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REVIEW ARTICLE

Phytochemical and bioactive potential of Cranberry (*Vaccinium macrocarpon*) Juice and its applications against Kidney and Urinary Track Infection (UTI)

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Cranberries (*Vaccinium macrocarpon*) are a popular superfood. People can eat it as a sauce or as a juice. Other fruit juices and additional sweeteners often come into the cranberry juice. People who are looking for the most beneficial cranberry juice should consume juice that is the primary ingredient for cranberry. Cranberry juice is a widely used and advised remedy for the prophylaxis of urine (UTI). In females with recurrent UTI but not in other patient groups, clinical studies have proved their effectiveness. This effectiveness mechanism is traceable in oral intake of cranberry products in the urine of patients and appears to be caused by a type of A-linkage of the proanthocyanidins. Cranberry proanthocyandins are now also being studied in other common diseases such as Helicobacter pyloric-associated gastritis and dental caries and periodontal diseases in this anti-adhesion mechanism. This is also being useful in other body diseases. The use of cranberries is safe and offers further advantages due to activity that reduces antioxidants and cholesterol.

Keywords: Cranberry, Kidney health, Urinary Tract Infection

INTRODUCTION

Unique among fruits are cranberries. Only a combination of specific factors can they grow and survive. Cranberry, a North American native plant, belongs to the family of *Ericaceae*. The American cranberries and the European cranberries (Vaccinium macrocarpon) are two main cranberries (*V. oxycoccos*). The fruit in Europe is smaller than the American fruit (Zhao, 2007). They are bustards that grow approximately 4 meters with dark pink flowers and reddish black berries. The cranberry fruit is a rich source of bioactive components with a wide range of activities throughout the cool temperature of the northern hemisphere. Cranberries are a rich in-vitro source of polyphenols that have been associated anti-bacterial, antimutagenic and anti-cancinogenic, anti-angiogenic, anti-inflammatory and anti-oxidant in vitro (Mckay *et al*., 2015). Flavonoids, anthocyanin, proanthocyanidins, Phenolic Acids and Vitamin C are cranberries with a high biological activity (Blumberg *et al*., 2013). Cranberries that can prevent urinary tract infections and treat their occurrence are known. Proanthocyanidin in cranberries achieves this effect (Skrovankova *et al*., 2015). About 95% of the grown cranberries are treated. The rest of the five percent is sold freshly to consumers. In large containers these are usually frozen at a receiving station immediately after arrival. In their primary way of collecting cranberries, cranberry use the ability to float.

Effect of cranberry juice against UTI and Kidney health:

Cranberry juice was mainly a juice cocktail of 27 per cent cranberry, the traditional choice of most women who attempted to prevent UTI. 100% cranberry juice has a high degree of accuracy and is therefore regularly prepared into sweetened diluted, highly palatable cocktails. Although most clinical trials have employed sweetened cannabis juice, one major study has shown the effective UTI prevention of the artificially sweetened cannbus juice cock tail. Clinical research has shown that the 240–300 mL daily doses of cranberry juice can prevent UTI recurrence around 50% of the time and reduce bacteriuria and pyruria (Avoran et al.,1994).

Nutritional Composition of Cranberry:

Fresh cranberry	Nutritional composition(100 gm)
Calories	46
Water	90%
Protein	0.4g
Carbs	12.2g
Sugar	4g
Fiber	4.6g
Fat	0.1g

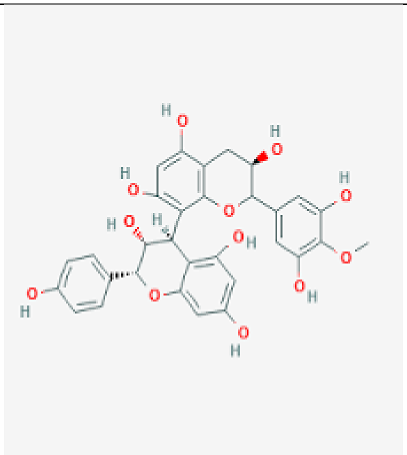
(Food Data Central, 2019.)

