



## Original Paper

# Coronavirus and Nutrition: Approach for Boosting Immune System in Morocco

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### Abstract

The Covid-19 pandemic is a pandemic of an emerging infectious disease, the 2019 coronavirus disease Covid-19, caused by the SARS-CoV-2 coronavirus. The essential protective measures recommended by WHO (2020) to limit the spread of the Coronavirus (Covid-19) limited in the suppression of travel, quarantine and containment. In the first part of this review, we will examine the origin of the coronavirus, the modes of spread and their adverse effects on human health. We will include in our analysis the nutritional importance of the different approaches based on mechanisms to boost the immune system and therefore good viral defense. The immune system helps protect the host against environmental agents such as pathogenic microorganisms (bacteria, fungi and viruses), thus preserving the integrity of the organism. To preserve the defense mechanisms of the organisms, an adequate nutritional state must be maintained with adequate intakes of calories, vitamins, minerals and water which must be continuously provided by a healthy diet. In addition, it is necessary to have nutritional information that will help boost the immune system of people in the fight against Covid-19, nutritional diagnosis and early nutritional management of affected patients must be integrated into the overall therapeutic strategy. Several clinical data have shown that micronutrients like vitamins, including vitamins A, C, D, E, B12, B6 and folic acid; trace elements like iron, zinc, copper, magnesium, selenium, and omega-3 fatty acids like docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) play a major role in supporting the immune system.

## 1. Introduction

The Covid-19 pandemic is a pandemic of an emerging infectious disease, the 2019 coronavirus disease Covid-19, caused by the SARS-CoV-2 coronavirus. It appeared on November 17, 2019 in the city of Wuhan, central China, and then spread around the world. To date, all countries in the world are already affected by this pandemic [1,2]. Added to this is the emergence of chronic noncommunicable diseases (NCDs) including hypertension, cardiovascular disease, diabetes and cancers which are on the rise [3]. These are linked to hereditary factors but above all to unhealthy eating habits. Faced with this overwhelming health emergency, recommended essential protective measures to prevent the saturation of intensive care services and strengthen preventive hygiene [4]. These measures include the elimination of physical contact, shaking of hands, hugs, crowds and large demonstrations, as well as unnecessary travel and travel; promotion of hand washing, quarantine of suspected cases, etc. This global pandemic is causing serial cancellations of scientific, sporting and cultural events all over the planet in general and in Morocco in particular. In addition, the implementation by many countries of containment measures and the closing of borders to slow the formation of new sources of contagion is causing a sharp fall in the stock market due to the uncertainties and fears it poses to the regional economy, and especially food and nutritional security. In the response against Covid-19, the governments of the affected countries and the scientific community have shown good observable reactivity through the various clinical studies in progress and the proposals for therapeutic measures resulting from traditional medicine and studies in proven vitro [5, 6, and 7]. However, the implications of the pandemic for food and nutrition security are seldom mentioned, while the early consideration of this aspect is essential in the fight against Covid-19. The importance of nutrition in the body's response to bacterial and viral infections is widely documented [8, 9, and 10].

## 2. Experimental details

### 2.1. Nutritional interventions

The evidence for nutritional interventions for viral diseases from previous clinical trials and their importance for optimizing the host immune response was reviewed in this article. Where clinical trials have shown that micronutrients like vitamins including vitamins A, C, E, D, B12, B 6 and folic acid, trace minerals like iron, zinc, copper, magnesium, and selenium and omega-3 fatty acids like DHA and EPA which play a major role in supporting the immune system.

### 2.2. Data collection

The data was collected from analytical studies of micronutrient analysis indexed supported by researchers from Morocco, Palestine and Djibouti.

### 2.3. Statistical analysis

The data analyzes were performed using IBM SPSS® Statistics 23.0. Results shown are rounded averages.

## 3. Results and discussion

### 3.1. Coronavirus infection and symptoms Covid-19

Coronavirus disease is an infectious disease caused by a recently discovered coronavirus [11, 12]. Most people infected with the virus that causes Covid-19 will have the following symptoms: fever, fatigue, headache, cough and sore throat, body aches, and mild to moderate difficulty breathing [13, 14, 15, and 16]. These symptoms will recover without the need for special treatment, but unfortunately older people and those with other health problems, such as cardiovascular disease, diabetes, chronic respiratory disease or cancer, are at higher risk. to present a serious form. The best way to prevent and slow transmission is to be well informed about the Covid-19 virus, how it is spread and the disease it causes [17]. You can protect yourself and others from infection by washing your hands frequently with soap and water or a hydroalcoholic solution, and avoiding touching your face [18]. The virus that causes Covid-19 is spread primarily through droplets of saliva or nasal secretions when an infected person coughs or sneezes. It is therefore important to also apply the rules of respiratory hygiene [19, 20].

### 3.2. Overview of nutrition and the immune system

Food is made up of micronutrients like vitamins and minerals, while macronutrients are made up of carbohydrates, proteins and fats, all of these are necessary and essential for the body which cannot function properly if it lacks sufficient 'one or more nutrients and therefore ensure survival [21, 22]. Food is essential for our body to develop, replace and repair cells and tissues, produce energy used to stay cold, to move and work, to carry out chemical processes such as digestion of food and to strengthen the immune system essential for the protection, resistance and fight of the organism against infections and cure disease processes. The main functions of the immune system are to protect the body against infections and harmful microorganisms, to cleanse damaged tissue, and to prevent the growth of malignant cells in the body. The strength of the immune system's performance largely depends on factors such as genetics, living environment, lifestyle, nutrition and the interaction between these factors [23, 24, and 25]. Nutrition has been studied as a factor in altering the influence on the functioning of the immune system for decades, and research in this area has become an important topic called nutritional immunology [26, 27, and 28]. The immune system, like other systems in the body, needs enough nutrients to function properly and therefore almost all nutrients in the diet play an important role in maintaining an optimal immune response. And therefore, their deficiency or even high consumption can have negative consequences on the state of the immune system and increased susceptibility to various pathogens [29, 30].

**Table 1:** Recommended energy intake for the population for an average level of activity.

|                | Age (years) | Weight | Energy (kcal)     |
|----------------|-------------|--------|-------------------|
| <b>Men</b>     | 20–40       | 70     | 2 700             |
|                | 41–60       | 70     | 2 500             |
| <b>Women</b>   | 20–40       | 60     | 2 200             |
|                | 41–60       | 60     | 2 000             |
| <b>Seniors</b> | 60–75       | -      | 36/kg body weight |

### ***3.3. The food environment in Morocco***

The Moroccan food environment is undergoing a transition which affects the urban and rural areas, eating habits have changed with urbanization, globalization and economic development which have generated a Mediterranean-type diet based on a large consumption of cereals, fruits and vegetables. Food is gradually diversifying, especially for the wealthier classes and urban households, it includes more foods rich in macronutrients and micronutrients, but the consumption of animal products remains very limited despite the country's resources [31, 32, and 33]. Very important. Ready-to-eat foods and out-of-home catering are becoming more common in urban areas, favoring the consumption of foods high in carbohydrates (sugar) and lipids (fat). This development reflects the nutritional transition underway in rural as well as urban areas. Coupled with a reduction in physical activity, these changes are responsible for the progression of overweight and obesity in the adult population [34].

### ***3.4. Recommendations to boot the immune system in the face of Covid-19***

To effectively cope with Covid-19, it is necessary to strengthen the immune system to prevent infection and therefore it requires a program based on a healthy and balanced diet. People must adopt a diet rich in protein, carbohydrates, fats, vitamins and minerals with an optimal intake of water. These food components provide calories for activity, growth and all body functions, such as respiration, digestion and temperature maintenance, and elements for growth, maintenance of the body, and maintaining a healthy immune system [35, 36].

### ***3.5. Food variations***

#### ***3.5.1. Eat starchy foods with each meal***

Starches include grains (such as fonio, rice, corn, millet, sorghum, wheat, and barley), roots and tubers (such as potatoes, sweet potatoes, cassava, and yam) and fruits rich in starch such as plantains [37].

#### ***3.5.2. Eat legumes (or pulses) if possible, every day***

Legumes include dried beans, peas, lentils, peanuts (including peanut butter), and soybeans [38].

#### ***3.5.3. Eat food of animal origin and dairy products regularly***

These foods include all forms of meat, poultry, fish, eggs and dairy products such as milk, sour milk, buttermilk, yogurt, cheese, eggs, native chickens and rabbit meat, the latter are excellent sources of protein, phosphorus, zinc and iron,... of animal origin of excellent nutritional quality [39, 40].

#### ***3.5.4. Eat fruits and vegetables every day***

Fruits and vegetables are essential components of a healthy, balanced meal [41]. They provide vitamins and minerals that keep the body working and support the immune system [42]. The nutritional quality provided by the consumption of vegetables and legumes has been the subject of several in-depth studies. Legumes and vegetables are rich sources of protein, fat, carbohydrates, minerals, antioxidants, fiber, and water, as well as being excellent sources of  $\beta$ -

carotene (provitamin A), thiamine (B1), riboflavin (B2), niacin, pyridoxine (B6), pantothenic acid, folic acid (folacin), ascorbic acid and vitamins E and K [43]. Fruits such as cabbage, oranges, tangerines, grapefruits, lemons, guavas, mangoes, passion fruit, ripe pineapple, baobab fruit, tomatoes are very rich in vitamin C. Green leafy vegetables like spinach, pumpkins, green peppers, squash, carrots, papaya and mango are good sources of vitamin A. These food resources are especially important for people already affected by COVID-19 to fight infection [44].

### ***3.5.5. Moderately consume oils, fat, sugar and sweet products***

They are an important source of energy, even in small amounts. They are found in butter, bacon, margarine, cooking oils (vegetable, coconut and palm) cream, mayonnaise and coconut cream [45]. It can also be found in avocados, oil seeds (sunflower, peanut and sesame), the fatty parts of meats and fish, sour milk and cheese. Sugar and sweet products are honey, jam, table sugar, cakes and cookies [46]. Although fats and sugars are good sources of energy, they do not contain other nutrients. They should therefore be consumed in addition to other foods, and not as a replacement [47].

### ***3.5.6. Drink plenty of clean water***

Water is important for life and you need to drink it every day. To this drinking water consumption, can be added all the liquids from juices, soups, vegetables and fruits as well as dishes in sauce. However, you should avoid drinking tea or coffee with meals as they can decrease the absorption of iron from food. Thus, avoid alcoholic beverages that absorb water from the body and they can also interact with the action of drugs, especially for people treated for a Coronavirus disease [48, 49].

### ***3.5.7. Increase the intake of vitamins and minerals (Tables 2 & 3)***

Vitamins and minerals are essential for maintaining good health [50, 21, and 51]. They protect you against opportunistic infections by preserving and maintaining healthy skin, lungs and intestines and by keeping the immune system functioning properly. Vitamins A, C, E, some of group B and minerals such as selenium, zinc and iron are of great importance. Vitamin A is important for the maintenance of healthy skin and mucous membranes (lungs and intestines) [30, 52, and 27]. Dark green, yellow, orange, and red fruits and vegetables are good sources of vitamin A. Spinach, pumpkin, green pepper, squash, carrots, yellow peach, apricot, papaya and mango are one of them [53]. This vitamin is also found in palm oil, corn, sweet potatoes, egg yolks and liver. Vitamin C protects the body against infections and promotes healing. It is particularly found in citrus fruits such as oranges, grapefruits, lemons and tangerines. Mangoes, tomatoes and potatoes are also a good source of vitamin C [54]. Vitamin E protects cells and promotes resistance to infection. Foods that contain vitamin E include green leafy vegetables, vegetable oils, peanuts and egg yolks. Group B vitamins are necessary for the maintenance of healthy immune and nervous systems. White beans, potatoes, meat, fish, chicken, watermelon, corn, seeds, nuts, avocado, broccoli and green leafy vegetables contain a lot of it [55]. The iron is found in green leafy vegetables, oilseeds, whole grain products, dried fruits, sorghum, millet, beans, alfalfa, red meat, chicken, liver, fish, seafood and eggs. Selenium is an important mineral because it has a stimulating effect on immunity [56].

