



Food processing and effects on bioactive constituents: an opinion piece

Fereidoon Shahidi

Department of Biochemistry, Memorial University of Newfoundland, St. John's, NL, Canada A1B 3X9. E-mail: fshahidi@mun.ca

DOI: 10.31665/JFB.2020.12243

Received: December 29, 2020; Revised received & accepted: December 31, 2020

Citation: Shahidi, F. (2020). Food processing and effects on bioactive constituents: an opinion piece. J. Food Bioact. 12: 1–2.

Abstract

Food processing is an essential unit operation required for production of most food, both industrially and domestically. While, palatability and wholesomeness of food are most important, over processing and inclusion of excessive amount of salt, sugar and solid fat with high content of *trans* isomers must be avoided. Furthermore, while preservatives and additives are essential for safety of products and shelf-life extension, when and where possible natural products with established safety records should be used. The so-called, ultra-processed food (UPF) that may refer to products that do not follow these criteria are often associated with a myriad of diseases, but again here, caution must be exercised to avoid misuse of terminologies that may create misconception.

Keywords: Food processing; Bioactive compounds; Ultra-processing; Junk food; Controversies.

Processing is a unit operation that is often carried out to convert certain raw material intended for use as food. However, pre-processing may often be used to clean, tamper, or to remove husk and shells from raw materials. Conversion of the raw material into food often requires processing that may be thermal or non-thermal. The impact of processing on the products depends further on the degree of processing which may be categorised as minimally processed, regularly processed and ultra processed. Although several systems have been proposed, the NOVA system has received considerable attention and has generated much discussion and controversies. In this system, food is categorized in four groups as unprocessed, processed culinary ingredients, processed, and ultra-processed (UPF). Ultra-processed foods are defined as mass production formulations that contain a high amount of salt, sugar, and oil/fat and may provide insufficient amounts of fibre, micronutrients and bioactive compounds. Such foods are generally energy-dense and designed to be highly palatable and convenient (Monteiro et al., 2018). This system was first proposed by Monteiro and colleagues (2010) who associated such foods with increasing risk of a multitude of non-communicable diseases. This system has been increasingly accepted by some government regulators although has been opposed by some major companies and interest groups. Although one may infer that UPFs are certain types of ready-to-eat products that are rich in salt, sugar, and fat along with a long list of chemical ingredients and preservatives, one should pay attention to the fact that there are

many variations in such foods and while presence of too much salt, sugar and fat, especially trans fat, is not healthful, use of certain additives and preservatives is essential for safety and wholesomeness of food and the elimination of pathogenic microorganisms. Additionally, the modern food chain relies on the transportation of raw materials and finished products across large distances. Therefore, preservatives help prevent contamination and spoilage before foods reach the consumers' table (Carocho et al., 2014). However, uncontrolled use of additives may not necessarily help consumers as they may pose problems of their own as it is the dose that makes the poison. Therefore, search for natural alternatives, when and where possible, must continue. Nonetheless, safety aspects and potential toxicity of natural products must also be carefully examined as natural cannot always be equated with healthful. For example, formation of acrylamide in preparation of French fries may be noted (Mesias et al., 2019). Meanwhile, high level of oxidation products in polyunsaturated oils, if not processed properly, is responsible for off-odors and formation of toxic compounds (Shahidi and Zhong, 2010). However, presence of a minute amount of oxidation products is responsible for the appealing aroma of donuts and French Fries. Therefore, a balance among different factors involved should govern the choice of processing and its level/intensity in the formulation and preparation of food, either industrially or domestically.

In this regard, half-baked solutions should also be avoided. For example, using modified celery juice as an alternative to direct use

of nitrites may lead to products that have more residual nitrite than those prepared directly with nitrites (Sebranek and Bacus, 2007). This sort of manipulation may even be considered unethical by some and both scientists and manufacturers should pay attention to details so that the consumer is not fooled by misuse of terminologies. In addition, food that is subjected to new processing methods using sophisticated technologies, such as high-pressure processing (Huang et al., 2017), should not be included in this category. Minimally processed and whole foods are always preferred if safety aspects are carefully considered as this would have an impact on the retention of healthful bioactive compounds (Ramos et al., 2018). Thus, phenolic compounds may be affected by processing, either due to oxidation or reaction/interaction with other food components, hence may have their efficacy compromised (Randhir et al., 2008). However, heat processing in preparation of tomato paste makes lycopene more bioavailable due to a *trans* to *cis* isomerization in the molecule (Unlu et al., 2007).

