YEDITEPE UNIVERSITY
INSTITUTE OF HEALTH SCIENCES
DEPARTMENT OF NUTRITION AND DIETETICS

INVESTIGATION INTO ANTIMICROBIAL ACTIVITIES OF METHANOLIC EXTRACTS OF ARDIÇ (*Juniperus communis*), ATKUYRUĞU (*Equisetum arvense*), YILDIZ ANASON (*Illicium verum*) and ÜVEZ (*Cormus domestica*)

MASTER THESIS

ÖZGE BASIN

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ONAY

Bu tez Yeditepe Üniversitesi Lisansüstü Eğitim-Öğretim ve Sınav Yönetmeliğinin ilgili maddeleri uyarınca yukarıdaki jüri tarafından uygun görülmüş ve Enstitü Yönetim Kurulu'nun 07./02./2020.. tarih ve 2020/02-54.... sayılı kararı ile onaylanmıştır.

Prof. Dr. Bayram YILMAZ
Sağlık Bilimleri Enstitüsü Müdürü

DECLARATION

I hereby declare that this thesis in my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree except where due acknowledgement has been made in the text.

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Özge BASIN

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ABBREVIATIONS and SYMBOLS

WHO: World Health Organization

MIC: Minimum inhibitory concentration values

MBC: Minimum bactericidal concentration values

BHT: Butylated Hydroxytoluene

BHA: Butylated Hydroxyanisol

MeOH: Methyl alcohol

DPPH: 2,2-diphenyl-1-picrylhydrazyl

ABSTRACT

Basın, Ö. (2020). Investigation into antimicrobial activities of methanolic extracts of Ardıç (*juniperus communis*), Atkuyruğu (*equisetum arvense*), Yıldız Anason (*illicium verum*) and Üvez (*cormus domestica*). Yeditepe University, Institute of Health Sciences, Department of Nutrition and Dietetics, Master Thesis. İstanbul.

This study aimed to determine antimicrobial activities of methanolic extracts of ardıç (Juniperus communis), atkuyruğu (Equisetum arvense), yıldız anason (Illicium verum) and üvez (Cormus domestica). The extracts were tested against Staphylococcus aureus (ATCC 25923), Listeria monocytogenes (ATCC 15313), Saccharomyces cerevisiae (ATCC 9763), Escherichia coli (ATCC 25922) and Salmonella typhimurium (ATCC 14028) microorganisms. Inhibition zones of Ardıç (*Juniperus communis*) methanolic extract against *Staphylococcus aureus, Escherichia coli* and *Listeria monocytogenes* were measured and found as 18 mm, 8 mm, and 18 mm respectively. Inhibition zones of Atkuyruğu (*Equisetum arvense*) methanolic extract against *Staphylococcus aureus* and *Salmonella typhimurium* were measured and found to be 9 mm and 10 mm, respectively. Inhibition zones of Yıldız anason (*İllicium verum*) methanolic extract against *Staphylococcus aureus*, *Listeria monocytogenes, Salmonella typhimurium,* and *Saccharomyces cerevisiae* were measured and found to be 15 mm, 19 mm, 11 mm, 18 mm and 18 mm, respectively. Inhibition zones of Üvez leaves (*Cormus domestica*) methanolic extract against *Staphylococcus aureus* and *Salmonella typhimurium* were measured and found to be 12 mm, and 12 mm, respectively. Due to the increase of microorganisms with multiple antibiotic resistance in recent years, the treatment of the infection caused by these microbes has become increasingly complicated. Thus, it is recommended to use medicinal plants as an alternative to medicines, and some traditional herbs are also used as antimicrobials.

Keywords: Antimicrobial activity, ardıç (Juniperus communis), atkuyruğu (Equisetum arvense), yıldız anason (Illicium verum), üvez (Cormus domestica)

ÖZET

Basın, Ö. (2020). Ardıç(*Juniperus communis*), Atkuyruğu(*Equisetum arvense*), Yıldız Anason(*İllicium verum)* ve Üvez (*Cormus domestica*)'nin metanol ekstraklarının antimikrobiyal aktivitelerinin incelenmesi. Yeditepe Üniversitesi, Sağlık Bilimleri Enstitüsü, Beslenme ve Diyetetik Bölümü, Master Tezi, İstanbul

Bu çalışmada, ardıç(*Juniperus communis*), atkuyruğu(*Equisetum arvense*), yıldız anason(*İllicium verum)* ve üvez (*Cormus domestica*)'nin metanol ekstraklarının antimikrobiyal aktiviteleri belirlenmiştir. Ekstraktlar *Staphylococcus aureus* (ATCC 25923), *Listeria monocytogenes* (ATCC 15313), *Saccharomyces cerevisiae* (ATCC 9763), *Escherichia coli* (ATCC 25922) ve *Salmonella typhimurium* (ATCC 14028) mikroorganizmalarına karşı test edildi. Ardıç (*Juniperus communis*) metanol ektraktının *Staphylococcus aureus*, *Escherichia coli* ve *Listeria monocytogenes*' a karşı inhibisyon zonu 18 mm, 8 mm ve 18 mm bulundu. Atkuyruğu(*Equisetum arvense*) metanol ektraktının *Staphylococcus aureus* ve *Salmonella typhimurium*'a karşı inhibisyon zonu 9 mm ve 10 mm bulundu. Yıldız anason(*İllicium verum*)'un metanol ektraktının *Staphylococcus aureus, Listeria monocytogenes, Salmonella typhimurium,* and *Saccharomyces cerevisiae* karşı inhibisyon zonu 15 mm, 19 mm, 11 mm, 18 mm ve 18 mm bulundu. Üvez yapraklarının (*Cormus domestica)* metanol ektraktının *Staphylococcus aureus* ve *Salmonella typhimurium* karşı inhibisyon zonu 12 mm, 12 mm bulundu. Böylece ilaçlara alternatif olarak tibbi bitkilerin kullanılması önerilebilir ve bazı geleneksel bitkiler, antimikrobiyaller olarak da kullanılabilir.

Anahtar Kelimeler: Antimikrobiyal aktivite, ardıç (*Juniperus communis*), atkuyruğu (*Equisetum arvense*), yıldız anason (*Illicium verum*) ve üvez (*Cormus domestica*)

1. INTRODUCTION AND PURPOSE

People have used plants for food supply and treatment of diseases since ancient times. The ongoing connection between humans and plants has caused the ethnobotanical field to emerge (1). Through the accumulation of knowledge for years, ethnobotany has contributed plants to be investigated scientifically and used in medical and various fields (2).

World Health Organization describes Herbal Medicines as prepared and labeled products that contain herbal drugs or mixtures as an effective part, as is or herbal mixtures, in order to prevent or treat the diseases. The importance and amount of use of Medicinal and Aromatic Plants, which have been used in many fields such as food, spice, condiment, and treatment for centuries, are increasing day by day. World Health Organization (WHO) data report that approximately 21,000 plant species are used for medical purposes in the world. Today, the medicinal plant market is estimated to be around $ 100 billion per annum. Germany (Hamburg), USA (New York), and Hong Kong are the main commercial centers for herbal drugs in the world. Although substantial progress has been made in the modern medicine, pharmaceutical, and chemical industry, alternative treatment methods and treatment with medicinal plants have continued to be relevant, and have even attracted intensive attention in developed countries in recent years. On the other hand, a population of approximately 2.5 billion in underdeveloped and developing countries cannot make benefit of known modern drugs (2). The World Health Organization (WHO) finds the use of medicinal plants in these countries important to consider as an alternative to these medicines only for economic reasons, but to develop a health technology compatible with its own culture and natural resources, and to avoid being dependent on developed countries (3). Available studies show that primary and secondary metabolites, which are natural products produced by plants, are, directly and indirectly, one of the most basic products of the industry. Plants convert the water, minerals, and some components obtained from the soil into compounds in their own metabolism in a way that the human body can use. For example, some primary metabolites such as carbohydrates, proteins, fats, vitamins, and secondary metabolites are among these compounds. These are active ingredients that can be used for medical purposes. These active substances can enhance the body's defensive power and have a positive effect on the functions of certain tissues and organs in the organism (1). The active substances should be isolated in

order to make use of plants for medical purposes. The active ingredient extracts of plants are of vital importance (3).

This study aims to determine the antimicrobial activities of methanolic extracts of ardıç (*Juniperus communis*), atkuyruğu (*Equisetum arvense*), yıldız anason (*Illicium verum*) and üvez (*Cormus domestica*).

