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Growth performance, carcass characteristics and meat quality of broilers fed diets supplemented with some dry herbs

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Abstract

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During the last years, numerous studies were performed to evaluate the effect of various plants and their derivatives as alternatives to nutritional antibiotics on animal productive performance and quality of products of animal origin. This study aimed to test the dietary inclusion of 2% dry herbs on live body weight, feed consumption, slaughter traits and meat quality in broiler chickens reared to 39 days of age. The treatment groups were randomly allocated into 7 treatment groups (n = 30) each with three replicates of 10 birds (3 replicates, 10 chickens/replicate). Control group of broilers received basal diet without the herbal. Experimental groups were fed basal diet with supplemented the herbal for E1 –2% *Matricaria;* E2 – 2% *Rosmarinus officinalis;* E3 – 2% *Lavandula;* E4 – 2% *Origanum vulgare;* E5 – 2% *Thymus;* E6 – 2% *Hypericum perforatum* (St John's wort), respectively.

Over the entire growth period, the inclusion of 2% dry rosemary to compound feed of chickens influenced adversely live weight of supplemented broilers vs controls. At the end of the fattening period (day 39), no significant difference in feed conversion ratio was demonstrated among control and experimental groups.

Slaughter yield (%), grill weight and breast with bone weight did not show considerable between-group differences, yet it could be seen that broilers from group E4 supplemented with 2% oregano with feed showed the highest average values for these parameters. Again, this group had the highest average thigh and wings weights, and they were the lowest in group E2, supplemented with 2% rosemary ($P < 0.05$).

The highest breast meat pH_{24} values were observed in group E2 supplemented with 2% rosemary, whereas the lowest (5.66) − in group E6 that received 2% St John's wort ($P < 0.001$). The highest breast meat L* was demonstrated by chickens from group E6 supplemented with 2% St John's wort – 63.06, whereas the lowest breast L* was found out in group E2 supplemented with 2% rosemary – 59.90 ($P < 0.001$). The highest WHC of breast meat was that of group E6 supplemented with 2% St John's wort – 23.20%. The lowest breast WHC percentage was measured in group E5 whose diet contained 2% thyme − 12.67%. The highest cooking loss percentage was observed in breast meat of controls (C) – 48.30% compared to chickens supplemented with 2% dry herbs whose meat cooking loss values were statistically significantly lower ($P < 0.001$). Physicochemical parameters of thigh meat in birds fed 2% dry herbs followed almost the same trends depending on the added dry herb.

The analysis of meat saturated fatty acids, LA18:2(n-6):linoleic acid, ALA18:3(n-3): linolenic acid, ARA20:4(n-6): arachidonic acid, EPA20:5(n-3): eicosapentaenoic acid and DHA22:6(n-3) – docosahexaenoic acid in breast and thigh meat did not differ significantly among the groups that received 2% dry herbs with feed and untreated controls.

Keywords: broiler; herbs; performance; carcass characteristics; meat quality

Introduction

For the last few decades, the utilisation of feed phytosupplements became increasingly popular in poultry farming. This is due to the ban of using antibiotics as growth promoters in EC countries since 2006 (Puvača et al., 2015a), as well as to numerous studies and evidence that herbs, added individually or in combination in the feed or drinking water, had beneficial effects on poultry health and productivity of poultry (Abudabos et al., 2016; Alzawqari et al., 2016; Hafeez et al., 2016; Ali et al., 2019; Sorwar et al., 2016; Yang et al., 2019; Ahmadian et al., 2020). Gerzilov et at. (2016) investigate the effect of the combination of 0.05% garlic powder, 0.03% cinnamon powder and five dried herbs – yarrow, rosemary, thyme, basil and oregano in an equal proportion (0.03% for each herb) on the growth performance, egg laying capacity, serum biochemical parameters, fatty acids in the egg yolk and the viability of chickens reared in free range management system. They find that over the entire investigation period the chickens from the experimental group had a better feed conversion ratio (with 3.37%) and the death rate from 0 to 7, from 8 to 21 and from 22 to 52 weeks of age was 18.33%, 0% and 8.57% in the control group and 1.00%, 0.26% and 2.62% in the experimental group, respectively.

