Amol University of Special Modern Technologies

Caspian Journal of Veterinary Sciences

doi: 10.22034/cjvs.2026.582811.1070

Journal homepage: https://cjvs.ausmt.ac.ir/

Effect of barley malt extract on intestinal *Escherichia coli* populations in broiler chickens

Forough Talazadeh[1*], Kiavash Houshmandi [2]

[1]Department of Livestock, Poultry and Aquatic Animal Health, Faculty of Veterinary Medicine, Shahid Chamran University of Ahvaz, Ahvaz, Iran.

[2]Nephrology and Urology Research Center, Clinical Sciences Institute, Baqiyatallah University of Medical Sciences, Tehran, Iran.

(*) Corresponding Author: ftalazade@gmail.com

Article Info

Article history:

Submit Date: 24 May 2026

Accept Date: 2 June 2026

Online Date: 14 November 2026

Keywords:

Bacterial population

Broiler chickens

Escherichia coli

Intestine

Malt extract

Abstract

The recent study was performed to investigate the effect of malt extract in drinking water on intestinal bacterial population in broiler chickens. A totalof 120 day-old broiler chicks, Ross strain, were purchased and divided into four equal groups. Each group divided into three subgroups of 10 chicks. Groups “A”, “B”, and “C” chickens received 0.2%, 0.3%, and 0.5% of malt extract, respectively, in drinking water. group “D” as control group did not receive malt extract. The results showed that receiving of malt extract at 0.2% concentration reduced colony forming units of *Escherichia coli* in group “A” compared to all groups. The colony forming units of *E. coli* in digesta of ileo-cecum in group “A” on Mac Conkey agar, Nutrient agar and Eosin methylene blue agar showed a lower number compared to control group.

©2026 Published by Amol University of Special Modern Technologies Press.

This is an open-access article under the CC-BY4.0 license (https://creativecommons.org/licenses/by/4.0/).

Introduction

At the beginning of 2006, in the European Union, medical and public concerns focused on the complete deleting of antibiotic growth promoters from animal food (Nollet, 2005; Wakeman, 2005; Cervantes, 2006). Therefore, in poultry industry, it is important to replace antibiotic growth promoters in the food by other substances (Erik and Knudsen, 2001). Application of feed additives has two objectives: controlling pathogenic microorganisms and enhancing beneficial microorganisms in the digestive content of the gut (Vahdatpour *et al*., 2011). Recently, some substances such as phytogenic feed additive, prebiotics, and probiotics, have been used instead of antibiotics (Patterson and Burkholder, 2003; Ricke, 2003). The advantage of herbal extracts or active substances in animal nutrition may include the stimulation of appetite and feed intake, the improvement of endogenous digestive enzyme secretion, activation of immune response and antibacterial, antiviral, antioxidant and antihelminthic actions. Isoprene derivatives, flavonoids, glucosinolates, and other plant metabolites may affect the physiological and chemical function of the digestive tract. The stabilizing effect on intestinal microflora may be associated with intermediate nutrient metabolism (Baratta *et al*., 1998; Horton *et al*., 1991; Jamroz *et al*., 2003). Volatile oil from thyme (*Thymus vulgaris*) was assessed for antibacterial and antiviral activity as inhibitors of microbial growth (Dorman and Deans, 2000). In older animals the effectiveness of plant extract supplementation was relatively low, but higher digestibility of nutrients and reduction of *Escherichia coli* (*E. coli)* and *Clostridium* sp. in intestinal content were stated (Jamroz *et al*., 2003). Some herbs that are full of flavonoids such as thyme (*T. vulgaris*) increase the activity of vitamin C, and act as antioxidants and seem to improve the immune function (Cook and Samman, 1996; Manach *et al*., 1996). Carvacrol and thymol are the main phenolic components in *T. vulgaris*. Researches have shown that vegetables, cereals, and fruits contain a very large number of phenolic compounds. Principally (80–90%) barley production is for animal feeds and malt (Dorman and Deans, 2000). There are increasing affections in barley yields because of their high levels of phenolic acids (cinnamic and benzoic acids), tannins, chalcones, flavanones, proanthocyanidins, flavonols, flavones, and amino phenolic compounds (Manach *et al*., 1996). Malt contains different complexes from the malting process (Maillard reaction products) or from barley (phenolic compounds) (Cook and Samman, 1996). Due to the high levels of antioxidant contents in barley and malt, they are used as ingredients for the functional foods production. While the antioxidant activity of malt or barley has been studied, there is no publication recording the effects of malt extract from barley in drinking water on intestinal bacterial population in broiler chickens. In the present survey, we intend to determine the effects of malt extract from barley in drinking water on intestinal bacterial population in broiler chickens.

Materials and Methods

Malt extract

Malt extract from barley was acquired commercially as solution from Gorgan Malt Zarrin Co. (Golestan province, Iran) (Table 1).