In consideration of ultra processed foods, junk food should not necessarily be equated with this type of processing. However, there is much confusion and controversy over the categorization of junk food and definitions obscured by sensational arguments are not helpful. Nonetheless, condemnation of UPF consumption due to its potential association with a number of diseases, especially its relationship with the prevalence of obesity in high-income countries (Lin et al., 2018), has resulted in revisiting of the formulations by multi-national companies and delivery of somewhat better food and beverages to the public. The responsible action of the progressive segment of the food industry has therefore been essential for striving to develop new products that ensure wholesomeness and nutritional value of a safe and sustainable food supply to address the needs of consumers. In this regard, we now witness beverages with reduced sugar content, prepared food with a lower content of salt and inclusion of certain minerals, such as calcium, vitamins (e.g., vitamin C and D), and bioactives such as phytosterols as well as other ingredients and fiber in a variety of forms and in different product formulations, including baked goods (Ambigaipalan and Shahidi, 2015; Ferguson et al., 2019). Air frying instead of deep fat frying and other precautions have also contributed to a healthier food supply but one should always remember that sensory quality of food as reflected in a desirable taste, appealing flavor and texture is essential for providing products that makes eating pleasurable and not just as a source of nutrients.

References

- Ambigaipalan, P., and Shahidi, F. (2015). Date seed flour and hydrolysates affect physicochemical properties of muffin. *Food Biosci.* 12: 54–60.
- Carocho, M., Barreiro, M.F., Morales, P., and Ferreira, I.C. (2014). Adding molecules to food, pros and cons: A review on synthetic and natural food additives. *Comp. Rev. Food Sci.* 13(4): 377–399.
- Ferguson, J.J., Wolska, A., Remaley, A.T., Stojanovski, E., MacDonald-Wicks, L., and Garg, M.L. (2019). Bread enriched with phytosterols with or without curcumin modulates lipoprotein profiles in hypercholesterolaemic individuals. A randomised controlled trial. *Food Funct.* 10(5): 2515–2527.
- Huang, H.W., Wu, S.J., Lu, J.K., Shyu, Y.T., and Wang, C.Y. (2017). Current status and future trends of high-pressure processing in food industry. *Food Control* 72: 1–8.
- Lin, T.K., Teymourian, Y., and Tursini, M.S. (2018). The effect of sugar and processed food imports on the prevalence of overweight and obesity in 172 countries. *Glob. Health* 14(1): 1–14.
- Mesias, M., Delgado-Andrade, C., Holgado, F., and Morales, F.J. (2019). Acrylamide content in French fries prepared in food service establishments. *LWT – Food Sci. Technol.* 100: 83–91.
- Monteiro, C.A., Cannon, G., Moubarac, J.C., Levy, R.B., Louzada, M.L.C., and Jaime, P.C. (2018). The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing. *Public Health Nutr.* 21(1): 5–17.
- Monteiro, C.A., Levy, R.B., Claro, R.M., Castro, I.R.R.D., and Cannon, G. (2010). A new classification of foods based on the extent and purpose of their processing. *Cad. Saude Publica* 26: 2039–2049.
- Ramos, J.A., Furlaneto, K.A., Lundgren, G.A., Mariano-nasser, F.A.D.C., Mendonca, V.Z., Nasser, M.D., and Vieites, R.L. (2018). Stability of bioactive compounds in minimally processed beet according to the cooking methods. *Food Sci. Technol.* 38(4): 643–646.
- Randhir, R., Kwon, Y.I., and Shetty, K. (2008). Effect of thermal processing on phenolics, antioxidant activity and health-relevant functionality of select grain sprouts and seedlings. *Innov. Food Sci. Emerg. Technol.* 9(3): 355–364.
- Sebranek, J.G., and Bacus, J.N. (2007). Cured meat products without direct addition of nitrate or nitrite: what are the issues? *Meat Sci.* 77(1): 136–147.
- Shahidi, F., and Zhong, Y. (2010). Lipid oxidation and improving the oxidative stability. *Chem. Soc. Rev.* 39(11): 4067–4079.
- Unlu, N.Z., Bohn, T., Francis, D.M., Nagaraja, H.N., Clinton, S.K., and Schwartz, S.J. (2007). Lycopene from heat-induced *cis*-isomer-rich tomato sauce is more bioavailable than from all-*trans*-rich tomato sauce in human subjects. *Br. J. Nutr.* 98(1): 140–146.