the consumers need to be aware of the brand and their priority issues before purchasing the products. However, some of the brand priority can be labelled and these are shown on products such as Fairtrade, ecology and asthma-allergy. These labels that can be put on products includes Fairtrade, which controls and supervises that the working conditions are fair for the workers (31). Fairtrade portray *people* in the 3 p's. However, it is only possible to achieve this label for some products such a coffee, teas and chocolate. Other products cannot have a Fairtrade indication (31). When including *planet* in the 3 p's there are labels such as ecology and asthma-allergy. These ensure that the products comply with the condition of limiting the use of pesticides and gene modified plants or no perfume and colouring are among some of these conditions (20; 44). The ecology label is available for every food that meets the requirements. Asthma-allergy labels are mainly for health care products (20; 44). These labels can help the different brand to target a group of people who cares about these actions and wants to take an active choice when purchasing products. These labels also make it possible for brands to market themselves better. The different brands can furthermore charge extra for the label of being ecologically, Fairtrade etc. and this might eventually increase their profit.

There is still a limited assortment of labels for brands and only some products are included to use the labels. There is still no label for sustainability. The only option to market about sustainability is on the company's own website which means that the consumer actively needs to search for information. If the companies could market themselves as sustainable with a label, there could possibly be an economic benefit for them and maybe more companies would implement it. However, sustainability might look good on paper, but the company needs an economical incentive to change to a more sustainable production.

Creating a label for sustainability is very difficult due to the complexity of sustainability and all that it entails. The 3 p's should be included and there should be an agreement of the content of each *p*. Further some methods should be made on how to control it. This might sound easier than it is, but sustainability is multifactorial and many factors needs to be included. Researching sustainability there are many definitions and even though the definitions largely are similar. The small details differ and could possible create difficulties when implementing the term sustainability label. On top of that, another question is raised about who has the responsible for creating awareness and labels for sustainability. The companies who want to implement it or should it be a more objective company that is created only for the cause of sustainability labelling or even the government. Furthermore, who has the responsibility. When looking at the wheel of sustainability the government has the biggest influence and can target more people by creating laws that apply to companies and the population. To some degree that also implies that the government has the largest responsibility to implement more sustainable actions and awareness. However, it might be easier to influence individuals to change their habits and awareness. The awareness from the individuals could further lead to influence the politicians to create laws about sustainability. The government are depended on the people's vote and so if the population demands sustainability on the agenda, there might be a bigger chance that sustainability will be implemented.

### Comparing diets

In this report plant-based diets and western diets have been compared, but this comparison might not be defendable. It has been promoted in some articles that a plant-based diet might be healthier. Some research shows that by being vegetarian or vegan there is a smaller risk of developing obesity, cardiovascular diseases and diabetes and thereby possible prolonged life expectancy is seen (12; 36). There can be different reasons for these effects. It is probably due to the absence of meat

or the increased amount of vegetables (71) or it could be that people on a plant-based diet have a general better lifestyle (22). Vegetarians and vegans tend to consume less alcohol, drug, are non-smokers and more physical active and thus their lifestyle is generally healthier that the average population. This could contribute to a better health and therefore cause the beneficial results seen in some articles (22; 36; 49). When comparing diets, there are many other factors that has a great influence on the results such as a generally healthier lifestyle. These factors when not taking into consideration, could lead to a wrong correlation. So, promoting plant-based diet might not be accurate but rather a change in lifestyle could be more correct to indorse. Especially since plant-based diets exclude animal originated products and might not be sufficient.

#### Sufficiency

When is a diet sufficient? Sufficiency might be when a diet is adequate, but does this include supplying the intake with supplements. A vegan diet demands some supplement to ensure that the nutrients absent in their diet are still consumed. This includes vitamin $B_{12}$, DHA and vitamin D. There are some other nutrients that vegans need to be conscious about consuming since there might only be a few food sources that contain these.

