Elderberry (Sambucus Nigra) : A Comprehensive Analysis of its Medical benefits

Shyam Kumar Gupta[1*], Dr. Ashutosh Kumar[2]

[1] Research Scholar, Sunrise University, Alwar, Rajasthan

[2] Associate Professor (Dept. of Pharmaceutical Science), Sunrise University, Alwar, Rajasthan

Abstract - The elderberry plant (Sambucus nigra) is an excellent resource for many essential nutrients, including protein, free and conjugated forms of amino acids, unsaturated fatty acids, fibre fractions, vitamins, antioxidants, and minerals. Elderberry has been found to contain a number of bioactive compounds, including the polyphenols anthocyanins, flavonols, phenolic acids, proanthocyanidins, terpenes, and lectins. Elderberry has been utilised in the treatment of a wide variety of illnesses and conditions in traditional medicine. Antioxidant-potential chemicals called polyphenols are responsible for elderberry's therapeutic benefits. Beneficial effects on blood pressure, glycaemia, immune system stimulation, antitumor potential, increase in the activity of antioxidant enzymes in the blood plasma (including glutathione), and reduction in uric acid levels are just a few examples of the ways in which these substances can significantly alter the progression of disease processes.

Keywords - elderberry plant (Sambucus nigra), polyphenols anthocyanins, Antioxidants flavonols, phenolic acids, proanthocyanidins, terpenes, and lectins.

---------------------------------X---------------------------------

INTRODUCTION

Using plants, first those found in the wild and later those grown specifically for medicinal purposes, is a common practise in folk medicine that dates back millennia. For centuries, people throughout Europe (French 1651), northern Africa, and some areas of Asia have relied on black elder for anything from protecting against evil spirits to warding off disease. Some of this knowledge was conveyed to the New World by early settlers, who discovered that the American elder, a closely related plant, grew freely throughout the continent. Elderberry has been used for centuries by Native Americans for its medicinal purposes, especially in the treatment of fever and rheumatism (Borchers et al., 2000). (Moerman 1986). While many of the purported benefits have not been well studied, there is growing evidence that American and African elders possess substantial therapeutic or medicinal characteristics.

American elder has been used for over a century, yet despite its popularity, it is still mostly unknown outside of the business. In contrast, black elder is widely grown and processed in Europe, where a wide variety of edible (pies, jellies, jams, wines...) and medicinal (supplements, extracts, syrups, lozenges...) items are on offer. Black elder's widespread and historic application is supported by abundant evidence, but American elder has been the subject of far less research. However, due to their close taxonomic relationship, these two plants will be considered to be the same species. This paper will provide a critical analysis of the purported and demonstrated therapeutic effects of these substances. Where applicable, we will highlight any major discrepancies.

Botany

The American elder, or Sambucus nigra ssp. canadensis (L.) R. Bolli, Adoxaceae, is a plant with multiple common names. This plant is closely related to the common European black elder [S. nigra sbsp. nigra (L.) R. Bolli]. Recent work by Bolli (1994) has reclassified American and black elders as subspecies within the genus Sambucus. Unfortunately, S. canadensis and S. nigra are still regularly used to refer to American elder and black elder, respectively, despite the recognition of this distinction. Donoghue (2003) found that Sambucus should be moved from the Caprifoliaceae family to the Adoxaceae family, and this change is being implemented gradually. Read Atkinson & Atkinson if you want a thorough account of black elder (2002).

Eastern and central North America are the homelands of the American elder tree. Its range spans from Nova Scotia in Canada to Florida in the United States, and from Manitoba in the west to Texas in the east (Small et al. 2004). It's adaptable enough to flourish in many soil conditions and may even survive brief periods of flooding, though spring floods are usually disastrous. Birds and mammals that eat the berries are mostly responsible for spreading the seeds. New plants want to settle in unoccupied spaces where they won't face as much opposition from older, slower-growing plants like weeds.

Figure 1: Cluster of American elder berries (*Sambucus nigra* sbsp. *canadensis*)

The fruit clusters of the elderberry, a deciduous multi-stemmed shrub, are heavy enough to break the brittle branches. Dense thickets are formed as a result of the plant's root suckers and the main stems' basal branching. The southern half of its range is where it reaches heights of up to 9 m, but the southern section of Canada sees it peak at under 4 m. (Small et al. 2004). Inevitably, as a shrub ages, its older branches die off, which limits its potential height.

