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The Preventive Approach of Biocompounactives (2): A Review in Recent Advances in Common Fruits

Abdelkarim Guaâdaoui[1, *], Fatma Bouhtit[2], Mounir Cherfi[3], Abdellah Hamal[1]

[1]Department of Biology, Laboratory of Genetics & Biotechnology (LGB), Faculty of Science - Oujda (FSO), University Mohammed Premier (UMP) Oujda, Morocco
[2]Department biological analysis, Laboratory for Analysis & Quality Control (LACQ), University Mohammed Premier (UMP) Oujda, Morocco
[3]Medical Analysis Laboratory, Provincial Medical Center of Taourirt, Health Provincial Delegation of Taourirt, Ministry of Health, Morocco

Email address:
abdelkarim119@gmail.com (A. Guaâdaoui)

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Abstract: Biocompounactives contain chemicals that are found in small quantities in plants and certain foods (such as fruits, vegetables, nuts, oils and whole grains), they have actions in the body that can promote good health. The importance attached to benefits of food on health has never been so high before. All scientific studies confirm that a varied and balanced diet is factor of protection against cancer, cardiovascular disease (CVD), osteoporosis, diabetes, obesity and high cholesterol. In this second part of the review, we focus on studies that have been conducted on biocompounactives of common fruits, and opportunities that present bioactivity of these phytochemicals to prevent many chronic diseases. As well, we discuss some challenges that face the good investissment of biocompounactives, especially that related to bioavailability and bioefficacy, on the horizon to discuss the limits of experiments interpretation, mentioned here, in the third part of this review.

Keywords: Biocompounactives, Bioactive Compound, Phytochemicals, Functional Foods, Healthy Diet, Nutraceuticals, Fruits

1. Introduction

Biocompounactives are compounds which have the capability and the ability to interact with one or more component(s) of the living tissue by presenting a wide range of probable effects [1-3]. They are non-essential natural ingredients in, or derived from, plant, animal or marine sources, which have the ability to modulate biochemical, physiological and metabolic processes in the human body, while exerting beneficial effects beyond basic nutritional functions [4-6]. Generally, there is no difference in biological activity between the bioactive compounds derived from nature and synthetic products [1, 7].

Biocompounactives are experiencing a growing interest in wide range of applications: geo-medicine, plant science, modern pharmacology, agrochemicals, cosmetics, food industry, nano-bio-science... etc. This is a very promising area in full development, which has resulted in research works more and more numerous, designed to diversify the resources of bioactive compounds and improve their salvage pathways or synthesis [1, 2].

The importance attached to benefits of food on health has never been so high before [8], and if we except the genetic, ecological, physiological and botanical studies on food; research on the bioactive potential has experienced a veritable boom during the first decade of the twenty-first century, and took an accelerated rates over the beginning of the second decade, in a way that the research carried out during the past five years (2010-2014) on the majority of foods are equal or superior to the work done during all the previous decade (2000-2009) [3].

Biocompounactives contain chemicals that are found in small quantities in plants and certain foods (such as fruits, vegetables, nuts, oils and whole grains), they have actions in the body that can promote good health [9].

In this work, we continue on preventive approach of biocompounactives (part 2), and opportunities that present bioactivity of common fruits phytochemicals to prevent many chronic diseases. As well, we discuss some challenges that face the good investissment of biocompounactives.

2. Food Biocompounactives Opportunities

Noting that prevention is a more effective strategy than is treatment of chronic diseases [10]; the philosophy that food can be health promoting beyond its nutritional value is gaining acceptance within the public arena and among the scientific community as mounting research links diet/food components to disease prevention and treatment [11, 12].

Recent trends in the functional food market suggest that products with multiple health benefits become more and more popular [13] and dietary bioactive compounds have become another quality indication [14].

Over the past two decades, there has been a growing interest in the potential benefits of natural compounds on human health [15]. Interest in food composition has expanded beyond the nutrients to include bioactive compounds consumed in the traditional foods, which may help to prevent many chronic diseases that can coexist with malnutrition and undernutrition [16].

