Effects of administering an essential oil mixture and an organic acid blend separately and combined to diets on broiler performance

Einfluss des Einsatzes von Mischungen an ätherischen Ölen und organischen Säuren einzeln und in Kombination im Futter auf die Leistung von Broilern

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Introduction

Feed additives both antibiotics and organic acids have antimicrobial effects against pathogenic bacteria like *E. coli*, *Salmonella spp* and *Campylobacter spp*. which are found in gut microflora (CORPET, 2000; McCARTNEY, 2001; RICKE, 2003). Beyond their antimicrobial effects, organic acids and antibiotics improve protein digestibility and energy metabolism by reducing the incidence of sub-clinical infections and, thus, promoting growth and feed efficiency (ENGBERG et al., 2000; RICKE, 2003; DIBNER, 2004; GARCIA et al., 2003; MANZANILLA et al., 2004; FENG ZHOU et al., 2007). However, consumers have become alarmed by the hazards associated with the sub-therapeutic use of antibiotics in pig and poultry feeds. Thus, the prophylactic use of AGPs in animal feed was banned in the European Union at the beginning of 2006 (CERVANTES, 2006; MICHAID, 2008).

There is a need for alternatives to AGPs that ensure animal health and performance without compromising human health. Such alternatives – so-called „alterbiotics“ have, so far, been based mostly on probiotics, prebiotics, organic acids, phyto products, enzymes, betain or mixtures of these (HERTRAMPF, 2001; O’KEEFE, 2005; PLAAL, 2006; VAN DAM, 2006).

Herbal medicines, including the extracts and essential oils of some herbs and spices are gaining importance as natural alternatives, especially in regions where AGPs are prohibited (GILL, 1999; LANGHOUT, 2000; MELLOR, 2000; HERTRAMPF, 2001). Besides having well-demonstrated antimicrobial effects, it has been suggested that essential oils improve feed digestion by stimulating the digestive enzyme activities of intestinal mucosa and the pancreas (RAMARSHINA et al., 2003; JAMROZ et al., 2005; BASMACIOGLU et al., 2010). It is supposed that when bactericide and bacteriostatic effects of essential oils are combined with the antibacterial effects of acidification, the microflora population in the gut are controlled more effectively (LUCKSTADT, 2005). Several studies have shown that combining essential oils and acids generates antibacterial activities in gut lumen and acts as a growth promoter in early life of pigs and broilers (MANZANILLA et al., 2004; FENG ZHOU et al., 2007) – i.e. that essential oils and acids provide more benefits when combined than when administered individually. Therefore, investigating the potential synergistic or additive benefits of combining essential oils with other feed additives, including organic acids, probiotics, prebiotics and enzymes particularly in AGP-free feeding assays is of far higher importance than investigating the individual effects of each of these.

This study was conducted to investigate the effects of three doses of individual and combined dietary supplements of specific blends of organic acids and essential oils on broiler performance. Special attention was paid to possible synergisms between organic acids and essential oils and to the use of these in novel, antibiotic-free, feed-additive strategies.

Materials and Methods

Three thousand and three hundred one-day-old broiler chicks (Ross-308) obtained from a commercial hatchery were divided into 11 treatment groups of 300 birds each and randomly assigned to 11 treatment diets. Each treatment group was further sub-divided into six groups of 50 birds (25 males and 25 females) as replicates. Each of the 66 groups was housed in a separate floor pen (3.0 m × 1.4 m) equipped with wood shavings. Bird density in each pen was 12 birds per square meter. Chicks were placed in a curtain-sided open house, with natural ventilation, where standard management practices were applied. Ambient temperature was maintained at 32°C during the first three days and was gradually decreased from 32°C on day four to 23°C on day 21. Chicks were exposed to natural environmental conditions thereafter. Ambient temperature ranged from 19°C to 29°C throughout the growth period (days 22 to 42). Fluorescent lamps provided 23 hours of continuous light per day. Chicks were vaccinated against infectious bursal disease and Newcastle disease (B1- Hitchner, Lasota) on days 14, 21 and 28 via drinking water. The experiment lasted for 42 days. Days 1 to 21, as well as days 22 to 42, are described as the starter and grower periods, respectively, in this study.

