

Potential Health Benefits of Fruits and Vegetables

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In recent decades, the consciousness of consumers regarding the importance of a balanced diet to prevent the occurrence of chronic diseases has significantly increased. In particular, the consumption of plant-based foods, both vegetables and fruits, have been demonstrated to have a central role in the prevention of many chronic diseases, due to the high amount of bioactive compounds they contain. To date, many researchers and scientists in different fields of research have contributed with great efforts to the characterization of the phytochemical pattern of hundreds of fruits and vegetables, and have elucidated several mechanisms of actions and metabolic pathways through which fruits and vegetables exert their health-promoting and/or disease-preventing activities.

The aim of this special issue was to compile the most recent research on fruit and vegetable phytochemical composition, on the health-promoting effects and mechanisms of action of their application/assumptions in different models, such as in vitro cellular models, in vivo animal trials and in vivo human trials.

The first step of the evaluation of the potential health benefits of fruit and vegetables is the evaluation of the phytochemical composition. In this special issue, six studies were focused on the evaluation of the phytochemical composition and the antioxidant capacity of different fruit/vegetables species.

Li et al. characterized the phenolic composition of five different varieties of apples grown in Australia ('Royal Gala', 'Pink Lady', 'Red Delicious', 'Fuji' and 'Smitten') through liquid chromatography. The results underlined that different genotypes showed different amounts of total phenolic and total flavonoid content. Furthermore, a total of 97 different phenolic compounds were detected in the five apple varieties, highlighting the interest of Australian apple varieties as a rich source of bioactive compounds [1].

Among fruits, berries are raising interest for their proven high nutritional quality, due to the high amount of several phytochemicals. Two berries were analyzed in this special issue: in the first study, Kruger et al. evaluated the effect of cultivar, environmental variations and their interaction on anthocyanin composition of six strawberry cultivars grown in five locations from the North to South of Europe, for two different years. As a general trend, fruits grown in southern locations were richer in total anthocyanins and pelargonidin-3-glucoside content. Principal component analysis revealed that anthocyanin content of cultivars is influenced by environmental factors; in particular, the minor anthocyanins (cyanidin-3-glucoside, cyanidin-3-(6-O-malonyl)-glucoside, pelargonidin-3-rutinoside and pelargonidin-3-(6-O-malonyl)-glucoside) were sensitive to the maximum temperature value. However, different cultivars changed their anthocyanin pattern in relation to the environmental conditions to varying extent, with 'Gariguette' and 'Clery' cultivars remaining unaffected [2].

The second study on a berry species involved the phytochemical characterization of 30 haskap berry genotypes. In this manuscript, different spectrophotometric and spectrofluorimetric methods were used to evaluate the antioxidant capacity and the amount of



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different phenolic compounds and vitamin C. This study allowed for the identification of those genotypes, which were more interesting for a high content of the studied phytochemicals, and that could be recommended to consumers for a healthy diet. Furthermore, the heritability and genetic process analyses allowed for the indication of the effectiveness of breeding for the transmission of the analyzed traits to the progeny, suggesting the most suitable genotypes for the implementation of future breeding programs aimed at obtaining healthier fruits [3].

Together with fruits, fresh vegetables are also interesting for their content of specific bioactive compounds. In particular, vegetables belonging to the *Brassicaceae* family have attracted increasing attention in recent years for the quantity and quality of their bioactive compounds, and this attention has also been confirmed in this special issue, where two studies (one review and one research) were published on this argument.

The research study presented an investigation on the amount of nine inorganic elements (Cd, Co, Cr, Cu, Fe, Ni, Mn, Pb and Zn) in genotypes from three different species belonging to the *Brassicaceae* family (*Brassica rapa*, *Eruca vesicaria* and *Sinapis alba*), grown according to both conventional and organic cultivation techniques, during two agricultural seasons on two different experimental farms. The results underlined that the inorganic elements amount is influenced mainly by many factors other than the cultivation technique, comprising the soil characteristics. The organic cultivation technique did not decrease the heavy metal content or increase the nutritional quality of *Brassicaceae*, as commonly believed. As a final result, it was predicted that the consumption of 150–200 g of these vegetables, both from organic and conventional agriculture, fulfill the same percentage of Dietary Reference Intakes for Co, Cr, Cu, Fe, Mn and Zn. Regarding the heavy metal (Cd, Ni and Pb) tolerable intakes, only slight differences (mainly for Pb) have been found between both cropping systems [4].

The second manuscript regarding the quality of *Brassicaceae* is a review article, which aimed to highlight the main phytochemical compounds present in brassicas used as a food vegetable that confer nutritional and sensorial quality to the final product, and to investigate the main factors that affect the phytochemical concentration and the overall quality of Brassica vegetables. In summary, the bioactive molecules responsible for the nutritional quality of *Brassicaceae* can be divided in antioxidant compounds (e.g., phenols, vitamin C) and non-antioxidant compounds (e.g., minerals, glucosinolates). The amount of these compounds in Brassica vegetables could be influenced by many factors, including the genetic source, the environmental conditions and the cultivation techniques adopted for the vegetable production [5].

