

Zdravo povrće za zdravo srce: šparoge

Healthy vegetables for healthy heart: asparagus

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SAŽETAK: Šparoga (*Asparagus officinalis* L.) je povrće koje se uzgaja zbog ukusnih bijelih ili zelenih izboja. Iznimne je hranjive i zdravstvene vrijednosti. Jedno serviranje kuhane šparoge odličan je izvor vitamina K, folne kiseline, vitamina C i vitamina A. Od minerala bogat je izvor selena, bakra i mangana. Šparoga je poznata po sastavu fitonutrijenata, karotenoida (capsanthin, caprorubin, zeaxanthin), steroidnih saponina i flavonoida (rutin). Pokazuje jaču antioksidativnu aktivnost od brokule zbog većeg udjela flavonoida. Zahvaljujući snažnom antioksidativnom kapacitetu pomažu u prevenciji srčanožilnih bolesti smanjenjem nakupljanja homocisteina, prevenciji arterijske hipertenzije, dislipidemije i dr. Potencijalno djeluje na pospješivanje izlučivanja žučnih kiselina i uklanjanje suviška kolesterola.

KLJUČNE RIJEČI: šparoge, povrće, hranjiva i zdravstvena vrijednost, antioksidativni kapacitet, srčanožilne bolesti.

SUMMARY: Asparagus (*Asparagus officinalis* L.) is a vegetable that is grown for tasty white or green shoots. It has exceptional nutritional and health value. One serving of cooked asparagus is an excellent source of vitamin K, folic acid, vitamin C and vitamin A. Concerning minerals, it is a rich source of selenium, copper and manganese. It is known for the composition of phytonutrients, carotenoids (capsanthin, caprorubin, zeaxanthin), steroidal saponins and flavonoids (rutin). It shows a more potent antioxidant activity than broccoli due to a larger portion of flavonoids. Owing to its more potent antioxidant capacity, it helps in the prevention of cardiovascular disease by reducing the formation of homocysteine, prevention of hypertension, dyslipidemias, etc. It potentially has an effect on stimulating the secretion of bile acids and the removal of excess cholesterol.

KEYWORDS: asparagus, vegetables, nutritional and health value, antioxidant capacity, cardiovascular diseases.

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Porijeklo i rasprostranjenost

Šparoga (*Asparagus officinalis* L.) je višegodišnja dvodomna biljka koja po novoj klasifikaciji pripada porodici Asparagaceae.¹ Porijeklom je iz južne Europe, Azije i sjeverozapadne Afrike (Alžir, Maroko, Tunis). Prvi tragovi šparoge potječu iz egipatskih grobnica iz 4. stoljeća p.n.e., a kasnije su je kultivirali i stari Grci i Rimljani.²

Najveći svjetski proizvođači šparoge su Kina, Peru, SAD i Meksiko. Šparoge se u svijetu proizvode na 195.819 ha, od toga 121.694 ha zelenih i 74.125 ha bijelih. U Europi se šparoga proizvodi na 56.198 ha, od čega je 39.544 ha bijelih i 16.654 ha zelenih. Najveći europski proizvođači šparoge su Njemačka, Španjolska, Francuska i Italija.³

Osim kultivirane vrste šparoga, u našem priobalnom području rastu i one samonikle. Tu valja biti oprezan jer je u Republici Hrvatskoj dozvoljena berba za jelo oštrolosne šparoge (*Asparagus acutifolius* L.) i za njeno branje nije potrebno ishoditi dozvolu. Kod nas su zaštićene tri vrste šparoga: morska (*Asparagus maritimus* (L.) Mill), ljekovita šparoga (*Asparagus officinalis* L.) i tankolisna (*Asparagus teneuifolius* Lam.).⁴

Origin and distribution

Asparagus (*Asparagus officinalis* L.) is a perennial dioecious plant that according to the new classification belongs to the family Asparagaceae.¹ It originates from southern Europe, Asia and north-west Africa (Algeria, Morocco, Tunisia). The first traces of asparagus originate from the Egyptian tombs in the 4th century BC and later the plant was grown by the ancient Greeks and Romans.²

The world's largest asparagus producers are China, Peru, the United States and Mexico. Asparagus is produced on 195,819 ha worldwide, of which green asparagus on 121,694 ha and white asparagus on 74,125 ha. In Europe, asparagus is produced on 56,198 ha, of which white asparagus on 39,544 ha and green on 16,654 ha. Europe's largest asparagus producers are Germany, Spain, France and Italy.³

In addition to cultivated species of asparagus, there are species of self-grown asparagus that grow in our coastal area. One must be cautious here, because harvesting of wild asparagus (*Asparagus acutifolius* L.) is permitted in the Republic of Croatia and no license is required for its harvesting. Three species of asparagus are protected in our country: sea (*Asparagus maritimus* (L.) Mill), medicinal garden as-

Uzgoj šparoga

Šparoga je višegodišnja biljka koja na jednom mjestu ostaje deset i više godina. Podzemni dio šparoge je podanak na čijoj se gornjoj strani razvijaju brojni pupovi, a na donjoj strani korijenje. Iz pupova se u proljeće razvijaju mladi, sočni izboji iz kojih se, ako se u proljeće ne odrežu, razvija stabljika koja može narasti i do 1,5 m.

