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Professional paper

BENEFITS OF TEAS AND PROBIOTIC PROFILE AT SPECIFIC STAGES OF EMBRYONIC DEVELOPMEN IN CHICKEN EGGS

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Abstract

Introduction: The Sharr Mountain is characterized by a highly expressed biological diversity, with a particular endemism and a wide spectrum of various types of flora characteristic of this mountainous massif. Plants with nutritional and health benefits can be considered species such as: mountain tea (Sideritis scardica) and St. John's wort (Hypericum perforatum), etc. These bioproducts are characterized by special importance both in terms of their presence, quality, and health benefits. Therefore, exploration of these species would have positive cost for consumption as forms of teas or plant extracts for commercial purposes, but also for health benefits and above all for the population of the country, the region, and beyond.
Research Objective: This study aims to investigate the probiotics and the effect of plant extract teas such as mountain tea (Sideritis scardica) and St. John's wort (Hypericum perforatum) by applying a specific dose of extract to chicken embryos at different stages of ontogenesis.
Materials and Methods: Fertilized chicken eggs were taken for the study and were incubated in an incubator for 21 days. The eggs were treated with species such as mountain tea (Sideritis scardica) and St. John's wort (Hypericum perforatum) at certain stages of embryonic development. The eggs were opened on the seventh, fourteenth, and twenty-first day. Macroscopic and microscopic changes at certain stages of embryonic development were analyzed using stereomicroscope.The effect of the extract of these teas was studied on the chicken embryos (Gallus domesticus), by applying a specific dose of extract to the chicken embryos at different stages of embryonic development during ontogenesis.
Research Results: The dose given in the form of extract has resulted in positive benefits of these teas as effective probiotics during certain stages of embryonic development in chicken embryos.
Conclusions: This research will explore the effect of the given dose of plant extracts at certain stages of embryonic development during ontogenesis to observe the benefits of dose administration at specific quantities and times to detect the positive effect of these teas.

Keywords: Benefits of teas, Sideritis scardica, effective doses, Gallus domesticus, stages of ontogenesis.

1. Introduction

The Sharr Mountain is characterized by its geographical peculiarities and biological diversity, with a wide range of its authentic flora and fauna. Plant species found exclusively in the Sharr massif have various medicinal and nutritional values. Within the project, species such as St. John's wort (Hypericum perforatum), Sideritis (Sideritis scardica), Chamomile (Matricaria chamomilla), and Peppermint (Mentha piperita) have been studied from abiochemical aspect. The use of these teas and more dates back for a long time, however, recent data has been found for their medicinal properties, as a form of herbal supplements.
The effect of probiotics extracted from the mentioned plants has been studied in chicken eggs (Gallus domesticus), at different stages of embryogenesis, by applying precise doses directly to the embryo at the first stage of ontogenetic development.
The main objective of this study is to investigate the positive and negative effects of teas on embryonic development in chicken eggs.

- What are probiotics& their use in embryonic development

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Probiotics are defined as live microorganisms that, when administered in adequate amounts, confer a health benefit on the host (Hill C et al., 2014).
In non-pregnant individuals, probiotics have been shown to support a healthy gut and digestive tract, including in the treatment or prevention of Clostridium difficile-associated diarrhoea (Goldenberg JZ et al., 2017), irritable bowel syndrome (Didari T et al., 2015), abdominal pain and bloating (Ritchie ML et al., 2012), and necrotizing enterocolitis (AlFaleh K et al., 2014). Additionally, probiotics may provide health benefits in pregnancy, such as the prevention of gestational diabetes (Chen X et al., 2019), mastitis (Fernandez L et al., 2016), constipation (Mirghafourvand M et al., 2016), post-partum depression (Slykerman R.F et al., 2017), and growth of B Streptococcus bacteria (Ho M et al., 2016).
In a recent meta-analysis, probiotic consumption during pregnancy and/or lactation was shown to be generally safe for pregnant mothers in terms of gastrointestinal symptoms, tachycardia, vaginal discharge, eczema, and headache (Sheyholislami H et al., 2021).
Despite potential benefits, there remains uncertainty about the effectiveness of probiotics, prebiotics, and synbiotics for human health, largely because many studies do not consider that the effects are likely strain, dose, and condition specific, and an individual's response to an intervention may be unique, in part determined by their health status, age, and composition of their gut microbiome (Van Baarlen P et al., 2011).
The administration of probiotics in pregnant women is crucial in providing long-lasting health benefits to mothers and their offspring (Parvirti Dhillon et al., 2020).