**Table 2.** Daily intake of some vitamins

|                       | Vitamins |     |    |     |     |     |     |     |       |       |
|-----------------------|----------|-----|----|-----|-----|-----|-----|-----|-------|-------|
|                       | B1       | B2  | PP | B6  | B9  | B12 | C   | A   | D     | E     |
|                       | mg       | mg  | mg | mg  | µg  | µg  | mg  | µg  | µg    | mg    |
| <b>Adult males</b>    | 1.3      | 1.6 | 14 | 1.8 | 330 | 3.4 | 110 | 800 | 5     | 12    |
| <b>Adult women</b>    | 1.1      | 1.5 | 11 | 1.5 | 300 | 2.4 | 110 | 600 | 5     | 12    |
| <b>Pregnant women</b> | 1.8      | 1.6 | 16 | 2   | 400 | 2.6 | 120 | 700 | 10    | 12    |
| <b>The elderly</b>    | 1.2      | 1.6 | 14 | 2.2 | 350 | 3.0 | 120 | 700 | 10–15 | 20–50 |

**Table 3.** Recommended daily intake of some minerals

|                       | Minerals and trace elements |     |     |    |    |     |    |
|-----------------------|-----------------------------|-----|-----|----|----|-----|----|
|                       | Ca                          | P   | Mg  | Fe | Zu | I   | Se |
|                       | mg                          | mg  | mg  | mg | mg | µg  | µg |
| <b>Adult males</b>    | 900                         | 750 | 420 | 9  | 12 | 150 | 60 |
| <b>Adult women</b>    | 900                         | 750 | 360 | 16 | 10 | 150 | 50 |
| <b>Pregnant women</b> | 1 000                       | 800 | 400 | 30 | 14 | 200 | 60 |
| <b>The elderly</b>    | 1 200                       | 800 | 400 | 10 | 12 | 150 | 80 |

It is found in whole grains such as wholemeal bread, corn and millet, and dairy products such as milk, yogurt and cheese. Meat, fish, poultry, eggs, and all foods high in protein like peanut butter, beans, and nuts are high in selenium. Zinc is also important for the immune system. Zinc deficiency reduces appetite. It is found in meat, fish, poultry, shellfish, whole grains, corn, dried beans, peanuts, milk and dairy products [54].

### 3.6. Physical activities

During the Covid-19 pandemic, the movements of many people are limited, when restrictions allow activity, routine physical distancing and hand hygiene should be practiced. Indoor exercise and online physical activity classes are encouraged, in preference to outdoor activities [57]. Obviously, to maintain good health and optimal weight, especially during this period of confinement, daily physical activity (30 to 60 minutes each day) goes hand in hand with a healthy diet. Physical activity is recommended both to prevent cardiovascular disease and its occurrence and to limit the consequences when they occur. The main conditions involved are coronary artery disease, chronic heart failure and arteriopathy of the lower limbs. Regular physical activity can delay or slow down certain deleterious processes associated with aging. The relationships between physical activity and respiratory disease are close. Physical activity is the most effective therapeutic tool in the treatment of dyspnea and chronic obstructive pulmonary disease (COPD) and the respiratory disease of smokers, the prevalence of which is rampant.

### 3.7. The fasting

We speak of fasting when there is no food intake for at least 16 hours. In the case where there is no calorie intake and only water is allowed, it is called a complete fast. If the individual does not eat and drink water, it is a dry fast. The fast can also be partial: the diet is then based on

fruit or vegetable juices, which limits the calorie intake to about 300 kilocalories per day (for an adult, the recommended intake is about 2000 kilocalories). A fast can be continuous or intermittent (one or two days a week). Deprivation of food for several days leads to an upheaval in the metabolism. The body must do everything to compensate for this loss of energy intake by alternately using its various fuel reserves. On the first day of fasting, nothing changes. The body uses glucose circulating in the blood or that stored in the liver. But by the second day, these stocks are exhausted. The body and brain then draw on fat and protein stores to make glucose. After five days, the body stops pumping its protein stores. And for good reason: when half of these reserves have been consumed, the individual is no longer viable. Energy must then be produced from fat stores - more precisely fatty acids - which can be directly used or transformed into ketones, substitutes for glucose [58, 59, and 60].

### 3.8. The benefits of fasting:

Fasting is a means of acquiring good health where the body can rest and purify itself. The human body is then cleansed of old cells, fats, wastes and toxins that have accumulated during the year through its diet and activity [61].

The benefits of fasting have been proven by several physiological studies:

- ✓ It fights against metabolic pathologies (excess cholesterol, triglycerides, fatty diabetes, etc.),
- ✓ Improves physical and intellectual fitness,

Fasting also makes it possible to rejuvenate the skin, strengthen the teeth, strengthen the hair, soothe the senses, increase concentration, etc.

Fasting remains accessible to everyone (except in a few pathological cases), because the human body has the necessary reserves to hold out without problems for several hours:

- ✓ The liver can provide large amounts of glycogen, an excellent internal fuel.
- ✓ Blood and lymph carry many nutrients.
- ✓ Bone marrow contains nutrients.
- ✓ Several kilos of fat (even in thin people) are stored: the body draws primarily on its fat reserves.

No studies have been done on the yield and risk of infection with the Covid-19 virus. Healthy people should be able to fast during this Ramadan, as in previous years, while Covid-19 patients should consider not doing so, following the exemptions provided by religion, in consultation with their doctor, as with any other disease.

### 3.9. The micronutrient composition of some foods:

after having seated the essential recommendations for the fight against the harmful effects of coronavirus with the aim of reducing the dangerous symptoms causing death, we carried out research, statistics and in-depth analyzes to the food constituents (Meat and assimilated, eggs, fish, dairy products and assimilated, breads, cereals and assimilated, fruits, legumes and oilseeds) ,and their nutritional compositions in micronutrients to give a correct strategy and effective in choosing the most suitable organic food and the most responsive to boost the human immune system and therefore prepared a strong body ready to defend against viruses.

**Table 4:** The micronutrient composition of meat and assimilated.

| Meat and assimilated                  | Calcium<br>(mg/100 g) | Copper<br>(mg/100 g) | Iron<br>(mg/100 g) | Magnesium<br>(mg/100 g) | Manganese<br>(mg/100 g) | Phosphorus<br>(mg/100 g) | Selenium<br>(µg/100 g) | Zinc<br>(mg/100 g) | Vitamin D<br>(µg/100 g) | Vitamin E<br>(mg/100 g) | Vitamin K1<br>(µg/100 g) | Vitamin K2<br>(µg/100 g) | Vitamin C<br>(mg/100 g) | Vitamin B1 ou<br>(mg/100 g) | Vitamin B2<br>(mg/100 g) | Vitamin B3<br>(mg/100 g) | Vitamin B5<br>(mg/100 g) | Vitamin B6<br>(mg/100 g) | Vitamin B9<br>(µg/100 g) | Vitamin B12<br>(µg/100 g) |
|---------------------------------------|-----------------------|----------------------|--------------------|-------------------------|-------------------------|--------------------------|------------------------|--------------------|-------------------------|-------------------------|--------------------------|--------------------------|-------------------------|-----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---------------------------|
| Kidney. beef. cooked                  | 19                    | 0.56                 | 9.5                | 12                      | 0.19                    | 304                      | -                      | 3.1                | 1.1                     | 0.08                    | 0                        | -                        | -                       | 0.43                        | 2.97                     | 6.5                      | 2.34                     | 0.66                     | 83                       | 26                        |
| Sheep. shoulder. raw                  | 8.25                  | 0.095                | 2.15               | 16                      | 0.01                    | 130                      | 0.4                    | 3.5                | 0.4                     | 0.43                    | 0                        | -                        | 1                       | 0.17                        | 0.27                     | 5.4                      | 0.55                     | 0.2                      | 2                        | 5                         |
| Tongue. beef. cooked                  | 14.5                  | 0.13                 | 3.5                | 9.44                    | 0.044                   | 144                      | < 2.2                  | 2.2                | 0.4                     | 0.3                     | 1.2                      | -                        | 1.3                     | 0.05                        | 0.3                      | 3.9                      | 1.07                     | 0.12                     | 7                        | 6.62                      |
| Gizzard. chicken. raw                 | 11                    | 0.12                 | 2.49               | 14                      | 0.055                   | 148                      | -                      | 2.72               | 0.6                     | 0.27                    | 0                        | -                        | 3.7                     | 0.059                       | 0.14                     | 4.09                     | 0.63                     | 0.12                     | 21.5                     | 0.91                      |
| Liver. poultry. cooked                | 6.6                   | 0.51                 | 12                 | 24                      | 0.37                    | 380                      | 90                     | 3.9                | 1.29                    | 1.51                    | 3.2                      | -                        | < 0.5                   | 0.28                        | 1.4                      | 32.6                     | 8.77                     | 0.59                     | 1440                     | 50.5                      |
| Liver. veal. cooked                   | 6.5                   | 20.1                 | 4.5                | 21.5                    | 0.29                    | 302                      | 40.9                   | 4.6                | 2.52                    | 0.64                    | 1.5                      | -                        | 13.2                    | 0.15                        | 1.72                     | 18.8                     | 1.81                     | 1.03                     | 592                      | 52.6                      |
| Liver. veal. raw                      | 4.9                   | 22                   | 4.6                | 18                      | 0.13                    | 280                      | 40                     | 5.3                | 0.62                    | 0.79                    | < 0.8                    | -                        | 9.75                    | 0.14                        | 0.67                     | 17.1                     | 3.13                     | 0.5                      | 1180                     | 46.5                      |
| Liver. chicken. raw                   | 10.5                  | 0.5                  | 8.68               | 19                      | 0.24                    | 309                      | 49.8                   | 2.79               | 0.21                    | 0.51                    | 80                       | -                        | 19.7                    | 0.35                        | 2.36                     | 9.54                     | 6.41                     | 0.83                     | 1640                     | 19.3                      |
| Liver. turkey. raw                    | 20                    | 0.86                 | 8.94               | 24                      | 0.3                     | 279                      | -                      | 3.37               | 1.3                     | 0.24                    | 0                        | -                        | 24.5                    | 0.21                        | 2.25                     | 11.2                     | 6.28                     | 1.04                     | 677                      | 19.7                      |
| Heart. turkey. raw                    | 18                    | 0.49                 | 3.7                | 21                      | 0.1                     | 183                      | -                      | 3.21               | 0.4                     | 0.31                    | 0                        | -                        | 3                       | 0.17                        | 1.13                     | 6.44                     | 3.12                     | 0.48                     | 6                        | 13.3                      |
| Heart. beef. cooked                   | 5                     | 0.56                 | 6.7                | 21                      | 0.033                   | 254                      | -                      | 2.3                | 0.1                     | 0.29                    | 0.5                      | -                        | -                       | 0.36                        | 1.21                     | 6.9                      | 1.06                     | 0.33                     | 5                        | 11.5                      |
| Beef. tenderloin. raw                 | 7.93                  | 0.061                | 2.75               | 17                      | 0.006                   | 196                      | 10.1                   | 3.46               | 0.4                     | 0.23                    | 1.5                      | -                        | 0                       | 0.06                        | 0.18                     | 5.21                     | 0.63                     | 0.51                     | 5.5                      | 1.16                      |
| Beef. minced steak 10%<br>MF. raw     | 12                    | 0.072                | 2.24               | 20                      | 0.01                    | 184                      | 13.9                   | 4.79               | 0.1                     | 0.17                    | 0.8                      | 6.7                      | 0                       | 0.042                       | 0.15                     | 5.07                     | 0.6                      | 0.37                     | 6                        | 2.21                      |
| Beef. rump. raw                       | 7.33                  | 0.067                | 2.48               | 16.5                    | 0.0075                  | 195                      | 9.3                    | 3.54               | 0.5                     | 0.29                    | 1.5                      | -                        | 0                       | 0.062                       | 0.21                     | 6.17                     | 0.58                     | 0.57                     | 5                        | 1.52                      |
| Beef. chuck. raw                      | 7.45                  | 0.087                | 2.5                | 25                      | 0.012                   | 223                      | 10.2                   | 5.51               | 0.1                     | 0.2                     | 1.5                      | -                        | 0                       | 0.08                        | 0.21                     | 3.67                     | 0.86                     | 0.27                     | 3                        | 2.77                      |
| Beef. shank. raw                      | 6                     | 0.17                 | 3.68               | 19                      | 0.17                    | 142                      | 11.8                   | 4.51               | 0.1                     | 0.15                    | 1.5                      | -                        | 0                       | 0.1                         | 0.56                     | 3.97                     | 1.13                     | 0.29                     | 3                        | 4.61                      |
| Beef. rib eye. grilled /<br>pan-fried | 20                    | 0.081                | 2.26               | 22                      | 0.009                   | 209                      | 12.9                   | 3.95               | 0.2                     | 0.44                    | 1.6                      | -                        | 0                       | 0.04                        | 0.13                     | 5.77                     | 0.3                      | 0.48                     | 8                        | 1.19                      |
| Beef. rib eye. raw                    | 9.28                  | 0.076                | 2.26               | 21.3                    | 0.011                   | 189                      | 10.6                   | 3.26               | 0.55                    | 0.37                    | 1.4                      | -                        | 0                       | 0.059                       | 0.15                     | 5.77                     | 0.73                     | 0.48                     | 9.6                      | 1.19                      |
| Beef. shoulder. raw                   | 7.38                  | 0.073                | 2.29               | 22.5                    | 0.012                   | 192                      | 7.25                   | 5.46               | 0.55                    | 0.32                    | 1.5                      | -                        | 0                       | 0.057                       | 0.19                     | 5.38                     | 0.77                     | 0.5                      | 5                        | 1.84                      |



