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Use of Wild and Semi-Wild Edible Plants in Nutrition and Survival of People in 1430 Days of Siege of Sarajevo during the War in Bosnia and Herzegovina (1992–1995)

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A B S T R A C T

This study is a systematic overview of data on use of wild and semi-wild edible plants in nutrition of people in 1430 days of the siege of Sarajevo during aggression on Bosnia and Herzegovina (1992–1995). The author of this study spent all that time in Sarajevo. In 1993, the author prepared a survival program for people that included usage of edible wild plants. In addition, he conducted a detailed survey, including special interviews, on 630 people of average age 37.4 years (55% residential inhabitants, the rest were refuges), 310 males and the rest were females. According to survey, 91 species of mostly wild plants and three species of fungus were used: Küchneromyces mutabilis, Armillariella mellea and Coprinus comatus*. Wild vegetables included 49 species, spices 24, wild fruits 16, and 2 species of bread-plants. They belong to 26 plants communities, and grew on 24 different habitats (urban surfaces, river coasts, low forest and scrubs, meadows and rocky grasslands). The 156 plant parts (leaves, young branches, fruit, flower, seed, root and rhizome) from 91 plant species were used. Vegetables were dominant category of use (soups, pottages, sauces) with 80 ways of preparation (30.53%), then salads 41 (15.65%), spices 39 (14.89%), different beverages 38 (14.50%), sweets 21 (8.02%), nutritive teas 15 (5.73%), and other preparations. In order to improve conventional food (war pasta, rice, lentils, old beans) people used spices made from different wild plants.*

Key words: *war nutrition, war anthropology, malnutrition, food shortage, human behavior, vegetables, condiment, field fruit, beverage, Balkan peninsula, siege*

Introduction

Nutrition is one of the most important factors for all living organisms, including humans. It is an important factor in peace and during the war. Wars, as special form of human interaction, are accompanied by a number of shortages, for example, shortage of food, water and medicines. Therefore, wars often cause acute and chronic hunger. Wars, as a way of interaction among people, unfortunately, are becoming more and more present in the world[1–4]. One of them is was the four-years long war in Bosnia and Herzegovina (BiH) (1992–1996) followed by exoduses, civilian casualties, gethoisation, sieges of cities and whole regions[5]. Among others, the war in BiH is characterized by chronic shortages of food, drinking water and medicines[6–8]. During a relatively short period of time this caused malnutrition of all groups of people in BiH[9]. Specially difficult and vague situation was in occupied and completely blocked Sarajevo[9,10]. Circumstances were not better in Tuzla, Zenica, Podrinje and a number of smaller cities were humanitarian aid programs had difficulties reaching[11].

Previous wars and extraordinary circumstances around the world were accompanied by shortages in food, malnutrition of people of all ages, as well as soldiers[12,13]. Malnutrition initiates appearance of a number of syndromes. Specially emphasized is development of diabetes[1] and reproduction issues[14], decrease of body mass index at boys in surrounded Tuzla[15], high level of miscarriages of women in the surrounded Sarajevo[16]. In all wars to date the food was a big problem. During the First

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World War there was great want to feed the entire world. Part of the experience in the field of Central Europe, as well as measures to combat hunger in different periods provides an exhaustive presented of Adam Maurizio[17–19].

The city of Sarajevo was totally blocked for 1443 days – between April 6, 1992 and November 25th, 1995. In such conditions, with everyday bomb shelling, shortages of food, water, heating, and people spontaneously organized among themselves. One of first forms of organization of civilians was attempt to provide food. Conventional forms were significantly reduced. Especially difficult and complicated, even lethal, was period of 1992 and 1993, both for local inhabitants and refugees. That winter was extremely cold and long. People began making habits of living in war, under bomb shelling, with shortages of water, in cold apartments. However, most difficult was to get accustomed to being hungry or to monotonous food and shortages of food. Even when humanitarian aid program began, it was limited and very monotonous, consisting of rice, lentil, old beans and cans that were dozens of years old. As there was no electricity and natural gas, and no fire wood, preparation of available food was very inadequate. Aside from non-ordinary taste of food, it additionally aggravated already difficult situation. Especially endangered were infants, children and elderly people. During first couple of months people significantly lost weight, some over 20–30 kg. Mass undernourishment appeared[9]. After that, people developed accented urge for living. First reaction to new conditions was search for food in direct environment[10]. Living conditions in surrounded Sarajevo were additionally compliated by lack of dietetics and medicines, necessary for elderly chronic patients. That is the reason why programs of alternative treatments from natural environment were conducted[8], so medicinal herbs, found on free territories were collected and used for preparation of dietetics[11–16,20–22].

Living conditions were difficult in both bigger urban centers and in the surrounded area of Podrinje, during three and a half year long total blockade. Especially difficult conditions were in June of 1995, when mass exodus of local inhabitants began and when several thousands people wandered in mountains for months on their way to freedom. They were exposed to panic and severe hunger. For some people, this living drama lasted for about 6 months. People ate everything. Centuries long prejudices toward wild food and some smaller animals were broken. People used different parts of 147 plants[11], 25 species of mushrooms and 7 species of lichens[22].

In the pre-war period most people had almost no knowledge about edible wild plants, alternative ways of nutrition and survival. However, they learned fast in the war. The war period in the surrounded Sarajevo was followed by all kinds of tempest, which proved that nutrition factor and fear of hunger are some of the most powerful factors in struggle for life and survival. The Sarajevo ghetto was a place where old saying that »hunger has no eyes« found its full meaning. For that reason, inhabitants turned to their environment, to wild plants, mushrooms, even smaller animals, and seek for salvage for them and their families. The use of wild edible plants didn't solve complex nutritional issues, but, it helped to avoid nutritional catastrophe, as well as prevented the appearance of a number of diseases followed by avitaminosis, that is often present in poor environments, even in peaceful conditions[23–25].

Circumstances

On April 6 1992, former Yugoslav People's army supported by different para-military groups began the aggression on city of Sarajevo. Aggression on independent and sovereign, internationally recognized state of BiH started in November 1991, by incineration of village Ravno in south east Herzegovina, on border with Croatia[26].

War in BiH lasted till Dayton peace agreement[27] was signed in Dayton (USA) on November 21 1995. The siege of Sarajevo, the capital of BiH, commenced by taking over the international airport on April 4–5 by *de facto* Serb's Yugoslav People's Army (JNA) and it lasted through until February 29, 1996. The Sarajevo siege is the longest siege in history of modern wars (1425 days). In addition, air bridge for support of 450000 inhabitants of Sarajevo lasted longer than the Berlin air bridge[26,27]. During the siege, city was bombed on average by 329 bomb shells a day (on July 22 1993, record 3777 bomb shells were noted). Number of »smaller« lethal means is unknown. During siege, 11,000 people were killed (1601 children), while 50,000 were partially of severely injured. In order to paralyze the city even more, large number of people (mostly women and children) were taken out of the city in different convoys, so toward the end of the siege only 250,000 people were living in Sarajevo[31,32]. At all times, Sarajevo was multicultural and multinational city. Bosnian Muslims, Bosnian Orthodox, Bosnian Catholics, Bosnian Jews and other minorities and religions lived together in Sarajevo. In addition to number of demographic, economical and political circumstances, panic, fear and discredit were present in the city. Soon after the aggression busted, shortages first in food, then in water became reality. Natural gas was turned off, electricity as well. Besides, constant bomb shelling of settlements, hospitals, schools, cultural monuments have additionally raised fear and panic.

In addition to all problems, severe shortage of food was in place. Search for food suppressed shortages of water, lack of heating and bomb shells. At this time, the food factor proved to be dominant in survival and struggle for living.

The basic goals of this study are:

(1) determination of food models in conditions of extreme shortages in conventional food, in conditions of total blockade and strictly limited movement area, with constant danger of being killed or wounded,

(2) making the inventory of wild edibles and »semi-wild« edible plants, some mushrooms and animals that were used in nutrition, time and place of their collection, usable parts and ways of preparation and use, and

(3) assessment of the level of adaptation of people to non-conventional food.

Material and Methods

Study area

Research was conducted in surrounded Sarajevo. Area is determined by coordinates 43°51×39×N, 18°24×81×E (Figure 1). Sarajevo valley is surrounded by high mountains (Figure 1). On the east is mountain Romanija (1656 m), on north are slopes of Bukovik and Crepoljsko (1532 m), on the south is Trebević (1687 m), and on the south east are mountains Igman and Bjelašnica (2087 m). Sarajevo has very dynamic relief. Small river Miljacka runs through the city in direction east – west. It separates city into two parts. This is the valley that spreads in direction east – west, 10 km long (Figure 1), and in that period 4–5 km wide. The rest of the city and its near surrounding were under control of the aggressor. One part of the city, Grbavica, was occupied by the aggressor, and it is located about 800 m from the administrative – political center of the state government at that time. At some locations in the city, river and its 50–100 meters wide coast were separating two territories of two war sides. See altitude in lowest part of the city is 540 m. Sloping areas (Sedrenik, Širokača, Pofalići) are on about 800 m. Several smaller confluents (Mošćanica) and brooks (Koševski, Bistrik) instill in river Miljacka. However, they are much polluted. Larges number of former springs was already adapted and out of reach for humans. Main springs (Jahorinska vrela and Vrelo Bosne) were under control of the aggressor.