- Sideritis scardica – origin and use

There are more than 150 species in the genus Sideritis, which is a member of the Lamiaceae family, growing primarily in mountainous regions, with the majority located in the Mediterranean countries and Macaronesia. The genus name comes from the Greek word for iron, "sideros", since these species were used in the ancient era to treat battle wounds caused by iron weapons. Its well-known health-beneficial properties led to its use in traditional medicine (Gonzalez-Burgos E et al., 2011).
Sideritis scardica, with the alias "mountain tea", is a medicinal, aromatic plant commonly used in Mediterranean countries to prepare medicinal herbal infusions. Mountain tea has a long tradition of usage in the Balkans ethnomedicine for treating the common cold and gastrointestinal disorders, while it is thought to maintain antioxidant and anti-inflammatory properties [(Lakka A et al., 2021), (Zyzelewicz D et al., 2020), (Dina E et al., 2022)].
Hydroalcoholic extracts inhibit the reuptake of serotonin, noradrenaline, and dopamine. Therefore, they can potentially be used in treating neurotransmiter imbalances associated with various mental disorders (Knörle R et al., 2012).

- Hypericum perforatum

As in all herbal medicines, Hypericum perforatum is considered innocuous and widely used against depression, and even women who are pregnant or lactating are also exposed to Hypericum perforatum (Deligiannidis KM et al., 2014). However, the effects of its use on gestation have yet to be clarified (HMPC et al., 2018).
Hypericum perforatum has recently received interest as a herbal product that has anti-inflammatory and antiviral properties, and is effective for wound healing, inflammatory bowel disease, and depression [(Kaçar O et al., 2005), (Monograph, Hypericum perforatum 2004)].

2. Materials and Methods

For the study, three groups of 22 chicken eggs each were taken, where the first group served as control samples, the second group consisted of experimental eggs injected with extracts of Sideritis (Sideritis scardica), St. John's wort (Hypericum perforatum), Peppermint (Mentha piperita), and Chamomile (Matricaria chamomilla), and the third group consisted of

experimental eggs injected with extracts of St. John's wort (Hypericum perforatum) and Sideritis (Sideritis scardica).
After selecting the fertilized eggs, which were examined using fluorescent light, the eggs were injected with the aforementioned probiotics.
The plant specimens were collected from the Sharr massif, in regions such as Vakuf, Karabunar, Uliveric, and Luboten. The common characteristic of the mentioned regions is their average altitude of 1700 m.
After collection, the plants underwent a drying process and then were ground using a Primax apparatus.
Two methods were used for the extraction of the teas Peppermint (Mentha piperita), St. John's wort (Hypericum perforatum), Sideritis (Sideritis scardica), and Chamomile (Matricaria chamomilla): the first with a Rota Bucher apparatus, which extracts the teas in a liquid state as a plant extract, and the second with the tea brewing technique.

3. Results

In the following table, the data of the experiment are presented, specifically the weight, temperature, and humidity of the eggs injected only with specimens: Sideritis (Sideritis scardica) and St. John's wort (Hypericum perforatum) which were extracted using the brewing method, and were injected with precise doses of 0.2 ml into the air chamber of the chicken eggs.