The leaflets of the large (5-15 cm long) opposing pinnately compound leaves are pinnately compound and have highly serrated margins. In Canada, American elder is one of the earliest shrubs to bloom in spring. When it comes to heat buildup, it doesn't matter in the northern portion of its distribution zone, where it blooms at the end of June (Guilmette 2006). Lots of commercially important cultivars bloom at the same time. Creamy white flowers form massive terminal clusters that can measure up to 35 centimetres in diameter.

Elderberry contains compounds that are beneficial to human health

Many factors influence elderberry's (Sambucus nigra) chemical make-up, including cultivar, maturity level, location, and weather (Kader & Barrett, 2005). The protein content of elderberry ranges from 2.7-9.0%, with the highest concentration found in the leaves (3.3%) and the highest in the flowers (2.4%). Fruits, vegetables, and flowers all contain amino acids, either as free molecules or as part of a peptide bond. Elderberry contains all of the essential amino acids that humans need to thrive. Of the sixteen amino acids found in the fruit, seven are considered exogenous (meaning they must be obtained from food) or relative exogenous (meaning they can be synthesised by the body from other amino acids). The nutritional value of a protein, calculated as the ratio of the amount of amino acid in a product to the amount of the corresponding amino acid in a reference egg albumin (Akbulut et al, 2009, Kislichenko, Vel'ma, 2006), was determined to be 0.9 when taking the amino acid composition of elderberry into account. The seeds of elderberries are where you'll find most of the fruit's lipids. According to Dulf, Oroian, Vodnar, Socaciu, and Pintea (2013), the oil content in seeds is an estimated 22.4%, and the meal made from seeds has an estimated 15.9%. (Fazio, Plastina, Meijerink, Witkamp, & Gabriele, 2013). Unsaturated fatty acids, specifically linolenic (40.7 g/100 g oil), linoleic (34.3 g/100 g oil), and oleic acid (13.8 g/100 g oil), predominate in the fatty acid profile of lipids as a whole (Dulf et al., 2013). The n-6/n-3 ratio in both seed oil and meal is rather desirable, coming in at 0.84 and 1.19 respectively (Dulf et al, 2013, Fazio et al, 2013). Elderberry fruits have a carbohydrate composition of 18.4 percent, of which 7.4 percent is fibre (Bender, 2006). Fruit contains a number of different types of fibre, including pectin, pectic acid (polygalacturonic acid), protopectin (hemicellulose), and calcium pectinate (Vuli, Vraar, & umi, 2008). The fruit contains sugars at a concentration of 6.8-11.5%, with glucose and fructose accounting for more than 95% of this total. The ratio of glucose to fructose is almost the same. There is less than 0.33 percent sucrose in fruits (Mratini, Fotiri, 2007; Veberic et al., 2009). Elderberry contains vitamin C, vitamin E, tocopherols, and several members of the B vitamin family. There are 6-35 milligrammes of vitamin C per one hundred grammes of fresh elderberry fruit (Akbulut et al, 2009, Kaack, Austed, 1998). Elderberry seed oil contains a variety of tocopherols, including -tocopherol (0.49 g/g oil) and -tocopherol (2.63 g/g oil) (Fazio et al., 2013). However, the residues left behind after oil is extracted from the seeds include a variety of tocopherols, including -, -,

-, and -tocopherols (0. The three types of tocopherols found in the leaves were identified as -, -, and -tocopherols (313, 8.1, and 2.9 g/g DW, respectively) (Barros, Cabrita, Boas, Carvalho, & Ferreira, 2011). K, Ca, Fe, Mg, P, Na, Zn, Cu, Mn, Se, Cr, Ni, and Cd were found in the 0.99% ash found in elderberry fruit (Koodziej et al., 2012; Rupasinghe and Clegg., 2007).