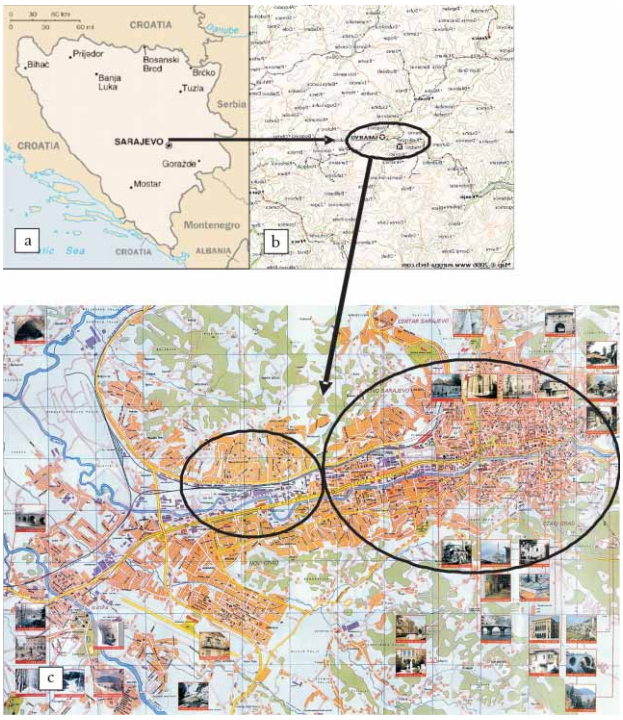

Fig. 1. Geographical position of investigated area; a. map of Bosnia and Herzegovina; b. detailed map of surroundings of Sarajevo city; c. siege zone of Sarajevo city during the 1415 war days.

Natural vegetation in this valley consisted of remains of downy oak forest *Quercus pubescens* in east part and remains of forests of sessile oak *Quercus petraea* and hornbeam *Carpinus betulus* in other parts of the city[30]. Meadows vegetation by such grasses as *Arrhenatherum elatius*, *Festuca pratensis*, *Agrostis capillaris*, *Bromus erectus*, *Dactylis glomerata* and others still remained at certain locations. Dominant were different forms of anthropogenic vegetation with *Artemisia vulgaris*, *Artemisia absinthium*, *Arctium lappa*, *Stellaria media*, *Bidens tripartitus*, *Cichorium intybus*, *and Onopordum acanthium*. Sole green areas were available in several smaller parks with lime trees *Tilia* sp., *Aesculus hippocastanum*, *Catalpa bignonioides*, *Sophora japonica*, *Ailanthus altissima*. However, due to the lack of firewood, large number of park trees was cut in this period[28]. That additionally endangered safety in the city and deteriorated the already complex ecological conditions. Typical arable land almost didn't exist. Small private gardens that people used for growing some of the basic crops (onion, cabbage, lettuce, etc.) existed in the sloping part of the city.

The climate of Sarajevo was semi-continental with strong influence of mountain climate[29]. Winters were cold and long, and summers were short and medium hot. Average annual temperature was about 9.51°C (at Meteorological station Sarajevo, Bjelave, on 630 m above sea). Absolute minimum temperatures were down to –25°C, while absolute maximum could reach up to 40°C. Common precipitation level is about 960 mm of water sediments during a year. This area is characterized by long and cold winters with a lot of snow[30].

Filed work and data analysis

Seeing that war is blazing, in June of 1992, when conventional food was already lacking and program of humanitarian aid didn't yet began, the author of this study in cooperation with Republic Center of Civilian Protection of BiH initiated the/an *ad hoc* program of survival of people in war conditions. Program included the completion of list of plants that could be used in human nutrition, ways of identification, the time of picking and ways of preparation[10]. In addition, the author provided education for people in local communities, presenting them edible plants that could be found in their neighborhood. A special program for soldiers and members of armed forces was also prepared by the author. In short intervals, when certain parts of the city had electricity, state TV broadcasted a show »Nutrition in nature« that the author prepared several years before the war. Besides, the author in the cooperation with BiH TV shot everyday instructive shows about nutrition in nature in Sarajevo war conditions. That was very often conducted under bomb shelling and under sniper activities. People were very interested in this type of education. Everybody collected dandelion *Taraxacum officinale*, stinging nettle *Urtica dioica*, chicory *Cichorium intybus* and other herbs that brought joy to their war tables.

TABLE 1
QUOTATION OF PLANTS AND PROPORTIONS OF EXAMINED PEOPLE

Quotation rating	Proportion of informants (%)	Number of informants
5	81–100	510–630
4	61–80	384–504
3	41–60	258–378
2	21–40	132–252
1	5–20	31–126

Plants that were quoted by less than 5% of examinees were not included in the final data basis

Program of survival and nutrition in nature continued to the following year (1993). That year, during different seasons, the author conducted open interviews with a large number of adults on the use of wild plants in nutrition through 1994/95. In this study the results of 630 such of interviews are presented (Table 1). The respondents were adults (mean age 37.4 years, 310 were males, 320 females). Examinees were of different educational background and pre-war social status. About 20% had higher education, including some people with PhD diplomas, 45% had secondary education and the rest of examinees were lower educated people. Local residents constituted 55% and the rest were refugees, mostly from east Bosnia (region Podrinje), as well as from other (occupied) parts of the city (Ilidža, Vogošća). Almost 80% were Bosnian Muslims (some of them extremely conservative in view of nutrition), and the rest were Bosnian Orthodox, Bosnian Catholics, and a small percentage of other ethnics. All people agreed to be interviewed and supported this project.

Gathering data was conducted in two ways: (i) interviews where chosen person verbally informed the author which plants he/she used (stating common people's title), place of picking, ways of preparation, used part, (ii) interview with demonstration in field conditions, where examinee or group of examinees showed used plants to the author, and (iii) when the author showed certain plants and interviewed examinees on their potential use.

For every species concrete botanical identification was determined by using identification keys[33], herbarium material was gathered and (voucher specimens) stored in Herbarium of Center for Ecology and Natural Resources in Sarajevo (HERBSARA), along with all information on the ways of preparation, conservation and ways of preparation as supplements to conventional food (rice, pasta, lentil).

The nomenclature of species and families was given in accordance with Flora Europaea[34]. Determination of biotope/habitat types was given in accordance with Oberdorfer[35] and vegetation conditions in accordance with Redžić[36–38].

Taxonomy of variable plant species

It has been determined the dominant species in the very variable plants. In addition, listed and related forms with the addition of agg (which means the unit that includes or may include more mutually related species) or the inclusion and other related forms specifying their scientific name). According to Flora Europea[34] such taxonomic and nomenclature status have the following species (aggregates): *Achillea millefolium* L. (Incl. *Achillea millefolium* agg.), *Malus sylvestris* Miller (Incl. *Malus domestica* Borkh.), *Prunus avium* L. (Incl. *Prunus avium* agg.), *Pyrus pyraster* Burgsd. (Incl. *Pyrus communis* L.), *Rosa canina* L. (Incl. *Rosa canina* agg.), *Rubus fruticosus* L. (Incl. *Rubus fruticosus* agg.), *Taraxacum officinale* Weber (Incl. *Taraxacum officinale* agg.), *Thymus pulegioides* L. (Incl. *Thymus serpyllum* agg.)

Results

Most quoted plant species

Ninety-one plant species (quoted by at least 5% of informants) were used in alternative nutrition of people in surrounded Sarajevo. With highest level of quotation (above 80%), are following species: *Urtica dioica*, *Taraxacum officinale*, *Tussilago farfara*, *Cichorium intybus* and *Malva sylvestris* (Table 2). Thirteen species were used by 61–80% of respondents. The most significant of them are the following: *Amaranths retroflexus*, *Sempervivum tectorum*, *Rumex patientia*, *Primula vulgaris* and *Pastinaca sativa*. Twenty-nine species were used by 41–60% of respondents, while 35 species were used by 21–40% of respondents. The most significant as supplements in nutrition were the following: *Trifolium repens*, *Stellaria media*, *Sinapis arvensis*, *Raphanus raphanistrum*, *Rumex acetosa*, *Lamium maculatum*, *Helianthus tuberosus*, and »semi-wild« species *Rubus* sp., *Malus* sp., *Chaenomeles* sp., *Levisticum* sp., *Prunus* sp. and others (Table 2 and 3).

Taxonomy and habitat of edible plants

The identified plants belong to 28 families. The first five families include 53 species (58.24%) (*Compositae*, *Rosaceae*, *Labiatae*, *Cruciferae* and *Umbelliferae*). *Compositae* mostly include wild vegetables and bread additives, *Rosaceae* vitamin plants and wild fruits, *Labiatae* condiments and preservatives, *Cruciferae* vegetables and condiments, and *Umbelliferae* vegetables and condiments. Twelve families are represented by one species (Table 4).

The listed plants grow on 24 ecologically different habitats (Table 5). Dominant are urban and semi-urban biotopes with extinct and nitrification vegetation, categorized in 23 vegetation orders. The most species inhabit nitrophilous ruderal sites (*Artemisietalia*, *Chenopodietalia*, *Onopordetalia* and *Glechometalia*), artificial and less natural meadows (*Arrhenatheretalia*), and moist habitats along river Miljacka (*Agrostetalia*) (Table 5). A significantly lower number of species inhabits forest habi-

TABLE 2
WILD AND SEMI-WILD EDIBLE PLANTS USED DURING THE SIEGE OF SARAJEVO (1992–95)

