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The Use of St. John's Wort (Hypericum perforatum) Extract in Drinking Yoghurt Production and Determination of Changes Occuring During Storage

Ayran Üretiminde St. John's Wort (Hypericum perforatum) ekstraktının kullanımı ve depolama boyunca meydana gelen değişikliklerin belirlenmesi

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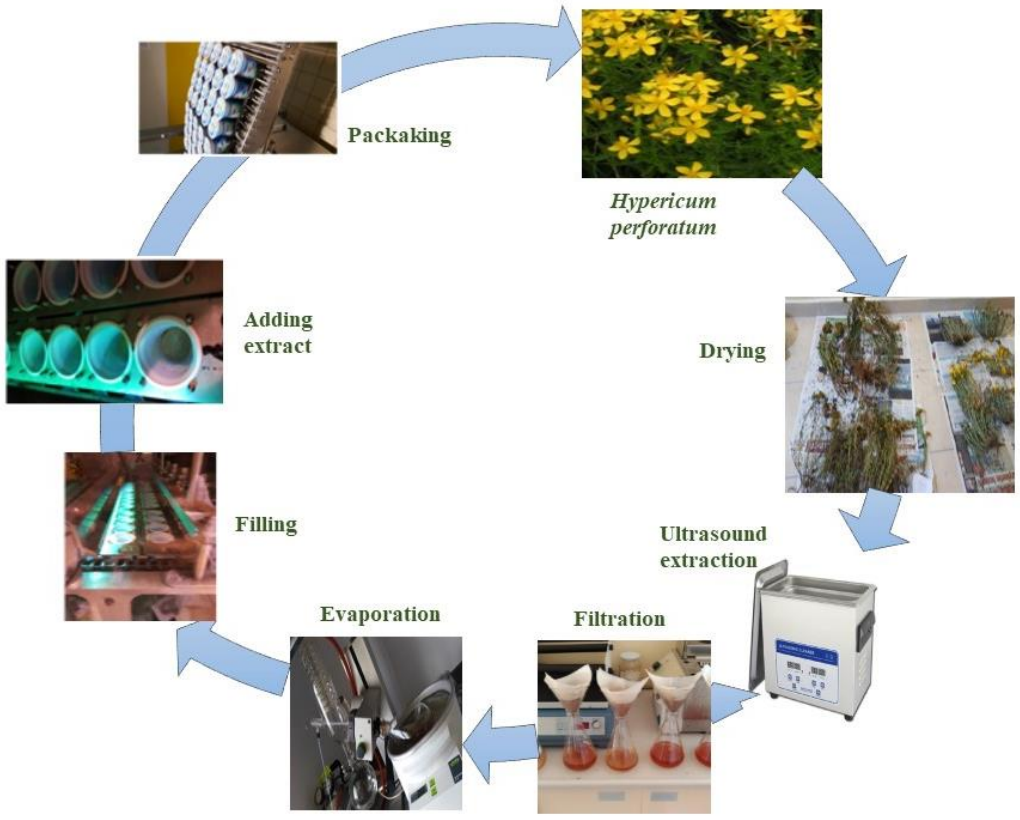
Graphical Abstract



Abstract

Medicinal and aromatic plants and extracts, essential oils obtained from these plants are widely used in many sectors as well as meeting the nutritional needs of people. Hypericum species have many biological activities such as antidepressant, antiviral, antibacterial, antioxidant and antinflammatory and are used as folk remedies in many areas such as sleep enhancement, rheumatic pain treatment, wound healing, skin diseases treatment among the public. One of the Hypericum species, St. John's wort (*Hypericum perforatum*) is found in almost all regions of our country and is one of the most studied plants. In our study, this plant, which has a very common medical use, was extracted and added to different amounts of drinking yoghurt. A mixture of 70% ethanol + 30% water was used as solvent during the extraction. In the study, three types of drinking yoghurt containing 1%, 2% and 3% St. John's wort extract were obtained. The control group and the drinking yoghurt samples obtained were stored for 28 days and some physicochemical and microbiological analyzes were performed on the 1st, 7th, 14th, 21st, and 28th days of the storage. According to the findings obtained; During the storage period, it was observed that the ash and salt values of the samples did not change, the dry substance, water activity and pH values decreased and the acidity values increased. In the microbiological* analyzes performed during the storage period, the number of mesophyl bacteria groups increased statistically, while yeast – mold and coliform groups were not observed. Sensory analyzes were applied to the panelist group consisting of 10 people and when the taste – smell and general appreciation points were considered, samples containing 2% St. John's wort extract were the most liked. General appreciation scores increased statistically during storage. With this study, a functional product has been produced by adding this plant, which is not widely used alone, to a product that we consume a lot in

Özet

Tıbbi ve aromatik bitkiler ve bu bitkilerden elde edilen ekstraktlar, uçucu yağlar insanların besin ihtiyaçlarını karşılamanın yanında birçok sektörde de yaygın olarak kullanılmaktadır. Hypericum türleri antidepresan, antiviral, antibakteriyel, antioksidan, antienflamatuvar gibi birçok biyolojik aktiviteye sahip olup, halk arasında uyku güçlendirme, romatizmal ağrı tedavisi, yara iyileştirme, cilt hastalıkları tedavisi gibi birçok alanda da halk ilacı olarak kullanılmaktadır. Hypericum türlerinden sarı kantaron (*Hypericum perforatum*) ülkemizde hemen hemen tüm bölgelerde bulunmakta ve üzerinde en çok çalışılan bitkilerdendir. Çalışmamızda tıbbi kullanımı oldukça yaygın olan bu bitkinin ekstraksiyonu gerçekleştirilmiş ve farklı miktarda ayrana ilave edilmiştir. Ekstraksiyon sırasında çözücü olarak %70 etanol + %30 su karışımı kullanılmıştır. Çalışmada %1, %2 ve %3 oranında sarı kantaron ekstraktı içeren üç çeşit ayran elde edilmiştir. Kontrol grubu ve elde edilen ayranlar 28 gün boyunca depolanmış ve depolamanın 1., 7., 14., 21. ve 28. günlerinde bazı fizikokimyasal ve mikrobiyolojik analizleri gerçekleştirilmiştir. Elde edilen bulgulara göre; depolama süresi boyunca örneklerin kül ve tuz değerlerinin değişmediği, kuru madde, su aktivitesi ve pH değerlerinin azaldığı, asitlik değerlerinin ise arttığı gözlemlenmiştir. Depolama süresi boyunca yapılan mikrobiyolojik analizlerde, toplam mezofil bakteri grubu sayısı istatistiksel olarak artış gösterirken, maya-küf ve koliform grup gözlemlenmemiştir. 10'ar kişiden oluşan panelist grubuna duyusal analizler uygulanmış ve tat- koku ve genel beğeni puanlarına bakıldığında en fazla beğeniyi %2 oranında sarı kantaron ekstraktı içeren örnekler almıştır. Depolama süresince genel beğeni puanları istatistiksel olarak artış göstermiştir. Bu çalışmayla tek başına kullanımı yaygın olmayan bu bitkinin günlük hayatta çok tükettiğimiz bir ürüne ilave edilmesiyle fonksiyonel bir ürün üretimi gerçekleştirilmiş ve kullanımı daha yaygın hale getirilmeye çalışılmıştır.

daily life, and its use has been tried to be made more common.

Key Words: St. John's wort (*Hypericum perforatum*), extraction, drinking yoghurt, storage

Anahtar kelimeler: Sarı kantaron (*Hypericum perforatum*), ekstraksiyon, ayran, depolama.