Polyphenols, including flavonols, phenolic acids, proanthocyanidins, and anthocyanins, give elderberry its signature black-purple colour and are responsible for the fruit's high biological activity (Anton et al., 2013). The anthocyanins found in elderberries are primarily cyanidin derivatives, with some other anthocyanins present in very little concentrations. Several flavonoid compounds can be found in S. nigra, including cyanidin-3-glucoside (C3G), cyanidin-3-sambubioside (C3S), cyanidin 3-sambubioside-5-glucoside (C3S5G), cyanidin-3,5-diglucoside (C3,5-DIG), cyanidin-3-rutinoside (C3R), pelargonidin-3 (D3R). More than one type of anthocyanin can be found in Sambucus canadensis because of the existence of acylated anthocyanins. These include cyanidin-3-(Z)-(p-coumarin)-sambubioside-5-glucoside, cyanidin-3-(p-coumarin)-glucoside, cyanidin-3-(E)-(p-coumarin)-sambubioside-5-glucoside. Furthermore, petunidin 3-rutinoside was reported in S. canadensis without cyanidin 3-rutinoside or pelargonidin 3-glucoside (Labun et al., 2011, Lee, Finn., 2007, Wu et al., 2004). Elderberry fruits may or may not contain specific anthocyanins. Depending on cultivar and stage of fruit development, cyanidin 3-glucoside is the most abundant anthocyanin in S. nigra fruits (204.6-481.4 mg CGE/100 g fruits). Cyanidin 3-sambubioside (122.2-269.1 mg CGE/100 g fruits) was the second most abundant anthocyanin (Lee & Finn, 2007). Twelve of the thirteen S. nigra varieties tested had higher concentrations of cyanidin 3-glucoside than the others, with var. Allese being the only exception (Kaack & Austed, 1998). Cyanidin 3-sambubioside (630.8 mg CGE/100 g) and cyanidin 3-glucoside (586.4 mg CGE/100 g fruit) were found to be the most abundant anthocyanins in S. nigra, according to research by Veberic et al., 2009. A similar amount of C3G and C3S (225 mg/100 g) was found by Ochmian, Oszmiaski, and Skupie (2009). According to other sources, cyanidin 3-sambubioside-5-glucoside makes up 55.5% of the total cyanidin content in S. nigra fruits, while cyanidin 3-glucoside accounts for just 10.4% (Bridle & Garca-Viguera, 1997). An estimated 69.8% of the total anthocyanins in S. canadensis were p-coumarin acylated cyanidins (Johansen et al, 1991, Osamu et al, 1996).

Elderberry is rich in antioxidants including flavonols and phenolic acids. Flavonols such as quercetin, kaempferol, and isorhamnetin predominated. The flavonols in elderberries are found as rutin and glucose glycosides, as well as acylated quercetins (Christensen, Kaack, & Fretté, 2008). The leaves, fruit, and flowers all contain polyphenolic chemicals. Elderberry blooms had ten times the flavonols (214.25 mg/100 g) of elderberry fruits (20.18 mg/100 g) and more than three times the flavonols of elderberry leaves (17.01 mg/100 g) (Dawidowicz, Wianowska, & Baraniak, 2006). In addition to flavonols, elderberry blooms and fruits are rich in phenolic acids. Nine phenolic acids, including variants of caffeic and p-coumaric acid, and two phenolic acids with unknown structures were extracted from flowers by Christensen et al. (2008). Elderberry fruits had a narrower range of phenolic acids compared to flowers. Fruits were found to have trace levels of ellagic acid (0.04 mg/100 g seeds), in addition to chlorogenic, crypto-chlorogenic, and neochlorogenic acids (Fazio et al, 2013, Lee, Finn, 2007).

S. nigra contains a low amount of proanthocyanidins (23.3 mg/100 g) compared to other berry fruits (black chokeberry: 663.7 mg/100 g; blackcurrant: 120.6-165.8 mg/100 g). Because only polymers from dimers to hexamers of proanthocyanidins have been documented, degree of polymerization may be seen as a defining feature of these compounds (Wu et al., 2004). Elderberry (S. nigra) fruits and blossoms have been analysed for their polyphenolic content and structural formulae, which are shown in Table 1 and Fig. 2.

Table 1: Composition of polyphenolics in fruits, leaves and flowers of elder (*Sambucus nigra*).

