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EFFECT OF HERB MIXTURE ON PRODUCTIVITY, MORTALITY, CARCASS QUALITY AND BLOOD PARAMETERS OF BROILER CHICKENS

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Abstract

A total of 608 Ross 308 chickens were studied for the effect of diets with added 1% herb mixture in the presence of mannan oligosaccharide and fumaric acid (WHE), compared to the group receiving no herbs (NHE), the control group (CON) and the group receiving antibiotic (ANT). In the antibiotic group (ANT) and in the group receiving no herb mixture (NHE), the final body weight of the broilers increased significantly compared to the control group (CON; P<0.01). Mannan oligosaccharide and fumaric acid with herbs (WHE) did not increase broilers' body weight either, compared to the control group (CON) and reduced it significantly compared to the group given no herbs (NHE; P<0.01). Mannan oligosaccharide and fumaric acid with (WHE) and without (NHE) herb mixture reduced chicken mortality compared to the control group (CON). It did not differ from that in the antibiotic group (ANT). Compared to no herb supplementation (NHE), herb mixture (WHE) had no significant effect on chicken mortality. There were no significant differences in feed intake and conversion between the groups. Mannan oligosaccharide and fumaric acid with (WHE) and without (NHE) herb mixture significantly increased the weight of carcasses compared to the control group (CON; P<0.01). The treatment factors had no effect on dressing percentage. The herb mixture (WHE) significantly increased gizzard weight compared to the other groups (P<0.01). It is concluded that the experimental herb mixture given to broiler chickens in the presence of mannan oligosaccharide and fumaric acid did not have a beneficial effect on production and carcass quality parameters and failed to reduce chicken mortality.

Key words: broilers, herb mixtures, body weight, feed conversion, mortality, meat composition, blood serum

The lack of antibiotics in feed mixtures increases inflammation of the intestinal mucosa and the incidence of diarrhoea, reduces the rate of growth, and increases broiler mortality and production costs (Davidson, 2003). It increases the use of in-feed antibiotics in the form of medicated feeds. Although there are no official data available in Poland, this view is held by most veterinarians who work in practice (personal communication).

Researchers are still looking for a bactericidal substance to replace feed antibiotics in livestock feeding. The search is on for dietary supplements that have a negative effect on gastrointestinal pathogens such as *Clostridium*, *Escherichia coli*, *Campylobacter* and *Salmonella* Spp. Earlier findings show a positive effect on chicken performance of probiotic bacteria, mannan oligosaccharide and feed acidifier in the form of fumaric acid (Patterson and Burkholder, 2003; Chung and Day, 2004; Brzóska et al., 2005, 2007). Certain types of herbs which are considered an antibacterial factor, are made into mixtures or extracts for piglets, fattening pigs, laying hens or broiler chickens. Herb mixtures contain biologically active substances that are formed during plant photosynthesis and are classified as alkaloids, saponins, tannins, flavonoids, aromatic substances, volatile oils, terpens or mucilages (Grela and Klebaniuk, 2001). Increasing immunobiological resistance in addition to antibacterial action is an important role of herbs in diets for living organisms (Łuczkowska et al., 2005).

Research to date concerning the use of herb mixtures in broiler diets has produced inconsistent results (Fritz et al., 1990; Fritz et al., 1992; Fritz et al., 1993). Fritz et al. (1992) showed no significant effect of herb mixture on chickens' body weight, with an increase in mortality in relation to the control group receiving the antibiotic Avotan. Earlier studies published by Fritz et al. (1990, 1992) reach different conclusions, namely that herbs can replace antibiotics in broiler feeds and have a positive effect on body weight and feed conversion.

It was hypothesized that combined use of mannan oligosaccharide and fumaric acid with herb mixture in broiler diets may increase the power of herbs to influence the digestive system of chickens, and thus to reduce mortality and improve productivity.

The objective of the study was to determine the effect of giving chickens dietary herbs with and without prebiotic and acidifier on body weight, mortality, dressing percentage, weight of carcass and carcass cuts, and basic parameters of blood plasma.