Table 1. Chemical analysis of malt extract from barley.

pH	3.8-4.2
Water soluble solid substances (%)(brix)	60
Reducing sugars (maltos)%	At least 45
Acidity (lactic acid)	0.6
Crud protein (%)	1.5
Moisture (%)	38
Total solid substances (%)	62
Specific weight at 20 degree	1.3
Refractive index at 20 degree	1.4

Chickens and housing

A total of 120 one-day-old (average weight about 45 g), Ross 308 broilers, were obtained from the South Sahraye Jonoob's broiler breeder farm (Pirmoradi Co., Khuzestan, Iran).

Chickens in each group were kept in floor pens with suitable temperature, light, and humidity at the department of avian medicine (the faculty of veterinary medicine of Shahid Chamran University of Ahvaz, Iran). Chickens were provided with free access to water and broiler diets and received feed (Table 2) and water ad libitum during the experiment. A standard basal diet in pellet form was formulated which was mainly composed of corn and soybean meal. The birds were reared under similar conditions from one day old to 47 days of age.

Table 2. Ingredient (%) and chemical composition of broiler diets.

Ingredient	Starter diet (1-21 days)	Finisher diet (22-47 days)
Corn	55.2	60.81
Soybean meal	37.47	31.60
Soybean oil	3	3.60
Oyster powder	1.42	1.13
Dicalcium phosphate	1.6	1.50
Sodium chloride	0.3	0.23
Coccidiostate (Salinomycin, Robenidine)	0.05	0.05
Limestone	0.23	0.23
Mineral supplements	0.25	0.25
DL-methionine	0.23	0.24
lysine	0	0.11
Nutrient composition (%)		
Metabolizable energy (kcal/kg)	2969.20	3086.91
Crude protein (%)	21.3	19.35
Calcium (%)	1	0.85
Available phosphorus (%)	0.45	0.43

Results

Table 3. The effect of malt extract on *E. coli* numbers in ileo-cecal contents of broilers.

Medium groups	NA	Mac	EMB
A (0.2%)	7.53 ± 0.88^{bcd} *	7.33 ± 0.21^{bcd}	7.12 ± 0.45^{bcd}
B (0.3%)	8.73 ± 0.92^{a}	8 ± 0.47^{a}	8.28 ± 0.64^{a}
C (0.5%)	8.6 ± 0.31^{a}	8.46 ± 0.21^{a}	8.23 ± 0.74^{a}
D(control)	8.88 ± 0.95^{a}	8.54 ± 0.52^{a}	8.5 ± 0.32^{a}

log CFU g^{-1} ± standard deviation of means. * Columns with different superscripts (a, b, c and d) were significantly different ($p < 0.05$).

According to Table 3, the results of this study showed that receiving of malt extract at 0.2% concentration reduced colony forming units of *E. coli* compared to all groups. The colony forming units of *E. coli* in digesta of ileo-cecum in group "A" on Mac Conkey agar, Nutrient agar, and Eosin methylene blue agar showed a lower number compared to control group.

Discussion

This study showed that lower *E. coli* counts were related to group "A", and there was significant difference between group "A" and all groups. In earlier studies significant reduction of *E. coli* number has been obtained following an application of natural plant extract (Jamroz *et al*., 2005). It has been documented that garlic extracts exert a differential inhibition between beneficial intestinal microflora and potentially harmful enterobacteria (Rees *et al*., 1993). Inhibition observed in *E. coli* was more than 10 times greater than that seen in *Lactobacillus casei* for the same garlic dose. Exactly why this differential inhibition should occur is not clear, but it may be due to differing composition of bacterial membranes and their permeability to allicin (Miron *et al*., 2000). Garlic extract and allicin have been shown to exert bacteriostatic effects on some vancomycin-resistant *Enterococci*. Decreasing number of such viable Gram-positive bacteria, as *Lactobacilli* and *Bifidobacteria*, may increase the presence of Gram-negative species. Pollystilenes from coneflower showed bacteriostatics against *E. coli*. Bölükbaşi and Erhan (2007) showed that control group and the 1% thyme group had the highest average concentration of *E. coli* in feces. The group fed 0.5% thyme had a significantly lower *E. coli* count than the control and the 1% thyme group (Bölükbaşi and Erhan, 2007). In agreement with

our result, thymol (from thyme essential oil) has been shown to reduce the number of coliforms within the digesta of chickens (Cross *et al*., 2004). Furthermore, it has been suggested that supplementation with oligosaccharides may have a prebiotic effect through an increase in production of lactic acid, thus increasing the proliferation of beneficial bacteria and reducing the presence of Gram-negative bacteria (TF, 1996).

A 2021 study demonstrated that dietary supplementation with 0.3% malt extract significantly reduced the population of pathogenic *E. coli* in the cecum which is attributed to the carbohydrates present in malt, such as beta-glucans and mannan-oligosaccharides, which inhibit the colonization of harmful pathogens, ultimately improving gut health and fat digestibility by preserving bile salt integrity (Rezvani *et al*., 2021).

