

Health Benefits of *Cornelian cherry* (*Cornus mas* L.)

Zeliha Kaya¹([ID](#)), Ikay Koca²([ID](#))

¹Department of Food Engineering, Faculty of Engineering, Giresun University, Giresun, Turkey

²Department of Food Engineering, Faculty of Engineering, Ondokuz Mayıs University, Samsun, Turkey

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Abstract

Medicinal plants have been used for medical objectives since ancient times due to their beneficial properties, and their uses continue to this day. The *Cornelian cherry* fruit (*Cornus mas* L.) is considered to be one of those medicinal plants with important nutritional and therapeutic properties. It has been also used for different medical purposes in many countries in Europe and Asia for centuries due to its various important components in terms of health. *Cornelian cherry* is known to have antimicrobial, antioxidant, anticancer and anti-inflammatory effects due to its composition of phenolic compounds and ursolic acid. It is reported in the literature that This fruit is used in different countries for different purposes; for the treatment of intestinal and kidney diseases, strengthening immunity, and preventing some types of cancer and others. It is also used in traditional medicine to cure fever, cholera, kidney stones, malaria, urinary tract infections, heat stroke and bleeding. Many studies have reported the positive effect of *Cornelian cherry* in regulating blood sugar and preventing fat accumulation in the liver. Similar to many countries, it is grown in Turkey in many regions and it is consumed processed or fresh into several crops such as compote, jam, marmalade and fruit leather. This paper has reviewed the investigative studies of the health effect of cornelian cherry.

Keywords: Medicinal plants; *Cornellian cherry*; antioxidant; antimicrobial; health benefit.

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Address for correspondence/reprints:

Zeliha Kaya

Telephone number: +90 (543) 380 0824

E-mail: zeliha_mol@hotmail.com

Introduction

In recent years, interest in fruits rich in antioxidant compounds has increased with the emergence of the relationship between food and health. *Cornelian cherry* is one of the fruits that grow naturally in Turkey. This fruit is a rich source of phenolic compounds, anthocyanin, and ascorbic acid. It has been reported in the literature that it has antibacterial, antihistamine, antiallergic, antimicrobial, antimalarial and anti-diabetic properties due to its antioxidant properties (1). *Cornelian cherry* fruits can be consumed dried or fresh as well as processed into marmalade, jam and fruit juice.

It is known that many factors such as developing technology, increasing environmental pollution, used pesticides, smoking and alcohol use, Ultraviolet (UV) rays, and work and living conditions all increase the stress level. These environmental and psychological factors cause the formation of free radicals in humans and the increase of the resulting radicals can trigger various diseases. These highly reactive radicals damage the cell membrane and biomolecules found in the cell structure such as proteins, enzymes, lipids, carbohydrates and nucleic acids. In some cases, the body's defense mechanism is insufficient to fight against these radicals and the oxidative stress arises in the human body (2). Oxidative stress can be a cause of aging, cancer, cardiovascular diseases, lung diseases, diabetes and cataracts. The elimination of these factors adversely affecting human health is thought to prevent the formation of such diseases and protect human life (3).

General taxonomy information and distribution

The genus *Cornus* L. from the Cornaceae family consists of 65 known species that grow mostly in the form of trees and bushes. *Cornus* L. species are widely grown in the northern hemisphere, mostly Anatolia, the Caucasus and Europe (1). Among the *Cornus* species found in different parts of Asia and Europe, four species are known to have edible fruits, namely *Cornus officinalis*, *C. mas*, *C. kousa* and *C. controversa* (4). *Cornelian cherry* is a type of fruit that grows on trees with a stem diameter of 25-45 cm, which can grow up to 7-8 meters in height, or bush that shed its leaves in winter.

Cornelian cherry is a type of stone fruit. It ripens in late summer and early autumn. This fruit is an elliptical-shaped, 10-15 mm long, pink-red colored, slightly sour, tasty and nutritious fruit (5,6). Average fruit weight is between 5-8 g and kernel constitutes 7.5-11% of whole fruit weight. In wild-growing species, the yield is between 2.8 and 4.8 kg per bush,

while with ideal rain and sun intake, this amount can reach up to 10 kg per bush. A yield of 30-80 kg per plant can be obtained in agriculturally grown species (6).

Phytochemical Composition

It is reported that *Cornelian cherry* fruit contains up to 88% of water, and it is a wealthy source of organic acids, vitamin C, proanthocyanidin, anthocyanin, epicatechin, and catechin (7). This fruit has an impressive red color due to the anthocyanin compounds that contain. They also contain phenolic compounds which have very beneficial effects on health. The diverse phytochemicals found in different parts of *Cornelian cherry* are summarized in Table 1.