Voucher Specimens	Scientific Name	English Common Name	Plant Family	Season	Part (s) used	Citation rating (%)	Habitat / Community*	Preparation/ kind of use
S311401	*Achillea millefolium* L. (Incl. Achillea millefolium agg.)	Common Yarrow	*Compositae*	III-X (XI)	Young leaves Flower	41–60	*Arrh, O, Gle*	Cooked vegetables Condiment
S314901	*Aegopodium podagraria* L.	Ground Elder	*Umbelliferae*	IV-X	Young leaves	21–40	*O, Gle, Art*	Cooked vegetables Condiment
S312705	*Alcea rosea* L.	Hollyhock	*Malvaceae*	IV-X	Leaves Flowers	41–60	*Art, O, Cult*	Cooked vegetables Stuffing for pie Pie Beverage
S311818	*Alliaria petiolata* (M.Bieb.) Cavara & Grande	Garlic Mustard	*Cruciferae*	IV-IX	Leaves and young shoots	21–40	*O, Ch, Rob*	Salad Condiment
S314001	*Amaranthus retroflexus* L.	Pigweed	*Amaranthaceae*	V-X (XI)	Young shoots Leaves	61–80	*Ch*	Cooked vegetables Pie Soup
S311425	*Arctium lappa* L.	Great Burdock	*Compositae*	IV-X	Root Young leaves Steam of leaf	41–60	*O, Art*	Mush Vegetables Cooked vegetables Stuffing for pie
S311819	*Armoracia rusticana* P.Gaertn. B.Mey. & Scherb.	Horseradish	*Cruciferae*	IV-XII	Root Arial part	41–60	*Art, Ch, Gle*	Salad Condiment
S311402	*Artemisia vulgaris* L.	Mug worth	*Compositae*	IV-V (X)	Young shoots	5–20	*O, Art*	Condiment Cooked vegetables
S311803	*Barbarea vulgaris* R.Br.	Yellow Rocket	*Cruciferae*	IV-X	Young shoots	5–20	*Ch, Ag, Gle*	Cooked vegetables Condiment
S311425	*Bellis perennis* L.	Daisy	*Compositae*	IV-X	Young leaves	21–40	*Arrh, Pm, Gle*	Salad Cooked vegetables
S311818	*Brassica nigra* (L.) D.J.Koch	Black Mustard	*Cruciferae*	III-X	Leaves Young shoot	41–60	*Ch, O*	Salad Condiment
S311814	*Cardaria draba* (L.) Dsv.	Hoary Cress	*Cruciferae*	V-IX	Young shoots	5–20	*Gle, O*	Salad Condiment Cooked vegetables
S311405	*Carlina acaulis* L.	Stem less Carline Thistle	*Compositae*	VIII-XI	Root	21–40	*Be, Ps*	Fresh salad Beverage
S311407	*Cichorium intybus* L.	Chicory	*Compositae*	IV-XI	Root Young leaves	81–100	*Art, Arrh, O*	Mush Cooked vegetables Condiment Salad Surrogate for coffee
S313931	*Chaenomeles japonica* (Thunb.) Spach	Dwarf Quince	*Rosaceae*	X-XII	Fruit	41–60	*Cult*	Fresh fruit Beverage Apple cider Brine
S311305	*Chenopodium album* L.	Fat Hen	*Chenopodiaceae*	V-X	Leaves Young shoots	41–60	*Ch, O*	Cooked vegetables Pie Stuffing

S311426	*Crepis biennis* L.	Hawks beard	*Compositae*	V-X	Young leaves Fried root	21–40	*Arrh, O, Gle*	Salad Cooked vegetables Additives to pasta and rice Surrogate for coffee
S311427	*Crepis capillaris* (L.) Wallr.	Hawks beard	*Compositae*	V-X	Young leaves Fried root	21–40	*O, Art, Arrh*	Salad Additives to pasta and rice Cooked vegetables Surrogate for coffee
S314915	*Daucus carota* L.	Wild carrot	*Umbelliferae*	VI-XI	Root Leaves Seeds	41–60	*Art, O, Arrh*	Condiment Cooked vegetable Additives to different food
S314906	*Eryngium amethystinum* L.	Sea holly Blue	*Umbelliferae*	VIII-XI	Root	21–40	*Be, O*	Salad Beverage
S313913	*Fragaria vesca* L.	Wild Strawberry	*Rosaceae*	III-XI	Fruit Leaves	61–80	*Ea, Gle, O*	Fresh fruit Sweet Vitamin beverage Additives to different food
S313102	*Fraxinus ornus* L.	Manna Ash	*Oleaceae*	V-VI	Fresh Juice Young leaves Flowers	21–40	*Qp, O-Co*	Beverage Condiment Sweet
S314101	*Galium aparine* L.	Goose grass	*Rubiaceae*	VIII-X	Fruit	5–20	*O, Ch, Art*	Fried fruit for a substitute of coffee
S314102	*Galium verum* L.	Lady's Bedstraw	*Rubiaceae*	VI-IX	Flowers	5–20	*Be, Arrh, Ps*	For milk fermentation to produce yoghurt
S312422	*Glechoma hederacea* L.	Ground Ivy	*Labiatae*	IV-X	Aerial part Flowers	41–60	*Gle, O, Art* *Ps*	Condiment Beverage Sweet
S400101	*Hemerocallis fulva* (L.) L.	Common Day Lily	*Liliaceae*	III-XI	Bulb Flowers	21–40	*O, Art, Cult*	Mush as a potato Sweet
S314201	*Humulus lupulus* L.	Hop	*Cannabaceae*	IV-X	Young shoots Young leaves	21–40	*Ps, Sp, Pa*	Salad Cooked vegetables Additives to other meals
S311428	*Helianthus tuberosus* L.	Jerusalem Artichoke	*Compositae*	VIII-XI	Tuber	41–60	*O, Art, Bid*	Mush, as a potato
S314909	*Heracleum sphondylium* L.	Cow Parsnip	*Umbelliferae*	IV-XI	Root Young shoots Stem of leaves	21–40	*Art, Arrh, Gle*	Cooked vegetables Condiment Beverage
S312301	*Hypericum perforatum* L.	St. John's Worth	*Gutiferae*	V-X	Young shoots Flowers	41–60	*Orig, Be, Ps*	Condiment Beverage Additives to salads
S312423	*Hyssopus officinalis* L.	Hyssop	*Labiatae*	VIII-X	Aerial part Shoots with flowers	21–40	*S-Ch*	Condiment Beverage Tea
S325801	*Juglans regia* L.	Walnut Tree	*Juglandaceae*	VI-XI	Immature fruit Fruit	41–60	*Pa, F, Cult*	Vitamin rich condiment Sweet Leaves as a substitute for tobacco

S205901	*Juniperus communis* L.	Common Juniper	*Cupressaceae*	VIII-XI	Fruit	21–40	*Jun, Ps*	Beverage Condiment with wild meat
S312406	*Lamium maculatum* L.	Spotted Dead Nettle	*Labiatae*	IV-V	Young shoots Flowers	41–60	*O, Ch*	Cooked vegetables Condiment Salad
S312407	*Lamium purpureum* L.	Purple Dead-Nettle	*Labiatae*	III-XI	Young shoots	21–40	*Ch, O*	Cooked vegetables Condiment Salad
S311429	*Leontodon autumnalis* L.	Autumn Hawk bit	*Compositae*	V-XI	Young leaves Root	21–40	*Arrh, Agr, O, Art*	Cooked vegetables Surrogate for coffee
S311430	*Leucanthemm vulgare* Lam.	Ox-Eye Daisy	*Compositae*	VI-XI	Young leaves	21–40	*Arrh, Be, O*	Salad Cooked vegetables
S314910	*Levistucum officinale* W.D.J.Koch	Lovage	*Umbelliferae*	IV-XI	Leaves Fruit	21–40	*O, Cult*	Condiment Beverage
S313932	*Malus sylvestris* Miller (Incl. *Malus domestica* Borkh.)	Crab Apple	*Rosaceae*	V-XII	Fruit Dried Bark of fruit Leaves	61–80	*F, Qp*	Fresh fruit Beverage »SIRCE« as a apple cider Sweet Pay Brine
S312704	*Malva neglecta* Wallr.	Dwarf Mallow	*Malvaceae*	IV-X	Young shoots Young leaves Immature fruits	61–80	*O, Ch, Art*	Cooked vegetables Stuffing Pie Sweet
S312703	*Malva sylvestris* L.	Musk Mallow	*Malvaceae*	V-XI	Young shoots Young leaves Immature fruits	81–100	*Ch, O, Art*	Cooked vegetables Stuffing Pie Sweet
S312511	*Medicago sativa* L.	Alfalfa	*Leguminosae*	VI-X	Young shoots Seed	21–40	*Arrh, Art, Gle*	Salad Additives to pasta and rice
S312411	*Mentha arvensis* L.	Corn Mint	*Labiatae*	VI-X	Young shoots	21–40	*Ch, Bid, Ag*	Condiment Tea
S312410	*Mentha longifolia* (L.) Huds.	Horsemint	*Labiatae*	V-X	Young shoots	41–60	*Bid, Ag, Pa Sp*	Condiment Tea
S312412	*Mentha pulegium* L.	Pennyroyal	*Labiatae*	VI-XI	Young shoots	41–60	*Bid, Gle, Ag*	Condiment Tea
S312426	*Micromeria thymifolia* (Scop.)Fritsch.	Thyme Savory	*Labiatae*	VII-XI	Aerial part	5–20	*S-Ch, O-Co, Amph*	Condiment Tea Salad
S311431	*Onopordum acanthium* L.	Scotch Thistle	*Compositae*	VI-XI	Root	21–40	*O, Art*	Salad Cooked vegetables Beverage
S312413	*Origanum vulgare* L.	Oregano	*Labiatae*	VI-XI	Young shoot Flower	61–80	*Orig, Ps, Ea, Qp*	Condiment Tea Beverage
S314911	*Pastinaca sativa* L.	Wild Parsnip	*Umbelliferae*	VI-XI	Young leaves Root	61–80	*Gle, Arrh, Art*	Cooked vegetables Additives to pasta and rice Sweet

