ROSEHIP TEA AS A PHYTOGENIC ADDITIVE IN BROILERS DRINKING WATER - A REVIEW

M. Stătescu, S. I. Petrescu*, I. M. Pop, P.-C. Boișteanu

"Ion Ionescu de la Brad" Iasi University of Life Sciences, Romania

Abstract

The welfare and productive performance of broiler chickens are influenced by a number of nutritional, microclimatic, and immunological factors that affect nitrogen metabolism, renal function, and intestinal health. Phytotherapy, through the administration of plant substances with antioxidant effects, is a promising strategy for supporting poultry health. This study synthesizes information on the phytochemical composition and biological properties of rosehip extract (Rosa canina), with a focus on its administration in the drinking water of broilers. Active compounds such as vitamin C, flavonoids, tannins, and phenolic acids have antioxidant and antibacterial potential, which can modulate the intestinal microbiota, reduce oxidative stress, and influence nitrogen metabolism, with indirect effects on ammonia emissions. Studies indicate that rosehip tea administration may contribute to maintaining renal function and normal nitrogen excretion, being a natural and safe option for sustainable poultry meat production. Further research is needed to optimize the dose and form of administration, evaluate the impact on productive performance, and elucidate the molecular mechanisms by which the active compounds influence the health and welfare of broilers.

Key words: *Rosehip, renal function, phytotherapy, poultry health*

INTRODUCTION

The welfare and health of birds are influenced by a number of factors, including the level of nitrogen in the body, protein intake expressed as crude protein (CP%) in the diet, the type of rearing system used (including microclimate conditions), and the vaccination schedule and treatments administered. The interaction between these factors determines the physiological and immune response of birds, with a direct impact on productive performance and disease resistance [1].

The excretory system of birds contributes to metabolic homeostasis by eliminating uric acid, accompanied by the release of ammonia. The nitrogen content in excrement reflects protein intake and increases with the age of the birds [2]. Renal function is influenced by nutritional factors, especially hydration, and diseases can worsen these processes through immune and renal dysfunction.

In literature, water management in poultry farming has been insufficiently studied, although water use efficiency is an essential aspect from both an economic and agricultural point of view [3].

Suboptimal housing conditions, characterized by low temperatures and high ambient humidity, can promote frostbite and other peripheral tissue disorders in poultry [4]. Excessive reduction of ventilation in an effort to conserve heat contributes to the accumulation of ammonia, which can cause eye and respiratory damage. Moisture of bird's litter is a major risk factor for dermatitis and ulcerative pododermatitis (bumblefoot), with a negative impact on animal productivity and welfare [5, 6].

* Corresponding author: silvia.petrescu@iuls.ro

The manuscript was received: 15.09.2025
Accepted for publication: 01.11.2025

Increased humidity, along with high ammonia concentrations, aggravates inflammation of the respiratory mucosa through Th1/Th2 imbalance and activation of the NF-κB pathway [7]. Typically, the optimal relative humidity in chicken houses is maintained between 50–65%; higher values increase ammonia release and amplify the toxic effects on bird health.

According to Aloui et al. (2024), there are certain genes in the hypothalamus of broiler chickens whose gene expression is dependent on the environment.

Considering the environmental factors and housing conditions of broilers mentioned above, numerous studies highlight phytotherapy as a promising solution, with the use of phytogenics (functional plant extracts) contributing to the reduction of ammonia emissions by inhibiting the activity of urease, the enzyme responsible for the conversion of urea into ammonia.

MATERIAL AND METHOD

The purpose of this paper is to review the current scientific literature on the phytochemical composition, therapeutic properties, and application potential of rosehip extract (*Rosa canina*) in poultry nutrition, with a focus on its administration in the drinking water of broiler chickens. The paper aims to highlight the proven biological benefits of the active compounds present in Rosa canina, such as vitamin C, flavonoids, and tannins, and to argue for the use of this phytochemical as a natural strategy to support the health, productive performance, and welfare of poultry.

The information was collected from international scientific databases (Web of Science, Google Scholar, ResearchGate, CABI VETMED Resource, ScienceDirect, Elsevier Ebooks, SpringerLink Journals), as well as from relevant sources in the national literature.

In developing the study, 34 scientific papers published between 1997 and 2025 were analyzed, including both classic reference sources and recent research from 2023 to 2025, reflecting current developments in poultry nutrition and health. Papers in both Romanian and English were selected, providing data on the chemical composition of *Rosa canina* fruits, phytotherapeutic applications, and biological effects in birds.

