

Effect of adding herb extracts to drinking water on production results and some quality parameters of broiler chicken meat

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Banning the use of feed antibiotics as growth promoters in the European Union countries in 2006 has led to a rapid development of research on alternative agents. In addition to prebiotics, probiotics and organic acids, interest in all kinds of preparations of plant origin, the so-called phytobiotics, also increases. They are considered to be “natural” and “safe” additives with a wide range of animal-related effects (Alçiçek et al., 2004; Hippenstiel et al., 2011; Hashemipour et al., 2013).

Numerous studies indicate that the addition to of herbs and their extracts to feed or water has a positive effect on production parameters, including consumption and use of feed, and body weight gains in poultry (Hertrampf, 2001; Kwiecień et al., 2006; Bölükbaşı et al., 2008; Skomorucha and Sosnówka-Czajka, 2013). The herbs are also considered to be beneficial measures aimed at improving the quality of products of animal origin. In case of poultry meat, characterized by a relatively high level of polyunsaturated PUFAs, a search continues for natural antioxidants that inhibit lipid oxidation, which is a serious problem for the meat industry due to the negative effect on smell, taste, texture, and nutritional value of meat (Ahn et al., 2007). Because of that, there are ongoing studies on the influence of herbal plants – with antioxidant properties attributed to them – on improving the quality of poultry meat (Kamboh and Zhu, 2013; Loetscher et al., 2013; Kasapidou et al., 2014). Czajka and Gornowicz (2004) report that the herbal mixture additive for feed mixes has a beneficial effect on both rearing efficiency, as well as whole poultry pigmentation

and quality. On the other hand, Luna et al. (2010) demonstrated that the use of natural antioxidants can improve the quality of poultry meat.

Literature reports that herbal plants with antioxidant properties may include, among others: melisa (Marcinčáková et al., 2011; Kasapidou et al., 2014), sage (Lopez-Bote et al., 1998; Werenśka, 2013) and nettle (Bonetti et al., 2016).

The aim of the study was to determine the effect of lemon balm herb (*Melissa officinalis* L.), sage (*Salvia officinalis* L.) and common nettle (*Urtica dioica* L.) extracts added to the drinking water on the production results, pH, water holding capacity, colour and chemical composition of breast and leg muscles of broiler chickens.

Material and methods

The experimental material comprised 640 one-day broiler chickens Ross 308 from the Poultry Hatching Plant in Łęzkowice. On the first day of life, the chicks were weighed and labeled with hatching stamps assigned to four groups, each of them consisting of four subgroups. Group I was the control group, in groups II, III and IV between the 21st and 42nd day of bird rearing, lemon balm herb extract (*Melissa officinalis* L.), sage extract (*Salvia officinalis* L.) and common nettle extract (*Urtica dioica* L.) was added to water at 2 ml/l of water.

Birds were kept for 42 days on litter with a density not exceeding 33 kg/m² (Regulation of the Ministry of Agriculture and Rural Development, Dz. U. 2010.56.344). All groups had uniform environmental and nutritional

conditions. Chickens were freely fed with the following mixes: starter up to 3rd week (ME 12.5 MJ; CP 22%), grower from 4th to 5th (ME 13 MJ; CP 20.5%) and with finisher in the 6th week of life (ME 13 MJ; CP 20.5%), prepared on concentrate basis. Throughout the entire rearing period, the broiler chickens had free access to feed and drinking water.

