

THE ROLE OF PHYTOCHEMICALS IN GOOD HEALTH

¹ Dorcas Olajoju OBISESAN ²Ekemini E. UKO-AVIOMOH

¹Home Economics Department School of Secondary Education,
Vocational and Technical Programmes

Federal College of Education (Special) Oyo, Oyo State, Nigeria
Obisesandorcas@Gmail.Com. 08137221902

²Department of Vocational and Technical Education, Faculty of Education,
University of Benin, Benin City Edo State, Nigeria.
08056650906

Abstract

The study examines the role of phytochemicals in good health. Phytochemicals are chemicals of plant origin. They are generally regarded as research compounds rather than essential nutrients because proof of their possible health effects has not been established yet. Naturally occurring compounds, known as phytochemicals are thought to be largely responsible for the protective health benefits of these plant-based foods and beverages. Conclusively plant-based foods are complex mixtures of bioactive compounds; information on the potential health effects of individuals, phytochemicals is linked to information on the health effects of foods that contain those phytochemicals. It is recommended that prolong cooking of fruits and vegetables should be avoided which destroy the phytochemical present in the food.

Keywords: Role, Phytochemicals, Good Health.

Introduction

Phytochemicals are chemical compounds produced by plants, generally to help them resist fungi, bacteria and plant virus infections, and also consumption by insects and other animals. The name comes from Greek word (phyton) 'plant'. Some phytochemicals have been used as poisons and others as traditional medicine such as red, blue, and purple colors of berries derive mainly from polyphenol phytochemicals called anthocyanins. Cucurbita fruits, including squash and pumpkin, typically have high content of the phytochemical pigments called carotenoids. As a term, phytochemicals is generally used to describe plant compounds that are under research with unestablished effects on health and are not scientifically defined as essential nutrients. Regulatory agencies governing food labeling in Europe and the United States have provided guidance for industry limiting or preventing health claims about phytochemicals on food product or nutrition labels (Sclbert, Johnson and Satlmarsh 2005).

The Concept of Phytochemicals

Phytochemicals are chemicals of plant origin. Phytochemicals (from Greek phyto, meaning "plant") are chemicals produced by plants through primary or secondary metabolism. They generally have biological activity in the plant host and play a role in plant growth or defense against competitors, pathogens, or predators. Phytochemicals generally are regarded as research compounds rather than essential nutrients. Phytochemicals under research can be classified into major categories, such as carotenoids and polyphenols, which include phenolic acids, flavonoids, and stilbenes/lignans. Flavonoids can be further divided into groups based on their similar chemical structure, such as anthocyanins, flavones, flavanones, and isoflavones, and flavanols. Flavanols further are classified as catechins, epicatechins, and proanthocyanidins. In total, there has been over 25,000 phytochemicals discovered and in most cases, these phytochemicals are concentrated in colourful parts of the plants like fruits, vegetables, nuts, legumes, and whole grains, and so many other (Kris 2021).

Phytochemists study phytochemicals by first extracting and isolating compounds from the original plant, followed by defining their structure or testing in laboratory model systems, such as cell cultures, in vitro experiments, or in vivo studies using laboratory animals. Challenges in that field include isolating specific compounds and determining their structures, which are often complex, and identifying what specific phytochemical is primarily responsible for any given biological activity. Without specific knowledge of their cellular actions or mechanisms, phytochemicals have been used as poison and in traditional medicine. Salicin for example with anti-inflammatory and pain-relieving properties, was originally extracted from the bark of the white willow tree and later synthetically produced to become the common, over-the-counter drug, aspirin. The tropane alkaloids of *Atropa belladonna* were used as poisons, and early humans made poisonous arrows from the plant.