2. GENERAL INFORMATION

2.1. Healthy Nutrition

Nutrition is one of the important factors that have been proven to be effective in growth, development, and protection and improvement of human health. For this reason, lifelong adequate and balanced nutrition is essential for everyone. Foods need to be consumed for healthy nutrition, growth, and development, maintenance of life, protection, improvement, and promotion of health, and increasing the quality of life. In addition, by taking into consideration the individual's age, gender, and physiological status, all nutrients the individual is needed should be provided for her/him in a sufficient amount. Many factors including food production to its consumption influence the nutritional status of the individual. These factors include the individual's genetic characteristics, age, nutritional status, and other forms of lifestyle (such as physical activity and smoking habits), social and environmental factors (such as home conditions, sanitation and hygiene), and the product of many other social and cultural environmental features such as stress, working conditions and family support (4). Turkey has a view that includes along with the problems of both developing and developed countries in terms of nutritional status. Turkish public nutrition is based on cereals and cereals products. As it goes from west to east, from urban to rural areas and income level decreases, cereal consumption increases and consumption of animal foods decreases. The consumption of dairy products is low, and a decrease also shows in meat consumption yearly. The effects of customs and traditions, social and cultural structure, economic situation, and educational level are reflected in the behavior. This affects the quality and frequency of nutritional problems. Aim of healthy nutrition is to take all the nutritional elements in required amounts specific to the individual and maintain the ideal body weight by enjoying consumed foods and eating differently and properly. Providing healthy nutrition starting from the mother's womb is important in terms of protecting health and preventing chronic diseases throughout life.

Nutrition should not mean to suppress the individual's feeling of hunger, to eat her/his fill, or to eat the nutrients he/she desires. Nutrition is an action that needs to be done consciously to consume the nutrients that the body is required in sufficient quantities and at appropriate times in order to maintain health and improve the quality of life. This action should be provided at every stage of the life cycle. The difference between these compounds and complex carbohydrates such as pulp and starch is that these compounds have a smaller structure. Considering the evidence-based scientific researches, it is determined that human needs about 70 nutrients for growth and development, and for longevity in a healthy and productive manner. In addition, it has been specified how much he/she should also take from each of these nutrients daily. Yet, it is scientifically demonstrated that when any of these nutrients are not taken or when they take more or less than necessary, growth and development are prevented and health is impaired. The term "Adequate and Balanced Nutrition" explains that the energy and nutrients required for the body's growth, renewal and work are each taken in sufficient amounts and used properly in the body. The goal of healthy nutrition is to ensure adequate and balanced nutrition (4,5).

2.2.Basic Food Groups and Their Functions in the Body

About 70 nutrients that the body needs and are found in the composition of nutrients can be collected in 5 groups according to their chemical structure and effectiveness in body activities. These are proteins, lipids, carbohydrates, minerals, and vitamins. It would also be correct to incorporate water into these groups.

Proteins: An average of 16% of an adult human body consists of proteins. Proteins are not stored in the body. They exist in the form of cells and cell components that perform specific functions. Proteins are broken into amino acids, which are building blocks in the digestive tract, pass into the blood and are transported to the liver. Body tissue proteins are produced from amino acids in the liver. Proteins build the main structure of cells. Certain cells combine together to form body tissues and organs. Many cells die over time and new ones are produced. Therefore, protein is the most important nutrient for growth and development. Proteins are the basic building blocks of the body's defense system, enzymes regulating body activities, and some hormones. Proteins can also be utilized as energy sources in cases where energy requirements cannot be fulfilled from carbohydrates and fats (6). Fats: An average of 18% of an adult human body consists of lipids. Women generally have a higher

percentage of body fat than men. Body fat is the primary energy store of human. When the energy is not received sufficiently, the body uses this store. When energy expenditure is less than energy intake, fats are stored in the body and the rate of body fat increases. Fats are a nutritional element that is the most energy-efficient form of food. Since the fats leave the stomach slowly, it gives a feeling of satiety. Subcutaneous adipose tissue prevents the body from rapidly losing heat. Fats are necessary for the production of certain hormones and hormone-like elements that participate in the regular work of the body. Carbohydrates: The total amount of carbohydrates in an adult human body is below 1%. The primary role of carbohydrates is to supply energy. Most of the daily energy used by the body derives from carbohydrates. In the human body, carbohydrates are stored as glycogen in small amounts and, when needed, released into the blood as glucose. Glycogen is mainly stored in the liver and the muscles. There is also some glycogen in other organs. Stored glycogen is necessary to maintain blood glucose, which is an uninterrupted energy source for the body tissues. Minerals: Minerals account for an average of 6% of an adult human body. Most of the minerals, notably calcium and phosphorus, are the building blocks of the skeleton and teeth. Minerals such as sodium and potassium maintain the fluid balance of the body. The iron mineral is necessary for the transport of oxygen used for the generation of energy from the nutrients in the body to the tissues. Minerals are found in the composition of enzymes that regulate body activities, and are used in the body's defense system.

Vitamins: Although they are present in rather small amounts in the human body, they are involved in many body activities. Some of them (vitamin B) help regulate metabolic and biochemical events related to the formation of energy from carbohydrates, fats, and proteins in the foods we have eaten. Vitamin D helps minerals such as calcium and phosphorus to precipitate into bones and teeth. Antioxidant vitamins (vitamins A, C, and E) prevent cellular injury in the body, thus ensuring normal cellular functions and removing some harmful substances from the body (6, 7). Water: Approximately 60% of an adult human body consists of water. Babies have a higher ratio of body water than adults. Water is necessary for the digestion of nutrients, transport of nutrients to tissues, and their use in cells, removal of harmful residues from the body, and regulation of body temperature. Since all chemical reactions in the body occur in a solution, the body is imperative to have enough water to survive. As can be seen, life is based on getting enough nutrients, digesting nutrients, absorbing digested nutrients from the small intestine to blood, transporting them to the required cells, converting them into energy in the presence of inspired oxygen, and using some nutrients for repairing and building cells. All these events in the body are called

“metabolism”. The process by which the dietary carbohydrates, fats and proteins are broken down into the building blocks and are used to produce energy by burning with the help of oxygen, minerals and vitamins is called “catabolism”. The process whereby the building blocks of carbohydrates, fats and proteins build new cells by combining together with the help of vitamins and minerals is called “anabolism”. Any nutrient does not have sufficient efficacy alone. When all the necessary nutrients are received together, the body continues its normal growth and development, and its healthy and strong operation (8,9).

2.3.Definition of Medicinal and Aromatic Plants

Today, the term medicinal and aromatic plants are usually used in conjunction. Medicinal and aromatic plants are those used as medicine to prevent diseases, maintain health or cure diseases. Medicinal plants are used in areas such as nutrition, cosmetics, body care, incense, or religious rituals while aromatic plants are used for their smell, fragrance, and taste characters (10). Aromatic plants have a wide range of usages in food, cosmetics, and perfumery sector (11). The original material of herbal medicines is usually included in the group of medicinal plants. Herbal medicine is plant-derived materials or preparations that have therapeutic properties and contain either raw or processed ingredients from one or more plants, or that are useful for other people’s health (12). However, this definition does not apply to the cases in which a drug product is isolated or synthesized as a chemical component and the active substance is defined (13). When it comes to medicinal and aromatic plants, they cover a very large area in terms of both plants and active substances and consumption areas. Use Areas of Medicinal Plants are as follow:

- Increasing the quality of life by reducing the side effects of medical treatment that has been administered.
- Wanting people to take a more active role in protecting their health
- Preferring traditional treatment methods and products due to cultural impact.

On the other hand, the World Health Organization (WHO) deems this tendency significant not only for the use of medicinal plants as an alternative to medicines for economic reasons in underdeveloped and developing countries but also for the countries to develop a health technology compatible with their own culture and natural resources and to avoid being dependent on developed countries (14).