During the experiment, the body weight of birds, the use of fodder for 1 kg of body weight and mortality were monitored. On the 42nd day of rearing broiler chickens, 20 birds with a weight similar to the mean in the group were selected from each group. Selected chickens were slaughtered and after 15 minutes after slaughter, as well as after 24 hours after slaughter, after pre-cooling the whole poultry to 4°C, the pH measurement of breast muscles and legs (pH₁₅ and pH₂₄) was performed. The pH measurements were made using the CyberScan 10 pH meter with the EC-FG 73905 electrode. Next, breast muscles and legs were dissected and their colour was determined using the Minolta CR 310 colourimeter in the L*a*b* measurement system, where L* is brightness, and a* corresponds to the red colour, and b* corresponds to the yellow colour. Muscle water holding capacity (WHC) according to the methodology provided by Grau and Hamm (1953), as well as drip loss from meat weight after 24 hours of cooling at 4°C were also determined. In addition, the chemical composition (dry matter, crude protein and crude fat) was determined in muscle samples: SOP M. 011a version 1 of 28.03.11. PN-ISO 1442: 2000 Meat and meat products – Determination of water content. SOP M.007, version 2 from 21.02.2008 – Determination of nitrogen in meat and meat products, Kjeldahl method, SOP M.013a version 1 from 28.03.11 PN-ISO 1444: 2000. Meat and meat products – Determination of free fat content. The analyzes were carried out at the Central Laboratory of the National Research Institute of Animal Production in Aleksandrowice.

Spirit extracts from herbs were made in a professional herbal company, and have a certificate of compliance with the quality standards developed in this plant (ZN-16 / NX / 900, ZN-07 / NX / 523, ZN-11 / NX / 546).

The results were statistically analysed using a one-way analysis of variance, estimating the significance of the differences with Duncan's

test. Statistical software Statgraphics plus 6.0 was used for statistical calculations.

Results and discussion

According to authors' own studies, supplementing the drinking water with extracts from herbs considered to be highly antioxidant, i.e. lemon balm, sage and common nettle in the amount of 2 ml/l did not have a statistically significant effect on body weight and the use of feed (Tab. 1). However, there is a tendency towards a higher body weight on the 42nd day of the experiment in chickens from the group receiving herbal extracts compared to chickens from the control group, 40, 29, and 57 g, respectively. Kasapidou et al. (2014) noted a higher final weight of chickens reared ecologically, and fed with feed supplemented with lemon balm in the amount of 5 g/kg, compared to the control group, however, no similar effect was found in the groups where the concentration of lemon balm in the feed was 2,5 and 10 g/kg.

In addition, the authors demonstrated a positive effect of lemon balm addition on the feed use by broiler chickens. On the other hand, Marcinčáková et al. (2011) did not observe the effect of the 20 g/kg lemon balm dietary supplement on the final body weight or the feed use by Ross 308 broiler chickens. Similarly, Skomorucha and Sosnówka-Czajka (2013) did not show statistically significant differences in the final body weight and the use of feed between chickens from the control group and birds receiving a water supplement of lemon balm extract in the amount of 2 ml/l. On the other hand, Koreleski and Świątkiewicz (2007) did not find the influence of the sage supplement, and Loetscher et al. (2013) – the influence of nettle supplement for broiler chicken feed on their final body weight, consumption and use of feed.

Schleicher et al. (1998) reported that the addition of chamomile or common dandelion to chicken broiler diet decreased the bird mortality. Kasapidou et al. (2014) observed a lower percentage of dead chickens in groups in which lemon balm extract was added to the diet in comparison to the control group. In studies conducted by Skomorucha and Sosnówka-Czajka (2013) broiler chickens receiving water with lemon balm extract also demonstrated 100% survival rate. Similarly, in author's own studies,

the effect of lemon balm on the survival rate of broiler chickens was also observed during the period of its administration, i.e. from the 22nd to the 42nd day of life in comparison to the control

group. The lowest mortality rate – 0.83%, was observed in the group receiving water with nettle extract (Tab. 1) which matches the studies by Loetscher et al. (2013).

Table 1. Production results of broiler chickens

Item	Days of rearing	Group				SEM
		I control	II. lemon balm	III sage	IV nettle	
Body weight (g)	1	45.21	45.84	45.52	45.59	0.40
	21	582.32	600.12	593.37	577.85	12.55
	42	2351.07	2394.10	2380.00	2408.99	63.58
Feed conversion ratio (kg/kg gain)	1–21	1.47 a	1.47 a	1.48 a	1.55 b	0.02
	22–42	1.81	1.80	1.81	1.79	0.02
	1–42	1.71	1.71	1.72	1.73	0.01
Mortality (%)	1–21	1.67	3.33	2.0	0.83	–
	22–42	2.5	1.67	3.00	0.83	–
	1–42	4.17	5.00	5.0	1.67	–

a,b – values in rows with different letters differ significantly ($P \leq 0.05$).