The ingredients and nutritional composition of the corn-soybean based basal starter and grower diets are pre-

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sent in Table 1. The diets were isoenergetic and isonitrogenous. Birds in the negative control group (CNT) were given commercial, untreated, basal starter and grower diets from days 1 to 21 and 22 to 42, respectively. The remaining ten experimental diets were based on the basal diet and were supplemented with AGP (the positive control), three doses of a commercial OAB (organic acid blend) or EOM (essential oil mixture) and a combination of OAB and EOM. For the positive control 30 mg/kg of the antibiotic Avilamycin\(^1\) were added to the basal diet. An OAB\(^2\) that consisted of formic acid, lactic acid, citric acid, propionic acid and ammonium formate was added to the basal diet in three amounts 0.9 g/kg (OAB–1), 1.8 g/kg (OAB–2) and 2.7 g/kg (OAB–3). For the EOM\(^3\) treatments, 12, 24 and 36 mg of EOM were added to each kg of feed (EOM–1, EOM–2 and EOM–3, respectively). EOM contains six essential oils, derived from wild herbs in Turkey – oregano oil (*Origanum* sp.), laurel leaf oil (*Laurus nobilis*), sage leaf oil (*Salvia triloba*), myrtle leaf oil (*Myrtus communis*), fennel seed oil (*Foeniculum vulgare*) and citrus peel oil (*Citrus* sp.). Hydrodistillation was used to isolate the essential oils. The main active components of Herbromix\(^4\) were carvacrol, thymol, 1,8-cineole, p-cymene, and limonene. An essential oil premix used 952 g of zeolite as a carrier for 48 g of essential oil mixture (0.75 g/kg) and 2.7 g/kg (EOM–3) were added to each kg of feed. This premix was added to the basal diet in quantities of 250 g/ton, 500 g/ton, and 750 g/ton levels. Thus, 12 mg, 24 mg and 36 mg of EOM were added to each kg of feed for the EOM–1, EOM–2 and EOM–3 treatments, respectively. The OAB and EOM were combined in three different amounts, based on their individual dietary additive levels.

The experimental diets in mash form and drinking water were provided *ad libitum*. Diets were formulated to meet the minimum nutritional needs of broiler as outlined by NRC (1994). All of the experimental feed additive combinations were added to the basal diet replacing saw dust. The feed additive procedures applied in this study were as follows:

- **CNT**: A commercial corn-soybean diet – the basal diet (negative control)
- **AGP**: The basal diet supplemented with an antibiotic growth promoter (positive control)
- **OAB–1**: The basal diet supplemented with an organic acid blend (0.9 g/kg)
- **OAB–2**: The basal diet supplemented with an organic acid blend (1.8 g/kg)
- **OAB–3**: The basal diet supplemented with an organic acid blend (2.7 g/kg)
- **EOM–1**: The basal diet supplemented with an essential oil mixture (0.25 g/kg)
- **EOM–2**: The basal diet supplemented with an essential oil mixture (0.50 g/kg)
- **EOM–3**: The basal diet supplemented with an essential oil mixture (0.75 g/kg)
- **OEC–1**: The basal diet supplemented with an OAB–1 (0.9 g/kg) + EOM–1 (0.25 g/kg)
- **OEC–2**: The basal diet supplemented with an OAB–2 (1.8 g/kg) + EOM–2 (0.50 g/kg)
- **OEC–3**: The basal diet supplemented with an OAB–3 (2.7 g/kg) + EOM–3 (0.75 g/kg)

The body weight (BW) of broilers in each pen was measured individually on days 21 and 42. The body weight gain (BWG) from day 22 to 42 was determined as pen basis.