Emphasis was placed on studies evaluating the impact of bioactive compounds in *Rosa canina* on the health of the renal, immune, digestive, and metabolic systems in broiler chickens, as well as on papers dealing with aspects related to phytonutrition and animal welfare.

RESULTS AND DISCUSSIONS

In Romania, the wild rose is an indigenous shrub, with rosehip species found from the Black Sea coast up to 1,700 m in mountainous areas, having a long history well preserved in Romanian folk traditions. It is well known that tea or infusion prepared from rosehip leaves, flowers, and fruits has phytotherapeutic effects in humans after regular administration for at least three months. In the case of birds, a rosehip-based supplement (phytodietary supplement) was administered orally through food, in the form of rosehip powder or flour, rosehip oil [8], prepared from dried fruits, flowers, and rosehip leaves. The rosehip flour analyzed had 92.37% dry matter and the following concentrations: 10.53% crude protein (CP), 49.53% crude fiber, 4.48% crude fat.

However, according to Eldaw and Ciftci (2023), depending on temperature conditions and fruit species variety, and considering the homogenization and ultrafiltration stages in the rosehip fruit processing method, the protein concentration may vary. The specific lipid composition is as follows: polyunsaturated fatty acids (PUFA) 67.65 g/100 g, monounsaturated fatty acids (MUFA) 22.80 g/100 g, SFA 9.55 g/100 g, omega-3 fatty

acids 14.28 g/100 g, omega-6 fatty acids 53.07 g/100 g. In general, the concentration of bioactive compounds in rosehip flour is as follows: TPC (total phenolic components) 60.23 mg gallic acid equivalent (GAE)/g, TAC (total antioxidant capacity) 23.87 mM Trolox, TFC (total flavonoid content) 12.18 mq eq rutin/g [10].

Considering the botanical characteristics, according to Prisăcaru and Burlacu (2009), the true fruits are yellowish achenes, covered with rough bristles and found inside the receptacle, while the false fruits, or achenes, come from the fleshy receptacle transformed into a fruit with a shiny red surface and an ellipsoidal shape. Properly dried rosehip fruits (80-100°C) have been used to make plant products for use in phytotherapy (from 500 mg% to 1000 mg% ascorbic acid). The literature specifies that approximately 100 grams of rosehip fruit has a variable content of 200-500 mg of vitamin C [12]. For rosehip seeds, Vlaicu et al. (2024) specified a vitamin C content of 1789 µg/g of dried rosehip fruit.

In general, by reducing free radicals and reactive oxygen species (ROS), an increase in the antioxidant capacity of the body can be observed in broiler chickens [13, 14]. A substance with an antioxidant effect actually has an inhibitory effect on the production of reactive oxygen species (ROS) and nitric oxide [15]. The antioxidant potential is given by the substance's ability to donate hydrogen atoms or electrons and eliminate the free radicals produced by closing the peroxide chain reaction [16]. Rosehip (*Rosa* spp.) are one of the richest natural sources of vitamin C in the form of the L-isomer, with a content ranging from 300 to 4000 mg/100 g [16]. Compared to other plant species with a high antioxidant content, rose hips have been shown to have the strongest antioxidant properties. The L-isomer of L-ascorbic acid is the natural and biologically active form of vitamin C, used by the human and animal body in metabolic processes. It has antioxidant activity and is essential for collagen synthesis, iron absorption, and immune system function [17].

The immunostimulatory effect of rosehip fruit is provided by pectins [11]. The biologically active components of rose hips are phenolic chemicals such as tannins, flavonoids, phenolic acids [18], and anthocyanins [9], which, together with the high concentration of ascorbic acid, determine the antioxidant properties of rose hips. According to the literature, light-colored rose hips have a higher vitamin C content than dark-colored fruits [18].

In 1989, Razungles et al. observed a higher concentration of vitamin C in fully ripe fruits, evaluating the effect of rosehip ripening on ascorbic acid content [19].