Material and methods

A total of 608 day-old Ross 308 broiler chickens were randomly assigned to 4 groups and placed in 16 pens. Each group had 4 replications with 38 birds per replication. Chickens were kept in wire-mesh pens on wood-shavings litter with free access to feed and water. Stocking density was 16 chicks/m^2 at the beginning of rearing and 34 kg of body weight/m^2 at the end of rearing. Chickens were maintained in a centrally heated facility. Until 21 days of age, they were heated with panel heaters. The treatment factor was commercial herb mixture for growing poultry, used in starter and grower diets (Table 1). The herb mixture contained the following herbal plants (% by weight): chamomile inflorescence (*Metricaria chamomilla*), peppermint (*Mentha piperita*), marigold flower (*Calendula officinalis*), St. John's wort (*Hypericum perforatum*), marshmallow root (*Althaea officinalis*), yarrow (*Achillea millefolium*) and stinging nettle (*Urtica dioica*).

Table 1. Feed ingredients and additives and nutritive value of starter and grower diets (g/kg)

Item	Diet	
	Starter, 1–21 days	Grower, 22–42 days
Diet ingredients:		
Maize	26.90	34.40
Wheat	28.60	23.60
Soybean meal	32.00	28.50
Rapeseed meal	4.00	4.00
Herb mixture	2.00	2.50
Dicalcium phosphate	1.70	1.70
Ground limestone	0.60	0.60
Sodium chloride	0.35	0.35
L-lysine HCL (78%)	0.11	0.11
DL-methionine (99%)	0.14	0.14
Vitamin-mineral premix[1, 2)]	0.50	0.50
Biomos (mannan oligosaccharide)	0.10	0.10
Fumaric acid		
Nutrients per kg diet dry matter:		
Crude protein (g)	236.6	223.8
Lysine (g)	10.70	10.74
Methionine-cystine (g)	6.80	6.71
Calcium (g)	8.3	8.5
Phosphorus (g)	6.8	6.9
Metabolizable energy (MJ)	12.55	12.49

[1)] Supplements per kg starter diet: vit. A 13 500 IU; vit. D 3 600 IU; vit. E 45 mg; vit. B_1 3.25 mg; vit. B_2 7.5 mg; vit. B_6 5 mg; vit. B_{12} 0.0325 mg; vit. K_3 3 mg; biotin 0.15 mg; nicotinic acid 45 mg; calcium panthothenate 15 mg; folic acid 1.5 mg; choline chloride 100 mg; Mn 100 mg; Cu 1.75 mg; Fe 76.5 mg; Se 0.275 mg; I 1 mg; Zn 75 mg; Co 0.4 mg; Endox (antioxidant) 125 mg; Sincox (coccidiostat) 1 g and calcium 0.679 g.

[2)] Supplements per kg grower diet: vit. A 12 000 IU; vit. D 3 250 IU; vit. E 40 mg; vit. B_1 2 mg; vit. B_2 7.25 mg; vit. B_6 4.25 mg; vit. B_{12} 0.03 mg; vit. K_3 2.25 mg; biotin 0.1 mg; nicotinic acid 40 mg; calcium panthothenate 12 mg; folic acid 1.0 mg; choline chloride 450 mg; Mn 100 mg; Cu 1.75 mg; Fe 76.5 mg; Se 0.275 mg; I 1 mg; Zn 75 mg; Co 0.4 mg; Endox (antioxidant) 125 mg; Sincox (coccidiostat) 1 g and calcium 0.79 g.

The negative control group (CON) and the positive control group (ANT) were not supplemented with herb mixture, mannan oligosachcharide and fumaric acid. The positive control group received 5 mg Flavomycin/kg of diet. The experimental groups were supplemented with mannan oligosaccharide and fumaric acid (MOS + FUA), the third experimental group received no herb mixture (WTH) and the fourth experimental group received 15 g herb mixture/kg of diet (WHE). The mannan oligosaccharide was purchased from Alltech-Polska Co. as Biomos supplement and given at 1 g/kg feed. Fumaric acid was purchased from ORFFA-Polska Sp. z o.o. and given at 9.7 g/kg feed.

Chickens were fed *ad libitum* experimental feed concentrate. Body weight was recorded at 21 and 42 days of age after a 12-hour feed withdrawal. Mortality was monitored throughout the experiment. Feed intake was measured in groups and individual feed intake was calculated with regard to bird mortality during the experiment. On the 43rd day of the experiment, 16 birds (8 cockerels and 8 hens) were selected from each group and slaughtered. Blood samples were collected into