Compound	Fruits	Flowers
Total polyphenols	371–432 mg GAE/100 g FW[1]; 364–582 mg GAE/100 g[8]; 513.6 mg/100 g FW[11]; 19.5 mg GAE/g FW[14];	
Anthocyanins total/sum	242–283 mg CGE/100 g FW[1]; 272.87 mg/100 g FW[2]; 664–1816 mg CGE/100 g FW[6]; 8.33–101.40 mg CGE/g DW[7]; 1.9–20.2 g CGE/kg[7]; 170–343 mg CGE/100 g[8]; 465.1 mg/100 g FW[11]; 602.9–1265.3 mg CGE/100 g FW[12]; 1374.4 mg CGE/100 g[14];	
Cyanidin total/sum	48,4568–52,8869 g/100 g extr[5]; 3316 mg/kg FW[9];	
Delphinidin	Nd[9];	
Petunidin	Nd[9];	
Peonidin	Nd[9];	
Malvidin	Nd[9];	
Pelargonidin 3-glucoside	Tr[8]; 1.8 mg CGE/100 g[14];	

Cyanidin 3-sambubioside-5-glucoside	23.34 mg/100 g FW[2]; 14–47 mg CGE/100 g FW[6]; 0.86–11.5 mg CSE/g DW[7]; 16.0–59.2 mg CGE/100 g FW[8]; 19.52–53.49 mg CGE/100 g FW[12]; 82.6 mg CGE/100 g[14];	
Cyanidin 3,5-diglucoside	47.1 mg/100 g FW[2]; 5–36 mg CGE/100 g FW[6]; 0.12–5.22 mg CSE/g DW[7]; 8.2–19.5 mg CGE/100 g FW[8]; 14.39 mg/100 g FW[11]; 7.41–23.29 mg CGE/100 g FW[12];	
Cyanidin 3-sambubioside	134.94 mg/100 g FW[2]; 27.0453–27.7027 g/100 g extr[5]; 269–656 mg CGE/100 g FW[6]; 4.62–40.30 mg CSE/g DW[7]; 122.2–269.1 mg CGE/100 g FW[8]; 225.45 mg/100 g FW[11]; 270.8–630.8 mg CGE/100 g FW[12]; 3500–3907 µg CGE/g FW[13]; 545.9 mg CGE/100 g[14];	Nd[5];
Cyanidin 3-glucoside	44.83 mg/100 g FW[2]; 21.4115–25.1842 g/100 g extr[5]; 361–1266 mg CGE/100 g FW[6]; 2.74–49.5 mg CSE/g DW[7]; 204.6–481.4 mg CGE/100 g FW[8]; 225.26 mg/100 g FW[11]; 221.4–586.4 mg CGE/100 g FW[12]; 739.8 mg CGE/100 g[14];	

Benefits to Health Sustained by Indirect Evidence

The antioxidant properties of elderberries are what give them their therapeutic value, however this is a trait shared by many other phytochemicals. The human body uses free radicals as a defence mechanism against the persistent assaults it endures. Yet, this technique can set off a chain reaction that ultimately harms the cells and can even cause cancer. The elderberry has one of the highest total antioxidant capacities of all the tiny fruits, which the human body employs to neutralise damaging free radicals from the environment. (Figure 2) The black elder ranked third among the species studied for its antioxidant capability using the ferric reducing antioxidant power (FRAP) method (Halvorsen et al. 2002). Using the ORAC method, Wu et al. (2004a,b) demonstrated that the American elder had a significantly higher antioxidant potential than the well lauded cranberry and blueberry Our lab tests have shown the significant antioxidant capacity of American elder berries (unpubl. data).

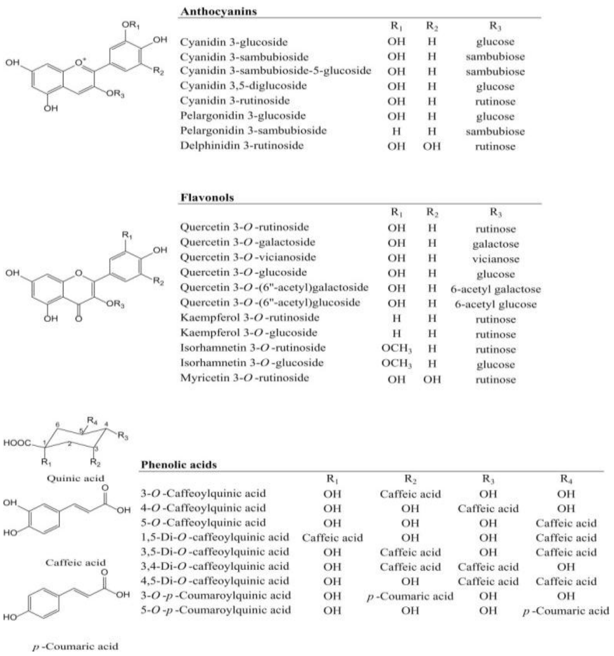

Figure 2: Chemical structures of polyphenolics in fruits and flowers of elder (*Sambucus nigra*).

