CITRUS A POTENTIAL PHYTONUTRIENT-A REVIEW

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Abstract

Citrus trees grown throughout the world for their refreshing juice and health benefits. The numerous pytonutrients, health benefits of citrus fruits are linked to the high amounts of photochemical and bioactive compounds such as flavonoids, carotenoids, vitamins and minerals. These phytonutrients act asan antioxidants, stimulate the immune systems and block the damage of the genetic materials. The phytonutrients the utilization of these bioactive rich citrus residues can provide an efficient, inexpensive, and environment friendly platform for the production of novel nutraceuticals.

***Keywords**: Citrus, phytonutriets, micronutrients and macro nutrients.*

Introduction

Citrus is one of the major fruit crops covering significant agricultural areas globally. Citrus fruits processing accounts for approximately one third of total citrus fruit production, more than 80% of it is orange processing, mostly for orange juice production. citrus categoried into types: sweet oranges (most are C. sinensis but also includes blood and acidless oranges), mandarins (such as Satsuma (C. unshi), tangerines (C. tangerina, and reticulata), and clementines (C. clementine)), sour/bitter oranges (such as Seville, C. aurantium), lemons (C. limon), limes (C. aurantifolia and latifolia), grapefruit (C. paradisi) and pummelos (C. grandis), hybrids (e.g., tangelos, tangors, and limequats), and citrons (C. medica, which has a rind that is used primarily for confectionary and is only commercially grown in limited areas). Citrus fruits are rich in various nutrients, such as vitamins A and C, folic acid and dietary fiber and a source of bioactive compounds, as flavonoids, coumarins, limonoids and carotenoid.Fruits as a class are valuable chiefly for their content of essential minerals. Minerals are inorganic substances required by the organism in very small amount for maintenance of vital processes essential for life. At least fourteen minerals are essential for normal functioning of human body processes, each of which has its specific role to play. Fruits are generally low in natural sodium. Fruits are not considered to be the source of calcium but some fruits contain appreciable amount of calcium [5]. Magnesium content of fruits is relatively high. Citrus essential oils are another by-product of citrus fruits used in pharmaceutical industry for the preparation of drugs, soaps, perfumes and other cosmetics as well as for home cleaning products. Phytonutrients in dietetic and therapeutic plays a vital in both; health promotion and disease prevention. The contribution of citrus species in deterrence of life threatening diseases have been assessed and it has been reported that citrus fruits, citrus fruit extracts and citrus flavonoids exhibit a wide range of promising biological properties due to their phenolic profile and antioxidant properties.

Phyto Nutrients in Citrus (Macro and Micro Nutrients)

Citrus fruits are ready to be consumed and processed upon harvesting with no further significant change in composition, which are cultivated worldwide, have been recognized as some of the most high-consumption fruits in terms of energy, nutrients and health supplements. *Citrus* fruits are abundant in other macronutrients, including sugars, dietary fiber, potassium, folate, calcium, thiamin, niacin, vitamin B6, phosphorus, magnesium, copper, riboflavin and pantothenic acid.Citrus fruit composition varies significantly due to fluctuating effects horticultural conditions, and climate.

Macro Nutrients

The soluble portion of citrus largely contains mono- and disaccharide. Sucrose, glucose, and fructose the key to sweetners of the citrus The main fiber in citrus is pectin, a soluble fiber, which makes up 65%–70% of the total fiber content. Pectin reduce blood cholesterol levels by decreasing its re-absorption in the colon by binding to bile acids in the colon. Seeds of citrus fruits have higher amounts of protein. Amino acids in citrus juices, arginine is the only semi essential amino acid that exists in relatively detectable amounts. Free amino acids contribute nitrogen values in all citrus varieties The ionic polar consist of phospholipids, that represent almost 50% of the total juice lipid content. They are primarily found in seeds and rinds, although they can also be found in the flesh in small quantities. The oil yielded from the fruits, rinds, flowers and a seed of various Citrus species is used in confectionary and perfumery industry.