S314301	*Pelargonium graveolens* L'Hér.	Lemon geranium	*Geraniaceae*	I-XII	Leaves	21–40	*Cult*	Condiment Beverage
S311422	*Petasites hybridus* (L.) B.Meg. et Schreb.	Butterbur	*Compositae*	V-XI	Young leaves Dried leaves	41–60	*Ad, M-C*	Cooked vegetables Beverage Pie Substitute for tobacco
S313402	*Plantago lanceolata* L.	Ribwort Plantain	*Plantaginaceae*	V-XI	Aerial part	21–40	*Arrh, Gle, Agr*	Cooked vegetables Additives to pasta and rice
S313404	*Plantago major* L.	Common Plantain	*Plantaginaceae*	IV-X	Leaves			Cooked vegetables Salad
S313403	*Plantago media* L.	Hoary Plantain	*Plantaginaceae*	V-XI	Aerial part	21–40	*Be, Arrh, Ps*	Cooked vegetables Additives to other meals
S313933	*Potentilla reptans* L.	Cinquefoil	*Rosaceae*	IV-XI	Leaves Rhizome	21–40	*Arrh, Pm, Ag, Ch*	Cooked vegetables Additives to other meals Salad Beverage
S313803	*Primula vulgaris* Huds.	Primrose	*Primulaceae*	II-XII	Young leaves Flower	61–80	*Gle, F, Arrh, Art, Ps*	Fresh/salad Beverage
S313938	*Prunus avium* L.	Wild Cherry	*Rosaceae*	VI-VIII	Fresh fruit Dried fruit Peduncle	41–60	*F, Qp*	Fresh fruit Stewed fruit Beverage Tea
S313922	*Prunus spinosa* L.	Sloe	*Rosaceae*	V-XI	Fruit Leaves	21–40	*Ps, F, O-Co*	Fresh fruit Beverage Brine Preservative Substitute for tobacco
S310601	*Pulmonaria officinalis* L.	Lungwort	*Boraginaceae*	III-X	Young shoot	41–60	*F, Ps*	Cooked vegetables Salad decoration
S313919	*Pyrus pyraster* Burgsd. (Incl. *Pyrus communis* L.)	Common Pear Tree	*Rosaceae*	VI-XI	Fresh fruit Dried fruit Leaves	41–60	*F, Qp*	Fresh fruit Beverage Brine Vitamin rich tea
S311815	*Raphanus raphanistrum* L.	Wild Radish	*Cruciferae*	III-XI	Leaves	41–60	*Ch*	Salad Condiment Additives to other meals
S313504	*Reynoutria japonica* Houtt.	Japanese Knotweed	*Polygonaceae*	V-X	Young shoots Young leaves	21–40	*Art, O*	Salad Condiment Beverage
S312510	*Robinia pseudacacia* L.	Black Locust	*Leguminosae*	V-IX	Flower Seeds	61–80	*Rob, Pa*	Sweet, Salad Cooked meal instead of kidney bean
S311813	*Rorippa sylvestris* (L.)Besser	Yellow Cress	*Cruciferae*	IV-X	Young shoot	5–20	*Agr, M-C*	Condiment Additives to cooked vegetables
S313924	*Rosa arvensis* Huds.	Weed rose	*Rosaceae*	V-XI	Fruit Leaves	21–40	*Ps*	Fresh fruit Beverage Marmalade Tea

S313923	*Rosa canina* L. (Incl. *Rosa canina* agg.)	Dog-rose	*Rosaceae*	V-XII	Fruit	41–60	*Ps*	Fresh fruit Beverage Marmalade Tea
S313929	*Rubus idaeus* L.	Raspberry	*Rosaceae*	V-XI	Fruit Leaves	41–60	*Ea, Art*	Fresh fruit Beverage Marmalade Tea
S313930	*Rubus fruticosus* L. (Incl. *Rubus fruticosus* agg.)	Blackberry	*Rosaceae*	I-XII	Fruit Leaves	61–80	*Ps, Rob*	Fresh fruit Marmalade Beverage Vitamin rich tea
S313508	*Rumex acetosa* L.	Sorrel	*Polygonaceae*	IV-X	Leaves Young shoot	41–60	*Arrh, Gle*	Salad Vegetables Condiment
S313503	*Rumex crispus L.*	Curled Dock	*Polygonaceae*	IV-X	Leaves Young shoot Root	21–40	*Arrh, Gle, O*	Salad Vegetables Beverage
S313512	*Rumex patientia* L.	Herb Patience	*Polygonaceae*	IV-X	Leaves Young shoots Root	61–80	*Agr, Arrh, Art*	Salad Vegetables Beverage
S311102	*Sambucus nigra* L.	Elderberry	*Caprifoliaceae*	V-X	Flower Fruit	61–80	*Pa, Ps, F*	Beverage Marmalade Tea Syrup
S311103	*Sambucus ebulus* L.	Red Elder	*Caprifoliaceae*	X-XI	Fruit	5–20	*Ea, Ad*	Marmalade Syrup
S313931	*Sanguisorba minor* Scop.	Salad Burnet	*Rosaceae*	III-XI	Aerial part	41–60	*Be, Arrh*	Fresh salad Condiment Beverage
S311707	*Sedum spectabile* Boreau.	Ice Plant	*Crassulaceae*	IV-X	Fresh leaves	41–60	*Cult*	Salad, water
S311705	*Sedum telephium* L.	Orpine	*Crassulaceae*	I-XII	Fresh leaves	21–40	*Amph, O-Co*	Salad, water
S311706	*Sempervivum tectorum* L.	Houseleek	*Crassulaceae*	I-XII	Fresh leaves	61–80	*Cult*	Salad, water
S311202	*Silene vulgaris* (Moench) Garcke	Bladder Campion	*Caryophyllaceae*	IV-X	Young shoots Leaves	21–40	*Arrh, Be, Art*	Salad Cooked vegetables Tea
S311816	*Sinapis arvensis* L.	Charlock	*Cruciferae*	III-XI	Young leaves Young shoots	41–60	*Ch, O, M-C*	Salad Condiment Additives to other meals
S311432	*Sonchus arvensis* L.	Field Milk Thistle	*Compositae*	IV-IX	Young leaves	21–40	*Ch, O*	Salad Cooked vegetables
S311433	*Sonchus oleraceus* L.	Sow Thistle	*Compositae*	IV-VI	Young leaves	21–40	*Ch, O*	Salad Cooked vegetables
S311203	*Stellaria media* (L.)Vill.	Chickweed	*Caryophyllaceae*	III-XII	Young shoots With leaves	41–60	*Ch*	Salad Cooked vegetables Condiment Additives to other meals

S311423	*Taraxacum officinale* Weber (Incl. *Taraxacum officinale* agg.)	Dandelion	*Compositae*	III-IX	Leaves Root Flowers	81–100	*Arrh, Art, Gle, Pm, Ag*	Fresh salad Cooked vegetables Additives to pasta rice Coffee substitute Sweet
S312421	*Thymus pulegioides* L. (*Thymus serpyllum* agg.)	Broad-Leaved Thyme	*Labiatae*	V-X	Aerial part	61–80	*Be, S-Ch*	Condiment Beverage Tea
S311817	*Thlaspi arvense* L.	Pennycress	*Cruciferae*	IV-VI	Young leaves	5–20	*Ch, O*	Condiment Additives to other meals
S312515	*Trifolium pratense* L.	Red Common Clover	*Leguminosae*	IV-X	Leaves Flowers	21–40	*Arrh, Art, Gle*	Fresh salad Vegetables Beverage Sweet
S312516	*Trifolium repens* L.	White Clover	*Leguminosae*	IV-XI	Leaves Flowers	41–60	*Arrh, Pm, Ag, Gle*	Fresh salad Vegetables Beverage Sweet
S311424	*Tussilago farfara* L.	Coltsfoot	*Compositae*	IV-XI	Fresh leaves Dried leaves	81–100	*O, Ch, Art*	Cooked vegetables Instead of cabbage in stuffed rolls Instead of tobacco
S315001	*Urtica dioica* L.	Stinging Nettle	*Urticaceae*	II-XII	Fresh young shoots Fresh young leaves Dried leaves	81–100	*O, Ch, Art, Rob, Pa, Sp*	Cooked vegetables Pie Beverage Condiment
S315201	*Viola odorata* L.	Common dog violet	*Violaceae*	III-VI	Flower Leaves	21–40	*Ps, Orig, Gle*	Salad Condiment Beverage
S315202	*Viola alba* Besser	White violet	*Violaceae*	III-VI	Flowers Leaves	21–40	*Ps, Orig, Gle*	Salad Condiment Beverage

Meaning of abbreviations: Ad – *Adenostyletalia* (High herbaceous vegetation); Agr – *Agrostetalia* (Hygrophilous nitric grasslands); Amph – *Amphoricarpetalia* (Calcareous cliff vegetation); Arrh – *Arrhenatheretalia* (Mesophilous grasslands); Art – *Artemisietalia* (High herbaceous neglected vegetation); Be – *Brometalia erecti* (Thermophilous calcareous grasslands); Bid – *Bidentetalia* (Nitrogen rich hygrophilous vegetation); Ch – *Chenopodietalia* (Mesophilous nitrogen rich neglected vegetation); Ea – *Epilobietalia angustifoliae* (Rosebay Willow-herb); F – *Fagetalia* (Mesophilous deciduous forests); Gle – *Glechometalia* (Semi neglected vegetation); Jun – *Juniperetalia* (Juniper scrubs); Mol – *Molinietalia* (Hygrophilous grasslands); M-C – *Montio-Cardaminetalia* (Spring vegetation); O – *Onopordetalia* (Neglected vegetation); Orig – *Origanetalia* (Thermophilous high herbaceous vegetation); Pa – *Populetalia albae* (Hygrophilous forests); P-h-n – *Pinetalia heldreichii-nigrae* (Black pine calcareous forests); Ps – *Prunetalia spinosae* (Thorny scrub); Ph – *Phragmitetalia* (Reed wetlands); P – *Pteridietalia* (Bracken vegetation); Rob – *Robinietalia* (Black locust vegetation); S-Ch – *Scorsonero-Chrysopogonetalia* (Rocky calcareous grasslands); Sp – *Salicetalia purpureae* (Low willow scrub).
**N – new plant food species registered in this investigation.

tats (*Fagetalia* and *Quercetalia pubescentis*) and forest habitats were mostly located outside of the city. The high level of diversity of habitats caused significant diversity of vascular plants, among which are edible and medicinal plants. Besides wild plants, used were 8 cultivated species. Those are mostly decorative plants cultivated in parks and gardens and sometimes escape from cultivations. Some of them grow wild. Most important are *Levisticum officinale*, *Hemerocallis fulva* and *Chaenomeles japonica*. Only *Pellargonium graveolens* is plant of closed spaces.