Polyphenols

Different definitions are proposed, however there is consensus that these compounds are ubiquitous in plants even if the proposed definitions differ in some way. Many, however, exercise caution when attributing therapeutic benefits to polyphenols. Since there are so many phenolic chemicals in nature, there are often contradictory findings in the literature.

Elderberry juice, like many other fruit juices, has a complex polyphenolic profile due to the presence of a wide variety of chemicals, many of which are anthocyanins (Schwarz et al. 2001; Bermdez-Soto and Tomás-Barberán 2004; Proestos et al. 2005). (Sanchez-Moreno et al. 2003). Flavonols, hydroxycinnamic acid derivatives, and flavan-3-ols are some other polyphenols that are found frequently. Total phenolics, anthocyanins, and flavonols are all found in abundance in elderberry juice, and all three compounds have been demonstrated to have a strong correlation with the antioxidant potential of this species (Bermdez-Soto and Tomás-Barberán, 2004). Even though phenolic chemicals are widely present in the foods we eat, the extent to which our bodies can absorb and use them is still up for debate (Karakaya 2004). Reading this author's take on the topic is a good idea.

Flavonoids

It's important to note that flavonoids are a type of polyphenol. Humans lack the requisite biosynthetic machinery to produce these phytochemicals (Peterson and Dwyer 1998). Consumption estimates range from 23 milligrammes to 1 gramme per day (Peterson and Dwyer 1998). Among these are the anthocyanins (cyanidin, pelargonidin), flavanols (catechin, epicatechin), flavonols (quercetin, kaempferol), flavones (apigenin, luteolin), and flavanones (galangin, rutin) (hesperetin, naringenin). Anthocyanidins may be the most common type of pigment, while flavan-3-ols and flavonols are more common (Gebhardt et al. 2002). Multiple studies have shown that they contain antioxidant and antimutagenic properties, which may have protective effects against cardiovascular disease and stroke (Peterson and Dwyer 1998). Much remains to be learned about flavonoids and their absorption and metabolism, as is the case with the other polyphenols (Peterson and Dwyer 1998).

The Anthocyanins and the Anthocyanidins

Many different types of fruit get their vibrant colours from a class of natural pigments called anthocyanins

(Fossen et al. 1998). Anthocyanidins are aglycones of anthocyanins, whereas anthocyanins exist naturally as glycosides (tied to a sugar molecule).

Anthocyanins, specifically cyanidin 3-glucoside and cyanidin 3-sambubioside, are the most significant polyphenols in elderberry (Gebhardt et al. 2002). Elderberries have one of the highest anthocyanin concentrations of any commonly available food (Clifford 2000). Intriguingly, unlike in black elder, the anthocyanins in American elderberries are acylated and, as a result, are more stable to light and heat during processing (Nakatani et al. 1995; Inami et al. 1996).

Cyanidin. Common foods in the United States often contain cyanidin, one of the six anthocyanin aglycones (anthocyanidins) (Wu et al. 2006). An estimated 45-75% of the average American's daily intake of anthocyanins comes from cyanidin, per these authors.

Among the many polyphenolic flavonoids found in plants, cyanidin has one of the strongest antioxidant properties (Rice-Evans et al. 1995). Based on the research of Stintzing et al. (2002), which found that acylation can boost the antioxidant activity of anthocyanins, the enhanced antioxidant potential of American elder compared to black elder is not surprising. An intriguing anthocyanins review was offered by Sterling (2001). Since the extent of cyanidin 3-glucoside absorption, metabolism, and bioavailability is still unknown, more research is required (Mülleder et al. 2002; Andlauer et al. 2003; Bitsch et al. 2004; Galvano et al. 2004).

Table 2: Chemical composition of various small fruits. Adapted from (Products and Services: Fruits and Fruits Juices, 2005).

