Highly pigmented fruits and vegetables are rich in phytochemicals such as anthocyanins and carotenoids. These compounds are strong antioxidants and have been found to contribute significantly to the health benefits of a diet rich in pigmented foods. Although research has been actively conducted on colored fruits such as small berries, the phytochemical pigments and the health promoting roles of highly pigmented vegetables, particularly those of the root vegetables such as carrots and potatoes, have not been thoroughly studied. The consumption of small berry fruits is limited due to seasonal and dietary reasons, however, vegetables such as pigmented potato can be consumed as a staple food. We have therefore studied the phytochemical profiles of more than two dozens of highly pigmented vegetables (carrots, cabbage, cauliflower, potatoes, onions, asparagus, eggplant and amaranth) using UPLC and LC-MS, and how these phytochemicals, particularly the anthocyanins, betanins and carotenoids contributed to the antioxidant, anti-cancer and alpha-glucosidase inhibitory activities using different chemical, biochemcial and cell-based assay systems. More than 26 anthocyanins from mainly 4 aglycones cyanidin, petunidin, pelargonidin and delphinidin, were found in red, purple and black vegetables at total concentrations ranging from 0.08-2.01 mg cyanidin-3-glucoside equivalent/g dry weight. The purple pigment of amaranth was from betanin and isobetanin, and the more lipophilic yellow to red pigments were carotenoids (120-260 mg beta-carotene equivalent/g dry weight). The bioaccessibility and bioavailability of these compounds were assessed using *in vitro* digestion and a caco-2 monolayer system. Results of this study provide important information for the development of health promoting vegetable cultivars, functional foods and nutraceuticals.