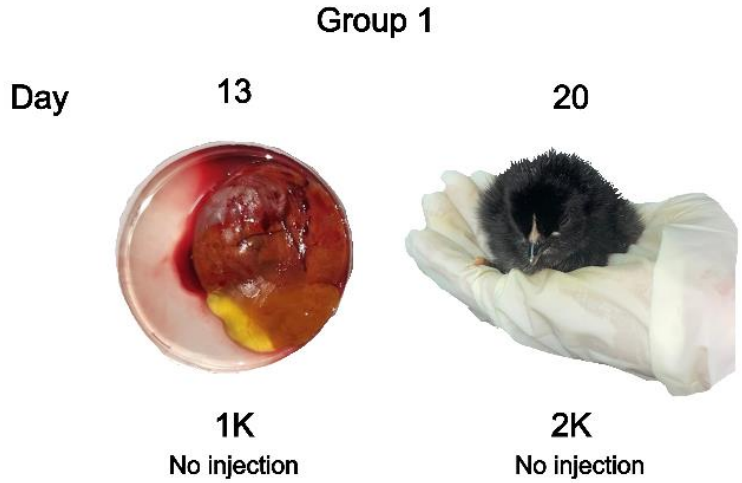

Figure 1. 1K on day 13 and 2K on day 20. As expected, normal embryonic development is clear and distinct macroscopically.

Table 1. Determination of weight (gr), day of hatching and status of embryonal growth of 24 chicken eggs.

Nr.	Egg	Weight 1st week	Weight 2nd week	Weight 3rd week	Hatching of eggs	Temp.	Humidity
1	1K	56.4	54.3	54.1	Yes	37.5 C	88%
2	2K	Early hatch	Early hatch	Early hatch	Yes	37.5 C	88%
3	1E	Early hatch	Early hatch	Early hatch	No	37.5 C	88%
4	2E	Early hatch	Early hatch	Early hatch	No	37.5 C	88%
5	3E	Early hatch	Early hatch	Early hatch	No	37.5 C	88%
6	4E	68.2 gr	Early hatch	Early hatch	No	37.5 C	88%
7	5E	54.6 gr	Early hatch	Early hatch	No	37.5 C	88%
8	6E	60.1 gr	Early hatch	Early hatch	No	37.5 C	88%
9	7E	57.6 gr	Early hatch	Early hatch	No	37.5 C	88%
10	8E	64.1 gr	61.6 gr	Early hatch	No	37.5 C	88%
11	9E	59.1 gr	57.6 gr	Early hatch	No	37.5 C	88%
12	10E	58.3 gr	52.0 gr	Early hatch	Yes	37.5 C	88%
13	11E	61.5 gr	59.6 gr	Early hatch	No	37.5 C	88%

14	12E	65.0 gr	63.2 gr	54.1 gr	No	37.5 C	88%
15	13E	62.9 gr	60.8 gr	58.7 gr	No	37.5 C	88%
16	14E	65.4 gr	63.2 gr	60.7 gr	No	37.5 C	88%
17	15E	60.8 gr	58.9 gr	56.9 gr	No	37.5 C	88%
18	16E	53.8 gr	52.2 gr	50.2 gr	Yes	37.5 C	88%
19	17E	60.8 gr	58.2 gr	57.3 gr	No	37.5 C	88%
20	18E	49.2 gr	47.4 gr	45.4 gr	Yes	37.5 C	88%
21	19E	61.7 gr	59.6 gr	57.9 gr	No	37.5 C	88%
22	20E	70.6 gr	68.3 gr	65.7 gr	Yes	37.5 C	88%
23	21E	56.7 gr	54.7 gr	52.5 gr	Yes	37.5 C	88%
24	22E	59.2 gr	57.6 gr	55.1 gr	Yes	37.5 C	88%

From the experiment, we conclude that the combination of probiotics Sideritis (Sideritis scardica) and Chamomile (Matricaria chamomile) has yielded positive results in the embryonic development of chicken eggs. However, a negative effect on organogenesis has been observed in the chicken eggs with the use or insertion of the probiotic extracted from Sideritis (Sideritis scardica) and St. John's wort (Hypericum perforatum). These changes have been observed at certain stages of embryonic development, which have been documented from day one until day 21, throughout the incubation process of the eggs.
The eggs injected with different combinations of probiotics have yielded varying results in embryonic development aspects. The first combination, Sideritis (Sideritis scardica) and Chamomile (Matricaria chamomile), has resulted in the following outcomes: It has stimulated organogenesis and ontogenetic stages of embryonic development in the chicken eggs. Whereas the second combination, Sideritis (Sideritis scardica) and St. John's wort (Hypericum perforatum), has resulted in total stagnation of embryonic development in the chicken eggs.