Biocompounactives are members of a large class of organic molecules that are widely distributed in the plant kingdom and, as such, are an integral part of the daily diet of humans [17].

Until 2013, it was estimated that more than 8000 phytochemicals have been identified in foods [18]. All these bioactive food components are mostly found in whole grains, fruits and vegetables [19, 20], but a large percentage still remain unknown and need to be identified before we can fully understand the health benefits of phytochemicals in whole foods [19].

The phytochemicals may be classified into carotenoids, phenolic compounds, alkaloids, nitrogen compounds and organosulfur compounds. But the most studied of these biocompounactives are phenolics and carotenoids [21].

Recent investigations show that food biomolecules that contribute to human health can be found particularly in glycosylated, esterified, thiolated or hydroxy forms. These bioactive compounds display their health benefits in metabolic activity associated with several diseases [20].

So the important role that biocompounactives can have in health is related to the intake of these compounds, which, in turn, strongly linked to the high consumption of fruits, vegetables and unrefined grains [22]. Indeed, several studies have shown that a high intake of fruits and vegetables reduces the risk of cardiovascular disease, certain cancers, and other chronic diseases [21, 23-26].

The concept of a healthy diet is considered an aspect of good and healthy practices. The observations in social behavior and archaeological discoveries lead researchers to notice that the longevity and healthy life, away from the high incidence of myocardial infarction and cancer, are caused by good habits of feeding [27].

The table (1) present bioactivities studied on some most common fruits, with their major biocompounactives.

Table 1. *Bioactivity of dietary biocompounactives (Common Fruits case).*

Common Fruits	Bioactivities studied	Biocompounactives	References
Almond *Prunus amygdalus* (Rosaceae)	Reduce the risk of: • Cardiovascular disease • Type 2 diabetes • gallstones and ablation of the gallbladder • colon cancer in women	Polyphenols Phytosterols (squalenes) Soluble fiber Monounsaturated fatty acids	[28-33]
Apple *Malus x domestica Borkh.* *Malus pumila Mill.* (Rosaceae)	Prevent against cancer (colorectal, colon, breast & lung) Reduce the risk of neurodegenerative diseases (such as Alzheimer's) Prevent lipid oxidation & reduce blood cholesterol Reduce the risk of cerebrovascular accidents (CVA) Reduce the incidence of acute coronary syndrome (ACS) Reduce the incidence of asthma and respiratory diseases Activities: antioxidant, anti-inflammatory & antiprolefirative Extend the life of *Caenorhabditis elegans*	Flavonoids (quercetin, procyanidins, catechin & epicatechin) Chlorogenic acids Soluble fiber	[34-54]
Apricot *Prunus armeniaca* (Rosaceae)	Reduce the risk of colon cancer Control of type 2 diabetes Reduce chronic gastritis	Flavonoids Carotenoids (Lycopene) Fiber	[55-59]
Avocado *Persea americana* (Lauraceae)	Reduce the proliferation of cancer cells Prevent cardiovascular diseases & constipation Control of type 2 diabetes Ability to repair liver damage	Proanthocyanidins lycopene phytosterols Fiber	[60-64]
Banana *Musa spp.* (Musaceae)	Reduce the risk of neurodegenerative diseases (such as Alzheimer's) Reduce cardiovascular & glycemia Protect the lining of the stomach against ulcers Relieve symptoms of diarrhea	Flavonoids / leucocyanidin β & α-carotene Fiber	[65-70]
Cherry *Prunus avium* or *cerasus* (Rosaceae)	Antioxidant, antiproliferative and anti-inflammatory activities Vasodilator activity Effects pain & muscle recovery Regulate sleep	Phenolic acids (chlorogenic & hydroxycinnamic) Flavonoids (anthocyanins, flavanols and flavonols)	[71-83]