Standard techniques of proximate analysis were used to determine the nutritional composition of each diet (NAUMANN

#### Table 1. Composition and nutrient contents of the experimental starter and grower diets

<table>
<thead>
<tr>
<th>Ingredients, g/kg</th>
<th>Starter diet</th>
<th>Grower diet</th>
<th>Composition, % (% analysed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Starter diet</td>
<td>Grower diet</td>
<td>Dry matter</td>
</tr>
<tr>
<td></td>
<td>Starter diet</td>
<td>Grower diet</td>
<td>Crude protein</td>
</tr>
<tr>
<td></td>
<td>Starter diet</td>
<td>Grower diet</td>
<td>Ether extract</td>
</tr>
<tr>
<td></td>
<td>Starter diet</td>
<td>Grower diet</td>
<td>Crude fibre</td>
</tr>
<tr>
<td></td>
<td>Starter diet</td>
<td>Grower diet</td>
<td>Crude ash</td>
</tr>
<tr>
<td></td>
<td>Starter diet</td>
<td>Grower diet</td>
<td>Starch</td>
</tr>
<tr>
<td></td>
<td>Starter diet</td>
<td>Grower diet</td>
<td>Sugar</td>
</tr>
<tr>
<td></td>
<td>Starter diet</td>
<td>Grower diet</td>
<td>Calcium</td>
</tr>
<tr>
<td></td>
<td>Starter diet</td>
<td>Grower diet</td>
<td>Total phosphorus</td>
</tr>
<tr>
<td></td>
<td>Starter diet</td>
<td>Grower diet</td>
<td>Calculated values (%)</td>
</tr>
</tbody>
</table>

1 Provides per kg of diet: vitamin A 12000 IU; vitamin D\(_3\) 1500 IU; vitamin E 75 mg; vitamin K\(_3\) 5 mg; vitamin B\(_6\) 3 mg; thiamin 1 mg; riboflavin 10 mg; niacin 35 mg; vitamin B\(_6\) 5 mg; vitamin B\(_12\) 0.03 mg; nicotinic acid 40 mg; calcium-D-pantothenate 10 mg; folic acid 0.75 mg; D-biotin 0.075 mg; choline chloride 375 mg.

2 Provides per kg of diet: Mn 80 mg; Fe 40 mg; Zn 60 mg; Cu 5 mg; I 0.5 mg; Co 0.2 mg; Se 0.15 mg.

3 Provides per kg of diet: Narasin 70 mg.

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and Bassler, 1993). The experimental diets were also analyzed for starch, sugar, calcium and phosphorus content using methods outlined by the Association of German Agricultural Analysis and Research Institutes (VDLUFA) for the chemical analysis of feedstuffs (Naumann and Bassler, 1993). The metabolizable energy content of the diets was calculated based on chemical composition (Anonymous, 1991).

Statistical analysis

The data obtained from this study were statistically analyzed as a one-way ANOVA using the General Linear Models procedure of the SAS (SAS Institute, 1991). Significant differences between treatment means were separated using the Duncan’s multiple range test, with a 5% probability.

Results

Influences of different feed additive regimens on BW, BWG and mortality at days 21 and 42 of the experiment are presented in Table 2. Experimental treatments had significant effects on BW and on BWG. All feed additives tested in this trial increased BW at both 21 and 42 days of age (P < 0.01). They also increased the BWG of broilers between days 22 and 42, as compared to those birds given the unsupplemented negative control diet (P < 0.05). At 21 days, birds fed AGP were considerably heavier than those given EOM-added diets; however, this was not the case thereafter. At 42 days, the BWs of birds fed AGP- or OAB-1-supplemented diets were significantly higher than those of birds given the OAB-1, EOM-1,2, and CNT diets (P < 0.05). However, gradually increasing the supplemental doses of OAB (from 0.9 to 1.8 or 2.7 g/kg diet, respectively) and EOM (from 12 to 24 or 36 mg/kg diet, respectively) led to insignificant improvements in BW and BWG.