|   |      |       |      |      |       |     |      |      |      |      |     |   |   |       |      |      |      |      |    |      |
|---|------|-------|------|------|-------|-----|------|------|------|------|-----|---|---|-------|------|------|------|------|----|------|
| Beef, rib steak, lean part, grilled / pan-fried | 12   | 0.085 | 2.55 | 23   | -     | 200 | 12.3 | 6.34 | 0.1  | 0.58 | 1.6 | - | 0 | 0.07  | 0.15 | 4.4  | 0.22 | 0.34 | 6  | 1.85 |
| Beef, steak, raw                                | 5.44 | 0.066 | 2.21 | 19.5 | 0.011 | 154 | 8.13 | 4.25 | 0.45 | 0.66 | 1.5 | - | 0 | 0.069 | 0.2  | 3.91 | 0.6  | 0.29 | 4  | 1.85 |
| Lamb, shoulder, lean, roasted / baked           | 19   | 0.11  | 2.13 | 25   | 0.026 | 200 | 6    | 6.04 | 0.1  | 0.18 | 4.5 | - | 0 | 0.09  | 0.26 | 5.76 | 0.73 | 0.15 | 25 | 2.7  |

Table 5: The micronutrient composition of eggs.

| Eggs                           | Calcium (mg/100 g) | Copper (mg/100 g) | Iron (mg/100 g) | Magnesium (mg/100 g) | Manganese (mg/100 g) | Phosphorus (mg/100 g) | Selenium (µg/100 g) | Zinc (mg/100 g) | Vitamin D (µg/100 g) | Vitamin E (mg/100 g) | Vitamin K1 (µg/100 g) | Vitamin K2 (µg/100 g) | Vitamin C (mg/100 g) | Vitamin B1 (mg/100 g) | Vitamin B2 (mg/100 g) | Vitamin B3 (mg/100 g) | Vitamin B5 (mg/100 g) | Vitamin B6 (mg/100 g) | Vitamin B9 (µg/100 g) | Vitamin B12 (µg/100 g) |
|--------------------------------|--------------------|-------------------|-----------------|----------------------|----------------------|-----------------------|---------------------|-----------------|----------------------|----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| Egg, white (egg white), cooked | 6.67               | 0.023             | 0.067           | 9.67                 | 0.011                | 14.7                  | 6.1                 | 0.025           | 0                    | 0                    | -                     | -                     | 0                    | 0.006                 | 0.35                  | 0.078                 | 0.18                  | 0.007                 | 7.9                   | 0.056                  |
| Egg, yolk (egg yolk), cooked   | 76.4               | 0.15              | 0.95            | 4.5                  | < 0.1                | 121                   | 76.4                | 1.4             | 2.11                 | 5                    | -                     | -                     | 0                    | 0.17                  | 0.39                  | < 0.16                | 4.54                  | 0.3                   | 166                   | 2.43                   |
| Hard egg                       | 41                 | 0.068             | 1.72            | 14                   | 0.031                | 172                   | 7.01                | 1.27            | 1.12                 | 1.03                 | 0.3                   | -                     | 0                    | 0.066                 | 0.51                  | 0.064                 | 1.4                   | 0.12                  | 44                    | 1.11                   |
| Poached egg                    | 68.2               | 0.069             | 1.75            | 10.8                 | 0.03                 | 197                   | 7.68                | 1.1             | 2                    | 1.04                 | 0.3                   | -                     | 0                    | 0.032                 | 0.39                  | 0.063                 | 1.53                  | 0.14                  | 35                    | 0.71                   |
| Boiled egg                     | 150                | < 0.1             | 1.9             | 11.7                 | < 0.1                | 155                   | 23.8                | 0.93            | 1.28                 | 2.17                 | -                     | -                     | < 0.5                | 0.081                 | 0.41                  | 0.06                  | 1.34                  | 0.06                  | 57                    | 0.96                   |
| Egg, fried, fried, salted      | 57                 | 0.051             | 2.2             | 10.4                 | 0.026                | 134                   | 8.95                | 0.87            | 0.55                 | 3.06                 | 5.6                   | -                     | 0                    | 0.044                 | 0.41                  | 0.082                 | 1.27                  | 0.18                  | 62.6                  | 1.08                   |
| Egg, scrambled, with fat       | 66                 | 0.059             | 1.31            | 11                   | 0.022                | 165                   | 22.5                | 1.04            | 1.8                  | 0.98                 | 4                     | -                     | 0                    | 0.04                  | 0.38                  | 0.076                 | 1.22                  | 0.13                  | 36                    | 0.76                   |
| Egg, fried, no fat             | -                  | -                 | 2.6             | -                    | -                    | -                     | -                   | -               | 0.74                 | -                    | -                     | -                     | -                    | -                     | -                     | -                     | -                     | -                     | -                     | -                      |
| Egg, raw                       | 76.8               | 0.055             | 1.88            | 11                   | 0.027                | 204                   | < 2.58              | 1.01            | 1.88                 | 1.43                 | 0.3                   | -                     | 0                    | 0.055                 | 0.45                  | 0.063                 | 1.57                  | 0.15                  | 34                    | 1.45                   |
| Egg, white (egg white), raw    | 6                  | 0.023             | 0.05            | 11                   | 0.011                | 15                    | 6                   | 0.03            | 0                    | 0                    | 0                     | 0.9                   | 0                    | 0.004                 | 0.44                  | 0.093                 | 0.2                   | 0.0035                | 5.5                   | 0.09                   |

|                           |      |       |      |     |       |     |      |      |      |      |     |      |   |      |      |       |      |      |     |      |
|---------------------------|------|-------|------|-----|-------|-----|------|------|------|------|-----|------|---|------|------|-------|------|------|-----|------|
| Egg, yolk (egg yolk). raw | 50.2 | <0.1  | 0.7  | 1.5 | <0.1  | 141 | 83.5 | 1.1  | 2    | 3.89 | 0.7 | 32.1 | 0 | 0.17 | 0.38 | <0.16 | 2.87 | 0.29 | 159 | 3.03 |
| Quail egg, raw            | 64   | 0.062 | 3.65 | 13  | 0.038 | 226 | -    | 1.47 | 1.4  | 1.08 | 0.3 | -    | 0 | 0.13 | 0.79 | 0.15  | 1.76 | 0.15 | 66  | 1.58 |
| Duck egg, raw             | 64   | 0.062 | 3.85 | 17  | 0.038 | 220 | -    | 1.41 | 1.7  | 1.34 | 0.4 | -    | 0 | 0.16 | 0.4  | 0.2   | 1.86 | 0.25 | 80  | 5.4  |
| Goose egg, raw            | 60   | 0.062 | 3.64 | 16  | 0.038 | 208 | -    | 1.33 | 1.7  | 1.29 | 0.4 | -    | 0 | 0.15 | 0.38 | 0.19  | 1.76 | 0.24 | 76  | 5.1  |
| Turkey egg, raw           | 99   | 0.062 | 4.1  | 13  | 0.038 | 170 | -    | 1.58 | 1.75 | 1.11 | -   | -    | 0 | 0.11 | 0.47 | 0.024 | 1.89 | 0.13 | 71  | 1.69 |

**Table 6:** The micronutrient composition of fish.

| Fish                         | Calcium (mg/100 g) | Copper (mg/100 g) | Iron (mg/100 g) | Magnesium (mg/100 g) | Manganese (mg/100 g) | Phosphorus (mg/100 g) | Selenium (µg/100 g) | Zinc (mg/100 g) | Vitamin D (µg/100 g) | Vitamin E (mg/100 g) | Vitamin K1 (µg/100 g) | Vitamin K2 (µg/100 g) | Vitamin C (mg/100 g) | Vitamin B1 ou (mg/100 g) | Vitamin B2 (mg/100 g) | Vitamin B3 (mg/100 g) | Vitamin B5 (mg/100 g) | Vitamin B6 (mg/100 g) | Vitamin B9 (µg/100 g) | Vitamin B12 (µg/100 g) |
|------------------------------|--------------------|-------------------|-----------------|----------------------|----------------------|-----------------------|---------------------|-----------------|----------------------|----------------------|-----------------------|-----------------------|----------------------|--------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| Herring, grilled / pan-fried | 76.5               | 0.15              | 1.51            | 41.5                 | 0.045                | 307                   | 46                  | 1.24            | 10.8                 | 1.37                 | 0.1                   | -                     | 0.7                  | 0.11                     | 0.28                  | 4.06                  | 0.76                  | 0.35                  | 11                    | 14.1                   |
| Mackerel, roasted / baked    | 12.8               | <0.1              | 1.57            | 28.5                 | <0.1                 | 207                   | 51.6                | 0.94            | 7.72                 | 0.71                 | -                     | -                     | 0.4                  | 0.16                     | 0.41                  | 6.85                  | 0.37                  | 0.62                  | 22.6                  | 19                     |
| Mackerel, fried              | -                  | 0.16              | -               | -                    | 0.06                 | 273                   | 94.7                | 1               | 12.3                 | -                    | -                     | -                     | -                    | -                        | 0.29                  | 10.5                  | 0.49                  | 0.58                  | -                     | 12                     |
| Cod, salted, boiled / boiled | 64.9               | 0.089             | 0.35            | 13.7                 | 0.019                | 42                    | 20.7                | 0.84            | 1.25                 | 0.55                 | -                     | -                     | -                    | <0.04                    | 0.052                 | 0.47                  | <0.16                 | 0.075                 | 23.5                  | 2.2                    |
| Swordfish, roasted / baked   | 5.5                | 0.046             | 0.53            | 34.1                 | 0.021                | 200                   | 122                 | 0.78            | 16.6                 | 7.2                  | 0.1                   | -                     | 0                    | 0.047                    | 0.13                  | 9.8                   | 0.46                  | 0.62                  | 2                     | 2.91                   |
| Sardine, grilled             | 130                | 0.14              | 1.7             | 34                   | 0.08                 | 320                   | 38                  | 1.4             | 12.3                 | 0.31                 | -                     | -                     | traces               | traces                   | 0.25                  | 6.9                   | 0.88                  | 0.41                  | 4                     | 12                     |
| Eel, cooked (medium food)    |                    | 0.029             |                 |                      | 0.04                 |                       |                     | 2.08            |                      |                      |                       |                       |                      |                          |                       |                       |                       |                       |                       |                        |
| Pike, roasted / baked        | 73                 | 0.058             | 0.71            | 40                   | 0.28                 | 282                   | -                   | 0.77            | 2.7                  | -                    | -                     | -                     | 3.8                  | 0.067                    | 0.077                 | 2.8                   | 0.81                  | 0.14                  | 16                    | 2.15                   |
| Carp, roasted / baked        | 52                 | 0.12              | 1.59            | 38                   | 0.23                 | 531                   | 20.2                | 1.58            | 3.25                 | -                    | -                     | -                     | 1.6                  | 0.14                     | 0.07                  | 2.1                   | 0.87                  | 0.22                  | 17                    | 1.47                   |
| Perch, roasted / baked       | 73                 | 0.058             | 0.71            | 26                   | 0.28                 | 105                   | 26                  | 0.77            | 9                    | 1.32                 | -                     | -                     | 3.8                  | 0.09                     | 0.077                 | 2.98                  | 0.81                  | 0.13                  | 16                    | 0.83                   |
| Herring, raw                 | 61.6               | 0.15              | 1.21            | 27                   | 0.027                | 235                   | 31.2                | 0.79            | 10.7                 | 1.21                 | 0.45                  | 0.21                  | 0.75                 | 0.035                    | 0.24                  | 3.95                  | 0.84                  | 0.38                  | 9.4                   | 11.5                   |
| Rascasse, raw                | 61                 | 0.5               | -               | 21                   | 0.3                  | -                     | -                   | 1.8             | 4.3                  | -                    | -                     | -                     | -                    | -                        | -                     | -                     | -                     | -                     | -                     | -                      |