Abbreviations:

1. INTRODUCTION

Studies conducted for a longer life span aim to increase the quality of life as well as increase the importance of a healthy and balanced diet (Anonym, 2014). Due to the wrong nutritional rules that are known as correct, people have turned to the search for healthy and reliable food. In this context, the tendency to foods whose effects on health are scientifically proven and approved is increasing day by day (Sevilmiş, 2013). For this reason, studies in recent years have focused on food production, which is rich in nutrients and has positive effects on human health (Seçkin & Baladura, 2011). Considering the role of nutrition in health and preventing diseases, the importance of studies in this field increases even more. In the world and in our country, medicinal and aromatic plants and products produced from these plants have gained value each passing day by gaining the appreciation of the consumers. In the future, it is expected that the production of medicinal and aromatic plants, the production of the plant extracts obtained from these plants and the industrial production that processes them will increase and will be standardized in order to meet the demand of the consumer and to obtain a product of standard quality (Bayram et al., 2010).

Represented by 350 – 400 species in the world, Hypericum genus has 84 species in our country (Wichtl, 1986; Zeybek & Zeybek, 1994). Although H. perforatum L., the most common in Hypericum species, is used as a 'Natural Antidepressant' without side effects in European countries (Chrea et al., 2014), it also plays an active role in the treatment of symptoms such as insomnia and anxiety (Özgür Devrim, 2009). While cardiac and anticholinergic side effects were observed in patients using antidepressant drugs, no side effects were observed in studies using Hypericum extract (Cass, 1997; Ernst, 2003; Francis, 2005; Linde & Knüppel, 2005). Antidepressant drugs, which are becoming more common today, are widely used to prevent alcoholism and various types of addiction (Buonopane, 2005). In the studies conducted, H. perforatum extracts were given to experimental animals and as a result, serious decreases were observed in the alcohol intake of the experimental animals (Rezvani et al., 1999; Xu et al., 2005). Extracts of H. perforatum plant reduce alcohol addiction and withdrawal symptoms

caused by addiction (Abstinens Syndrome), (Coskun et al., 2006), as well as prevent withdrawal symptoms observed as a result of addictions such as nicotine (Uzbay et al., 2005; Uzbay et al., 2007) and caffeine (Uzbay et al., 2005; Uzbay et al., 2006). It has been determined that the antidepressant property of the plant is due to the secondary metabolite content of the plant, especially the hypericin molecule, and this molecule provides a significant increase in the transmission of nerve impulses in the brain (Uzbay, 2008).

Apart from the antidepressant properties of H. perforatum plant, it is used in the treatment of cancer, diabetes, chronic rheumatism, liver – biliary diseases, stomach ulcer and gastrointestinal diseases; In addition, it is known to be used in many areas such as jaundice, bronchitis, diarrhea and dysentery (Duke, 2002), throat infection (Tümen & Sekendiz, 1989) and the treatment of colds (Duke, 2002; Baytop, 1999). As a result of the studies, it has been determined that the compounds contributing to the pharmacological activity of H. perforatum are hypericin, pseudohypericin, hyperforin, flavonoids (rutin, hyperoside, and quersitrin), xanthones and tannins (Barnes et al., 2001; Kaçar & Azkan, 2004). Studies have shown that the bioactive components of Hypericum species, hypericin and pseudohypericin, are highly effective against viruses. In studies conducted in in vitro environment; It has been found to be effective against Type A and B influenza, Herpessimplex, Hepatisis C viruses, Vesicular Stomatitis virus, Epstein-Barrvirus. (Cass, 1997; Mazza, 1998; Mills & Bone, 2000). It has been established that the bioactive compound hypericin exerts an antiviral effect by inactivating the HIV virus and protecting the membranes of healthy cells from virus attack (Cass, 1997; D'Hallewin et al., 2002). It has been supported by studies that the hypericin compound also shows anticancer activity in many different types of cancer (Ali et al., 2001; Blank et al., 2003; Colasanti et al., 2000; Linde et al., 1996; Martarelli et al., 2004; Mills & Bone, 2000). Hyperforin, another important bioactive ingredient, has been determined to have more antibacterial and antidepressant effects (Hölzl & Petersen, 2003). Hyperforin compound shows cytotoxic activity by inducing apoptosis in various cancer cells (Martarelli et al., 2004). This plant, which has many health benefits, has been accepted by the Council of Europe as a natural source for sweetening foods. Its aroma and fragrance has increased its use in the liquor industry (Anonym, 2000). It is used as a herbal additive in instant soups, breakfast cereals, chocolate, cakes, desserts and fruit – flavored beverages because it contains many bioactive ingredients that are beneficial for health (Anonym, 2000; Anonym, 2014).

Milk, which contains water, sugar (lactose), lipids and proteins as well as trace amounts of minerals, enzymes, vitamins, hormones and various compounds in its structure, is a very

complex liquid (Tilki, 2008). Milk is of great importance in food groups as it contains water, carbonhydrates, fat, lipids, vitamins, macro and micro elements and trace elements that are necessary for our metabolism and has a high nutritional value (Souza et al., 2018). According to the Food and Agriculture Organization (FAO), global milk consumption per capita is expected to increase by 12.5% by 2025. It is known that milk and its products have an important role in preventing or treating cardiovascular disease, metabolic syndrome, osteoporosis, digestive disorders and cognitive decline (Coutinho et al., 2018).

Being in the low viscosity yoghurt class in many countries around the world and known as 'drinkiable yoghurt' or 'lactic drink', drinking yoghurt is accepted as one of the most important consumptions forms of yoghurt or a yoghurt derivative product that has settled in our culture (Anonym, 2009; Bölükbaşı, 2007). Drinking yoghurt is expressed as a fermented milk product created by adding water to yoghurt or adding yoghurt cultures to milk whose dry matter value is adjusted in the Turkish Food Codex Fermented Milks Communiqué (Anonym, 2009). Drinking yoghurt, with its high nutritional value, is an important alternative to carbonated beverages in our country and takes its place in the market as a food with a wide range of consumers from children to adults (Kuş, 2010; Taş, 2005). Hypericum species, which have many biological activities such as antidepressant, antiviral, antibacterial, antioxidant, anti-inflammatory, are popularly used as folk remedies in many areas such as sleep enhancement, rheumatic pain treatment, wound healing skin diseases treatment. Studies on the use of this plant, which has a very common medical use, in the food field are very few and insufficient. In the literature, various additions were made to yogurt and drinking yoghurt, but no studies were found on the use of Hypericum species in milk and its products. Thanks to the bioactive compounds it contains, *Hypericum perforatum*, which has a wide area of use in the treatment of many diseases in the medical field, has been added to our traditional drink drinking yoghurt, which plays an important role in daily nutrition; thus, a healthy, natural and useful functional product has been obtained and the deficiency in the literature has been tried to be overcome.

2. MATERIAL AND METHODS

2.1. Material

The *Hypericum perforatum* plant to be used in the study was collected from Amasya region in 2018 between June and August. Ayran samples to be used were produced in OTAT Provisions Industry and Trade LLC, Samsun/Havza according to the process of the factory and supplied from the factory.

Production was carried out by going to the Otat Provisions Industry and Trade LLC. The factory made production the ayran samples according to its own process. *Hypericum perforatum* extracts were added to ayran samples immediately after filling and before capping process. Production was carried out by adjusting the dry matter amount of the milk. The composition of the produced control group ayrans was calculated as (%): dry matter content: 7.9, fat content: 1.5, salt content: 0.5, protein content: 2.