Common Fruits	Bioactivities studied	Biocompounactives	References
		Melatonin & Serotonin	
Clementine Tangerine *Citrus reticulata* (Rutaceae)	Reduce the risk of certain cancers (lung, liver) Cause apoptosis of cancer neuroblastoma cells Antioxidant activities Protect the integrity of neuronal cells Anti-inflammatory potential *in vitro* Prevent bone loss Reduce blood cholesterol in animals	Flavonoids (isoflavones, hesperetin, nobiletin & tangeretin) Limonoids (limonine & nomiline) Carotenoids (β-cryptoxanthin) Soluble fiber Vitamin C	[84-92]
Date *Phoenix dactylifera L.* (Arecaceae)	Anti-inflammatory Antioxidant power Reduce cholesterol Normalize glucose and insulin levels Prevent constipation	Flavonoids (anthocyanins, luteolin, quercetin & rutin) Phenolic acids (gallic, caffeic & coumaric) Carotenoids (β-carotene) Fiber	[93-101]
Fig *Ficus carica* (Moraceae)	Antioxidant activities Antispasmodic & antiplatelet activities Potential against human melanoma Normalizing cholesterol , glucose and insulin blood levels Maintain proper intestinal function	Flavonoids (anthocyanin) Chlorogenic acid Carotenoids (lycopene, lutein & β-carotene) Coumarins Fiber	[102-111]
Grapefruit & Pomelo *Citrus grandis (L.) Osbeck* *Citrus maxima (Burm.)Merr.* (Rutaceae)	Induce apoptosis in cancer cells of the stomach Reduce the risk of breast cancer Inhibition of cell lines (Leukemia & colon) in humans Antihyperlipidemic & antidiabetic properties Antioxidant & antiinflammatory activities Effects on bone homeostasis	Flavonoids (rhoifolin, cosmosiin, naringin & Hesperetin) Carotenoids (lycopene & β-carotene) Coumarins (auraptene) Limonoids (limonine) Soluble fiber	[112-122]
Grapes *Vitis sp.* (Vitaceae)	Prevent cardiovascular disease (CVD) Remove carcinogenesis of breast cells / Reduce the proliferation of cancer cells of the mammary gland Induce apoptosis in colon cancer cell lines Protective effect against cancer of the white blood cells Prevent skin cancer Protective effect against nephrotoxicity (in male rats) Improve cognitive and immune functions Prevent brain lipotoxicity (in rats) Hepatoprotective effect Activities: anti-inflammatory, anti-hypertensive, anti-thrombotic, antiviral & antibacterial	Flavonoids: quercetin, myricetin, kaempferol, catechin, epicatechin, proanthocyanidins anthocyanins & Stilbene Trans-Resveratrol & viniferin	[123-154]
Hazelnut *Corylus avellana* (Betulaceae)	Antineoplastic agent Reduce total cholesterol & LDL cholesterol Antibacterial activity	Flavonoids Tocopherols & tocotrienols Carotenoids (β-carotene) Tannins Phytosterols (β-cytosterol)	[155-159]
Kiwifruit *Actinidia deliciosa* (Actinidiaceae)	Protection against oxidative DNA damage Cardioprotective & Hepatoprotective potential Control diabetes (type 2) & appetite Help immune function Treat chronic ulcers Prevent constipation	Flavan (epicatechin, catechin & procyanidins) Flavonols (quercetin & kaempferol) Vitamin C Fiber	[160-167]
Lemon *Citrus limon* Lime *Citrus aurantifolia* (Rutaceae)	Inhibit the activity of HIV protease Improve the immune system Induce apoptosis of leukemic & pancreatic cancer cells Reduce the risk of the digestive tract cancers Slow the growth of tumors and metastases (antiangiogenic properties) Reduce cholesterol.	Flavonoids (eriocitrin, hesperetin & nobiletin) Limonoids (limonine, nomiline & obacunone) Soluble fiber Vitamin C	[168-178]
Loquat *Eriobotrya japonica* (Rosaceae)	Anti-inflammatory & anti-coagulant Anticancer & antimetastatic Antihyperglycemic Hepatoprotective & gastroprotective activities Antioxidant & anti-inflammatory activities	Carotenoids (β-carotene & β-cryptoxanthin) Phenolic acids Fiber	[214-219]
Mango *Mangifera indica* (Anacardiaceae)	Anticancer activity (prostate, colon, blood, breast) *in vivo* & *in vitro* Repair and modulate DNA damage Treat cognitive decline (in rats) Antidiabetic & Hypoglycemic effect	Flavonoids (quercetin) Mangiferine & gallotannins Carotenoids (β-carotene, β-cryptoxanthin & violaxanthine) Soluble fiber	[179-184]