2.4.Production and use of Medicinal and Aromatic Plants from past to present

Considering the developments in the production and use of medicinal and aromatic plants in the 20th century, innovations, social and political changes about which technology have brought at the beginning of the century have caused a rapid decrease in the use of plants as medicines. The synthesis of sulfa drugs in the 1930s and of the organic chemicals in the 1940s encouraged the production of synthetic drugs in addition to medicinal plants. Economic and social changes following the World War and new definitions about plants and treatments have led to a decrease in the use of plants and their extracts until the end of the 1970s in the modernized western countries through industrial advances as a result of the production of synthetic chemical drugs (15). While more than 40% of the drugs (mostly those which are not refined) listed in the early 20th century are of herbal origin, this has fallen to below 5% by the mid-1970s (16). In the 1980s and 1990s, having consumers more information about the health, increased interest in herbal medicines, especially in developed countries, and the tendency towards organic and natural foods had brought medicinal and aromatic plants up. This has pushed the laws and regulations related to herbal medicines in developed countries to rehandle seriously (17). Concerns about the trade globalization of and conservation of genetic diversity in the late 1990s and early 2000s affected the cultivation of medicinal plants. The quality standards of plant materials have increased with the processing of the product and the buyers' demands for clean, continuous, and certified products. Researches on medicinal and aromatic plants in the 1980s and 1990s pioneered the developments in the production of plants, the extraction of bioactive components and the verification of medical applications (16). In the same years, many new medicinal plants were cultivated, produced, and put on the market. They formulated products containing extracts of a large number of herbs, such as *Aloe barbadensis*, *Celastrus paniculatus*, *Cyperus scariosus*, *Ginkgo biloba*, *Myrtus caryophyllus*, and *Withania somnifera*, to revitalize and protect the skin in cosmetics (18).

In parallel with the fact that income growth in Asia raises the people's standard of living, the demand for medicinal and aromatic plants will increase as a result of the aging, weight gain, and increase in the population with other medical problems frequently occurring in very rich societies (19). This increase in demands will likely pose a permanent threat to natural species in some regions. Due to the demand for natural plant material or the lack of cultivated plant material, the price differences between natural and cultivated plants encourage unsustainable excessive collection practices in some regions, especially those that suffer from resource deficits to protect the vegetative material and in economically underdeveloped

regions (20). It is expected that continued habitat loss in the future due to the deforestation and development will continue to threaten many medicinal and aromatic plants in both developing and industrialized countries (21). The interest in and demand for organically produced plants and drugs are increasing day by day. There has still been a trend towards organic products that match the demand for organic foods in the medicinal and aromatic plant markets. This reveals that the current basis of consumers of medicinal and aromatic herbal products is the same as those who purchase organic foods (22). Medicinal and aromatic plant combinations and sales of herbal beverages have increased their market gains in the past five years by offering the vitality and strength of youth, and the hope, simplicity, and sustainability of youth that are expected to remain a key market concept in the sale of medicinal and aromatic products in the near future. Sales of non-food organic products, including medicinal and aromatic plants or plant extracts, had increased by 1/3 in 2005 (23).

Publications of nutrition report that sales of dietary supplements containing many medicinal plants reached to $ 21.3 billion in 2005 with an increase of 4.5%. The use of aromatic plants and plant extracts has become widespread in the flower arrangements and perfumery industry. The market in candles and home fragrances containing aromatic plants and/or plant extracts that contribute to aromatherapy and scented candles has reached to an estimated $ 8.4 billion in 2004 by a growth of 14.1% as from 2003 (Unity Marketing Inc., 2005). Global market estimates for medicines derived from plants are $ 18 billion in 2005. In view of the fact that the market demands will exceed 50% in the USA and Canada, this value is expected to reach 26 billion dollars in 2011 (24).

In recent years, a great increase in the use of medicinal and aromatic plants and products derived from them has been striking in Turkey. In order to meet the ever-growing demand and produce a higher quality standard product in the future years, it is expected that the production of medicinal and aromatic plants, the plant extracts derived from them and the branches of industry processing these products will expand and grow.

2.5. Distribution of Medicinal and Aromatic Plants in Turkey

Turkey is one of the leading countries that trade in the medicinal and aromatic plants in terms of geographical features, climate diversity, plant variations, agricultural capacity, and wide agricultural areas. The importance of Turkey is due to the presence of plants in the

natural areas of our country that constitute the input of the industries such as herbal medicine, plant chemicals, food additives, cosmetics and perfumery in the developed countries and that provide the raw materials for herbal products. These plants are mostly wild-collected and put on the market. Medicinal and aromatic plants are collected mainly from the Aegean, Marmara, and Mediterranean regions (24). The countries that import and export medicinal and aromatic plants in the world include the USA, England, Germany, France, Netherlands, China and India. Turkey ranks 18th among 110 countries that export medicinal plants while it ranks 5th in the export and 8th in the import among the East and the southeast European countries (25). A study on the medical and aromatic plants, which are traded in Turkey, showed that the number of plant species including sub-species is 347, of which 139 are exported.

Some of the important medicinal, pharmaceutical and spice plants exported by Turkey are thyme, bay leaf, cumin, anise, fennel seeds, juniper bark, mahaleb, fenugreek, rosemary, licorice, mint, sumac, sage and lime flower (26). In order to increase the production amounts of medicinal and aromatic plants and to obtain products with high-quality standards, the product should be done upon cultivation. Although wild-collection of some species is very economical, it is very difficult to obtain quality and standard products from wild-collected plants. In this way, it is very difficult to make a sustainable collection without damage to nature. Unnecessary wild-collection of medicinal and aromatic plants in an unconscious manner may also lead to decreases in plant populations (25). Incentivizing the producer with various supports and establishing facilities that will provide post-harvest packaging, packaging, and storage in accordance with ordinary standards will be able to increase production. Export may also be boosted by taking medicinal and aromatic plants within the scope of incentive. In order to adequately assess the sustainable production and market potential of medicinal and aromatic plants, these products should be in the requested quantity and quality (28).

2.6.Use of Medicinal Plants in Phytotherapy

The use of medicinal plants before chemical drugs in the treatment of diseases is an old order that took place with the transition to humankind’s settled life. Herbal medicines constitute an important part of the traditions of the rural populations in developing countries. According to reports of the World Health Organization (WHO), 80% of the population living

in developing countries rely generally on plant-originated non-chemical drugs to ensure the sustainability of their health. It has been reported that at least 25% of the active ingredients of pharmacologically produced modern drugs generally derive from plants.

In addition, the active ingredients of many synthetically produced drugs are structural analogs of chemicals that are for the first time isolated from plants. Demand for plants from which the drug is obtained increases at a high level in both developed and developing countries since they are moderate-cost, have low side effects compared to synthetic medicines and very rare toxic effects and are organically produced (29). Medicinal plants are the natural source of compositions that may utilize to cure many diseases today (30). Many herbs contain a wide variety of chemicals and active substances that have important effects on humans. Chemicals such as flavonoids, alkaloids, terpenoids, tannins, berberine and quinine, all of which are synthesized by plants, are widely used to improve health and treat most diseases. Due to the increase of microorganisms with multiple antibiotic resistance in recent years, the treatment of the infection caused by these microbes has become increasingly complicated. Thus, it is recommended to use medicinal plants as an alternative to medicines, and some traditional herbs are also used as antimicrobials. Some studies indicate that the therapeutic properties of plants are caused by a single active ingredient and the interplay of a large number of compositions, and that herbal compositions provide a more effective healing process by overcoming the resistance of microorganisms that are difficult to kill with a single synthetic drug (31).

This pushes researchers to investigate the inhibitory compositions of the active ingredients obtained from plant extracts. A study by American scientists in Saudi Arabia revealed that black tea significantly reduced the risk of heart disease. The research results showed that an antioxidant substance called flavonoid, which is copious amounts in black and green tea, heals the heart and vascular diseases. They reported that the antioxidant substance present in black tea significantly prevents the risk of heart disease although some of the subjects participating in the research of American scientists have a habit of smoking and an unhealthy diet. They also reported that 20% of adults aged 30 to 70 participating in the research conducted in Saudi Arabia, where drinking tea is a social lifestyle, consume more than 6 cups of tea a day. Experts stated that the flavonoid substance present in tea also prevents vessel stiffness (arteriosclerosis) and reduces bad cholesterol (32). Studies showed that antioxidant-containing compounds would be beneficial to apply locally in order to heal wounds and protect tissues from damage to destruction reactions. While some plants are used

in the treatment of newly formed wounds, others are used in the treatment of chronic, prolonged wounds (33).

While the primary and secondary metabolites, which are naturally produced by plants, are used, directly and indirectly, plants convert the water, minerals and various substances up which they take from the soil into compositions able to be absorbed by the human body in their own metabolism. Carbohydrates, proteins, fats, vitamins, and minerals from essential nutrients are an example to these. These are the active ingredients commonly used in plant metabolism. On the other hand, essential oils, tannins, alkaloids and bitter substances are an example to these (34). Side effects of herbs and drug interactions that may occur when used with drugs have not yet been known. While plants and herbal products are used in the treatment and in the prevention of the occurrence of any disease, attention should be paid that when used with medicines, potential drug interactions and side effects may occur. It has been reported that the active substances in spices consumed daily with antibiotics may interact with each other and cause undesirable side effects and decreased effectiveness.