In 2011, Roșu et al. found that freezing the fruit reduced the protein content by 15.24% in *Rosa corymbifera* and by 31.90% in *Rosa nitidula*, also observing a decrease in protein content in dried *Rosa corymbifera* and *Rosa subcanina* species, by 21.33% and 46.89%, respectively [20]. In 2013, Roman and his colleagues reported the total amount of flavonoids, 163.3 mg quercetin/100 g rosehip, following analyses performed on frozen *Rosa canina* fruits collected in Transylvania, also establishing a vitamin C content of 112.20–360.22 mg/100 g rosehip. From samples of fresh rose hips of the *Rosa corymbifera* and *Rosa nitidula* species, the total amount of protein was determined to be 0.9–1.10 g/100 g rosehips, with rose hips having a lower protein concentration than other fruits [21]. In Romania, the antioxidant capacity was evaluated from rosehip samples collected in Transylvania and recorded in the range of 63.35–127.8 µM trolox/100 g rosehip. In 2015, Soare et al. obtained a total flavonoid content ranging from 211.8 to 672.67 mg quercetin/100 g rosehip from rosehip samples found in northern Romania [22].

In studies evaluating antioxidant capacity, it was reported that the method of extracting rosehip fruit and storing it by

freezing after homogenization, until the samples were processed, influences the flavonoid concentration in the samples [9].

According to Eldaw and Çiftci (2023), the antibacterial capacity derives from the ability of rose hips to inhibit the growth of bacteria such as *Enterococcus faecalis*, *Escherichia coli*, *Staphylococcus aureus*, *Enterococcus faecium*, *Staphylococcus epidermidis*, and *Pseudomonas aeruginosa*. These researchers reported that following microbiological testing of rosehip samples, the largest inhibition diameter was 15.84 mm for *Enterococcus faecalis*, followed by 15.73 for *Staphylococcus aureus* and 15.39 for *Pseudomonas aeruginosa*, and the lowest antibacterial activity was recorded against *Enterococcus faecium*.

All these bacteria on which the antibacterial activity of rosehip has been studied can be either commensal or pathogenic in broilers, but under conditions of stress, inadequate microclimate, or immunosuppression, they cause respiratory, digestive, or skin disorders with a direct impact on mortality, productive performance, and the safety of poultry products, all of these observations being summarized in Table 1.

Table 1 Antimicrobial activity of rosehip (*Rosa canina*) extracts on the main pathogenic bacteria found in broilers

Bacteria	Main sickness	Impact on broilers	Inhibitory activity of rosehip
Enterococcus faecalis [(1),(2)]	Enteritis, septicemias, opportunistic infections	Performance decreasing. Risk of antimicrobial resistance	Very High
Enterococcus faecium [(1),(2)]	Enteritis, septicemias, antimicrobial resistance	Could become opportunistic pathogens, risk for public health	Very Low
Escherichia coli [(3),(4)]	Colibacillosis (coli septicemia, airsacculitis, peritonitis, perihepatitis)	Increased mortality, significant economic loss	Moderate
Staphylococcus aureus [(5),(6)]	Arthritis, osteomyelitis, pododermatitis (bumblefoot)	Impact on welfare, decreasing of performance	High
Staphylococcus epidermidis[(7),(8)]	Cutaneous infectious, pododermatitis, wound infections	Chronical lesions, impact on welfare	High
Pseudomonas aeruginosa [(9),(10)]	Respiratory infections, septicemias, Cutaneous lesions	Opportunistic infections under poor hygiene conditions, economic loss	High

Fertner et al., 2011[(27)] ; Hammerum, A.M., 2012[(28)]; Dho-Moulin et al.,1999[(29)] ; Guabiraba et al., 2015[(30)], Abd El-Ghany W., 2021[(31)], Daum et al., 2011 [(32),] Skeeles, J.K., 1997[(33)]; Becker et al., 2014 [(34)]; Abd El-Ghany, 2021 [(35)]; Anzai et al., 2000 [(36)]

Studies analyzing the biological activity of rosehip plants have found that extracting rosehip seeds with methanol has an antibacterial effect against E. coli [6].

By modulating the intestinal microflora and reducing E. coli, nitrogen metabolism and, indirectly, the amount of ammonia eliminated in litter could be influenced. Studies on similar functional plant extracts show that phytogenics can inhibit bacterial urease activity, which would reduce the formation of ammonia in excrement [24].

Disruption of the intestinal microbiota and protein metabolism leads to increased blood uric acid concentrations, reflecting inefficient nitrogen utilization and kidney stress. Reducing the breakdown of proteins into nitrogen compounds could improve the absorption and utilization of amino acids and proteins in the diet [25].

