Nutraceutical insight into fruits, vegetables and their metabolite potential for nutrition mediated healthcare

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Vegetables and fruits or horticultural crops in general represent the best examples of edible plant harvest having functional food properties with a potential to develop nutritional ingredients or supplements. The perception of horticultural crops and products only as food, pulps and juices in various forms is now changing with developments in nutrition research. The chemistry of horticultural crops including edible and non-edible plant biomass is gaining importance for their metabolome capabilities to compete with conventional medicinal plants constituents for preventive health care (*Khanuja & Shukla, 2011*[1]). Among fruits, berries are the most common. True types represent the fleshy fruit produced from a single ovary called bacciferous berries. Many other fruits are classified as epigynous berries. These include diverse examples including bananas, cranberries and blueberries, and the cucurbitaceous species like cucumbers, melons and squash. Therefore, the berries whether bacciferous (true berry) or epigynous ((False berry), represent a huge diversity and metabolic potential to be used in or as functional foods. Important case examples are grape (*Vitis vinifera*), watermelon (*Citrullus lanatus*), banana (*Musa spp.*) and tomato (*Solanum lycopersicum*).

Other fruits and vegetables with nutraceutical potential and secondary metabolite rich genomes include carrot (*Daucus carota*), bael (*Aegle marmelos*), pomegranate (*Punica granatum*), ginger (*Zingiber officinale*), vanilla (*Vanilla planifolia*), capsicum / chilli (*Capsicum annuum*), amla / Indian gooseberry (*Phyllanthus emblica*), garlic (*Allium sativum*), broccoli (*Brassica oleracea* var. Italica), cranberry (*Vaccinium* spp.) and **c**itrus fruits like orange (*Citrus sinensis*) and lemon (*Citrus limon*). The list is expanding very fast with research leads emerging across the globe in the nutraceutical and health food sectors including medical foods. Further, metabolomics approach is widening the horizons of the research on horticulture crops. Tomato volatiles present a case example of the power of metabolomics-based research. With these analysis results, among many tomato fruit volatile compounds, only a fraction of these appear to be actually affecting the organoleptic properties of the tomato fruit (*Tikunov et al, 2010*[2])

The metabolome of plants is case example of evolving secondary metabolome and metabolic pathway diversity (*Khanuja et al., 2010*[3]). These tools for small-molecule analysis aided by software innovations have enabled identification and quantification of numerous phytomolecules and the generated metabolomics data provides novel opportunities for comprehending plant metabolism (*Last et al, 2007*[4]). Transcriptome and metabolome analyses have been carried out with tomato microarrays and analytical methods (including proton nuclear magnetic resonance and liquid chromatography-mass spectrometry), respectively for analyzing gene and metabolite regulatory network in early developing tomato fruit tissues (*Mounet et al, 2009*[5]).

Recently published *"Handbook of Fruit and Vegetable Flavors"* by *Hui, 2010*[6] quotes: *"Fruit has been a part of human diet and is an important nutritional source, with high water content (70-85%) and a relatively high amount of carbohydrates but low contents of fat (less than 0.5%) and protein (<3.5%. It usually contains many useful vitamins as well as minerals, dietary fiber and antioxidants (Golf and Klee 2006*[7]*, Knee 2002*[8]*)".* The metabolome of fruits (vegetables included scientifically) thus do make them the base as well as resource of health bioactives for designer functional foods of future.

References

1. Khanuja SPS, Shukla AK (2011) Human health and nutrition: Functional foods. In: *Horticulture to Horti-Business* (Editors: KL Chadha, AK Singh, VB Patel), Proceedings Book of the Fourth Indian Horticulture Congress held at New Delhi during 18-21 November, 2010, Westville Publishing House, New Delhi, pp 433-445.
2. Tikunov YM, de Vos RC, González Paramás AM, Hall RD, Bovy AG, 2010. A role for differential glycoconjugation in the emission of phenylpropanoid volatiles from tomato fruit discovered using a metabolic data fusion approach. *Plant Physiol*. **152**: 55-70.
3. Khanuja SPS, Jhang Tripta, Shasany AK, 2010. Medicinal and aromatic plants: A case example of evolving secondary metabolome and metabolic pathway diversity, In: *Nature at Work – Ongoing Saga of Evolution* (Ed: VP Sharma), National Academy of Sciences, India, Springer (India), New Delhi, 355-358.
4. Last RL, Jones AD, Shachar-Hill Y, 2007. Towards the plant metabolome and beyond. *Nat Rev Mol Cell Biol* **8**: 167-174.

5. Mounet F, Moing A, Garcia V, Petit J, Maucourt M, Deborde C, Bernillon S, Le Gall G, Colquhoun I, Defernez M, Giraudel JL, Rolin D, Rothan C, Lemaire-Chamley M, 2009. Gene and metabolite regulatory network analysis of early developing fruit tissues highlights new candidate genes for the control of tomato fruit composition and development. *Plant Physiol*. **149**: 1505-1528.
6. Hui YH (ed), 2010. *Handbook of Fruit and Vegetable Flavors,* John Wiley & Sons Inc. Hoboken, New Jersey, USA, 1095p.
7. Golf S, Klee J, 2006. Plant volatile compounds: Sensory cues for health and nutritional value? *Science* **311**:815-819
8. Knee M, 2002. *Fruit Quality and its Biological Basis*. Boca Raton, FL:Shaffield Academic Press