Production and consumption of horticultural products in Korea and cancer chemopreventive activity of fruit and vegetables

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1. Production and consumption of horticultural products in Korea

Fruit production in Korea quadrupled during last three decades and the total production reached more than 2.4 million tons in 2004 as shown in Fig. 1. The citrus held the biggest portion of 25%, followed by pears of 19%, apples and grapes of 15% each, and persimmons of 12%. The portion of apple was more than 50% in the 1970's, has decreased continuously, and now it takes only 15% of the total fruit production.

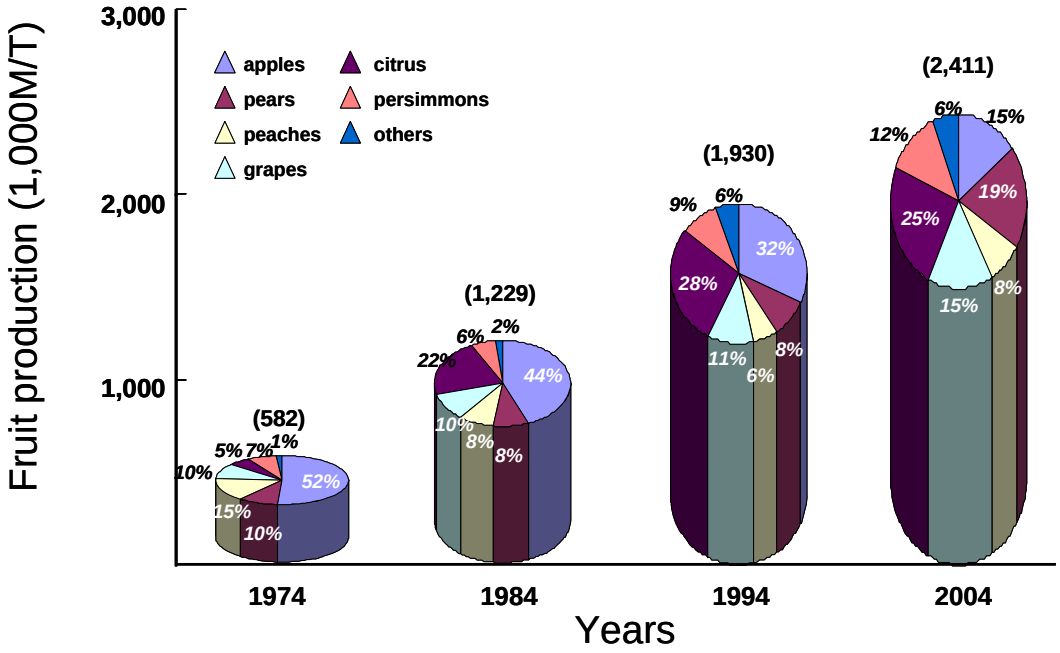

Fig. 1. Fruit production in Korea.

In the fruit trade, Korea imports more than 250,000 M/T of bananas and 120,000 M/T of oranges in 2004, and exports less than 60,000 M/T of pears, persimmons, and apples in total.

Fruit consumption pattern is summarized in Fig. 2. About 15 kg of citrus fruit per capita per year was consumed in 2003, however, consumption of the apple which has been most favorite fruit for decades, decreased to less than 10 kg/yr in recent years. Grape, pear, persimmon, and peach are other favorite fruits in Korea.