Vitamin D is only necessary as supplements when not being absorbed in an adequate amount from the sun, which Nordic countries might need during the winter. This also applies for people on a western diet and so a western diet might not be sufficient either. Additionally, women in the childbearing age also need to be aware of their iron intake, due to their monthly loss of iron. This includes both people on a plant-based and meat-based diets and thus none of the diets seem to be sufficient. However, there are a difference between the nutrients people need to be aware of. When excluding a food group there will be some nutrients that are lacking and an extra focus on these are important. A western diet does not exclude any food groups however there are an excess of nutrients in the diet. The excess of energy can potentially lead to obesity. Furthermore, some nutrients are known to effect absorption of other and thus consciousness about these are also essential. A balance and varied diet is needed and could be adequate in providing sufficient energy and nutrients. An adequate diet is defined as a diet with no nutrient deficiencies that can prevent human growth and reproduction whereas an optimal diet promotes health and ensures a longer life expectancy by reducing the risk of chronic diseases (53). However, a well-balanced and adequate diet can be difficult to achieve in some countries due to lack of wealth.

There are many millions in the world living in poverty and they do not have the capacity to ensure a healthy lifestyle. This number might further increase if the demand of animal products keeps

increasing. It will likely rise the prices of animal products due to the high demand and the low supply of animals. Therefore, people living in poverty will be affected the most and so animal products might not be an option for some people (1).

## Sustainable or health?

This raise the question about what is best for the future and what is best for the individual when looking at health and sustainability. For the individual, most people focus on their own situation and health. Whereas the population might consider that a sustainable future is more important to ensure future generations. There are multiple ways that health and more environmental actions can be implemented. Meat- and dairy products have shown to have the highest impact on the environment compared to other food but tropical fruits that are transported by airplane also have a high carbon footprint (11). Buying locally grown products that do not require a long transportation, can help decrease the environmental effect. This could also mean that by purchasing seasonal fruits and vegetables gives a guarantee that no extra energy is used to produce these. To take this a step further, a scenario could be that fruits and vegetables only could be bought in the countries that produces the food without no extra energy applied. This would mean that people can only consume tropical fruits- and vegetables when living in the tropical countries. However, from an economically point of view this would be impossible due to the economic system that are based on export to other countries.

### Sustainable production

Another option could be to take a closer look at how foods are being produced and hereby improve the production. This includes that each part in the food production chain becomes more efficient and thus a more sustainable production could be implemented. Optimizing the harvesting, collection, storage, production and transportation and optimizing the production or replacing machines to more energy efficient ones could have a great influence on the environment and might additionally provide an economic benefit. Another action could be to implement renewable energy to all these processes and thereby reduce the ecological footprint. The same applies to reduce the waste produced during the production and promote recycle system. From the production to consumption about 30 % energy is due to waste (53). In the future, the industry needs to improve efficiency of the food production by producing more food with less impact on the environment.

These environmental actions are not only for companies but can also apply to a common household to replace items to more energy efficient and reduce waste and recycle more. There is more action that can be implemented to ensure a less environmental impact.

## Possible actions for a more sustainable future

The current situation is a paradox. Approximately half of the global population are underweight or obese (22). This means that around the world, the people are not being fed effectively. Even though is seems as there is generated enough food energy for the world's population, it does not seem to bring adequate and affordable nutrition for all (53).

### Overconsumption

The increase in the incidence of obesity in the world is notable. The pathogenesis of obesity is complex but a high intake in calories, in which the body receives more energy than it uses, could contribute to the development of obesity. This overconsumption of food could also have an impact on the environment. When producing more food than needed and creating 'waste' from food, it might further increase the carbon footprint. The food might have been used for other people who did not consume enough or could not have been produced. This might be improved if people stayed within the recommended quantity of food. When following the diet close to the dietary recommendation a lower environmental impact is seen compared to a typically western diet (43). Additionally, a healthier population might also appear, due to less overconsumption.

### Change in dietary habits

Other actions for a more sustainable future could be to change dietary habits. A possible option could be to integrate meat free days or primarily consume animal products with lower carbon footprint. Additionally, if only calves and lamb, which have a high carbon footprint, are consumed on festive and special occasion it might decrease the environmental impact. Moreover, another action is that the average individual who consumes 150 g meat a day (8), only should consume 56 g a day according to the dietary recommendation (47). By consuming the 'right' amount of meat, and replacing it with for example vegetables, the ecological footprint could be reduced. Additionally, a study has shown that changing to a healthy diet could have a greater reduction in climate impact than by having a meat free day. The reduction increased by a factor of three if the meat consumed was those with low carbon footprint (7). Furthermore, for the consumers, there might be a big

difference in not consuming meat in the daily life and thus eating less might be more appealing to them.

