



## An apple a day keeps more than the doctor away

Most of us remember the old adage "an apple a day keeps the doctor away". Well, now science is telling us how and why this tasty fruit has been linked to a such a wide array of health benefits such as decreasing cancer risk, heart disease, diabetes, lung problems like asthma and even Alzheimer's disease. Increased apple consumption may also have a beneficial effect on the development of cataracts, adding new meaning to the old serenade "you are the apple of my eye" <sup>1,2</sup>. Well, maybe not.

### **Decreasing your risk of lung cancer, even if you don't smoke**

Apple consumption has been linked to a reduction in the risk of lung cancer in several studies. In one of the largest follow-up studies involving 77,000 women and 47,000 men, eating fruits and vegetables was associated with a 21% decrease in lung cancer risk <sup>3</sup>. When they looked at individual fruits and vegetables, apples were one of the few that was directly associated with this drop in cancer risk (though in this study, only the women seemed to enjoy this benefit). This decrease in cancer can be even more significant. When 582 patients with lung cancer and 582 without were compared, those who had the highest intake of apples, onions and grapefruit had a whopping 40-50% decrease in their risk of developing lung cancer <sup>4</sup>.

How could apples be causing this effect. Well, to begin with researchers have found

that whole apple extracts slow down the growth of both colon and liver cancer cells *in vitro* (cells that are grown and studied in a special dish in the laboratory) <sup>5</sup>. Part of this growth inhibition seems to be due to the antioxidant activity of two of the many important phytochemicals found in apples, flavonoids and phenolic acids. One hundred grams of fresh apples has about the same antioxidant activity as 1500 mg of vitamin C <sup>5</sup>, something to remember when we are tempted to load up on just pills.

### **An apple after my own heart... and mind**

Next time you go for that cardio workout, consider taking an apple along as a light snack. In a follow-up study of 40,000 women for close to seven years, those who ingested apples had a 13-22% decrease in cardiovascular disease risk <sup>6</sup> and a study of 34,489 post-menopausal women found apples to be among the foods associated with a significant reduced risk of death due to coronary heart disease and cardiovascular disease <sup>7</sup>. In two Finnish studies, the greater your apple intake, the less your chances of dying from coronary artery disease <sup>8</sup> and the lower your risk of thrombotic stroke (stroke from a blood clot) <sup>9</sup>. A more recent prospective study of 20,069 men and women also suggests that increased apple consumption decreases the incidence of stroke <sup>10</sup>.

How can apples protect your heart and blood vessels? Studies in rats suggest that

apples lower cholesterol levels, increase the good cholesterol HDL and prevent oxidation of the troublesome LDL cholesterol which does a lot of damage <sup>11,12</sup>. It's important to eat the whole fruit because the effect of apples on lowering cholesterol was found to be much greater when both pectin (found in fruit fiber) and the chemical compound phenolic acids were given together as opposed to separately <sup>13</sup>.

### ***Sweet***

In another Finnish study of 10,000 people, a reduced risk of type II diabetes (which develops in adulthood) was associated with apple consumption <sup>14</sup>. This may be due to another phytochemical called quercetin which is highly concentrated in apple peels. In diabetic rats, quercetin has been shown to lower blood glucose levels <sup>15</sup> and when cells from the pancreas (important in the control of sugar metabolism) were studied, quercetin stimulated the cells to secrete insulin (which causes glucose to be transported into cells thereby keeping blood sugar levels under control) <sup>16</sup>.

### ***Is this taking your breath away?***

Eating two apples a week has a beneficial effect on asthma according a survey that compared the diet and lifestyle 600 individuals with asthma and 900 without <sup>17</sup>. Lung function also improved on special breathing tests that measure how well your lungs handle air movement.

### ***A cure for the common cold?***

Not so fast. There is still no 'cure' for the common cold which is caused by viruses, but apple flavonoid has been shown in animal studies to work against the deleterious effects of a few bad bugs such as the bacterium E. Coli O157:H7 <sup>18</sup> associated with ingestion of contaminated ground beef, water and vegetables. Apple extract has also been shown to inhibit the effects of the bacterium

*Vibrio cholerae's* toxin in mice <sup>19</sup>. Both of these infections cause severe diarrhea.

### ***Keep the peel***

Make sure you eat the peel, so that you won't miss out on getting the full benefit that apples can offer you. Apples with peels inhibited the growth of cancer more than those without peels. The peel is also associated with higher antioxidant activity <sup>20</sup>. Depending on the variety, apples with peels contain from 2 to 6 times more phenolic compounds than the flesh alone and two to three times more flavonoids.

### ***What about apple juice?***

Probably better to juice your own. Commercial processing of apples for juice has shown that the levels of phenolics are very reduced <sup>21</sup>, though the processing of apple peels does not seem to have the same detrimental effect.

### ***How much is enough?***

These studies have all looked at different levels of apple consumption. Eating one serving per day was linked to a lower risk of lung cancer, while ingesting three apples daily for twelve weeks was associated with more weight loss <sup>22</sup> and two apples per week showed a beneficial effect on asthma and overall lung function. So take a balanced approach, remembering the importance of overall good nutrition since, even in the best of studies, it is always very difficult to attribute all the benefits observed to just one manipulation.

### ***Are all apples created equal?***

In terms of the concentration of phenolic and flavonoid compounds, the answer appears to be no. If you must choose, Fuji apples have the highest concentration of these phytochemicals. Red Delicious is also quite high. Many other factors also affect the

phytochemical content in apples such as the stage of development, maturation, types of fertilization and exposure to sunlight. Long-term storage (up to 52 weeks in controlled conditions) does not seem to have detrimental effect.