Fruit	Water	Energy (kcal)	Iron (mg)	Phosphorous (mg)	Vitamin A (IU)	Vitamin B6 (mg)	Vitamin C (mg)
Blueberry	84	27	0.28	12	54	1.052	9.7
Cranberry	87	46	0.25	13	60	0.057	13.3
Elderberry	80	73	1.60	39	600	0.230	36.0
Grape	81	69	0.36	20	66	0.086	10.8
Mulberry	89	43	0.62	22	214	0.030	21.0
Raspberry	86	52	0.69	29	33	0.055	26.2
Strawberry	91	32	0.42	24	12	0.047	58.8

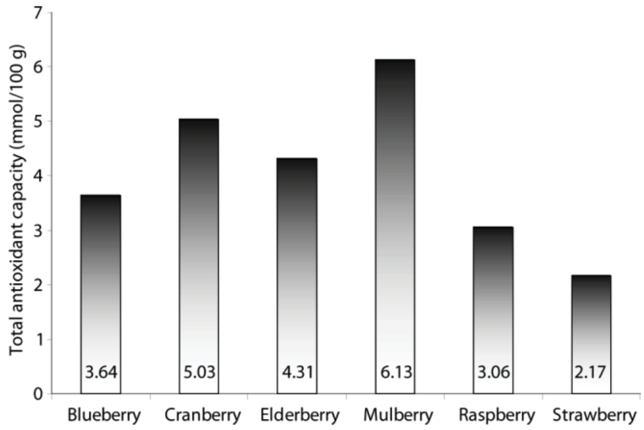

Figure 3: Total antioxidant capacity of various small fruits as measured using the FRAP method. [FRAP = Ferric Reducing Antioxidant Potential]. In this ex- ample, elderberry is the European subspecies. Adaptedfrom: (Halvorsen et al. 2002).

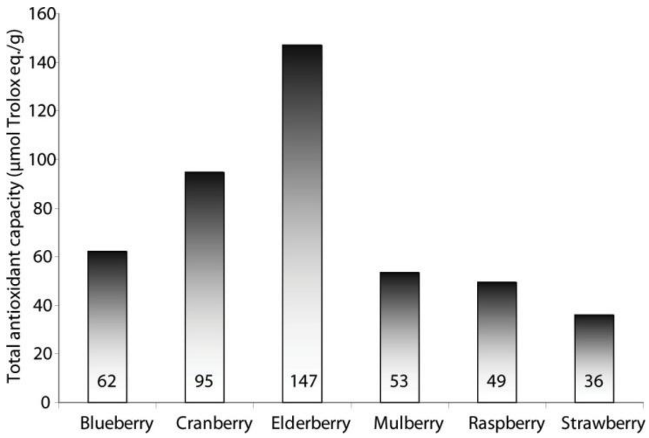

Figure 4: Total antioxidant capacity of various small fruits as measured using the ORAC method. [ORAC]= Oxygen Radical absorbance Capacity. In this ex- ample, elderberry is the American subspecies. Adaptedfrom: (Wu et al. 2004a).

Proof Positive for Health Effects

Only recently has there been conclusive proof that humans are able to absorb anthocyans (Cao and Prior 1999). These authors demonstrated that cyanidins are taken up in the glycosidic form after oral administration of elderberry extract. Regardless of these findings, there is still some dispute on the precise manner under which people absorb the anthocyanins in elderberries. Additional data suggested that their glycosidic forms are absorbed more efficiently (Cao et al. 2001; Murkovic et al. 2001; Milbury et al. 2002). Sugar molecular structure can affect perceived absorption and metabolism (Wu et al. 2005). There was a finding that anthocyanin absorption and excretion were less than those of other flavonoids (Wu et al. 2002). There is now more evidence that mammals are able to absorb anthocyanins, such as cyanidin 3-glucoside (Talavéra et al. 2003, 2004; Felgines et al.

Since it has been shown that anthocyanins are indeed absorbed (Cao and Prior 1999) and able to considerably improve plasma antioxidant capacity, these results have an essential impact when thinking about putative health advantages from elderberry con-sumption (Netzel et al. 2002). Anthocyanins bind to free iron ions in the digestive tract after being digested. Anthocyanins enter the bloodstream and bind to free iron radicals when there is an inadequate supply of free iron (Sardi 2000). However, it is unclear whether anthocyanins enter cells or the proper subcellular compartments in sufficient quantities to influence metabolic processes (Prior 2003). There is still a lot to learn about the absorption, metabolism, and health implications of dietary anthocyanins, despite intriguing advancements (Netzel et al. 2002; He et al. 2006).