|  |      |       |      |      |       |     |      |      |      |      |      |   |      |       |       |      |      |      |      |      |
|--|------|-------|------|------|-------|-----|------|------|------|------|------|---|------|-------|-------|------|------|------|------|------|
| Sardine. raw   | 57.5 | 0.41  | 1.67 | 36   | 0.33  | 286 | 52.8 | 1.5  | 14   | 0.28 | -    | - | 2.5  | 0.038 | 0.23  | 7.56 | 0.81 | 0.47 | 3.18 | 8.6  |
| Common anchovy. raw                                  | 86.5 | 0.38  | 2.63 | 22.3 | 0.23  | 162 | 21.3 | 1.86 | 11   | 0.57 | 0.1  | - | 0    | 0.061 | 0.32  | 12.7 | 0.65 | 0.14 | 9    | 0.62 |
| Sea bream. or sea bream or real sea bream. raw. wild | 33.3 | 0.11  | 1.6  | 19   | 0.12  | 178 | 20   | 0.76 | 7.15 | 0.85 | 0    | - | 1    | 0.15  | 0.095 | 1.2  | -    | 0.24 | 7    | -    |
| Swordfish. raw                                       | 12.1 | 0.035 | 0.65 | 33.6 | 0.017 | 289 | 52.7 | 0.79 | 12.5 | 0.5  | 0.1  | - | 0.5  | 0.089 | 0.11  | 7.38 | 0.39 | 0.47 | 2    | 2.46 |
| Sea trout. raw                                       | 12.7 | 0.04  | 1.23 | 29.3 | 0.027 | 270 | 22.9 | 0.95 | 2.1  | 0.65 | 0    | - | 0.55 | 0.1   | 0.14  | 3.5  | 1.95 | 0.54 | 16   | 5    |
| Cod. salted. dry                                     | 124  | 0.098 | 2.09 | 80.7 | 0.05  | 551 | -    | 1.07 | 4    | 1.67 | 0.4  | - | 0    | 0.13  | 0.2   | 5.26 | 1.01 | 0.58 | 22.3 | 5.43 |
| Cod liver. raw                                       | 10   | 0.66  | 4    | 8    | -     | 100 | 63.5 | 1.94 | 100  | 20   | -    | - | 4    | 0.1   | 0.65  | 2.5  | 0.64 | 0.15 | 300  | 10   |
| Common garfish. raw                                  | 73   | 0.2   | 0.73 | 27.5 | 0.02  | 196 | 30.9 | 0.77 | 5    | 1.7  | 0    | - | 1.5  | 0.012 | 0.063 | 5.75 | 0.8  | 0.9  | 1    | 2    |
| Whitefish. raw                                       | 43   | 0.049 | 0.44 | 31.5 | 0.059 | 280 | 16   | 0.77 | 7.5  | 1.45 | 0.1  | - | 0    | 0.11  | 0.095 | 3.5  | 0.75 | 0.3  | 15   | 1    |
| Pike. raw  | 33   | 0.09  | 0.9  | 21   | 0.15  | 176 | 12.7 | 0.97 | 4.33 | 0.45 | 0.1  | - | 3.6  | 0.076 | 0.058 | 1.83 | 0.75 | 0.13 | 15   | 2    |
| Eel. raw   | 23.6 | 0.041 | 0.71 | 18   | 0.078 | 285 | 28.7 | 2.27 | 16   | 6    | 1.25 | - | 1.6  | 0.17  | 0.24  | 3.16 | 0.17 | 0.21 | 13.8 | 2.8  |

Table 7: The micronutrient composition of dairy products and assimilated.

| Dairy products and assimilated                       | Calcium (mg/100 g) | Copper (mg/100 g) | Iron (mg/100 g) | Magnesium (mg/100 g) | Manganese (mg/100 g) | Phosphorus (mg/100 g) | Selenium (µg/100 g) | Zinc (mg/100 g) | Vitamin D (µg/100 g) | Vitamin E (mg/100 g) | Vitamin K1 (µg/100 g) | Vitamin K2 (µg/100 g) | Vitamin C (mg/100 g) | Vitamin B1 ou (mg/100 g) | Vitamin B2 (mg/100 g) | Vitamin B3 (mg/100 g) | Vitamin B5 (mg/100 g) | Vitamin B6 (mg/100 g) | Vitamin B9 (µg/100 g) | Vitamin B12 (µg/100 g) |
|--|--------------------|-------------------|-----------------|----------------------|----------------------|-----------------------|---------------------|-----------------|----------------------|----------------------|-----------------------|-----------------------|----------------------|--------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| Sheep's milk. whole                                  | 199                | 0.011             | 0.46            | 17.1                 | 0.018                | 158                   | 3                   | 0.54            | 0.2                  | 0.15                 | -                     | -                     | 4.2                  | 0.057                    | 0.34                  | 0.42                  | 0.41                  | 0.06                  | 9.19                  | 0.71                   |
| Whole milk. UHT                                      | 120                | < 0.01            | 0.01            | 9.8                  | < 0.01               | 97                    | < 50                | 0.37            | < 0.25               | 0.089                | < 0.8                 | 0.9                   | < 0.5                | 0.041                    | 0.17                  | < 0.1                 | 0.43                  | 0.02                  | < 2.5                 | 0.24                   |
| Whole milk. pasteurized                              | 117                | < 0.1             | 0.04            | 10.9                 | 0.002                | 93                    | < 2.2               | 0.37            | 0.1                  | 0.089                | 0                     | -                     | 1.2                  | 0.042                    | 0.17                  | 0.092                 | 0.34                  | 0.047                 | 11                    | 0.32                   |
| Semi-skimmed milk. UHT. enriched with vitamin D only | 120                | < 0.01            | < 0.05          | 9.8                  | < 0.01               | 84                    | < 20                | 0.37            | 0.78                 | < 0.08               | < 0.8                 | -                     | < 0.5                | 0.023                    | 1.16                  | < 0.1                 | 0.28                  | 0.023                 | 5.39                  | 0.21                   |
| Powdered milk. whole                                 | 960                | 0.058             | 0.62            | 93                   | 0.061                | 810                   | 14                  | 3.91            | 1.2                  | 0.68                 | -                     | -                     | 10                   | 0.33                     | 1.42                  | 0.65                  | 2.27                  | 0.3                   | 37                    | 3.25                   |
| Unsweetened condensed milk. whole                    | 273                | -                 | 0.06            | 25.7                 | 0.011                | 225                   | 2.1                 | 0.8             | 0.1                  | 0.2                  | -                     | -                     | 1.9                  | 0.055                    | 0.34                  | 0.2                   | 2.16                  | 0.28                  | 30.7                  | 0.16                   |

|   |          |           |      |      |            |     |          |      |      |      |      |      |       |           |      |      |      |           |      |      |
|---|----------|-----------|------|------|------------|-----|----------|------|------|------|------|------|-------|-----------|------|------|------|-----------|------|------|
| Sweetened condensed milk. whole   | 290      | 0.01<br>3 | 0.19 | 25.2 | 0.005<br>6 | 253 | <<br>4.5 | 0.96 | 0.2  | 0.16 | 0.6  | -    | 2.6   | 0.09      | 0.42 | 0.21 | 0.75 | 0.05<br>1 | 11   | 0.44 |
| Milk powder. semi-skimmed   | 103<br>0 | -         | 0.35 | 97   | 0.048      | 829 | 8.8      | 3.7  | 0.2  | 0.4  | -    | -    | -     | 0.21      | 1.71 | 0.8  | 3.07 | 0.32      | 69   | 2.8  |
| Cheese (average food)   | 626      | 0.13      | 0.27 | 29.2 | 0.028      | 454 | 7.75     | 2.87 | 0.29 | 0.55 |      |      | 0.057 | 0.03<br>5 | 0.41 | 1    | 0.51 | 0.11      | 34.4 | 1.36 |
| Camembert. unspecified  | 449      | 0.03      | 0.18 | 19.3 | 0.016      | 370 | 5.76     | 2.5  | 0.24 | 0.57 | 0    | -    | 0     | 0.04<br>5 | 0.45 | 1.8  | 1.36 | 0.25      | 62   | 1.13 |
| Soft cheese with a bloomy rind (Camembert type)                           | 523      | -         | -    | 23   | -          | 354 | -        | -    | 0.4  | -    | -    | -    | -     | -         | 0.1  | -    | -    | -         | -    | 1.1  |
| Soft cheese and bloomy double cream rind about 30% fat                    | 200      | <0.1      | 0.3  | 6    | <0.1       | 160 | 3.5      | 0.54 | 0.31 | 0.8  | 0    | -    | 0     | 0.04      | 0.2  | 0.1  | 0.27 | 0.05<br>5 | 13   | 0.22 |
| Round soft cheese with a bloomy rind 5 to 11% fat, low-fat camembert type | 720      | 0.07      | 0.18 | 20   | 0.048      | 370 | 8.5      | 2.38 | 0.14 | 0.28 | 0    | -    | 0     | 0.04<br>5 | 0.45 | 1.8  | 1.36 | 0.25      | 62   | 1.13 |
| Brie, unspecified   | 424      | 0.04<br>5 | 0.36 | 20   | <0.1       | 282 | 6.41     | 2.38 | 0.39 | 0.47 | 2.3  | -    | 0     | 0.06      | 0.43 | 0.38 | 0.69 | 0.24      | 77.7 | 0.76 |
| Triple cream soft cheese about 40% fat                                    | 230      | 0.07      | 0.3  | 6    | 0.035      | 140 | 3.2      | 0.54 | 0.36 | 0.94 | 0    | -    | 0     | 0.03<br>5 | 0.2  | 0.1  | 0.27 | 0.05<br>5 | 13   | 0.22 |
| Soft cheese with washed rind (average food)                               | 535      |           |      | 22.4 |            | 396 |          |      | 0.68 |      |      |      |       |           | 0.6  |      |      |           |      | 1.54 |
| Munster   | 717      | 0.03<br>1 | 0.41 | 27   | 0.008      | 468 | 4.32     | 2.81 | 0.6  | 0.26 | 2.5  | -    | 0     | 0.01<br>3 | 0.32 | 0.1  | 0.19 | 0.05<br>6 | 12   | 1.47 |
| Semi-dry goat cheese  | 145      | 0.06<br>8 | 1.62 | 18.2 | 0.036      | 375 | 8.85     | 0.64 | 0.5  | 0.26 | 2.5  | -    | 0     | 0.07<br>2 | 0.68 | 1.15 | 0.19 | 0.06      | 2    | 0.22 |
| Dry goat cheese   | 895      | 0.07      | 1.88 | 54   | -          | 729 | -        | 1.59 | 0.7  | 0.31 | 3    | -    | 0     | 0.14      | 1.19 | 2.4  | 0.41 | 0.08      | 53   | 0.12 |
| Blue cheese made from cow's milk  | 494      | <0.1      | 0.23 | 23   | <0.1       | 369 | 5.5      | 3.88 | 0.42 | 0.59 | 2.4  | -    | 0     | 0.03<br>5 | 0.43 | 1.01 | 1.73 | 0.2       | 36   | 1.23 |
| Gorgonzola  | 390      | 0.02      | 0.08 | 18   | 0.01       | 310 | <20      | 2.1  | 0.24 | 0.16 | 0.9  | -    | <0.5  | 0.07      | 0.32 | 2.93 | 0.81 | 0.13      | 41.2 | 0.73 |
| Cooked pressed cheese (medium food)                                       | 935      | 0.25      | 0.32 | 45.2 | 0.028      | 630 | 7.53     | 3.79 | 0.28 | 0.66 | 5.52 |      | 0.051 | 0.03<br>6 | 0.43 | 0.21 | 0.3  | 0.08<br>8 | 17.1 | 1.86 |
| Gruyere   | 109<br>0 | 0.41      | 0.29 | 39.2 | 0.031      | 608 | 5.33     | 4.89 | 0.44 | 0.52 | 2.7  | -    | 0     | 0.05      | 0.39 | 0.1  | 0.43 | 0.08<br>1 | 15   | 1.55 |
| Emmental or Emmenthal   | 898      | 0.04<br>3 | 0.15 | 48.9 | 0.024      | 610 | <10      | 3.48 | 0.28 | 0.74 | 6.59 | 5.23 | 0     | 0.04      | 0.5  | 0.1  | 0.3  | 0.08      | 20   | 1.5  |
| Fontina   | 550      | 0.02<br>5 | 0.23 | 14   | 0.014      | 346 | -        | 3.5  | 0.6  | 0.27 | 2.6  | -    | 0     | 0.02<br>1 | 0.2  | 0.15 | 0.43 | 0.08<br>3 | 6    | 1.68 |
| Pecorino  | 116<br>0 | -         | 1.4  | -    | -          | 675 | -        | 3.5  | 0.5  | 0.73 | -    | -    | 0     | 0.03      | 0.47 | 0.2  | -    | 0.09      | 7    | -    |
| Provolone   | 756      | 0.02<br>6 | 0.52 | 28   | 0.01       | 496 | -        | 3.23 | 0.5  | 0.23 | 2.2  | -    | 0     | 0.01<br>9 | 0.32 | 0.16 | 0.48 | 0.07<br>3 | 10   | 1.46 |
| Salers  | 680      | 0.03      | 0.11 | 25   | 0.02       | 480 | <20      | 2.9  | 0.31 | 0.72 | 2.03 | -    | <0.5  | 0.06<br>3 | 0.37 | <0.1 | 0.31 | 0.07<br>9 | 37.5 | 1.86 |