The studies on herbs' effects on the productivity of poultry and the quality of their products are contradictory. Landy et al. (2012) reported that the addition of *Hypericum perforatum* powder (10 g/kg) influenced adversely growth performance by increasing feed consumption per 1 kg weight gain. Ghazalah & Ali (2008) and Tollba (2010) found out that the addition of rosemary leaves to broilers' diet had positive effects on slaughter traits. Many researchers reported that the supplementation of feed of broiler chickens with herbs did not influence meat quality (Marcinčáková et al., 2011; Marcinčák et al., 2011; Narimani-Rad et al., 2011).

The controversial results on effects of phytogenic additives documented by research trials motivated us to evaluate the effect from independent addition of 2% dry herbs from chamomile (*Matricaria chamomilla*), rosemary (*Rosmarinus officinalis*), lavender (*Lavandula angustifolia*), oregano (*Origanum vulgare*), thyme (*Thymus vulgaris*) and St John's wort (*Hypericum perforatum*) to compound feed on productive and meat quality traits.

Materials and Methods

Experimental design

Broilers were reared in the poultry farm of the Agricultural Institute, Stara Zagora. A total of 210, one day-old, male chickens (ROSS) were weighed individually and were randomly allocated to 7 treatment groups (n = 30) each with three replicates of 10 birds (3 replicates, 10 chicken/replicate) for 39 days, namely control (C) and experimentals (E1, E2, E3, E4, E5, E6). Control group broilers received basal diet and without the herbal. The basal diet was formulated for:

– Starter from 1 to 10 day old broiler – Crude protein -22.47% and Metabolic energy-2912.79 kcal/kg;
– Grower from 11 to 28 day old broiler – Crude protein-21.010% and Metabolic energy- 3042.19 kcal/kg;
– Finisher from 29 to 39 day old boiler – Crude protein-19.022% and Metabolic energy- 3111.17 kcal/kg.

The experimental groups received basal diet plus 2% supplemented with powder herbs (E1 – 2% *Matricaria;* E2-2% *Rosmarinus officinalis;* E3 – 2% *Lavandula;* E4 – 2% *Origanum vulgare;* E5 – 2% *Thymus;* E6 – 2% *Hypericum perforatum*). All diets were in mashed form. Each group was placed to a clean floor pen, in a brooder ring for the first seven days, with equal floor space, one feeder, one drinker and one heating lamp for each group. The litter (wood shavings) was covered with paper during the first week to prevent the poults from eating the litter. Birds had ad libitum access to feed and water and lighting was provided continuous.Feed intake was measured based on residual feed deduction from the total supplied feed. Body weight (BW) and feed intake (FI) were recorded by treatment group, and FCR (feed conversion ratio) per group were then calculated for the total experimental period.

Slaughter procedures and carcass evaluation

At 39 days of age, slaughter analysis was performed on 3 chickens with live body weight close to the group average value. After 12 hours of fasting, the birds were stunned and slaughtered as per Ordinance 22 of 14.12.2005 of the Ministry of Agriculture and Food for reduction of animal suffering during slaughter or killing to a minimum. The cleaned carcass, without the neck and edible offal was cut after 24-hour cooling at 0-4°C. Edible offal were removed during the slaughter after the legs, feathers and the head. Ten slaughter parameters were determined after evisceration and weighing of internal organs: live weight after 12-hour fasting, grill weight, breast with bone weight, thigh, wings, back, gizzard, liver, heart and abdominal fat weights. On the basis of these data, the slaughter yield and the ratios of different body parts were calculated.

Proximate analysis of meat

The analysis of meat quality traits was conducted at the Meat and meat products unit, Faculty of Agriculture, Trakia University – Stara Zagora. The samples for physicochemical analysis of breast and thigh muscles for determination of meat pH and

water holding capacity (WHC %) were obtained 24 hours post mortem from *m. pectoralis superficialis*, *m. pectoralis profundus* and *m. femorotibialis* with a Testo 205 pH-meter.

The water holding capacity (WHC %) of meat was determined by the classical method of Grau & Hamm (1953), described by Zahariev & Pinkas (1979) with modifications of Petrov (1982).

The colour of muscles was analysed in the CIE LAB system (CIE, 1986) using a spectrophotometer Lovibond SP60 (X-Rite Incorporated), calibrated with white and black standards. The coordinates L* (white-black), a* (red-green) and b* (yellow-blue) were determined 24 hours post mortem hour as followed:

m. Pectoralis superficialis – in the middle third of the medial surface (facies medialis) of the muscle;

*m. Pectoralis profu*ndus – in the middle third of the lateral surface (facies lateralis) of the muscle.

m. Femorotibialis – in the middle third of the medial surface (facies medialis) from the part of the cranial edge of the thigh.