## Methods

The methods in this report are primarily literature review study and the main results are based on calculation from Vitakost and Foodcomp.

### Calculation of nutritional value

The calculation of nutrients in the recipes have to some degree defective due to data at Vitakost is not sufficient and some food are not presented in database. This means that the accuracy of the given nutrient might not be accurate on Vitakost website. Vitakost reports about the accuracy for each nutrient to inform the user about these insufficient data. However, this might still give a wrong indication of the nutrient content in this report. Additionally, the content of foods is not consistent when looking at different reliable websites. Accordingly, to Foodcomp (21) there are no vegetarian source that contains DHA, however when calculating the content of egg in Vitakost (45) there is a small amount noted. These differences could also affect the results and is the reason why table 1 and table 4 are inconsistent. The same applies in the inconsistency with different results showing no food sources of vitamin $B_{12}$ and vitamin D in the tables and new research showing the possibility that these vitamins might be represented in some plant sources.

### Bioavailability

Even though bioavailability is mentioned in this report it is not taken into consideration in the result section. Eggs are added to increase vitamin $B_{12}$ and vitamin D, however eggs have the lowest bioavailability compared to other meat sources. The bioavailability has a great importance for the absorption of each food mentioned. Non-haem from iron found in vegetable origin has a lower bioavailability than haem found in animal origin. This means that the same content of iron will not have the same absorption in the body and thus vegetable origin could potentially lead to deficiency. The same applies to nutrients that influence the absorption of other nutrients. Some nutrients have shown to affect the absorption of the potential lacking nutrients in a plant-based diets. Further vitamin $B_{12}$ which also is lacking in vegan diets, is needed for folate acid to become activated and absorbed. This means that even if folate acid is present in a diet it cannot be absorbed and might lead to deficiency.

The results only show the amount of nutrients present in the food and not bioavailability or the potentially interaction in the absorption. When not taking these into consideration, there might be a big risk that the amount of nutrients noted in table 4 are inconsistent with the amount absorbed and the nutrients might be insufficient. Some of these interactions between nutrients in absorption is mentioned in this report. However, it is noteworthy to mention that there might still be some other nutrients yet to be discovered that inhibit or active the absorption of other nutrients. New research and information are being discovered all the time. Having an adequate amount of nutrients are crucial to remain healthy.

# Conclusion

The report indicates that staying on a vegan diet is impossible without taking supplements to obtain a nutrient balance. For vegetarian supplements are not necessarily needed, if they are conscious about absorbing adequate amount of nutrients. However, when excluding animal origin vegetarians also need to consider bioavailability when consuming food. The same applies for people on a western diet. They need to be conscious about receiving the right amount of nutrients and simultaneously not overconsume both due to health and environmental concern. There are an optimal range of intake that is recommended. These are based on research and should be followed to ensure an optimal diet. More research is needed to fill the knowledge gap and help to navigate through the jungle of combining sustainability and healthy diet. How to obtain a healthy diet while not harming the environment can be done in multiple actions. These actions have some different demands to the consumers to change their habits and have different level of impact on the environment. Most actions include reducing consumption and thereby production of the products. Even small changes might improve the environmental situation.

Some of the actions can be to eat less. Obesity is a big and growing concern. Overconsumption is not only a problem for the environment but also the health and consuming less could benefit both. Another action can be to replace cow and lamb with poultry or fish. Replacing or eating less of animal products that have a higher impact on the ecological footprint could benefit the environment without compromising the health. Additional eating less meat, less dairy products or have meatless days are also possible actions that might improve the environment. Currently animal origin is overconsumed in many countries and so staying within the recommendation could decrease the

production of animal products. These actions could improve the environmental impact and might be implemented without compromising on individual's health. The most important is to meet the needs of today while preserving resources for tomorrow.