|  |     |           |      |      |       |     |      |      |      |      |     |      |       |                |      |           |        |           |      |      |
|--|-----|-----------|------|------|-------|-----|------|------|------|------|-----|------|-------|----------------|------|-----------|--------|-----------|------|------|
| <b>Cheddar</b>   | 675 | 0.05<br>6 | 0.16 | 27   | 0.033 | 473 | 11.1 | 3.43 | 0.6  | 0.78 | 2.9 | -    | 0     | 0.02<br>7      | 0.43 | 0.03<br>9 | 0.48   | 0.04<br>9 | 26   | 0.88 |
| <b>Edam</b>  | 802 | 0.05<br>6 | 0.12 | 41.2 | 0.018 | 536 | < 10 | 3.09 | 0.5  | 0.24 | 2.3 | 47.5 | 0     | 0.03<br>7      | 0.39 | 0.08<br>2 | 0.28   | 0.07<br>6 | 16   | 1.54 |
| <b>Gouda</b>   | 728 | 0.03<br>6 | 0.24 | 29   | < 0.1 | 546 | 9.02 | 3.9  | 0.5  | 0.24 | 2.3 | -    | 0     | 0.03           | 0.33 | 0.06<br>3 | 0.34   | 0.08      | 21   | 1.54 |
| <b>Old mimolette</b>                                       | 910 | 0.05      | 0.15 | 36   | 0.03  | 660 | < 20 | 4.5  | 0.33 | 0.6  | 1.3 | -    | < 0.5 | <<br>0.01<br>5 | 0.3  | 1.15      | 0.38   | 0.06<br>6 | 33   | 2.06 |
| <b>Maasdam type firm cheese about 27% fat</b>              | 848 | < 0.1     | 0.12 | 33.5 | < 0.1 | 519 | 8    | 3.06 | 0.2  | 0.5  | -   | -    | 0     | 0.04           | 0.28 | 0.1       | 0.3    | 0.07      | 20   | 1.9  |
| <b>Pyrenean sheep cheese</b>                               | 750 | < 0.1     | 0.3  | 35.9 | < 0.1 | 505 | 19.9 | 2.4  | 1.08 | 0.67 | -   | -    | -     | 0.03<br>2      | 0.49 | 0.19      | < 0.16 | 0.06<br>4 | 26.8 | 0.73 |
| <b>Asiago</b>  | 770 | -         | 0.7  | -    | -     | 530 | -    | 2.2  | 0.19 | 0.48 | -   | -    | 0     | 0.03           | 0.35 | 0.1       | -      | 0.09      | 40   | -    |
| <b>Processed cheese in portions or cubes about 20% fat</b> | 513 | 0.35      | 0.34 | 26   | 0.041 | 800 | 8    | 2.6  | 0.25 | 0.63 | 0   | -    | 0     | 0.09           | 0.38 | 0.1       | 0.4    | 0.02<br>5 | 7    | 0.85 |
| <b>Cancoillotte (fondue cheese specialty)</b>              | 101 | 0.1       | 0.13 | 8    | 0.02  | 425 | 4.5  | 1.4  | 0.2  | 0.15 | -   | -    | 0     | 0.08           | 0.31 | 0.49      | 0.4    | 0.04      | 12   | 0.39 |
| <b>Feta-type cheese, made from cow's milk</b>              | 557 | 0.05<br>1 | 0.42 | 19.5 | 0.044 | 349 | 6.2  | 2.63 | 0.32 | 0.37 | 1.8 | -    | 0     | 0.1            | 0.65 | 1.4       | 1.16   | 0.34      | 47   | 1.41 |
| <b>Ricotta</b>   | 314 | 0.02<br>1 | 0.38 | 11   | 0.006 | 158 | -    | 1.16 | 0.2  | 0.11 | 1.1 | -    | 0     | 0.01<br>3      | 0.2  | 0.1       | 0.21   | 0.04<br>3 | 12   | 0.34 |
| <b>Cow's milk mozzarella</b>                               | 545 | 0.01<br>1 | 0.44 | 20   | 0.03  | 354 | 16.3 | 2.92 | 0.4  | 0.19 | 2.3 | -    | 0     | 0.03           | 0.28 | 0.1       | 0.14   | 0.03<br>7 | 7    | 2.28 |

**Table 8:** The micronutrient composition of pasta. breads. cereals and assimilated.

| Pasta, breads, cereals and assimilated                       | Calcium (mg/100 g) | Copper (mg/100 g) | Iron (mg/100 g) | Magnesium (mg/100 g) | Manganese (mg/100 g) | Phosphorus (mg/100 g) | Selenium (µg/100 g) | Zinc (mg/100 g) | Vitamin D (µg/100 g) | Vitamin E (mg/100 g) | Vitamin K1 (µg/100 g) | Vitamin K2 (µg/100 g) | Vitamin C (mg/100 g) | Vitamin B1 ou (mg/100 g) | Vitamin B2 (mg/100 g) | Vitamin B3 (mg/100 g) | Vitamin B5 (mg/100 g) | Vitamin B6 (mg/100 g) | Vitamin B9 (µg/100 g) | Vitamin B12 (µg/100 g) |
|--|--------------------|-------------------|-----------------|----------------------|----------------------|-----------------------|---------------------|-----------------|----------------------|----------------------|-----------------------|-----------------------|----------------------|--------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| <b>Durum wheat, precooked, whole grain, cooked, unsalted</b> | 21                 | 0.17              | 0.78            | 28                   | 0.8                  | 96                    | < 20                | 0.71            | 0                    | < 0.08               | -                     | -                     | < 0.5                | 0.061                    | < 0.01                | 0.26                  | 0.29                  | 0.052                 | 10.2                  | 0                      |
| <b>Brown rice. cooked. unsalted</b>                          | 13                 | 0.1               | 0.32            | 49                   | 1.1                  | 120                   | < 20                | 0.62            | 0                    | 0.08                 | < 0.8                 | -                     | < 0.5                | 0.065                    | < 0.01                | 0.25                  | 0.38                  | 0.049                 | 29.4                  | 0.094                  |
| <b>White rice. cooked. unsalted</b>                          | 14                 | 0.07              | 0.04            | 7.1                  | 0.17                 | 35                    | < 20                | 0.26            | 0                    | < 0.08               | < 0.8                 | -                     | < 0.5                | 0.03                     | < 0.01                | 0.16                  | 0.21                  | 0.029                 | 9.9                   | 0.032                  |
| <b>Wild rice. cooked. unsalted</b>                           | 3                  | 0.12              | 0.6             | 32                   | 0.28                 | 82                    | -                   | 1.34            | 0                    | 0.24                 | 0.5                   | -                     | 0                    | 0.052                    | 0.087                 | 1.29                  | 0.15                  | 0.14                  | 26                    | 0                      |
| <b>Basmati rice. cooked. unsalted</b>                        | 11                 | 0.08              | 0.17            | 7.1                  | 0.23                 | 32                    | < 20                | 0.4             | < 0.25               | -                    | < 0.8                 | -                     | < 0.5                | < 0.015                  | < 0.01                | < 0.1                 | 0.13                  | < 0.01                | 8.77                  | -                      |

|  |      |       |      |      |      |     |      |      |   |        |       |   |       |         |        |        |       |       |      |       |
|--|------|-------|------|------|------|-----|------|------|---|--------|-------|---|-------|---------|--------|--------|-------|-------|------|-------|
| Oatmeal. boiled / boiled   | 9    | 0.074 | 0.9  | 27   | 0.58 | 77  | -    | 1    | 0 | 0.08   | 0.3   | - | 0     | 0.076   | 0.016  | 0.23   | 0.31  | 0.005 | 6    | 0     |
| Pearl barley. boiled / boiled. unsalted                          | 11   | 0.11  | 1.33 | 22   | 0.26 | 54  | -    | 0.82 | 0 | 0.01   | 0.8   | - | 0     | 0.083   | 0.062  | 2.06   | 0.14  | 0.12  | 16   | 0     |
| Millet. cooked. unsalted   | 3    | 0.16  | 0.63 | 44   | 0.27 | 100 | -    | 0.91 | 0 | 0.02   | 0.3   | - | 0     | 0.11    | 0.082  | 1.33   | 0.17  | 0.11  | 19   | 0     |
| Quinoa. boiled / boiled. unsalted                                | 23   | 0.21  | 1.6  | 71   | 0.7  | 180 | < 20 | 1.2  | 0 | 0.88   | < 0.8 | - | 0     | 0.14    | 0.014  | 0.2    | 0.61  | 0.089 | 49.9 | 0     |
| Couscous seed (precooked durum wheat semolina). cooked. unsalted | 15   | 0.16  | 0.53 | 19   | 0.31 | 73  | < 20 | 0.57 | 0 | < 0.08 | < 0.8 | - | < 0.5 | 0.064   | < 0.01 | 0.24   | 0.32  | 0.43  | 12.4 | 0     |
| Standard dry pasta. cooked. unsalted                             | 17   | 0.12  | 0.43 | 17   | 0.31 | 59  | < 20 | 0.47 | 0 | < 0.08 | < 0.8 | - | < 0.5 | 0.025   | < 0.01 | 0.52   | 0.28  | 0.022 | 23.5 | 0.014 |
| Dry. gluten-free. cooked. unsalted pasta                         | 9.6  | 0.07  | 0.48 | 23   | 0.34 | 62  | < 20 | 0.46 | - | < 0.08 | < 0.8 | - | < 0.5 | 0.04    | < 0.01 | 0.15   | 0.17  | 0.019 | 12.7 | 0.09  |
| Dry. whole wheat pasta. cooked. unsalted                         | 22   | 0.19  | 0.98 | 36   | 0.76 | 110 | < 20 | 0.99 | 0 | < 0.08 | < 0.8 | - | < 0.5 | 0.07    | 0.021  | 0.16   | 0.19  | 0.032 | 10.5 | 0.021 |
| Pasta. gluten-free. made from rice and corn. boiled. unsalted    | 9.6  | 0.06  | 0.13 | 8.6  | 0.1  | 27  | < 20 | 0.19 | - | 0.12   | < 0.8 | - | -     | < 0.015 | < 0.01 | < 0.1  | 0.058 | 0.019 | 6.32 | -     |
| Pasta. gluten free. made with red lentils. boiled. unsalted      | 29   | 0.48  | 2.7  | 59   | 0.57 | 130 | < 20 | 1.8  | - | < 0.08 | 2.12  | - | -     | 0.12    | < 0.01 | 0.21   | 0.29  | 0.066 | 23.1 | -     |
| Spelled. raw   | 27   | 0.51  | 4.44 | 136  | 2.98 | 401 | -    | 3.28 | - | 0.79   | 3.6   | - | 0     | 0.36    | 0.11   | 6.84   | 1.07  | 0.23  | 45   | 0     |
| Khorasan wheat. raw  | 22   | 0.51  | 3.77 | 130  | 2.74 | 364 | -    | 3.68 | - | 0.61   | 1.8   | - | 0     | 0.57    | 0.18   | 6.38   | 0.95  | 0.26  | -    | -     |
| Sprouted wheat. raw  | 28   | 0.26  | 2.14 | 82   | 1.86 | 200 | -    | 1.65 | 0 | -      | -     | - | 2.6   | 0.23    | 0.16   | 3.09   | 0.95  | 0.27  | 38   | 0     |
| Whole durum wheat. raw   | 30.2 | 0.44  | 3.51 | 130  | 3.31 | 390 | 4.1  | 3.48 | 0 | 1.4    | 30    | - | 0     | 0.38    | 0.12   | 6.17   | 1.02  | 0.39  | 32   | 0     |
| White rice. raw  | 33   | 0.19  | 1.57 | 31.3 | 0.99 | 118 | 6    | 1.41 | 0 | 0.08   | 0.1   | - | 0     | 0.15    | 0.042  | 1.92   | 0.88  | 0.13  | 19.3 | 0     |
| Parboiled white rice. raw  | 101  | 0.24  | 0.97 | 31   | 2.47 | 162 | 6    | 1.36 | 0 | 0.04   | 0.1   | - | 0     | 0.42    | 0.043  | 5.02   | 0.79  | 0.43  | 13   | 0     |
| Brown rice. raw  | 11.1 | 0.27  | < 1  | 118  | 2.2  | 163 | < 5  | 2    | 0 | 0.2    | 1.9   | - | 0     | 0.26    | 0.05   | < 0.05 | 1.1   | 0.09  | 48   | 0     |
| Wild rice. raw   | 6.95 | < 1   | < 1  | 90.1 | 1.1  | 317 | < 5  | 3.7  | 0 | < 0.1  | 1.9   | - | 0     | 0.41    | 0.15   | 3.5    | 1.1   | 0.24  | 49   | 0     |
| Red rice. raw  | 13.5 | < 1   | < 1  | 130  | 2    | 372 | < 5  | 2.1  | - | 0.7    | -     | - | -     | 0.26    | 0.06   | 1.7    | 1.1   | 0.12  | 15   | -     |
| Thai or basmati rice. cooked. unsalted                           | 10   | 0.07  | 0.07 | 7.2  | 0.26 | 29  | < 20 | 0.44 | - | < 0.08 | < 0.8 | - | < 0.5 | 0.01    | < 0.01 | < 0.1  | 0.16  | 0.03  | 10.7 | 0.048 |
| Whole corn. raw  | 40   | 0.2   | 3.2  | 100  | 0.8  | 260 | 12.8 | 1.9  | - | 1.7    | -     | - | -     | 0.4     | 0.14   | 2.1    | 0.6   | 0.5   | -    | 0     |