Common Fruits	Bioactivities studied	Biocompounactives	References
Melon *Cucumis melo* (Cucurbitaceae)	Activities: immunomodulatory, anti-inflammatory & anti-bacterial Antimutagenic & antioxidants effects Prevent colon cancer Anti-inflammatory property	Carotenoids (β-carotene) Sulfur compounds (MTAE, PETM, MTPA ...)	[185-192]
Nuts *Juglans spp.* (Juglandaceae)	Prevent breast cancer Induce apoptosis of prostate cancer Antiproliferative activity of human cancer cells Prevent coronary heart disease Lower blood cholesterol Protection against oxidative stress	Flavonoids (tocopherols & tocotrienols) Ellagic acid & α-linolenic acid Phytosterols Fiber	[196-204]
Olive (Olive oil) *Olea europaea* (Oleaceae)	Anti-inflammatory, antibacterial & antiviral activities Reduce oxidative stress in the body Risk Reduction: • myocardial infarction • mortality from coronary heart disease control of blood pressure anticoagulant effect Prevent atherosclerosis	Hydroxytyrosol & Oleuropein Monounsaturated fatty acids vitamin E	[205-211]
Orange *Citrus sinensis* Bitter orange *Citrus aurantium* (Rutaceae)	Cause apoptosis of cancer neuroblastoma cells Reduce the proliferation of cancer cells (breast, stomach, lung, mouth & colon) Inhibit the activity of HIV protease Reduce the incidence of cerebrovascular disease Anti-inflammatory (rheumatoid arthritis)	Flavonoids (hesperetin, naringenin & eriocitrin) Carotenoids (β-carotene, lutein, zeaxanthin & β-cryptozanthine) Limonoids (limonine & nomiline) Fiber	[212-224]
Peach *Prunus persica (L.) Batsch* *Prunus vulgaris* Nectarin *Prunus persica nucipersica* (Rosaceae)	Prevent breast cancer Inhibition of proliferation of liver cancer cells Improve the chemotherapeutic efficacy and protection against nephrotoxicity in mice Prevent oxidation of LDL cholesterol Promote longevity in *Drosophila melanogaster* Anti-photoaging	Flavonoids (flavan-3-ols, flavonols & anthocyanins) Carotenoids (β-carotene, lutein, zeaxanthin) Hydroxycinnamates Fiber	[225-234]
Peanut *Arachis hypogaea* (Fabaceae)	Reduce the growth of breast, colon and prostate cancer cells Lower risk of colorectal cancer in women Reduction of blood cholesterol Decreased risk of: • cardiovascular disease • gallstones in humans • removal of the gall bladder in women	Resveratrol / Piceatannol Hydroxy-benzoic acid Coumaric acid Phytosterols Fiber	[235-238]
Pear *Pyrus communis L.* (Rosaceae)	Reduce the risk cerebrovascular accidents (CVA) Antimicrobial activity Antiulcer capacity (in rats)	Flavonoids (Procyanidins) hydroxycinnamic acid Insoluble fibers	[239-242]
Pineapple *Ananas comosus* (Bromeliaceae)	Activities: anti-tumor, anti-inflammatory, anti-edematous & help digestion Improve circulatory and cardiovascular systems	Polyphenols Bromelain	[243-246]
Pistachio *Pistacia vera L.* (Anacardiaceae)	Antimutagenic, neuro-protective & hepato-protective activities Decrease the rate of LDL cholesterol Reduce blood pressure / effect on atherosclerosis (in rabbits) Activities: anti-nociceptive anti-inflammatory &	Flavonoids (Anthocyanins) ɣ-tocopherol Carotenoids (β-carotene) Stilbene (resveratrol) Phytosterols (squalene) Soluble fiber	[247-255]
Pomegranate *Punica granatum* (Punicaceae or Lythraceae)	Delay the progression of certain cancers (prostate, blood, colon & breast) *in vitro* Antimutagenic activity & Antigenotoxic potential Neuro-protective effect Decrease of atherosclerotic lesions & cholesterol (LDL) Anti-inflammatory, anti-obesity, anti-bacterial (caries ...) & antiviral (influenza ...) properties	Flavonoids (anthocyanins & procyanidins) Ellagic acid Tannins (punicalagin)	[256-273]
Prickly pear *Opuntia ficus-indica* (Cactaceae)	Induce apoptosis of human leukemia cells / Anti-genotoxicity Reduce neuronal damage (in rats) / Neuroprotective & Improve memory (long term) Reduce acute glycemia / Antidiabetic Reduce blood cholesterol Activities: hepatoprotective, anti-inflammatory & anti-hyperlipidemia	Flavonoids (kaempferol, quercetin & narcissin) Alkaloids (indicaxantin neo-betanin & mescaline) Betalain β-cyanine Fiber	[274-285]
Prune & Plum	Reduce the risk of colon cancer	Flavonoids (anthocyanins, catechins,	[286-292]