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# Appendix

## Appendix 1: Selected vegan recipes noted per portion

| **Beets with toasted buckwheat, celery and apple (ENG)** | | |
|---|---|---|
| **Betor med rostat bovete, blekselleri och äpple (SE)** | | |
| Mängd | Mått | Ingrediens |
| 50 | g | Gulbetor |
| 50 | g | Rödbeta |
| 10 | g | Blekselleri |
| 10 | g | Gulbetor |
| 12 | g | Äpple (Aroma) |
| 1,50 | g | Bovete |
| 1,50 | g | Libbsticka |
| 5 | ml | HELLMANN'S Citrus Vinaigrette, 6 x 1L |

| **Broccoli with sesame seeds, coriander and miso (ENG)** | | |
|---|---|---|
| **Broccoli med sesamfrön, coriander och miso (SE)** | | |
| Mängd | Mått | Ingrediens |
| 30 | g | Broccoli |
| 30 | g | Bönor, färska sockerärtor, brytbönor eller haricot verts |
| 3 | g | Koriander, färsk hackad |
| | | Dressing: |
| 25 | ml | HELLMANN'S Sesame Soy Vinaigrette, 6 x 1L |
| 3 | g | Misopasta |
| 0,20 | g | Salt |
| 2 | g | Sesamfrön |

| Korean turnip salad (ENG) | | |
|---|---|---|
| **Koreansk kålrotssallad (SE)** | | |
| Mängd | Mått | Ingrediens |
| 50 | g | Kålrot, strimlad |
| 1,20 | g | Salt(1) |
| 20 | ml | Vatten |
| 10 | g | Vårlök, skivad |
| | | Dressing: |
| 6 | g | Sesamfrön, rostade |
| 20 | g | Vinäger, ris |
| 3 | g | Socker, farin |
| 2 | g | KNORR Grönsaksfond, koncentrerad 6 x 1 L Ersätter F14093 v34 2016 |
| 2 | g | Chilipasta, Koreansk( Go chu jang) |
| 4 | g | KNORR Professional Ingefära kryddpuré 2 x 0,75 kg |
| 2 | g | KNORR Professional Vitlök kryddpuré 2 x 0,75 kg |

| Fruity white cabbage salad (ENG) | | |
|---|---|---|
| **Fruktig vitkålssallad (SE)** | | |
| Mängd | Mått | Ingrediens |
| 40 | g | Vitkål, strimlad |
| 20 | g | Mango, tärnad |
| 15 | g | Paprika, gul tärnad |
| 15 | g | Gurka, tärnad |
| 15 | g | Avokado, tärnad |
| 5 | g | Vårlök, skivad |
| | | Dressing: |
| 10 | ml | HELLMANN'S Citrus Vinaigrette, 6 x 1L |
| 0,30 | g | KNORR Professional Vitlök kryddpuré 2 x 0,75 kg |

| | | |
|---|---|---|
| 1 | g | Limejuice |
| | | Till dekoration: |
| 2 | g | Sesamfrön, rostade |

**Caramelized pineapple salad (ENG)**

**Karamelliserad ananassallad (SE)**

| Mängd | Mått | Ingrediens |
|---|---|---|
| | | Ananassallad: |
| 50 | g | Ananassallad, skuren i bitar (3 cm) |
| 3 | g | Socker, farin |
| 40 | g | Gurka, urkärnad och skivad |
| 2 | g | Mynta, blad |
| 15 | G | Lök, strimlad |
| 2 | G | Chili, röd urkärnad hackad |
| 5 | G | Jordnötter, rostade hackade |
| | | Stark jordnötsdressing: |
| 3 | G | Chili, röd urkärnad hackad |
| 5 | ml | Limejuice |
| 15 | g | Jordnötter, rostade |
| 4 | g | KNORR Professional Vitlök kryddpuré 2 x 0,75 kg |