As mentioned above, the nutritional quality of fresh fruits and vegetables depends on many factors, which could affect the final quality of the products. However, if the product is not stored properly after its harvest, the loss or degradation of phytochemical compounds is a tangible possibility. In this regard, a study in this special issue evaluated different options for prolonging the apricot fruit quality during cold storage and shelf life, decreasing the postharvest losses of apricots. The quality parameters (quality losses, antioxidant properties and enzyme activities) were evaluated at different time periods (from 7 to 21 days) at cold storage (1 °C) and shelf life (25 °C), comparing post-harvest treatments with methyl jasmonate and salicylic acid. As a general trend, both post-harvest treatments significantly decreased the quality loss of chilling injury and fruit decay on all dates. The antioxidant capacity and the phenolic patterns increased for both treatments at all dates, and almost all the antioxidant enzyme activities increased significantly on all dates for both treatments (except catalase activities, which decreased with the methyl jasmonate treatment). In conclusion, both methyl jasmonate and salicylic acid are useful and inexpensive techniques to maintain the apricot fruit quality in both cold storage and shelf life conditions [6].

The second step for the evaluation of the health potential of fruit vegetables is testing the product in an in vitro model. Usually, in this step the capacity of the fruit/vegetable extract is evaluated to limit the viability of pathological cells, or to protect the healthy cells

from an induced external stress. In this special issue, a study evaluating the effect of olive (*Olea europaea* L.) vegetation water on human cells regarding its antioxidant properties and radical scavenger bioactivities was published. The study involved the treatment of two cell lines, human hepatocellular carcinoma and human keratinocytes, with two food supplements containing concentrated olive water in combination with 6% lemon juice or 70% grape juice, respectively. The first analysis of the extracts revealed that hydroxytyrosol was the most abundant polyphenol in both formulations, followed by tyrosol and oleuropein (for the olive-derived concentrate with lemon juice), and by proanthocyanidins and tyrosol (for the olive concentrate with grape juice). Both extracts were demonstrated to be effective antioxidants, also preventing the advanced glycation end product formation. In addition, preliminary data indicate that the administration of hydroxytyrosol through these hydrophilic matrices is better absorbed into the human body [7].

After the demonstration of the beneficial effects of fruit and vegetable consumption in in vitro models, the following step is the evaluation of the positive effects also in in vivo animal models. A trial on morbidity and mortality in the context of sepsis and septic shock on male Sprague Dawley[®] rats was presented in this special issue. In this study, a thiosulfate-enriched *Allium sativum* extract was used as adjuvant in the management of sepsis induced by intraperitoneal *Escherichia coli* ATCC 25922 inoculation. To evaluate the efficacy in the sepsis-induced management, clinical, analytical, microbiological and histopathological parameters were evaluated in the control group, in the group treated with antibiotic, and in the group treated with antibiotic plus *Allium sativum* extract. The results confirmed that the utilization of *Allium sativum* extract as an adjuvant to antibiotic treatment in the management of sepsis could improve the sepsis attenuation, ameliorating clinical parameters of rats as weight, ocular secretions, whiskers separation and physical activity level, inhibiting *Escherichia coli* proliferation and thus, reducing overall mortality after an animal peritonitis model [8].

The final step for the valorization of the potential health benefits of fruit and vegetable consumption is the introgression of these products in the human diet. With this aim, two studies were published in this special issue. The first study involved a particular group of people affected by prediabetes mellitus, whose glucose levels did not meet the criteria for diabetes but were higher than those considered normal. These people were fed with two servings per day of *Gynura bicolor*, a red purple-colored vegetable, and the effect on glycemic control and antioxidant ability was evaluated. People were divided into control group and *Gynura bicolor*-fed group, and data on anthropometry and biochemical analysis were collected at 0, 8 and 12 weeks. The results clearly showed that *Gynura bicolor* consumption improved both the glycemic control and the antioxidant activity, mainly because of its high content of polyphenols [9].

The second interventional study was focused on the vulnerable category of elderly people, in particular, regarding the respiratory tract infections. The objective of this study was to evaluate the efficacy of the consumption of a combination of elderberry and reishi extracts on the incidence, severity and duration of respiratory tract infections in a group of healthy elderly volunteers. A group of 60 nursing home residents ≥ 65 years of age randomly received a combination of 1.5 g of elderberry + 0.5 g of reishi or a placebo daily for 14 weeks. If the incidence of respiratory infections was similar in both groups, the berry-fed group presented a significant reduction of common cold event duration and of high severity influenza-like illness events. Moreover, the sleep disturbances were significantly reduced in the berry-fed group. Thus, the suitability of the elderberry + reishi extract in reducing the respiratory tract infections was confirmed [10].

To summarize, in this special issue we have published several works demonstrating that fruit and vegetables contain several bioactive compounds, which give high potentiality to these foods in the prevention of many chronic human diseases. Furthermore, we have published some studies showing that fruit and vegetables demonstrated their positive activities both in in vitro and in vivo models. The last study of the special issue that we want to present is the correct conclusion of this editorial because it translates all the

previous suggested findings for a healthy life; in fact, the broad recognition of the positive effects of the Mediterranean Diet, the dietary patterns that were followed in specific regions of the area in the 1950s and 1960s on the longevity of Mediterranean populations led to the adoption of this diet in other regions of the world. This study reviewed the scientific knowledge regarding the beneficial health effects of adherence to this diet, underlying that it is not only linked to the consumption of specific food products but also to social, religious, environmental and cultural aspects. Therefore, the Mediterranean Diet represents a healthy lifestyle in general that can allow to optimize the positive effect of fruit and vegetable consumption [11].

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