Micronutrients

The phytochemical composition Vitamin C, folic acid, potassium and pectin in Citrus contributes in health promotion and it has been recognized citrus species exhibit promising biological properties including antiatherogenic, anti-inflammatory, antitumor activity, anticlotting and strong antioxidant activity. Citrus fruits' peels contain significant amount of phenolic compounds, especially phenolic acids and flavonoids. Polyphenols present in oranges prevents viral infections and skin infections. Phytophenols provide effective means for preventing and treating free radical-mediated diseases such as cancer, diabetes, neurodegenerative diseases, process of ageing and cardiovascular dysfunctions by scavenging free radicals and quenching ROS. In addition, many of the antioxidants found in citrus plants exhibit a wide range of biological effects, including antibacterial, antiviral, anti-inflammatory, antiallergic, antithrombotic and vasodilatory actions.The citrus fruits and their products in general are a complex source of carotenoid pigments, with the largest number of them reported for any fruit.Mandarin varieties, such as Satsuma mandarin (Citrus unshiu Marc.), accumulated ß-cryptoxanthin predominantly in the flavedo as well as juice sacs in mature fruit but in mature sweet orange (Citrus sinensis Osbeck) accumulated violaxanthin isomers. Flavonoids in citrus rinds are represented by two classes of compounds referred to as flavanone glycosides (FGs), polymethoxylated flavones. The citrus flavonoids have been found to have a health-related property, which include anticancer, antiviral and antiinflammatory activities, reduce capillary fragility, and restricts human platelet aggregation.Citrus fruits are good sources of minerals. Orange juice provides approximately 235 mg and 500 mg of potassium. Potassium is an essential mineral that works to maintain the body's water and acid balance. Citrus species are known for unique limonoids. Limonin in Citrus juice contribute to the cholesterol lowering effect. Limonoids are secondary metabolites in all Citrus fruits tissue and occur as either limonoidaglycones or limonoid glycosides.

Citrus limonoids (Limonin, nomilin and obacunone) in seeds of Citruslimon showed antifeedent activity against Spodopetrafrugiperda thus confirming their probable role as chemical defense agents in Citrusherbivore interactions.Nomilin as an agent having anti-obesity and anti-hyperglycemic effects that are likely to be mediated through the activation of TGR-591limonin and nomilin in plant products is a significant indicator of the pest control.

The high concentration of vitamin C (ascorbic acid) is probably the most significant contribution of citrus fruits to human health and nutrition. Vitamin C is also involved in the immune system by stimulating white blood cell function.200 mg/day of vitamin C may be optimal for maximum health benefits, and citrus may be the best food source for increasing vitamin C intake. Vitamin C is also involved in the immune system by stimulating white blood cell function. Vitamin C can help reduce the risk of pre-eclampsia during pregnancy, and in some studies vitamin C has been shown to lessen the severity and duration of cold symptoms.

Citrus fruits also provide vitamin B complex, in particular thiamin (vitamin B_1) and pyridoxal phosphate (vitamin B_6). Folic acid, a pteroyl-glutamic acid, or folate as the naturally occurring form in citrus, is another water-soluble B vitamin which acts as an essential coenzyme involved in many important biological functions such as synthesis, repair, and methylation of DNA; cell division and growth; and metabolism of homocysteine. Citrus fruits and juice are natural sources of folate, and orange juice contains higher concentrations of folate than other commonly consumed fruit juices. Citrus fruit have antioxidant and antimutagenic properties and positive

associations with bone, cardiovascular, and immune system health. The worldwide importance of citrus, both on the fresh and processed markets, is in constant rising mainly due to their preferred flavor and important role in human health.

Conclusion

Citrus plants are known to possess beneficial biological activity and consumption has a considerable potential for their nutrients and chemotherapeutic medicine to promote health. The multiple secondary metabolites in *Citrus*, including flavonoids, alkaloids, coumarins, limonoids, carotenoids, phenolic acids and volatile compounds, provide a rational basis for various biological activities. This review on citrus depicts the occurrence of secondary metabolites and its bioactivities related to human health.