Table 1. Composition of milk used in ayran production

Properties	Fat milk	Skimmed milk
Fat (%)	3.7	0.1
Dry matter (%)	11.25	10.5
Sh	6.8	7
pH	6.78	6.72
Briks	9.8	10

The solvent used in the extraction process and all chemicals used during the analysis were of analytical purity and were obtained from Merck (Darmstadt, Germany).

2.2. Preparation of Extract and Drinking Yoghurt Samples

The aerial parts of the *Hypericum perforatum* plant were dried for 3 weeks in the Suluova Vocational School of Amasya University in a cool place and in the shade. Dried plant samples were grinded in a grinder and cut into small pieces. Later, they were sealed and placed in boxes for use in the study. Ultrasonic wave assisted extraction technique was used to isolate the bioactive components of the *Hypericum perforatum* plant. The most suitable solvent to be used in ultrasonic wave assisted extraction, the temperature and time to be applied have been tried to be determined by previous preliminary tests (Seyrekoğlu & Temiz, 2019). Considering the studies carried out, the most worked temperature, time and solvent were used in Hypericum species. Optimum conditions found as a result of preliminary tests; 70% ethanol + 30% water as a solvent, the optimum temperature and time were found to be 30 ^{o}C and 40 minutes. The *Hypericum perforatum* plant was extracted under these conditions in the ultrasonic wave assisted bath (Çalışkan Lab. Ult 4010, Turkey) Then the ethanol remaining in the extract was removed in Rotary evaporator (Buchi). The obtained *Hypericum perforatum* extract was added to drinking yoghurt in three different proportions (1%, 2%, 3%). Drinking yoghurt samples containing *Hypericum perforatum* extract were stored in (+4) ^{o}C. Physical, chemical, microbiological and sensory analyses were performed on the 1st, 7th, 14th, 21st and 28th days of the storage.

Ayran samples production were carried out according to Otat Food Industry operating standards. According to the factory's own production process, the content of dry matter of milk was adjusted and ayran samples were produced. Then *Hypericum perforatum* extracts were added to ayran samples after filling process. The ayran production process was carried out as follows; dry matter content of milk was adjusted by mixing fat milk, skimmed milk and water and then standardization process was carried out. After evaporation and homogenization, pasteurization was applied at 92±2 ºC at 5±1min. Then culture was added to the milk, which was cooled to 42-43 ºC temperature. After the fermentation was completed, the clot was broken and sent to the filters. *Hypericum perforatum* extract in determined proportions added to ayran samples at this stage and then were filling to the 200 mL pet cups in the filling machine. At the last stage lid closure, dating and packaging processes were carried out. The ayran samples were stored at 4 °C until analysis.

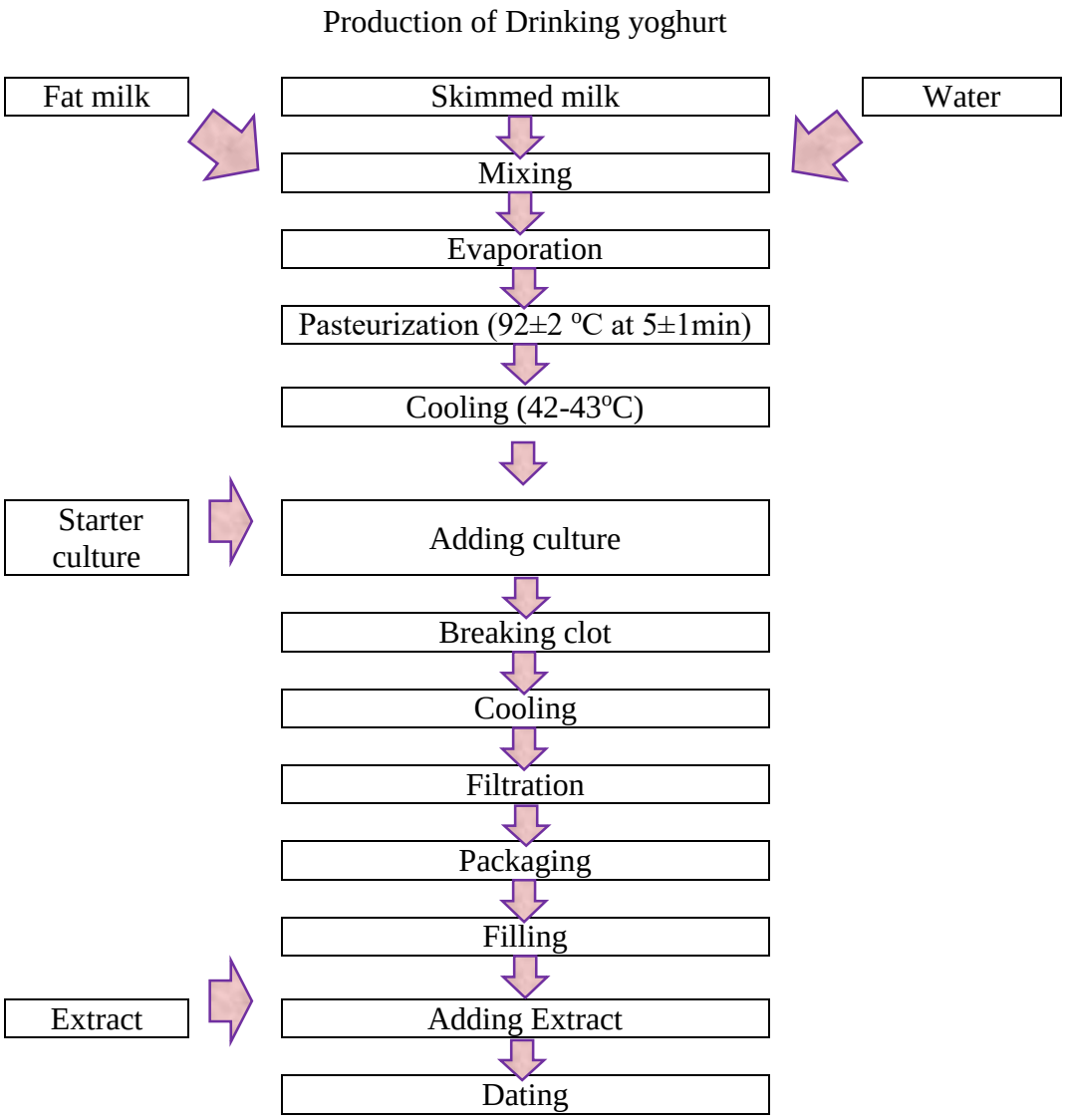


Figure 1. Production of drinking yoghurt

Figure 2. *Hypericum perforatum*

2.3. Physico-Chemical Analyses

The pH values of drinking yoghurt samples (at 25 ± 1 °C) to which *Hypericum perforatum* extract was added were determined with an inoLab (Wellheim, Germany) brand pH meter, and the water activity amount was determined with a water activity analyzer (Novasina, LabSwift-aw). The acidity of samples was made according to TS 1018 (Anonym, 2000). Dry matter values of drinking yoghurt samples were calculated based on the method proposed by TS 1018 in the determination of dry matter (Anonym, 2000). The method made by Kezer (2013) was used in the determination of ash (Kezer, 2013). The amount of salt (%) in drinking yoghurt samples was made according to the Mohr method (Şeker & Patır, 2011).