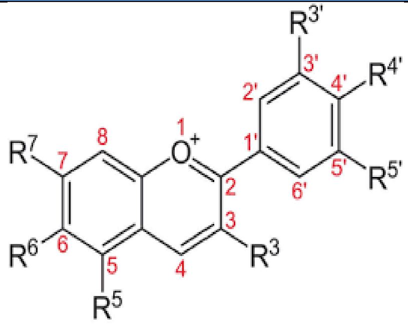
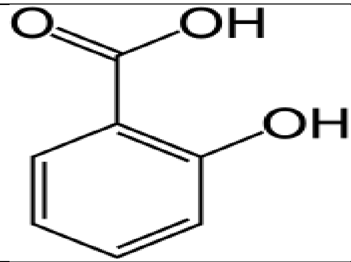
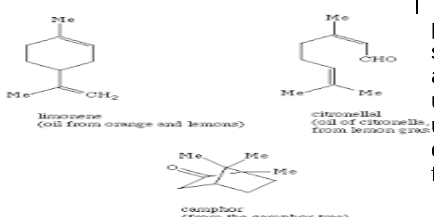
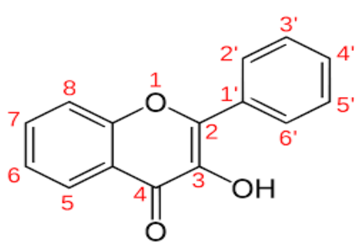
Nutritional facts of Cranberry juice

Cranberry juice	Daily value	Nutritional composition (200gm)
Calories		90
Total fat	0%	0g
Trans fatty acid		0g
Polyunsaturated fat		0g
Saturated fat	0%	
Monounsaturated fat		0g
Cholesterol	0%	0g
Sodium	1%	12mg
Potassium	4%	152mg
Total carbohydrates	7%	22g
Dietary fibers	1%	0.2g
Sugar		20g
Protein		0.5g
Vitamin A	1%	
Vitamin C	105%	
Vitamin E	20%	
Iron	0.9%	
Calcium	2.9%	
Copper	15%	
Vitamin K1	11%	
Vitamin B6	8%	

(Food Data Central, 2019)

Bioactive compounds Present in Cranberries and Cranberry Juice:

Constituents	Structure	Description	Refrences
Proanthocyanidins.		American cranberry is rich and difficult to compose, notably flavano-3 oils, procyanidine atypes (PACs), anthocyanine, ursolic acid and benzoic acid. Cranberry are present like monomers, oligomers and polymers. These oligomers and polymers are also referred to as the PACs or condensed tannins. A group of heterogeneous chemical structures comprises cranberry PACs with their units, connecting types and polymerisation grades (DP). Epicatechin is predominant in cranberry PACs, while (+)-catechin and gallocatechin are present only in trace quantities. A single C-C-bond can be used to condense C4-Size C8 or C6 of the lower unit, or an additional ether-type connection between C2 of the lower unit and the Hyderoxy group of the C7 of the bottom unit, into the PAC building blocks (A-type PACs). PACs with 1 A-type connection at least represent 51-91 percent of the total cranberry PACs. The distinction between PAC structures of type A and B is important as their biological properties can be affected by their differences. The in vitro adhesion of the P-fimbriated *Escherichia coli* bacteria to uroepithel cells of the A- type PACs exhibit considerably greater inhibition than the PACs of the B type. Importantly, the heterogeneous PACs family analysis, including numerous stereoisomers lacking in trade standards, remains problematic and data obtained using global methods do not solve this problem. The average PAC DP in cranberry has not been determined. The in vitro adhesion to E was impeded by the cranberry PACs. Initially, coli reported a mean DP4.7 in uroepithelial cells. In a higher average PACs for cranberry PACs (8.5–15.3) PACs with DPs up to 23 were subsequently identified in matrix-assisted laser deorption-ionization flight time MS. In particular, the cranberry contains high cell wall-bound PACs resistant to conventional methods of extraction. There is therefore a risk of underestimation of cranberry PACs in previous literature. The linked PACs are important for health effects because bioaccessibility has proved to be the human large intestine. Due to the limited data available on the PAC content of cranberries today, it is difficult to draw comparisons of other berries. However, the qualitative profiles are significantly different. 3 A-type trimers and procyanidine A2, identified by V. macrocarPon as putative active substances, are only present in the European cranberries in trace amounts and in lingonberries at significantly higher amounts. Flavan-3-OL profile in the 3 species of vaccine have also been found to be different in comparison with the other berries, such as a much higher epicatechin:catechin ratio in US cranberries. As with red wine, in final maturation or in post-harvest storage, cannberry anthocyanins and proanthocyanins can be condensed into complex polymer pigments. The characterisation of these structures has only begun.	(White *et al*., 2017) (GU *et al*., 2004) (Foo *et al*., 2000) (Feliciano *et al*.,2012) (Howell *et al*.,2005) (Beltsvile 2004) (Pappas et al.,2009) (Reed et al., 2005) (Saura et al., 2012) (Perez et al., 2012) (Terescou et al., 2011)