The excretory system in birds regulates the body's metabolism by eliminating uric acid into the external environment, releasing ammonia, while the total nitrogen content in excrement increases with age and thus reflects nitrogen intake [2]. Nutritional factors, and in particular hydration, influence renal function. Therefore, a pathological agent that affects the immune status of birds can also cause altered excretion through renal dysfunction.

The water given to birds must be constantly purified using an appropriate water filter and periodically enriched with natural nutrients, vitamins, and minerals to maintain clean water free of pathogenic microorganisms, as contaminated water is primarily associated with enteric disorders, which are aggravated by the onset of metabolic disorders.

Research recommends the use of deep well water sources to reduce the use of antimicrobials and maintain health. Guo et al. (2022) observed that internal pH can be modified by adding an acidifier (2-hydroxy-4-methylbutyric acid) to drinking water, thus finding a way to reduce the growth of pathogenic microorganisms by stimulating the healthy development of the intestinal microbiota.

CONCLUSIONS

Studies indicate that natural vitamin C, for example, the vitamin obtained from rose hips, may have comparable or even better bioavailability than synthetic vitamin C, due to the presence of natural co-factors that can support absorption and utilization in the body. In addition, there is a growing demand for animal products obtained without synthetic additives. The use of natural additives (phytogens, medicinal plants) is well regarded in the context of organic or semi-intensive agriculture. Administering rosehip tea in drinking water as a phytotherapy method with antioxidant effects can help reduce oxidative stress and, theoretically, maintain renal function and normal nitrogen excretion in poultry. At the same time, the use of rosehip is a natural and safe strategy, suitable for organic or sustainable production.

Adding rosehip tea to broiler chicken feed or water is a promising natural alternative to synthetic vitamin C supplementation, providing not only L-ascorbic acid but also a complex of bioactive compounds with antioxidant and immunostimulatory effects that can help improve the health and productive performance of poultry.

At the same time, further research is needed to determine the optimal dose and form of administration, to assess the impact on growth and productive performance, as well as on biochemical parameters related to nitrogen metabolism. Further studies should analyze how rosehip extract influences the intestinal microbiota, ammonia emissions, and interaction with environmental factors such as humidity or stocking density.

REFERENCES

1. Spieß, F.; Reckels, B.; Abd-El Wahab, A.; Ahmed, M.F.E.; Sürie, C.; Auerbach, M.; Rautenschlein, S.; Distl, O.; Hartung, J.; Visscher, C. The influence of Different Types of Environmental Enrichment on the Performance and Welfare of Broiler Chickens and the Possibilities of Real-Time Monitoring via a Farmer-Assistant System. *Sustainability* **2022**, *14*, 5727. https://doi.org/10.3390/su14095727
2. Gheorghe, A; Hăbeanu, M; Lefter, NA; Idriceanu, L; Tudorache, M; Custură, I Age-related changes in performance, plasma proteins and nitrogen content of excreta in ROSS 308 breeders. *Scientific Papers* **2022**. Series D. Animal Science, Vol. LXV, No. 2.
3. Aloui, L; Greene, ES; Tabler, T; Lassiter, K; Thompson, K; Bottje, WG; Orlowski, S; Dridi, S Effect of heat stress on the hypothalamic expression profile of water homeostatis-associated genes in low- and high-water efficient chicken lines. *Physiological Reports* **2024**, 12:e15972. doi:10.14814/phy2.15972.
4. Copley, M.A.; Wiedemann, S.G. Environmental impacts of the Australian poultry industry. I. Chicken meat production, *Animal Production Science* **2022**. https://doi.org/10.1071/AN22230