The use of herbal medicines in pregnant women and breastfeeding mothers can be inconvenient. Caution should also be exercised in the use of herbal medicines in infants and children. Because children's physiology is quite different from adults' body physiology, their metabolic enzyme systems are not as developed as those of adults. In addition, it is possible to reach toxic doses easily since it is difficult to adjust the dose according to body weights (35).

2.7.Classification of Medicinal Plants

2.7.1. Alphabetical Classification: Medicinal plants are classified according to their names in Latin or any language, and this classification is often used in the encyclopedia and introductory books.

2.7.2. Morphological Classification: It is a form of classification based on the used parts of medicinal plants (leaves, flowers, fruits, seeds, etc.), which is widely used in the trade of medicinal plants. It is also an important classification in terms of cultivation. According to the morphological classification;

Herba (herb): plants used in the classification of aboveground parts. Chicory, sage, milk thistle.
Folia: (leaf): plants whose leaves are used. Peppermint, sage, melissa, balm.
Flores (flower): plants whose flowers are used. Marshmallow, chamomile, lavender.

Fructus (fruit): Rosehip, cumin, anise, coriander
Semen (seed): linum, fenugreek
Radix (root): Licorice, centranthus, couch-grass
Rhizome (rhizome): Licorice, couch-grass
Tuber (Tuber): Sahlep
Bulb (onion): Garlic

2.7. 3. Botanical (taxonomic) Classification: It is a classification based on the order, family, genus, and species of the plants and is an important form of classification in terms of the recognition of plants. This classification is used in pharmaceutical botany. Compositae, Alliaceae, Amaryllidaceae, Papaveraceae, Solanaceae, Umbelliferae, Labiatae and Iridaceae, Liliaceae.

2.7. 4. Chemical Classification: It is the classification method based on the structure of the active substances included in the plants, which is mostly used in pharmacognosy.
A. Essential oil-containing plants- Anise, parsley, mint
B. Bitter substance-containing plants- Vermouth, gentian
C. Glycoside-containing plants- Digitalis, Sicilla
D. Saponin-containing plants- Chalk plant, Saponaria, Hedera helix
E. Alkaloid-containing plants- Datura, atropa, poppy, Nicotiana
F. Flavonoid-containing plants- Silybum, Verbascum
G. Tannin- containing plants- Hamamelis, Quercus

2.7. 5. Pharmacological classification: It is the classification method of the substances included in the plants according to their mechanism of action. Accordingly;

1. Nervina - Effective on nervous system - morphine, nicotine, egotamine
2. Effective on blood circulation - digitalin
3. Diuretica-diuretics - coffein, theobromin
4. Effective on digestion function (laxatives)

2.7. 6. Pharmachemical classification: In this classification that is a combination of two classification forms, drugs are divided into the main group according to their pharmacological effects and into the subgroups according to their chemical effects.

2.7.7. Classification According to Their Consumption and Use:

1. Soft drinks, herbal teas and stimulating plants (tea, coffee, tobacco)
2. Spice plants (pepper, mustard, thyme)
3. Pharmaceutical plants (digitalis, Atropa)
4. Perfume plants (Lavender, rose)
5. Gum and mucilage plants (Acacia, Astragalus, Plantago)
6. Resin plants (Sığala tree, Ferula)
7. Tannin plants (Sumac, oak)
8. Dye plants (Rubia tinctorum, Bixa, Alkana tinctorium)
9. Insecticide plants (Phyretrum, anabasis, neem tree)
10. Wax plants (jojoba, myrica)

2.8. Juniper berries (Juniperus communis)

Figure 1. Juniper berries (*Juniperus communis*)

2.8.1. Botanical characteristics: The plant is coniferous and belongs to the family Cupressaceae. There are many species of juniper known by the genus Juniperus. Its seedling

grows very slowly, takes years to reach a human height, and lasts tens of years to become a tree. Pointed, stiff and blue color needles can even withstand the most severe drought without damage. The needles of the juniper tree owe their stiffness not only to thick outer cells but also to the rich silicic acid they contain. When you burn such a needle, a white skeleton made up of silicic acid remains, which bears all the detail of the needle in its initial form.

The berries of this coniferous tree, which can remain evergreen, are actually not real fruit, but fleshy fruit leaves. These are called pseudo-fruit, in fact, they are cones completely covered with pericarp. Thus, juniper tree is included in the group of trees with cones, such as black pine, calabrian pine, and other pine trees. While young needles and shoots of juniper trees are collected from April to June, the fruits are collected by shaking their branches from September to November in the fall. The collected harvest is cleaned and the underripe product is winnowed out. It should not be forgotten that there are many varieties of juniper, which are partially poisonous. Dwarf juniper (*Juniperus nana*), whose berries are extremely curative, is distributed in mountainous areas over 3.500 m. Juniper berry is considered an ancient herbal therapy for the digestive system. It supports metabolism and removes uric acid from the body (36).

It helps digest dock (*Rumex*) and like foods that lead to fart. Berries and leaves of juniper are used for wound healing as a diuretic, stimulant and antiseptic. J. excelsa widespread in the Anatolian mountains was used by locals against tuberculosis and hepatitis (37). Juniper berries had also been considered a traditional remedy for diabetes in the past. The extract obtained by decoction from *Juniperus communis* was found to decrease the glycemic level in normoglycemic rats at a dose of 250mg / kg. With the effect of the mountain-wind, its branches look as if they are leaning on the ground. Juniper (*Juniperus oxycedrus*) with red fruit is found in Mediterranean countries. The chestnut berries of this juniper are likewise used as a medicinal herb. Juniper we used medically should not be confused with black juniper (*Juniperus sabina*), which has the same growth pattern but foul-smelling and scaly leaves. The fruits and leaves of this juniper species are poisonous. Similarly, thuja or tree of life (*Thuja occidentalis*) with fleshy scaly leaves resembling a multipartite fern form is also poisonous. There are woody brown cones on its branches. The healing aspect of juniper berries had been known in ancient times as juniper berries, antiseptic and water-attracting drugs. New researches reveal that fruits contain essential oils consisting of turpentine and juniperin, tannin, resin, oil, pentosan, glucose, antic acid (acid formic), acid acetic, calcium, potassium and manganese as the main active ingredients.

Fresh needles of juniper tree are rich in vitamin C. *Juniper* berries are invigorative, warm the blood of the human, relaxes the internal cramps, clear the stomach, intestines, lungs and blood, are diuretics, removes excess water, are disinfector, strengthens the stomach and stimulates metabolism (38). When juniper berry is taken orally, essential oils are degraded by the kidney. Thus, the kidney wall is stimulated and urine flow increases.

2.8.2. Use of juniper berries: When the juice obtained from the crushed fruit is consumed as tea, it helps to strengthen the stomach and intestines, increase body resistance, reinforce the metabolism, remove uric acid and salt from the body in rheumatism and gout disease and urinate plentifully in the hydropysis (overhydration), edema, swelling and weakening cures. Juniper essence can be used in rheumatism, eczema, herpes, and skin rash. When taken overdose, juniper berries can irritate the kidneys. Therefore, the recommended allowance should be taken (37).

2.9.Chinese star anise (*Illicium verum*)

Figure 2. Chinese star anise (*Illicium verum*)

Although it is indigenous to southern China, it is cultivated in Japan, East Indian islands, China and Vietnam. It is used internally as an antiflatulent, gastric and galactagogue substance in a decoction form (0.5%). While it is used in indigestion, bloating, intestinal spasm, dysentery, facial paralysis, partial paralysis, and rheumatoid arthritis in Indian

medicine, it is used in nausea, abdominal pain, and insomnia, and externally, in skin inflammations and rheumatic pain in Chinese medicine (39).

2.9.1. Botanical characteristics: They are trees with a straight round stem and green, hairless branches that can reach 8-15 meters in length. Its bark is white or bright gray. Its leaves are 3-6 bunches in clusters in nodes and petiole is 0.8-2 cm. The fruit is clustered in a star shape and in boat form. The seeds are bright brown or reddish and contain high levels of oil. Fruits are collected and dried before ripening. Flowering occurs in March-May and August-October. This species is cultivated in various states of China and Vietnam to be used in perfumery, medicine, and food industry (as a spice) (40).