References

1. Anagnostopoulou, M.A., Kefalas, P., Papageorgiou, V.P., Assimopoulou, A.N., Boskou, D., (2006), "Radical scavenging activity of various extracts and fractions of sweet orange flavedo (Citrus sinensis)", Food Chem. 94, pp. 19–25.
2. Asp NG, Johansson CG. *(*1981*),* "Techniques for measuring dietary fiber", *In:* JamesWPT, TheanderO, *editors,* "The analysis of dietary fiber in food", *New York: Marcel Dekker. pp.* 173-89.
3. Attaway JA, Barron RW, Blair JG, Buslig BS, Carter RD, Dougherty MH, Fellers PJ, Fisher JF, Hill EC, Huggart RL, Maraulja MD, Petrus DR, Ting SV, Rouse AH., *(*1972*),* "Some new analytical indicators of processed orange juice quality" ProcFla State HortSoc 85, *pp.*192-203.
4. Bartholomew ET, Sinclair WB. *(*1952*), "The* lemon fruit" *Berkeley, CA: University of California, Berkeley.*
5. Benavente-Garcia, O., Castillo, J., Francisco, R., Ana-Ortuno, M., Delrio, J., (1997), "Uses and properties of citrus flavonoids", J. Agric.Food Chem, 45, pp. 4505–4515.
6. Benk E. *(*1965*),* "Content of inorganic materials, especially sodium, in natural orange juice", Mitt Geb Lebensmittelunters Hyg, 56*: pp.*273-81.
7. Benk E. *(*1975*),* "The concentration of various nitrogen compounds in grapefruit juice and lemon juice", Mineralbrunnen 25*: pp.* 80-2.
8. Boynes, J.W., (1991), "Role of oxidative stress in the development of complication in diabetes", Diabetes 40, pp. 405–411.
9. Codoñer-Franch, P.; Valls-Bellés, V. (2010), "Citrus as Functional foods", Curr. T. Nutraceut. Res.8, pp. 173–183.
10. Contenton I., (1995), "The effectiveness of nutrition education and implications for nutrition education, policy, programs, and research: a review of research", J. Nutr. Educ., 27, pp. 277-418.
11. Cook, N.C., Sammon, S., (1996) "Flavanoids chemistry, metabolism, cardioprotective effects, and dietary sources", Nutr.Biochem.7, pp. 66– 76.
12. Ding, X., Fan, S., Lu, Y., Zhang, Y., Gu, M., Zhang, L., (2012), "Citrus ichangensispeel extract exhibits anti-metabolic disorder effects by the inhibition of PPARgand LXR signaling in high-fat diet-induced C57BL/6 mouse", Evidence-BasedComplementary and Alternative Medicine, 10.
13. Fenech M, Aitken C, Rinaldi J. (1998), "Folate, vitamin B12, homocysteine status and DNA damage in young Australian adults", Carcinogenesis19, pp. 1163–71.
14. Ferguson LR, Harris PJ. *(*1996*),* "Studies on the role of specific dietary fibers in protection against colorectal cancer", Mutat Res350, *pp.* 173-84.
15. Goodner, K.L., R.L. Rouseff and H.J. Hofsommer (2001), "Orange, man-darin, and hybrid classification using multivariate statistics based on carotenoid profiles", J. Agric. Food Chem. 49, pp. 1146–1150.
16. Gorinstein, S., Cvikrova, M., Machackova, I., Haruenkit, R., Park, Y. S., Jung, S.T., Yamamoto, K., Ayala, A.L.M., Katrich, E., Trakhtenberg, S., (2004), "Characterization of antioxidant compounds in Jaffa sweeties and white grapefruits", Food Chem. 84, pp. 503–510.
17. Gross J (1987), "Pigments in fruits", Academic Press, London.
18. Guimara˜es, R., Barros, L., Barreira, J.C.M., Sousa, M.J., Carvalho, A.M., Ferreira, I.C.F.R., (2009), "Targeting excessive free radicals with peels and juices of citrus fruits: grapefruit, lemon, lime and orange", Food Chem. Toxicol. 48 (1), pp. 99–106.
19. Harding PL. (1947), "Quality in citrus fruits: seasonal changes in relation to consumer acceptance of oranges, grapefruit, temple oranges and tangerines", Proc Am SocHortSci 49, pp.107–15.
20. Heird WC. *(1998)* "Amino acids in pediatric and neonatal nutrition", CurrOpinClinNutrMetab Care, Jan;1(1), pp. 73-8.
21. Hensley, K., Floyd, R.A., (2002), "Reactive oxygen species and protein oxidation in aging: a look back, a look ahead", Arch. Biochem. Biophys, 397, pp. 377–383.
22. Hercberg S, Galan P, Preziosi P, Bertrais S, Mennen L, Malvy D, (2004), "The SU.VI.MAX Study: a randomized, placebo-controlled trial of the health effects of antioxidant vitamins and minerals", Arch Intern Med ,164, pp. 2335-42.