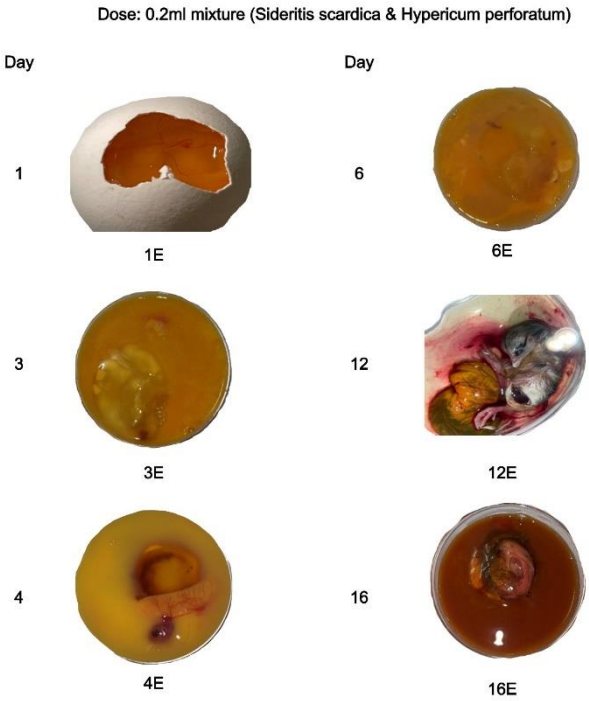

Figure 2. Embryonic development of control eggs on different monitoring days.

- Day 1: In egg 1E, it is clearly observed that that the cardiovascular system (heart pulsations) is more developed compared to the control group.
- Day 3: In egg 3E, the experimental egg shows clear differentiation into 2 blastomeres and pronounced and advanced cleavage.

- Day 4: In egg 4E, differentiation and heart pulsation are clearly visible, the amniotic membrane is growing, the shape of the embryo is distinct, and differentiation of the head and differentiation of the eyes and blood vessels are well defined.
- Day 6: In egg 6E, differentiation of the heart and pronounced vascularization of the blood vessels are visible, but the development has stagnated.
- Day 12: In egg 12E, clear differentiation of the fetus, approximately **3 cm** in size, and the embryo begins to move, with differentiation of the extremities. This embryo is very well developed, compared to control groups.
- Day 16: In egg 16E,clear differentiation of the fetus at a size of **8 cm** is visible, with the yolk sac greatly reduced, and in more advanced stages, differentiation of the extremities and other organs is observed, as seen in the head, body, and extremities.
- Day 19: In egg 19E, clear differentiation of the fetus at a size of **10 cm** is visible, with a greatly reduced amnion, and in more advanced stages, differentiation of the extremities and other organs is observed. There is a more advanced differentiation of these organs compared to the control group, as seen in the differentiation of the head, body, and extremities.

4. Discussions

Commercially produced chickens, together with other poultry species, have become key food-producing animals within the global food system. Both egg and meat-type chickens provide easily achievable and affordable animal protein, which is particularly important for food security in developing countries. An increase in global food production is critical to meet the demand of the rapidly growing human population. The recent prognosis for overall growth in agriculture is expected to be between 25 and 70% by 2050 compared to current production rates (Hunter MC et al., 2017). Poultry production is predicted to double worldwide, especially in developing countries, which will require further intensification of the chicken food chain (Aleksandratos, Bruinsma 2012). These increased production rates will be accompanied by serious quality adjustments, mainly in animal welfare and food safety. For this reason, anti-antibiotic strategies will continue, and the introduction of prebiotic and/or probiotic preparations will be in demand as safe and efficient methods to improve food production in a manner called “sustainable intensification.” Meeting all these challenges in the future will be possible with the further development of technologies of precision livestock farming for egg (Xin H, Liu K 2017) and meat (Mollo V.Okano 2009) poultry production.
Use of probiotics has been researched in many studies.
Necrotizing enterocolitis is a complex, multi-factorial disease. The primary predisposing factor for necrotizing enterocolitis is prematurity, which is associated with 1) immature mucosal barrier development, 2) altered barrier responses associated with increased susceptibility to inflammation and loss of epithelial integrity; and 3) abnormal intestinal microbiota patterns [(Claud EC et al., 2013), (Clark JA et al., 2006)]. Currently, approaches to prevent necrotizing enterocolitis have become a focus of research efforts. One of these approaches is to manipulate the intestinal microbiota by bolstering the growth of beneficial microbes. Probiotics are one potential way to achieve this aim [(Bron PA et al., 2011), (Blackwood BP et al., 2017)]. However, many regulators, researchers and clinicians are reluctant to adopt routine administration of probiotics in high risk infants owing to concerns about the quality and efficacy of available probiotic products. In the field of early microbial interactions and infant disease prevention studies, evidence indicates that maternal probiotic supplementation during pregnancy and breastfeeding could be effective in reducing the risk of immune/inflammatory and metabolic diseases in both mother and infants (Rautava S et al., 2012).
Probiotics use on other species is also an interesting topic to touch.