|   |      |       |      |      |      |     |      |      |        |        |       |   |       |       |        |        |      |        |      |       |
|---|------|-------|------|------|------|-----|------|------|--------|--------|-------|---|-------|-------|--------|--------|------|--------|------|-------|
| Oats. raw   | 54   | 0.63  | 4.72 | 177  | 4.92 | 523 | 9    | 3.97 | 0      | 1.09   | -     | - | 0     | 0.76  | 0.14   | 0.96   | 1.35 | 0.12   | 56   | 0     |
| Whole barley. raw                                   | 33   | 0.5   | 3.6  | 133  | 1.94 | 264 | 6.15 | 2.77 | 0      | 0.57   | 2.2   | - | 0     | 0.65  | 0.29   | 4.6    | 0.28 | 0.32   | 19   | 0     |
| Pearl barley. raw                                   | 29   | 0.42  | 2.5  | 79   | 1.32 | 221 | -    | 2.13 | 0      | 0.02   | 2.2   | - | 0     | 0.19  | 0.11   | 4.6    | 0.28 | 0.26   | 23   | 0     |
| Quinoa. raw   | 47   | 0.59  | 4.57 | 197  | 2.03 | 457 | -    | 3.1  | 0      | 2.44   | 0     | - | -     | 0.36  | 0.32   | 1.52   | 0.77 | 0.49   | 184  | 0     |
| Amaranth. raw                                       | 159  | 0.53  | 7.61 | 248  | 3.33 | 557 | -    | 2.87 | 0      | 1.19   | 0     | - | 4.2   | 0.12  | 0.2    | 0.92   | 1.46 | 0.59   | 82   | 0     |
| Whole sorghum. raw                                  | 13   | 0.28  | 3.36 | 165  | 1.61 | 289 | 43   | 1.67 | 0      | 0.5    | -     | - | 0     | 0.33  | 0.096  | 3.69   | 0.37 | 0.44   | 20   | 0     |
| Buckwheat. whole. raw                               | 16.3 | 1.1   | 2.2  | 231  | 1.3  | 362 | -    | 2.4  | 0      | -      | -     | - | 0     | 0.1   | 0.43   | 7.02   | 1.23 | 0.21   | 30   | 0     |
| Rye. whole. raw                                     | 26.4 | 0.34  | 3.32 | 104  | 3.14 | 346 | 1.5  | 2.78 | 0      | 1      | 5.9   | - | 0     | 0.34  | 0.21   | 2.99   | 1.4  | 0.29   | 47   | 0     |
| Durum wheat semolina. raw                           | 16.9 | 0.3   | 0.92 | 26.5 | 2.31 | 102 | 1    | 2.18 | 0      | 0.1    | 30    | - | 0     | 0.25  | 0.063  | 2.16   | 0.54 | 0.094  | 57   | 0     |
| Couscous seed (precooked durum wheat semolina). raw | 24   | 0.25  | 1.08 | 44   | 0.78 | 170 | -    | 0.83 | 0      | -      | -     | - | 0     | 0.16  | 0.078  | 3.49   | 1.24 | 0.11   | 20   | 0     |
| Standard dry pasta. raw                             | 20.5 | 0.27  | 1.5  | 57.5 | 0.75 | 165 | 4.8  | 1.31 | 0      | 0.2    | 0.1   | - | 0     | 0.12  | 0.048  | 1.35   | 0.37 | 0.096  | 23.7 | 0     |
| Dry. whole wheat. raw pasta                         | 32.1 | < 1   | 3.2  | 82.2 | 1.8  | 160 | 5.8  | 1.9  | 0      | < 0.1  | 0     | - | 0     | 0.25  | 0.07   | 0.87   | 0.66 | 0.13   | 22.4 | 0     |
| Frik (crushed immature durum wheat). raw            | 50.3 | < 1   | 5.2  | 114  | 3.6  | 321 | < 5  | 3.6  | -      | < 0.1  | -     | - | -     | 0.24  | 0.09   | 3.49   | 0.82 | 0.14   | 68.2 | -     |
| Bread (average food)                                | 31.1 | 0.14  | 1.25 | 27.7 | 0.67 | 108 | 10.3 | 0.75 | 0.16   | 0.28   | 0.6   | - | 0.3   | 0.098 | 0.01   | 0.63   | 0.41 | 0.023  | 23   | -     |
| Bread. baguette. running                            | 22   | 0.13  | 1.2  | 23   | 0.59 | 110 | < 20 | 0.73 | < 0.25 | 0.32   | < 0.8 | - | < 0.5 | 0.17  | < 0.01 | 2.88   | 0.46 | < 0.01 | 26.8 | -     |
| Sandwich bread. wholemeal                           | 141  | < 1   | 1.6  | 51.5 | 1.5  | 160 | < 5  | 1.1  | -      | 0.5    | -     | - | -     | 0.17  | 0.1    | < 0.05 | 0.56 | 0.11   | 25   | -     |
| Sandwich bread. bran                                | -    | < 0.5 | 3.5  | 76.6 | 1.6  | -   | < 5  | 1.4  | -      | -      | -     | - | -     | -     | -      | 1.35   | -    | -      | < 2  | -     |
| Sandwich bread. multi-grain                         | 77.6 | < 0.5 | 1.9  | 40.9 | 1.52 | 140 | 8    | 1.5  | < 0.5  | 3      | -     | - | < 1   | 0.2   | 0.12   | 4.2    | 0.55 | 0.13   | 52   | -     |
| Bread. gluten free                                  | 60   | 0.06  | 0.5  | 16   | 0.19 | 95  | < 20 | 0.36 | -      | 0.98   | < 0.8 | - | 38.6  | 0.045 | 0.02   | 0.15   | 0.4  | 0.025  | 10.7 | 0.059 |
| Bread. baguette. no salt                            | 42   | 0.12  | -    | 21.3 | 0.52 | -   | 4.7  | 0.75 | -      | -      | -     | - | -     | 0.069 | -      | -      | -    | 0.067  | 23   | -     |
| Sandwich bread. running                             | 88   | 0.11  | 0.7  | 17   | 0.43 | 75  | < 20 | 0.47 | 0      | 0.12   | 2.22  | - | < 0.5 | 0.12  | 0.015  | 0.31   | 0.43 | 0.03   | 13.3 | -     |
| Sandwich bread. crustless. prepackaged              | 87   | 0.12  | 0.74 | 20   | 0.42 | 86  | < 20 | 0.49 | -      | < 0.08 | 3.07  | - | < 0.5 | 0.091 | 0.013  | 0.37   | 0.42 | 0.034  | 18.6 | -     |

|  |    |      |      |    |      |     |      |      |        |      |       |   |       |       |        |      |      |       |      |      |
|--|----|------|------|----|------|-----|------|------|--------|------|-------|---|-------|-------|--------|------|------|-------|------|------|
| Brioche sandwich bread, prepackaged                        | 65 | 0.09 | 0.7  | 17 | 0.39 | 95  | < 20 | 0.67 | < 0.25 | 1.19 | 5.67  | - | < 0.5 | 0.11  | 0.056  | 0.24 | 0.76 | 0.028 | 14.5 | 0.26 |
| Bread, baguette or ball, with cereals and seeds, artisanal | 40 | 0.25 | 1.6  | 53 | 0.78 | 150 | < 20 | 1.1  | < 0.25 | 0.85 | < 0.8 | - | < 0.5 | 0.098 | < 0.01 | 0.71 | 0.43 | 0.059 | 30.5 | -    |
| Homemade white bread (with flour for bread machine)        | 21 | 0.09 | 0.85 | 20 | 0.47 | 94  | < 50 | 0.62 | -      | 0.18 | < 0.8 | - | 0.6   | 0.079 | 0.04   | 0.69 | 0.31 | 0.082 | 30.3 | -    |
| Homemade country bread (with flour for the bread machine)  | 20 | 0.13 | 1.3  | 34 | 0.84 | 130 | < 50 | 1.1  | -      | 0.26 | < 0.8 | - | 1.33  | 0.16  | 0.06   | 0.64 | 0.31 | 0.062 | 25.6 | -    |

**Table 9:** The micronutrient composition of fruits.

| Fruits   | Calcium (mg/100 g) | Copper (mg/100 g) | Iron (mg/100 g) | Magnesium (mg/100 g) | Manganese (mg/100 g) | Phosphorus (mg/100 g) | Selenium (µg/100 g) | Zinc (mg/100 g) | Vitamin D (µg/100 g) | Vitamin E (mg/100 g) | Vitamin K1 (µg/100 g) | Vitamin K2 (µg/100 g) | Vitamin C (mg/100 g) | Vitamin B1 ou (mg/100 g) | Vitamin B2 (mg/100 g) | Vitamin B3 (mg/100 g) | Vitamin B5 (mg/100 g) | Vitamin B6 (mg/100 g) | Vitamin B9 (µg/100 g) | Vitamin B12 (µg/100 g) |
|--|--------------------|-------------------|-----------------|----------------------|----------------------|-----------------------|---------------------|-----------------|----------------------|----------------------|-----------------------|-----------------------|----------------------|--------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| Blueberry, raw   | 6                  | 0.057             | 0.28            | 6                    | 0.34                 | 12                    | traces              | 0.16            | 0                    | 0.57                 | 19.3                  | -                     | 9.7                  | 0.037                    | 0.041                 | 0.42                  | 0.12                  | 0.052                 | 6                     | 0                      |
| Pomegranate, pulp and seeds, raw                                     | 9.5                | 0.11              | 0.17            | 12                   | 0.1                  | 27                    | < 20                | 0.22            | 0                    | < 0.08               | < 0.8                 | -                     | 9.02                 | 0.054                    | < 0.01                | 0.23                  | 0.37                  | 0.032                 | 8.77                  | 0                      |
| Red fruits, raw (raspberries, strawberries, currants, blackcurrants) | 40                 | 0.088             | 1               | 16.9                 | 0.42                 | 32.6                  | 0.35                | 0.22            | 0                    | 0.67                 | -                     | -                     | 87                   | 0.031                    | 0.084                 | 0.38                  | 0.21                  | 0.064                 | 37.6                  | 0                      |
| Kiwi, pulp and seeds, raw  | 29                 | 0.15              | 0.16            | 12                   | 0.05                 | 26                    | < 20                | 0.12            | 0                    | 0.96                 | 16.6                  | -                     | 81.9                 | < 0.015                  | 0.021                 | 0.23                  | 0.24                  | 0.036                 | 22.2                  | 0                      |
| Blueberry, frozen, raw   | 10                 | 0.035             | 0.39            | 4.25                 | 0.18                 | 10                    | -                   | 0.068           | 0                    | 0.5                  | 17.1                  | -                     | 8.08                 | 0.029                    | 0.041                 | 0.45                  | 0.13                  | 0.059                 | 7                     | 0                      |
| Plum, raw  | 7.29               | 0.06              | 0.16            | 6                    | 0.076                | 17.8                  | 0.11                | 0.096           | 0                    | 0.33                 | 6.4                   | -                     | 7.25                 | 0.024                    | 0.026                 | 0.41                  | 0.14                  | 0.037                 | 4                     | 0                      |
| Banana, pulp, raw  | 5.1                | 0.06              | 0.2             | 28                   | 0.36                 | 29                    | < 20                | 0.14            | 0                    | < 0.08               | < 0.8                 | -                     | 7.16                 | 0.054                    | < 0.01                | 0.39                  | 0.31                  | 0.18                  | 19                    | 0                      |