Za komercijalni uzgoj šparoga se uzgaja izravno iz sjemena ili presadnicama koje je moguće proizvesti i u kontejnerima i kulturom tkiva (naročito hibride samo muških biljaka). Presadnice se presađuju u jarke ili brazde od sredine ožujka do sredine travnja i odmah prekriju s 5-7 cm tla, a s porastom biljaka do kraja prve vegetacijske sezone jarci se postupno zatrpavaju. Za proizvodnju bijelih etiliranih izboja potrebno je nasad u proljeće nagnuti zemljom ili prekriti crnom polietilenskom folijom.⁵ Berba šparoga koje su proizvedene iz presadnica može započeti već druge godine nakon sadnje presadnica, a one koje su proizvedene iz sjemena tek treće godine. Važno je napomenuti da se u prvoj godini berbe sa svake biljke reže samo nekoliko izboja, a ostali se ostave da biljka ojača i skupi što više hranjivih tvari potrebnih za rast i razvoj u sljedećim godinama.

Pri punoj berbi svi izboji dužine oko 15 cm režu se specijalnim nožem pod kutem od 45° na 5 cm u tlu. Izboje je nakon berbe potrebno što prije spremirati u hladnjače i čuvati na temperaturi od 0-2 °C.

U toku vegetacije potrebno je usjev održavati zdravim, zaštićen od štetnika, bolesti i korova. Najznačajniji štetnici šparoge su šparogine zlatice (*Crioceris asparagi*, *Crioceris duodecimpunctata*), šparogina muha (*Platyparaea poeciloptera*), šparogin kornjaš (*Parahypopta / Hypopta / caestrum*), stjenica (*Lygus*), minirajuće muhe i dr., a od bolesti najznačajnije su hrđe (*Puccinia asparagai*), crvena trulež (*Helicobasidium brebissonii*) i Fusarium vrste koji se smatraju glavnim uzrocima degeneracije usjeva šparoge.⁶ Zaštita usjeva od korova, naročito je važna agrotehnička mjera u prvim godinama uzgoja šparoge gdje je moguće uspješno regulirati rast korijena i malč folijama.⁷

U početku sezone berbe šparoga ima znatno višu cijenu, pa se u Nizozemskoj, Belgiji i Francuskoj razvijaju tehnologije i za zimsku proizvodnju šparoge.⁸

Iako se u Njemačkoj, na primjer organiziraju festivali šparoga, biraju kraljice šparoga i provodi postupak zaštite šparoge u smislu zaštite zemljopisnog podrijetla i oznake izvornosti poljoprivrednih i prehrambenih proizvoda⁹, u Republici Hrvatskoj nema veće organizirane proizvodnje šparoga. Trenutačno postoji organizirana proizvodnja samo u okolici Vinkovaca.

Kod nas je više zastupljena sadnja šparoge uz rub vrtova i okućnica. Pretpostavlja se da bi za jednu peteročlanu obitelj bilo dovoljno uzgajati 6-10 biljaka šparoge.¹⁰

Čuvanje i priprema šparoga

Svježe šparoge treba pažljivo skladištiti i brzo konzumirati. U šparogama se i nakon berbe odvija intenzivna metabolička aktivnost koja je vrlo visoka u odnosu na drugo povrće. Umatanjem krajeva šparoga u vlažnu krpu ili ručnik tijekom skladištenja u hladnjaku može se zaustaviti razgradnja škroba i šećera i ispuštanje ugljikovog dioksida. Najbolje je konzumirati šparoge u roku od otprilike 48 sati nakon kupnje.¹¹

Šparoga se u domaćim uvjetima prilikom pripreme najčešće sjecka i kuha. Utvrđeno je da sjeckanje značajno utječe na

paragus (*Asparagus officinalis* L.) and narrow-leaved (*Asparagus tenuifolius* Lam.).⁴

Growing asparagus

Asparagus is a perennial plant that stays in one place for more than 10 years. The underground part of asparagus consists of upper side with numerous buds and roots on the bottom. Young, succulent shoots develop from the buds in the spring from which, if not cut off in spring, the stem is developed that can grow up to 1.5 meters.