The effects of additive procedures on FI and FCR are presented in Table 3. No significant differences in FI were observed amongst the different treatment groups between 1 to 21, 22 to 42 and 1 to 42 days of age (P > 0.05). Dietary treatments significantly influenced FCR between the first and twenty-first days of treatment, as well as between the twenty-second and forty-second and first and forty-second days of treatment. Except for the OAB-1 and OAB-3 treatments, all of the feed additive treatments significantly improved FCR during the entire experimental period compared to the unsupplemented control treatment. All of the EOM and OEC treatments generated remarkable improvements (P < 0.01) in FCR when compared to the untreated control during the grower period (22 to 42 days). Elevating supplementary doses of OAB, EOM and OEC two- to three-fold did not result in significant improvements during the test periods (Table 3). Compared to OAB, the OAB – EOM mixture induced significant enhancements in FCR throughout the grower period and the overall test period, though this was not the case during the starter period (1 to 21 days). Bird mortality did not differ amongst the treatment groups during the 1 to 21 and 0 to 42 day periods (P > 0.05).

Discussion

Dietary supplementation with AGP at 10 mg/kg diet, and three different dosages of OAB and EOM significantly increased BW of broilers at 21 and 42 days of age; they also increased BWG between days 22 and 42. Our results are in agreement with those reported in earlier works, which revealed that supplementing broiler diets with organic acids (Patten and Waldroup, 1988; Skinner et al., 1991; Bozkurt et al., 2009a) and essential oils (Alçık et al., 2003, 2004; Çiftçi et al., 2005; Erdas et al., 2005; Bozkurt et al., 2009b) significantly improves broiler body weight gain. The antimicrobial activities of these additives are supposed to be the cause of the growth-enhancing effects observed in this study.

As a matter of fact, other reports that have dealt with essential oil dietary supplementation have shown inconsistent effects on broiler performance. This may be due to differences in the supplemental doses and active components of the essential oils administered and to supplementation procedures (e.g. administering oils individually or in com-

Table 2. Body weight, body weight gain and mortality of broilers fed on diets supplemented with AGP, OAB or EOM

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Body weight, g</th>
<th>BWG, g</th>
<th>Mortality, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>605 ± 2063d</td>
<td>1458c</td>
<td>2.33</td>
</tr>
<tr>
<td>AGP</td>
<td>684 ± 2180ab</td>
<td>1496ab</td>
<td>1.33</td>
</tr>
<tr>
<td>OAB–1</td>
<td>649 ± 2128c</td>
<td>1479ab</td>
<td>2.66</td>
</tr>
<tr>
<td>OAB–2</td>
<td>653 ± 2132bc</td>
<td>1479ab</td>
<td>2.00</td>
</tr>
<tr>
<td>OAB–3</td>
<td>667 ± 2156abc</td>
<td>1489ab</td>
<td>1.00</td>
</tr>
<tr>
<td>EOM–1</td>
<td>641 ± 2127c</td>
<td>1486ab</td>
<td>2.00</td>
</tr>
<tr>
<td>EOM–2</td>
<td>649 ± 2171abc</td>
<td>1522a</td>
<td>1.66</td>
</tr>
<tr>
<td>EOM–3</td>
<td>658 ± 2178abc</td>
<td>1520a</td>
<td>1.33</td>
</tr>
<tr>
<td>OEC–1</td>
<td>678 ± 2195a</td>
<td>1517a</td>
<td>1.33</td>
</tr>
<tr>
<td>OEC–2</td>
<td>668 ± 2198a</td>
<td>1530a</td>
<td>0.66</td>
</tr>
<tr>
<td>OEC–3</td>
<td>660 ± 2184a</td>
<td>1525a</td>
<td>1.66</td>
</tr>
<tr>
<td>SEM</td>
<td>6.53 ± 18.52</td>
<td>14.56</td>
<td>1.43</td>
</tr>
<tr>
<td>P</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0245</td>
</tr>
</tbody>
</table>

a,b,c Means with in column different superscript differ at P < 0.05.
Feed Intake, g

1–21 days 22–42 days 1–42 days

Control 949 2988 3937
AGP 1018 3016 4034
OAB–1 995 2984 3979
OAB–2 982 2971 3953
OAB–3 994 3037 4031
EOM–1 976 2944 3920
EOM–2 966 2991 3957
EOM–3 968 2996 3964
OEC–1 993 2959 3952
OEC–2 996 2987 3983
OEC–3 968 2948 3916
SEM 10.19 31.60 35.24
P 0.0941 0.1651 0.2953

