



# Medicinal Properties in Whole Foods

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## An Apple a Day Keeps... Lung Cancer at Bay?

"Functional foods," "nutraceuticals," "designer foods" and "medicinal foods" are terms that describe foods, and key ingredients isolated from foods, that have non-nutritive or tertiary functional properties. Researchers, healthcare practitioners, laypersons, and the popular media use these words interchangeably. The purpose of this article is to detail valid scientific information available on the lung-protective properties of apples.

Apple trees are cultivated throughout the Northern Hemisphere, occasionally growing wild. The saying, "an apple a day keeps the doctor away," has some basis in fact, as apple pectin holds preventive activity in cancer and cardiovascular disease. Preliminary evidence suggests a positive relationship between lung function and consumption of five or more apples per week (Butland, et al., 2000). An inverse association may exist between lung cancer risk and foods containing quercetin, found in high concentrations in apples (Le Marchand, et al., 2000).

Apple pectin is the soluble fiber fraction of the apple fruit. Pectin comes in liquid or dried form and the source is the solid fruit residue with 10-20% pectin in the dried mass (Fleming, 2000). The pectin is extracted from the dried residue at pH 1.5-3 and at temperatures ranging from 60-100°C.

### Known Medicinal Constituents

The most well-recognized and evaluated medicinal constituents found in apples include:

- Quercetin and other flavonoids
- Pectins
- Tannins
- Vitamins, especially ascorbic acid (3-30 mg/100 g)
- Fruit acids, chiefly malic acid

### Indications for Use

Apples and apple pectin are indicated for use in the following health challenges:

- Impaired lung function
- Lung cancer
- Colon cancer
- Diarrhea and constipation
- Toxic accumulation and toxicity syndromes

### Mechanisms of Action

It is unknown by what mechanism apples may affect lung function or lower the risk of lung cancer. It has been proposed that the antioxidant flavonoid **quercetin may play a major role** (Le Marchand, et al., 2000; Butland, et al., 2000). Pectins and pectin-like rhamnogalacturonans found in apples have pronounced **antimutagenic effects** against 1-nitropyrene

**Table 1 Odds ratio for lung cancer in the highest vs. the lowest quartiles for apple intake in a Hawaiian population. An odds ratio of 1.0 indicates no difference (Q1). Parentheses indicate 95% CI. Other foods high in isoflavones are shown for comparison. Of these, only apples and onions are high in quercetin. Adapted from Le Marchand et al (2000).**

	Q1 (lowest)	Q2	Q3	Q4 (highest)	Two-sided P for trend
Apple	1.0	0.9 (0.6-1.4)	1.0 (0.6-1.6)	0.6 (0.4-1.0)	0.03
Onion	1.0	1.4 (0.9-2.3)	0.9 (0.5-1.4)	0.5 (0.3-0.9)	0.001
Red wine (tertiles)	1.0	0.8 (0.4-1.8)	0.7 (0.4-1.2)	-	0.20
Soy products	1.0	1.6 (1.0-2.7)	1.2 (0.7-2.2)	1.0 (0.5-1.8)	0.28

**Table 2 Cross-sectional analysis: Differences in forced expiratory volume in one second (FEV<sub>1</sub>) in mL associated with increases in the frequency of apple intake from baseline Adapted from Butland et al (2000).**

Frequency of apple consumption	N	(1) Adjusted for age, height, age <sup>2</sup> , and height <sup>2</sup>	(2) Adjusted for (1), body mass index, and smoking	(3) Adjusted for (2) social class, work exercise, and leisure exercise	(4) Adjusted for (3) and total energy intake
None	645	0 (baseline)	0 (baseline)	0 (baseline)	0 (baseline)
1	270	97.1 (3.2-191.0)	75.7 (-15.7-167.1)	49.3 (-40.9-139.5)	44.5
2-4	753	159.9 (90.2-229.5)	102.9 (34.6-171.1)	84.7 (17.2-152.1)	88.0
5	433	291.8 (211.2-372.4)	185.7 (104.9-266.5)	146.6 (66.5-226.8)	138.1
Test for trend		P<0.001	P<0.001	P<0.001	P<0.001

induced mutagenicity *in vitro* (Hensel, A. and Meier, K., 1999). *In vitro*, pectin polysaccharides most likely interact directly with cells (*Salmonella typhimurium*) to sterically protect them from mutagenic attack.

As well, apple pectin decreases the incidence and number of dimethylhydrazine- and azoxymethane-induced colon tumors in rats (Ohkami, H. et al., 1995; Tazawa, K. et al., 1997; Tazawa, K. et al. 1999). It is also believed that pectin **lowers  $\beta$ -glucuronidase activity**, a key enzymatic step in carcinogen activation and tumor initiation in the colon.

In the intestine, apple pectin is a bulk-forming agent similar to psyllium and prevents diarrhea and constipation by a similar mechanism. Pectin also may **modify intestinal bacterial enzyme activity** in favor of a reduction of toxic breakdown products in the gut (Mallett, A. K. et al., 1987). This may contribute to a chemoprotective effect in colon carcinogenesis.

### Research

#### Apples in lung function and lung cancer

Researchers (Le Marchand, et al., 2000) found a **statistically significant inverse relationship between lung cancer risk and food sources high in the isoflavone quercetin (onions and apples)** after controlling for smoking and intakes of saturated fat and  $\beta$ -carotene in a population-based, case-controlled study conducted in Hawaii (Table 1).

A long-term cross-sectional analysis of a cohort of 2512 Welshmen aged 45-59 living in Caerphilly, Wales between 1979 and 1983 found that **lung function was linearly associated with dietary apple intake** (Table 2) (Butland, et al., 2000).

**This study additionally found that the age-related decline in lung function over five years in these men was offset by consuming five or more apples per week during the study period** (Butland, et al., 2000).

### Apples

These clinical results coupled with the results of earlier trials strongly suggest that **apples**:

- Protect against cancer, primarily lung cancer
- Improve lung function

### Contraindications

- None known

### Side Effects

• No adverse reactions are known to occur with consumption of apple fruit or isolated pectin. However, apple seeds contain potentially toxic levels of hydrogen cyanide that, if used incorrectly, can be dangerous.

### Possible Interactions with Drugs

- None known

### Possible Interactions with Herbs and other Dietary Supplements

- Insufficient reliable information available

### Possible Interactions with Diseases or Conditions

- None known

### Typical Dosage

- Oral: 500 mg apple pectin in capsules taken daily or "an apple a day."

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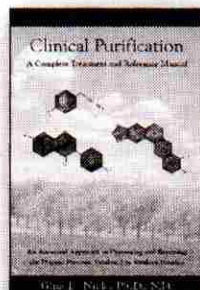
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