Elderberry extracts have several fascinating qualities, most of which were documented by Zakay-Rones et al (1995). Mycovirus haemagglutinin was shown to be inhibited by a mixture including elderberry extract, the authors of which followed the lead of Konlee (1998). Barak et al. (2001, 2002) extended these findings by showing that this combination might increase cytokine production and reduce replication of 11 different influenza virus strains.

In a broader sense, phenolics found in berries, such as anthocyanins, have been shown to protect against lipid and protein oxidation (Viljanen et al. 2004). Rhodopsin regeneration was shown to benefit from cyanidin 3-glucoside by Matsumoto et al. (2003). Hecht et al. (2006) found that cyanidin 3-glucoside inhibited tumour growth in an animal model, leading the authors to speculate that it may have chemopreventive effects in humans. Further in vitro studies confirmed cyanidin's efficacy against human tumour cells (Meiers et al. 2001).

Market Potential And Future

There doesn't seem to be a good explanation for the relatively low levels of American elder production in North America, given the plant's obvious commercial potential and the improved stability of its anthocyanins compared to those of black elder pigments. As a matter of fact, both the blooms and the berries are well-suited for processing, and around a hundred various goods, predominantly made from black elder, are proposed on the Internet.

In general, we can classify these goods as either food and drink or health aids.

Health Products

Elderberry fruits have been recognised for their high polyphenol content, particularly anthocyanins, and are being exploited by the pharmaceutical and natural products sectors as a result. Consumers are encouraged to try the suggested shampoos and body creams. Lozenges, syrups, herbal teas, extracts, and supplements are just some of the many items that cash in on the purported health advantages of the components of elderberry fruits and blooms. Although advertisements can be overly optimistic at times, there is now sufficient direct and indirect evidence to support most of these promises.

Antiviral, antibacterial and antifungal activity

The antiviral and antibacterial properties of elderberry make it a popular plant for fighting off influenza and colds (Kong, 2009). When added to infected Madin-Darby canine kidney (MDCK) cells, elderberry flower extract at a concentration of 252 g/mL significantly reduced viral replication (Roschek, Fink, McMichael, Li, & Alberte, 2009). Analysis of polyphenolic compounds revealed that their antiviral efficacy was based on direct binding to the H1N1 virus, which halted virus penetration into cells and infection in vitro. Antiviral activity against H1N1 virus and cytotoxicity of elderberry juice concentrate using MDCK cells have also been studied (Kinoshita, Hayashi, Katayama, Hayashi, & Obata, 2012). The findings demonstrated that the juice had an influence on viral multiplication, viral binding, and viral entry into cells. According to data collected on rats afflicted with the H1N1 virus, elderberry juice concentrate prevented them from losing weight as the sickness progressed. Furthermore, elderberry juice concentrate boosted both the body's general and local defences. High molecular weight (HM) fractions were the most active, with the HM II fraction, composed primarily of acidic polysaccharides, causing the greatest reduction in viral reproduction and the greatest increase in antibody production. Not much activity was observed in the polyphenol-rich medium molecular weight fraction (288 mg/g).

Inhibition of the spread of influenza viruses A and B was one of the results of Krawitz et al(2011) .'s investigation into the antibacterial and antiviral properties of Rubini, a commercial medication derived from elderberry extract. Elderberry bark extract was discovered to have potent anti-FIV (feline immunodeficiency virus) activity in CrFK (Crandell feline kidney cells). Elderberry extract's phenolic constituents, flavonoids, have been shown to inhibit HIV-1 from entering GHOST cells and causing infection (Fink, Roschek, & Alberte, 2009). Rubini extract was shown to be antibacterial against gram-positive Streptococcus pyogenes, gram-negative Branhamella catarrhalis, and gram-positive Enterococcus faecalis, all of which are common causes of upper respiratory tract infections (Krawitz et al., 2011). Additions of 10% and 20% of the extract, respectively, suppressed bacterial growth by 70% and 99%, demonstrating an inhibitory action at these doses. Bacillus subtilis, Bacillus megaterium, Escherichia coli, and Staphylococcus aureus, as well as yeasts Debaryomyces hansenii, Zygosaccharomyces rouxii, Rhodotorula rubra, Candida shehatae, and Candida tropicalis, were found to be inhibited in their growth by an elderberry leaf infusion, according to other studies (Hussein, Shedeed, Abdel-Kalek, & El-Din, 2011).