|   |      |        |      |      |       |      |      |        |   |        |       |   |      |         |        |       |      |        |      |   |
|---|------|--------|------|------|-------|------|------|--------|---|--------|-------|---|------|---------|--------|-------|------|--------|------|---|
| Papaya. pulp. raw                           | 22   | < 0.01 | 0.16 | 18   | 0.04  | 8.7  | < 20 | < 0.05 | 0 | < 0.08 | < 0.8 | - | 65.3 | 0.017   | 0.017  | 0.29  | 0.18 | 0.02   | 55.3 | 0 |
| Chinese grapefruit. pulp. raw               | 4    | 0.048  | 0.11 | 6    | 0.017 | 17   | -    | 0.08   | - | -      | -     | - | 61   | 0.034   | 0.027  | 0.22  | -    | 0.036  | -    | 0 |
| Strawberry. raw                             | 18   | 0.02   | 0.19 | 12   | 0.26  | 23   | < 20 | 0.11   | 0 | 0.3    | < 0.8 | - | 54   | < 0.015 | < 0.01 | 0.21  | 0.13 | 0.04   | 98.9 | 0 |
| Clementine or Mandarin. pulp. raw           | 23   | 0.04   | 0.09 | 9.3  | 0.02  | 18   | < 20 | 0.1    | 0 | 0.21   | < 0.8 | - | 49.2 | 0.064   | < 0.01 | 0.23  | 0.2  | 0.079  | 27.6 | 0 |
| Orange. pulp. raw                           | 66   | 0.04   | 0.57 | 15   | 0.02  | 38   | < 20 | 0.25   | 0 | 0.19   | < 0.8 | - | 47.5 | 0.045   | < 0.01 | 0.37  | 0.16 | < 0.01 | 25.9 | 0 |
| Pineapple. pulp. raw                        | 8    | 0.06   | 0.17 | 15   | 0.84  | 8.1  | < 20 | 0.08   | 0 | < 0.08 | < 0.8 | - | 46.1 | 0.056   | 0.033  | 0.31  | 0.17 | 0.052  | 19.6 | 0 |
| Lemon. pulp. raw                            | 11   | 0.04   | 0.15 | 7.9  | 0.02  | 12   | < 20 | 0.33   | 0 | < 0.08 | < 0.8 | - | 45   | 0.043   | < 0.01 | < 0.1 | 0.14 | 0.023  | 28.4 | 0 |
| Blackberry (mulberry). raw                  | 39   | 0.06   | 1.85 | 18   | 1.1   | 38   | -    | 0.12   | 0 | 0.87   | 7.8   | - | 36.4 | 0.029   | 0.1    | 0.62  | 0.26 | 0.05   | 6    | 0 |
| Lime or Lime. pulp. raw                     | 57   | 0.08   | 0.2  | 14   | 0.09  | 24   | < 20 | 0.15   | 0 | 0.45   | < 0.8 | - | 29.3 | < 0.015 | 0.023  | 0.25  | 0.23 | 0.018  | 36.5 | 0 |
| Mango. pulp. raw                            | 12   | 0.07   | 0.09 | 11   | 0.07  | 12   | < 20 | 0.11   | 0 | 2.05   | 1.12  | - | 25   | < 0.015 | < 0.01 | 0.72  | 0.18 | 0.1    | 70.2 | 0 |
| Raspberry. frozen. raw                      | 29.9 | 0.11   | 0.78 | 17   | 1.2   | 38   | 0.19 | 0.34   | 0 | 1.4    | -     | - | 24.5 | 0.03    | 0.05   | 0.5   | 0.24 | 0.09   | 44   | 0 |
| Guava. pulp. raw                            | 14   | 0.23   | 0.26 | 16   | 0.15  | 40   | 0.5  | 0.21   | 0 | 0.73   | 2.6   | - | 228  | 0.052   | 0.04   | 1.08  | 0.45 | 0.094  | 49   | 0 |
| Blackcurrant. raw                           | 57.1 | 0.093  | 1.17 | 23   | 0.28  | 53.5 | 1.1  | 0.28   | 0 | 2.1    | -     | - | 181  | 0.038   | 0.038  | 0.3   | 0.4  | 0.073  | 8.2  | 0 |
| Raspberry. raw                              | 16   | 0.04   | 0.4  | 20   | 0.44  | 29   | < 20 | 0.24   | 0 | 0.88   | 5.02  | - | 18.7 | < 0.015 | 0.02   | 0.35  | 0.85 | 0.032  | 38.1 | 0 |
| Honeydew melon or honeydew melon. pulp. raw | 6    | 0.033  | 0.34 | 9.08 | 0.034 | 15.8 | 0    | 0.086  | 0 | 0.035  | 2.9   | - | 16.8 | 0.032   | 0.016  | 0.58  | 0.13 | 0.072  | 17   | 0 |
| Cranberry or cranberry. raw                 | 11   | 0.061  | 0.44 | 6    | 0.36  | 13.5 | 0    | 0.1    | 0 | 1.2    | 5.1   | - | 13.7 | 0.012   | 0.018  | 0.3   | 0.3  | 0.057  | 1    | 0 |

|                                       |      |       |      |      |       |      |        |       |   |      |      |   |      |         |       |      |       |       |    |   |
|---------------------------------------|------|-------|------|------|-------|------|--------|-------|---|------|------|---|------|---------|-------|------|-------|-------|----|---|
| Lemon. zest. raw                      | 134  | 0.092 | 0.9  | 15   | -     | 12   | 7      | 0.25  | 0 | 0.25 | 0    | - | 129  | 0.06    | 0.08  | 0.4  | 0.32  | 0.17  | 13 | 0 |
| Prickly pear. pulp and seeds. raw     | 118  | 0.019 | 0.25 | 77   | 0.58  | 17.5 | -      | 0.14  | 0 | 0.01 | 2.9  | - | 12.5 | 0.011   | 0.046 | 0.38 | -     | 0.079 | 8  | 0 |
| Custard apple or cherimoya. pulp. raw | 9    | 0.069 | 0.29 | 17   | 0.093 | 26   | -      | 0.16  | 0 | 0.27 | -    | - | 12.1 | 0.096   | 0.13  | 0.61 | 0.35  | 0.26  | 23 | 0 |
| Black grape. raw                      | 8.98 | 0.078 | 0.2  | 6.78 | 0.051 | 21.8 | < 2.97 | 0.038 | 0 | 0.4  | -    | - | 10.8 | 0.045   | 0.01  | 0.15 | 0.075 | 0.04  | 5  | 0 |
| Blackberry. raw                       | 31   | 0.07  | 0.4  | 20   | 1.1   | 25   | < 20   | 0.18  | 0 | 1.28 | 14.1 | - | 10.1 | < 0.015 | 0.02  | 0.33 | 0.31  | 0.015 | 17 | 0 |
| Morello cherry. raw                   | 16   | 0.1   | 0.32 | 9    | 0.11  | 15   | -      | 0.1   | 0 | 0.07 | 2.1  | - | 10   | 0.03    | 0.04  | 0.4  | 0.14  | 0.044 | 8  | 0 |

Table 10: The micronutrient composition of vegetables, legumes and oilseeds.

| Vegetables, legumes and oilseeds | Calcium (mg/100 g) | Copper (mg/100 g) | Iron (mg/100 g) | Magnesium (mg/100 g) | Manganese (mg/100 g) | Phosphorus (mg/100 g) | Selenium (µg/100 g) | Zinc (mg/100 g) | Vitamin D (µg/100 g) | Vitamin E (mg/100 g) | Vitamin K1 (µg/100 g) | Vitamin K2 (µg/100 g) | Vitamin C (mg/100 g) | Vitamin B1 ou (mg/100 g) | Vitamin B2 (mg/100 g) | Vitamin B3 (mg/100 g) | Vitamin B5 (mg/100 g) | Vitamin B6 (mg/100 g) | Vitamin B9 (µg/100 g) | Vitamin B12 (µg/100 g) |
|----------------------------------|--------------------|-------------------|-----------------|----------------------|----------------------|-----------------------|---------------------|-----------------|----------------------|----------------------|-----------------------|-----------------------|----------------------|--------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| White bean. dry                  | 183                | 0.73              | 7.97            | 187                  | 1.9                  | 363                   | 8.8                 | 3.23            | 0                    | 0.28                 | 5.6                   | -                     | 2.04                 | 0.44                     | 0.15                  | 0.48                  | 0.86                  | 0.41                  | 307                   | 0                      |
| Blond lens. dry                  | 54                 | 0.79              | 7.4             | 91                   | 1.2                  | 360                   | 50                  | 3               | < 0.25               | -                    | 9.82                  | -                     | < 0.5                | 0.32                     | 0.029                 | 1.92                  | 1.62                  | 0.44                  | 103                   | -                      |
| Broad bean. dry                  | 103                | 0.82              | 6.7             | 192                  | 1.63                 | 421                   | -                   | 3.14            | 0                    | 0.05                 | 9                     | -                     | 1.4                  | 0.56                     | 0.33                  | 2.83                  | 0.98                  | 0.37                  | 423                   | 0                      |
| Red bean. dry                    | 83                 | 0.7               | 6.69            | 138                  | 1.11                 | 406                   | -                   | 2.79            | 0                    | 0.21                 | 5.6                   | -                     | 4.5                  | 0.61                     | 0.22                  | 2.11                  | 0.78                  | 0.4                   | 394                   | 0                      |
| Lentil. dry                      | 45.4               | 0.71              | 6.51            | 62                   | 1.39                 | 326                   | 12                  | 3.17            | 0                    | 0.49                 | 5                     | -                     | 4.5                  | 0.69                     | 0.21                  | 2.3                   | 1.75                  | 0.55                  | 257                   | 0                      |
| Green lentil. dry                | 64                 | 0.6               | 6.3             | 97                   | 1                    | 480                   | < 20                | 3.4             | < 0.25               | -                    | 11.9                  | -                     | 1.63                 | 0.29                     | 0.046                 | 1.98                  | 1.34                  | 0.35                  | 117                   | -                      |
| Chickpeas. dry                   | 90.5               | 0.71              | 5.36            | 120                  | 2.2                  | 276                   | 2                   | 1.88            | 0                    | 3.1                  | 9                     | -                     | 3.5                  | 0.49                     | 0.18                  | 1.52                  | 1.59                  | 0.48                  | 369                   | 0                      |
| Split peas. dry                  | 37.4               | 0.75              | 5.16            | 65.5                 | 1.21                 | 364                   | 14                  | 3.68            | 0                    | 0.09                 | 47.8                  | -                     | 1.4                  | 0.77                     | 0.2                   | 2.69                  | 1.88                  | 0.12                  | 154                   | 0                      |