In Ancient Rome, it was used as a poison by Agrippina the Younger, wife of Emperor Claudius on advice of Locusta, a lady specialized in poisons, and Livia, who is rumored to have used it to kill her husband Emperor Augustus. (Kris 2021) The English yew tree was long known to be extremely and immediately toxic to animals that grazed on its leaves or children who ate its berries. However, in 1971, paclitaxel was isolated from it, subsequently becoming an important cancer drug. As of 2017, the biological activities for most phytochemicals are unknown or poorly understood, in isolation or as part of foods. Phytochemicals with established roles in the body are classified as essential nutrient. (Webb 2013). The phytochemical category includes compounds recognized as essential

Phytochemicals Role in Good Health

Studies suggest that consuming foods and beverages rich in these compounds may help prevent disease. Much of early medicine relied on the prescription of specific plants and herbs for healing, a practice still supported by contemporary research. One of the principle recommendations from the 2010 Dietary Guidelines is to eat more fruits, vegetables, and whole grains by having fruits and vegetables represent one-half of the food on the plate and making whole grains account for one-half of the recommended six or more daily servings of grains (Webb 2013). That recommendation was developed based on several population studies suggesting diets rich in fruits, vegetables, and whole grains may offer some degree of protection against cancer, cardiovascular disease, type 2 diabetes, and neurodegeneration. 2-5. Consumption of tea, wine, and cocoa, which also are plant based (tea comes from the dried leaves of the *Camellia sinensis* bush, wine from grapes, and cocoa from the dried and fermented seed of the *Theobroma cacao* tree), has been associated with reduced risk of these diseases as well. 6- (Kris 2021).

Naturally occurring compounds, known as phytochemicals (phyto means plant in Greek) are thought to be largely responsible for the protective health benefits of these plant-based foods and beverages, beyond those conferred by their vitamin and mineral contents. These phytochemicals, which are part of a large and varied group of chemical compounds, also are responsible for the color, flavor, and odor of plant foods, such as blueberries' dark hue, broccoli's bitter taste, and garlic's pungent odor. Research strongly suggests that consuming foods rich in phytochemicals provides health benefits, but not enough information exists to make specific recommendations for phytochemical intake. (Bauer, Johnson, Beebe-Dimmer 2012).

Phytochemicals, also referred to as phytonutrients, are found in fruits, vegetables, whole grains, legumes, beans, herbs, spices, nuts, and seeds and are classified according to their chemical structures and functional properties. The terminology used to describe phytochemicals (flavonoids, flavonols, flavanols, proanthocyanidins, procyanidins) can be confusing. Phytochemicals include compounds such as salicylates, phytosterols, saponins, glucosinolates, polyphenols, protease inhibitors, monoterpenes, phytoestrogens, sulphides, terpenes, lectins, and many more. The Phytochemical Family Tree shows the major groups of phytochemicals found in foods. Tens of thousands of phytochemicals have been identified, and researchers speculate that there are likely many more they haven't yet discovered in the foods we eat. Though the broadest groups of phytochemicals, such as flavonoids, isoflavones, or anthocyanidins, often are referred to as if they were a homogenous group, the individual compounds within each group have different chemical

structures, are metabolized differently by the body, and may have different health effects. Flavonoids are the largest, most varied, and most phytochemicals (Uzzo, Brown, & Horwitz, 2004).

How Phytochemicals Work

There are many phytochemicals and each works differently. These are some possible actions:

- Antioxidant - Most phytochemicals have antioxidant activity and protect our cells against oxidative damage and reduce the risk of developing certain types of cancer. Phytochemicals with antioxidant activity include; allyl sulfides (onions, leeks, garlic), carotenoids (fruits, carrots), flavonoids (fruits, vegetables), polyphenols (tea, grapes).
- Hormonal action - Isoflavones, found in soy, imitate human estrogens and help to reduce menopausal symptoms and osteoporosis.
- Stimulation of enzymes - Indoles, which are found in cabbages, stimulate enzymes that make the estrogen less effective and could reduce the risk for breast cancer. Other phytochemicals, which interfere with enzymes, are protease inhibitors (soy and beans), terpenes (citrus fruits and cherries).
- Interference with DNA replication - Saponins found in beans interfere with the replication of cell DNA, thereby preventing the multiplication of cancer cells. Capsaicin, found in hot peppers, protects DNA from carcinogens.
- Anti-bacterial effect - The phytochemical allicin from garlic has anti-bacterial properties.
- Physical action - Some phytochemicals bind physically to cell walls thereby preventing the adhesion of pathogens to human cell walls. Proanthocyanidins are responsible for the anti-adhesion properties of cranberry. Consumption of cranberries can reduce the risk of urinary tract infections and will improve dental health. (Thomas, Williams, & Bellamy (2014)

How Do We Get Enough Phytochemicals.

