

Healthcare industry BW

Does cloudy apple juice prevent colon cancer?

The likelihood of developing colon cancer very much depends on dietary factors. Foods and nutrients with antioxidative and anti-inflammatory properties have been found to reduce the likelihood of developing this kind of cancer. Research done by scientists from the Karlsruhe-based Max Rubner-Institut suggests that cloudy apple juice can prevent colon cancer. However, little is yet known about the molecular relationships between diet and disease.

In Germany, colon cancer is the second most frequent cancer and cause of death; every year, more than 27,000 men and women die as a result of colon or rectal (i.e. colorectal) cancers. The incidence of colorectal cancer in Germany and other western industrial nations increased steadily in the second half of the last century, with the number of cases starting to decrease slightly over the last few years.



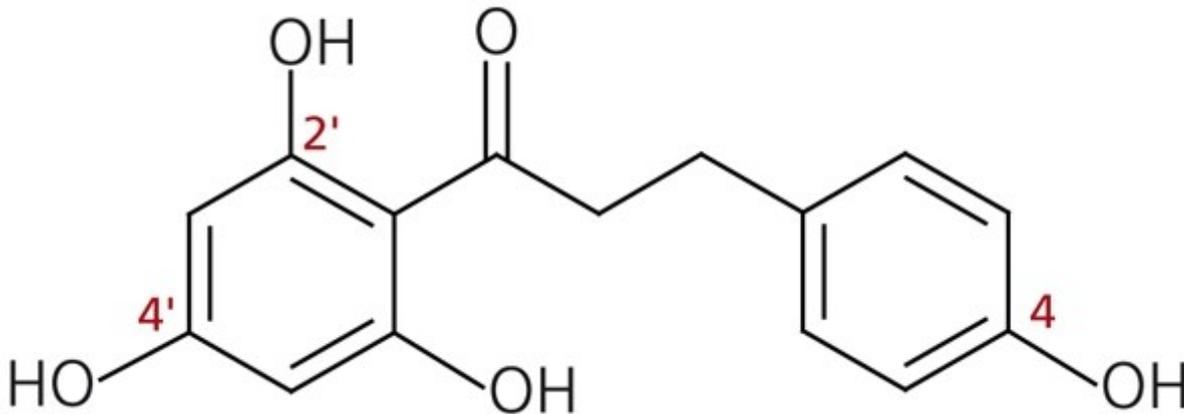
Apple juice has been found to prevent cancer
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Many epidemiological studies have found that the likelihood of developing colorectal cancer is closely connected to lifestyle factors, in particular nutrition and physical activity: obesity, the lack of physical exercise, metabolic disorders such as type 2 diabetes, the consumption of low-fibre food, not enough vegetables, too many red (iron-containing) meat and meat products, and elevated alcohol and tobacco consumption all contribute to increasing the likelihood of developing colorectal cancer. Little is yet known about the molecular modes of actions of these factors; more or less plausible hypotheses have been put forward, but no scientifically founded findings have yet been produced. It is the same story regarding factors that could potentially act to prevent colorectal cancer.

Can the ingredients of apples prevent colorectal cancer?

A number of polyphenolic compounds in many plants have been found to have antioxidative and anti-inflammatory effects; some have also been found to prevent the development and growth of

tumours. Such polyphenols (e.g. hypericin, which is one of the principal active constituents of Saint John's wort (*Hypericum*), oak quercetin and cotton gossypol) play an important role in traditional plant medicine. Some of the polyphenols, including EGCG (epigallocatechin gallate) contained in green tea, have long been known to have a preventive effect against colorectal cancer.



Structural formula of phloretin, a polyphenol found in apples.
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Scientists from the Max Rubner-Institut (MRI), which is the Federal Research Institute of Nutrition and Food, are investigating the bioactivity of such substances using cell cultures and animal experiments. They are also looking into people's dietary habits. A long-term study carried out by the MRI in collaboration with the University of Gießen and the Research Institute of Biological Agriculture in Frick (Switzerland) has shown that the antioxidative capacity and bioavailability of apple-derived phloretin (see formula) and coumaric acid is no different whether the apples are produced in conventional or organic agriculture (Eur. J. Nutr. 49, 301-310; 2010). The finding proved to be a bit of a disappointment to supporters of bio-organic agriculture.

Dr. Stephan Barth and PD Dr. Achim Bub from the Institute of Physiology and Biochemistry of Nutrition at the MRI in Karlsruhe have investigated the bioactivity of apple ingredients in terms of their capacity to prevent colorectal cancer in animal models and intervention studies (i.e. studies testing the effect of ingredients prior and after the administration of a substance under investigation) involving men suffering from adiposity and type 2 diabetes. The researchers analysed numerous colorectal cancer biomarkers in volunteers who had consumed unfiltered cloudy and clear apple juice. Cloudy and clear apple juice not only differ in the amount of fine apple particles they contain but also in the quantity of polyphenols. The researchers also investigated the effect of individual juice fractions (polyphenol fraction, cloud fraction, etc.). They used a standard rat model in which colon cancer can be induced by 1,2 dimethylhydrazine.