2.4. Microbial Analyses

Dilutions up to 10^{-6} were prepared from drinking yoghurt samples for microbiological analysis. Total mesophilic aerobice bacteria count was made according to Harrigan (1998), yeast-mold count was made according to the method specified in TS ISO 6611 (Anonym, 1996). The coliform group bacteria count in the samples was made according to the method made by Al-Kadamany et al. (2002).

2.5. Sensory Analyses

Sensory analyses were carried out on the basis of color and appearance, texture and consistency, taste and aroma and general taste characteristics, on the 1st, 7th, 14th, 21st and 28th days of storage with a panelist group of ten people. Before the sensory analysis, the panelists were informed about the product and the sensory analysis they would apply. Ayran samples were presented in 200 mL pet glasses with their covers closed. They were stored at 4 ^{o}C until analysis. By giving codes on the samples and was asked to fill in the characteristics corresponding to

those codes in the sensory analysis form. Drinking yoghurt samples added with *Hypericum perforatum* extract were compared among themselves and during storage. The evaluation was done in a range of points from 1 (quite bad) to 5 (quite nice) and their likelihood was checked (Anonym, 1982).

2.6. Statistical Analyses

All the analyzes applied to the samples in the study were made with at least two replications and their mean standard deviations were calculated. The data, analysis of variance and comparisons between groups obtained as a result of the study were made using the SPSS 16.0 package program (Tukey Test). The significance levels of the groups were evaluated at the $p < 0.05$ level (SPSS, 2011).

3. RESULTS AND DISCUSSION

3.1. Physicochemical Analyses

The results in physicochemical analyses of our drinking yoghurt samples were indicated in the Table 2.

When the physical and chemical analyses of the samples were examined, it was found that the added extracts did not cause a significant change on the physicochemical analysis (Table 2). Similarly, Şanlı et al. (2011), found that the physicochemical properties were not affected in the study in which transglutaminase was added to drinking yoghurt, and Dilek et al. (2018), similarly found that there was no difference between the control group and samples in their study where they added black carrot powder to drinking yoghurt.

Table 2. Change in physicochemical properties of drinking yoghurt samples during storage.

		Samples			
Properties	**Storage days**	**K**	**P1**	**P2**	**P3**
pH	**1st**	3.93^{Ac} ±0.04	3.93^{Ab} ±0.02	3.93^{Ab} ±0.01	3.94^{Ab} ±0.02
	7th	3.96^{Abc} ±0.04	3.93^{ABb} ±0.03	3.92^{ABb} ±0.01	3.91^{Bb} ±0.02
	14th	3.83^{ABd} ±0.01	3.83^{Bc} ±0.02	3.86^{Ac} ±0.02	3.82^{Bc} ±0.01
	21st	3.73^{ABab} ±0.02	3.78^{Ca} ±0.01	3.76^{ABCa} ±0.00	3.80^{Ca} ±0.00
	28th	3.73^{Aa} ±0.02	3.76^{BCb} ±0.01	3.66^{ABCb} ±0.01	3.72^{Bab} ±0.01
Acidity (% lactic acid)	**1st**	0.66^{ABCb} ±0.01	0.64^{BCa} ±0.05	0.63^{Cb} ±0.00	0.66^{ABCa} ±0.01
	7th	0.68^{ABab} ±0.01	0.61^{Ba} ±0.02	0.67^{ABab} ±0.04	0.67^{ABa} ±0.11
	14th	0.72^{Aa} ±0.04	0.65^{Ba} ±0.05	0.67^{ABab} ±0.01	0.65^{Ba} ±0.00
	21st	0.65^{Cb} ±0.00	0.69^{Ba} ±0.00	0.67^{Ba} ±0.01	0.71^{Aa} ±0.00
	28th	0.71^{ABa} ±0.02	0.65^{Ca} ±0.01	0.68^{BCa} ±0.00	0.68^{BCa} ±0.00
a_w	**1st**	0.96^{Ab} ±0.00	0.97^{Aa} ±0.00	0.97^{Ab} ±0.00	0.96^{Ab} ±0.00
	7th	0.97^{Aa} ±0.00	0.97^{ABa} ±0.00	0.97^{Aab} ±0.00	0.97^{Aab} ±0.00
	14th	0.97^{ABab} ±0.00	0.97^{ABa} ±0.00	0.96^{Bb} ±0.00	0.97^{ABab} ±0.00
	21st	0.97^{Aa} ±0.00	0.97^{ABa} ±0.00	0.97^{Aa} ±0.00	0.97^{Aa} ±0.00
	28th	0.96^{Ac} ±0.00	0.96^{Ab} ±0.00	0.96^{Ac} ±0.00	0.96^{Ac} ±0.00
Dry matter (%)	**1st**	7.96^{Aa} ±0.46	7.98^{Aa} ±0.01	8.08^{Aa} ±0.27	8.11^{Aa} ±0.02
	7th	7.56^{Cc} ±0.03	7.80^{Bb} ±0.05	7.83^{Ba} ±0.26	7.98^{ABab} ±0.07
	14th	7.88^{Bd} ±0.22	7.64^{Cc} ±0.01	7.86^{Ba} ±0.01	8.21^{Aa} ±0.01
	21st	7.64^{ABc} ±0.06	7.79^{ABb} ±0.10	7.73^{ABa} ±0.46	7.75^{ABbc} ±0.03
	28th	7.84^{Ab} ±0.05	6.61^{Cd} ±0.13	7.26^{ABb} ±0.44	7.61^{Ac} ±0.41
Ash (%)	**1st**	1.20^{Aa} ±0.07	1.20^{Aa} ±0.46	1.09^{Ab} ±0.02	1.11^{Ab} ±0.01
	7th	1.18^{Aa} ±0.01	1.18^{Aa} ±0.01	1.14^{Aab} ±0.09	1.15^{Aa} ±0.02
	14th	1.11^{Aa} ±0.05	1.12^{Aa} ±0.01	1.10^{Ab} ±0.03	1.067^{ABc} ±0.01
	21st	1.18^{Aa} ±0.00	1.17^{ABa} ±0.01	1.18^{Aa} ±0.01	1.14^{BCab} ±0.00
	28th	1.06^{Ba} ±0.00	1.11^{Aa} ±0.01	1.10^{Ab} ±0.00	1.06^{Bc} ±0.01
Salt (%)	**1st**	0.54^{Aa} ±0.06	0.58^{Aa} ±0.00	0.54^{Aa} ±0.06	0.58^{Aa} ±0.11
	7th	0.58^{Aa} ±0.17	0.59^{Aa} ±0.067	0.58^{Aa} ±0.13	0.54^{Aa} ±0.06
	14th	0.51^{Aa} ±0.00	0.52^{Aa} ±0.06	0.53^{Aa} ±0.06	0.53^{Aa} ±0.00
	21st	0.51^{Aa} ±0.17	0.57^{Aa} ±0.13	0.53^{Aa} ±0.00	0.51^{Aa} ±0.00
	28th	0.50^{Aa} ±0.11	0.50^{Aa} ±0.06	0.51^{Aa} ±0.06	0.50^{Aa} ±0.13

*: mean standard ± deviation. A-C: For drinking yoghurt samples, the capital letters on the same line are comparable and the same letters show no statistical difference between the samples. (P> 0.05).
a-c: The lower case letters in the same column are the comparison of the storage times and the same letters show that there is no statistical difference between the samples. (P> 0.05).

