Cider and Health - a historic overview by Dr Erik Skovenborg

The adage "an apple a day keeps the doctor away" is still quite popular. The Englishman of the early seventeenth century found that cider raised his spirits, lowered his temperature in fevers and loosened his bowels. He also maintained that under its benign influence he would not contract rheumatism or stone of the bladder, that there was moral but not medical danger in getting drunk upon cider twice a day and that it was a wonderful preservation in old age (1). "Indeed", Evelyn stated in his book Pomona, "cider is above all the most eminent, soberly to exhilarate the Spirits of us Hypochondrical Islanders" (2).

Recently, many studies have provided the scientific backing for some of the old sayings, however, while extensive research exists, a literature review of the health benefits of ciders has not been compiled, and the purpose of this paper is to review the most recent literature regarding the health benefits of apples and their phytochemicals in general and the benefits of alcoholic ciders in particular.

Apple phytochemicals

There are about 8000 phytochemicals (plant polyphenols) present in whole foods. Plant polyphenols play an important role as antioxidants and are therefore regarded to exhibit protective effects against cardiovascular diseases (3) and cancer (4). Epidemiological studies have linked the consumption of apples with reduced risk of some cancers, cardiovascular disease, asthma, and diabetes. In the laboratory, apples have been found to have very strong antioxidant activity, inhibit cancer cell proliferation, decrease lipid oxidation, and lower cholesterol. Recently apple polyphenols and fibers supplied at nutritional doses were shown to limit the development of atherosclerotic lesions in the aorta of apo-E-deficient mice _ an atherosclerosis-prone animal model (5).

The main polyphenol sources are fruits and vegetables; apples account for an important part of the fruit intake and when compared to many other commonly consumed fruits, apples have the second highest level of antioxidant activity. Also beverages like red wine, cider, coffee, green and black tea as well as cocoa contribute to the total daily polyphenol intake (6). Flavanols (catechin and proanthocyanidins) are the major class of apple polyphenols (71-90%), followed by hydroxycinnamates (4-18%), flavonols (1-11%), dihydrochalcones (2-6%), and in red apples anthocyanins (1-3%).

In Western Europe apples provide a clearly important dietary contribution of total polyphenols estimated at 144.8 mg per serving. The mean composition of a single serving of apples contains 121.7 mg of flavanols, 16.2 mg of hydroxycinnamates, 8.9 mg of flavonols, and 4.4 mg of dihydrochalcones while the content in anthocyanins at 1.2 mg is very low (7). Little attention has been given to the absorption and metabolism of polyphenols, however, Susan DuPont and colleagues from Institute of Food Research, Norwich, determined the uptake and excretion of low doses of polyphenols in six subjects who each consumed 1.1 L of an alcoholic cider beverage. The results show that polyphenols from alcoholic apple cider are absorbed and metabolized by humans (8).

Apples, Malus domestica (Rosaceae), may contain up to 2 grams of polyphenols per kilogram wet weight. There are known to be more phenolics in the skins of apples than in the flesh: 142.7 and 97.6 mg flavonoids per 100 g apples (Red Delicious) with and without skin, respectively. The total antioxidant activity of phytochemicals in 1 gram of apples with peels is equivalent to 83.3 µmol vitamin C equivalents — much higher than the antioxidant activity of the normal amount of vitamin C in 1 gram of apples with skin (0.057 mg). In other words, vitamin C in apples contributes only < 0.4% of total antioxidant activity of apples. The antioxidant value of one apple is equivalent to 1500 mg of vitamin C (9).

Dessert versus cider apples

Polyphenols are important secondary metabolites in apples that are involved in essential organoleptic criteria such as colour, bitterness and astringency of cider. Cider apples contain higher levels of phenolics than dessert apples, which gives them their characteristic bitter and astringent flavour (10). Even in cider apples, polyphenol concentrations show a great variability according to the variety. Sylvain Guyot and coworkers compared five French cider apple varieties on the basis of their detailed polyphenol profile in the cortex and in the juices: total polyphenols varied from 1899 to 5065 milligrams per kilograms of fresh apple weight (11). Similar results were found in a HPLC-analysis of 20 apple cultivars comprising 19 English cider apple varieties and one dessert apple variety: the cider varieties contained higher levels than the dessert apple and the peel was richer in phenolics than the flesh. The phenolic concentrations ranged between 230 and 4920 mg/kg fresh weight in the flesh

and between 546 and 6306 mg/kg fresh weight in the peel (12).