The spectrophotometer was previously calibrated with white and black standards. The colour coordinates were measured by the protocol of Oguz et al. (2004) by three measurements in the same muscle area with spectrophotometer oriented along the length of muscle fibres during the first measurement. The 2nd and 3rd measurements were done at the same point after rotating the appliance at 45° and 90° clockwise. The mean arithmetic value from the three measurements of L* , a * and b* was finally retained.

The muscle colour was evaluated in the CIE L*, a*, b* colour space, where L* is meat lightness, a*- meat redness and b*- meat yellowness of. A colorimeter Minolta CR-400 (Konica Minolta, Osaka, Japan), with illuminate D65 and observation angle 2° was used.

Cooking loss was determined by cutting meat into 2- cm cubes, which were first weighed on analytical scales with precision of 0.0001 g. The meat cubes were then cooked in a forced air convection oven at 150° C for 10 minutes which resulted in a core meat cube temperature of 75-80°C.

After cooking, meat samples were carefully dried with filter paper and weighed again.

Cooking loss was calculated by the formula:

$$\text{Cooking loss, \%} = \frac{a - b}{a}.100$$

Fatty acids were expressed as a percentage of the sum of identified fatty acids.

Statistical Analysis

The data were analysed by One-Way ANOVA. When statistically significant differences ($P < 0.05$) were identified, a post hoc LSD test was also done to identify the level of significance of differences between average values. In case of lack of normal distribution, non-parametric Kruskal-Wallis test was performed.

Results and Discussion

Performance

The supplementation of broiler chickens' feed with 2% dry herbs during the starter period (1-10 days) had no statistically significant effect on live weight at the end of the period and it ranged between 190.47 g (for the group receiving 2% dry rosemary wit compound feed) to 225.57 g (for the group fed 2% oregano with compound feed) (Table 1).

At 28 days of age, the birds supplemented with 2% dry rosemary (E2 group) exhibited the lowest statistically significant live weight compared to controls (by 13.03%). The experimental group supplemented with 2% dry *Hypericum perforatum*, known as perforate St John's-wort also had a lower average live weight – by 3.03% vs controls, but the difference was not significant. During that period (11-28 days) the groups supplemented with 2% dry thyme – E5, chamomile – E1, lavender – E3, oregano – E4 with the feed had by 1.51% , 4.06%, 4.75% and 6.15% higher live weights, respectively, than controls yet differences were not statistically significant. At the end of the 39-day period, the chickens from the five experimental groups attained a live weight from 1667.14 g (group E3 supplemented with 2% lavender) to 1713.02 (group E4 supplemented with 2% oregano) which was close to the average weight of controls – 1705.94 g. The inclusion of 2% dry rosemary in the finisher had a negative effect on live weight of supplemented chickens – decrease by 11.80% (1504.60 g) vs controls (1705.94 g, $P < 0.05$).

The average daily weight gain of birds supplemented with 2% dry herbs at 10 days of age was comparable: from 14.52 g for the group supplemented with 2% rosemary to 18.12 g for the group supplemented with 2% oregano, but the differences were statistically insignificant. At 28 days of age, the group with the lowest weight gain was again E2 – supplemented with rosemary with the feed ($P < 0.05$), followed by the group that received 2% St John wort (38.33 g). At 39 days of age, the average weight gain varied from 41.62 g (in chickens supplemented with 2% lavender) to 42.78 g (in chickens supplemented with oregano). The lowest average daily weight gain was demonstrated for the group supplemented with 2% rosemary (37.42 g) and the average value was statistically significantly different compared to all other groups ($P < 0.05$).