The participants with UI were evaluated in terms of quality of life. Comparisons of the participants with different types of UI are presented in Table 2A,B. Mixed incontinence patients exhibited the least satisfaction in quality of life compared to both urge and stress incontinence in our study. According to UDI-6 total and subscale scores, patients with stress incontinence were in more discomfort than patients with urge incontinence. The same results were obtained with IIQ-7 total and subscales (Table 2A,B).

Cornelian cherry contains plenty of phenolic compounds, anthocyanin, and ascorbic acid. The fresh fruit contains 101-193 mg/100g ascorbic acid (19), 223-292 mg/100g total anthocyanin expressed as cyanidin-3-O-glycoside (1) and 281-704 mg/100g total phenolic compounds (20). Anthocyanins are the most important phenolic compounds of this fruit, followed by other flavonoids, phenolic acids and tannins, respectively. The leaves are richer in phenolic compounds (11.30%) when compared to fruits. Although the leaves contain more flavonoids, they contain no anthocyanins (10). Besides, the flowers are rich source of phenolic compounds, especially flavonoids (21).

Cornelian cherry is usually consumed fresh, as jam, compote, marmalade and pestle. Recently, this fruit got interestingly importance in pharmaceuticals since it contains many nutraceuticals. It displays a sour taste, since it has a high level of vitamin C. The juice is 10-fold richer in calcium than pear, plum and apple juices. The juice contains also an important level of Fe, Mn, Zn, Na, and K (22). It was reported that *Cornelian cherry* could be used for prevention remedy of coronary heart diseases and cancer thanks to its bioactive compounds. Furthermore, it exhibits antioxidant and inflammatory properties due to its high level of phenolic compounds and ursolic acid (1).

Table 1. The diverse phytochemicals found in different parts of cornelian cherry

Phytochemical group	Part of plant	Chemical constituents	References
Flavonoids	Fruits, flowers and leaves	aromadendrin 7-O- glucoside, aromadendrin 7-O- xyloside, aromadendrin 7-O- glucoside, trans-Aromadendrin, kaempferol 3-O-galactoside, kaempferol 3-O-glucuronide quercetin, quercetin 3-O-xyloside, quercetin 3-O-rhamnoside, quercetin 3-O- galactoside, quercetin 3-O-rutinoside, quercetin 3-O-glucoside quercetin 3-O-robinobioside quercetin 3-O-galactosyl 7-O-rhamnoside myricetin, naringenin 3-O-methyl ester 7,3'-dihydroxy-5,4'-dimethoxyflavanone, 4-acetoxy-5,2',4',6'- β - pentahydroxy-3-methoxychalcone, isorhamnetin 7-O-rhamnoside	(8-12)
Flavanols	Fruits and leaves	(+) -Catechin, (-) -epicatechin	(10)
Anthocyanins	Fruits	cyanidin 3-O-robinobioside, cyaniding 3-O-galactoside cyanidin 3-O-glucoside, cyanidin 3-O-rutinoside, delphinidin 3-O- β -galactopranoside, delphinidin-3-O-galactoside delphinidin 3- <i>o</i> -rutinoside pelargonidin 3-O-rutinoside, pelargonidin 3-O-glucoside, pelargonidin 3-O-galactoside pelargonidin 3-O-robinobioside pelargonidin 3-O- glucoside, peonidin 3-O-glucoside chloride.	(1,9,11,13)
Phenolic acids and tannins	Fruits and flowers	ellagic acid, gallic acid, quinic acid, shikimic acid, chlorogenic acid 5-O-caffeoylquinic acid 3-O-caffeoylquinic acid, ferulic acid, vanillic acid salicylic acid, p-coumaric acid	(10,14-16)
Iridoids	Fruits	Loganin, loganic acid, comuside, sweroside	(13,16)
Carotenoids	Fruits	β -Carotene, β -carotene-5,6-monoxide, lutein-5,6-epoxide, lutein, luteoxanthin (13Z, 13'Z)-lutein, (9Z, 9'Z)-lutein, (9'Z)-neoxanthin, (all-E)-neoxanthin,	(17)
Fatty acids	Fruits and leaves	Linoleic acid, oleic acid, α -linolenic acid, palmitoleic acid, palmitic acid, stearic acid, 2,4-heptadienoic acid	(15)
Organic acids	Fruits and leaves	oxalic acid, maleic acid, isocitric acid, malonic acid, succinic acid, tartaric acid, citric acid, fumaric acid	(9,15)
Vitamins	Fruits	Ascorbic acid, α -tocopherol, biotin, riboflavin	(18)