K: Control drinking yoghurt, P1: Drinking yoghurt produced by adding 1 % H. perforatum extract, P2: Drinking yoghurt produced by adding 2 % H. perforatum extract, P3: Drinking yoghurt produced by adding 3 % H. perforatum extract.

3.2. pH and acidity of drinking yoghurt samples

When the physicochemical properties of the samples are examined; While the pH values decreased with the storage, the amount of lactic acid (%) increased in accordance with this. pH values are quite close to each other. Lactic acid that formed as a result of the activities of lactic acid bacteria during storage, increased the acidity values and caused the pH values to decrease. Similar to our samples, pH values decreased with storage in the production of drinking yoghurt with pepper made by Akçay (2016), and drinking yoghurt samples with quinoa flour made by Temen (2018). In our examples, the amount of acidity is 0.61–0.72%, and this amount is quite close with the amount of 0.55–0.61% found in the study made by Avsar et al. (2001), and the amount of 0.58–0.67% in the study on the use of pectin in the production of durable drinking yoghurt by Atamer et al. (1999).

3.3. Dry matter content

While the dry matter values of the samples decreased with storage, the water activity, salt and ash values did not change. While the dry matter value in our study was between 6.61% and 8.21%; Patır et al. (2006), found the dry matter amounts of 3.80%- 8.70 % in packaged drinking yoghurt samples, and Saltoğlu (2014), between 8.61 and 8.83% in fruit drinking yoghurt samples, and they are very similar to our results.

3.4. Water activity

The values of the water activity of our samples wasn't observed change during the storage importantly. Since the amount of added extract was not high the amount of water activity did not change, and in paralel with the amount of water activity, the microbiological analysis of the samples were also similar. When we look at the literature, there are no studies on the amount of water activity of drinking yoghurt.

3.5. Ash content

While the ash values of the drinking yoghurt with the addition of hot pepper and the control group made by Akçay (2016), varied between 0.55% and 0.61%, the amount of ash in the samples used in our study was between 1.06 – 1.20%. The difference between the ash values in our study and the values reported in the literature is due to the raw material, production method

and the added extract. Physicochemical analysis results of all samples showed similar results when compared with the literature. The differences arise from the raw materials used, auxiliary substances, initial culture, fermentation conditions and the different components and extracts added into it.

When the literature is examined, it has not been found that the plant *Hypericum perforatum* is added to drinking yoghurt. For this reason, while making comparisons, studies in which different ingredients are added to make the drinking yoghurt more functional have been looked at and the analyzes made were compared in this way. The number of studies on *Hypericum perforatum* is quite high, but the use of plant in foods is very low. *Hypericum perforatum* extract was added to ice cream and some of its properties were studied. Addition of St. John's wort extract to ice cream caused a decrease in pH values and an increase in acidity and dry matter values (Aydemir, 2015). Similarly, in our samples, it caused a increase in acidity values and decrease pH values. The fact that the extract added was the same plant provided similar results. When *Hypericum perforatum* extract was added to drinking yoghurt, it did not cause major changes on physical and chemical properties and the product preserved its unique properties.

3.6. Microbial Analyses

The results in microbial analyses of our drinking yoghurt samples were indicated in the Table 3. As seen in Table 3 the total mesophylic aerobic bacteria group showed a linear increase with storage. Yeast-mold counts of the samples were similar to the control during storage. Yeast-mold was not observed in any of the samples. On the first day of storage, P3 sample (drinking yoghurt containing 3% *Hypericum perforatum* extract) had the lowest bacteria count with 4.07 log cfu / mL, while C (Control) was showed the highest number of bacteria with 4.67 log cfu / mL. On the 7th day of storage, the control sample contained the highest total mesophilic bacteria group with 4.68 log cfu, while the P3 sample contained the least bacteria with 4.13 log cfu / mL. Control and other samples were showed statistically similarity on other days of storage. *Hypericum perforatum* is showed antimicrobial effect in normally but everything could changed this antimicrobial effect. The reason for this change may be the year the plant was collected, the region where it was collected, the part used, the drying process applied before the extraction and the parameters used in the extraction.

Table 3. Change in microbial properties of drinking yoghurt samples during storage.

		Samples			
Microbiological Analysis	**Storage days**	**K**	**P1**	**P2**	**P3**
Total Mesophyl Bacteria (log cfu / mL)	**1st**	$4.67^{Ca} \pm 0.02$	$4.20^{Ba} \pm 0.01$	$4.11^{Aa} \pm 0.01$	$4.07^{Aa} \pm 0.02$
	7th	$4.68^{Ba} \pm 0.02$	$4.23^{Aa} \pm 0.09$	$4.14^{Aa} \pm 0.12$	$4.13^{Aa} \pm 0.06$
	14th	$4.73^{Ba} \pm 0.04$	$4.42^{Ab} \pm 0.06$	$4.69^{Bb} \pm 0.01$	$4.73^{Bb} \pm 0.14$
	21st	$4.87^{Ab} \pm 0.08$	$4.87^{Ac} \pm 0.03$	$4.89^{Ac} \pm 0.04$	$4.85^{Ab} \pm 0.06$
	28th	$4.94^{Ab} \pm 0.08$	$4.95^{Ac} \pm 0.03$	$4.97^{Ac} \pm 0.04$	$4.96^{Ab} \pm 0.06$
Coliform Group (log cfu / mL)	**1st**	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$
	7th	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$
	14th	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$
	21st	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$
	28th	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$
Yeast and Mold (log cfu / mL)	**1st**	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$
	7th	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$
	14th	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$
	21st	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$
	28th	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$	$<1^{Aa}$

*: mean standard ± deviation.
A-C: For drinking yoghurt samples, the capital letters on the same line are comparable and the same letters show no statistical difference between the samples. (P> 0.05)
a-c: The lower case letters in the same column are the comparison of the storage times and the same letters show that there is no statistical difference between the samples. (P> 0.05)
K: Control drinking yoghurt, P1: Drinking yoghurt produced by adding 1 % H. perforatum extract, P2: Drinking yoghurt produced by adding 2 % H. perforatum extract, P3: Drinking yoghurt produced by adding 3 % H. perforatum extract

Phenolic compounds contribute directly to the antioxidative effect and it has inhibitory effects on mutagenesis and carcinogenesis in humans (Barış et al., 2011). Also *Hypericum perforatum* extract could be affect from envoirement conditions undesirable reactions such as temperature, oxygen and heat during processing and storage. Everything of this situations afffect antimicrobial charecteristic of plant. The antimicrobial effect of *Hypericum perforatum* was investigated by Düzgüner & Erbil (2020), and it was concluded that methanol extract was effective on all test bacteria. Likewise, Orhan et al. (2013), found that the plant has antibacterial activity. Essential oils in the structure of the plant have antimicrobial, antiproliferative and antioxidant effects (Schepetkin et al., 2020). Hyperforin, one of its bioactive components, was found to be responsible for its antibacterial effect (Hölzl & Petersen, 2003). Aydemir (2015), determined the total number of aerobic mesophilic bacteria as 8 log cfu / g in the samples he

obtained by using saffron and St. John's wort in ice cream production, and found quite higher values than our results. The difference here may be due to the plant extract used, its composition, the amount of bioactive ingredient it contains, especially the amount of hyperforin. In addition, the year, location, climatic conditions, altitude difference, the parts of the plant used for extraction and extraction methods affect the antimicrobial properties of the plant. In addition, if examined on a product basis, ayran is an acidic product and structurally, it is completely different from ice cream. The amount of secondary components used in ice cream production is quite high and this causes an increase in microbial load. Coliform group and yeast development could not be observed in any of the samples used in our study. This is an indication that the raw material, extract, production and storage conditions used are completely hygienic and a healthy functional dairy product is produced.