Feed conversion ratio, g feed/g gain

1–21 days 22–42 days 1–42 days

Control 1.673a 2.049b 1.944a
AGP 1.575b 2.016b 1.883c
OAB–1 1.628ab 2.017b 1.903b
OAB–2 1.596ab 2.008b 1.887c
OAB–3 1.580b 2.039a 1.903b
EOM–1 1.618ab 1.981bcd 1.876bcd
EOM–2 1.581b 1.966bcd 1.855bcd
EOM–3 1.561b 1.972bcd 1.852bcd
OEC–1 1.551b 1.950d 1.832d
OEC–2 1.580b 1.952d 1.844d
OEC–3 1.556b 1.933d 1.823d
SEM 0.024 0.022 0.018
P 0.0362 0.0096 0.0001

a,b,c,d Means with in column different superscript differ at P < 0.05.

Combination). Indeed, generating consistent biological results with essential oils is quite difficult (Steiner, 2009). Like our previous reports (Alçiçek et al., 2003, 2004), this study indicates that a commercial essential oil blend may enhance performance at levels of statistical significance (P < 0.01). In agreement with those reports, other authors have also indicated that including essential oils either alone (Bassett, 2000; Halle et al., 2004; Çiftçi et al., 2005; Bozkurt et al., 2009b) or in combination (Jamroz et al., 2003; Ertas et al., 2005; Zhang et al., 2005) in broiler diets increases BWG in broilers up to 42 days of age.

Other studies have reported conflicting findings on the dietary use of essential oils, either alone (Lee et al., 2003; Botsoglou et al., 2004) or in combination (Hernandez et al., 2004; Jamroz et al., 2005; Çabuk et al., 2006), or have shown no effect on broiler BWG. Likewise, Basmacioğlu et al. (2004) did not identify any beneficial effects of dietary supplementation with two essential oils (rosemary or oregano) administered in two different amounts (150 or 300 mg/kg) and two different procedures (alone or in combination). It appears that the combination of six herbal essential oils might exhibit synergistic and/or additive effects. In this study, the effects of 24 and 36 mg/kg supplements of essential oil combinations – mostly containing oregano oil – on broiler growth rate and feed efficiency were either similar or superior to the effects of dietary oregano oil supplements alone, even at relatively high dosages (150 mL/L for Bassett, 2000; 100 mg/kg for Botsoglou et al., 2002; 150 or 300 mg/kg for Basmacioğlu et al., 2004; and 0.1, 0.2, 0.5, 1.0 g/kg, respectively, for Halle et al., 2004).

Our findings are consistent with those of other authors (Basmacioğlu et al., 2004; Botsoglou et al., 2004; Hernandez et al., 2004; Ertas et al., 2005; Zhang et al., 2005) who have reported that the effects of essential oil feed additives on feed intake are insignificant. It is obvious that the characteristic flavours of essential oils, which have been used as appetizing agents in human and, recently, piglet and calf diets, had neither stimulating nor depressive effects on the voluntary feed intake of broilers in our study. However, earlier studies have indicated depressive effects. Çabuk et al. (2006) have reported that an essential oil combination led to notable reductions in the cumulative feed intake of broilers but did not negatively affect body weight gain. Thus, feed efficiency was enhanced, in spite of a 150-gram reduction in feed intake per bird. By contrast, Alçiçek et al. (2004) have reported that broilers given diets supplemented with 36 mg/kg and 48 mg/kg of Herbromix® consumed significantly more feed (136 g and 95 g, respectively) than birds in a control group, thus maximizing feed efficiency.

In this study, it is clear that FCRs of birds fed diets supplemented with increasing amounts of EOM were comparable to those of birds fed AGP and OAB treatments and were significantly better than those of birds fed an untreated diet (Table 3). Our findings are in agreement with those of other authors (Alçiçek et al., 2003, 2004; Çiftçi et al., 2005; Jamroz et al., 2005; Zhang et al., 2005) who have reported that supplementing broiler diets with essential oils improves FCR. Moreover, Halle et al. (2004) and Çabuk et al. (2006) have determined that adding oregano oil and a commercial combination of six essential oils to broiler diets enhances FCR significantly, despite reductions in feed intake of up to 150 g per bird.