heparin-containing tubes and centrifuged to obtain plasma. Warm carcass weight, gizzard weight, and weight of depot fat were determined. After slaughter, carcasses were weighed, dressing percentage was calculated and the carcasses were cooled in a chamber at 5°C for 24 h. The weight of gizzard, liver and depot fat was expressed as a percentage of hot carcass weight. On the next day, carcasses were dissected according to the procedure described by Zgłobica and Różycka (1972). The weight of breast and leg muscles was expressed as a percentage of cold carcass weight. Right breast muscles were sampled, ground and frozen at –18°C for chemical analyses. The samples were thawed after two weeks. The meat tissue was assayed for the content of dry matter, crude protein, crude fat and crude ash. The analyses were performed with standard methods used at the Central Laboratory of the National Research Institute of Animal Production, in accordance with the AOAC (1990) procedures. Fresh blood plasma was analysed for glucose, and the other components (including total protein and triglycerides) were determined in thawed plasma using enzymatic methods and diagnostic kits (Cormay, Lublin). Measurements were made with a Beckmann DU640 spectrophotometer.

The data were analysed statistically by analysis of variance and Duncan's multiple range test using SAS Institute software (1989).

Results

Feed ingredients and the nutritive value of starter and grower diets are shown in Table 1. Giving broiler chickens the antibiotic diet (ANT) and the diet with mannan oligosaccharide and fumaric acid without herb mixture (NHE) significantly increased the final body weight of the chickens compared to the unsupplemented control group (CON; $P<0.01$; Table 2). Giving mannan oligosaccharide and fumaric acid with herbs (WHE) did not increase it significantly compared to the no-herb group (NHE; $P<0.01$). Giving mannan oligosaccharide and fumaric acid with (WHE) and without herbs (NHE) reduced mortality compared to the control group (CON). It did not differ from the antibiotic-supplemented group (ANT). The group with herb mixture (WHE) compared to the no-herb group (NHE) had no significant differences in feed intake and conversion between the control and experimental groups.

Warm and cooled carcass weight in chickens receiving mannan oligosaccharide and fumaric acid with (WHE) and without herbs (NHE) was significantly higher than that of the control chickens (CON; $P<0.01$). It did not differ from the antibiotic-supplemented group (Table 3).

The treatment factors had no significant effect on dressing percentage. There were no significant differences in the proportion of breast muscle, leg muscle and gizzard weight in carcass weight. Giving herb mixture (WHE) significantly increased gizzard weight compared to the other groups ($P<0.01$). Giving antibiotics (ANT) and mannan oligosaccharide and fumaric acid with (WHE) and without herbs (NHE) significantly increased the amount of depot fat in the carcasses ($P<0.01$).

Table 2. Broilers' body weight, mortality and feed conversion

Item	Dietary factor				SEM
	CON	ANT	MOS + FUA		
			NHE	WHE	
Body weight, 21 days (g)	660 aA	752 bB	805 cC	677 aA	5
Body weight, 42 days (g)	2430 aA	2486 abAB	2555 bB	2439 aA	13
Mortality (%)	2.43 bB	1.85 aA	1.94 aA	1.89 aA	0.37
Feed intake (kg/42 days)	4.25	4.38	4.42	4.39	0.05
Feed conversion (kg/kg of BWG)	1.78	1.79	1.74	1.80	0.01

a, b, c – values in the rows with different letters differ significantly (P<0.05.)
A, B, C – values in the rows with different letters differ significantly (P<0.01).
CON – control.
ANT – antibiotic.
MOS – prebiotic.
FUA – fumaric acid.
NHE – without herb mixture.
WHE – with herb mixture.
SEM – standard error mean.
BWG – body weight gain.
LBW – final live body weight.

Table 3. Carcass weight, dressing percentage, and weight of breast and leg muscles

Item	Dietary factor				SEM
	CON	ANT	MOS + FUA		
			NHE	WHE	
Final body weight (g)	2447 aA	2457 aA	2580 bB	2491 aA	32
Warm carcass weight (g)	1844 aA	1881 aAbB	1919 bB	1901 bB	25
Cooled carcass weight (g)	1799 aA	1836 bB	1872 cC	1867 cC	24
Dressing percentage (%)	72.87	74.72	74.28	72.99	0.33
Breast muscles (%LBW)	24.8	25.3	23.9	23.6	0.42
Leg muscles (%LBW)	20.9	20.9	29.6	20.9	0.46
Gizzard (%LBW)	1.6	1.6	1.6	1.7	0.1
Liver (%LBW)	2.4 aA	2.3 aA	2.4 aA	2.7 bB	0.1
Depot fat (%LBW)	1.7 aA	2.1 bB	2.0 bB	2.0 bB	0.2

a, b, c – values in the rows with different letters differ significantly (P<0.05).
A, B, C – values in the rows with different letters differ significantly (P<0.01).
For explanations see Table 2.

