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Case 1: Organic foods and contribution to the protection of body cells and molecules form oxidative damage

REPORT CASE 1: Organic foods and contribution to the protection of body cells and molecules (lipids and DNA) from oxidative damage

1. Introduction

Organic foods are produced through certain farming characteristics, which consist of the prohibition of using hormones and antibiotics and only using natural fertilizers (European Commission, n.d.).

The health claim application submitted by the Cyprus University of Technology regarding the substitution of non-organic food by organic food, based on their beneficial effect, has been rejected by the EFSA NDA Panel. The proposal was focused on the low pesticide residue level of organic food, which according to the applicant, had a positive outcome on oxidation of lipids. The Panel concludes that this application lacks necessary information, like the nutritional value needed to characterize the organic food as a healthy product, or any study that confirms a cause-and-effect relationship between the intake of organic food and protection against oxidative damage (EFSA Panel on Nutrition et al., 2021). As a result, a new proposal based on the antioxidant role of Vitamin C in organic leafy vegetables has been suggested.

2. Mode-of-action

Vitamin C, ascorbic acid (AA), is a water-soluble vitamin. This means that it dissolves in water and is delivered to body tissues. Ascorbic acid is actively transported by the sodium vitamin C cotransporter, it diffuses into capillaries and ultimately enters general circulation (Marin, Perez, Serrano, & Macias, 2018). The effect of vitamin C has been well documented: vitamin C acts as a powerful antioxidant. It can donate a hydrogen atom and form a relatively stable ascorbyl-free radical *(Figure 1)*. So that it is a potent reducing agent and scavenger of free radicals in biological systems (Duarte & Lunec, 2005). Antioxidation process help alleviate oxidative stress of lipids from free radical attacking.

Free radicals play a role as toxic compounds, in metabolic processes and in response to exogenous stimulations. When an overload of free radicals cannot be scavenged, their accumulation in the body generates oxidative stress. This occurs when free radical formation exceeds the ability of protection against them. If vitamin C deficiency occurs, free radicals would accumulate and attack lipid molecules in body leading cell damages. Vitamin C can effectively protect lipids and adipose tissues from oxidative damage by scavenge free radicals: vitamin C can donate electrons to free radicals for stabilising radicals and terminating oxidation chain reactions.

The methods to assess the vitamin C antioxidative capacity *in vivo* are the total reactive antioxidant potential (TRAP), the trolox-equivalent antioxidant capacity (TEAC), the ferric reducing antioxidant potential (FRAP), the oxygen radical absorbance capacity (ORAC) or ferrous oxidation xylenol orange (FOX) assays (EFSA Panel on Dietetic Products et al., 2018). The total antioxidant capacity of serum determined as ORAC, TEAC and FRAP increased significantly by 7–25% during the 4-h period following consumption of red wine, strawberries, vitamin C or spinach (Cao, Russell, Lischner, & Prior, 1998).

