ABSTRACT

Polyphenols are abundantly found phytochemicals and are an important part of human diet. Phenolic compounds have a wide range of beneficial biological properties. To elucidate the significance of polyphenols in human health, it is essential to know the amount of polyphenols consumed in the diet and their bioavailability. The present research programme was carried out to determine the bioavailability of polyphenols from a few representative foods (finger millet, pearl millet, wheat, sorghum, green gram, chickpea and onion) that provide conventionally abundant amounts of polyphenols. An understanding of polyphenol bioactivity requires a more complete understanding of their intake, bioavailability and metabolism. In this direction, investigation was carried out to study the effects of domestic processing methods (sprouting, roasting, pressure-cooking, open-pan boiling, and microwave-heating) on polyphenol bioavailability, using appropriate in vitro models. Effect of commonly used food acidulants- lime juice and amchur, on the bioaccessibility of polyphenols was also determined. Human intestinal Caco-2 cell line was used as a model for studying the absorption of food derived polyphenols. Finally, bioavailability of polyphenols from a representative cereal grain- finger millet, which is also a rich source of the same was investigated in vivo and also, an attempt was made to enhance the bioavailability of the same using piperine, a known bioavailability enhancer.

Total polyphenol content of wheat, sorghum, finger millet, green gram, chickpea and onion increased on roasting. Not all the phenolic compounds present in them were bioaccessible. Composition of the bioaccessible phenolic compounds varied on domestic processing. Concentration of bioaccessible phenolic compounds increased especially on sprouting and roasting of these cereal grains, except chickpea, as compared to other domestic processing methods. Increased bioaccessibility of specific phenolic acids from finger millet and pearl millet was observed upon addition of food acidulants. Lime juice and amchur increased bioaccessible flavonoids from most of the grains. Bioaccessible flavonoid content increased 2-fold on addition of lime juice and >3-fold on addition of amchur from native chickpea. Presence of food acidulants- lime juice or amchur increased bioaccessible total polyphenols and flavonoids from food grains and onion. Highest absorbed phenolic compound by the Caco-2 cells was
syringic acid, while lowest was the flavonoid isovitexin. Sprouting of grains enhanced the uptake of syringic acid by the Caco-2 cells from finger millet and green gram. Open-pan boiling drastically reduced the uptake of quercetin from onion. Permeability of phenolic acids across Caco-2 cell monolayer was in the order: protocatechuic acid $>$ ferulic acid $>$ syringic acid, and was more when compared to that of flavonoids which was in the order: quercetin $>$ isovitexin. Phenolic compounds studied were able to cross the Caco-2 monolayer. Finger millet phenolic compounds were distributed in various tissues of rats as a function of time after oral administration of finger millet polyphenols alone or along with piperine. Area under the curve (AUC) for phenolic concentration in plasma significantly increased when piperine was concomitantly administered while AUC for individual polyphenols was also significantly increased.

Concentration of polyphenols in liver, kidney, small intestine, and brain increased significantly when co-administered with piperine at all the time intervals as reflected in the AUC values. Appearance of highest phenolic concentration in plasma, small intestine and kidney following the oral administration of finger millet phenolics was earlier when the same was co-administered with piperine. Urinary excretion of absorbed finger millet phenolics was significantly higher when co-administered along with piperine, presumably because of higher absorption. Thus, piperine co-administration significantly increased the absorption of finger millet polyphenols as well as their distribution and retention in different tissues following oral administration.