Effects on Immunity

Both healthy creatures and those with diseases may benefit from elderberry's ability to modulate defence mechanisms. It was discovered that elderberry extract induced the production of both proinflammatory cytokines (such as IL-1, IL-6, IL-8, and TNF-) and anti-inflammatory cytokines (such as IL-10) (Barak, Birkenfeld, Halperin, & Kalickman, 2002). Biosynthesis of IL-1, IL-1, and TNF was either seen or inhibited (Yeşilada et al., 1997), depending on the kind of extract (leaf, flower, solvent type). In murine-derived dendritic cells, elderberry extract boosted IFN-interferon production alongside elevation of TLR-3 (toll-like receptor 3) and variations in the amount of generated IL = 12, IL = 6, IL-1 cytokines and TNF- (Frkiaer et al., 2012). TNF-alpha and IFN-alpha production was boosted by elderberry extract in both normal and diabetic rats (Groza, Ciocoiu, Bădescu, Bădulescu, & Bădescu, 2010). Elderberry derived polyphenols lowered IL-1, the inflammatory cytokine responsible for chronic disease-related, long-term inflammation that ultimately leads to organ damage, by more than 50%. (Ciocoiu et al, 2012a, Ciocoiu et al, 2012b). Other studies have shown that elderberry polyphenols improved immune defence in diabetic rats by boosting lymphocyte number (Groza, Jitaru, Bădescu, Ciocoiu, & Bădescu, 2011).

CONCLUSIONS

Plants contain a wide variety of bioactive chemicals, many of which have powerful antioxidant properties. Elderberry (Sambucus nigra) preparations have been shown to have positive effects in a number of scientific research. Their anti-inflammatory, anti-cancer, anti-diabetic, anti-obesity, and anti-viral properties have been well-documente Additionally, it has been established that it has a substantial effect on the immune system, has antiviral and antibacterial action, and provides protection from UV radiation. Despite the encouraging findings, more research is required to fully understand how elderberry components may interact with other molecules to influence their activity. Questions about the interaction mechanism of elderberry components, their stability during storage, and their use in complex systems (such as food) have not yet been answered by the literature.

REFERENCES

1. Andlauer, W., K. Frank, P. Fürst, and C. Stumpf. 2003. Absorption and metabolism of anthocyanin cyanidin-3-glucoside in the isolated rat small intestine is not influenced by ethanol. Eur. J. Nutr. 42:217–223.

2. Anonymous. 2005. Products and services: Fruits and fruits juices. United States Department of Agriculture. Online database. www.nal.usda.gov/fnic/foodcomp/search/.

3. Atkinson, M.D. and E. Atkinson. 2002. *Sambucus nigra* L. J. Ecol. 90:895–923.

4. Barak, V., S. Birkenfeld, T. Halperin, and I. Kalickman. 2002. The effect of herbal remedies on the production of human inflammatory and anti-inflammatory cytokines. Isr. Med. Assoc. J. 4:919–922.

5. Barak, V., T. Halperin, and I. Kalickman. 2001. The effect of Sambucol, a black elderberry-based, natural product, on the production of human cytokines: I. Inflammatory cytokines. Eur. Cytokine Netw. 2:290–296.

6. Bermúdez-Soto, M.J. and F.A. Tomás-Barberán. 2004. Evaluation of commercial red fruit juice concentrates as ingredients for antioxidant functional juices. Eur. Food Res. Technol. 219:133–141.

7. M. Akbulut, S. Ercisli, M. Tosun Physico-chemical characteristics of some wild grown European elderberry (*Sambucus nigra* L.) genotypes Pharmacognosy Magazine, 5 (2009), pp. 320-323

8. Medicinal plants in folk tradition: An ethnobotany of Britain & Ireland Timber

Press, Portland (2004

9. A.M. Anton, A.M. Pintea, D.O. Rugină, Z.M. S conţa, D. Hanganu, L. Vlase, D. Benedec Preliminary studies on the chemical characterization and antioxidant capacity of polyphenols from *Sambucus sp*

10. Digest Journal of Nanomaterials and Biostructures, 8 (2013), pp. 973-98 L. Badescu, O. Badulescu, M. Badescu, M. Ci ocoiu Mechanism by *Sambucus nigra* extract improves bone mineral density in experimental diabetes

---

Corresponding Author

Shyam Kumar Gupta*

Research Scholar, Sunrise University, Alwar, Rajasthan