NUTRITION & DIGESTIVE CANCERS PREVENTION

Depending on the level of the alimentary tract which is concerned, several nutritional factors increase the risk of cancer. We can mention: **alcohol** and **tobacco** are related to *mouth and pharynx cancers*; **alcohol**, **tobacco**, **overly hot** foods, **smoked** foods and **grilled** foods are related to *esophagus cancer*; **nitrosamines**, **salted** foods and **smoked** foods are related to *gastric cancer*; excess of **animal fats**, excess of **red meat**, **excessively cooked** foods, insufficient intake of ***alimentary fibers*** are related to *colorectal cancer*.

From all cancers, *colorectal cancer* is the one which seems to be the most related to nutritional habits. Recently, the mortality rate due to this cancer has only modestly decreased, despite progress of surgery, chemotherapy and radiotherapy. "Colorectal cancer is one of the leading causes of mortality and accounts for approximately 200,000 deaths per year in Europe and the USA" [1]. Adapting nutrition to prevent *colorectal cancer* represents the logical response to its continuing increase in prevalence.

A diet containing less than 40 g/day of **animal fats** is associated with a *colic cancer* risk reduction of half compared with a diet containing more than 65g/day of such fats. A diet bringing less than 65 g/day of **red meat** is associated with a *colic cancer* risk reduction of half compared with a diet bringing more than 130 g/day of such meat [2]. As recently published by *JAMA*, it is clear that "prolonged high consumption of red and processed meat may increase the risk of cancer in the distal portion of the large intestine" [3].

Overcooked meat produces carcinogenic **heterocyclic aromatic amines** from its content in phenylalanine and in creatine. When cooking food directly in contact with flame, its combustion produces **polycyclic aromatic hydrocarbons** (**benzopyrene**).

Epidemiological studies have consistently shown an inverse association between consumption of ***vegetables*** and ***fruits*** and the risk of human alimentary tract cancers [4, 5]. Intake of vegetables and fruits may prevent carcinogenesis by several plausible mechanisms. Plant foods contain many anticancer phytochemicals with potential bioactivities that may reduce cancer susceptibility. ***Flavonoids*** are especially promising candidates for cancer prevention: flavanones (***naringenin***), flavanols (***catechin***), flavones (***apigenin***), flavonols (***quercetin***), flavanonols (***taxifolin***), isoflavones (***genistein***, ***daidzein***), not forgetting other polyphenols such as stilbenoids (***resveratrol***).

Flavonoids are plant secondary metabolites, present in all terrestrial vascular plants, embracing over 4,000 compounds. In mammals, flavonoids occur only through dietary intake. The average daily human intake of flavonoids has been estimated to be between 20 mg and 1 g. These compounds are present in ***fruits***, ***vegetables***, ***grains***, ***nuts***, ***tea***, ***beer*** and ***wine*** [6]. Many mechanisms of action have been identified for flavonoids prevention of cancer, including anti-estrogenic activity, anti-proliferative activity, induction of cell-cycle arrest, induction of apoptosis, prevention of oxidation, regulation of the host immune system, changes in cellular signaling, inhibition of several liver phase I detoxification enzymes and induction of several liver phase II detoxification enzymes [7].

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We give the practical example of ***quercetin*** protection through the inhibition of cytochromes P450 1A isoforms, CYP 1A1 [8] and CYP1A2 [9] (liver phase I detoxification enzymes) and through the induction of quinone reductase [10] and of glutathione-S-transferase [7] (liver phase II detoxification enzymes). Quercetin and its glycosylated form ***rutin*** are ubiquitous in nature, abundant in most fruits and vegetables [10].

Besides, the consumption of **meat** and **fat** stimulates the growth of putrefactive bacteria among the intestinal microflora [11, 12]. Bacteria belonging to the putrefactive genus *Bacteroides*, *Clostridium* and *Escherichia* produce **β-glucuronidase**. This specific enzyme disrupts estrogen glucuronidation, the detoxification phase II pathway used by the liver to eliminate excess of estrogens and of estrogen-like pesticides [13]. Higher levels of β-glucuronidase in stool have been linked to increased rates of *colorectal cancer* [14]. These putrefactive bacteria also produce **azoreductase** and **nitroreductase** enzymes, which transform common food azo dyes into potentially carcinogenic aromatic amines [15].

Putrefactive bacteria belonging to the genus *Clostridium* produce **7α-dehydroxylases**, enzymes converting primary biliary acids (cholic / chenodeoxycholic acids) into secondary biliary acids (deoxycholic / lithocholic acids), considered as cancer promoters [16].

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Doctor Mouton reports no competing interest in this field.

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