5. Petrik, M Backyard Chicken Medicine. OVMA Conference **2023**.
6. Loetscher, Y; Kreuzer, M; Messikommer, RE Oxidative stability of the meat of broilers supplemented with rosemary leaves, rosehip fruits, chokeberry pomace, and entire nettle, and effects on performance and meat quality. *Poultry Science* **2013**, 92:2938-2948. https://dx.doi.org/10.3382/ps.2013-03258
7. Wang, C; Bing A; Iiu H; Wang, X; Zhao, J; Lin, H; Jiao, H High ambient humidity aggravates ammonia-induced respiratory mucosal inflammation by eliciting Th1/Th2 imbalance and NF-κB pathway activation in laying hens. *Poultry Science* **2022**, 101:102028. doi.org/10.1016/j.psj.2022.102028
8. Vlaicu, PA; Saracila, M; Panaite, TD; Tabuc, C; Bobe, E; Criste RD Effect of the dietary grape seeds and rosehip oils given to broilers (14-42 days) reared at 32°C on broiler performance, relative weight of carcass cuts and internal organs and balance of gut microflora. *Archiva Zootechnica* **2017**, *20*:1, 77-88.
9. Eldaw, B. & Çiftci, G. Antioxidant Capacity and Antibacterial Potential of Rosehip (*Rosa canina*) Fruits Grown. *J. Anatolian Env. and Anim. Sciences* **2023**, *8* (1), 103-109. doi:10.35229/jaes.1240877.
10. Vlaicu, PA; Untea, AE; Oancea, AG Sustainable Poultry Feeding Strategies for Achieving Zero Hunger and Enhancing Food Quality. *Agriculture* **2024**, *14*, 1811. doi:10.3390/agriculture14101811
11. Prisăcaru, C; Burlacu, A-I Plante medicinale și toxice, Ed. a 2-a – Iași: Tehnopress, **2009**.
12. Tekeli, A. Effect of Rosehip Fruit (*Rosa canina l.*) supplementation to rations of broilers grown under cold stress conditions on some performance, blood, morphological, carcass and meat quality characteristics. *Europ. Poult. Sci.* **2014**, *78*, ISSN 1612-9199. doi:10.1339/eps.2014.19.
13. Mustafa, MA; Shokry, NK Improving Behavior, Immune Statue and Growth of Broilers by Adding Some Neurotransmitters in Drinking Water and Hero Flowers (*Alcea Kurdica*) in Diets. *Egypt. J. Vet. Sci.* **2024**, *55*, 1067-1075. doi.org/10.21608/EJVS.2023.231406.1575
14. Monesa, SB; Oluremi, OIA Effect of Adding Different Levels of Undecorticated Rosehip (*Rosa canina* L.) Fruit in the Diets on Productive Performance of Broiler Chickens. *Asian J. Res. Animal Vet. Sci.* **2024**, *7*, 122-133. doi.org/10.9734/AJRSVS/2024/v7i2292
15. Hvattum, E Determination of phenolic compounds in rose hip (*Rosa canina*) using liquid chromatography coupled to electrospray ionization tandem mass spectrometry and diode-array detection. *Rapid Commun. Mass Spectrom.* **2002**, *16*(7):655-662. doi:10.1002/rcm.662.
16. Sardar, D; Afsana, S; Habib, A; Hossain, MT Dietary effects of multi-strain probiotics as an alternative to antibiotics on growth performance, carcass characteristics, blood profiling and meat quality of broilers. *Vet. Integr. Sci.* **2025**, *23*(2): e2025059-1-17. doi.org/10.12982/VIS.2025.059
17. Miljković, VM; Nikolić, L; Mrmošanin, J; Gajić, I; Mihajilov-Krstev, T; Zvezdanović, J; Miljković, M Chemical Profile and Antioxidant and Antimicrobial Activity of *Rosa canina* L. Dried Fruit Commercially Available in Serbia. *Int. J. Mol. Sci.* **2024**, 25, 2518. doi:10.3390/ijms25052518
18. Kubczak, M; Khassenova, AB; Skalski, B; Michlewska S; Wielanek, M; Aralbayeva, AN; Murzakhmetova, MK; Zmaraeva M; Skłodowska, M; Bryszewska, M; Ionov, M Bioactive compounds and antiradical activity of the *Rosa canina* L. leaf and twig extracts. *Agronomy* **2020**, *10*, 1897. doi:10.3390/agronomy10121897.
19. Hatipoglu, IH; Ak, BE Fatty acids and mineral composition of seed oils extracted from different *Rosa* L. taxa. *Grasas y Aceites* **2023**, *74* (2). ISSN-L: 0017-3495. doi:10.3989/gya.0673221.
20. Kasapoğlu, KN; Demircan, E; Gültekin-Özgüven, M; Kruger, J; Frank, J; Arslaner, A; Özçelik, B Recovery of Polyphenols Using Pressurized Hot Water Extraction (PHWE) from Black Rosehip Followed by Encapsulation for Increased Bioaccesibility and Antioxidant Activity. *Molecules* **2022**, *27*, 6807. doi:10.3390/molecules27206807
21. Vlaicu, AP; Turcu, RP; Panaite, DT Rosehip (*Rosa canina*) as a Beneficial Dietary Feed in Poultry Nutrition: Review.