Table 2. Quality of breast and leg muscles from 42-day-old broiler chickens

Item		Group				SEM
		I control	II. lemon balm	III sage	IV nettle	
pH	15 min	6.68	6.86	6.64	6.72	0.08
	24 h	6.29	6.31	6.22	6.25	0.03
Drip loss (%)		0.86	0.86	1.04	0.90	0.16
WHC (%)		12.39 Aa	15.01	17.69 B	16.22 b	1.25
Colour	L*	54.76 a.	57.09	58.47 b	57.32	1.00
	a*	10.63 A	9.51 B	9.18 B	9.67 B	0.25
	b*	11.88 A	13.07 B	13.29 Bb	12.56 a	0.24
Chemical composition (%)	dry matter	24.50	24.51	24.61	24.53	0.29
	crude protein	23.61	23.44	23.32	23.48	0.30
	crude fat	1.23	1.31	1.49	1.25	0.12

A,B – values in rows with different letters differ highly significantly ($P \leq 0.01$).

a,b – values in rows with different letters differ significantly ($P \leq 0.05$).

Herbs and spices demonstrating antibacterial, antiparasitic, antiviral and antioxidant properties are used as a supplement of the poultry diet not only to increase yield and health, but also to improve the quality of the final product (Kasapidou et al., 2014; Kirkpinar et al.,

2014). Tables 2 and 3 show the quality of the breast and leg muscles of 42-day old broiler chickens. No statistically significant differences between groups in pH₁₅ and pH₂₄, and drip loss was noted in case of breast muscles and legs. On the other hand higher WHC ratio of breast

muscles of broiler chickens was obtained in the group receiving sage extract and nettle extract in water, compared to the control group at $P \leq 0.01$ and $P \leq 0.05$, respectively (Tab. 2).

On the other hand, Czaja and Gornowicz (2004) did not find the statistically significant effect of feeding birds with feed mixes including herbs on water holding capacity of their muscles.

Table 3. Quality of breast and leg muscles from 42-day-old broiler chickens

Item	Group				SEM	
	I control	II. lemon balm	III sage	IV nettle		
pH	15 min	6.72	6.77	6.83	6.72	0.04
	24 h	6.73	6.78	6.69	6.65	0.04
Drip loss (%)		0.37	0.42	0.41	0.32	0.08
WHC (%)		11.56	10.89	9.95	10.07	1.03
Colour	L*	47.73	48.20 a	48.63 a	46.96 b	0.42
	a*	15.79	15.82	15.19	15.74	0.23
	b*	9.53 bc	9.93 ac	10.53 Aa	9.04 Bb	0.30
Chemical composition (%)	dry matter	24.83	24.85	25.03	24.34	0.41
	crude protein	19.10 Aa	19.37 A	19.90 b	20.35 B	0.18
	crude fat	5.27 a	5.27 a.	5.19 a	3.81 b	0.37

A,B – values in rows with different letters differ highly significantly ($P \leq 0.01$).

a,b – values in rows with different letters differ significantly ($P \leq 0.05$).

Herbs and plant components used as antioxidants usually affect the colour of poultry meat (Young et al., 2003; Karre et al., 2013). Eleroğlu et al. (2013) noted a lighter colour of breast muscles of broiler chickens fed with feed supplemented with lemon balm in the amount of 10 g/kg of feed. In authors' own studies, the addition of lemon balm and common nettle extract to water had no effect on the L* index, yet, lighter colour of the breast muscles in broiler chickens from the group receiving water supplemented with sage extract was noted, compared to the control group, with $P \leq 0.05$ (Tab. 2). Extracts from individual herbs resulted in lower saturation of the breast muscles towards red ($P \leq 0.01$), and lemon balm and sage extract also resulted in the higher saturation of the breast muscles towards yellow ($P \leq 0.01$) when compared to the control group (Tab. 2). In case of leg muscles, the difference was found in the yellow colour between the control group and the group receiving water with the addition of sage extract at $P \leq 0.05$ (Tab. 3). Kasapidou et al. (2014) also obtained a lower level of the a* index of breast muscles in birds receiving feed with the addition