Common Fruits	Bioactivities studied	Biocompounactives	References
Prunus domestica L (Rosaceae)	Antiproliferative activity against breast cancer cell lines *in vitro* Help to reduce the viability and inhibit the proliferation of various cancer cells Reduce cognitive deficits (in aged rats) Prevent diabetes Type 2 & Antihyperglycemic Reduce the risk of atherosclerosis Modulate the immune response (in mice) Activities: anxiolytic, anti-osteoporosis (menopausal women), antihypertensive & antimicrobial	proanthocyanidol, quercetol & kaempferol) Carotenoids Chlorogenic acids Dihydroxyphénylisatine	
Raspberry & Blackberry *Rubus idaeus* (Rosaceae)	Inhibit the growth of various cancer cells and tumors (liver, breast, colon, lung, prostate, cervix, esophagus and mouth) Antimicrobial & antiviral activities *in vitro* Antioxidant properties Reduce plaque deposits in the aorta Reduce inflammatory rates Protect intestinal cells	Flavonoids (tocopherols, quercetin & anthocyanins) Gallic & ellagic acid Carotenoids (Lutein & Zeaxanthin) Vitamin C	[293-305]
Strawberry *Fragaria x ananassa* (Rosaceae)	Anti-carcinogenic activity (breast cancer) Anti-proliferative activity (cells of cervical cancer) Reduce the risk of neurodegenerative diseases *in vitro* Antioxidant / Prevention of oxidative DNA damage Antiviral & antimicrobial activity *in vitro* Antihypertensive & antihyperglycemic potential *in vitro* Protective effect against prostate cancer	Flavonoids (anthocyanins) Ellagic acid (ellagitannins) & folic acid (vitamin B9) Carotenoids (β-carotene) Vitamin C Fiber	[306-314]
Tomato *Solanum lycopersicum L.* or *Lycopersicon esculentum Mill.* (Solanaceae)	Lower incidence of lung cancer Inhibit the growth of cancer cells in humans (colon, breast, liver and stomach) Prevent the proliferation of certain types of cancer cells Activities: antimutagenic & Hepato-protective (reducing the accumulation of heavy metals) Reduce the risk of cardiovascular disease Cholesterol-lowering effects & anti-inflammatory Prevent the harmful effects of lead on blood constituents Inhibit human platelet aggregation *in vitro*	Carotenoids (lycopene, lutein & β-carotene) Alkaloids (dehydrotomatine α-tomatine & filotomatine) Flavonoids (anthocyanins) Saponins	[315-338]
Watermelon *Citrullus lanatus* (Cucurbitaceae)	Reduce the risk of prostate cancer Anti-inflammatory activities / Analgesic Improve arterial function in individuals with hypertension Reduce atherosclerosis in mice deficient in LDL receptors Effect on uterine contractility (in rats)	Carotenoids (lycopene, β-carotene & β-cryptoxanthin) Citrulline	[339-351]

3. Challenges of Biocompounactives Studies

It is true that many phytochemicals such as polyphenols, carotenoids and organosulfur and nitrogen compounds, are thought to be involved in the prevention and treatment of many diseases, including some cancers, cardiovascular diseases, diabetes , degenerative diseases, inflammation, infections, psychotic diseases, ulcers, macular degeneration, ... etc. [352-354]. But, how manifest this mutual interaction between the different biocompounactives and biological systems? and what are the main factors that can affect the physicochemical properties of bioactive compounds in biological systems?