The treatment factor had no significant effect on the chemical composition of breast muscle (Table 4). No significant differences were found in the content of dry matter, crude protein and crude fat in breast muscle tissue. In the group with herbs (WHE) there were significantly increased plasma levels of glucose and triglycerides compared to both control groups (CON; ANT; P<0.01), with no significant differences in total protein content.

Table 4. Breast muscle components and blood serum parameters

Item	Dietary factor				SEM
	CON	ANT	MOS + FUA		
			NHE	WHE	
Chemical composition of meat (% DM):					
Dry matter	25.08	24.88	25.15	25.14	0.07
Crude protein	23.76	23.50	23.78	23.92	0.07
Ether extract	1.01	1.07	1.16	1.12	0.03
Crude ash					
Blood serum parameters (mg/dl):					
Glucose	262.60 aA	270.90 abAB	292.20 bcBC	301.60 cC	3.87
Total protein	3.25	3.34	3.17	3.21	0.04
Triglycerides	36.38 aA	41.59 abAB	59.82 bcBC	54.20 cC	2.40

a, b, c – values in the rows with different letters differ significantly ($P<0.05$).
A, B, C – values in the rows with different letters differ significantly ($P<0.01$).
For explanations see Table 2.

Discussion

Research on the use of herb mixtures in animal nutrition began before a ban on in-feed antibiotics was considered. The ban on in-feed antibiotics in the feeding of animals, including broiler chickens, has forced producers to find bactericidal substances and feed ingredients that have no negative effect on poultry growth and meat quality while reducing chickens' mortality during the first weeks of rearing. Antibiotics used in the feed mixtures inhibited the development of unwanted bacterial microflora in the digestive tract of birds by preventing diarrhoea and deaths. These antibiotics were dietary supplements with negative effects on pathogens such as *Clostridium*, *Escherichia coli*, *Campylobacter* and *Salmonella* Spp.

The antibacterial action of herbs on human and animal organisms has long been known. Increasing immunobiological resistance in addition to antibacterial action is an important role of herbs in diets for living organisms (Łuczkowska et al., 2005). Certain herbs influence secretory function of some organs, including the digestive tract, intestines, pancreas and liver. Research to date concerning the use of herb mixtures in broiler diets has produced inconsistent results (Fritz et al., 1990; Fritz et al., 1992; Fritz et al., 1993). Research by Fritz et al. (1992) showed that herb mixture had no significant effect on the growth rate and final body weight of broiler chickens but increased mortality in relation to the antibiotic Avotan group. Other studies published by Fritz et al. (1990, 1992) conclude that herbs can replace antibiotics in broiler feeds and have a positive effect on body weight and feed conversion. A tendency towards better sensory quality of meat, including tenderness, colour and taste was also demonstrated (Fritz et al., 1990, 1993). Later research by Schleicher et al. (1998) concerning the effect of single herbs on rearing performance of broiler chickens showed that herbs such as onion, thyme, chamomile and dandelion, which

are often used in herb mixtures for chickens, have a negative effect on the body by reducing body weight at 52 days of age and reducing feed conversion efficiency. Chamomile and dandelion were the only herbs to reduce mortality. The reasons for chicken mortality were not identified.

In later studies, Wężyk et al. (2000 a, b) and Połtowicz and Wężyk (2001) suggested, based on the evaluation of broiler chicken meat quality and feeding of laying hens supplemented with herbs that they have a beneficial effect on rearing conditions and egg and carcass colour while improving their quality. Subsequent research by Czaja and Gornowicz (2004) showed that dietary herb mixture may increase the body weight of chickens. In the above research, chicken mortality did not decrease and it was also found that giving chickens herb mixture may increase the fat content of leg muscles. A review of the Polish studies has shown that the results obtained are considerably different and often studies have shown that the results obtained are considerably different and often contradictory.

Research conducted at the National Research Institute of Animal Production in conjunction with the Institute of Agricultural and Food Biotechnology has confirmed the suitability of probiotic bacteria, oligosaccharides and low-molecule organic acids in broiler chicken nutrition as they match antibiotics' efficiency in the digestive tract. Good effects were obtained when these factors were used separately (Collins and Gibson, 1999; Ricke, 2003), but best results were obtained when they were applied together (Brzóska, 2007; Brzóska et al., 2007). Because no studies used herb mixtures or herb extracts in the presence of a prebiotic and acidifier, it was hypothesized that the application of a prebiotic and acidifier may strengthen the antibacterial action and the power of herb mixture to influence the digestive system of chickens, improve nutrient absorption and thus feed conversion efficiency, and increase chicken survival by reducing deaths due to inflammation of the digestive tract.