Table 2A. Beneficial effects of different parts of *Cornelian cherry*

Activity tested	Plant part	Effect	Reference
Antioxidant	fruits	Fruit extracts displayed important antioxidant activities and the FRAP value was 21–57.8 FRAP units.	(20)
	Leaves, flowers and fruits	The methanol extracts from leaves, flowers and fruit showed acceptable antioxidant activity and the IC ₅₀ value was 39.40, 27.58 and 251.87 µg/mL respectively.	(21)
	Fruits	All extracts displayed significant antioxidant activities with FRAP unit of 190–200 µM/g in FRAP assay and IC ₅₀ of 3.95–9.67 mg mL in DPPH assay.	(14)
	fruits	Showed good antioxidant activity with 1509–5954µmolFe ²⁺ /100 g FRAP assay, 623–1903µmol _{TE} /100 in DPPH assay and 441–1475µmol _{TE} /100 g in ABTS assay,	(31)
Antimicrobial	Fruits, leaves	The extracts of fruits and leaves showed acceptable antimicrobial activity against different bacterial and fungal strains (<i>Bacillus cereus</i> , <i>Clostridium perfringens</i> , <i>Escherichia coli</i> , <i>Listeria monocytogenes</i> , <i>Micrococcus flavus</i> , <i>Staphylococcus aureus</i> , <i>Pseudomonas aeruginosa</i> , <i>Sarcina lutea</i> , <i>Shigella sonnei</i> , <i>Candida albicans</i> , <i>Salmonella enteritidis</i> , <i>Proteus vulgaris</i> , <i>Klebsiella pneumonia</i>)	(10)
	fruits	Showed significant antimicrobial activity against <i>Pseudomonas aeruginosa</i> and <i>Staphylococcus aureus</i> . The extract was killed them all in one week and there was no bacterial growth until the 28th day.	(32)
	fruits	The most efficient antibacterial effect was enounced by water and methanol extract of CM fruit against <i>Staphylococcus aureus</i> the Minimum Inhibitory Concentration value was value 0.156 mg/ml and inhibition zone was 25 mm) and just methanol extracts showed an antifungal effect.	(33)
Anti-diabetic	Fruits	It was observed to reduce high levels of low-density lipoprotein cholesterol (LDL-C), (aspartate) AST, triglycerides (TG), alanine aminotransferase (ALT) and alkaline phosphatase (ALP) to normal levels.	(34)
	Fruits	After 6 weeks of intervention, significant increase in insulin as well as decrease in HgbA _{1c} and TG levels was seen in the drug group compared to the placebo. It has been observed that daily consumption of the CM extract improves glycemic control in adults with type 2 diabetes.	(35)
	Fruits	In pre-diabetic state of animals, it was found an important decrease of glucose level after the oral implementation of CM in dose of 1000 mg/kg bw and significant limitation of water intake. It is concluded that if higher doses of CM are consumed regularly in young animals, diabetic symptoms can be prevented.	(36)