In the following, we will discuss the main challenges encountering the study of biocompounactives; knowing that the mechanisms of action, in general, are not well understood and often difficult to identify [355, 356], which makes determining the mode of action of biocompounactives, including natural products, central problem in chemical biology [357].

3.1. Bioavailability & Bioefficacy

3.1.1. Variation Factors of Bioavailability and Bioefficacy

Bioactive compounds from a variety of sources (plant or animal) must be bioavailable to exert beneficial effects [358].

Bioavailability reflects the rate and extent to which a bioactive compound is absorbed and becomes available at the site of action in a biological system. This is a complex process involving several steps: liberation, absorption, distribution, metabolism and elimination phases (LADME). This process, of course, can vary considerably between individuals, and this variation depends on several key factors, including diet, genetic inheritance, composition and activity of the intestinal microbiota [359, 360].

In addition to the variations between individuals; many factors may be involved in the same person and affect the quality of bioavailability and consequently affect the bio-efficacy. Among these factors are briefly cited [2, 16, 359-361]:

o bioaccessibility: This is the fraction of a compound that is released from the matrix (food) in the gastrointestinal lumen and thus made available for intestinal absorption.

o Molecular structure and isomeric configuration of biocompounactives: High molecular weight compounds do not pass through the intestinal cells unless they are first broken (glycosylated flavonoids, for example) and a different stereochemistry has a bioavailability and bioefficacy different (for example *cis*-lycopene more bioavailable comparably to the all-*trans* isomer). Slight variations in chemical structure result in extreme variations in biological activities.

o Transport mechanisms: Since many biocompounactives have no optimal physicochemical properties required for passive diffusion, transmembrane transporters are necessary to improve their permeability. The activity of different transporters affects biocompounactives by several different mechanisms, such as limiting the absorption, facilitating the elimination and limiting distribution to target tissues. This limitation may be due to the selectivity and affinity of intestinal transport systems towards different biocompounactives or competition for transport by transporters (hypothesis of competitive inhibition).

o Metabolism: Once the bioactive molecule is input in an enterocyte, it can be submitted to metabolism by enzymes of Phase I and/or Phase II, resulting by molecular forms that are different from origins constituents. In a quite similar way, many other phytochemicals are highly metabolized by the intestinal microbiota before absorption; and again, the compounds in the systemic circulation to which the cells are exposed are different from those obtained directly from the plant.

It is only when the circulating forms of a bioactive molecule or a food product is known; a more complete view on the bioavailability, and possible correlation of bioefficacy, can be obtained. For drugs, it is a requirement when conducting bioavailability studies; and this type of approach can also be translated to nutritional research [360].

3.1.2. Improvement Approaches for Bioavailability and Bioefficacy

Face to this difficult course for the bioefficacy; several approaches have been evaluated to improve the bioaccessibility and bioavailability of bioactive ingredients and drugs. These sometimes include simple things, like the treatment and processing of the food matrix. For tomatoes, for example, lycopene has proved a better bioavailability when the tomatoes are cooked or mixed with a small amount of fat. Blood levels of lycopene may increase almost three times more than the consumption of fresh tomatoes [362-364]. But most approaches call technology by molecular changes to improve the solubility or absorption site of bioactive molecules [365].

Several chemical efforts aimed at improving bioavailability have led to the synthesis of derivatives or conjugates of natural molecules and the preparation of novel formulations and combinations having improved physicochemical properties. We can give as an example, the modification of a natural alkaloid (Huperzine A) in a semi-synthetic bioactive compound (ZT-1), whose the new design has improved the bioavailability and reduce the toxicity [366]. Molecular modeling of some coumarins is another example of combination of crystallographic and biological data, in order to design compounds which possess better bioavailability [367].