Rosa M. Alonso-Salces and coworkers determined the polyphenolic compositions of 31 Basque cider apple cultivars. Total polyphenols were distributed in a wide concentration range depending on the cultivar from 1.0 g/kg (Bost Kantoi) to 6.0 g/kg of apple (Mendexa 10) with Larrabetzu presenting the richest composition in total polyphenols:13.6 g/kg of apple. In apple juice, the total polyphenol concentration was around 1-2 g/L of juice with Bost Kantoi in the lower end (0.7 g/L) and Mendexa 10 in the higher end (5.4 g/L) (13). At the University of Würzburg an HPLC-analysis was performed of the polyphenol profiles of juices freshly made from 4 dessert and 7 cider apple cultivars as well as 24 commercially available apple juices. For dessert apples the total polyphenol content ranged from 154-178 mg/L, whereas for "old" German cider apple cultivars 261–970 mg/L were determined. The total polyphenol amounts in commercial apple juices were lower; in clear apple juices ranges varying from 110 to 173 mg/L were found (14).

Cider phenolic compounds

Several studies have shown that ciders can provide a wide range of phenolics to supplement a healthy, well-balanced diet. The Institute of Food Research at Norwich determined the amount of antioxidants in 18 UK ciders by adding some of the cider to a solution containing free radicals and then measuring the amount of free radicals knocked out by the beverage. The antioxidant activity score for ciders ranged between 100 and 2595 units for a 250 ml serving which compares to a 150 ml serving of red Bordeaux (2100-3400 units) and is better than a glass of white wine (220 units) and much better than 150 ml long life apple juice (140 units) (15). Rodríguez Madrera and coworkers from SERIDA performed an HPLC-analysis of 92 Asturian natural ciders and found a range of concentrations of phenolic compounds from 189 to 962 mg/L. The cidermaking process in Asturias is very similar to that used in the Basque Country. Natural cider is produced by milling, followed by traditional pressing (3 days) or pneumatic pressing (6 h), spontaneous clarification, natural fermentation to dryness, and long maturation times (4-10 months); moreover, the addition of sugars and CO2 in this kind of cider is prohibited by the Spanish legislation (16).

Except for an absence of anthocyanins, ciders have been shown to have a similar phenolic profile to that of apples. Ciders produced in England are usually made from more than one variety of apple and are known as blended ciders. The basic method used to produce English ciders involves juice extraction, fermentation, and clarification. Alan Crozier and coworkers quantified phenolic compounds in 23 English apple ciders to find out whether the high levels of phenolics in the cider apples is reflected in the ciders themselves. The effect of the choice of apple can be seen in two of the ciders. Both cider 4 and cider 5 were produced by the same manufacturer using the same method, but there is a massive difference in their phenolic profiles, with cider 5 having a much lower phenolic content of 44 mg/L compared with the 1559 mg/L in cider 4. Both of these ciders are single variety ciders, cider 4 being produced from Somerset Redstreak apples and cider 5 from Cox apples. It has been shown in previous studies than the Somerset Redstreak cider apple is especially rich in phenolics. This indicates that the choice of apples can play a major part in the final phenolic content of the cider (17).

Novel cider-making methods?

Conventional apple juice production (straight pressing of apple pulp) results in a juice poor in flavonoids and with only 3-10% of the antioxidant activity of the fruit they were produced from. Main areas of loss of phenolic content are incomplete extraction of apple tissue, oxidation during milling and pressing, and clarification and fining (10). All ciders do share the low levels of flavonols, a subgroup of phenolic compounds. Since these are found predominately in the peel, this would indicate that current methods do not extract the phenolics from the peel effectively, and processing methods may need to be adapted to increase the level of these compounds in cider. By manipulating the cider-making process and choosing an apple cultivar with a high phenolic content, it may be possible to produce a cider with a higher phenolic content and increased potential health benefits when consumed in moderation (17).

Scientists from Wageningen University have presented a process to obtain an apple juice with an enhanced content of polyphenolic antioxidants by applying an extra alcoholic extraction either on the pulp or on the pomace. The novel production process resulted in a new type of apple juice with an enhanced health-protecting capacity: the antioxidant activity of the final juice was 5 times increased and the concentration of polyphenolic antioxidants up to 9 times increased compared to conventional processing (18).