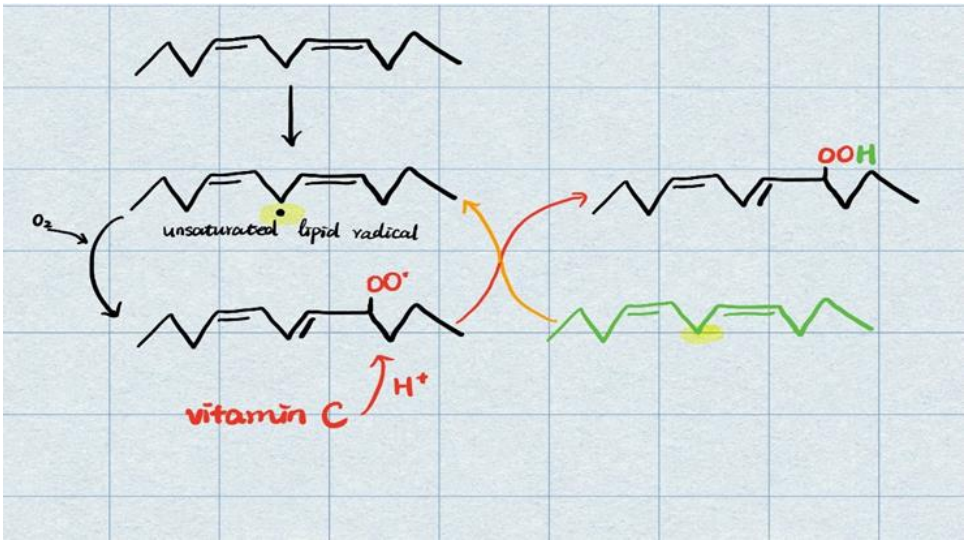

Figure 1 - Mode of action of vitamin C

3. Strengths of the approach described in the case study

The health claim presented to EFSA is a rather insufficiently characterized and incomplete proposal, in which almost no strengths can be found. A direct causal- effect relation between organic food and health benefits cannot be made, although some studies have confirmed their beneficial role, mostly based on the reduced level of pesticides and a higher amount of nutrients, like Vitamin C, compared to non-organic food (Brandt, Leifert, Sanderson, & Seal, 2011). The antioxidant and cancer-regulatory activity of vitamin C can be associated with the protection against cancer development, avoiding peroxidation of lipids, and thus, protecting the membranes and the cells (Vissers & Das, 2018).

4. Weaknesses of the approach described in the case study

In the application submitted by the Cyprus University of Technology, the nutritional composition and pesticide concentration in organic food are not reported. As a result, the EFSA panel has the opinion that the organic foods are insufficiently characterized, and therefore no causal relationship can be established between the consumption of those organic foods and the contribution to the protection of body cells and molecules (lipids and DNA) against oxidative damage (EFSA Panel on Nutrition et al., 2021). The case study also talks about organic foods in general, but there can be huge differences between different species and varieties.

According to Article 14 of Regulation (EC) No 1924/2006, the substance for which the claim is made must be present in the final product in quantities that are sufficient, or be absent or present in suitable reduced quantities, to achieve the claimed nutritional or physiological effect, to ensure that the claims are truthful. Here, that is not the case. Furthermore, according to Article 18, detailed nutrition labelling must be available, because the consumer must be able to properly assess the general nutritional quality of the product with health claims.

In the EFSA report, the human studies that took place, are not published, or even mentioned, so there is not much to say about them. There is nothing written about the design of the study, how they performed it or which biomarkers they used (EFSA Panel on Nutrition et al., 2021).

5. Summary of our improved proposal

"Vitamin C contributes to the protection of cells from oxidative stress"

Green leafy vegetables such as spinach, salad, cabbage, … are a source of vitamin C. Different studies show a bigger amount of this vitamin in organic green leafy vegetables, compared with non-organic green leafy vegetables (Crinnion, 2010). The recommended dose is 110 mg/day for the general population. This is a dose that can be reached easily with a varied, balanced, and healthy diet. This point is proven by following portions of vegetables (Nubel VZW, 2009):

- 300 g of Spinach = 138 mg of vitamin C.
- 300 g of Green cabbage = 240 mg of vitamin C.
- 200 g of Lamb's lettuce = 80 mg of vitamin C.
- 200 g of lettuce = 90 mg of vitamin C
- ….

For these that the amount is not reached with one portion of the vegetables they are mostly combined with other foods which also contains vitamin C, so in one menu, or at least a day, the goal can be reached.

The claimed effect of vitamin C is "the reduction of oxidative stress". It acts as antioxidant and helps to protect the body tissues against the potentially damaging effects of free radicals. The Panel assumes that the target population is the general population. Reactive oxygen species (ROS) including several kinds of radicals are generated in biochemical processes (e.g., respiratory chain) and because of exposure to exogenous factors (e.g., radiation, pollutants). These reactive intermediates damage biologically relevant molecules such as DNA, proteins, and lipids if they are not intercepted by the antioxidant network which includes free radical scavengers like antioxidant nutrients. The Panel considers that the protection of biologically relevant molecules such as DNA, proteins and lipids from oxidative damage is beneficial to human health (EFSA Panel on Dietetic Products & Allergies, 2009).