For the same purpose, and in addition to responding to the challenges of the sensitivity of biocompounactives, several technologies have been developed, including the encapsulation of bioactive molecules (water-soluble or fat-soluble) in different forms (microcapsule, micelle, uni/multilamellar vesicle ...) [368, 369].

Oehlke K. et *al.* (2014) cited the growing interest of nanoscale materials (nanotechnology) designed as delivery systems for organic and inorganic materials in order to overcome the problems associated with the low bioavailability of many bioactive compounds. The mechanisms leading to better bioavailability, according to the authors, are based on (i) improved solubility of the bioactive compounds in gastrointestinal conditions, (ii) protection of bioactive compounds from chemical conditions in the gastrointestinal tract, (iii) controlled release in the gastrointestinal tract, or (iv) improved transfer through the intestinal wall [370].

A final biotechnological method that can be mentioned in this context is that of biocatalysts. Some bacteria, such as *Klebsiella pneumoniae, Xanthomonas campestris* and *Lactobacillus delbrueckii*, are known to produce exopolysaccharides that are excreted into the culture medium. These bacteria are expected to convert exogenous lipophilic food ingredients in their glycosides soluble in water. In tocopherols, for example, this characteristic reaction (glycosylation), has converted the α- and δ-tocopherols by two biocatalysts glycosides tocopheryl, thus improving bioavailability and pharmacological properties as food additives with an effective antiallergic activity [371, 372].

3.2. Limits of Experiments Interpretation

The diversity and complexity of biocompounactives, alone, make the study of all these compounds and understanding their mechanisms of action a very difficult mission. While many critics emerge to highlight, and draw attention to, some details relating to the study of bioactive compounds.

Indeed, there are important limitations that must be considered before interpreting an experiment to prove the effectiveness of a product. Traka M.H. and Mithen R.F. (2011); underlining the need for human intervention studies to provide high quality data for health of bioactive components; have criticized the data types used to support activities of some phytochemicals that promote health, including limits of observational and epidemiological studies, and research through the use of cell lines and animal models [361].

So, the major problem for evaluating the biological activity is that these studies present many challenges in the interpretation and extrapolation to humans. But despite all these challenges, various studies have very important benefits, and that is what we will discuss in the third and the last part of this review, as already promised in our first study about this approach [3].

In all cases, significant efforts are needed to increase the number of clinical studies are still limited, and therefore, provide compelling evidence of the benefits of bioactive compounds in humans [373].

4. Conclusion

All scientific studies confirm that a varied and balanced diet, with minimal physical activity, is factor of protection against cancer, cardiovascular disease, osteoporosis, diabetes, obesity and high cholesterol. True that these diseases do not depend exclusively on food, they are also influenced by genetic factors, but if we cannot choose our ancestors, we can choose our food and organize our lifestyle [3, 374]!

In the first part of this review, we have presented opportunities that contain some most common vegetables and legumes, with discussion of challenges relating to (i) radical reversal dietary habits and how to provide science to the public, (ii) methods of food processing that may affect the content, activity and bioavailability of biocompounactives in foods, and (iii) allergic reactions of some food-borne phytochemicals that are responsible for a variety of symptoms and disorders in human body [3].

In this review (part 2) we focused on studies that have been conducted on biocompounactives of common fruits, and opportunities that present bioactivity of these phytochemicals to prevent many chronic diseases. As well, emphasis is placed on some challenges that face the good investissment of biocompounactives, especially bioavailability and bioefficacy; with discussion of some improvement approaches for these factors, like (i) molecular modeling, (ii) nanotechnologies and (iii) biocatalysts.

In the third, and last part of this study, we continue on preventive approach of biocompounactives that contain cereals and some foods of animal origin, with discussion of other opportunities and challenges facing this approach, especially those concerning the revelation of bioactivities using observational and epidemiological studies, and research through the use of cell lines and animal models as mentioned above.

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