



## CALIFORNIA STRAWBERRIES FIGHT AGAINST CANCER

Dozens of studies in the past 20 years have associated diets high in fruit and vegetables with reduced risk for cancer, but only recently have researchers begun to test individual foods for their cancer-fighting ability. California strawberries are a powerhouse of potential cancer-fighting nutrients. For this reason, they have become the subject of numerous current studies.

### Strawberries and Cancer Experiments

Studies examining strawberries' cancer-fighting potential are now underway. Results from initial studies using freeze-dried strawberries and strawberry extracts in cell cultures and in laboratory models have been promising.

- When two varieties of freeze-dried strawberries were added to two types of human breast cancer cells and two types of human cervical cancer cells growing in culture, both strawberry varieties significantly inhibited the growth of both types of cervical cancer cells. Both also inhibited the two types of breast cancer cells, although one variety was more potent than the other.<sup>1</sup>

- In another study, freeze-dried strawberries when fed as five or ten percent of the diet, inhibited the development of chemically-induced esophageal cancer in a dose-dependent manner.<sup>2</sup> A similar study found that freeze-dried strawberries fed after the initiation of cancer were effective in blocking the cancer's progression.<sup>3</sup>

- Various fractions of freeze-dried strawberries were tested for their ability to inhibit cell transformation in animals. Although the fraction containing ellagic acid inhibited cell transformation, so did an extract containing no ellagic acid. This confirmed that compounds in strawberries besides ellagic acid have anti-cancer properties.<sup>4</sup>

### Strawberries are a Powerhouse of Antioxidants

The compounds found in strawberries and other fruits and vegetables credited with having protective effects are antioxidant vitamins like vitamin C, and other phytonutrients with antioxidant properties, including flavonoids and ellagic acid. Strawberries are a rich source of these compounds.

**Vitamin C** - A serving of California strawberries (140 grams or about eight strawberries) provides 96 mg or 160 percent of the recommended daily value for vitamin C. Vitamin C has been correlated with reduced rates of stomach, cervical and breast cancers.<sup>5,6,7</sup> In addition, a review of epidemiologic research found that people with higher intakes of vitamin C had nearly half the risk for nonhormone-dependent cancers than those with low intakes.<sup>8</sup>

**Flavonoids** - All of the flavonoids found in strawberries, including anthocyanins, quercetin and kaempferol, are potent antioxidants that have protective effects by scavenging oxygen free radicals. A serving of strawberries contains a mean value of 315 mg/100 grams of anthocyanins, a subgroup of flavonoids that give strawberries and other fruits their red, blue and purple colors.<sup>9</sup> Anthocyanins are one of the health-promoting compounds that strawberries have in common with blueberries, raspberries and blackberries.<sup>10</sup>

- Anthocyanins suppressed the growth of colon cancer cells in vitro.<sup>11</sup>

- Quercetin has been found in animal studies to inhibit chemically induced cancers of the lung, tongue, colon, mammary glands and mouth.<sup>12</sup>

- Quercetin has been found to inhibit the growth of human prostate cancer cells and human breast cancer cells.<sup>9</sup>

**Ellagic acid** - A serving of California strawberries contains about 63 mcg of ellagic acid,<sup>13</sup> an anticarcinogen that has shown promise in inhibiting cancer formation and progression in laboratory animals and cell cultures, including human cell lines.<sup>14</sup>

- In animal studies, ellagic acid inhibited the development of chemically-induced cancers of the lung, esophagus, skin and liver.<sup>9,14</sup>

- In a laboratory study using human breast cells in culture, ellagic acid inhibited carcinogenesis by 45 percent.<sup>15</sup>

### Strawberry Antioxidant Activity

The antioxidant power of strawberries has been measured and scored by researchers at the U.S. Department of Agriculture (USDA) using the oxygen radical absorbance capacity method, commonly known as ORAC. In a recent study of the antioxidant value of foods, strawberries scored in the fruit group with the highest total ORAC values, along with other berries, plums and some varieties of apples. Of all the fruit samples, those with the highest ORAC scores were the ones that had high anthocyanin content.<sup>16</sup> To determine whether the antioxidant power in the fruit translates to antioxidant power in the body, researchers measured the effect of strawberries on blood plasma levels of ORAC.



After ingestion of strawberries, subjects had an average 9.6 percent increase in plasma ORAC levels.<sup>17</sup> Other researchers measured antioxidant capacity in serum and urine in elderly women following consumption of spinach, strawberries or red wine. All three items increased antioxidant capacity - spinach the most, strawberries second and red wine the least.<sup>18</sup>

### **Strawberries/Fruit and Lower Cancer Risk**

Diets high in fruits and vegetables have been associated with reduced risk for cancers of the colon, stomach, rectum, esophagus, lung and pharynx, as well as cancers of the breast, bladder, pancreas and larynx. In fact, the American Institute of Cancer Research estimates that if everyone ate their "5 A Day," cancer rates could drop by 20 percent. Although the link between strawberry consumption and a reduced risk for certain cancers is limited, there is vast epidemiological evidence linking fruit consumption to a reduced risk of these diseases and some showing an association with strawberries in particular.

- Harvard researchers determined that strawberries were associated with a decreased risk of death from all cancers in a large population of elderly persons. Only three food items in this analysis stood out as being protective: tomatoes, green/yellow vegetables and strawberries.<sup>19</sup>

- In a pooled analysis of eight epidemiological study populations, elevated fruit and vegetable consumption was associated with a modest reduction in lung cancer risk, which was attributable mostly to fruit intake.<sup>20</sup>

- Total fruit and vegetable consumption was associated with lower colorectal cancer risk in a large cohort of more than 61,000 women in Sweden. Analysis of subgroups showed that the protective effect was largely due to fruit intake.<sup>21</sup>

- Women in the Nurses' Health Study who consumed three or more servings of fruit per day had a 30 percent reduced risk for non-Hodgkin's lymphoma.<sup>22</sup>

- In the Iowa Women's Health Study of more than 40,000 women, risk of lung cancer was cut in half among women consuming five or more servings of fruits and vegetables a day, compared to those with low intakes.<sup>23</sup>

- When the populations of the Nurses' Health Study and the Health Professionals' Follow-up Study were analyzed together, higher fruit and vegetable consumption was associated with a lower risk of lung cancer in women, but not in men.<sup>24</sup>

### **Folate and Cancer Risk**

In addition to antioxidants, strawberries contain folate, a B vitamin that has been associated with reduced risk of several cancers.

- Epidemiological studies suggest that folate is protective against cervical dysplasia, an early precancerous stage that sometimes proceeds to cervical cancer.<sup>8</sup>

- The Nurses' Health Study found a 31 percent reduced risk for colon cancer in women with higher dietary folate intakes.<sup>25</sup>

- When women in a cohort screened for breast cancer in the 1980s were followed up more than a decade later, it was found that those with the highest folate intakes had the lowest risk of cancer of the colon, rectum or both.<sup>26</sup>

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