There is no significant correlation between type of habitat and usable value of edible plants. However, the analysis of Table 3 shows that in communities of urban and semi-urban vegetation dominant are vegetable plants, in meadows and rocky grasslands dominant are condiment plants, while in remains of woods and thicket and natural hedges dominant are fruit plants.

TABLE 3
THE FREQUENCY OF USE OF EDIBLE PLANTS

Category	Number of plant species	Proportion of informants (%)
1	9	9.89
2	35	38.46
3	29	31.87
4	13	14.29
5	5	5.49
Total	91	100

TABLE 4
TAXONOMY OF EDIBLE PLANTS

No	Plant family scientific name	Number of plant species	Proportion (%)
1	*Compositae*	17	18.68
2	*Rosaceae*	12	13.19
3	*Labiatae*	10	10.99
4	*Cruciferae*	9	9.89
5	*Umbelliferae*	6	6.59
6	*Leguminosae*	4	4.40
7	*Polygonaceae*	4	4.40
8	*Crassulaceae*	3	3.30
9	*Malvaceae*	3	3.30
10	*Plantaginaceae*	3	3.30
11	*Caprifoliaceae*	2	2.19
12	*Caryophyllaceae*	2	2.19
13	*Rubiaceae*	2	2.19
14	*Violaceae*	2	2.19
15	Other 12 families one species each	12	13.19
	Total	91	100

Structure of edible plants according to their basic purpose

Determined plant species at this area, according to their basic purpose, are classified into four groups: wild vegetable (53.85%), wild fruits (17.58%), spices (26.37%) and plants in making bread of only 2.20% (Table 2).

Wild vegetable is used in preparation of cooked meals (potages, sauces, pies, stuffing), and for salads. The most quoted species in this category are: *Urtica dioica*, *Malva*

TABLE 5
MAIN TYPE OF HABITAT AND COMMUNITY OF EDIBLE PLANTS

No	Abbreviation of scientific name of plant community	Habitat/Community	Number of plant species	Proportion (%)
1	*F*	*Fagetalia*	5	2.22
2	*Qp*	*Quercetalia pubescntis*	5	2.22
3	*O-Co*	*Ostryo-Carpinetalia orientalis*	4	1.78
4	*Pa*	*Populetalia albae*	6	2.67
5	*Sp*	*Salicetalia purureae*	3	1.33
6	*Ps*	*Prunetalia spinosae*	16	7.11
7	*Rob*	*Robinietalia*	4	1.78
8	*Jun*	*Juniperetalia*	1	0.44
9	*Ea*	*Epilobietalia angustifolii*	4	1.78
11	*Ad*	*Adenostyletalia*	2	0.89
12	*Orig*	*Origanetalia*	4	1.78
13	*S-Ch*	*Scorzonero-Chrysopogonetalia*	3	1.33
14	*Be*	*Bometalia erecti*	8	3.56
15	*Arrh*	*Arrhenatheretalia*	24	10.67
16	*M-C*	*Montio-Cardaminetalia*	3	1.33
17	*Agr*	*Agrostetalia*	11	4.89
18	*Gle*	*Glechometalia*	22	9.78
19	*Bid*	*Bidentetalia*	4	1.78
20	*Art*	*Artemisietalia*	28	12.44
21	*O*	*Onopordetalia*	35	15.56
22	*Ch*	*Chenopodietalia*	21	9.33
23	*Pm*	*Plantaginetalia majoris*	4	1.78
24	Cult	Cultivated	8	3.56
Total			225	100

sylvestris, *Taraxacum officinale*, and *Amaranthus retroflexus*, *Arctium lappa*, *Lamium maculatum*, *Malva neglecta*, *Pastinaca sativa*, *Petasites hybridus* and some others. Within this category represented are also some plants that are used as condiment (*Daucus carota*, *Heracleum sphondylium*, and root vegetables, such as root of *Carlina acaulis*, *Eryngium amethystinum* and *Onopordum acanthium)*. Out of 24 spice plants, most significant are the following: *Origanum vulgare*, *Thymus* sp., the species of genus *Mentha* sp., *Armoracia lapathifolia*, *Achillea millefolium*, *Hypericum perforatum*, *Levisticum officinale,* etc.

The 16 species or almost 18% were wild fruit. Most quoted are the following: *Malus sylvestris*, *Pyrus pyraster*, *Sambucus nigra*, species of genera of *Rosa* and *Rubus*. Bread-like plants are represented by only two species – *Helianthus tuberosus* and *Hemerocallis fulva* (Table 2).

Most commonly eaten edible plants

Stinging nettle *Urtica dioica* L.

It is a commonly known edible plant. Due to its capability of annealing it is simple for identification. It grows on soils rich in nitrates, and so it is very often in human settlements. For that reason it was available in most urban parts during the war. In 1992–93 it was the most wanted plant. Everyone tried to alter the monotony of home made pasta (without eggs and fats) and fine grained rice by using green shoots of stinging nettle. Shoots are fresh from early spring (February/March through October/November) and were used in preparation of following meals: (i) boiled shoots with a little bit of vinegar were used as a tasty salad and mineral – vitamin side dish with everyday rice, without any fat, (ii) boiled and additionally fried shoots, were good as sauces, (iii) finely chopped raw shoots were good stuffing for traditional pies, (iv) finely chopped shoots mixed with flour were good mash for children, (v) finely chopped fresh shoots mixed with flour were baked in oven like »vegetable« pizza and called »uljevak« and (vi) chopped fresh shoots left in water and exposed to sun for seven days. Nettle was used either fresh or dried. Many people picked nettles during peaceful mornings and dried it, preserving it for long and cold winters.

As in other earlier periods of food shortages on the territory of Balkan peninsula, nettle played a significant role[42,43, 5–47]. They were so important in nutrition of people in Sarajevo and brought so much joy in everyday sparely menus, which it deserved to, get a well deserved monument. Besides, nettle was used for a long time in this area as folk remedy in prevention and treatment of anemia, inflammation of urinary systems, and for immunity[11].

Dandelion *Taraxacum officinale* Weber

Everyone were waiting for period when deep snow starts melting and first rosettes of dandelion start appearing on sunny hills around Sarajevo. *Taraxacum officinale* was mostly used in supplemental nutrition. Used were young leaves, and in lack of those, used were other leaves during whole vegetation season (early spring through late fall). Even rosettes were used during warmer and snow less winters. Besides leaves, used were blossoms – yellow flower heads and root during the whole year. Fresh leaves when left in cold water for a while (to reduce their natural bitterness) are tasty dietetic salad. Boiled leaves are tasty vegetable, could be used as addition to pasta and especially rice. Boiled leaves with a bit of vinegar are tasty salad that was served with old and tasteless cans »Ikar« (»Ikar« were canned as part of humanitarian aid to people in the occupied Sarajevo). They are very old and in bad taste and people do not like. Even cats and dogs do not like eating this type of canned food. So they were necessary to enrich some wild vegetables). Flower heads were used for making »honey«, in a way that 100 or so flower heads are put in glass jar and exposed to sun for 10–15 days. After that, flowers are reabsorbed. Received mass has sweet taste. Root was very famous. Dried on sun and then fried and grinded, it was used for making coffee that people called »chicory«.

Chicory *Cichorium intybus* L.

Chicory, beside the fact it's a great decoration on urban green fields, is a very nutritive plant. Their sky-blue blossoms have magical influence on humans. In sunny periods they brought back self-confidence and trust in life among grenades and other projectiles. Same as dandelion, chicory was intensively used in supplemental nutrition. Young leaves were used as salad. Boiled leaves with addition of vinegar were good side dish with rice or pasta. Boiled leaves were used for making mash that was mixed with wild vegetables. Chicory root was picked during whole vegetation season. Dried in sun and fried was used for preparation of »war coffee«. This is important since coffee was unavailable in Sarajevo.

Coltsfoot *Tussilago farfara* L.

This is the plant of abandoned urban surfaces. It is very common in urban parts of Sarajevo and reaches very high production of green biomass. It has been used as dietetic food for a very long time in this area[41–43,47].

Young and healthy leaves are used in nutrition during whole year. They are used for making tasty stews, pie stuffing, and mashes. It was used also before the war[43]. Specialty and refreshment in war nutrition was »sarma« rolls of boiled leaves stuffed with rice, sometimes even lentil. Lentil was successful substitute for meat. The *Tussilago* rolls are commonly made in the Central Europe[44]. Young leaves were threaded on a string and dried for use during winter. Besides, leaves were also preserved for later use. They are cooked in boiled water with added a bit of apple vinegar, blackthorn fruits *Prunus spinosa* and branches of hyssop *Hyssopus officinalis*. As cigarettes were also unavailable during the war, dried and partially fermented leaves were used as substitutes for tobacco. Most interviewed smokers were more than satisfied.

Mallow *Malva sylvestris* L.

Favorite and known plant from abandoned urban territories. In early summer it excels with pink flowers that are often formed and create mallow gardens. From early spring, leaves and young shoots are used for preparation of tasty stew, stuffing, pies, and mashes for children. Green fruits are used as substitutes for sweets. Children often use them as substitutes for candies and other sweets. Flowers are used as salad decorations and for tea dietetic beverages[10,11].

Other edible plants

With quotation between 61% and 80% are 13 species (Table 2 and 3). Among them is wild vegetable *Malva neglecta*, *Pastinaca sativa*, *Amaranthus retroflexus*, then tasty wild salads from species *Primula vulgaris*, *Rumex patientia*, *Sempervivum tectorum*, spice plants *Origanum vulgare*, *Thymus pulegioides*, and beverages – species *Fragaria vesca*, *Rubus fruticosus, Sambucus nigra* and *Robinia pseudacacia*, whole flowers are used as sweets and for preparation of tasty pancakes. Unlike previous group of plants, this group has very limited potential on free territory.