Table 1 shows no statistically difference in the average daily feed intake among the groups. During the 1st and 10th day

Table 1. Performance of broilers supplemented with 2% dry herbs in the diet

Items	Groups							SEM	P-value
	C	E1	E2	E3	E4	E5	E6		
Body weight (BW), g									
1 d	44.58	44.40	45.23	44.10	44.37	44.50	44.23	0.39	0.706
10 d	223.36	219.77	190.47	205.50	225.57	204.80	205.73	8.57	0.089
28 d	1152.42 a,b	1199.20 a,b	1002.30 c	1223.32 a	1169.85 a,b	1207.20 a,b	1117.53 b	30.92	0.003
39 d	1705.94 a	1702.18 a	1504.60 b	1667.14 a	1713.02 a	1674.44 a	1678.71 a	42.50	0.048
Average daily gain (ADG), g/day									
1-10 d	17.88	17.27	14.52	16.14	18.12	16.03	16.15	0.80	0.078
1-28 d	39.56 a,b	41.24 a,b	34.18 c	41.54 a,b	42.11a	40.19 a,b	38.33 b	1.11	0.003
1-39 d	42.60 a	42.51 a	37.42 b	41.62 a	42.78 a	41.79 a	41.91 a	1.09	0.047
Daily feed intake (DFI), g/day									
1-10 d	31.54	29.37	28.08	29.52	33.57	30.27	29.92	1.33	0.178
1-28 d	67.45	66.19	62.50	67.02	68.51	69.47	63.68	2.69	0.536
1-39 d	76.70	74.32	67.52	72.91	76.45	77.48	69.99	2.34	0.069
Feed conversion ratio (FCR), kg/kg									
1-10 d	1.78	1.71	1.94	1.83	1.85	1.89	1.86	0.09	0.672
1-28 d	1.71	1.61	1.84	1.61	1.63	1.73	1.66	0.07	0.286
1-39 d	1.80	1.75	1.81	1.75	1.79	1.85	1.67	0.05	0.251

a, b, c – means with different letters in the row represent significant differences at $P < 0.05$

C – Control group; E1 – 2% *Matricaria*; E2 – 2% *Rosmarinus officinalis*; E3 – 2% *Lavandula;* E4 – 2% *Origanum vulgare*; E5 – 2% *Thymus*; E6 – 2% *Hypericum perforatum*

of life, the feed intake per 1 kg weight gain (FCR kg/kg) in groups fed 2% dry lavender, 2% oregano, 2% St John's wort, 2% thyme and 2% rosemary tended to increase by 2.81%, 3.93%, 4.49%, 6.18% and 8.99% respectively, compared to untreated controls, but the differences were inconsistent ($P > 0.05$). In a previous report, Landy et al. (2012) stated that the supplementation of St John's wort powder to the diet of broiler chickens had no effect on their growth performance. Broilers supplemented with the herb at 10 g/kg feed had higher feed intake compared to other groups during the starter period.

Better yet statistically insignificantly different feed conversion ratio by 3.93% vs controls was found out in the group supplemented with 2% dry chamomile (group E1). During the grower period (days 1-28), the dietary supplementation with 2% dry thyme (group E5) resulted in increased FCR by 1.17% (1.73 kg/kg) whereas the supplementation with 2% dry rosemary (group E2) – in considerable increase in FCR by 7.60% compared to control group. Lower FCR during that period was established for the other treatment groups: E1 – chamomile; E3 – lavender; E4 – oregano and E6 – St John's wort: by 5.85%, 5.85%, 4.68 and 2.92% respectively. It was reported that the chamomile blossom inhibited harmful intestinal microorganisms impeding their replication (Kolacz et al., 1997), and also, the addition of 0.25% chamomile blossoms in broiler diets improved productive performance and feed conversion ratio.

Over the entire experimental fattening period (days 1-39), the FCR ranged between 1.67 and 1.85 kg/kg weight gain. No statistically significant difference between FCR of groups that received 2% dry herbs with the compound feed was identified. In a trial with broiler chickens reared to 49 days of age, Ghazalah & Ali (2008) found out a positive effect from the addition of 0.5% rosemary leaves in the feed on daily feed consumption and feed conversion vs non-supplemented birds. In another experiment, the same authors demonstrated lower live weight after addition of 1% and 2% rosemary leaves to the diet and attributed the decreased feed intake to its taste in young birds. Abdel-Wareth et al. (2012) observed that the addition of thyme (*Thymus vulgaris*) and oregano (*Origanum vulgare*) to the compound feed at 15 or 20 $g.kg^{-1}$ may increase feed intake and daily weight gain of broilers.

Some authors reported positive effect on productive traits (Ertas et al., 2005; Peric et al., 2008), while others found not effect on live weight and feed conversion ratio (Ocak et al., 2008; Mikaili et al., 2010).