In conclusiom, the colony forming units of *E. coli* in digesta of ileo-cecum in group "A" on Mac Conkey agar, Nutrient agar, and Eosin methylene blue agar showed a lower number compared to control group and Groups "B" and "C". It concluded that malt extract at 0.2% concentration reduced colony forming units of *E. coli*, so has beneficial effect on microflora of intestine. However, more trials are needed to clarify the effect of different medicinal plants on intestinal bacterial population in broiler chickens.

Acknowledgment

The authors appreciate Shahid Chamran University of Ahvaz for supporting the current study financially.

Conflict of Interest

The authors declare no conflicts of interest.

References

Baratta, MT; Dorman, HD; Deans, SG; Biondi, DM and Ruberto, G (1998). Chemical composition, antimicrobial and antioxidative activity of laurel, sage, rosemary, oregano and coriander essential oils. J. Essential Oil Res., 10: 618-627.

Bölükbaşi, ŞC and Erhan, MK (2007). Effect of dietary thyme (*Thymus vulgaris*) on laying hens performance and *Escherichia coli* (*E. coli*) concentration in feces. Int. J. Natural Eng. Sci., 1: 55-58.

Cervantes, H (2006). Banning antibiotic growth promoters: Learning from the European experience. Poult. Int., 45: 14-15.

Cook, NC and Samman, S (1996). Flavonoids-chemistry, metabolism, cardioprotective effects, and dietary sources. J. Nutr. Biochem., 7: 66-76.

Cross, D; Hillman, K; Fenlon, D; Deans, S; McDevitt, R; Acamovic, T and Pennycott, T (2004). Antibacterial properties of phytochemicals in aromatic plants in poultry diets. Poisonous Plants Related Toxins, 18: 175-180.

Dorman, HD and Deans, SG (2000). Antimicrobial agents from plants: antibacterial activity of plant volatile oils. J. Appl. Microbiol., 88: 308-316.

Erik, K and Knudsen, B (2001). Development of antibiotic resistance and options to replace antimicrobials in animal diets. Proceed. Nutr. Soc., 60: 291-299.

Horton, G; Fennell, M and Prasad, B (1991). Effect of dietary garlic (*Allium sativum*) on performance, carcass composition and blood chemistry changes in broiler chickens. Can. J. Anim. Sci., 71: 939-942.

Jamroz, D; Orda, J; Kamel, C; Wiliczkiewicz, A; Wertelecki, T and Skorupińska, J (2003). The influence of phytogenic extracts on performance, nutrient digestibility, carcass characteristics, and gut microbial status in broiler chickens. J. Anim. Feed Sci., 12: 583-596.

Jamroz, D; Wiliczkiewicz, A; Wertelecki, T; Orda, J and Skorupińska, J (2005). Use of active substances of plant origin in chicken diets based on maize and locally grown cereals. British Poult. Sci., 46: 485-493.

Manach, C; Regerat, F; Texier, O; Agullo, G; Demigne, C and Remesy, C (1996). Bioavailability, metabolism and physiological impact of 4-oxo-flavonoids. Nutr. Res., 16: 517-544.

Miron, T; Rabinkov, A; Mirelman, D; Wilchek, M and Weiner, L (2000). The mode of action of allicin: its ready permeability through phospholipid membranes may contribute to its biological activity. Biochim. Biophys. Acta (BBA)-Biomembranes, 1463: 20-30.

Nollet, L (2005). AGP alternatives-part I. EU close to a future without antibiotic growth promoters. World Poult., 21: 14-15.

Patterson, J and Burkholder, K (2003). Application of prebiotics and probiotics in poultry production. Poult. Sci., 82: 627-631.

Rees, L; Minney, S; Plummer, N; Slater, J and Skyrme, D (1993). A quantitative assessment of the antimicrobial activity of garlic (*Allium sativum*). World J. Microbiol. Biotechnol., 9: 303-307.

Rezvani, MR; Abbasi, M and Sabet, S (2021). Effect of malt extract on growth performance, nutrient digestibility, and cecal microflora in broilers. J. Anim. Prod., 23: 471-479.

Ricke, S (2003). Perspectives on the use of organic acids and short chain fatty acids as antimicrobials. Poult. Sci., 82: 632-639.

TF, S (1996). The effects of feeding a mannan oligosaccharide on immunoglobulins, plasma IgG and bile IgA, of Wrolstad MW male turkeys. Poult. Sci., 75: 143-148.

Vahdatpour, T; Nikpiran, H; Babazadeh, D; Vahdatpour, S and Jafargholipour, MA (2011). Effects of Protexin®, Fermacto® and combination of them on blood enzymes and performance of Japanese quails (*Coturnix Japonica*). Ann. Biol. Res., 2: 283-291.

Wakeman, W (2005). AGP alternatives-Part II. Dietary strategies to influence bacterial microflora. World Poult., 21: 28-29.