With quotation between 41% and 60% are 29 species. Especially interesting is nutritive composition of the following species: *Althaea rosea*, *Arctium lappa*, *Lamium maculatum*, *Plantago major*, *Stellaria media* used for preparation of tasty stews, potages, stuffing, and pies. During the war, due to lack of conventional fruits, fruits of flowering quince *Chaenomeles japonica,* available in many Sarajevo parks, were often used. Fruits were eaten as fresh after first frosts, and they were also used for preparation of beverages, vinegar, as well as alcohol beverage called »jabukovača« (apple brandy). During this period, potato was in a great shortage. Bulbs of species *Helianthus tuberosus* were used as substitutes. If mildly boiled, and then cooked in order to maintain natural form, they could be used as tasty »potato«.

With quotation between 21% and 40% are 35 species. Among them are useful and nutritive plants, but many were present in a very small number. From this group we should mention following species: *Alliaria petiolata*, *Carlina acaulis*, *Eryngium amethystinum*, *Heracleum sphondylium*, *Onopordum acanthium* and *Reynoutria japonica* (*Polygonum cuspidatum).*

With quotation between 10–20% are 9 species. Species that were quoted less than 10% are not included in this list.

TABLE 6
PLANT PART USED

No	Part of plants	Number of plants	Proportion (%)
1	Arial parts	8	5.13
2	Young shoots	28	17.95
3	Fresh young shoots	1	0.64
4	Shoot with flowers	1	0.64
5	Leaves	27	17.31
6	Young leaves	20	12.82
7	Fresh leaves	5	3.21
8	Dried leaves	3	1.92
9	Flowers	17	10.90
10	Fruit	14	8.97
11	Fresh fruit	2	1.28
12	Dried fruit	2	1.28
13	Dried bark of fruit	1	0.64
14	Immature fruit	3	1.92
15	Peduncle of leaf and fruit	2	1.28
16	Seed	3	1.92
17	Fresh juice	1	0.64
18	Root	13	8.33
19	Fried root	2	1.28
20	Bulb	1	0.64
21	Rhizome	1	0.64
22	Tuber	1	0.64
Total		156	100

TABLE 7
FOOD PREPARATION

No	Kind of food preparation	Number of plant species	Proportion (%)
1	Cooked vegetables	44	16.79
2	Additives to different food	9	3.43
3	Pasta additives	8	3.05
4	Stuffing	6	2.29
5	Pie	8	3.05
6	Salad	41	15.65
7	Beverage	38	14.50
8	Condiment	39	14.89
9	Nutritive teas	15	5.73
10	Sweet	13	4.96
11	Marmalade	5	1.91
12	Stewed fruit	1	0.38
13	Syrup	2	0.76
14	Mush	4	1.53
15	Soup	1	0.38
16	Fresh fruits	10	3.82
17	Brine	4	1.53
18	Apple cider	2	0.76
19	To curdle milk	1	0.38
20	Preservative	1	0.38
21	Coffee substitute	6	2.29
22	Tobacco substitute	4	1.53
Total		262	100

Usable parts of edible plants

Out of 91 plants total of 156 parts were used in making of different nutritive preparations (Table 6). Domi-

nant are aerial green parts (leaves, shoots) 93 (59.62%), fruits 25 (16.03%), underground parts (root, bulb, rhizome) 18 (11.54%), flowers 17 (10.90%) and seeds 3 (about 2%). These relations correspond with the climate where multi-year herbaceous plants-chemicryptophytes, otherwise characteristic for semi-continental climate. Due to absence of moist biotopes, very low representation is geophytes, containing carbohydrates.

Preparations and use

Dominant are vegetables prepared in different ways (soups, potages, sauces) with 80 preparations (30.53%), then salads with 41 (15.65%), condiments with 39 (14.89%), different beverages with 38 (14.50%), different sweets with 21 (8.02%), nutritive teas with 15 (5.73%), and other preparations (Table 7).

Ways of food preparation

During the war in Sarajevo there was no electricity or firewood and coal, especially during first two years. Due to food shortages, one of the most difficult issues was heating during cold part of a year (about 6 months), and means for thermic preparation of food. Humble fires were used for preparation of even more humble meals. Bread was »baked« in steam pot, and everyday pasta and rice were prepared on small fires, often in collective centers or for several households at once. For that reason, all meals should have been prepared with as less energy-generating products as possible, mostly wood. Dominant was boiled meals – wild vegetables. Conventional vegetables were not available in surrounded city. Food was baked very rarely (as that required more energy).

Vegetables were prepared with no fat and with wild spices. During research, it was found that some families had no fat for months (fall-winter 1992). Some of them were loosing weight significantly, up to 40 kg. Fortunately, they had salt.

Salads were made out of fresh or boiled vegetable with added natural vinegar. Some plants were used raw such as the leaves of *Primula vulgaris*, *Rumex acetosa*, *Rumex patientia* and *Reynoutria japonica*.

Beverages were made from different parts of plants left in water and exposed to sun for several days. Further added were preservatives, such as *Origanum vulgare*, *Hyssopus officinalis*, *Thymus* sp., *Micromeria thymifolia*, and species of genus *Mentha*. A beverage of *Sambucus nigra* flowers was prepared in this way. Special beverage was pickles of fruits of wild apples *Malus sylvestris* (Incl.*Malus domestica*), wild pears *Pyrus pyraster* (Incl. *Pyrus communis*) with added pseudo fruits of *Juniperus communis* and fruits *Prunus spinosa*. This was important winter beverage. No other spices but salt was available. That is the reason why self-growing flora was so important.

Spices were made from both fresh and dried parts of plants. They significant improved taste of rice, pasta and lentils (everyday menu for the most part of Sarajevo populations).

Among them were substitutes for coffee, a valuable beverage, very important in Bosnian tradition. Six plant species were used in making coffee that was called chicory. The root of *Cichorium intybus* (vodopija), *Taraxacum officinale* (maslačak), and fruits of *Galium aparine* (broć), were dried, fried on low fire, beaten or grained. The fruit of *Galium aparine* as a substitute for coffee used by some residents who were instructed in the workshops. Otherwise in some literature sources mentioned in this species as a substitute for coffee[40]. A certain amount of the ground mass is covered with boiling water and it is »enjoyed« along with some sweets. Sugar was very rare. With added powder milk, this was not a bad beverage. It was important as it was warm.

There was a huge shortage in cigarettes and tobacco. As substitute for tobacco the following combination was used: 80% of leaves of coltsfoot *Tussilago farfara*, 20% of leaves of walnuts *Juglans regia*.

Alcohol beverages were also unavailable. Some inventive people tried to »make« a home made apple brandy or pear brandy from fruit of wild pear or wild apple. Some were successful in getting alcohol from rice. At this time, alcohol beverages were more than pure necessity. They were expected to relieve everyday fear from death, wounding and to assist in overcoming accumulated psychological problems. As there were no officials sedatives[8] people often reached for alcohol. As there was no conventional alcohol available, they were forced to make it themselves. Unfortunately or fortunately, all plum woods were out of reach zone. Otherwise, fruits of plum *Prunus domestica* were used for making plum brandy in the past.

Seasonal distribution

Seasonal distribution of edible plants in surrounded Sarajevo is given in Table 8. Most plants are available in late spring, summer and early fall. Despite the fact that winters are rather severe some of the species available to people could be found in this period. Those are the following: *Pellargonium graveolens* as spices leaves of *Rubus fruticosus* and fruits of *Chaenomeles japonica* as tea and fruit plants. Above-ground parts of tasty vegetable and salads, such as: *Urtica dioica*, *Stellaria media*, *La-*

TABLE 8
SEASONAL DISTRIBUTION OF EDIBLE PLANTS

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Number of plant species	4	6	20	50	71	82	78	84	83	69	45	11
Proportion (%)	4.4	6.59	21.98	54.95	78.02	90.11	85.71	92.31	91.21	75.82	49.45	12.09

mium purpureum, *Pulmonaria officinalis* and *Primula vulgaris* start to grow rather early. A tasty salad made of leaves of *Sedum telephium* and *Sempervivum tectorum* and underground parts of species *Hemerocallis fulva* are available even during winter months. Even though most wild vegetables could be found in spring, when they are the tastiest, young shoots could be found during whole vegetation season. Significant number of plants develops very tasty fall shoots, besides spring ones. Those are the following: *Urtica dioica*, *Primula vulgaris*, *Amaranthus retroflexus*, *Alliaria petiolata*, *Taraxacum officinale*, and species of genus *Sonchus*, *Chenopodium*, *Mentha*, *Rumex*, *Trifolium* and *Raphanus* (Table 3).

Discussion and Conclusion

Already in first month of the war (April 1992) significant number of households was without basic food products such as flour, sugar and oil. Humanitarian aid still didn't arrive. Many bakeries stopped their work. Bread was a big issue. Food stocks were downsizing. In addition, more and more refugees were arriving. Available aid in food was stretched to accommodate refugees and residential people were faced with additional dearth. Besides basic victuals, great shortages were in vegetables and fruits. Since the city was truly under siege, the only way to get »green« food was in nature. Hunger was already showing its effects in general condition of people and health of people in all categories[6,7,9].

Through TV shows (in the beginning of the siege was at times when electricity), and through seminars in different parts of the besieged population of the city were presented to edible plants that can be easily identified by relying on already forgotten ethnographic background. In addition, the TV mission and workshops have helped people gain confidence and break the established bias toward sources of wild food. As time went on and the situation of people began to use a species that had high ethnographic ratings (*Onopodrum acanthium*, *Artemisia vulgaris*, *Barbarea vulgaris*, *Crepis* sp., *Eryngium* sp., *Galium* sp., *Trifolium* sp., *Aegopodium podagraria*, *Heracleum* sp., *Chaenomeles* sp, *Leontodon* sp. and some others).