Zebrafish raised with probiotic-supplemented diet showed faster development, with earlier onset of backbone calcification (Avella MA et al., 2012).
Today, the use of probiotics in many cases is difficult because of the low viability of the bacteria after pelleting, during storage as well as problems with feed handling and preparation. Additionally, there is a possibility of environmental issues as probiotics enter into the aquatic ecosystem in flow through systems or in facilities without proper waste treatment (Arkadios Dimitroglou et al., 2011).

5. Conclusions

Our research has focused on the teas of the Sharri mountain range, such as Peppermint (Mentha piperita), St. John's wort (Hypericum perforatum), Scardica (Sideritis scardica), and Chamomile (Matricaria chamomilla), and their impact on the healing and stimulating effects on the body.
Extracts of *Hypericum perforatum L*. (St John's wort) are now successfully competing for status as a standard antidepressant therapy. Because of this, great effort has been devoted to identifying the active antidepressant compounds in the extract. From a phytochemical point of view, St John's wort is one of the best-investigated medicinal plants. A series of bioactive compounds has been detected in the crude material, namely flavonol derivatives, biflavones, proantho-cyanidines, xanthones, phloroglucinols and naphthodianthrones (Butterweck V et al., 2003).
The given dose of 0.5ml of the peppermint and St. John's wort extract solution has caused stagnation in processes during certain stages of embryonic development in both quail and chicken eggs, and in some cases, even total inhibition of organogenesis.
The dose of 0.5 ml of the Scardica and Chamomile extract solution has resulted in normal development, as well as stimulation of processes at certain stages of embryonic development in chicken eggs and pronounced differentiation in organogenesis. This phenomenon indicates that not all types of teas may have positive effects at specific stages of embryonic development, hence further research is warranted on the effect of these species' extracts to verify their stimulating or inhibitory effects. This research could find application in the field of alternative therapy and bio-products in the food industry as an effective product for the production of natural foods as a necessity for preserving food quality and general health. These teas may also serve as supplementary alternative therapy and significantly improve human health, thus finding healing applications in human health.

References

[1] Aleksandratos, Bruinsma. World Agriculture towards 2030/2050: The 2012 Revision. ESA Working Paper No. 12–03. Rome: FAO; 2012. [Ref list]
[2] AlFaleh, K.; Anabrees, J. Probiotics for prevention of necrotizing enterocolitis in preterm infants. Cochrane Database Syst. Rev. 2014, Cd005496.
[3] Arkadios Dimitroglou, Daniel L. Merrifield, Oliana Carnevali, Simona Picchietti, Matteo Avella, Carly Daniels, Derya Güroy, Simon J. Davies. Microbial manipulations to improve fish health and production – A Mediterranean perspective. Fish & Shellfish Immunology,Volume 30, Issue 1, Pages 1-16. 2011. ISSN 1050-4648.
[4] Avella MA, Place A, Du SJ, Williams E, Silvi S, Zohar Y, Carnevali O. Lactobacillus rhamnosus accelerates zebrafish backbone calcification and gonadal differentiation through effects on the GnRH and IGF systems. PLoS One. 2012;7(9):e45572. doi: 10.1371/journal.pone.0045572. Epub 2012 Sep 20. PMID: 23029107; PMCID: PMC3447769.
[5] Blackwood BP, Yuan CY, Wood DR, et al. Probiotic Lactobacillus Species Strengthen Intestinal Barrier Function and Tight Junction Integrity in Experimental Necrotizing Enterocolitis. Journal of probiotics & health 2017;5:159.
[6] Bron PA, van Baarlen P, Kleerebezem M. Emerging molecular insights into the interaction between probiotics and the host intestinal mucosa. Nat Rev Microbiol 2011;10:66–78. pmid:22101918