Foods containing phytochemicals are already part of our daily diet. In fact, most foods contain phytochemicals except for some refined foods such as sugar or alcohol. Some foods, such as whole grains, vegetables, beans, fruits and herbs, contain many phytochemicals. The easiest way to get more phytochemicals is to eat more fruit (blueberries, cranberries, cherries, apple) and vegetables (cauliflower, cabbage, carrots, broccoli). It is recommended take daily at least 5 to 9 servings of fruits or vegetable. Fruits and vegetables are also rich in minerals, vitamins and fibre and low in saturated fat.

Future of Phytochemicals

Phytochemicals are naturally present in many foods but it is expected that through bioengineering new plants will be developed, which will contain higher levels. This would make it easier to incorporate enough phytochemicals with our food. The known phytochemical containing foods should be planted on a larger scale to increase the supply of phytochemicals to humans for healthy living.

Phytochemicals for Health Living

Phytochemicals are natural compounds found in plants that are responsible for the colour, taste and aroma of foods. As well as these pleasant attributes, they protect us from environmental and ingested carcinogens by arming antioxidant enzymes and enhancing DNA repair pathways. They also have direct effects on the fundamental hallmarks of cancer progression and metastasis. It is not a surprise then that the World Cancer Research Fund and other academic bodies report that individuals eating phytochemical-rich foods have a lower risk of cancer or relapse after treatments. (Voorrips, Goldbohm, Van, & Poppel 2000).

Groups of Phytochemicals

There are three major groups of phytochemicals namely:

1. Polyphenols – sub categorised as the flavonoids, phenolic acids and other non-flavonoid polyphenols

* Flavonols: quercetin, kaempferol (onions, kale, leeks, broccoli, buckwheat, red grapes, tea, apples)

* Flavones: apigenin, luteolin (celery, herbs, parsley, chamomile, rooibos tea, capsicum pepper)

* Isoflavones: genistein, daidzein, glycitein (soya, beans, chick peas, alfalfa, peanuts)

* Flavanones: naringenin, hesperitin (citrus fruit)

* Anthocyanidins (red grapes, blueberries, cherries, strawberries, blackberries, raspberries, tea)

* Flavan-3-ols (tannins): catechins, epicatechin, epigallocatechingallate (tea, chocolate, grapes)

* Flavanolols: silymarin, silibinin, aromadedin (milk thistle, red onions)

* Dihydrochalcones: phloridzin, aspalathin (apples, rooibos tea)

Phenolic acids: These include:

* Hydrobenzoic acids: gallic acid, ellagic acid, vanillic acid (rhubarb, grape seed, raspberries, blackberries, pomegranate, vanilla, tea)

* Hydroxycinnamic acids: ferulic acid, P-coumaric acid, caffeic acid, sinapic acid (wheat bran, cinnamon, coffee, kiwi fruit, plums, blueberries)

Other non-flavonoid polyphenols: These include:

* Other tannins (cereals, fruits, berries, beans, nuts, wine, cocoa)

* Curcuminoids: curcumin (turmeric)

* Stilbenes: cinnamic acid, resveratrol (grapes, wine, blueberries, peanuts, raspberries)

* Lignans: secoisolariciresinol, enterolactone, sesamin (grains, flaxseed, sesame seeds)

2. Terpenoids – These are sub categorised as the carotenoids and non-carotenoid terpenoids

Carotenoid terpenoids:

* Alpha, beta and gamma carotene (sweet potato, carrots, pumpkin, kale)