2.9.2. Use of Chinese star anise: In terms of chemical composition, star anise contains containing oil, lignan, sesquiterpene, phenylpropanoid and flavonoid compounds. The main compounds of containing oil from its fruits are trans-anethole, estragole, d-limonene, l-limonene, d-fenkon, d-pinene, dl-limonene and anisaldehyde. Most of the sesquiterpene compounds it contains are seco-pyrazine sesquiterpene derivatives. The main flavonoids present in the drug are chemferol, routinozide, quercetin, isocercitrin, isoramnetin 3-O-rutinozide and tamariksetin 3-O-neohesperidoside. In addition to these, other compounds isolated from drog are fatty acids (hexadecanoic, heptadecanoic, octadecanoic, linoleic and oleic acid), farnesol, safrol, foenukulin and shikimic acid (41, 42). Effects and Usage: Essential oil and flavonoids it contains are effective on mucous membranes in respiratory system diseases and on smooth muscles in gastrointestinal diseases. It is also used in diminishing appetite and cough (41, 42). Antimicrobial Effect: A study investigating the in vitro antibacterial effect of methanolic extract and decoction of Ilicium verum fruits showed that it was effective against anaerobic and aerobic peridontal bacteria (Porphyromonas gingivalis, Prevotella spp., Fusobacterium nucleatum, capnocytophaga gingivalis, veilonella parvula, eikenella corrodens, peptostreptococcus micros and actinomyces adontolyticus). E. corrodens of these bacteria are only sensitive to both methanolic extract and decoction (with MIC values of 256 and 512 mg / mL, respectively) (43). The supercritical CO2 and ethanolic extract of the *I. verum* showed a significant antibacterial effect against a total of 67 resistant bacterial strains, including 27 acinetobacter baumannii, 20 pseudomonas aeruginosa and 20 methicillin-resistant staphylococcus aeruginosa. The diethyl-ether fraction obtained from ethanolic and supercritical CO2 extracts showed a strong antibacterial effect with MIC values of 0.15, 0.17 and 0.11 mg / mL (44). In the glyoxylate cycle, isocitrate is broken down into succinate and glyoxylate via the enzyme isocitrate lyase. This metabolic pathway occurs in

the majority of pathogens and is also of the utmost importance for Mycobacterium tuberculosis bacteria, which is the cause of tuberculosis disease. An in vitro study found that extract of I. verum inhibited the isocitrate lyase enzyme with an IC50 value of 47.7 +/- 16.9 µg / mL, thus disrupting the glyoxylate cycle (45).

Antifungal effect: In a study conducted to use natural products to control plant diseases, the essential oil of star anise fruits was examined due to its antifungal effect against pathogenic fungi in plants. The essential oil in the fruit was obtained by hydrodistillation and the chemical components it includes were analyzed by GC and GC-MS.Among the compounds obtained, the main compound with an antifungal effect was determined to be trans-anethole. Inhibitory effect of both the essential oil and trans-anethole against the fungi Alternaria solani, bipolaris maydis, botryodiplodia theobromae, Fusarium graminearum, fusarium oxysporum f. Sp. cucumerium, pythium aphanidermatum, rhizoctonia cerealis, rhizoctonia solani was tested using carbendazim standards. IC50 values of essential oil were found to be 0.09, 0.07, 0.11, 0.08, 0.16, 0.14, 0.25, 0.22, 0.09, 0.10, 0.08 mg / mL, respectively (46, 47).

Other Studies: The inhibitory effect of 70% ethanolic extract of *Illicium verum* fruits and butanol, ethyl acetate, chloroform fractions and anetol obtained from this extract on the acetylcholinesterase and butyrylcholinesterase was investigated colorimetrically in another study. IC50 values for acetylcholine esterase werre 58.67 +/- 0.16, 44.94 +/- 2.49, 83.75 +/- 0.11, 103.03 +/- 1.76,36.00 +/- 0.44 µg / mL, respectively, while I50 values for butyrylcholinesterase were 91.84 +/- 1.29, 80.67 +/- 0.33, 136.03 +/- 2.19, 171.44 +/- 0.55, 70.65 +/- 0.96 µg / mL, respectively. The effect of chimic acid obtained from *Ilicium verum* on proliferation of HepG2 Hepatocellular Carcinoma Cell Line and nuclear factor-kB (NF-KB) p65 was examined. The morphology of liver tumor cells varied under the microscope depending on different concentrations of shikimic acid and apoptotic cells were detected in cells exposed to different concentrations of shikimic acid for 48 hours. As a result, shikimic acid inhibited the proliferation of liver carcinoma cells and downregulated the NF-KB (p65) protein level (48).

2.10. Bottle-Brust (Equisetum arvense)

Figure 3. Bottle-Brust (*Equisetum arvense*)

2.10.11 Botanical characteristics

It is spread over the temperate regions of the northern hemisphere. It grows naturally throughout America, Europe and North Africa and a part of the Asian continent. It grows naturally in the south of Turkey and Iran, in the Himalayas and in the middle and north of China and Japan in the Asian continent. It is spread over streamsides and uncultivated land in the North and Eastern Anatolia in Turkey (49). It is a perennial, herbaceous and flowerless plant that grows up to 100 cm high, reproduces by spores and bears rhizome. Its leaves are quite small and scaly. Its stem is cylindrical, branched or unbranched, green or brown-green, hard and hollow. It is spread over streamsides and uncultivated lands up to 1700 m above sea level (50, 51).

2.10.2. Use of Bottle-Brust (Equisetum arvense): It was used by people in tuberculosis, kidney and bladder inflammations and as hemostatic in nose, lung and gastric bleeding, as well as against hand and nail breaks and hair loss and in the treatment of difficult-to-heal wounds and ulcers. It has been reported to be used in the supportive treatment of chronic leg swelling, difficult-to-heal sprain and fractures, dermatological disorders, rheumatic joint inflammation, jaundice and sore throat. The plant is used as a pain reliever, blood pressure reduction, blood cleanser, diuretic, and edema remover. Teas prepared from this herb in Iran are consumed against diabetes and kidney diseases (52).

Chemical Composition: Aboveground parts of *Equisetum arvense* should contain total flavonoids calculated on at least 0.3% isoquercetin. There are two chemotypes according to flavonoids. Asian and North American varieties contain high amounts of quercetin-3-O-beta-glucopyranoside and its manonyl esters, as well as apigenin of flavor derivatives, 5-O-glucosides of luteolin and malonyl esters. The composition of chemotype in Europe mainly contains quercetin-3-O-soforoside, genkwanin and chemferol derivatives, as well as protogenkwanin 4-O-beta-glucopyranoside, genkwanin-5-O-glucoside, chemferol 3,7-di-O-glucoside, chemferol-3-O-7-O-glucoside and luteolin glycosides and onitine and onitin-9-O-glucoside of phenolic petrosins (53). There are 1% of caffeic acid esters in the composition of *E. arvense*. Although di-E-cafeol-meso-tartaric acid of these compounds is found in small amounts (0.008%) in *E. arvense*, it is not found in other *Equisetum* species. So, it is a marker compound in both chemotypes. *E. arvense* also contains mono-Ocafeol-meso-tartrate, methyl esters of caffeic acids and 5-cafeoylchimic acid. Polyenic acids, rare dicarboxylic acids and other organic acids (aconitic acid, arabinoic acid, citric, fumaric gallic, gluconic, glyceric, malic, malonic, protocathic, threonic, p-coumaric, 4-hydroxybenzoic, vanicic acid and kinic acid) have been reported to be found. It has also been reported that Equisetum arvense contains traces of alkaloids (nicotine, spermidine bases, palustrine and palustrinine). The plant also contains carotenoids and rhodoxantine. The plant has also been reported to contain potassium (1.8%), calcium (1.3%), aluminum, magnesium, and manganese. Hexahydropharynyl acetone (18.34%), cis-geranyl acetone (13.74%), thymol (12.09%) and trans-phytol (10.06%) were detected as major compounds in the chemical composition of essential oil obtained from the stem of *Equisetum arvense* (54).