For commercial cultivation, asparagus is grown directly from seed or seedlings that can be produced in containers and by tissue culture (especially hybrids of only male plants). Seedlings are transplanted into ditches or furrows from mid March to mid April and are immediately covered with 5-7 cm of soil, and as the plants grow by the end of the first growing season, the ditches are gradually buried. The plantation is to be covered by soil in spring for production of white etiolated shoots or it is to be covered by black polyethylene foil.⁵ The harvesting of asparagus that are produced from seedlings may start already in the second year after planting seedlings, and those that are produced from the seed only during the third year. It is worth noting that in the first year of the harvest only a few shoots are cut off from every plant, while the others are left to allow the plant to become stronger and collect as more nutrients as possible needed for growth and development in the years to come.

In full harvest all of the shoots in a length of about 15 cm are cut off with a special knife at an angle of 45° in 5 cm in the soil. The shoots after harvest should be stored in refrigerators at a temperature of 0-2 °C as soon as possible.

During the growing season, the crop is to be maintained healthy and protected from pests, diseases and weeds. The most important asparagus pests are asparagus beetle (*Crioceris asparagi*, *Crioceris duodecimpunctata*), asparagus fly (*Platyparaea poeciloptera*), cossid moth (*Parahypopta / Hypopta / caestrum*), lygus bug (*Lygus*), stem-mining flies, etc., and concerning the diseases, the most important diseases are asparagusrust (*Puccinia asparagai*), violet root rot (*Helicobasidium brebissonii*) and Fusarium species that are considered to be the main causes of degeneration of the asparagus crops.⁶ Protection of crops from weed is a particularly important agro-technical measure in the first years of growing asparagus where it is possible to successfully regulate the growth of root and mulch by foil.⁷

At the beginning of the harvesting season, the asparagus is much more costly, so the technologies are being developed in the Netherlands, Belgium and France for the winter production of asparagus.⁸

While festivals of asparagus are organized in Germany, asparagus queens are elected and the procedure of protection of asparagus is conducted in terms of protection of geographical origin and designation of origin for agricultural and food products⁹, we lack some well organized production of asparagus in the Republic of Croatia. At present, there is some organized production only in the surrounding of Vinkovci.

In our country growing of asparagus is more common along the edge of gardens and yards. It is assumed that it would be enough to grow 6-10 asparagus plants for one five-member family.¹⁰

Storing and preparing asparagus

Fresh asparagus should be carefully stored and soon consumed. Intense metabolic activity, which is very high compared to the other vegetables, occurs in asparagus even fol-

sadržaj rutina, pad je bio 18,5% za 60 minuta, a kuhanje od 60 minuta reducira sadržaj flavonola za 43%. Sjeckanje ne utječe na ukupni antioksidativni potencijal biljke, ali kuhanje utječe.¹²

Pripremiti šparoge moguće je na bezbroj načina. Najbolje ju je pripremiti kuhanjem na pari tako da se snopići šparoge urone u lonac napunjen 1/3 vodom i kuhaju poklopljene 5 minuta. Tek tada ih lomiti i preliti umacima ili začiniti na salatu.

U našim mediteranskim krajevima, gdje se bere samonikla šparoga, najpoznatija je fritaja od šparoga i salata od šparoga i tvrdo kuhanih jaja uz dodatak maslinovog ulja i domaćeg vinskog octa.

Hranjivi sastav šparoga

Šparoga se uzgaja zbog sočnih, veoma ukusnih i nježnih bijelih, zelenih, a u novije vrijeme i ljubičastih izboja. Način uzgoja djeluje na hranjivu vrijednost šparoge, prije svega na sastav fitokemikalija. Iako zelena šparoga ima bolju hranidbenu i zdravstvenu vrijednost, naročito u sadržaju vitamina C na vrhovima izboja, u Europi se više cijeni bijela šparoga.⁸

Podaci u **Tablici 1** prikazuju usporedbu svježih plodova zelene i bijele šparoge. Šparoga ima mali sadržaj energije, s tim da je bijela šparoga nešto bogatija bjelančevinama, a sadržaj ugljikohidrata i masti je nizak.

lowing the harvest. Wrapping the ends of the asparagus in a damp cloth or towel during storage in the refrigerator can stop the degradation of starch and sugar and release of carbon dioxide. Asparagus should be consumed within approximately 48 hours after the plant is purchased.¹¹

Asparagus is usually chopped and boiled in households during preparation. It has been found that chopping significantly affects the rutin content. The decrease was 18.5% in 60 minutes, and boiling in duration of 60 minutes reduces the flavonol content by 43%. Chopping does not affect the total antioxidant potential of the plant, but boiling does.¹²

Asparagus can be prepared in number of ways. It is best to be prepared by steaming, so that the asparagus bundles are immersed in a pot 1/3 filled with water and cooked for 5 minutes under the lid. Only then they are to be crushed and sauce is to be poured over it and spiced as a salad.