Anthocyanins.		Cranberry has an extremely high amount of anthocyanins, which contributes to the fruit colour and food derived and to the potential impacts on human health. Cranberry in the U.S. is one of the rarities that include glycosides of the 6 anthocyanidin aglycones in the family: cyanidine, peonidine, malvidine and pelargonidine. 3-O-galactosides and 3-O-arabinosides of cyanidine and peonidine are the predominant anthocyanins; a total of thirteen anti-cyanines have been detected, mainly three O-monoglycosides. The content is increased with ripening of cranberry anthocyanin and depends on the cultivar and fruit size. Berry species vary in their anthocyanin profiles. Among the 100 foods commonly consumed in the United States, cranberry is reported to be the main source of peonidine. In many studies, however, instead of quantities of individual anthocyanins, the total anthocyanin content is reported. This approach may change because the structures of aglycons or glycosidic moieties appear to have an influence on the organic availability and the health effects of anthocyanins.	(Wu x et al.,2005) (Cote et al., 2010) (Vedenskaya et al., 2004) (Brown et al., 2012) (Wu x et al., 2006) (Czank et al., 2013)
Phenolic acids.		Phenolic acids, including hydroxybenzoic acids, are also found in cranberry. One is that there are 474 to 557 mg/100 g FW at highest benzoic acid concentrations and 2.4-dihydroxybenzoic, p-hydroxybenzoin, O-hydroxybenzoic and 2-4 mg/100 g FW significantly lower. P-coumaric, sinapic, coffeic and ferulic acids with a content of 8.8 to 25 mg/100g FW are the main hydroxycinnamic acids of cranberry. Of course, these phenolic acids are not cranberry-specific. In cranberries it is difficult to compare the content of phenolic acid with other berry fruits. In American cranberries, no substantial amounts of ellagic acid and ellagitannins were found.	(Zuo y et al., 2002) (Zhang k et al., 2004)
Terpenes.		Active terpenes present in cranberry is much less investigated than the polyphenol composition, further focus is needed. Titerpenes are a component of several herbal medicinal products and have high anti-information effects. Ursolic acid is in a variety of foods available. Cranberry also contains a range of rare uralic acid products for trans-3-O-p-hydroxycinnamoyl, namely, cystic acids and uralic acid Cranberry has also described the iridoids Monotropein and 6,7-dihydromonotropein. Two new coumarry iridine Glycoside, were analysed for fractionation of the cranberry juice.	(Kondo et al., 2011) (Ikeda et al.,2008) (Turner et al., 2007)
Flavonols.		Flavonols are found mostly in quercetin, myricetine and, to a lesser extent, in cranberry kaempferol glycosides. The most common form of crosscetin-3-galactoside is but at least 11 other low glycoside levels exist. Some are rarely found in fruit, including 3acetylrhamnoside quercetine.	(Mikulic et al., 2012)

Chemical constituents of Cranberry:

Chemical constituents	Whole cranberry fruit(mg/100gm)
Flavonols,	21.96
Quercetin	15.09 ± 1.06
Myricetin	6.78 ± 1.67
Kaempferol	0.09 ± 0.03
Anthocyanins,	91.57
Cyanidin	41.81 ± 2.86
Peonidin	42.10 ± 3.64
Delphinidin	7.66 ± 1.93
Flavan-3-ol monomers	7.26
Epicatechin	4.37 ± 0.93
Epigallocatechin	0.74 ± 0.28
Epigallocatechin gallate	0.97 ± 0.48
Catechin	0.39 ± 0.16
PACs,	411.5
Dimers	25.93 ± 6.12
Trimers	18.93 ± 3.39
4–6mers	70.27 ± 13.07
7–10mers	62.90 ± 14.71
Polymers	233.48 ± 49.08

(Food Data Central, 2004 and2007)