Despite the fact that majority of urban inhabitants had poor knowledge about alternative sources of food, in

TABLE 9
FOOD PREPARATION ACCORDING TO THE MOST FRIQUENT PLANT FAMILLES

No	Kind of preparation	Plant family									
		Compositae		*Rosaceae*		*Labiatae*		*Cruciferae*		*Umbelliferae*	
		Number of species	Proportion (%)	Number of species	Proportion (%)	Number of species	Proportion (%)	Number of species	Proportion (%)	Number of species	Proportion (%)
1	Cooked vegetables	18	25	1	1.72	2	7.69	2	8	4	26.67
2	Additives to different food	1	1.39	2	3.45	–	–	5	20	1	6.67
	Additives to pasta and rice	4	5.56	–	–	–	–	2	8	1	6.67
3	Stuffing for meals	2	2.78	–	–	–	–	2	8	–	–
4	Pie	2	2.78	1	1.72	–	–	–	–	–	–
5	Salad	12	16.67	2	3.45	2	7.69	6	24	1	6.67
6	Beverage	9	12.50	11	18.97	4	15.38	–	–	3	20
7	Condiment	13	18.05	1	1.72	10	38.46	8	32	4	26.67
8	Nutritive teas	1	1.39	6	10.34	7	26.92	–	–	–	–
9	Sweet	1	1.39	7	12.07	1	3.85	–	–	1	6.67
10	Mush	2	2.78	–	–	–	–	–	–	–	–
11	Fresh fruits	1	1.39	10	17.24	–	–	–	–	–	–
12	Brine	–	–	4	6.90	–	–	–	–	–	–
13	Apple cider	–	–	2	3.45	–	–	–	–	–	–
14	Coffee substitute	4	5.56	–	–	–	–	–	–	–	–
15	Tobacco substitute	2	2.78	1	1.72	–	–	–	–	–	–
16	Marmalade	–	–	7	12.07	–	–	–	–	–	–
17	Stewed fruit	–	–	3	5.17	–	–	–	–	–	–
Total		72	100	58	100	26	100	25	100	15	100

time they have turned toward use of wild plants and mushrooms. Common prejudices about food in natural environment were broken day by day. Food factor became very dominant and critical in life of people under siege. Therefore, the number of 91 plant species, which were used in nutrition, is extremely high. Off course, it is not even close to be proportional to a real number of edible and aromatic plants at this territory[10,34,39]. Species that were in most use are as follows: *Cichorium intybus*, *Malva sylvestris*, *Taraxacum officinale* and *Urtica dioica*, as they have a very high nutritive values[36–37] and were common in Sarajevo. Experience from the war points to huge influence of annual plants that appear during several cycles over a year, and they represent important vegetable. Those are as follows: *Stellaria media*, *Amaranthus retroflexus* and *Chenopodium album*, which were very favorable as supplements to monotonous nutrition with rice and pasta. We should also mention first time used species of genus *Sonchus* and species *Lamium purpureum*.

Compared to the spectrum of edible plants in other areas in the region[45–54] significant similarity is noted, especially in wild vegetables that grow on semi-urban biotopes. However, some species are used in nutrition in this area for the first time, while some species were forgotten or very rarely used in supplementary nutrition of humans, such as: *Onopordum acanthium*, *Barbarea vulgaris*, *Carlina acaulis*, *Eryngium amethystinum*, *Crepis biennis*, *Crepis setosa*, *Galium verum*, *Leontodon autumnalis* and *Micromeria thymifolia*. However *Leontodon autumnalis* and *Crepis biennis* are eaten in Italy[55]. Besides self-growing plants, very significant role in nutrition was played by some plants that are cultivated as decorative plants, while some of them could be found in the wild or abandoned in the neighborhood of human settlements. Those are as follows: *Chaenomeles japonica*, whose apple-like fruits were for a while the only safe fruits, or bulbs of species *Hemerocallis fulva*, and rhizomes of *Helianthus tuberosus*, sole substitute for potato. Species *Levisticum officinale*, that grew in proximity of houses and was the best spice and coregent of aroma. Leaves of aromatic species *Pelargonium graveolens* giving special taste to monotonous food had a similar role, while young shoots of *Reynoutria japonica* were excellent salad and stew. Since significant number of determined species reached high production of biomass and they have significant nutritive values[40,56–67] they could be used in conventional nutrition.

Compared to the spectrum of edible plants in other parts of BiH[42] noted are similarities in almost equal proportion of wild vegetables (Table 2), while significant differences were noted in proportion of spice plants. Spice plants were more in used in surrounded Sarajevo, which could have resulted from efforts to improve taste of conventional food, from rice to cans »Ikar«. Usage of carbohydrate-rich plants was smaller due to absence of these plants, especially in surrounded Sarajevo, and relatively good supply of flour for local residents, especially after 1994.

Taxonomy of edible plants

Most edible plants belong to families *Compositae*, *Rosaceae*, *Labiatae*, *Cruciferae* and *Umbelliferae* (out of 12–6 species). In composition of family *Compositae* dominating is wild vegetable and spice plants (Table 4 and 9), in composition of family *Rosaceae* wild fruit and beverages. Family *Labiatae* includes mostly condiment plants (over 50%), *Cruciferae* includes wild vegetable and condiment, and *Umbelliferae* aromatic vegetable and condiment. Those plants rich in chlorophyll, carotenoides and essential oils[68,69]. Similar relations in representation of certain categories of wild edible plants are determined on wider territory of Mediterranean[70–76]. Within the family *Compositae (=Asteraceae)* is 32% of plants, wild fruits included in family *Rosaceae* (42%), different tea plants included in family *Labiatae* (35%), and spice plants within family *Labiatae* (52%). Similar relations are noted in other geographical areas, with similar climate and bio-geographical characteristics[77,78].

Nutritive and caloric values

Even though the war continued, situation in conventional food supplies didn't improve significantly. Food was insufficient in qualitative and quantitative sense. Most dominant items in humanitarian aid were rice, lentil, old beans and cans of suspicious origin. Especially tasteless were cans »Ikar« not even pet were fond of them. Vegetables or fruits were never included in the aid. For that reason, some categories of people experienced certain alterations. Surveys on nutritive status of inhabitants of war Sarajevo that were conducted in several occasions during 1993–94[9] showed the following: nutritional status was assessed by calculating body mass index (BMI) (weight/height) in adults and weight for age percentiles in children (2–18 years of age). Under-nutrition in adults was defined as BMI <18.5 and in children as weight for age <25th percentile. Results from the first round of data collection showed a higher level of under-nutrition among refugees (15.0%) compared to residents (5.3%). The second round revealed higher levels of under-nutrition among residents (8.1%) than refugees (7%). The population of Sarajevo has been forced to eat a monotonous diet during the war which is deficient both in quantity and quality. Nevertheless the nutritional status of the resident and refugee populations has been maintained[9].

Particular risk groups in surrounded Sarajevo were children and elderly people[7]. Surveys that were conducted by the group of named authors showed that »While the nutritional status of adults and children consistently remained normal, high levels of under nutrition were detected among the elderly ranging from 16% to 21% (BMI <18.5). Between December 1993 and February 1994, adults lost an average of 260 grams in weight (paired t-test $p=0.005$). Indicators of household food security (food stocks per person, market food prices and access to food aid) showed negative trends during the same time period[7]«.

Elderly people in Bosnia-Herzegovina are at greater risk of under nutrition than other age groups. Under nutrition may be precipitated in elderly people by sickness, cold, stress, and problems related to food preparation[6].

Surveys that included several hundreds of households of residential people and refugees in individual and collective accommodation during 1993–94. showed that food catastrophe was avoided, even though malnutrition was detected, especially in categories of elderly people and children. Use of wild plants mostly as vegetable and vitamin salads, different beverages, spices and other nutritive forms, in addition to other emergency factors (delivery of individual aid through humanitarian organizations by relatives living abroad) significantly moderated nutritive catastrophe and made life easier. Most plants that were used by people in surrounded Sarajevo contained very significant nutritive values, and so they could have satisfied needs of human organism for carbohydrates and vitamins and elemental minerals up to a certain point. Data on nutritive status of wild plants on territory of west Balkans[10,36,37]. indicate their distinguished nutritive values (Table 10). Many species are rich in proteins, carbohydrates, even fats. Amount of carbohydrates varies between 5–25 mg/100 g of plant mass. Over 10 mg of carbohydrates is found in following species: *Taraxacum officinale*, *Robinia pseudacacia*, *Pyrus pyraster*, *Prunus avium*, *Daucus carota* and *Arctium lappa*. Amount of proteins varies between 0.42 mg and 7 mg. Richest are the following species: *Malva sylvestris*, *Urtica dioica*, *Chenopodium album*, *Trifolium repens* and *Lamium purpureum*. More than 1 mg of fats is found in following species: *Malva sylvestris*, *Daucus carota*, *Trifolium repens* and *Prunus spinosa*. Present are also species that contain significant amounts of vitamin C and carotene (Table 10). Four groups of plants could be distinguished based on the amount of vitamin C in their structure: (i) plants with over 300 mg/100 g (leaves of *Primula vulgaris*), (ii) plants with 100–150 mg/100 g (*Urtica dioica*, *Malva sylvestris* and *Alliaria officianlis*), (iii) species with 50–80 mg/100 g (*Cichorium intybus*, *Rumex acetosa* and *Chenopodium album*), and (iv) species that have less than 50 mg/100 g vitamin C (*Prunus spinosa*, *Lamium maculatum*, *Trifolium repens* and others) (Table 10). Some species are rich in carotenoides. Between 5–10 mg/100 g of different carotenoides are found in the following species: *Malva sylvestris*, *Urtica dioica*, *Taraxacum officinale*, *Trifolium repens* and *Lamium purpureum* (Table 10). That significantly improved efforts in avoiding avitaminosis, nutritive catastrophe and prevention from many diseases that otherwise appear in extraordinary circumstances (fevers, inflammations, malnutrition, avitaminosis, etc.). However, there was a problem in compensation of human needs for proteins and fats that are relatively poorly present in wild plants. Part of protein