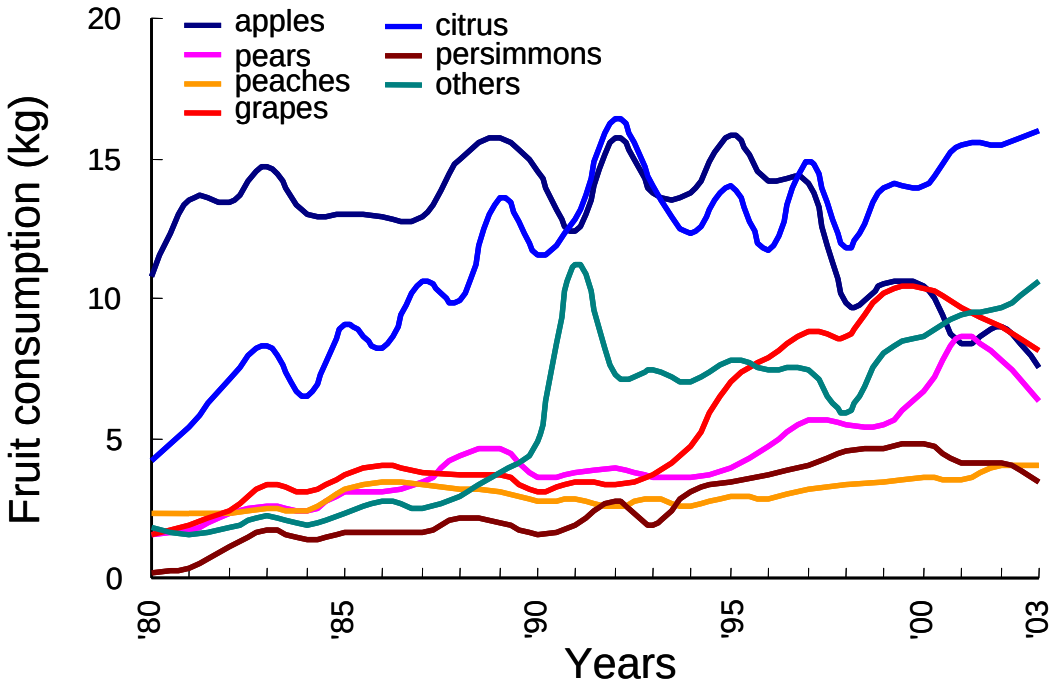

Fig. 2. Changes of fruit consumption per capita in Korea.

Total value of vegetable production in 2004 was about 7,700 billion Korean wons, which is about 7,700 million U.S. dollars (Fig. 3). The total vegetable production comprised of 48% of fruit vegetables such as water melons and tomatoes, 30% of flavor and spice vegetables such as red pepper and garlic, 14% of leafy and stem vegetables, 6% of root vegetables, and 2% of western vegetables.

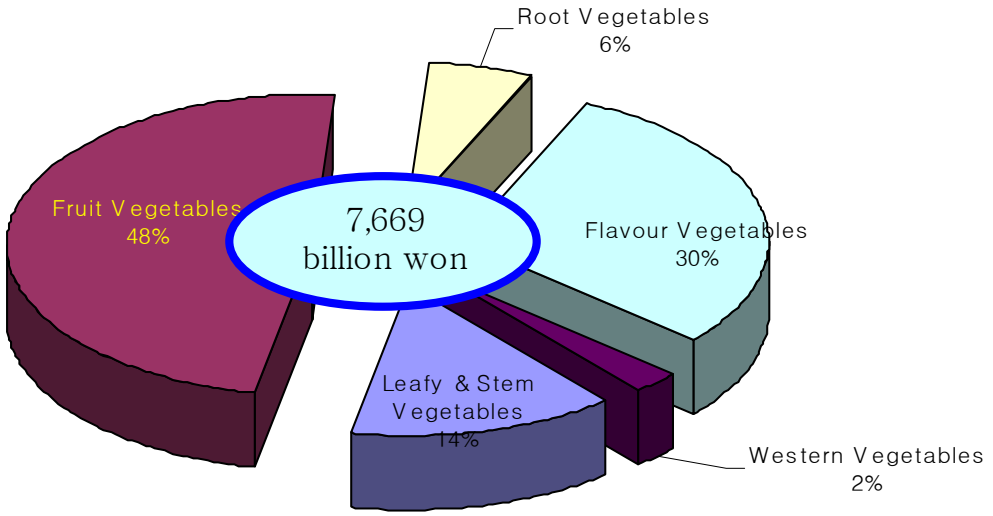

Fig. 3. Vegetable production in Korea (2004).

Fig. 4 shows the vegetable consumption pattern in Korea. Chinese cabbage and radish, which are two major raw materials to make kimchi, have been consumed in large amount ranging 20-40 kg/capita/yr. Of the spice vegetables, onion, garlic, and red pepper are major products that are consumed in significant amounts.

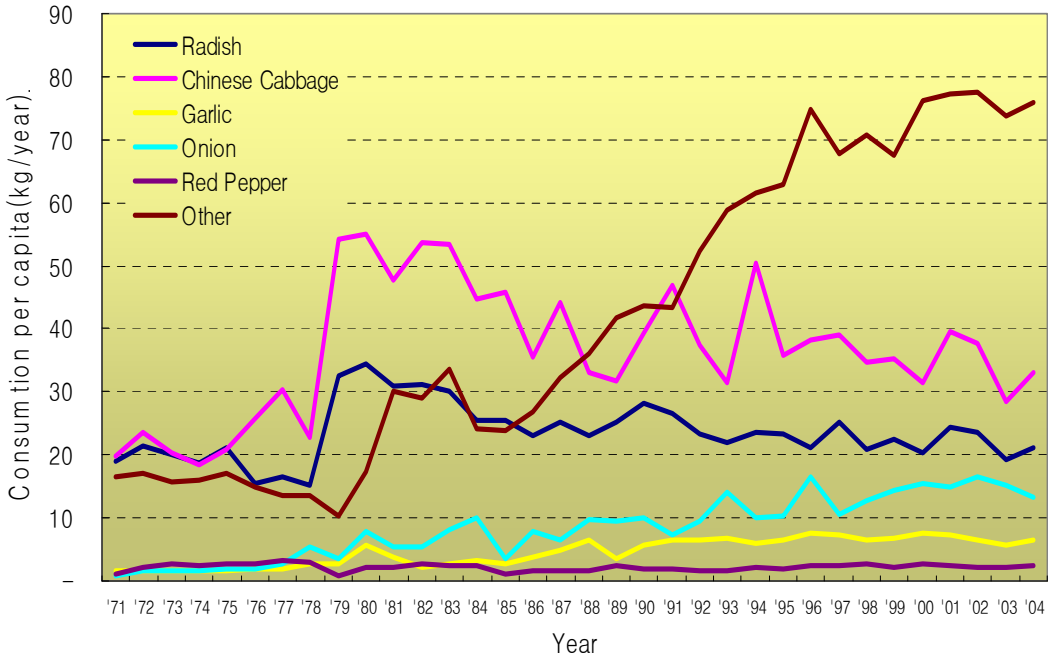

Fig. 4. Changes of vegetable consumption per capita in Korea.