Table 2B. Beneficial effects of different parts of *Cornelian cherry*

Cytotoxic and Anticancer	Leaves	Showed important cytotoxic effect against human breast cancer cells. After treatment of 72 h, it was reduced the survival of cells to 11.1% (at a dose of 750 µg/mL). It is stated that this effect is related to tannins and total polyphenols in leaves.	(37)
	Fruits	Exhibited important cytotoxic effect against different tumor cells (prostate adenocarcinoma, ovarian cancer, breast adenocarcinoma and lung non small cell cancer cells by growing inhibition of 80.3%, 82.2%, 79.4%, and 78.2% respectively).	(38)
	Fruits	Showed anticancer effect against liver cancer and breast cancer cells. It was observed that the cytotoxic effect of unripe fruit was higher than that of ripe fruit.	(39)
	Fruits	The two forms of CM extract (free CM extract and encapsulated into enteric coated nanocarriers) were studied. It was determined that the encapsulated CM extract effectively preserved the antioxidant activity and increased the anticancer effect.	(40)
Protective	Fruits	Demonstrated cardioprotective effect by enhancing myocardial endogenous antioxidant enzymes (glutathione peroxidase (GPx), superoxide dismutase (SOD), catalase (CAT)), lowering the high levels of myocardial lipid peroxides, serum creatine kinase, serum lactate dehydrogenase and fixing myocardial damage.	(41)
	Leaves	Decreased the lipid peroxidation products grades to 50.04% and showed important radioprotective effect.	(42)
	Fruits	Decreased the oxidative stress caused by methotrexate and exhibited significant dose dependent preventive effect of the sperms. Reported to have a similar effect to vitamin E.	(43)
	Fruits	Showed a protective effect on brain tissue by decreasing the levels of protein carbonyl groups and thiol groups in plasma and brain tissue and improving the activity of paraoxonase enzyme. Also improved the activity of catalase enzyme in brain tissue and showed preventive effect to the nervous system from oxidative stress.	(44)
	Fruits	At the tested doses the CM extract improved the levels of serum antioxidant enzymes and decreased the levels of urea, uric acid, serum creatinine and showed renal protective effect.	(45)
	Fruits	Increased the levels of antioxidant enzymes, decreased the elevated malondialdehyde (MDA) and showed important hepatoprotective effect. Also normalized the toxin-induced hepatic lesions.	(46)
	Fruits	Showed hepatoprotective effect by reducing the activity of, ALT, ALP, AST, Lactate dehydrogenase (LDH) and level of direct bilirubin, MDA.	(47)
	Fruits	Showed protective effect of nervous system. It was stated that CM flavonoids increased memory retention and can be used in the treatment of Alzheimer's disease.	(48)
Other	Fruits	Ethnomedical use of CM in the treatment of ulcerative colitis has been verified.	(49)
	Fruits	The extracts from fruits of CM showed important anti-amylase and anti-lipase effect. Therefore, CM can be regarded as effective inhibitors of digestive enzymes involved in the prevention or control of diseases associated with hyperlipidemia.	(50)

Health benefits

Since millennia, *Cornelian cherry* fruit, leaves and flowers are widely used in Caucasia and Central Asia as blood clotting as fruit and for the treatments of sore throat, anemia chickenpox, rachitis, and kidney-liver disorders (23,24). It is also used as an ingredient in melatonin-rich medicines since it contains a higher level of melatonin. It has antipyretic and diarrheal effects, and the juice, sherbet or compote helps for the treatment of kidney stone diseases by increasing the amount of acid in the urine (25). This fruit improves kidney and liver functions, displays neuroprotective and anti-aging effects and contributes to restoring memory and motor skills. Furthermore, the fruit has positive effects on human skin and is used in the cosmetic industry in Europe. In addition, it is used as anti-bleeding agents (25).

The health benefits of different parts of *Cornelian cherry* are given in Table 2. This fruit is used depending on the countries' traditions. In Serbia, *Cornelian cherry* is employed as a preventive and curative remedy for the treatments of intestinal diseases, diarrhea and anemia as well as to booster the immune system (26), while it is applied in the treatment of digestive disorders and hemorrhoids in Turkey and Azerbaijan (23,27). In Caucasian countries, seed oil and fresh fruits are used as cures of stomach ulcers, wounds, and colitis (24). It has been reported that fruits are used in traditional medicine as cures of intestinal inflammation, diarrhea, malaria, kidney stones, fever, urinary tract infections, cancer and sunstroke in Iran (18). *Cornelian cherry* is employed in the traditional medicine for the treatment of intestinal inflammation and digestive disorders and also the cosmetics industry in Italy (28). *Cornelian cherry* is also used to regulate kidney functions and to treat diabetes in China (29). In addition, it is commonly used in Greece to prevent gout, anemia and skin diseases as well as joint pain, metabolism disorders and tuberculosis (30).

Conclusion

Cornelian cherry is found wild or grown in many Asian and European countries. It is widely used since the positive effects on health are well-known. It has widespread uses in both gastronomy and traditional medicine. The *Cornelian cherry* produced in Turkey is rich in vitamins and minerals and have important antioxidant compounds. The fruit is considered as a valuable nutritional supplement thanks to the richness in flavonoids, carotenoids, anthocyanins, iridoids, vitamins, phenolic acids, pectins, tannins, minerals and sugars. It is used in the treatment of many diseases like obesity, diabetes, cancer,

hypercholesterolemia, digestive system diseases, liver and kidney disorders. Although the action mechanism of this fruit on the mentioned diseases is not clearly determined, it is well-known that most of these diseases are caused by oxidative stress. The clinical studies on patient groups should be completed on the plants rich in bioactive components like *Cornelian cherry* used in the prevention and treatment of illnesses. Furthermore, new studies are needed to discover the unknown effects on health and to review the known effects.

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