Survivalrate of this experiment was 100% in all treatments**.**

Slaughter yield

Data from slaughter analysis (Table 2) showed the highest slaughter weight in broilers from group E4, whose

Table 2. Slaughter traits properties of meat in broilers at 39 days of age supplemented with 2% dry herbs in the diet

Items	Groups							SEM	P-value
	C	E1	E2	E3	E4	E5	E6		
Slaughter weight, g	1724.00 a	1681.33 a,b	1515.00 c	1668.33 b	1741.67 a	1640.00 b	1665.00 b	14.16	0.000
Carcass yield , %	64.67	62.91	65.15	65.46	65.52	64.77	64.97	1.58	0.920
Carcass weight , g	1114.67	1057.67	987.00	1092.00	1141.33	1062.33	1082.33	29.41	0.053
Breast with bone, g	349.33	355.00	327.33	337.00	361.33	353.00	374.33	19.79	0.720
Thigh, g	352.67 b	342.33 b,c	317.67 c	361.00 b	393.33 a	348.33 b	354.33 b	9.39	0.003
Wings, g	133.33 a,c	131.67 b,c	125.67 b,c	127.67 b,c	142.00 a	138.00 a,d	133.67 a,b	3.10	0.031
Back, g	232.67	214.67	215.00	244.00	239.00	220.00	229.00	14.01	0.253
Gizzard, g	28.00	29.00	26.33	26.33	30.33	26.67	24.67	3.43	0.922
Liver, g	39.67	39.67	37.00	39.00	44.67	44.67	44.00	3.12	0.456
Heart, g	9.33	8.67	8.33	9.33	9.00	8.33	10.00	0.56	0.377
Abdominal fat, g	3.00	7.00	10.67	8.00	9.67	9.67	3.00	4.13	0.735
Spleen, g	2.67	2.16	2.50	2.00	2.00	2.67	1.50	0.55	0.517
Bursa, g	4.83	3.67	1.50	3.00	1.17	1.33	2.17	0.76	0.088

a, b, c – means with different letters in the row represent significant differences at $P < 0.05$

C – Control Group; E1 – 2% *Matricaria;* E2 – 2% *Rosmarinus officinalis*; E3 – 2% *Lavandula*; E4 – 2% *Origanum vulgare;* E5 – 2% *Thymus;* E6 – 2% *Hypericum perforatum*

diet was supplemented with 2% oregano – 1741.67 g and controls (group C) – 1724.00 g. Slightly lower live weight (1681.33 g) was found out in broiler supplemented with 2% dry chamomile (E1), followed by group E3 that consumed 2% dry lavender with the feed -1668.33 g, group E6 – 2% dry St John's wort (1665.00 g), group E5 – 2% dry thyme (1640.00 g) and finally, group E2 supplemented with 2% dry rosemary -1515.00 g ($P < 0.001$).

Slaughter yield (%), gill weight and breast with bone weight did not show statistically significant differences among the groups, but it should be noted that the highest values of these parameters were determined in group E4 that was supplemented with 2% oregano with the feed. The highest thigh and wings weights were in group E4 again, while they were the lowest in group E2 that received 2% rosemary with the feed ($P < 0.05$). The weights of the other studied slaughter traits – back, gizzard, liver, heart, abdominal fat, spleen and bursa, did not differ consistently ($P > 0.05$). The data of Hernández et al. (2004) and Landy et al. (2012) reported lack of significant impact from the addition of phytogenic supplements on slaughter traits of broiler chickens. Criste et al. (2017) have investigated the addition of 2% dry oregano and 2% *dog rose* powder on the productivity and slaughter traits in broiler chickens and reported statistically significantly lower liver weight ($P < 0.05$) in control birds compared to supplemented ones, whereas the spleen of the 2% oregano group was considerably larger ($P < 0.05$) than that of controls and of birds supplemented with 2% dog rose powder. Ghazalah & Ali (2008) and Tollba (2010) established that the addition of rosemary leaves to feed of broilers had positive effects on slaughter weight, slaughter yield and offal. Abdulkarimi et al. (2011) and Rafiee et al. (2013) found out substantial increase in grill weight, breast and gizzard weights in broilers whose feed was supplemented with thyme. Ahmadian et al. (2020) reported that abdominal fat was reduced by 41% in chickens fed thyme and by 62% in those fed sumac whereas according to Ocak et al. (2008), the addition of thyme leaves to the feed increase abdominal fat proportion in broilers at 42 days of age.