Evidence is needed to substantiate this claim:

- Referring to the alternative medical review "Organic foods contain higher levels of certain nutrients, lower levels of pesticides, and may provide health benefits for the consumer" we can conclude that there is a significant difference on the level of vitamin C and a greater antioxidant activity on organic foods compared with the non-organic varieties. Therefore, it is in the possibility to suppress more the mutagenic action of toxic compounds (Crinnion, 2010).

- The review study "Effect of agricultural methods on nutritional quality: a comparison of organic with conventional crops" which is an alternative medical review proves that conventional grown crops contain more water whereby there is dilution of some nutrients like vitamin C as this a water-soluble vitamin (Worthington, 1998).

- Animal studies like "Organic food: nutritious food or food for thought?" show that the amount of micronutrients like ascorbic acid is slightly higher in organic food. The animals who ate organic foods have a better health (Magkos, Arvaniti, & Zampelas, 2003).

- The conclusion of next study "Effects of vitamin C on oxidative stress, inflammation, muscle soreness, and strength following acute exercise: meta-analyses of randomized clinical trials" is that ascorbic acid attenuates the lipid peroxidation and inflammatory response (Righi et al., 2020).

- Studies show that the intake of vitamin C for post-diagnosis patients of breast cancer is significally associated with the reducing of overall mortality (Li, Lin, Lu, & Li, 2021).

With this information we would request two types of claims. The first one is a food claim: the claim that organic green leafy vegetables are a source of vitamin C. The requirement to claim the fact that a productgroup is a source of a type of vitamins/minerals is that the amount of that substance is equal or bigger than 15% of the Reference Intake (European Parliament and Council, 2006). The second claim is a health claim: a higher protection of the body cells from oxidative stress.

Article 13 of the regulation (EC) No 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods which says that the claim may be used only for food which is at least a source of vitamin C.

6. Situation in your own country

6.1.The point of view in Europe

Europe follows the Regulation (EC) No 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods.

Countries can make the legislations stricter for themselves. In this case, Belgium relies on the legislation on advertising which is the following: The royal decree of 17th of April 1980 which is changed by the royal decree of 29th of March 2012. The basis of these Belgian law is that there be no misleading of the consumer, not by product names, messages or any product information. In this law there is also a list available with all the forbidden mentions. In the case of Spain, health claims and food security are regulated by the Law 11/2001, 5 July, on Food Safety and Nutrition (Agencia Estatal Boletin Oficial del Estado, 2011).

The basis of the Belgian and Spanish law on organic foods is also the COMMISSION REGULATION (EC) No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products regarding organic production, labelling and control.

In Belgium, the recommended daily dose for the intake of vitamin C depends on the age, sex and for women if they are pregnant, lactating or not. In general, for adults the RDD for the Belgian population is 110 mg/day (+/- 20 mg / kg body weight) (Hoge Gezondheidsraad, 2016). In the case of Spain, it also depends on age, sex, and reproductive stage of women. In general, for adults the RDD for the Spanish population is 75 mg/day for women and 90 mg/day for men.

6.2.The point of view in China

Food in China is ranked in 3 different levels according to their growing or producing environment. The lowest rank is pollution free products, the second rank is green food, and the top one is organic food. (China food and agricultural products certification information)

Measures for the Administration of Organic Product Certification Order No. 67:

This article is the general law that regulates the activities of organic product certification and the production, processing, and sales of organic products in the territory of the People's Republic of China.

Organic Product Certification Implementation Rules:

This act stipulates the procedures and basic requirements for how organic product certification bodies carry out certification.

Organic Products (GB/T 19630-2011):

This act provides the rules for technical requirements that production, processing, identification, sales, and management of organic products should meet.

The organic food approval process takes a long period of time, usually at least 2 years, before it gets an organic food certificate. The approval for organic food is not undertaken by government but some organizations or companies that authorized by minister of agriculture and rural affairs of the people's republic of China.

There are two labels for organic food products. One is organic, and the other is conversion to organic. The former one is designed for foods that get the organic food certificate. The latter one is for those products that are undergoing the approval process. And only after the finish conversion period (under the supervision of authorized organisations) successfully, can they transfer conversion to organic to organic. Once they failed to pass the conversion time, those who applies for organic food certificate should submit application again.

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