In our Mediterranean regions, where wild asparagus is harvested, the most famous dish is the asparagus fritatta and asparagus salad as well as hard-boiled eggs with an addition of olive oil and local wine vinegar.

Asparagus nutritional ingredients

Asparagus is grown for succulent, very tasty and delicate white, green and more recently purple shoots. The cultivation method affects the nutritional value of asparagus, primarily the composition of phytochemicals. Although green asparagus has better nutritional and medicinal value, especially regarding the higher content of vitamin C on the tops of shoots, white asparagus is more priced in Europe.⁸

The data in **Table 1** shows the comparison of fresh fruits of green and white asparagus. Asparagus has low energy content, whereas the white asparagus is somewhat richer in proteins, while the carbohydrate and fat content is low.

Table 1. Chemical content in 100 g of fresh green and white asparagus (*Asparagus officinalis*) (DK7)

	Green asparagus	White asparagus
Water (g)	92.1-93.0	91.7-93.1
Energy (kcal/kJ)	26/109	26/109
Protein (g)	1.7-1.9	2.3-2.4
Carbohydrate (g)	4.9	4.3
Fat (g)	0.3	0.3
Dietary fibers (g)	1.4-2.2	1.4-2.2
Ash (g)	0.4-0.6	0.5-0.7

Tablica 2 prikazuje sadržaj vitamina i minerala i postotke od preporučenog dnevnog unosa. Podaci su izraženi za uobičajenu količinu za konzumiranje. Prema Pravilniku o navođenju hranjivih vrijednosti hrane značajni udio mikronutrijenta za hranu je minimalno 15%.¹³ Prema tome možemo uočiti da je šparoga bogat izvor vitamina K, zatim folne kiseline, odnosno folata, jednog od vitamina B kompleksa. Nadalje u značajnoj količini se nalazi vitamin C, snažni antioksidans, osobito u konzerviranom obliku te vitamin A i vitamin B1. Od minerala šparoga je bogat izvor selena, mangana, bakra i željeza kojeg ima u značajnoj količini u konzerviranoj šparogi. Vrijedi istaknuti da kuhana šparoga sadrži znatno manje natrija od konzervirane, stoga se osobama koji paze na unos natrija preporuča odabrati kuhane šparoge.

Table 2 shows the content of vitamins and minerals and the percentage of the reference daily intake. Data is expressed for the usual amount for consumption. According to the Regulation on Nutrition Labelling for Foodstuffs, a significant proportion of micronutrients in food is at least 15%.¹³ Thus, we can see that asparagus is a rich source of vitamin K, folic acid, or folate, one of the vitamin B complex. Besides, vitamin C, a potent antioxidant, is present in a significant amount especially in canned asparagus. Vitamin A and vitamin B1 are also present. Out of minerals, asparagus is a rich source of selenium, manganese, copper and iron, which are present in a significant amount in a canned asparagus. It is worth noting that cooked asparagus contains much less sodium than canned asparagus, so the people who must take care of the sodium intake are recommended to choose cooked asparagus.

Table 2. Vitamin and mineral content of asparagus per serving (*Asparagus officinalis*). (USDA 8)

	Cooked, boiled (1 cup; 180 g)		Canned (1 cup; 242 g)	
	Content	%RDI*	Content	%RDI
VITAMINS				
Vitamin C (mg)	14.00	23.30	44.50	74.0
Vitamin B1 (thiamin) (mg)	0.30	20.00	0.15	10.0
Vitamin B2 (riboflavin) (mg)	0.25	14.70	0.24	14.1
Vitamin B3 (niacin) (mg)	2.00	10.00	2.30	11.5
Vitamin B6 (mg)	0.14	7.00	0.26	13.0
Folic acid (µg)	89.40	37.25	140.00	58.3
Vitamin A (µg)	50.00	19.40	99.00	16.4
Vitamin K (µg)	50.60	63.25	100.00	125.0
MINERALS				
Calcium (mg)	42.0	4.2	39.0	3.9
Iron (mg)	1.6	8.0	4.4	24.4
Magnesium (mg)	26.0	6.5	24.0	6.0
Phosphorus (mg)	98.0	9.8	104.0	10.4
Potassium** (mg)	404	11.5	416	12.0
Copper (mg)	0.3	15.0	0.23	11.5
Zinc (mg)	1.1	7.3	0.9	6.0
Selenium (µg)	11.0	15.7	4.1	27.3
Manganese (mg)	0.3	15.0	0.4	20.0
Sodium (mg)	26.0	1.1	695.0	29.0

USDA National Nutrient Database for Standard Reference Release 26

*RDI — Reference Daily Intake; **DV — Daily value for potassium; *** Significant source is 15% from RDI