Quality of Meat

The results from physicochemical parameters of breast and thigh meat of chickens whose feed was supplemented with 2% dry herbs are presented in Table 3. The breast pH_{24} values were the highest in group E2 (supplemented with 2% rosemary) and the lowest: 5.66 in group E6 (supplemented with 2% St John's wort) ($P < 0.001$). The average pH_{24} of poultry meat varies from 5.6 to 6.1 (Berri et al., 2005; Mikulski et al., 2010). The pH_{24} values obtained in the present study were in the optimum part of the reference range. The analysis of colour characteristics of poultry meat, especially breast L* values demonstrated differences. The highest lightness was obtained for breast meat from group E6 that was supplemented with 2% St John's wort – 63.06, followed by non-supplemented controls – 62.97 and the lowest L* values were found out in broilers fed 2% rosemary – 59.90 ($P < 0.001$). Breast a* and b* characteristics did not show any consistent differences among the groups. This study revealed that the highest WHC was that of breast meat of chickens supplemented with 2% St

Table 3. Physicochemical properties of meat in broilers at 39 days of age supplemented with 2% dry herbs in the diet

Items		Groups							SEM	P-value
	C	E1	E2	E3	E4	E5	E6			
Breast	pH_{24}	5.65 b	5.82 a,b	5.84 a	5.70 a,b	5.71 a,b	5.70 a,b	5.66 b	0.04	0.001
	L*	62.97 a	59.85 a,b	56.90 b,c	60.88 a,c	61.83 a	57.29 b	63.06 a	0.90	0.000
	a*	3.59	2.29	2.36	2.47	3.12	2.60	2.54	0.36	0.126
	b*	6.18	5.39	5.17	5.19	6.21	6.10	6.48	0.57	0.485
	WHC, %	17.92 b	20.54 a,b	14.49 b	16.45 b	19.02 a,b	12.67 b	23.20 a	1.33	0.001
	Cooking loss, %	48.30 a	26.39 c	25.53 c	24.11 c	30.14 b	25.59 c	25.99 c	1.31	0.000
Thight	pH_{24}	5.87 b	6.12 a	6.16 a	6.07 a,c	5.84 b	5.90 b,c	5.86 b	0.07	0.002
	L*	58.78	55.61	56.37	55.02	56.72	56.88	59.28	1.07	0.054
	a*	8.60	10.33	7.53	10.03	9.77	10.26	7.80	1.04	0.277
	b*	6.89	8.93	5.25	7.37	8.43	7.97	7.19	0.91	0.169
	WHC, %	15.83 a	11.97 a,b	8.59 b	8.34 b	11.17 a,b	12.41 a,b	15.75 a	1.36	0.001
	Cooking loss, %	48.07 a	28.53 c	28.91 c	28.11 c	37.95 b	31.25 c	31.86 c	1.33	0.000

a, b, c – means with different letters in the row represent significant differences at $P < 0.05$

C – Control group; E1 – 2% *Matricaria*; E2 – 2% *Rosmarinus officinalis*; E3 – 2% *Lavandula*; E4 – 2% *Origanum vulgare*; E5 – 2% *Thymus;* E6 – 2% *Hypericum perforatum*

John's wort – 23.20%, followed by group E1 that received 2% chamomile (20.54%) and group E4 that received 2% oregano (19.02%). The lowest meat WHC was found out for breast meat of group E5 supplemented with 2% thyme – 12.67%. The highest cooking loss percentage of breast meat was observed for the control group – 48.30%; compared to this group, all experimental groups supplemented with 2% dry herbs exhibited statistically significantly lower values ($P < 0.001$).