Cloudy apple juice is better

The researchers found clear differences between rats that were given cloudy apple juice and those that were given clear apple juice: cloudy apple juice led to less genotoxic damage to the colon epithelium, fewer hyperproliferations of the epithelium and smaller and fewer precancerous colon lesions. However, the researchers were not able to discern the different effects arising from the individual components of cloudy apple juice (fine apple particles and polyphenols). So the question arises as to whether other factors contribute to the observed cancer-preventive effect or whether it is the result of synergistic effects.

It is known that obesity and adiposity, which in many patients are associated with type 2 diabetes, increase the risk of developing colorectal cancer. Using the “adipose diabetes rat” animal model, the researchers from Karlsruhe investigated the effect adiposity-associated metabolic risk factors have on the development of cancer. They found that apple juice had a cancer-preventive effect in thin animals, but not in fat animals.



Peeling apples at the “State Institute for the Preservation of Fresh Foods”, which was established in 1936 and later became the MRI

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Using clear apple juice with the same amount of calories as unfiltered apple juice as control, the MRI researchers carried out two intervention studies involving obese men and type 2 diabetics. The studies were aimed at investigating the effect of cloudy apple juice on the adiposity-associated risk of developing colorectal cancer. The researchers also measured numerous parameters of the fat and glucose metabolism and the concentration of adipokines in the blood plasma. They found that the consumption of cloudy apple juice caused less damage to blood lymphocytes than clear apple juice in adipose men and diabetics alike. The researchers took this as evidence for the cancer-preventive effect of cloudy apple juice. In addition, the consumption of cloudy apple juice had a positive effect on the sugar metabolism of diabetic men.

Food metabolomics

The studies carried out by Barth and Bub with rats have also shown that metabolic factors, in particular those related to energy uptake and energy homeostasis, gave more effective protection against the development of colorectal cancer than the ingredients of cloudy apple juice. The researchers will now conduct further research on the molecular level, in order to glean more information on how metabolic factors prevent the development of colorectal cancer. The potential of methodological approaches that enable the highly resolved analysis of foods was discussed at the “Food Metabolomics” conference held at the MRI in October 2011.

The emerging field of food metabolomics deals with the characterization and analysis of all small molecules (metabolome) contained in a specific food item, including products of the primary and secondary metabolism as well as substances arising from the processing of food, including residues and contaminants. Food metabolomics thus relates to the analysis of several thousand compounds, including the characterization of foods taking into account their origin, growth and storage conditions. Differences in the maturity stage and fungal growth of food also result in metabolome differences, which can then be measured using analytical methods. Cutting-edge analytical methods involve GC-MS (gas chromatography – mass spectrometry) and NMR (nuclear magnetic resonance) which also require complex data processing methods and comprehensive databases.

At the conference, Bruker Biospin GmbH, a Bruker Corporation subsidiary located in Rheinstetten close to Karlsruhe, presented the first commercial method to characterize and quality assure fruit juices using NMR.



Prof. Dr. Gerhard Rechkemmer, President of the Max Rubner-Institut.

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The MRI President, Professor Gerhard Rechkemmer, highlighted the importance of food metabolomics as a technology with great future potential in the field of food and nutrition research. He explained how the MRI will use cutting-edge methods to try and find answers to the plethora of questions relating to healthy, high-quality foods and comprehensive consumer safety.

The Max Rubner-Institut

The Max Rubner-Institut – Federal Research Institute for Nutrition and Food – was established on 1st January 2008 as a result of a merger between the individual federal research centres (the Federal Dairy Research Centre in Kiel, the Federal Centre for Cereal, Potato and Lipid Research in Detmold and Münster, the Federal Centre for Meat Research in Kulmbach and the Federal Research Centre for Nutrition in Karlsruhe as well as the fish quality section of the Institute for Fisheries Technology). All the research institutes under the aegis of the German Federal Ministry of Nutrition, Agriculture and Consumer Protection focused on food and nutrition, were thus brought together in one institute, with six, and in future, four, departments: the head office in Karlsruhe is home to the departments of Physiology and Biochemistry of Nutrition, Nutritional Behaviour, Food Technology and Bioprocess Engineering and Safety and Quality in Milk and Fish.



Rubner

Prof. Dr. Max Rubner (1854-1932), the people's scientist
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The MRI is named after Max Rubner (1854-1932), a doctor, physiologist and hygienist, who is remembered for his research into the bioenergetics of the metabolism with which he proved the validity of the law of the conservation of energy in living organisms, amongst other things. His experimental work is the basis for the calorie tables still in use today.

All research institutions of the Max Rubner-Institut focus on health and consumer protection in the nutrition sector. Important research fields are the determination and nutritional assessment of health-relevant food ingredients, the investigation of careful and resource-preserving procedures of processing, the quality assurance of food as well as the analysis of sociological parameters of nutrition and the improvement of nutrition information. Researchers at the MRI are involved in national and international research programmes and are members of national and international boards and authorities.

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