Tijekom vegetativnog razvoja šparoge stapke izlaze na površinu i pod utjecajem sunčeve svjetlosti dolazi do procesa fotosinteze, koja utječe na promjenu boje, a time i nutritivnog sastava biljke. Ispitivanja su utvrdila da tijekom vegetativnog sazrijevanja sadržaj minerala raste te da se u vrhu izboja šparoge u odnosu na bazalni dio nalazi najveći sadržaj minerala. To se pripisuje procesima razvoja biljke i diobi stanica za koju je potrebna veća koncentracija minerala.¹⁴ Uočeno je da sadržaj natrija u tim procesima opada, a kalija ostaje isti. Šparoga ima vrlo visoku nutritivnu gustoću, to je podatak koji ukazuje na nutritivnu raznolikost i bogatstvo sadržaja. Za sve elemente je visoko iznad 100%, osim za natrij.¹⁵ Osim toga, pokazalo se da i veći promjer izboja šparoge znači bogatiji mineralni sastav. Slični rezultati su dobiveni i za bijelu šparogu. Također su utvrđene razlike u hranjivoj vrijednosti između vrha biljke i bazalnog dijela. Mineralni sastav se postupno smanjuje od vrha prema dnu biljke, a to se različito manifestira prema sortama i debljini stapke. Valja napomenuti da te razlike nisu nutritivno značajne i da su podaci unutar preporučenih vrijednosti.¹⁶

Konzerviranje je jedna od često korištenih metoda za čuvanje hrane pa tako i šparoge. Sama tehnologija konzerviranja ne utječe značajno na hranjivi sastav tj. na ugljikohidrate, vlakna, bjelančevine i vlagu. Također se zadržava i oko 95% vitamina B1, B2, B6 i vitamina C.¹⁷

Druga uobičajena metoda čuvanja povrća je zamrzavanje. Ispitivanja su pokazala da na većinu minerala utječe skladištenje od 45 dana na -18 °C. Ovi gubici se djelomično mogu pripisati i postupcima u industrijskoj obradi šparoge (pranje i blansiranje), koji se provode prije zamrzavanja. Po-

During vegetative development of asparagus, the stem comes to the surface and the process of photosynthesis occurs under the influence of sunlight, which affects the change of the color, and thus the nutritional composition of the plant. Tests have determined that during vegetative maturation, the mineral content rises and that the largest mineral content is contained in the top of the asparagus shoot compared to its basal portion. This is attributed to the processes of plant development and cell division that requires higher concentration minerals.¹⁴ It was observed that the sodium content in these processes drops and potassium content remains the same. Asparagus has a very high nutritional density. This data suggests nutritional diversity and richness of content. Regarding all the elements, it exceeds 100%, except for sodium.¹⁵ In addition, it was shown that a larger diameter of asparagus stem implies a richer mineral composition. Similar results were obtained for the white asparagus. The differences in nutritional values between the top and the basal part of the plant have been identified. Mineral composition gradually decreases from the top to the bottom of the plant, and it is manifested in different ways according to the kinds and the thickness of the stem. It should be noted that these differences are not nutritionally significant, and that the data is within the recommended values.¹⁶

Canning is one of the most commonly used methods for preserving food including asparagus. The preservation technology itself does not significantly affect the nutrient composition i.e. carbohydrates, fibers, proteins and moisture. About 95% of vitamins B1, B2, B6 and vitamin C are preserved.¹⁷

Another common method of preserving vegetables is freezing. Tests have shown that the majority of minerals are af-

daci za skladištenje od 90 dana na istoj temperaturi od -18 °C, pokazuju da nema značajnog gubitka većine minerala.¹⁸

Šparoga je, nadalje, izvor raznih fitonutrijenata koje imaju vrlo povoljno djelovanje na zdravlje. Ubrajaju se u snažne antioksidanse koji štite organizam od štetnih posljedica oksidativnih procesa u organizmu. Među njima se ističu flavonoidi, karotenoidi i antocijani.

Manje poznata ljubičasta šparoga svoju boju dobiva iz visoke razine antocijana u izdancima. U odnosu na bijelu i zelenu šparogu ima niži sadržaj vlakna, slađa je i ima svjež, voćni okus.¹⁹

ected by the 45-day storage at -18 °C. These losses are partially attributable to the procedures in the industrial processing of asparagus (washing and blanching), that is carried out before freezing. Data on storage for 90 days at the same temperature of -18 °C, shows that there is no significant loss of most minerals.¹⁸

Asparagus is, besides, a source of a variety of phytonutrients that have a beneficial effect on health. They are included in potent antioxidants that protect the body from the harmful effects of oxidative processes in the body. Flavonoids, carotenoids and anthocyanins are distinguished among them.