The physicochemical parameters of thigh meat from chickens fed 2% dry herbs showed nearly the same tendencies depending on the type of added herb (Table 3). Thigh meat pH_{24} were the highest (6.16) in group E2 that received 2% rosemary and the lowest in the group supplemented with 2% St John's wort and 2% oregano (5.86 and 5.84 respectively; $P < 0.001$). The colour characteristics of thigh meat (L*,a*,b*) showed no statistically significant differences in supplemented groups. The highest thigh meat WHC was obtained in chickens fed 2% St John's wort (15.75%) and in controls (15.83%), whereas the lowest – in the groups supplemented with 2% lavender − 8.34% and 2% rosemary – 8.59% ($P < 0.001$). The highest cooking loss percentage of

Table 4. Fatty acid content (%) of thigh and breast muscles in broilers at 39 days of age supplemented with 2% dry herbs in the diet

Items		Groups							SEM	P-value
	C	E1	E2	E3	E4	E5	E6			
Breast	SFA	0.56	0.56	0.83	0.33	0.41	0.52	0.44	0.20	0.70
	LA18:2(n-6)	0.53	0.48	0.79	0.31	0.37	0.48	0.23	0.14	0.20
	ALA18:3(n-3)	0.02	0.02	0.04	0.02	0.02	0.04	0.01	0.01	0.60
	ARA20:4(n-6)	0.02	0.01	0.02	0.01	0.00	0.01	0.00	0.01	0.48
	EPA20:5(n-3)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	–	–
	DHA22:6(n-3)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	–	–
Thight	SFA	1.95	2.60	2.79	2.14	2.71	1.80	2.37	0.52	0.76
	LA18:2(n-6)	1.83	2.33	2.51	1.98	2.46	1.70	2.11	0.41	0.58
	ALA18:3(n-3)	0.06	0.07	0.21	0.06	0.14	0.06	0.10	0.07	0.71
	ARA20:4(n-6)	0.02	0.02	0.01	0.02	0.01	0.02	0.02	0.01	0.77
	EPA20:5(n-3)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	–	–
	DHA22:6(n-3)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	–	–

C – Control *group; E1 – 2% Matricaria; E2 – 2% Rosmarinus officinalis; E3 – 2% Lavandula; E4 – 2% Origanum* vulgare; E5 – 2% *Thymus;* E6 – 2% *Hypericum perforatum*

SFA – saturated fatty acids; LA18:2(n-6) – linoleic acid; ALA18:3(n-3) – linolenic acid; ARA20:4(n-6) – arachidonic acid; EPA20:5(n-3) – eicosapentaenoic acid; DHA22:6(n-3) – docosahexaenoic acid

thigh meat was found out in controls – 48.07%, while all supplemented groups demonstrated statistically significantly lower values ($P < 0.001$).

The saturated fatty acids, linoleic acid, α-linolenic acid, arachidonic acid, eicosapentaenoic acid and docosahexaenoic acid proportions in breast and thigh meat of studied groups of chickens are presented in Table 4.

The results from analysis of saturated fatty acids, LA18:2(n-6) linoleic acid, ALA18:3(n-3) α-linolenic acid, ARA20:4(n-6) arachidonic acid, EPA20:5(n-3) eicosapentaenoic acid and DHA22:6(n-3) docosahexaenoic acid contents in breast and thigh meat did not present any consistent between-group differences. The studied fatty acids did not differ substantially between supplemented groups (E1, E2, E3, E4, E5 and E6) vs the control one (C). These findings are in line with data reported by Eleroğlu et al. (2013), affirming that the addition of dry oregano and lemon balm leave to broilers' diet had not significant effect on fatty acid profiles of breast and thigh meat. Conversely, Gálik et al. (2015) reported differences in the content of some fatty acids in the thigh and breast meat of control turkey poults and birds whose feed was supplemented with phytoadditives.

Conclusion

In the present experiment, the inclusion of 2% dry rosemary to compound feed of chickens influenced adversely live weight of supplemented birds (1504.60 g) vs controls (1705.94 g) ($P < 0.05$). At the end of the fattening period (days 1−39), no statistically significant difference in feed conversion ratio was demonstrated among control and experimental groups. Compound feed supplementation with 2% dry herbs had not considerable effect on slaughter traits of 39-day-old broiler chickens. The highest cooking loss percentage was observed in breast and thigh meat of controls (C) compared to chickens supplemented with 2% dry herbs. The analysis of meat saturated fatty acids, LA18:2(n-6):linoleic acid, ALA18:3(n-3): linolenic acid, ARA20:4(n-6): arachidonic acid, EPA20:5(n-3): eicosapentaenoic acid and DHA22:6(n-3) – docosahexaenoic acid in breast and thigh meat did not differ significantly among the groups.

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