[7] Butterweck V. Mechanism of action of St John's wort in depression : what is known? CNS Drugs. 2003;17(8):539-62. doi: 10.2165/00023210-200317080-00001. PMID: 12775192.
[8] Chen, X.; Jiang, X.; Huang, X.; He, H.; Zheng, J. Association between Probiotic Yogurt Intake and Gestational Diabetes Mellitus: A Case-Control Study. Iran. J. Public Health 2019, 48, 1248–1256.
[9] Clark JA, Doelle SM, Halpern MD, et al. Intestinal barrier failure during experimental necrotizing enterocolitis: protective effect of EGF treatment. Am J Physiol Gastrointest Liver Physiol 2006;291:G938–49. pmid:16798726
[10] Claud EC, Keegan KP, Brulc JM, et al. Bacterial community structure and functional contributions to emergence of health or necrotizing enterocolitis in preterm infants. Microbiome 2013;1:20. pmid:24450928
[11] Committee on herbal medicinal products (HMPC) draft. EMA/HMPC/244315/2016. Assessment report on Hypericum perforatum L., herba. European Medicines Agency, Science Evaluation Medicines Health for Human Use London; 2018:1–144.
[12] Deligiannidis KM, Freeman MP. Complemantary and alternative medicine therapies for perinatal depression. Best Pract Res Clin Obstet Gynaecol. 2014;28:85–95.
[13] Didari T, Mozaffari S, Nikfar S, Abdollahi M. Effectiveness of probiotics in irritable bowel syndrome: Updated systematic review with meta-analysis. World J Gastroenterol. 2015 Mar 14;21(10):3072-84. doi: 10.3748/wjg.v21.i10.3072. PMID: 25780308; PMCID: PMC4356930.
[14] Dina E., Vontzalidou A., Cheilari A., Bagatzounis P., Agapidou E., Giannenas I., Grigoriadou K., Aligiannis N. Sustainable Use of Greek Herbs By-Products, as an Alternative Source of Biologically Active Ingredients for Innovative Products. Front. Nutr. 2022;9:867666. doi: 10.3389/fnut.2022.867666.
[15] Fernández, L.; Cárdenas, N.; Arroyo, R.; Manzano, S.; Jiménez, E.; Martín, V.; Rodríguez, J.M. Prevention of Infectious Mastitis by Oral Administration of Lactobacillus salivarius PS2 During Late Pregnancy. Clin. Infect. Dis. 2016, 62, 568–573.
[16] Goldenberg JZ, Yap C, Lytvyn L, Lo CK, Beardsley J, Mertz D, Johnston BC. Probiotics for the prevention of Clostridium difficile-associated diarrhea in adults and children. Cochrane Database Syst Rev. 2017 Dec 19;12(12):CD006095. doi: 10.1002/14651858.CD006095.pub4. PMID: 29257353; PMCID: PMC6486212.
[17] González-Burgos E., Carretero M., Gómez-Serranillos M. Sideritis spp.: Uses, chemical composition and pharmacological activities—A review. J. Ethnopharmacol. 2011;135:209–225. doi: 10.1016/j.jep.2011.03.014.
[18] Hill C, Guarner F, Reid G, Gibson GR, Merenstein DJ, Pot B, Morelli L, Canani RB, Flint HJ, Salminen S, Calder PC, Sanders ME. Expert consensus document. The International Scientific Association for Probiotics and Prebiotics consensus statement on the scope and appropriate use of the term probiotic. Nat Rev Gastroenterol Hepatol. 2014 Aug;11(8):506-14. doi: 10.1038/nrgastro.2014.66. Epub 2014 Jun 10. PMID: 24912386.
[19] Ho, M.; Chang, Y.Y.; Chang, W.C.; Lin, H.C.; Wang, M.H.; Lin, W.C.; Chiu, T.H. Oral Lactobacillus rhamnosus GR-1 and Lactobacillus reuteri RC-14 to reduce Group B Streptococcus colonization in pregnant women: A randomized controlled trial. Taiwan J. Obstet. Gynecol. 2016, 55, 515–518.
[20] Hunter MC, Smith RG, Schipanski ME, Atwood LW, Mortensen DA. Agriculture in 2050: recalibrating targets for sustainable intensification. *Bioscience.* 2017;**67**:386–391. doi: 10.1093/biosci/bix010. [CrossRef] [Google Scholar] [Ref list]
[21] Kaçar O, Azkan N. Bursa'da Doğal Florada Bulunan Sarı Kantaron (Hypericum perforatum L.) Populasyonlarında Farklı Yüksekliklerin Hiperisin Oranı Üzerine Etkisinin Belirlenmesi. U. Ü. Ziraat Fakültesi Dergisi. 2005;19:77–89.
[22] Knörle R. Extracts of Sideritis scardica as triple monoamine reuptake inhibitors. J. Neural Transm. 2012;119:1477–1482. doi: 10.1007/s00702-012-0824-9.
[23] Lakka A., Bozinou E., Makris D., Lalas S. Evaluation of Pulsed Electric Field Polyphenol Extraction from Vitis vinifera, Sideritis scardica and Crocus sativus. Chemengineering. 2021;5:25. doi: 10.3390/chemengineering5020025.
[24] Mirghafourvand, M.; Rad, A.H.; Alizadeh, S.M.; Fardiazar, Z.; Shokri, K. The Effect of Probiotic Yogurt on Constipation in Pregnant Women: A Randomized Controlled Clinical Trial. Iran. Red. Crescent Med. J. 2016, 18.
[25] Mollo V. Okano. Precision livestock tools to improve products and processes in broiler production: a review. Braz J. *Poult Sci.* 2009;11:211–218. [Google Scholar] [Ref list]
[26] No authors listed. Monograph. Hypericum perforatum. Altern Med Rev. 2004;9:318–25
[27] Parvirti Dhillon, Kuljit Singh, Kirandeep Kaur. The benefits of probiotic interventions in maternal-fetal health: An appraise review. PharmaNutrition. Volume 13. 2020. 100211. ISSN 2213-4344.