Ekici (1998), in a study examining the microbiological and chemical quality of ayran, found the number of yeast and mold between log 4 - 7.14 log cfu/ mL, and Aydemir (2015), found the average number of yeast and mold to log 5 cfu / g. Yeast and mold development was not observed in the samples used in our study, both at the beginning and at the end of storage, and our samples are quite healthy and microbiologically safe products within the limits given in the Microbiological Criteria Communiqué. Adding *Hypericum perforatum* to our drinking yoghurt samples has reduced the bacterial load and it is very advantageous for safe food production.

3.7. Sensory Analyses

The results in sensory analyses of our drinking yoghurt samples were indicated in the Table 4.

In the sensory analysis (Table 4), when looking at the color and appearance, texture – consistency, taste – aroma scores, the control group received the highest scores, followed by P1 (Drinking yoghurt containing 1% *Hypericum perforatum* extract) sample. As the amount of extract added increases, sensory scores decrease. After the control, the most admired P1 sample got higher scores at the end of the storage in terms of taste – aroma and general taste compared to the beginning of the storage. At the end of the 28 days of storage, while the P1 sample got the same score as the control group, according to their taste and aroma scores; it was preferred by the consumers by getting higher scores than control in structure – consistency and general taste scores. With storage, the interaction of drinking yoghurt, which is a fermented dairy product and extract has increased, and at the end of the storage, a popular product has been obtained for the consumer. However, the increase in the amount of extract caused the scores to decrease, as it was out of the traditional habits of the consumer in general.

Table 4. Change in sensory properties of drinking yoghurt samples during storage.

		Samples			
Sensory analyses	**Storage days**	**K**	**P1**	**P2**	**P3**
	1st	$4.71^{Aab} \pm 0.48$	$3.71^{Bb} \pm 0.75$	$3.28^{Bb} \pm 0.75$	$3.00^{Bbc} \pm 0.57$
	7th	$5.00^{Aa} \pm 0.00$	$4.14^{Bab} \pm 0.37$	$3.28^{Cb} \pm 0.75$	$2.71^{Cc} \pm 0.75$
Color and appearance	**14th**	$5.00^{Aa} \pm 0.00$	$4.57^{ABa} \pm 0.53$	$3.85^{BCab} \pm 0.69$	$3.28^{Cabc} \pm 1.11$
	21st	$4.42^{ABbc} \pm 0.53$	$4.71^{Aa} \pm 0.48$	$4.00^{Bab} \pm 0.57$	$3.85^{Ba} \pm 0.37$
	28th	$4.00^{Ac} \pm 0.57$	$3.85^{Ab} 7 \pm 0.37$	$4.14^{Aa} \pm 0.37$	$3.71^{Aab} \pm 0.48$
	1st	$4.85^{Aa} 7 \pm 0.37$	$4.42^{ABa} \pm 0.78$	$3.71^{Ba} \pm 1.11$	$3.42^{Ba} \pm 1.13$
	7th	$5.00^{Aa} \pm 0.00$	$4.28^{ABa} \pm 0.75$	$4.00^{Ba} \pm 0.81$	$3.85^{Ba} \pm 1.06$
Texture – consistency	**14th**	$4.85^{Aa} \pm 0.37$	$4.42^{ABa} \pm 0.53$	$4.42^{ABa} \pm 0.78$	$3.85^{Ba} \pm 1.06$
	21st	$4.28^{Ab} \pm 0.48$	$4.14^{Aa} \pm 0.89$	$4.14^{Aa} \pm 1.06$	$4.14^{Aa} \pm 0.89$
	28th	$3.85^{Ab} \pm 0.69$	$4.14^{Aa} \pm 0.69$	$4.00^{Aa} \pm 0.81$	$3.71^{Aa} \pm 0.95$
	1st	$4.57^{Aab} \pm 0.78$	$3.28^{Ba} \pm 1.25$	$2.71^{Bb} \pm 1.11$	$3.00^{Ba} \pm 1.15$
	7th	$4.85^{Aa} \pm 0.37$	$3.85^{ABa} \pm 1.21$	$3.14^{Bab} \pm 1.06$	$3.28^{Ba} \pm 1.13$
Taste – aroma	**14th**	$4.28^{Aabc} \pm 0.48$	$3.85^{ABa} \pm 0.69$	$3.28^{BCab} \pm 0.75$	$2.57^{Ca} \pm 0.97$
	21st	$3.85^{Ac} \pm 0.69$	$3.71^{Aa} \pm 0.48$	$3.28^{Aab} \pm 0.95$	$3.28^{Aa} \pm 0.75$
	28th	$4.00^{Abc} \pm 0.57$	$4.00^{Aa} \pm 0.00$	$3.85^{Aa} \pm 0.37$	$3.14^{Ba} \pm 0.69$
	1st	$4.57^{Aa} \pm 0.53$	$3.57^{Ba} \pm 0.53$	$3.28^{Ba} \pm 0.48$	$2.71^{Ca} \pm 0.48$
	7th	$4.71^{Aa} \pm 0.48$	$4.00^{ABa} \pm 1.00$	$3.57^{ABa} \pm 1.27$	$3.28^{Ba} \pm 1.38$
General taste	**14th**	$4.42^{Aa} \pm 0.53$	$4.14^{Aa} \pm 0.69$	$3.28^{Ba} \pm 0.75$	$2.85^{Ba} \pm 0.89$
	21st	$4.28^{Aab} \pm 0.48$	$3.71^{ABa} \pm 0.75$	$3.71^{ABa} \pm 1.11$	$3.14^{Ba} \pm 0.69$
	28th	$3.71^{ABb} \pm 0.75$	$4.14^{Aa} \pm 0.37$	$3.14^{BCa} \pm 0.37$	$2.85^{Ca} \pm 0.69$

*: mean standard ± deviation.
A-C: For drinking yoghurt samples, the capital letters on the same line are comparable and the same letters show no statistical difference between the samples. (P> 0.05)
a-c: The lower case letters in the same column are the comparison of the storage times and the same letters show that there is no statistical difference between the samples. (P> 0.05)
K: Control drinking yoghurt, P1: Drinking yoghurt produced by adding 1 % H. scabrum extract, P2: Drinking yoghurt produced by adding 2 % H. scabrum extract, P3: Drinking yoghurt produced by adding 3 % H. scabrum extract

4. CONCLUSION

In our study, *Hypericum perforatum* extract was added to drinking yoghurt, thus an alternative and healthy functional product was obtained. Whether *Hypericum perforatum*, which is not widely used in foods, is suitable for use in ayran has been demonstrated with scientific data. The drinking yoghurt samples obtained were evaluated in terms of physicochemical and

microbiology and presented to the consumer. In addition, the sensory properties of *Hypericum perforatum* were investigated and in case such a product was produced, a demand for the product was tried to be determined. The effects of the plant on the product and shelf life during the storage period were determined and evaluated by storing longer than the normal storage period. As a result, a product that is microbiologically safe and received high scores from consumer appreciate at the end of storage was obtained. Considering the antimicrobial properties of the plant, the fact that it can be used especially in products that have a microbial risk and have a long storage time becomes clear. This plant, which is very valuable in terms of its components, grows spontaneously in nature and can be used in industrial products without any cost in order to benefit from its antimicrobial properties. This kind of herbs can be used not only as tea but also as natural additives in food formulations.