**Roasted cabbage with lemon and thyme (ENG)**

**Rostad spetskål med citron och timjan (SE)**

| Mängd | Mått | Ingrediens |
|---|---|---|
| 0,20 | kg | Spetskål |
| 0,40 | g | Citron,zest |
| 2 | g | Timjan, färsk |
| 5 | ml | Olja, raps |
| 2 | g | KNORR Professional Medelhavsörter kryddpuré 2 x 0,75 kg |
| 0,60 | g | Salt |
| 10 | ml | HELLMANN'S Citrus Vinaigrette, 6 x 1L |

| | | |
|---|---|---|
| 2 | g | Vinäger, ris |
| 2 | g | Socker |
| 32 | ml | HELLMANN'S Citrus Vinaigrette, 6 x 1L |

## Appendix 2: Nordic Nutrition Recommendations[a]

| **Nutrient** | Child (6 mo – 9 yrs) | Young child (10-17 yrs) | Adult (18-74 yrs) | Elder (>75 yrs) | Upper intake limits |
|---|---|---|---|---|---|
| Vitamin B12 (µg) | 0.5-1.3 | 2 | 2 | 2 | ÷ |
| Calcium (mg) | 540-700 | 900 | 800 | 800 | 2500 |
| Vitamin D (µg) | 10 | 10 | 10 | 20 | 100 |
| Iron (mg) | 8-9 | 11-15 ♀, 11♂ | 9-15♀, 9♂ | 9 | 60 |
| Zinc (mg) | 5-7♀ | 8-9♀, 11-12 ♂ | 7♀, 9 ♂ | 7♀, 9 ♂ | - |
| EPA and DHA | ≥1 E% | ≥1 E% | ≥1 E% | ≥1 E% | ≥1 E% |

[a] The data is modified to fit

÷ not established

- not noted

Source: (43)

## Appendix 3: Overview of potential food sources

| Products | Highest content sorted after: | Vitamin D (µg) | Vitamin B12 (µg) | Calcium (µg) | Iron (mg) | Zinc (mg) | EPA 20:5 n-3 (g) | DHA 22:6 n-3 (g) |
|---|---|---|---|---|---|---|---|---|
| **Egg, Duck, raw** | $B_{12}$ | ÷ | 5,4 | 64 | 3,85 | 1,41 | 0 | 0 |
| Egg, Goose, raw | $B_{12}$ | ÷ | 5,1 | 60 | 3,64 | 1,33 | 0 | 0 |
| Egg, hen, yolk, dried | $B_{12}$ | ÷ | 4,56 | 320 | 9,95 | 7,35 | 0 | 0 |
| 70% margarine | $B_{12}$ | 0 | 0,1 | 10 | 0,09 | 0,047 | ÷ | 0 |
| 80 % margarine table use | $B_{12}$ | 0 | 0,1 | 10 | 0,09 | 0,047 | ÷ | 0 |
| *Baking powder* | Calcium | 0 | 0 | 113000 | ÷ | ÷ | 0 | 0 |
| ***Dried dill*** | Calcium | 0 | 0 | 1784 | ÷ | ÷ | ÷ | ÷ |
| ***Poppy seed*** | Calcium+ Zinc | ÷ | 0 | 1448 | 9,39 | 10,2 | 0 | 0 |
| ***Coriander*** | Calcium+ Iron | ÷ | 0 | 1246 | 42,5 | ÷ | 0 | 0 |
| **Egg, chicken, yolk, raw** | Vitamin D | 9,26 | 3,42 | 138 | 5,33 | 3,74 | 0,004 | 0 |
| Egg, chicken, yolk, pasteurised | Vitamin D | 7,35 | 3,06 | 103 | 4,08 | 2,79 | 0,041 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Egg, chicken raw | Vitamin D | 4,58 | 1,72 | 46,3 | 1,77 | 1,16 | 0 | 0,007 |
| *Curry powder* | Iron | 0 | 0 | 478 | 29,6 | 4,05 | ÷ | ÷ |
| *Wheat germ* | Zinc | 0 | 0 | 41 | 5 | 17,8 | ÷ | ÷ |
| *Cacaoa powder* | Zinc | 0 | 0 | 105 | 11 | 10,1 | 0 | 0 |
| *Yeast dried* | Zinc | 0 | 0 | 44 | 16,1 | 8 | ÷ | ÷ |
| ***Brocoli frozen*** | EPA | ÷ | 0 | 56 | 0,810 | 480 | 0,223 | 0 |
| Egg pasterurized | EPA | 7,35 | 3,06 | 103 | 4,08 | 2,79 | 0,041 | 0 |
| Egg boiled fru | EPA | 1,98 | 1,1 | 41,3 | 1,88 | 1,2 | 0,014 | 0 |
| - | DHA[a] | - | - | - | - | - | - | - |