Less well-known purple asparagus gets its color from the high level of anthocyanins in shoots. Compared to the white and green asparagus, it has a lower fiber content, it is sweeter and has a fresh, fruity flavor.¹⁹



Glavni bioaktivni sastojci šparoge su skupina steroidnih saponina. Od primarnih kemijskih sastojaka šparoge sadrže i eterična ulja, asparagin, arginin, tirozin, flavonoide (kaempferol, kvercetin i rutin), smole i tanin.²⁰

Ispitivanja plodova šparoga, dobivenih iz komercijalnog uzgoja u južnoj Mađarskoj, na sastav karotenoida provedena je HPLC tehnikom. Utvrđeni su: capsanthin, caprorubin, capsanthin 5,6-epoxid, antheraxanthin, violaxanthin, neoxanthin, mutatoxanthin epimeri, zeaxanthin, lutein, beta-cryptoxanthin, beta-karoten i neki cis-izomeri.²¹

Šparoga je prva u odnosu na ostale uspoređivane vrste povrća po ukupnoj kvaliteti i kvantiteti antioksidansa i četvrta po sadržaju ukupnih fenola.²²

Pokazuje jaču antioksidativnu aktivnost od primjerice brokule, iako posjeduju podjednaki sadržaj fenola, šparoga sadrži veći udio flavonida koji su u direktnoj korelaciji s antioksidativnom aktivnosti.²³

Zdravstvena vrijednost šparoga i utjecaj na srčanožilne bolesti

Šparoga je po svojoj zdravstvenoj vrijednosti poznata od davnina. U staroj Kini, 3000 godina p.n.e., jedna vrsta šparoga (*Asparagus lucidus*) se koristila protiv napadaja suhog kašlja, za liječenje otekline na koži i čireva, za jačanje pluća i za ublažavanje vrućine i bolova u nogama.²⁴

U kontekstu zdravstvene vrijednosti treba istaknuti da je šparoga povrće koje zahvaljujući izuzetnom nutritivnom sastavu ima potencijal u doprinosu prevenciji bolesti srčanožilnog sustava.

The main bioactive ingredients of asparagus are a group of steroidal saponins. Out of primary chemical ingredients, asparagus contain essential oils, asparagine, arginine, tyrosine, flavonoids (kaempferol, quercetin and rutin), resins and tannin.²⁰

Testing of asparagus fruits, obtained from commercial farming in South Hungary was conducted on the carotenoid composition by applying HPLC technique. The following has been identified: capsanthin, capsorubin, capsanthin 5.6-epoxide, antheraxanthin, violaxanthin, neoxanthin, mutatoxanthin epimers, zeaxanthin, lutein, beta-cryptoxanthin, beta-carotene and some cis-isomers.²¹

Asparagus takes the first place in relation to other compared types of vegetables judging by the overall quality and quantity of antioxidants and takes the fourth place judging by overall content of phenols.²²

It shows a more potent antioxidant activity than broccoli, though they contain an equal content of phenols. However, asparagus contains a greater proportion of flavonoids, which are in direct correlation with antioxidant activity.²³

Health value of asparagus and impact on cardiovascular diseases

Asparagus has been known for its health value since ancient times. In ancient China in 3000 BC, one species of asparagus (*Asparagus lucidus*) was used against the seizure of dry cough, for the treatment of skin swelling and ulcers, to strengthen the lungs and to alleviate the fever and pain in the legs.²⁴

Regarding the health values we should point out that asparagus is a vegetable that thanks to the extraordinary nutri-

Šparoga je također odličan izvor folne kiseline tj. reduciranog oblika folata. Folati sudjeluju u procesima stvaranja eritrocita i sprječavanju pojave anemije. Održava zdravu cirkulaciju krvi jer doprinosi smanjenju nakupljanja homocisteina koji je rizični čimbenik za pojavu srčanožilnih bolesti. Utvrđeno je da konzumacija 400 µg folne kiseline dnevno može smanjiti broj infarkta miokarda za 10%. Folati su posebno važni za trudnice jer doprinose pravilnom razvoju živčanog sustava kod fetusa.