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CONFLICT OF INTEREST

The authors of the article declare that there is no conflict of interest between them.

AUTHOR CONTRIBUTION

The authors declare that they have contributed equally to the article.

REFERENCES

Akçay F, 2016. Spicy Ayran Production and its Some Properties (Master's Thesis). Available from Council of Higher Education and Theses database. (Thesis No. 449278)

Ali, S. M., Chee, S. K., Yuen, G. Y., & Olivo, M. (2001). Hypericin and hypocrellin induced apoptosis in human mucosal carcinoma cells. *Journal of Photochemistry and Photobiology B: Biology*, *65*(1), 59-73.

Al-Kadamany, E., Toufeili, I., Khattar, M., Abou-Jawdeh, Y., Harakeh, S., & Haddad, T. (2002). Determination of shelf life of concentrated yogurt (Labneh) produced by in-bag straining of set yogurt using hazard analysis. *Journal of Dairy Science*, *85*(5), 1023-1030.

Anonym. 1982. Türk Standartları. Ayran, T.S. 3810. TSE, Necatibey Cad. Bakanlıklar, Ankara

Anonym, Enstitüsü, T. S. (1996). Süt ve Süt Ürünleri-Küf ve Mayaların Koloni Oluşturan Birimlerinin Sayımı-25 ºC'de Koloni Sayım Tekniği. TS ISO, 6611.

Anonym, Kodeksi, T. G. (2000). Çiğ Süt ve Isıl İşlem Görmüş İçme Sütleri Tebliği. Resmi Gazete, 14, 23964.

Anonym, Gıda, T., & Bakanlığı, H. (2009). Türk Gıda Kodeksi Fermente Süt Ürünleri Tebliği. Gıda, Tarım ve Hayvancılık Bakanlığı, Ankara, Türkiye, 25, 2009.

Anonym, (2014). Fonksiyonel Gıda Tanımı, Retrieved January 10, 2014 from http://www.dilekboyacioglu.com/ Fonksiyonel Gidalar Roportaj.pdf. Hagerman, A. E. (2002).

Atamer, M., Gürsel, A., Tamuçay, B., Gençer, N., Yıldırım, G., Odabaşı, S., & Kırdar, S. (1999). Dayanıklı Ayran üretiminde pektin kullanım olanakları üzerine bir araştırma. *Gıda, 24*(2).

Avsar, Y. K., Karagul-Yuceer, Y., Tamucay, B., Kocak, C., & White, C. H. (2001). A comparative study on the production methods of Ayran, traditional drinking yogurt of Turks. In 2001 IFT Annual Meeting Technical Program, Book of Abstracts (No. 15C-1).

Aydemir, K. (2015). Use of st john's wort (*Hypericum perforatum* L.) extract in the production of ice cream (Master's Thesis). Available from Council of Higher Education and Theses database. (Thesis No. 425832)

Barış, D., Kızıl, M., Aytekin, Ç., Kızıl, G., Yavuz, M., Çeken, B., & Ertekin, A. S. (2011). In vitro antimicrobial and antioxidant activity of ethanol extract of three Hypericum and three Achillea species from Turkey. *International Journal of Food Properties, 14*(2), 339-355.

Barnes, J., Anderson, L. A., & Phillipson, J. D. (2001). St John's wort (*Hypericum perforatum L.*): a review of its chemistry, pharmacology and clinical properties. *Journal of Pharmacy and Pharmacology*, *53*(5), 583-600.

Bayram, E., Kırıcı, S., Tansi, S., Yılmaz, G., Kızıl, O. A. S., & Telci, İ. (2010). Tibbi ve aromatik bitkiler üretiminin arttirilmasi olanaklari. TMMOB Ziraat Mühendisleri Odasi, Ziraat Mühendisligi VII. Teknik Kongresi (2010), 11-15.

Baytop, T. (1999). Türkiye'de bitkiler ile tedavi: geçmişte ve bugün. Nobel Tıp Kitabevleri.

Blank, M., Mandel, M., Keisari, Y., Meruelo, D., & Lavie, G. (2003). Enhanced ubiquitinylation of heat shock protein 90 as a potential mechanism for mitotic cell death in cancer cells induced with hypericin. *Cancer Research*, *63*(23), 8241-8247.

Bölükbaşı, B. (2007). A research on the isolation of lactic acid bacteria from yoğurt samples taken from different villages of Trakya region, definition of their EPS (exopolysaccharide) producing ability and choosing their best combination for ayran production (Master's Thesis). Available from Council of Higher Education and Theses database. (Thesis No. 216568)

Buonopane, A. & Petrakis, I. L. (2005). Pharmacotherapy of alcohol use disorders, Subst. Use Misuse., 40 (13-14), 2001-2020.Cass, H. (1997). St. John's Wort: Nature's Blues Buster. Avery.

Chrea, B., O'Connell, JA, Silkstone-Carter, O., O'Brien, J. ve Walsh, JJ (2014). Doğanın hafif ila orta dereceli depresyon için antidepresanı: Standartlaştırılmış bir St.John's wort (*Hypericum perforatum*) özünden hiperforinin izolasyonu ve spektral karakterizasyonu. *Kimyasal Eğitim Dergisi, 91*(3), 440-442.

Colasanti, A., Kisslinger, A., Liuzzi, R., Quarto, M., Riccio, P., Roberti, G., ... & Villani, F. (2000). Hypericin photosensitization of tumor and metastatic cell lines of human prostate. *Journal of Photochemistry and Photobiology B: Biology, 54*(2-3), 103-107.

Coskun, I., Tayfun Uzbay, I., Ozturk, N., & Ozturk, Y. (2006). Attenuation of ethanol withdrawal syndrome by extract of *Hypericum perforatum* in Wistar rats. *Fundamental & Clinical Pharmacology, 20*(5), 481-488.

Coutinho, N. M., Silveira, M. R., Rocha, R. S., Moraes, J., Ferreira, M. V. S., Pimentel, T. C., & Cruz, A. G. (2018). Cold plasma processing of milk and dairy products. *Trends in Food Science & Technology, 74*, 56-68.

D'Hallewin, M. A., Bezdetnaya, L., & Guillemin, F. (2002). Fluorescence detection of bladder cancer: a review. *European Urology, 42*(5), 417-425.

Dilek, S. A. Y., Saydam, İ. B., & Güzeler, N. (2018). Some properties of ayran fortified with black carrot powder. *Journal of Advances in VetBio Science and Techniques, 3*(3), 54-60.

Duke, J. A. (2002). Handbook of medicinal herbs. CRC press.

Düzgüner, V., & Erbil, N. (2020). Ardahan Yöresinde Yetişen Kılıç Otu Bitkisinin (*Hypericum perforatum*) Antimikrobiyal ve Antioksidan Etkilerinin Araştırılması. *Türk Tarım ve Doğa Bilimleri Dergisi, 7*(1), 27-31.

Ekici, K. (1998). Van'da açık olarak tüketime sunulan ayranların mikrobiyolojik ve kimyasal kalitesi. *Yüzüncü Yıl Üniversitesi Veteriner Fakültesi Dergisi, 9*(1), 57-58.

Ernst, E. (Ed.). (2003). Hypericum: the genus Hypericum. CRC Press.

Francis, A. J. P. (2005). Antidepressant action of St. John's Wort, *Hypericum perforatum*: a test of the circadian hypotheses. *Phytomedicine, 12*(3), 167-172.