Advanced Research in Life Sciences **2020**, *4*, 11-15. doi.org/10.2478/arls-2020-0012
22. Roman, I.; Stănilă, A.; Stănilă, S Bioactive compounds and antioxidant activity of *Rosa canina* L. biotypes from spontaneous flora of Transylvania. *Chemistry Central Journal* **2013**, *7*, 73. https://journal.chemistrycentral.com/content/7/1/73
23. Criste, RD; Panaite, TD; Tabuc, C; Sărăcilă, M; Şoica, C; Olteanu, M Effect of oregano and rosehip supplementson broiler (14-35 days) performance, carcass and internal organs development and gut health. *AgroLife Scientific Journal* **2017**, *6*, Number 1. ISSN 2285-5718.
24. Wang, J; Deng, L; Chen, M; Che, Y; Li, L; Zhu, L; Chen, G; Feng, T Phytogenic feed additives as natural antibiotic alternatives in animal health and production: A review of the literature of the last decade. *Anim. Nutr.* **2024**, *22*, 17:244-264. doi: 10.1016/j.aninu.2024.01.012. PMID: 38800730; PMCID: PMC11127233.
25. Chrubasik, C; Roufogalis, BD; Müller-Ladner, U; Chrubasik, S A Systematic Review on the *Rosa canina* Effect and Efficacy Profiles. *Phytother. Res.* **2008**, *22*, 725-733. doi.org/10.1002/ptr.2400
26. Guo, YJ; Wang, ZY; Wang, YS; Chen, B; Huang, YQ; Li, P; Tan, Q; Zhang, HY; Chen, W Impact of drinking water supplemented 2-hydroxy-4-methylthiobutyric acid in combination with acidifier on performance, intestinal development, and microflora in broilers. *Poultry Science* **2022**, 101:101661. doi:10.1016/j.psj.2021.101661
27. Fertner, ME; Olsen, RH; Bisgaard, M; Christensen, H Transmission and genetic diversity of *Enterococcus faecalis* among layer chickens during hatch. *Acta Veterinaria Scandinavica* **2011**, 53:56. http://www.actavetscand.com/content/53/1/56
28. Hammerum, AM Enterococci of animal origin and their significance for public health. *Clin. Microbiol. Infect.* **2012**, *18*, 619–625. doi:10.1111/j.1469-0691.2012.03829.x
29. Dho-Moulin, M; Fairbrother, JM Avian pathogenic Escherichia coli (APEC). *Vet. Res.* **1999**, *30*(2-3), pp. 299–316. https://hal.science/hal-00902571v1
30. Guabiraba, R.; Schouler, C. Avian colibacillosis: still many black holes. *FEMS Microbiology Letters* **2015**, *362*, fnv118. https://doi.org/10.1093/femsle/fnv118
31. Abd El-Ghany, W Staphylococcus aureus in poultry, with special emphasis on methicillin-resistant strain infection: A comprehensive review from one health perspective. *International Journal of One Health* **2021**, 7(2): 257-267. https://doi.org/10.14202/IJOH.2021.257-267
32. Daum, RS; Spellberg, B Progress Toward a *Staphylococcus aureus* Vaccine. *Clinical Infectious Diseases* **2011**, 54, 560–567. doi:10.1093/cid/cir828
33. Skeeles, JK *Staphylococcosis*. In B.W. Calnek (ed.), *Diseases of Poultry* **1997**, 10th ed., pp. 247–253. Ames, IA: Iowa State University Press.
34. Becker, K; Heilmann, C; Peters, G Coagulase-negative staphylococci. *Clin Microbiol. Rev.* **2014**, 27(4):870-926. doi: 10.1128/CMR.00109-13.
35. Abd El-Ghany, WA Pseudomonas aeruginosa infection of avian origin: Zoonosis and one health implications. *Veterinary World* **2021**, 14(8): 2155-2159. doi:10.14202/vetworld.2021.2155-2159
36. Anzai, Y; Kim, H; Park, J-Y; Wakabayashi, H; Oyaizu, H Phylogenetic affiliation of the pseudomonads based on 16S rRNA sequence. *International Journal of Systemic and Evolutionary Microbiology* **2000**, 50, 1563-1589. https://doi.org/10.1099/00207713-50-4-1563