|                        |      |       |      |      |      |      |      |      |     |       |      |   |      |        |       |      |        |        |      |   |
|------------------------|------|-------|------|------|------|------|------|------|-----|-------|------|---|------|--------|-------|------|--------|--------|------|---|
| Spinach. raw           | 114  | 0.1   | 3.61 | 52.5 | 1.3  | 45.2 | 0.1  | 0.82 | 0   | 2.47  | 521  | - | 41.1 | 0.087  | 0.21  | 0.71 | 0.18   | 0.21   | 207  | 0 |
| Lentil. sprouted       | 25   | 0.35  | 3.21 | 37   | 0.51 | 173  | -    | 1.51 | 0   | -     | -    | - | 16.5 | 0.23   | 0.13  | 1.13 | 0.58   | 0.19   | 100  | 0 |
| Spinach. cooked        | 140  | 0.1   | 2.14 | 54.4 | 0.43 | 40   | < 10 | 0.65 | 0   | 2.4   | 494  | - | 2.1  | < 0.05 | 0.1   | 0.24 | < 0.05 | 0.06   | 125  | 0 |
| Shell bean. fresh      | 29.5 | 0.24  | 1.73 | 35.5 | 0.49 | 112  | 0.6  | 0.79 | 0   | 1.16  | 40.9 | - | 18.4 | 0.15   | 0.2   | 1.87 | 0.16   | 0.071  | 122  | 0 |
| Green peas. raw        | 27.5 | 0.14  | 1.64 | 30.5 | 0.4  | 119  | 1.02 | 1    | 0   | 0.075 | 47.4 | - | 41.5 | 0.29   | 0.13  | 2.15 | 0.43   | 0.16   | 45   | 0 |
| Leek. raw              | 50.7 | 0.087 | 1.5  | 19   | 0.34 | 40.3 | 0.56 | 0.21 | 0   | 0.74  | 47   | - | 18.5 | 0.065  | 0.065 | 0.5  | 0.13   | 0.24   | 73   | 0 |
| Artichoke. raw         | 52   | 0.23  | 1.19 | 47.8 | 0.26 | 81.2 | 0.23 | 0.49 | 0   | 0.27  | 14.8 | - | 11.7 | 0.081  | 0.063 | 1.05 | 0.32   | 0.11   | 68   | 0 |
| Green peas. cooked     | 32.7 | 0.14  | 1.17 | 31.9 | 0.32 | 96   | < 10 | 0.8  | 0   | < 0.1 | 25.9 | - | 1.8  | 0.13   | 0.05  | 0.4  | < 0.05 | < 0.05 | 65.6 | 0 |
| Green beans. raw       | 48.5 | 0.063 | 1.02 | 21   | 0.23 | 38.5 | 0.3  | 0.32 | 0   | 0.36  | 14.4 | - | 13.6 | 0.086  | 0.11  | 0.72 | 0.14   | 0.12   | 48.5 | 0 |
| Mushroom. porcini. raw | 23   | 0.23  | 1    | 12   | 0.17 | 129  | -    | 0.4  | 3.1 | 0.04  | -    | - | 3    | 0.21   | 0.32  | 4.45 | 2.7    | 0.18   | 44   | - |
| Green cabbage. raw     | 96.2 | 0.049 | 0.93 | 18   | 0.17 | 32.7 | 1.86 | 0.22 | 0   | 0.16  | 121  | - | 69   | 0.059  | 0.039 | 0.26 | 0.17   | 0.15   | 67.9 | 0 |
| Pumpkin. raw           | 21   | 0.13  | 0.8  | 12   | 0.13 | 44   | -    | 0.32 | 0   | 1.06  | 1.1  | - | 9    | 0.05   | 0.11  | 0.6  | 0.3    | 0.061  | 16   | 0 |
| Pumpkin. pulp. raw     | 21   | 0.13  | 0.8  | 12   | 0.13 | 44   | -    | 0.32 | 0   | 1.06  | 1.1  | - | 9    | 0.05   | 0.11  | 0.6  | 0.3    | 0.061  | 16   | 0 |
| Broccoli. raw          | 45.9 | 0.059 | 0.76 | 21.9 | 0.4  | 76.5 | 0.6  | 0.4  | 0   | 1.04  | 181  | - | 106  | 0.074  | 0.12  | 0.82 | 0.78   | 0.17   | 153  | 0 |
| Cardoon. cooked        | 72   | -     | 0.73 | 43   | 0.13 | 23   | -    | 0.18 | 0   | -     | -    | - | 1.7  | 0.018  | 0.031 | 0.29 | 0.097  | 0.042  | 22   | 0 |
| Cardon. raw            | 70   | 0.23  | 0.7  | 42   | 0.26 | 23   | 0.2  | 0.17 | 0   | 0.19  | -    | - | 2    | 0.02   | 0.03  | 0.3  | 0.34   | 0.12   | 68   | 0 |
| Beetroot. raw          | 22.1 | 0.098 | 0.7  | 19   | 0.46 | 38.1 | 0.2  | 0.54 | 0   | 0.06  | 0.2  | - | 6.45 | 0.028  | 0.043 | 0.27 | 0.15   | 0.059  | 100  | 0 |
| Parsnip. raw           | 45.5 | 0.13  | 0.7  | 29.5 | 0.48 | 82.5 | 0.2  | 0.72 | 0   | 1.9   | 22.5 | - | 11.5 | 0.09   | 0.12  | 1.95 | 0.6    | 0.1    | 67   | 0 |

|                                   |      |       |      |      |       |      |        |      |       |        |       |   |       |         |        |       |        |        |      |   |
|-----------------------------------|------|-------|------|------|-------|------|--------|------|-------|--------|-------|---|-------|---------|--------|-------|--------|--------|------|---|
| Turnip. frozen. raw               | 23   | 0.045 | 0.7  | 10   | 0.071 | 20   | -      | 0.14 | 0     | -      | -     | - | 4.4   | 0.03    | 0.02   | 0.4   | 0.11   | 0.048  | 8    | 0 |
| Sweet corn. frozen. raw           | 4    | 0.051 | 0.68 | 32   | 0.16  | 87   | -      | 0.7  | 0     | 0.09   | 0.4   | - | 7.2   | 0.1     | 0.088  | 1.68  | 0.29   | 0.18   | 40   | 0 |
| Artichoke. cooked                 | 42.9 | 0.082 | 0.67 | 44.6 | 0.14  | 73   | < 10   | 0.29 | 0     | 0.19   | 14.8  | - | 9.1   | 0.05    | 0.089  | 1.11  | 0.24   | 0.081  | 89   | 0 |
| Green beans. cooked               | 55.3 | 0.081 | 0.6  | 22.3 | 0.19  | 36   | < 10   | 0.2  | 0     | 0.45   | 16    | - | 5     | < 0.05  | 0.08   | 0.34  | < 0.05 | < 0.05 | 33   | 0 |
| Green pepper. cooked              | 9    | 0.065 | 0.46 | 10   | 0.12  | 18   | traces | 0.12 | 0     | 0.5    | 9.8   | - | 74.4  | 0.059   | 0.03   | 0.48  | 0.079  | 0.23   | 16   | 0 |
| Pepper. green. yellow or red. raw | 7.7  | < 0.1 | 0.4  | 11.9 | 0.1   | 22.5 | 0.1    | 0.13 | < 0.5 | 1.44   | -     | - | 121   | 0.041   | 0.041  | 0.74  | 0.12   | 0.38   | 40.7 | - |
| Turnip. peeled. raw               | 40   | 0.063 | 0.4  | 9.5  | 0.1   | 38.5 | 1.25   | 0.25 | 0     | 0.03   | 0.1   | - | 18.5  | 0.04    | 0.038  | 0.7   | 0.2    | 0.085  | 17.5 | 0 |
| Batavia. flood                    | 26   | 0.04  | 0.39 | 8.7  | 0.28  | 17   | < 20   | 0.16 | -     | < 0.08 | 20.6  | - | 4.38  | 0.042   | < 0.01 | 0.2   | 0.079  | 0.051  | 65.6 | - |
| Avocado. pulp. raw                | 9.4  | 0.18  | 0.34 | 21   | 0.2   | 38   | < 20   | 0.43 | 0     | 2.23   | 14.5  | - | < 0.5 | 0.052   | 0.037  | 1.56  | 1.07   | 0.17   | 70.4 | 0 |
| Beetroot. cooked                  | 24   | 0.07  | 0.29 | 17   | 0.31  | 18   | < 20   | 0.29 | 0     | < 0.08 | < 0.8 | - | < 0.5 | < 0.015 | < 0.01 | < 0.1 | 0.14   | 0.031  | 12.4 | 0 |
| Green cabbage. cooked             | 69.7 | 0.098 | 0.28 | 15.1 | 0.18  | 33   | 3.56   | 0.22 | 0     | 0.14   | 109   | - | 27.3  | 0.056   | 0.029  | 0.14  | 0.17   | 0.13   | 38   | 0 |
| Cauliflower. raw                  | 23   | 0.02  | 0.27 | 9.8  | 0.14  | 40   | < 20   | 0.22 | 0     | < 0.08 | 3.31  | - | 4.14  | 0.031   | < 0.01 | 0.26  | 0.72   | 0.22   | 56.2 | 0 |
| Carrot. raw                       | 25   | 0.05  | 0.24 | 10   | 0.1   | 22   | < 20   | 0.18 | 0     | 0.27   | 2.96  | - | 2.05  | 0.028   | < 0.01 | < 0.1 | 0.2    | 0.093  | 59.4 | 0 |
| Black radish. raw                 | 39   | 0.01  | 0.23 | 10   | 0.06  | 32   | < 20   | 0.15 | 0     | < 0.08 | < 0.8 | - | 9.58  | 0.021   | 0.016  | 0.23  | 0.14   | 0.077  | 17.3 | - |
| Green bell pepper. raw            | 6.2  | 0.04  | 0.22 | 7.7  | 0.07  | 17   | < 20   | 0.11 | 0     | 0.28   | < 0.8 | - | 26.9  | < 0.015 | < 0.01 | 0.3   | 0.11   | 0.21   | 55.1 | 0 |

|                                |     |          |         |     |      |    |      |      |   |        |       |   |      |         |        |        |      |       |      |   |
|--------------------------------|-----|----------|---------|-----|------|----|------|------|---|--------|-------|---|------|---------|--------|--------|------|-------|------|---|
| <b>Red bell pepper. raw</b>    | 4.8 | 0.04     | 0.21    | 8.2 | 0.08 | 19 | < 20 | 0.14 | 0 | 3.45   | 3.16  | - | 121  | 0.036   | 0.11   | 0.34   | 0.18 | 0.31  | 81.8 | 0 |
| <b>Yellow bell pepper. raw</b> | 8.6 | 0.07     | 0.21    | 12  | 0.11 | 23 | < 20 | 0.23 | 0 | 1.76   | 1.18  | - | 121  | 0.03    | < 0.01 | 0.28   | 0.14 | 0.079 | 43.3 | 0 |
| <b>Fennel. raw</b>             | 37  | 0.08     | 0.2     | 11  | 0.1  | 28 | < 20 | 0.19 | 0 | < 0.08 | 62.8  | - | 2.57 | < 0.015 | < 0.01 | < 0.1  | 0.22 | 0.05  | 19.6 | 0 |
| <b>Red onion. raw</b>          | 22  | 0.05     | 0.19    | 9   | 0.12 | 29 | < 20 | 0.21 | - | 0.12   | < 0.8 | - | 4.09 | 0.029   | < 0.01 | 0.18   | 0.15 | 0.049 | 10.9 | - |
| <b>Cucumber. pulp. raw</b>     | 16  | 0.02     | 0.14    | 8.9 | 0.11 | 25 | < 20 | 0.13 | 0 | < 0.08 | 2.75  | - | 3.52 | < 0.015 | < 0.01 | < 0.1  | 0.15 | 0.042 | 7.2  | 0 |
| <b>Onion. raw</b>              | 25  | < 0.0001 | 0.00019 | 9   | 0.1  | 37 | 2.3  | 0.23 | 0 | 0.045  | 0.35  | - | 3.9  | < 0.05  | < 0.05 | < 0.05 | 0.15 | 0.1   | 29.6 | 0 |

#### 4. Conclusion

The global food system is undergoing a profound and rapid nutritional transformation due to economic development, globalization and increased production of food industries. Consumption of these products promotes a weakness within the immune system and consequently causes metabolic disturbances, the onset of chronic diseases and leading to viral infection. This study offers nutritional recommendations that will help boost the immune system in the fight against Covid-19 with regard to the potential in mineral elements, vitamins or cofactors of certain foods.

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#### Conflict Of Interest

The authors declare no conflicts of interest.

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#### Availability of data and materials

The dataset supporting the conclusion of this article is available from the authors on request.

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