Harrigan, W. F. (1998). Laboratory Methods In Food Microbiology. Academic Press Limited.

Hölzl, J., & Petersen, M. (2003). Chemical constituents of Hypericum ssp. Hypericum: the genus Hypericum, 78.

Kaçar, O., & Azkan, N. (2004). Sarı Kantaron'da (*Hypericum perforatum L.*) Hiperisin ve Üst Drog Herba Verimi ile Bazı Morfolojik ve Agronomik Özellikler Arasındaki İlişkiler. *Uludag. Üniv. Zir. Fak. Derg, 18*(2), 109-122.

Kezer, G. (2013). Effects of fat replacers on kefir? s physicochemical, microbial and sensorial properties which produced mix of cow and goats milk (Master's Thesis). Available from Council of Higher Education and Theses database. (Thesis No. 334893)

Kuş, H. (2010). The production of probiotic ayran using human orginated probiotic bacteria (Master's Thesis). Available from Council of Higher Education and Theses database. (Thesis No. 268614)

Linde, K., Ramirez, G., Mulrow, C. D., Pauls, A., Weidenhammer, W., & Melchart, D. (1996). St John's wort for depression—an overview and meta-analysis of randomised clinical trials. *Bmj, 313*(7052), 253-258.

Linde, K., & Knüppel, L. (2005). Large-scale observational studies of hypericum extracts in patients with depressive disorders—a systematic review. *Phytomedicine, 12*(1-2), 148-157.

Martarelli, D., Martarelli, B., Pediconi, D., Nabissi, M. I., Perfumi, M., & Pompei, P. (2004). *Hypericum perforatum* methanolic extract inhibits growth of human prostatic carcinoma cell line orthotopically implanted in nude mice. *Cancer Letters, 210*(1), 27-33.

Mazza, G. (1998). Herbs, botanicals and teas (No. 635.7 M4587h Ej. 1 017811). CRC Press,.

Mills, S., & Bone, K. (2000). Principles and practice of phytotherapy. Modern herbal medicine. Churchill Livingstone.

Orhan, IE, Kartal, M., Gülpinar, AR, Cos, P., Matheeussen, A., Maes, L. ve Tasdemir, D. (2013). *Hypericum perforatum*'un zeytinyağı maserat örneklerinin antimikrobiyal ve antiprotozoal aktivitesinin değerlendirilmesi ve LC-DAD-MS analizleri. *Gıda Kimyası, 138*(2-3), 870-875.

Özgür Devrim, C.A.N. (2009). Doğal Bir Antidepresan: *Hypericum perforatum* L. *Turkiye Klinikleri J Med Sci, 29*(3), 708-15.

Patır, B., Öksüztepe, G., Şeker, P., & Dikici, A. (2006). Elazığ'da tüketime sunulan açık ayranlar ile orijinal ambalajlı ayranların mikrobiyolojik ve kimyasal kalitesi. *Fırat Üniversitesi Sağlık Bilimleri Veteriner Dergisi, 20*(5), 357-363.

Rezvani, A. H., Overstreet, D. H., Yang, Y., & Clark Jr, E. (1999). Attenuation of alcohol intake by extract of *Hypericum perforatum* (St John's Wort) in two different strains of alcohol-preferring rats. *Alcohol and Alcoholism, 34*(5), 699-705.

Saltoğlu, S. B., (2014). The use of bioactive extracts from isabella grape by novel technologies in ayran production (Master's Thesis). Available from Council of Higher Education and Theses database. (Thesis No. 374118)

Schepetkin, I. A., Özek, G., Özek, T., Kirpotina, L. N., Khlebnikov, A. I., & Quinn, M. T. (2020). Chemical composition and immunomodulatory activity of *Hypericum perforatum* essential oils. *Biomolecules, 10*(6), 916.

Seçkin, A. K., & Baladura, E. (2011). Süt ve Süt Ürünlerinin Fonksiyonel Özellikleri-Functional Properties of Milk and Dairy Products. *Celal Bayar Üniversitesi Fen Bilimleri Dergisi, 7*(1), 27-38.

Seyrekoğlu, F., & Temiz, H. (2020). Effect of Extraction Conditions on the Phenolic Content and DPPH Radical Scavenging Activity of *Hypericum perforatum* L. *Turkish Journal of Agriculture-Food Science and Technology, 8*(1), 226-229.

Sevilmiş, G. (2013). Yükselen Trend: Fonksiyonel Gıdalar. *Ar&Ge Bülten*, 39.

Souza, S. O., Santos, V. S., Santos, E. S., Ávila, D. V. L., Nascimento, C. C., Costa, S. S. L., & Araujo, R. G. O. (2018). Evaluation of the mineral content in milk and yogurt types using chemometric tools. *Microchemical Journal, 143*, 1-8.

Spss, I. I. B. M. (2011). IBM SPSS statistics for Windows, version 20.0. New York: IBM Corp, 440.

Şanlı, T., Sezgin, E., Şenel, E., & Benli, M. (2011). Geleneksel yöntemle ayran üretiminde transglutaminaz kullanımının ayranın özellikleri üzerine etkileri. *Gıda, 36*(4), 217-224.

Şeker, P., & Patır, B. (2011). Kısa ve uzun ömürlü ayranlarda potasyum sorbat uygulamasının mikrobiyolojik kaliteye etkisi. *FÜ Sağ Bil Vet Derg, 25*, 23-30.

Taş, T., (2005 Determination of effects of using fat replacers on ayran quality (Master's Thesis). Available from Council of Higher Education and Theses database. (Thesis No. 197829)

Temen, Y., (2018). Ayran with quinoa flour and its properties (Master's Thesis). Available from Council of Higher Education and Theses database. (Thesis No. 531398)

Tilki, PF (2008). Süt: genel bakış. İçinde süt proteinleri (s. 1-54). Akademik Basın.

Tümen, G., & Sekendiz, O. A. (1989). Balıkesir ve merkez köylerinde halk ilacı olarak kullanılan bitkiler. Uludağ Üniversitesi Araştırma Fonu, Proje, (86/12).

Uzbay, I. T., Kayir, H., Coskun, I., Ozturk, N., & Ozturk, Y. (2005). St John's wort blocks caffeineinduced locomotor activity in mice. *World. J. Biol. Psychiat*, *6*, 310-311..

Uzbay, T., Kayır, H., Erşen, G., Öztürk, N., & Öztürk, Y. (2006). Extract of *Hypericum perforatum* blocks nicotine-induced locomotor activitiy in mice.

Uzbay, I. T., Coskun, I., Kayir, H., Ozturk, N., & Ozturk, Y. (2007). Extract of *Hypericum perforatum* blocks caffeine-induced locomotor activity in mice: a possible role of nitric oxide. *Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives*, *21*(5), 415-419.

Uzbay, I. T. (2008). Serotonergic anti-depressants and ethanol withdrawal syndrome: a review. *Alcohol & Alcoholism*, *43*(1), 15-24.

Wichtl, M. (1986). *Hypericum perforatum* L. das Johanniskraut. *Zeitschrift Phytother*, *3*, 87-90.

Xu, B. J., Zheng, Y. N., & Sung, C. K. (2005). Natural medicines for alcoholism treatment: a review. *Drug and Alcohol Review*, *24*(6), 525-536.

Zeybek, N., & Zeybek, U. (1994). Farmasötik botanik. *Ege Üniversitesi, Eczacılık Fakültesi Yayınları*, (2).