TABLE 10
NUTRITIVE VALUES OF SOME WILD EDIBLE PLANTS FROM INVESTIGATED AREA

Scientific Plant Name	Quotation Rating	Plant Part	Contents in g/100g plant material			Vitamin C mg/100g	Carotene mg/100g	Calories/100g
			Proteins	Lipids	Carbo hydrates			
Urtica dioica L.	81–100	Leaf	5.75	0.92	6.01	105	5.59	50
Malva sylvestris L.	81–100	Leaf	6.70	1.40	7.03	140	10.22	61
Taraxacum officinale Weber	81–100	Leaf	2.73	0.59	4.28	33	5.32	31
Taraxacum officinale Weber	81–100	Root	2.15	0.34	18.63			84
Cichorium intybus L.	81–100	Leaf	2.91	0.86	5.70	54	4.03	39
Sempervivum tectorum L.	61–80	Leaf	0.42	0.18	6.04	14	0.15	27
Robinia pseudacacia L.	61–80	Flower	4.64	0.71	10.45	39		62
Primula vulgaris Huds.	61–80	Leaf	1.92	0.80	7.84	305	2.75	44
Rumex acetosa L.	41–60	Leaf	3.89	0.74	6.55	66	3.55	44
Chenopodium album L.	41–60	Leaf	4.09	0.65	3.73	80	4.47	33
Stellaria media (L.)Vill.	41–60	Aerial part	2.39	0.46	3.07	29	4.14	24
Pyrus pyraster Burgsd.	41–60	Fruit	0.78	0.79	20.64	7		84
Prunus spinosa L.	41–60	Fruit	1.72	1.04	24.54	37		101
Trifolium repens L.	41–60	Leaf	5.47	1.46	7.87	36	7.04	61
Daucus carota L.	41–60	Root	1.26	1.29	12.96	10		65
Pulmonaria officinalis L.	41–60	Leaf	3.74	0.90	5.94	28	3.95	43
Plantago major L.	41–60	Leaf	2.81	0.87	9.52	48	3.27	54
Arctium lappa L.	41–60	Root	1.33	0.47	15.70	7		71
Bellis perennis L.	21–40	Leaf	2.80	0.64	5.22	34	2.59	35
Alliaria officinalis Andrz	21–40	Leaf	4.05	0.98	4.99	151	4.97	41
Lamium purpureum L.	21–40	Leaf	4.15	0.98	7.28	35	5.37	50

needs of people in surrounded Sarajevo was compensated by use of some edible mushrooms that grew in urban zones. Those are the following species: *Kühneromyces mutabilis*, *Armillariella mellea* and *Coprinus comatus.* Species of those genera usually contain proteins and minerals. Fruit bodies of *Armillariella mellea* in 100 g contain 91 g of water, 2.6 g of proteins, 4.5 g of carbohydrates, 0.4 g of fats and 40 kcals[39].

During the war daily energy intake was different in different periods. During 1993 it met only half recommended dietary allowances for the former Yugoslavia which is 2700kcals per day. Refugees were found to consume slightly higher quantities of energy (1500 kcals) compared to residents (1272 kcals). In the 1994, energy intake had increased both among refugees (1832 kcals) and residents (1630 kcals)[9]. Dietary intake was found to be low but this may have been partly due to under-reporting. The accuracy of data obtained through dietary intake surveys in emergency conditions may be questionable[9]. Due to significant caloric value of certain wild plants (Table 10) compensated were energetic needs of people that helped in prevention of nutritive catastrophe. Number of calories at examined plants was between 30 and 100 (in 100 g of herb material). More than 50 calories in 100 g is found in following: *Prunus spinosa*, *Urtica dioica*, *Taraxacum officinale*, *Robinia pseudacacia*, *Pyrus pyraster*, *Daucus carota*, *Trifolium repens* and *Plantago major* (Table 10).

Analysis of the nutritional value of plants used in surrounded Sarajevo (Table 10) shows that the majority of plants use the green part of the overhead that typically has a lower calorific value. To meet the energy needs of the organism to take significant amounts of wild plants which may be conditioned by various side effects (for example, disturbances in the metabolism of fats and proteins). However, people in larger quantities usually taken from the previously known edible plants (*Urtica dioica*, *Malva sylvestris*, *Plantago* sp., *Tussilago farfara*, *Taraxacum officinale*, *Cichorium inthybus*, *Sempervivum* sp.). Other species of wild vegetables people have used the war as a supplement canned food.

Especially difficult circumstances were during winter period, when due to low temperatures and insufficient heating, need for additional caloric food was enlarged. During winter, only several species that kept green shoots could be used in lesser amounts. Those are the following: *Sempervivum tectorum*, *Sedum telephium* (as fresh salad), root of *Armoracia lapathifolia* (as spice and salad), *Chaenomeles japonica* (as fruit), in-house plant *Pelargonium graveolens* (as spice and corrective of aroma and taste), and leaves of *Rubus fruticosus* as vitamin beverage.

During the war, reported the poisoning of people and some wild plants, including mushrooms. The use of some plants (the fruit of *Sambucus ebulus*, the fruit of *Solanum nigrum*, the fruit of ornamental species of genus *Berberis* and fungi from the genus *Clavaria* and *Lactarius*) caused disturbances in the organs of digestion without serious consequences for health. However, in the sub-urban parts of the occupied Sarajevo, there have been cases of poisoning from the fruits of *Atropa bella-donna* and *Tamus communis*, and seeds of *Datura stramonium*, fortunately without fatal consequences.

Elderly people were identified as the most nutritionally vulnerable when exposed to sickness, cold, stress and problems related to food preparation. The most food insecure group was refugees in collective centers who were highly dependent on food aid[6].

Nutritive and nutritional circumstances in surrounded Sarajevo (similar situation was in other bigger cities, such as Zenica and Tuzla) would have been more unfavorable in certain sense even damaging, if people didn't use wild vegetable, fruits and spices. Similar situation was among members of armed forces. However, the author will treat their nutritive habits in another study.

No significant difference in consumption of wild edible plants was noted based on level of education of examinees, their national and religious background. In this sense, they were all equal. Refugees in collective accommodation were simple in approach to wild edible plants and they used much wider assortment of wild fruits, vegetables and spices, compared to other categories of people.

War in BiH, especially in surrounded Sarajevo, has without doubt showed that factor of nutrition and fear of hunger are one of the most powerful influences in altering behavior, common habits and culture of nutrition. This example shows that other items (heating, living conditions, and fear of everyday death) characteristic to places exposed to war, are less dominant compared to food factor. Most of available time people spent trying to provide food for their families. For that reason and besides the fact that we are living in 21st century, facing new biotechnological solutions every day, greater attention should be given to research of new nutritive resources that would moderate the problem of providing food for mankind. Researches in this area in both developed and under-developed world[47,79–86] have greater significance and justification, as well as an obligation to provide new food and nutritive standards for people on planet Earth.

It should not be forgotten that one third of people is still hungry, while other third is semi-hungry despite the efforts of international community[24,87]. While on one side World Health Organization warned about serious issues in unfavorable and inadequate nutrition and a number of consequences on health and life of people[88], at the same time teams of researchers around the world are trying to reach new food sources that are found in self-growing wild plants[72,77,89,90]. Those findings and results are valuable not only for the world of hungry and semi-hungry people, but also for mankind in general, since it enables increase of level of nutritive diversity of flora in certain regions, that is still rather low[91–95].

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KORIŠTENJE DIVLJIH I POLUDIVLJIH JESTIVIH BILJAKA U PREHRANI I PREŽIVLJAVANJU LJUDI U 1430 DANA OPSADE SARAJEVA TOKOM RATA U BOSNI I HERCEGOVINI (1992–1995)

S A Ž E T A K

Ovaj rad je sustavni pregled podataka o uporabi divljih i polu-divljih jestivih biljaka u prehrani ljudi u 1430 dana opsade Sarajeva za vrijeme agresije na Bosnu i Hercegovinu (1992–1995). Autor ove studije je proveo svo vrijeme u Sarajevu. Godine 1993. autor je pripremio program za opstanak ljudi koji uključuje korištenje divljih jestivih biljaka. Osim toga, on je proveo detaljne ankete, uključujući i posebne intervjue, na 630 osoba prosječne dobi 37,4 godina (55% stalno nastanjenih stanovnika, a ostali su bili izbjeglice), 310 muškaraca i 320 žena. Prema anketi, uglavnom je korištena 91 vrsta divljih biljaka i tri vrste gljiva *Küchneromyces mutabilis*, *Armillariella mellea* i *Coprinus comatus*. Divlje povrće uključuje 49 vrsta, začini 24, divlje voće 16, i krušne sirovine dvije vrste. One pripadaju u 26 biljnih zajednica koje rastu na 24 različita staništa (urbane površina, riječne obale, šume i niske šikare, livade i kamenjare). Korišteno je 156 biljnih dijelova (list, mlade grane, plod, cvijet, sjeme, korijen i podanak) od 91 biljne vrste. Ustanovljena je velika različitost u načinima pripreme biljaka za jelo. Dominira povrće pripremljeno na različite načine (juhe, čorbe, umaci) s 80 načina pripreme (30.53%), zatim salate 41 (15,65%), mirođije 39 (14,89%), različiti napici 38 (14,50%), slastice 21 (8,02%), hranjivi čajevi 15 (5,73%) i drugi pripravci. U cilju poboljšanja konvencionalne hrane (ratni makaroni, riža, leća i stari grah) ljudi su koristili začine spravljene od različitih divljih biljaka.