Antimicrobial Effect: It was determined that the extract prepared with 90-95% ethanolic from the aboveground parts of Equisetum arvense exhibited weak activity against Bacillus subtilis and Streptococcus faecalis strains at 500 µg / disc concentration. The essential oil obtained from the fruitless stem of the plant was evaluated using the disk diffusion method in terms of the antimicrobial activity against Staphylococcus aureus, Escherichia coli, Klebsialla pneumoniae, Pseudomonas aeruginosa, Salmonella enteritidis, Aspergillus niger and Candida albicans strains. The solution of essential oil diluted in 1:10 was found to be active against all the strains tested and showed a broad-spectrum antimicrobial effect. It was observed that the dry extract prepared from the fresh above-ground part of the plant was active against the Aspergillus flavus strain. Extract prepared with 50% ethanol from the stem of Equisetum arvense was examined by using macrodilution

method for antimicrobial effect against Escherichia coli, staphylococcus aureus and bacillus cereus strains. The strongest effect was found to be against S. aureus strain, with a MIC (minimum inhibitory concentration) values of 11.14 mg / mL and a MBC (minimum bactericidal concentration) values of 22.28 mg / mL (55). The weakest effect was detected against B. cereus strain with a MIC value of 89.10 mg / mL. Antimicrobial effect of the aqueous ethanolic extract of the plant was investigated against Pseudomonas aeruginosa, Escherichia coli, Salmonella enteritidis, Klebsiella pneumoniae, Staphylococcus aureus, Candida albicans and Aspregillus niger strains. When inhibition zones were measured, it was found to be effective against all strains tested (inhibition zones: 11.3-14.1 mm) (56).

Other Studies: The aqueous extract (30 µL) obtained from the dried aboveground parts of *Equisetum arvense* exhibited a radical scavenging effect on cultured microsomes. The aqueous extract prepared from the dried above-ground part of *Equisetum ravens* was examined for its antioxidant capacities on various radicals. The aqueous extract was found to be a high activity of superoxide anion radical scavenging (>80%) (57). The antioxidant activities of the extract prepared from the above-ground parts with phosphate buffer (pH = 7) were investigated using four different methods. The radical scavenging effect of the extract was found to be 51.4 +/- 3.3% in DPPH (2,2-diphenyl-1-picrylhydrazyl) method, 73.5% in ESR (electron spin resonance) method and 9.13 +/- 0.98% in NO (Nitric Oxide) radical inhibition assay. Its total reductive effect was detected to 2.85 +/- 0.45 FRAP unit in the FRAP test. 70% ethanolic extract among extracts prepared from the plant using solvents with different polarities such as water, ethanol, 70% ethanol, methanol, 70% methanol, and chloroform was found to be effective in terms of antioxidant activity, with an IC50 value of 168.1 µg / mL. Superoxide scavenging effects of onitine and luteolin, isolated from the methanolic extract of the plant were IC50 = 35.3 and 5.9 µM, respectively while free radical scavenging effects of 1, diphenyl-2-picrylhydrazyl and 2.2-di (4-ter-octyl-phenyl) -1-picrylhydrazyl were IC50 = 35.8 +/- and 22.7 +/- 2.8 µM, respectively (58).

2.11. Beam Tree (Cormus domestica)

Figure 4. ***Beam Tree (Cormus domestica)***

2.11.1. Botanical characteristics: *Cormus domestica*, which has fruits resembling a miniature apple or pear, grows naturally or is cultivated in a small number of regions. Although it has been recorded that the plant has been widely cultivated since the time of the ancient Roman empire, it is not known exactly what the natural distribution area of this species is. It is spread in Western, Central and southeastern Europe, especially in the Balkan peninsula, and rarely in some parts of North Africa and West Asia. This plant also has a record as a species of the forest ecosystem of Central and Southern Europe. However, the regions in which it is widespread are not exactly known. In Turkey, it grows wild in the Western Part of Northern Anatolia (Kastamonu, Zonguldak), Marmara and Thrace region (Sakarya, Bolu), Central Anatolia (Ankara), Central Black Sea Region (Sinop, Tokat), and South Anatolia (Hatay) (59, 60).

2.11.2. Traditional Use: Cormus domestica has been known as a valuable tree since the Roman empire. Its leaves are used against diabetes in the form of 5% infusions among the people. Its fruits are known to have important therapeutic effects in intestinal diseases, anemia, and extreme weakness in folk medicine. It is registered that its fruits are used as a diuretic, anti-inflammatory, anti-diarrhea, vasorelaxant and vitamin source. Its fruits are also reported to be effective in situations such as dysentery, strengthening memory, and improving

thinking. It has been noted that its fruits are traditionally used in the treatment of long-term diabetes-related disorders. It is emphasized that over-ripening fruits are used only in Traditional Medicine. It is also stated that boiling its fruits in water and drinking are good for cough. It is stated that jam and marmalade prepared from fruits are also an internally antitussive around İstanbul. It has been reported that fruit decoction is used for gallbladder diseases in Sakarya and that after the fruits are kept in sugar and saltwater around Balikesir, they are internally used in diabetes. The fruit peel is brown and the fleshy part is yellowish-brown, and it is recommended to be consumed when it is ripen (61, 62).

Chemical Composition: Its fruits contain vitamins A, B2, C, and other minerals. The sexangularetin glycoside and the isorhamnetin conjugates, both of which have the flavonoid structure, were detected in a wide variety of parts of C domestica, such as leaves, fruits, and flowers. Its fruits are also rich in procyanidins, cinnamic acids, and quercetin. It has been reported that the plant is rich in phenolic compounds. These studies were conducted in various ripening periods of the plant for qualitative and quantitative purposes and all fruits were found to be rich in benzoic acid. In addition, cinnamoylquinic acid from phenylpropanoids, quercetin glycosides from flavonoids, hydroxycinnamic acid and its derivatives, cercetole and chemferol derivatives have been identified. In addition to these, a cercetole dimer was also found. In another study, caffeoylquinic acid and chlorogenic acid were isolated from its fruits (63, 64).

Other studies: The aqueous extracts of Cornos domestica fruits exhibited higher antioxidant activity (68.29%) than synthetic antioxidants (BHA, BHT and propyl gallate). Hydrogen peroxide scavenging capacity (12.89% and 3.62%) of Cormus domestica was found to be quite low. Cormus domestica showed a lower effect in experiments performed to determine the antioxidant capacity equivalent to trolox. The antioxidant capacity of the methanolic extracts of the fruits of Cormus domestica collected during 5 different ripening periods were also investigated. DPPH radical scavenging effect was found to be EC50 = 0.341-39.5 mg dry extract / mg. The butanol fraction of the fleshy portion and unripe fruit showed the best effect, followed by ether and ethyl acetate fractions. Water extract exhibited the weakest effect. The best antioxidant capacity was detected in all methanolic extracts and fleshy parts during different ripening periods (EC50=2.55+/-0.11; 10.6+/-0.34; 1.89+/-0.06; 20.0+/-0.12; 1.45+/-0.02). It has been determined that when the fruits were over-ripening, their antioxidant capacity is lower (65, 66).

3. MATERIAL and METHOD

3.1. Plant Material: Ardıç-Juniper berries (*Juniperus communis*) fruit, atkuyruğu-Bottle-brust (*Equisetum arvense*) plant, yıldız anason-Chinese star anise (*Illicium verum*) fruit and üvez-Beam tree (Cormus domestica) leaves were used in this study. Plant materials were obtained from a herbalist in Mısır Çarşısı as ready-packed (Harem Palace).

3.2. Preparation of extracts and their solutions. A dried sample (10 g) was chopped into small pieces using a blender. Metanol extraction was performed in a soxhlet apparatus until the refluxed solvent became colourless. Extraction was followed by filtration through Whatman No 1 filter paper and evaporation of the filtrate to dryness at 30^{O}C in the Büchi V-700 rotary vacuum evaporator. The dry residue was mixed with 150 ml of metanol in a screwcapped Erlenmeyer flask and placed on a Nüve SL 350 shaker (Nüve, Ankara, Turkey) to obtain an metanol extract. Extraction was repeared until the solvent became colourless; 200 ml of metanol was used in total. The combined extracts were filtered through Whatman No 1 filter paper and evaporated to dryness at 40^{O}C in the Büche V- 700 rotary vacuum evaporator. The residue obtained after filtration was left in a dark place at distilled water. This extract was filtered and the filtrate was frezee-dried in a Labconco 117 freeze-dryer at 5 m Hg and -50^{O}C. The dried samples of all the extracts were stored under nitrogen at 4^{O}C until use. For antioxidant activity measurements, dried extract solutions were prepared by dissolving 20 mg of dried exctract in 20 ml of solvent. Although the same solvent were used for all the assays, concentrations differed from assay to assay as described below. There was no detectable effect of the solvents on any meaured activity, as established by control experiments in which solvents containing no extract were used in the assays. In all cases, three independent experiments, each with triple measurements, were performed. The results show the means of these measurements (67).