Šparoga sadrži vitamin B6 koji pomaže u procesima sprječavanja nakupljanja homocisteina. Kad je razina ovog B vitamina niska, razina homocisteina u krvi raste, a to ovo stanje značajno povećava rizik od bolesti srca. Homocistein potiče aterosklerozu smanjujući integritet krvnih žila te ometajući stvaranje kolagena. Porast razine homocisteina uočen je u približno 20-40% osoba koje boluju od srčanih bolesti.²⁵

Konzumacija voća i povrća, naročito zelenog lisnatog povrća, bogatog vitaminom C, potencijalno ima zaštitni učinak protiv koronarne bolesti srca. Povećanje konzumacije voća i povrća za 1 serviranje na dan smanjuje rizik od koronarne bolesti za 4%.²⁶ Studija provedena u Španjolskoj ispitala je utjecaj konzumacije voća i povrća na arterijski tlak. Ispitanici su ispunjavali upitnik o prehrani na osnovu kojeg je utvrđeno da se mast konzumira u velikim količinama, 37% od dnevnih energetskih potreba. Ispitanici kojima je izmjeren sistolički tlak ≥ 140 ili dijastolički ≥ 90 mmHg smatrani su kao osobe s nedijagnosticiranom arterijskom hipertenzijom, iako nisu imali postavljenu medicinsku dijagnozu. Nakon prilagodbe čimbenika rizika za arterijsku hipertenziju, utvrđeno je da je visoki unos voća i povrća obrnuto proporcionalan arterijskom tlaku.²⁷

S obzirom da je šparoga bogata funkcionalnim sastojcima, pokušalo se razjasniti da li pomaže u snižavanju visokih vrijednosti arterijskog tlaka. Ispitivanja su provedena na spontano hipertenzivnim laboratorijskim životinjama. Zabilježeno je da su sistolički tlak, izlučivanje proteina u urin i aktivnost ACE (angiotenzin-konvertirajući enzim) značajno smanjene. Zaključak je da 2-hidroksinikotinamin iz šparoga inhibira ACE te na taj način doprinosi prevenciji hipertenzije i očuvanju funkcije bubrega.²⁸

Tijekom proizvodnje šparoge odvajaju se drvenasti dijelovi stabljike i lišća kao nuzproizvodi, a pokazuju veliki potencijal za zdravlje. U lišću je utvrđeno tri puta više rutina nego u stabljikama zelene šparoge.²⁹ Ispitivani su efekti unosa lišća i podnožja stabljike šparoga u prahu na metabolički sindrom kojega karakterizira hiperglikemija, arterijska hipertenzija i dislipidemija. Volonteri su bili nasumično podijeljeni u dvije grupe, jedna je konzumirala 6 g/dan praha lišća, a druga 6 g/dan podnožja stabljike šparoga tijekom 10 dana. Mjeren je arterijski tlak i CAVI (cardio-ankle-vascular indeks). Utvrđeno je da podnožje stabljike šparoge značajno smanjuje sistolički i dijastolički tlak. Također lišće i podnožje stabljike utječu na smanjenje ukupnih ugljikohidrata. Rezultati pokazuju značajan potencijal šparoge u prevenciji bolesti sastavnica metaboličkog sindroma.³⁰

Fitonutrijenti iz *Asparagus racemosus* tj. fitosteroli, saponini, polifenoli, flavonoidi i askorbinska kiseline mogu potencijalno djelovati na povećanje izlučivanja žučnih kiselina, uklanjanje suviška kolesterola i povišene vrijednosti jetrenog antioksidativnog statusa u uvjetima povišenih vrijednosti kolesterola.³¹

Saponin protodioscin kojeg u šparogi ima oko 0,01% posjeduju i snažno citotoksično djelovanje za mnoge vrste tumorskih stanica i djeluje na razinu androgena. Druga vrsta saponina diosgenin doprinosi smanjenju izlučivanja ukupnog

tional composition has a potential to contribute to the prevention of cardiovascular disease.

Asparagus is also an excellent source of folic acid that is, the reduced form of folate. Folate participates in the process of creating red blood cells and prevention of anemia. It maintains healthy blood circulation because it contributes to reducing the buildup of homocysteine, which is a risk factor for cardiovascular diseases. It was found that the consumption of 400 µg of folic acid a day can reduce the number of myocardial infarctions by 10%. Folate is especially important for pregnant women because they contribute to the proper development of the nervous system in the fetus.

Asparagus contains vitamin B6 which helps in the processes of preventing the accumulation of homocysteine. When the level of this B vitamin is low, the level of homocysteine in the blood increases, and this condition increases the risk of heart disease. Homocysteine stimulates atherosclerosis by reducing the integrity of blood vessels and interferes with the formation of collagen. The increased homocysteine levels was observed in approximately 20-40 % of patients suffering from heart diseases.²⁵

Eating fruit and vegetables, especially leafy green vegetables rich in vitamin C may have a protective effect against coronary heart disease. An increased consumption of fruit and vegetables by one dish per day reduces the risk of coronary heart disease by 4%.²⁶ A study conducted in Spain examined the impact of the consumption of fruit and vegetables on blood pressure. The subjects filled out the self-reported questionnaire on diet on the basis of which it was found that the fat was consumed in large amounts, 37% of daily energy needs. The subjects in whom the systolic blood pressure was measured ≥ 140 or diastolic was measured ≥ 90 mmHg were considered to be the persons with undiagnosed hypertension, although they did not have medical diagnosis. After adjusting for risk factors for hypertension, it was found that a high intake of fruit and vegetables is inversely proportional to blood pressure.²⁷