* Lutein (corn, eggs, kale, spinach, red pepper, pumpkin, oranges, rhubarb, plum, mango, papaya)

* Zeaxanthin (corn, eggs, kale, spinach, red pepper, pumpkin, oranges)

* Lycopene (tomatoes watermelon, pink grapefruit, guava, papaya)

* Astaxanthin (salmon, shrimp, krill, crab)

Non-carotenoid terpenoids:

* Saponins (chickpeas, soya beans)

* Limonene (the rind of citrus fruits)

*Perillyl Alcohol (cherries, caraway seeds, mint)

*Phytosterols: natural cholesterol, sitosterol, stigmasterol, campesterol (vegetable oils, cereal grains, nuts, shoots, seeds and their oils, whole grains, legumes)

*Ursolic acid: (apples, cranberries, prunes, peppermint, oregano, thyme)

*Ginkgolide and bilobalide (Ginkgo biloba)

3. Thiols – includes the glucosinolates, allylic sulfides and non-sulfur containing indoles

Glucosinolates include isothiocyanates (sulforaphane) and dithiolthiones (cruciferous vegetables such as broccoli, asparagus, Brussels sprouts, cauliflower, horseradish, radish and mustard)

Allylic sulfides such as allicin and S-allyl cysteine (garlic, leeks, onions)

Indoles such as indole-3-carbinol (broccoli, Brussels sprouts)

Other phytochemical groups, which although have some properties within these groups, have been classified within a miscellaneous category, including betaines (beetroot), chlorophylls (green leafy vegetables), capsaicin (chilli) and piperine (black peppers)

Importance of Phytochemicals

The health benefits of phytochemical-rich foods or concentrated nutritional supplements are often being highlighted in the medical and popular media, and hence they are an increasing topic of conversation between medical practitioners and their patients, especially those with cancer who have a particular interest in over-the-counter self-help strategies 2, 3. There is increasingly convincing evidence to show that plant phytochemicals, particularly polyphenols, have significant benefits for humans, such as reducing our risk of cancer and helping people living with and beyond treatments. Living well programmes, slowly being introduced in the UK, are beginning to highlight the importance of phytochemical-rich diets, as well as other lifestyle factors, largely being driven by the National Survivorship Initiative and guidelines from influential organisations such as the American Society of Clinical Oncology (ASCO)

Going a step further and concentrating these foods, or extracted elements of these foods, into nutritional supplements gives an opportunity to boost their beneficial anti-cancer effects, but have their pitfalls. Studies of concentrated minerals, vitamins and phytoestrogenic supplements have reported detrimental effects. No study has reported detrimental effects of whole, non-phytoestrogenic food supplements and some have reported significant advantages. (Thomas, Willam & Bellamy 2014). Despite these potential benefits and reports that over 60% of patients living with and beyond cancer take nutritional supplements, oncologists have been reluctant to discuss their pros and cons due to lack of randomised controlled trials from academic institutions. Hopefully this trend will change, particularly following the success of the study and ongoing studies registered with the National Cancer Institute.

Conclusion

Phytochemicals in general, in the strictest sense, are chemicals produced by plants. However, the term is generally used to describe chemicals from plants that may affect health but are not essential nutrients. Meanwhile there is ample evidence to support the health benefits of diets rich in fruit, vegetables, legumes, whole grains and nuts, evidence that these effects are due to specific nutrients or phytochemicals is limited because plant based foods are complex mixtures of bioactive compounds, information on the potential health effects of individual phytochemicals is linked to information on the health effects of foods that contain those phytochemicals

Recommendations

1. There should be more emphasis on health talks or nutrition educational programme for the populace on the role of phytochemicals in good health.
2. Meal planning should be majorly based on natural food which is plant origin rather than processed food or product which has no good benefit rather high risk of people with cancer, cardiovascular disease or diet related diseases.
3. Prolong cooking of fruits and vegetables should be avoided which destroy the phytochemicals present in the food.

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