3.3. Antimicrobial Activity

Disk diffusion susceptibility test was applied to determine the antimicrobial activity of plant extracts. Antibiotic disks were impregnated with 50 µL from these extracts under aseptic conditions using a micropipette with a diameter of 6 mm (Schleicher & Schül, Nr 2668, Germany). In our study, Mueller Hinton Agar (OXOID) was used to determine the

antimicrobial activity of bacteria and yeast as medium. Plaques in which bacteria were inoculated were incubated for 24 hours at 35°C and plates inoculated with yeasts were incubated for 3 days at 30°C. When the time was over, the diameters of the inhibition zones formed around the disks were measured. The antimicrobial activity experiments against all the test microorganisms were repeated three times (68).

3.3.1. Microorganisms used in the study

3.3.1.1. Staphylococcus

They are gram-positive bacteria. They breathe anaerobically. They cause food poisoning, wound infections, pharyngitis, meningitis, urinary tract infection (69).

3.3.1.2. Listeria

They are gram-positive bacteria. They are movable. They do not have capsules and sports. In general, they infect the vertebrate domestic animals. They cause meningitis in humans (70).

3.3.1.3. Salmonella

They are gram-negative bacteria. They produce hydrogen sulfide. They are movable. They cause food poisoning and typhoid. Salmonella seropi causing the most infection is Salmonella enteritidis (70).

Escherichia

They are gram-negative bacteria. They are basil-shaped. They are found naturally in the intestinal flora, but the weakening of the immune system and the increase in their number cause infections. They cause mammary gland, urinary tract, and wound infections in animals. They cause dysentery in humans (70).

3.3.1.4. Saccharomyces

Saccharomyces cerevisiae is a budding yeast species. Yeast cells can survive in haploid and diploid forms. Haploid cells have a simple life cycle consisting of mitosis and growth and usually die in a high-stress environment (70).

3.3.1.5. Ofloksasin

Ofloxacin is a fluoroquinolone (fluorine-o-KWIN-o-lone) antibiotic that destroys bacteria in the body. Ofloxacin is used to treat bacterial infections in the skin, lungs, prostate, or urinary tract (bladder and kidneys).

4. RESULTS

Test organisms were used to test the antimicrobial activity. Namely, *Staphylococcus aureus* (ATCC 25923), *Listeria monocytogenes* (ATCC 15313) ve *Saccharomyces cerevisiae* (ATCC 9763) are gram positive, *Escherichia coli* (ATCC 25922), *Salmonella typhimurium* (ATCC 14028) are gram negative.

Table 4. 1. Result of antimicrobial activity

Microorganisms	Ardıç- Juniper berries (*Juniperus communis*) fruit MeOH Exract	Atkuyruğu- Bottle-brust (*Equisetum arvense*) plants MeOH Exract	Yıldız anason- Chinese star anise (*İllicium verum)* fruit MeOH Exract	Üvez- Beam tree (*Cormus domestica*) leaves MeOH Exract
Staphylococcus aureus (ATCC 25923) (Gram-positive)	18 mm	9 mm	15 mm	12 mm
Escherichia coli (ATCC 25922) (Gram-negative)	8 mm	-	-	-
Listeria monocytogenes (ATCC 15313) (Gram-positive)	18 mm	-	19 mm	12 mm
Salmonella typhimurium (ATCC 14028) (Gram-negative)	-	10mm	11 mm	-
Saccharomyces cerevisiae (ATCC 9763) (Gram-negative)	-	-	18 mm	-
Ofloxocin (standard)	10 mm	10 mm	8 mm	10 mm

Inhibition zones of Ardıç- Juniper berries (*Juniperus communis*) methanol extract against *Staphylococcus aureus*, *Escherichia coli* and *Listeria monocytogenes* were measured and found to be 18 mm, 8 mm, and 18 mm, respectively, as displayed in Table 4.1. Inhibition zones of Atkuyruğu- Bottle-brust (*Equisetum arvense*) methanol extract against *Staphylococcus aureus* and *Salmonella typhimurium* were measured and found to be 9 mm and 10 mm, respectively, as seen in Table 4.1. Inhibition zones of Yıldız anason- Chinese star anise (*İllicium verum*) methanol extract against *Staphylococcus aureus*, *Listeria monocytogenes, Salmonella typhimurium,* and *Saccharomyces cerevisiae* were measured and found to be 15 mm, 19 mm, 11 mm, and 18 mm, respectively, as shown in Table 4.1.

Inhibition zones of Üvez- Beam tree leaves (*Cormus domestica*) methanol extract against *Staphylococcus aureus* and *Salmonella typhimurium* were measured and found to be 12 mm, and 12 mm, respectively, as shown in Table 4.1. The highest and lowest antimicrobial activity were observed against *Listeria monocytogenes* (Yıldız anason (*İllicium verum*) and *Escherichia coli* (Ardıç (*Juniperus communis*) methanol extract), with 19 mm and 8 mm zone of inhibition, respectively.

Figure 5 Antibacterial activity against *Staphylococcus aureus*(ATCC 25923), zone diameter values created by methanol extracts of Juniper berries (*Juniperus communis*), Bottle-brust (*Equisetum arvense*), Chinese star anise (*İllicium verum)* in disc diffusion test

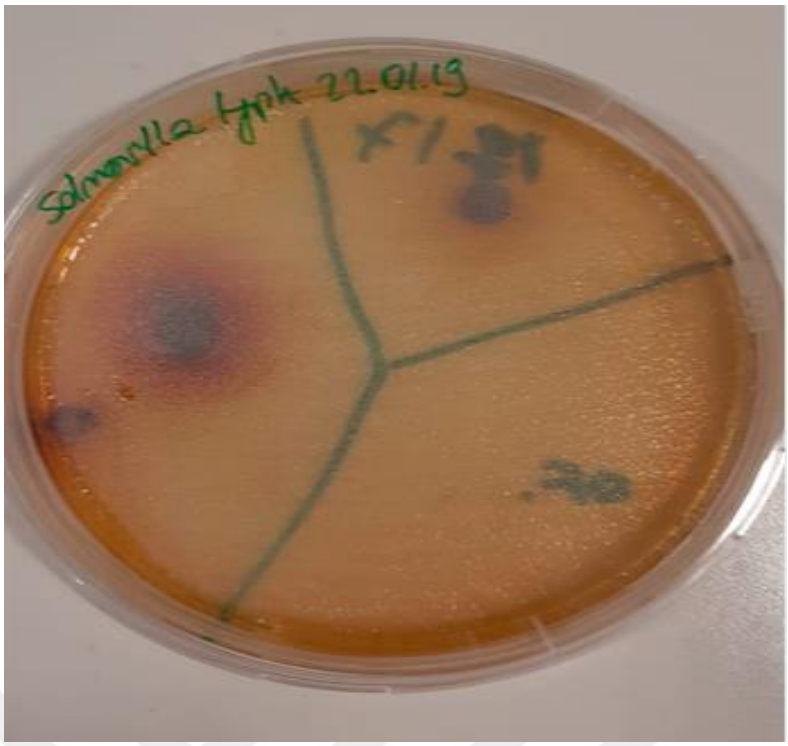

Figure 6. Antibacterial activity against *Salmonella typhimurium* (ATCC 14028),zone diameter values created by methanol extracts of Bottle-brust (*Equisetum arvense),* Chinese star anise (*İllicium verum)* in disc diffusion test

Methanol extracts were found to be more effective against gram positive bacteria. This may be since gram-negative bacteria has a multi-layered structure which consists of a lipopolysaccharide layer on the outhermost wall of the cell. This structure ensures gram-negative bacteria to be more resistant against microorganisms in the range of 8-19 mm in the antimicrobial activity of the plants. No antimicrobial activity was detected against *Salmonella typhimurium* and *Saccharomyces cerevisiae* (Ardıç (*Juniperus communis*) methanol extract). No antimicrobial activity was detected against *Escherichia coli, Listeria monocytogenes* and *Saccharomyces cerevisiae* (Atkuyruğu (*Equisetum arvense*) methanol extract).

No antimicrobial activity was detected against *Escherichia coli* (Yıldız anason (*İllicium verum)* methanol extract). No antimicrobial activity was detected against *Escherichia coli, Salmonella typhimurium* and *Saccharomyces cerevisiae.* (Üvez leaves (*Cormus domestica*) methanol extract).