The present findings only partly supported this hypothesis, because herb mixture was found to have no positive effect on increased body weight. On the contrary, the herb mixture reduced chickens' body weight, as a result of which the carcasses were lighter and smaller than those from birds receiving the in-feed antibiotic. This demonstrates that the herb mixture failed to stimulate chickens with regard to nutrient use and conversion into meat, fat and bone tissue. The herb mixture given to chickens also failed to differentiate feed intake and conversion. Dressing percentage was uniform but lower in the unsupplemented negative group and in the group supplemented with herbs. When used in the presence of mannan oligosaccharide and acidifier, the herb mixture did not reduce bird mortality. It seems that the use of herb mixtures in broiler chicken nutrition does not produce the expected results. Herb mixtures for animals are made mainly from waste material from the production of herbs as a supplement of the human diet. These preparations are not standardized for the content of active substances although their botanical composition is known. What is more, herb mixtures may differ according to production plant, production technology and the growing season, which may be the reason for divergent results.

It is concluded that the experimental herb mixture given to broiler chickens in the presence of prebiotic (mannan oligosaccharide) and acidifier (fumaric acid) does not have a specific effect on the birds, especially in terms of body weight, mortality

and carcass quality. Standardization of the herb mixture as a dietary supplement for birds is necessary.

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Wpływ mieszanki ziołowej na wyniki produkcyjne, śmiertelność, jakość tuszek i wskaźniki krwi kurcząt rzeźnych

STRESZCZENIE

Na 608 kurczętach ROSS-8 badano wpływ mieszanki ziołowej (WHE) podawanej w obecności prebiotyku (oligosacharydu manganu) i zakwaszacza (kwasu fumarowego), w porównaniu do grupy kontrolnej (CON) i grupy otrzymującej antybiotyk paszowy (ANT). Podawanie kurczętom rzeźnym mieszanki paszowej zawierającej antybiotyk (ANT), a także oligosacharyd mannanu z kwasem fumarowym bez mieszanki ziołowej (NHE) istotnie zwiększyło końcową masę ciała kurcząt w porównaniu do grupy kontrolnej bez dodatków (CON; $P<0,01$). Podawanie oligosacharydu mannanu i kwasu fumarowego z dodatkiem ziół (WHE) nie zwiększyło masy ciała kurcząt w porównaniu do grupy kontrolnej (CON), a obniżyło ją istotnie w porównaniu do grupy bez ziół (NHE; $P<0,01$). Podawanie oligosacharydu mannanu i kwasu fumarowego bez (NHE) i z dodatkiem ziół (WHE) zmniejszyło śmiertelność kurcząt w porównaniu do grupy kontrolnej (CON). Podawanie mieszanki ziołowej (WHE) w porównaniu do grupy bez ziół (NHE) nie miało istotnego wpływu na ilość upadków kurcząt i nie różniło się istotnie. Nie stwierdzono istotnych różnic w spożyciu i wykorzystaniu paszy.

Masa tuszek ciepłych i zimnych kurcząt otrzymujących oligosacharyd mannanu i kwas fumarowy bez (NHE) i z dodatkiem ziół (WHE) była istotnie wyższa od tuszek kurcząt kontrolnych (CON; $P<0,01$). Nie różniła się od grupy otrzymującej antybiotyk. Nie stwierdzono istotnego wpływu badanych czynników na wydajność rzeźną kurcząt. Nie stwierdzono również istotnych różnic w proporcji masy mięśnia piersiowego, mięśni nóg i masy żołądka w masie tuszki. Podawanie mieszanki ziołowej (WHE) zwiększyło istotnie masę żołądka w porównaniu do pozostałych grup ($P<0,01$). Podawanie kurczętom antybiotyku (ANT) oraz oligosacharydu mannanu i kwasu fumarowego bez (NHE) i z dodatkiem mieszanki ziołowej (WHE) zwiększyło istotnie ilość tłuszczu zapasowego w tuszkach ($P<0,01$).

Z badań wynika, że podawanie kurczętom mieszanki ziołowej nie miało dodatniego wpływu na masę kurcząt i masę tuszek, spożycie i wykorzystanie paszy, nie różnicowało istotnie składu mięśni piersiowych, nie wpływało na wskaźniki surowicy krwi oraz na śmiertelność w porównaniu do kurcząt nieotrzymujących ziół.