The total production value of fruit vegetables in 2004 was about 3,682 million U.S. dollars. Important fruit vegetable crops include water melon (23.2%), strawberry (17.5%), tomato (16.0%), cucumber (12.5%), green pepper (11.9%), sweet melon (10.4%), pumpkin (7.4%), melon (1.5%), and eggplant (0.5%).

Production of spice vegetables reached 2,277 million U.S. dollars in 2004. Red pepper and garlic, major spice ingredient for making kimchi, were the two most important crops, and held 42% and 28% of total spice vegetables, respectively. Other important spice crops include welsh onion (17%), onion (11%), and ginger (2%).

In the leafy and root vegetable production of about 1,523 million U.S. dollars in 2004, again, the Chinese cabbage and radish were the two most important crops, and counted as 37% and 24 % of that category of vegetables. Lettuce (20%) is the third important crop because it is consumed in large amount mainly with barbequed meat food such as bulgogi or galbi in Korean diet. Spinach (5%), cabbage (5%), carrot (3%), parsley (3%), lotus root (1%), and burdock (1%) are other important leafy and root vegetable products.

2. Cancer chemopreventive activity of fruit and vegetables

It is well known that the food has three different functions including nutritional, sensory, and physiological function as shown in Table 1, and functional food is the food where this tertiary, health promoting function is emphasized. Of many food components that contribute to this tertiary function of food, the phytochemicals mainly originated from fruit and vegetables are probably the most important components.

Table 1. Function of foods.

Function	**Effects**	**Components**
1’ function (Nutritional)	Physical strength	Nutrients (CHO, prot, lipid, vitamin, mineral)
2’ function (Sensory)	Pleasant sensation	Flavor, color, texture
3’ function (Physiological)	Health promoting	Phytochemicals, Peptides, lipids, probiotics, etc

Hundreds of phytochemicals have been studied for their different bioactivities. Many different phytochemicals in different chemical groups such as flavonoids, polyphenols, terpenes, sulfur compounds, and others exert numerous different physiological activities including antioxidant, antifungal, antivirus, and preventing cardiovascular diseases, cancer, osteoporosis, inflammation, hypertension, and thrombosis (Table 2).

Table 2. Phytochemicals and their bioactivities.

Phytochemicals		**Bioactivities**
Flavonoids	daidzein, genistein, glycitein	Antioxidant, Lowering cholesterol, Preventing cardiovascular diseases, cancer, and osteoporosis
Polyphenols	catechin, quercetin, epigallocatechin gallate, phytosterol, curcumin, proanthocyanidins	Antioxidant, antifungal, antivirus, and preventing inflammation, cancer, and cardiovascular disease
Terpenes	β & α -carotene, lycopene, lutein, zeaxanthin	Cancer chemoprevention
Sulfur compounds	thioallyls, isothiocyanates, glucosinolates	Preventing hypertension, cancer, and thrombosis
Others	saponins, ginkgolides, inositol phosphates	Improving blood circulation, cancer chemoprevention

Cancer is the disease that ranks the first in death rate in most of the countries in the world. The death rate of heart disease decreased to about half level during the last five decades, but that of the cancer have remained almost same during the same period although so many health programs and research works have been concentrated to deal with this disease.

Many different factors have been reported to cause cancer, but it is well known that the diet is the No. 1 cause of cancer, which contributes about 1/3 of cancer deaths. Carcinogenesis is a multistage process including initiation, promotion, and progression. The promotion is a long-term, usually takes more than 10 years, and reversible process. Once the progression begins, it is very difficult to stop the process, and the best way of dealing cancer would be prevention at the promotion stage with, for example,

phytochemicals. In this regard, the term “cancer chemoprevention” has been evolved and it is defined as “use of chemical agents that are designed to inhibit, reverse, or retard carcinogenesis.”

A lot of different components of food can contribute to the chemoprevention in the multistage carcinogenesis, and modes of action of these components are quite diverse. Mechanism of action includes supressing oxidative stress, inflammation, inhibition of cell to cell communication, cell proliferation, and matrix metalloproteinases. Phytochemicals are involved in different levels of signal pathways. Phytochemicals such as genistein, quercitin, resveratrol, vitamins, and phnolic compounds may suppress either ligand binding to receptors, activation of protein kinases, generation of intracellular hydrogen peroxide, or down regulate the oncogenes, and transcription factors, or down-stream processes including inflammation, cell communication, and metastasis.