At the end of the day, all things considered, you will have to agree that adding some apples to your well-balanced diet is likely to do you some good and may help to ward off a number of chronic diseases.

1. Willett WC: **Diet and Health: what should we eat?** Science 1994; 254:532-37.
2. Liu RH: **Health benefits of fruits and vegetables are from additive and synergistic combinations of phytochemicals.** Am J Clin Nutr 2003, 78 (517S-520S).
3. Feskanich D, Ziegler R, Michaud D, Giovannucci E, Speizer F, Willett W, Colditz G: **Prospective study of fruit and vegetable consumption and risk of lung cancer among men and women.** J Natl Canc Inst 2000, 92:1812-1823.
4. Le Marchand L, Murphy S, Hankin J, Wilkens L, Kolonel L: **Intake of flavonoids and lung cancer.** J Natl Canc Inst 2000, 92: 154-160.
5. Eberhardt M, Lee YL, Liu RH: **Antioxidant activity of fresh apples.** Nature 22 June 2000, 405: 903.
6. Sesso H, Gaziano JM, Liu S, Buring J: **Flavonoid intake and risk of cardiovascular disease in women.** Am J Clin Nutr 2003, 77: 1400-1408.
7. Knekt P, Jarvinen R, Hakkinen R, Reunanen A, Maatela J: **Flavonoid intake and coronary mortality in Finland: a cohort study.** BMJ 1996, 312:478-481.
8. Mink PJ, Scrafford CG, Barraj LM, Harnack L, Hong CP, Nettleton JA, Jacobs DR Jr.: **Flavonoid intake and cardiovascular disease mortality: a prospective study in postmenopausal women.** Am J Clin Nutr. 2007 Mar; 85(3):895-909.
9. Knekt P, Isotupa S, Rissanen H, Heliovaara M, Jarvinen R, Hakkinen R, Aromaa A, Reunanen A: **Quercetin intake and the incidence of cerebrovascular disease.** Eur J Clin Nutr 2000, 54:415-417.
10. Oude Griep LM, Verschuren WM, Kromhout D, Ocké MC, Geleijnse JM: **Colors of fruit and vegetables and 10-year incidence of stroke.** Stroke 2011 Nov, 42(11): 3190-95.
11. Aprikian O, Levrat-Verny M, Besson C, Buserrolles J, Remesy C, Demigne C: **Apple favourably affects parameters of cholesterol metabolism and of anti-oxidative protection in cholesterol fed rats.** Food Chem 2001,75:445-452.
12. Leontowicz H, Gorinstein S, Lojek A, Leontowicz M, Ciz M, Soliva-Fortuny R, Park Y, Jung S, Trakhtenberg S, martin-Bellosso O: **Comparative content of some bioactive compounds in apples, peaches, and pears and their influence on lipids and antioxidant capacity in rats.** J Nutr Biochem 2002, 13: 603-610.
13. Aprikian O, Duclos V, Guyot S, Besson C, Manach C, Bernalier A, Morand C, Remesy C, Demigne C: **Apple pectin and polyphenol rich apple concentrate are more effective together than separately on cecal fermentations and plasma lipids in rat.** J Nutr 2003, 133:1860-1865.
14. Knekt P, Kumpulainen J, Jarvinen R, Rissanen H, Heliovaara M, Reunanen A, Hakulinen T, Aromaa A: **Flavonoid intake and the risk of chronic diseases.** Am J Clin Nutr 2002, 76:560-568.
15. Vessal M, Hemmati M, Vasei M: **Antidiabetic effects of quercetin in streptozocin-induced diabetic rats.** Comp Biochem Physiol C. 2003; 135C: 357-364.
16. Youl E, Bardy G, Magous R, Cros G, Sejalon F, Virsolvy A, Richard S, Quignard JF, Gross R, Petit P, Bataille D, Oiry C: **Quercetin potentiates insulin secretion and protects INS-1 pancreatic B-cells against oxidative damage via the ERK1/2 pathway.** Br J Pharmacol 2010 oct; 161(4): 799-814.
17. Shaheen S, Sterne , Thompson R, Songhurst C, Margetts B, Buerney P: **Dietary antioxidants and asthma in adults- population based case control study.** Am J Resp Crit Care Med 2001, 164:1823-1828.

18. Lee, HJ, Regmi SC, Kim JA, Cho MH, un H, Lee CS, Lee J: **Apple Flavonoid phloretin inhibits Eschericia coli 0157:H7 biofilm formation and ameliorates colon inflammation in rats.** Infec Immun 2011 Dec;79 (12):4819-27.

19. Saito T, Miyake M, Toba M, Okamatsu H, Shimizu S, Noda M: **Inhibition by apple polyphenols of ADP-ribotransferase activity of cholera toxin and toxin-induced fluid accumulation in mice.** Microbiol Immunol 2002, 46:249-55.

20. Wolfe K, Wu X, Liu RH: **Antioxidant activity of apple peels.** J Agric Food Chem 2003, 51: 609-614.

21. van der Sluis A, Dekker M, Skrede G, Jongen W: **Activity and concentration of polyphenolics antioxidants in apple juice. I. effect of existing production methods.** J Agric Food Chem 2001; 50: 7211-7219.

22. de Oliviera M, Sichieri R, Moura A: **Weight loss associated with a daily intake of three apples or three pears among overweight women.** Nutr 2003, 19:253-256.