Phytochemical contents of Cranberry:

composition	Cranberry fruit(mg/100 g)	Cranberry juice(mg/L)	cranberry sauce (Canned) (mg/100 g)	dried cranberries (Sweetened) (mg/100 g)	References
Flavan-3-ol monomers and dimers	7–33	6–35	112.8	---	(Gu l et al.,2004) (Wang C,et al.,2011)
Proanthocyanidins	133–367	89–230	16–54.4	64.2	(Gu l et al.,2004) (Grace et al.,2012)
Anthocyanins	13–171	27–132	0.6–11.8	10.3	(Pappas et al., 2012) (Grace et al.,2012)
Hydroxybenzoic acids	503–602	64	476	---	(Wang C,et al.,2011) (zhang et al., 2004)
Hydroxycinnamic acids	73–82	12–19	47.5	---	(Wang C,et al.,2011) (Zhang et al., 2004)
Terpenes	65–125	Trace	1.1–22.8	98.5	(Kondo et al., 2011)
Flavonols	20–40	11–58	5	---	(Zhang et al., 2004)

An ex vivo study of human urine following the consumption of cranberry juice cocktails indicated that two daily dosages for cranberry could provide an additional 24-hour protection (Howell et al., 2002). Daily dose levels below 240 mL can be less protective (Gupta et al. 2004), but clinical confirmation is necessary. NIH-funded dose-response clinical intervention trials for the determination and clarification of effective cranberry cocktail dosages are currently ongoing. Although further clinical research in these products is necessary to determine doses and efficacy, other forms of cranberry have proven to be of benefit, including sweetened cranberry powder in tablets or capsules (Stother et al., 2002), sweetened sweetened cranberry sauce (Greenberg et al., 2005) as well as cranberry sauces (Howell et al., 2000) Cranberry has several attractive characteristics in patients with the chronic kidney. Cranberry juice has long been a source of belief that it helps the urinary tract and renal health. It was originally thought that bacteriostatic effect was due to fruit acids. But in cranberries, proanthocyanidins are isolated to have bacterial antiadhesive activity that prevents bacteria from binding to the bladder walls (Japson et al., 2012).

Mechanism of action:

Inflammatory and Nrf2 down-regulation in the Nrf2 disease is manifested in Chronic kidney disorders and other chronic diseases, which are mostly the effect of lifestyling disorders, such as obesity, diabetes, osteoporosis, depression and heart disease. Moreover, CKD patients suffer from intestinal dysbiosis that contributes to pro-oxidant and pro-inflammatory environments that can contribute to the growth of CKD and increase the cardiovascular risk. These observations suggest that the logical objective for CKD-patient interventions should be inflammation, oxidative stress and intestinal dysbiosis. Nutrition strategies can reduce certain of these complications. There is increasing evidence. Since cranberry, the principal bioactive compound found in cranberries – is a rich source of proanthocyanidins – this fruit can relieve oxidative stress, inflammation and dysbiosis in the gut and thus suggests the use of cranberry supplementation. We suggest that ample background information is now available to consider studies to test if regular intakes of cranberry can be beneficial for CKD patients. Although effects of cranberry in CKD patients have not yet been tested on the basis of the research described in the study, there are reasons to expect the effects of cranberry in CKD patients to be beneficial, oxidative stress alleviating, inflammatory and bowel dysbiosis(Potential impacts on patients with CKD are cranberries and phenolic compounds. Cranberry helps to avoid UTI, as well. Furthermore, CKD can also view the cranberry consumption as a promising strategy for its phytochemical anti-inflammatory, antioxidant and prebiotic effects. Cranberry can act in Nrf2/NF-μB, withochondrial dysfunction, a decreased cardiovascular risk and an inflammation of CKD by relieving oxidative stress**.)**

CONCLUSION

Cranberries are healthy, colourful fruits, flavours and nutritional value that provide functionality. They are one of just three American fruits. The public concern for North American cranberries (Vaccinium macrocarpon) has been growing over the last decade, reporting its potential health benefits in connection with the numerous phytochemicals found in the fruit, namely anthocyans, Flavonols, flavan 3 oils, phenolic acid derivatives and proanthocyanidines. The presence of these plant chemicals is responsible for the cranberry property, including UTI diseases and childish disorders, which prevents many diseases and infections.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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The authors declared that there is no acknowledgement

AUTHOR CONTRIBUTIONS

SN, MK, MAI, RI and FH explored literature on cranberry, SN supervised the data. All authors read and approved the final version.

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