5. DISCUSSION

Continuous exposure of people to substances with toxic activity, increase in diseases such as nutrition-related cardiovascular diseases and cancer, and failure to reach to sufficient and quality food are today increasing the significance of quality nutrition. Striving to produce foods with high nutritional value and long shelf life has also increased the importance of the quality of the produced foods and the ingredients used. Due to the devastating effects of synthetic antimicrobials on the body, the search for natural preservatives that can replace synthetic substances continues swiftly. Plant extracts with high antimicrobial activity should be determined through these types of studies and continuity of the studies should be ensured for industrial application by examining their protective effects on food systems (71).

Srinivasan *et al.* (2001) investigated the antimicrobial effects of 50 different medicinal plants in India. They observed that 72% of the plants had antimicrobial activity, 22 plants had an inhibitory effect on gram-positive and gram-negative bacteria, and 9 plants had an antifungal effect. In this regard, these data reveal that medicinal plants are very important. Mabesh and Satish (2008) studied the effect of some medicinal plant extracts on plant and human pathogens. They determined that methanol extract was effective on some pathogens. Similar results have also been obtained in other studies. Studies show that medicinal plants and products are an important alternative to anti-microbial production. The antimicrobial effects of the aqueous-ethanolic extract of Atkuyruğu (*Equisetum arvense*) against *Escherichia coli*, *Salmonella enteritidis* and *Candida albicans* strains were investigated and inhibition zones were found between 11.3 and 14.1 mm (72). Aqueous and ethanolic extracts of E. arvense were investigated in terms of antibacterial activity by using the disc diffusion method against Escherichia coli strain, which is one of the pathogens of the urinary system. The inhibition zone was found to be 7-14 mm for different concentrations (73). Ethyl acetate extract was found to exhibit antimicrobial activity against *Staphylococcus aureus* by the disc diffusion method (11 mm) (74). The aqueous extract that examines effects on viability, virulence factor, and biofilm formation of Escherichia coli strain being the urinary tract pathogen was found to have antimicrobial activity ($p < 0.05$). The antimicrobial activities of various aqueous ethanolic extracts prepared from E. arvense leaves using different extraction parameters (temperature, mixing speed, ethanol ratio, extraction time, and solvent amount) were investigated against *C. albicans, Escherichia coli* and *Staphylococcus* epidermides strains by disc diffusion method. None of the 24 different extracts were found to have an inhibitory effect against *C. albicans*. Their results are consistent with our findings (75).

Methanolic extract of *I. verum* fruits was found to be an antibacterial effect against *P. gingivalis, F. nucleatum, C. gingivalis, V. parvula, E. corrodens, P. micros* and *A. adontolyticus* (76). Another study showed that the ethanolic extract of *I. verum* had a significant antibacterial effect against *Acinetobacter baumannii, Pseudomonas aeruginosa* and *Staphylococcus aeruginosa* (77).

The highest and lowest antimicrobial activity were observed against *Listeria monocytogenes* and *Escherichia coli* with 19 mm and 8 mm zone of inhibition, respectively. In general, methabolic extracts exerted moderate inhibitory effects against the tested bacteria. The most reasonable explanation for this is that methanol is active in separating flavonoids and phenolics. Still, the inhibitory effect has a direct relation with extract concentration. So, if the concentration were higher, then bigger zones could likely be observed (78). In addition, various different factors should also be taken into consideration. In fact, the antibacterial of plant extracts are strongly with to their chemical composition. This composition and their relative chemical concentrations may vary in plant extracts with respect to the geographical location of the plant, climatic and growth environments (temperature, soil, fertilizers, etc.), the part of the plant used, the season during which plants were collected and the stage of plant development, as well as processing and storage conditions (79). Additionaly, culture conditions, e.g. the composition of the test medium, temperature and time of incubation, may also influence the result. In future studies, Ardıç (*Juniperus communis*), Atkuyruğu (*Equisetum arvense*) plants, Yıldız anason (*İllicium verum)* fruit, Üvez (*Cormus domestica*) leaves can be further analysed because of its biochemical composition that is specifically responsible for its antimicrobial activity. In addition, our results show that they are able to use as a food additive to prevent biological or microbial spoilage against deterioration.

6. CONCLUSIONS

In conclusion, consumers have an increased interest in natural antimicrobial agents due to the side effects of artificial preservatives on health. In recent years, research on the use of plants for medical purposes and preserving nutrients have increased, and therefore, the importance of plants' use as natural antimicrobials is increasing day by day. Antimicrobial resistance in bacteria is increasing rapidly. In contrast, bacteria do not develop resistance to plant and plant products that show antimicrobial properties. The reason for this is that synthetically produced medicines are made by isolating any active substance in plants. Bacteria can neutralize medicines by creating resistant breeds against synthetic drugs containing a single structure in time.

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8. CURRICULUM VITEA

KİŞİSEL BİLGİLER

Özge Basın Bayram

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Ehliyet: B/2013

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ARAŞTIRMA VE SEMİNERLER:

- Lisans Tez konusu ‘Prebiyotik. Probiyotik ve Sinbiyotiklerin Hastalıklar Üzerine Etkisi’ dir
- Yüksek Lisans Kapsamına Aldığı Dersler
    - Selectedtopics in foodsciencetechnology
    - Foodmycologyandmycotoxins
    - Micro andmacronutrients
    - Nutritionalassesment of anthropology

ALDIĞI SERTİFİKALAR VE KURSLAR:

- Nutraxin "Fitoterapi, Besin Destekleri ve Eklem Sağlığı" Semineri İstanbul 10/2015

- Kanser ve Beslenme Kongresi
  İstanbul 04/2015
- IX. Uluslar arası Beslenme ve Diyetetik Kongresi.
  İstanbul 04/2014
- Çocuk Hastalıklarında Beslenme Sempozyumu
  Ankara 11/2013
- 3.Ulusal Sağlıklı Yaşam Sempozyumu
  Ankara 03/2013
- 3.Ulusal Sağlıklı Yaşam Sempozyumu Kardiyoloji Diyetisyenliği Kursu
  Ankara 03/2013

MESLEKİ İLGİ ALANLARI:

- Diyabette Beslenme ve Tip 1 Diyabette Karbonhidrat Sayımı
- Probiyotik ve Probiyotikler (Mezuniyet Tezi)
- Sporcu Beslenmesi
- Metabolik Sendromda Beslenme Tedavisi
- Sağlıklı ve Dengeli Menü Planlama
- Detox Programları
- TPN (Total PatenteralNütrisyon)
- Sağlıklı Yemek Tarifleri Üretmek
- Obezitede Kilo Kontrolü
- Klinik Beslenme

İŞ TECRÜBESİ:

Fitslimlife Yönetici Diyetisyen **2017-halen**

Allianz Türkiye Kurumsal Diyetisyen **2016-2017**

Özel Meditime Cerrahi Tıp Merkezi Ataşehir/ İstanbul, Diyetisyen **2016**

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STAJ TECRÜBESİ

Yeditepe ÜniversitesiTıp Fakültesi Hastanesi

04/2015-05/2015

- Yatan hasta diyet hizmetleri
- Ayaktan hasta diyet hizmetleri
- Personel beslenme ve diyet hizmetleri

Maltepe Üniversitesi Tıp Fakültesi Hastanesi

03/2015-04/2015

İstanbul Üniversitesi ÇAPA Tıp Fakültesi Hastanesi

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Yeditepe Üniversitesi SANİTAS

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Live Hospital11/2014-11/2014

Ok Meydanı Eğitim ve Araştırma Hastanesi

10/2014-11/2014

AtaşehirMemorial Hastanesi

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Göztepe Medikal Park Hastanesi

06/2014-07/2014

- Poliklinik Hizmeti

Çamlıca Alman Hastanesi

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YABANCI DİL :

- **İngilizce(Advance)**

BİLGİSAYAR BİLGİSİ :

- Windows 7-8, Vista,XP, 2000, Linux, Mac Os,
- Microsoft Office Word, Excel, PowerPoint, Office 2007-2015
- SPSS İstatistik programı

HOBİ VE AKTİVİTELER:

- Kitap ve süreli yayınlar
- Reformar, voleybol, masa tenisi

GÖRSEL VE BASILI YAYIN:

- **Çeşitli gazete ve internet sitelerinde güncel konular hakkında yazıları yayınlanmıştır.**
  (www.somagundem.com**)**
- **Aktif olarak sosyal medya hesaplarıyla güncel bilgiler paylaşmaktadır. (İnstagram: diyetisyenozgebasin / Facebook: Diyetisyen Özge Basın)**

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3.