Cider alcohol and cardiovascular health

Strong evidence from observational studies suggests that all alcoholic drinks are linked with lower risk of coronary heart disease. Thus a substantial portion of the benefit is due to the alcohol content of the drink. Here are some of the known mechanisms of effects of alcohol on risk of coronary heart disease (19):

∑ Alcohol increases serum level of HDL - the beneficial cholesterol.

∑ Alcohol decreases serum fibrinogen thus thinning the blood.

∑ Alcohol decreases platelet adhesion making the blood less sticky.

The health benefits of moderate cider consumption

In conclusion cider is a well-balanced, low-alcohol beverage with significant levels of polyphenols. Regular, moderate cider drinking may be a part of a healthy lifestyle together with wholesome food, exercise, keeping your weight down and not smoking. To drink moderately is to drink within the limits set by your health, the society in which you live and your obligations towards your family and friends: 1-2 drinks (1 drink = 10-12 grams of alcohol) a day for most women and 1-3 drinks a day for most men. Cider varies in alcohol content from less than 3% alcohol by volume in French "cidre doux" to 8.5% abv in traditional English ciders. As a low-alcohol beverage cider may help to maintain moderation. The balance of minerals in cider (high in potassium, low in sodium) helps to keep the blood pressure down (20).

References:

1. French RK. The History and Virtues of Cyder. London: Robert Hale Ltd., 1982.

2. Evelyn J. Pomona. London, 1706.

3. Boyer J, Liu RH. Apple phytochemicals and their health benefits. Nutrition Journal 2004;3,5.

4. Gerhauser C. Cancer chemopreventive potential of apples, apple juice and apple components. Planta Med 2008;74:1608-24.

5. Auclair S et al. Apple polyphenols and fibers attenuate atherosclerosis in Apolipoprotein E-deficient mice. J Agric Food Chem 2008;56:5558-63.

6. Boyer J, Liu RH. Apple phytochemicals and their health benefits. Nutrition Journal 2004, 3:5-20.

7. Vrhovsek U et al. Quantitation of polyphenols in different apple varieties. J Agric Food Chem 2004;52:6532-38.

8. DuPont S et al. Polyphenols from alcoholic apple cider are absorbed, metabolized and excreted by humans. J Nutr 2002;132:172-75.

9. Eberhardt MV et al. Antioxidant activity of fresh apples. Nature 2000;405:903-04.

10. Lea GH, Arnold GM. The phenolics of ciders: Bitterness and astringency. J Sci Food Agric 1978;29:478-83.

11. Guyot S et al. Variability of the polyphenolic composition of cider apple (Malus domestica) fruits and juices. J Agric Food Chem 2003;51:6240-47.

12. Marks SC et al. Flavonoid and chlorogenic acid profiles of English cider apples. J Sci Food Agric 2007;87:719-28.

13. Alonso-Salces RM et al. Polyphenolic profiles of Basque cider apple cultivars and their technological properties. J Agric Food Chem 2004; 52:2938-52.

14. Kahle K et al. Polyphenol profiles of apple juices. Mol Nutr Food Res 2005; 49:797-806.

15. Paganga G et al. The polyphenolic content of fruit and vegetables and their antioxidant activities. What does a serving constitute? Free Radical Research 1999;30:153-162.

16. Rodríguez-Madrera R et al. Phenolic profile of Asturian natural cider. J Agric Food Chem 2006;54:120-24.

17. Marks SC et al. Flavonoid and hydroxycinnamates profiles of English apple ciders. J Agric Food Chem 2007;55:8723-30.

18. Van der Sluis AA et al. Activity and concentration of polyphenolic antioxidants in apple juice. 2. Effect of novel production methods. J Agric Food Chem 2004;52:2840-48.

19. Rimm E et al. Moderate alcohol intake and lower risk of coronary heart disease: meta-analysis of effects on lipids and haemostatic factors. BMJ 1999;319:1523-28.

20. Sacks FM et al. Effects on blood pressure of reduced dietary sodium and the dietary approaches to stop hypertension (DASH) diet. N Engl J Med 2001;344:3-10.