Source: (21)
This table shows the food sources, that if possible is vegetarian and/or vegan sorted after the highest content of nutrients in table 1. The food sources that is marked with cursive letters, are the sources that vegans can eat, however is it not possible to find food sources for all the nutrient (table 1) for vegans and thus noting is mention. The food sources marked with thick letters are the food sources added to the recipes.
[a] No vegan or vegetarian food sources for the nutrient 22:6: (21)

## Appendix 4: Calculation of mean for different recipes

| Recipes name | Vitamin $B_{12}$ (µg) | Calcium (mg) | Vitamin D (µg) | Long chain ω-3 (g) | | Iron (mg) | Zinc (mg) |
|---|---|---|---|---|---|---|---|
| | | | | EPA | DHA | | |
| | 0 | 14,7 | 0 | 0 | | 0,26 | 0,27 |
| | 0 | 39,3 | 0 | 0 | | 0,98 | 0,43 |
| | 0 | 40,6 | 0 | 0 | | 0,58 | 0,35 |
| | 0 | 24,1 | 0 | 0 | | 0,57 | 0,45 |
| | 0 | 80,5 | 0 | 0 | | 1,04 | 0,5 |
| | 0 | 34,9 | 0 | 0 | | 0,53 | 0,2 |
| **Mean** | 0 | 39,01667 | 0 | 0 | | 0,66 | 0,366667 |

**Original recipes**

**Recipes upgraded with vegan food**

| Recipes | Vitamin $B_{12}$ (µg) | Calcium (mg) | Vitamin D (µg) | Long chain ω-3 (g) | | Iron (mg) | Zinc (mg) |
|---|---|---|---|---|---|---|---|
| | | | | EPA | DHA | | |
| | 0 | 99,1 | 0 | 0,037 | 0 | 1,85 | 0,67 |
| | 0 | 120 | 0 | 0,051 | 0 | 2,3 | 0,75 |
| | 0 | 106 | 0 | 0,041 | 0 | 1,75 | 0,63 |
| | 0 | 75,2 | 0 | 0,031 | 0 | 1,44 | 0,64 |
| | 0 | 137 | 0 | 0,042 | 0 | 2,12 | 0,75 |
| | 0 | 76,6 | 0 | 0,026 | 0 | 1,27 | 0,49 |
| **Mean** | 0 | 102,3167 | 0 | 0,038 | 0 | 1,788333 | 0,655 |

**Recipes upgraded with vegetarian food**

| Recipes | Vitamin $B_{12}$ (µg) | Calcium (mg) | Vitamin D (µg) | Long chain ω-3 (g) | | Iron (mg) | Zinc (mg) |
|---|---|---|---|---|---|---|---|
| | | | | EPA | DHA | | |
| | 1,71 | 89,6 | 0,29 | 0,024 | 0,033 | 2,66 | 1,1 |
| | 2,08 | 99,6 | 0,35 | 0,03 | 0,04 | 3,1 | 1,24 |
| | 4,72 | 93,1 | 0,31 | 0,026 | 0,036 | 2,66 | 1,1 |
| | 1,51 | 74,1 | 0,26 | 0,021 | 0,029 | 2,28 | 1,02 |
| | 1,86 | 113 | 0,32 | 0,026 | 0,036 | 2,9 | 1,18 |
| | 1,34 | 75,3 | 0,23 | 0,019 | 0,026 | 2,06 | 0,81 |
| **Mean** | 2,203333 | 90,78333 | 0,293333 | 0,024333 | 0,033333 | 2,61 | 1,075 |

The mean is calculated by using the following equation:

$$mean = \frac{\sum Xi}{n}$$