[28] Rautava S, Luoto R, Salminen S, et al. Microbial contact during pregnancy, intestinal colonization and human disease. Nature Reviews Gastroenterology & Hepatology 2012;9:565.
[29] Ritchie ML, Romanuk TN (2012) A Meta-Analysis of Probiotic Efficacy for Gastrointestinal Diseases. PLOS ONE 7(4): e34938.
[30] Sheyholislami H, Connor KL. Are probiotics and prebiotics safe for use during pregnancy and lactation? A systematic review and meta-analysis Nutrients. 2021;13:2382.
[31] Slykerman, R.F.; Hood, F.; Wickens, K.; Thompson, J.M.D.; Barthow, C.; Murphy, R.; Kang, J.; Rowden, J.; Stone, P.; Crane, J.; et al. Probiotic Pregnancy Study, Grp. Effect of Lactobacillus rhamnosus HN001 in Pregnancy on Postpartum Symptoms of Depression and Anxiety: A Randomised Double-blind Placebo-controlled Trial. Ebiomedicine 2017, 24, 159–165.
[32] Van Baarlen, P.; Troost, F.; van der Meer, C.; Hooiveld, G.; Boekschoten, M.; Brummer, R.J.M.; Kleerebezem, M. Human mucosal in vivo transcriptome responses to three lactobacilli indicate how probiotics may modulate human cellular pathways. Proc. Natl. Acad. Sci. USA 2011, 108 (Suppl. 1), 4562–4569.
[33] Xin H, Liu K. Precision livestock farming in egg production. *Anim Front.* 2017;**7**:24. doi: 10.2527/af.2017.0105. [CrossRef] [Google Scholar] [Ref list]
[34] Żyżelewicz D., Kulbat-Warycha K., Oracz J., Żyżelewicz K. Polyphenols and Other Bioactive Compounds of Sideritis Plants and Their Potential Biological Activity. Molecules. 2020;25:3763. doi: 10.3390/molecules25163763.