

and Potter 1996; World Cancer Research Fund 1997; Ness and Powles 1997; Law and Morris 1998; Kaur and Kapoor 2001). It is estimated that plant-based diets prevent 20–50% of all types of cancer (Steinmetz and Potter 1996; WCRF 1997). Thus, dietary recommendations for the prevention of cancer and other chronic diseases have always emphasized the consumption of a variety of plant foods. The single composite approach has given way to the concept that overall protection against disease is provided by a range of phytonutrients contained in foods.

2.2.1 CAROTENOIDS

Among the phytochemicals, carotenoids have been the widely studied ones. Carotenoids are tetraterpenoids responsible for the yellow, orange and red colour of many fruits. Red, orange and green fruits and vegetables (including broccoli, leafy greens, carrots, sweet potatoes, cooked tomatoes, winter squash, apricots, cantaloupe, oranges and watermelon), a few roots, egg yolks, fish (like salmon and trout) and crustaceans are a rich source of carotenoids. They are synthesized by plants, algae, fungi, yeasts and bacteria, but they are merely accumulated from the diet consumed, unchanged or slightly modified, in some animals.

In foods, about a hundred of carotenoids have been established. Normally a food would have one to five major carotenoids with a series of minor carotenoids in trace amounts. The principal carotenoids encountered in human blood and are the most investigated in terms of human health benefits are: β -carotene, α -carotene, β -cryptoxanthin, lutein and lycopene. These are the carotenoids which are most commonly found in foods (Rodriguez-Amaya 1993, 1999).

The provitamin A activity of some carotenoids, such as β -carotene, α -carotene and β -cryptoxanthin, have been known for a long time. In recent times, carotenoids, whether they are provitamin A or not, have been recognized with other health-promoting effects: immunity enhancement and reduction of the risk of emergence of degenerative diseases like cancer, cardiovascular diseases (CVD), cataracts and macular degeneration (Gaziano and Hennekens 1993; Krinsky 1993; Mayne 1996; Olson 1999; Krinsky and Johnson 2005). The physiological activities of carotenoids were attributed to its antioxidant property, that is, the ability to quench singlet oxygen and interact with free reactive radicals (Palozza and Krinsky 1992; Palace et al. 1999). However, other mechanisms of action against chronic diseases involve the modulation of carcinogen metabolism, regulation of cell growth, inhibition of cell proliferation, cell differentiation enhancement, stimulation of cell-to-cell gap junction communication and the retinoid-dependent signal and filtering of blue light (Astorg 1997; Olson 1999; Stahl et al. 2002; Stahl and Sies 2005; Krinsky and Johnson 2005).

Many retrospective and prospective epidemiological studies performed in various countries have consistently and strongly revealed that the dietary intake of β -carotene or its serum level was inversely associated with the occurrence of cancer, especially lung cancer (Ziegler 1991; Block et al. 1992; Ziegler et al. 1996). This inverse relation was also observed with CVD (Gaziano and Hennekens 1993; Kohlmeier and Hasting 1995; Mayne 1996). β -carotene, though, faced disgrace when intervention studies unexpectedly found that this carotenoid, which was given in capsules to