of lemon balm, although these were not statistically significant differences. Kirkpınar et al. (2014) found the effect of supplementing the feed with oregano – a potent antioxidant – on lower saturation of the breast muscles towards red compared to the control group. Aksu et al. (2014) noted the effect of supplementing the quail diet with thyme on the a* index and found no effect on the L* and b* indices in case of breast muscles.

Tables 2 and 3 also present the chemical composition in the muscles of 42-day-old broiler chickens. In case of leg muscles, a higher level of total protein was found in the groups in which sage and nettle extract was added to the water, with $P \leq 0.05$ and $P \leq 0.01$, respectively. Kasapidou et al. (2014) obtained an increase in protein content in the breast and leg muscles of broiler chickens receiving a lemon balm supplement in the diet, which was not confirmed by authors' own research. Marcinčáková et al. (2011) also did not find the effect of the addition of lemon balm on the level of dry matter, crude protein and fat in chicken meat. On the other hand, Czaja and Gornowicz (2004) demonstrated a higher fat

content in the muscles of chickens receiving herbal mix in the feed. Lower crude fat content in leg muscles of chickens receiving water supplemented with common nettle extract was observed in authors' own study – compared to other groups, at $P \leq 0.05$ (Tab. 3).

In conclusion, the addition of single herb extracts demonstrating an antioxidant effect at 2 ml/l to drinking water did not affect the body weight and the feed use per 1 kg weight gain in broiler chickens. During the period of providing broilers with drinking water supplemented with

herbal extracts, a positive effect of lemon balm and nettle on the survival of birds was observed, in comparison with other groups. A change in the colour of the breast muscles of broiler chickens receiving water supplemented with herbal extracts was demonstrated. The sage and common nettle extract decreased the water holding capacity of the bird breast muscles, compared to the control group, whereas the nettle extract increased the percentage of total protein and decreased the raw fat in the leg muscles of broiler chickens.

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EFFECT OF ADDING HERB EXTRACTS TO DRINKING WATER ON PRODUCTION RESULTS AND SOME QUALITY PARAMETERS OF BROILER CHICKEN MEAT

Summary

The objective of the study was to determine the effect of supplementing drinking water with extracts from lemon balm (*Melissa officinalis* L.), sage (*Salvia officinalis* L.) and common nettle (*Urtica dioica* L.) on performance, pH, water holding capacity (WHC), colour, and chemical composition of breast and leg muscles in broiler chickens. Birds were allocated to four experimental groups: group I (control), and groups II, III and IV which received extracts from lemon balm, sage and common nettle, respectively, added to water in the drinking troughs (2 ml/l of water) from 22 to 42 days of rearing. Body weight, feed conversion and mortality were recorded throughout the study. At 42 days, 20 birds from each group were slaughtered, and the breast and leg muscles were measured for pH₁₅ and pH₂₄, colour, WHC, and drip loss; muscle samples were also analysed for dry matter, crude protein and crude fat. The supplementation of drinking water with extracts from single herbs with antioxidant effects at 2 ml/l had no effect on body weight and feed conversion in broilers. During the period when chickens received drinking water with herb extracts, lemon balm and nettle were observed to have a positive influence on bird survival compared to the other groups. The colour of breast muscles in broilers receiving water with herb extracts was found to change. Sage and nettle extracts had a negative effect on the water holding capacity of breast muscles compared to the control group, whereas nettle extract increased crude protein percentage and decreased crude fat percentage in the leg muscles of the chickens.

Key words: broiler chickens, herb extracts, meat quality



Phot. I. Skomorucha