23. Hill EC, Attaway JA, Streiff RR. (1971), "Folic acid—an essential vitamin present in citrus fruit", Proc Fla State Hortic Soc 84, pp. 238–41.
24. Hool, L.C., (2006), "Reactive oxygen species in cardiac signaling: from mitochondria to plasma membrane ion channels", Clin. Exp. Pharmacol. Physiol. 33, pp. 146–151.
25. Hua, Z.L., Yahong, Y., Yansong, G.P., (1986) Sepu 4 (1–2), 74–80. Mahmud, S., Akbar, S., Sattar, A., (2001), Pak. J. Sci. Ind. Res. 40 (2), pp. 93–95.
26. Huang, R.P., Golard, A., Hossain, M.Z., Huang, R., Liu, Y.G., Boynton, A.L., (2001), "Hydrogen peroxide promotes transformation of rat liver non-neoplastic epithelial cells through activation of epidermal growth factor receptor", Mol. Carninog. 30, pp.209–217.
27. Huet, R., (1982), "Constituants des agrumesa 'effetpharmacodynamique: 1982.
28. Les citroflavonoides (Constituents of citrus fruits with pharmacodynamic effect: citroflavonoids)", Fruits. 37, pp. 267–271.
29. Ikoma, Y., A. Komatsu, M. Kita, K. Ogawa, M. Omura, M. Yano and T. Moriguchi (2001), "Expression of a phytoene synthase gene and characteristic carotenoid accumulation during citrus fruit development", Physiol. Plant. 111, pp. 232–238.
30. *Imura* K, *Okada* A. (*1998*), "Amino acid metabolism in pediatric patients", Nutrition. 14(1), pp. 143-8.
31. J. F. *Kefford, B.* V. *Chandler, (1970), "*The Chemical Constituents of Citrus Fruits", Advances in food research, Volume 2, Publisher, Academic Press.
32. Kamen B. (1997), "Folate and antifolate pharmacology", Semin Oncol 24 (suppl 18):S18–30–S18–39.
33. King, CG, Waugh, WA. The chemical nature of vitamin C. Science 1932; 75:357-358.
34. Lee, H.S. and W.S. Castle (2001), "Seasonal changes of carotenoid pigments and color in Hamlin, Earlygold, and Budd Blood orange juices", J. Agric. Food Chem. 49, pp. 877–882.
35. Middleton, E., Kandaswami, C., (1994), "Potential health-promotingproperties of Citrus flavonoids", Food Technology 11, pp.115–119.
36. Middleton, E., Kandaswami, C., (1994), "Potential health-promoting properties of citrus flavonoids", Food Technol. 48, pp. 115–119.
37. Molnár, P. and J. Szabolcs (1980), "ß-Citraurin epoxide, a new carotenoid from Valencia orange peel" Phytochemistry 19, pp. 633–637.
38. Montanari, A., Chen, J., Widmer, W., (1998), "Citrus flavonoids: a review of past biological activity against disease", In: Manthey, J.A., Buslig, B.S. (Eds.), Flavonoids in the Living System. Plenum Press, New York, pp. 103–113.
39. Nagy S., and Norby H E., (1971), "Distribution of free and conjugated sterols in orange and tangor juice sacs", Lipids, vol: 6; pp.826-830.
40. Nagy S. (1980*), "*Vitamin C contents of citrus fruit and their products: a review*",* J Agric Food Chem28, *pp.* 8-18.
41. Perry, G., Raine, K.A., Nunomura, A., Watayc, T., Sayre, L.M., Smith, M.A., (2000), "How important is oxidative damage? Lessons form Alzheimer's disease", Free Radic. Biol. Med. 28, pp. 831–834.
42. Proteggente, A.R., Saija, A., De Pasquale, A., Rice-Evans, C.A., (2003), "The compositional characterisation and antioxidant activity offresh juices from Sicilian sweet orange (Citrus sinensisL. Osbeck) varieties", Free Radic. Res. 37, pp. 681–687.
43. Proteggente, A.R., Saija, A., De Pasquale, A., Rice-Evans, C.A., (2003), "The compositional characterisation and antioxidant activity of fresh juices from Sicilian sweet orange (Citrus sinensis L. Osbeck) varieties", Free Radic. Res. 37, pp. 681–687.
44. Samman, S., Lyons Wall, P.M., Cook, N.C., (1998), "Flavonoids and coronary heart disease: dietary perspectives", In: Rice-Evans, C.A., Packer, L. (Eds.), Flavonoids in Health and Disease. Marcel Dekker, New York, pp. 469–482.
45. Sawalha SMS, Arráez-Román D, Segura-Carretero A (2009), "Quantification of main phenolic compounds in sweet and bitter orange peel using CE–MS/MS", Food Chem 116, pp. 567–574.
46. Svirbely J, Szent-Györgyi A. Hexuronic acid as the antiscorbutic factor. Nature 1932; 129: 576.
47. Ting SV. (1980), "Nutrients and nutrition of citrus fruits" In: Nagy S, Attaway JA, editors. Citrus Nutrition and Quality. Washington, D.C.: American Chemical Society. pp.3-24.
48. Tsuda, H., Ohshima, Y., Nomoto, H. et al. (2004), "Cancer prevention by natural compounds, Drug Metabolism and Pharmacokinetics", vol.19, no. 44, pp. 245–263.
49. Walton, B. S., Bartholomew, E. T., Ramsey, R. C. (1945), "Analysis of the organic acids of orange juice", Plant Physiolvol., 20 no. 1, pp. 3–18.
50. Whitney, E. & Rolfes, S. (1999), "Understanding nutrition", Belmont, Ca., USA, West/Wadsworth. Eighth ed. (ed. W. Rolfes).
51. Zamorani A, Russo C, Lanza CM, CataldiLupo MC. *(*1973), *"*Research on nitrogen compounds in citrus fruits", III. Free amino acids in the juice of clementines. EssenzeDerivAgrum43, *pp.* 217-28.