Since asparagus is rich in functional ingredients, we attempted to clarify whether it helps in lowering high blood pressure. Tests were conducted on spontaneously hypertensive laboratory rats. It was noted that the systolic blood pressure, protein excretion in the urine and the activity of ACE (angiotensin-converting enzyme) have been significantly reduced. The conclusion is that 2-hydroxynicotinamine from asparagus inhibits ACE and thus contributes to the prevention of hypertension and preservation of renal function.²⁸

During the production of asparagus, woody parts of stems and leaves are separated as byproducts, but they show a great potential for health. The foliage is found to contain three times more rutin than in the stems of green asparagus.²⁹ The effects of powdered leaves and stem base of asparagus on a metabolic syndrome characterized by hyperglycemia, hypertension and dyslipidemia have been tested. Volunteers were randomly divided into two groups, one of them consumed 6 g/day of leave powder and the other group consumed 6 g/day the stem base for 10 days. Blood pressure and CAVI (cardio-ankle-vascular index score) was measured. It was found that the asparagus stem base significantly reduced systolic and diastolic pressure. The leaves and asparagus stem base contribute to the reduction of the total carbohydrates. The results show a significant potential of asparagus in prevention of diseases of the metabolic syndrome.³⁰

Phytonutrients from *Asparagus racemosus* i.e., phytosterols, saponins, polyphenols, flavonoids and ascorbic acids can potentially have an effect on increased excretion of bile acids, removal of excess cholesterol and elevated liver antioxidant status in conditions of elevated cholesterol values.³¹

kolesterola i LDL-kolesterola, ali ne i HDL-kolesterola. Preliminarni rezultati istraživanja pokazuju da rutin i kvercetin, potencijalno smanjuju pojavnost karcinoma debelog crijeva kod eksperimentalnih životinja.³²

U prevenciji srčanožilnih bolesti izuzetno je važno u prehranu uvrstiti dovoljne količine voća, povrća i ribe, a ograničiti unos soli, smanjiti potrošnju zasićenih masti i rafiniranih šećera. Konzumacija šparoga doprinosi raznolikosti prehrane, povećanju potrošnje povrća i stjecanju zdravih prehrambenih navika.

Zaključak

Bolesti srca i krvnih žila su vodeći uzrok smrtnosti i bolničkog liječenja u Republici Hrvatskoj. Jedan od vrlo važnih rizičnih čimbenika za njihovu pojavu uz arterijsku hipertenziju, pušenje i nedostatnu tjelesnu aktivnost je nepravilna prehrana. Uravnotežen unos hrane i raznolikost namirnica, kao temelj pravilne prehrane, podrazumijeva konzumiranje najmanje tri obroka povrća dnevno.

Šparoge su povrće koje zahvaljujući odličnom sastavu vitamina, minerala i fitonutrijenata, visokom antioksidativnom kapacitetu, maloj kalorijskoj vrijednosti doprinose prevenciji srčanožilnih bolesti i općem zdravlju. Iako je utvrđen pozitivan utjecaj šparoge na kardiovaskularno zdravlje, za očekivati je da će u budućnosti biti više istraživanja koja idu u tom smjeru.

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Saponin protodioscin is contained in the asparagus as much as 0.01% and possesses a potent cytotoxic effect on many types of tumor cells which has an effect on androgen levels. Diosgenin, another type of saponin, contributes to the reduction of secretion of total cholesterol and LDL-cholesterol, but not HDL-cholesterol. Preliminary results of the trial show that rutin and quercetin potentially reduce the incidence of colon cancer in experimental animals.³²

In prevention of cardiovascular disease, it is extremely important to introduce adequate amounts of fruit, vegetables and fish in the diet, and limit the intake of salt, reduce the consumption of saturated fats and refined sugars. Consumption of asparagus contributes to the diversity of the diet, increase in consumption of vegetables and acquiring healthy eating habits.

Conclusion

Cardiovascular diseases are the leading cause of death and in hospital treatment in the Republic of Croatia. An unbalanced diet is one of the most important risk factors for their development along with hypertension, smoking and low physical activity. A balanced intake of food and the variety of foodstuff as the foundation of proper nutrition includes eating at least three meals of vegetables a day.

Asparagus is a vegetable that owes excellent composition of vitamins, minerals and phytonutrients, high antioxidant capacity, low calorie value contribute to the prevention of cardiovascular diseases and general health. Although a positive impact of asparagus on cardiovascular health has been confirmed, more trials addressing that topic are expected to be conducted in the future.

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