Adding increasing levels of the OAB–EOM mixture to broiler diets induced similarly positive effects on FCR. It is interesting to note that the lowest dose (OEC–1) of the OAB–EOM mixture proved as efficacious as higher doses. Hence, it could be said that this mixture resulted in synergistic benefits to the conversion of feed to body mass. Organic acids lower the pH of the feed by reducing its buffering capacity and, thus, promote digestion in the intestinal tract. In addition, a reduced pH creates an unsuitable environment for the growth of intestinal flora, which ensures the stable digestion by increasing bile salt secretion and stimulating the enzymatic activities of intestinal mucosa and the pancreas (Platei and Sriravanas, 2000; Ramakrishna et al., 2003; Jamroz et al., 2005; Basmacioğlu et al., 2010).

Confirming our findings and conclusions regarding acidifiers and essential oils, recent in vivo experiments and field trials with farm animals have demonstrated a synergistic collaboration between essential oils and organic acids.

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Table 3. Feed intake and feed conversion ratio of broilers fed on diets supplemented with AGP, OAB or EOM

**Futteraufnahme und Futterverwertung der Broiler bei Fütterung mit Rationen mit Zusatz an Antibiotika (AGP), organischen Säuren (OAB) oder essentiellen Ölen (EOM)**
and have shown the ability of such collaboration to inhibit pathogenic bacteria and improve performance. FENG ZHOU et al. (2007) have shown that a combination of thymol and acetic acid killed Salmonella far more effectively than each substance did individually. MANZANILLA et al. (2004) have also demonstrated the synergistic effects of a combination of formic acid and essential oil in piglets. They found that this combination improved feed metabolisation and reduced the rate of mortalities resulting from E. coli. LUCKSTADT (2005) have reported that a commercial acid-phyto-biotic blend improved BWG and FCR and shortened the fattening periods of piglets in two field trials in Germany. Encouraging results have also been reported by ZHANG et al. (2005), who have indicated that a commercial organic acid and essential oil blend significantly improved the feed efficiency of broiler chickens, compared to the individual use of an essential oil combination and an antibiotic program.

Conclusion

Results showed that OABs and EOMs could serve as effective alternatives to AGPs. It is noteworthy that even the smallest amounts of an OAB – EOM combination had effects on body weight and feed conversion ratio that were comparable to or significantly better than the individual effects of larger amounts of OAB and EOM, administered separately. This suggests that combining acidifiers and essential oils, particularly in small amounts, may successfully improve broiler performance. Furthermore, such combinations may be more cost-effective than other supplemental strategies because their synergistic effects may allow for reductions in dosages.

Summary

This study compares the performance-enhancing effects of adding an antibiotic growth promoter (AGP), a commercial organic acid blend (OAB), a commercial, herbal, essential oil mixture (EOM) and an OAB – EOM combination to feeding regimens of broiler chicks. The corn and soybean-based basal diet was supplemented with three doses of one of the following additives: AGP (Avilamycin, 10 mg/kg diet), OAB (0.9, 1.8, 2.7 g/kg diet, respectively), EOM (12, 24, 36 mg/kg diet, respectively) and OAB – EOM combination. Diets were fed as mash to 3,300 one-day-old broiler chicks (Ross-308) that were randomly assigned to 11 groups, each with six identical subgroups. Birds were studied until they were 42 days old.

At 21 and 42 days of age, the body weights of broilers in all treatment groups were significantly heavier than the body weights (BW) of broilers in the control group (P < 0.01). A similar disparity in body weight gain (BWG) was observed between 22 and 42 days (P < 0.05). The OAB, EOM and OAB – EOM supplements promoted significantly growth when incorporated into the diets of broiler starters and growers, even at low levels. Likewise, broilers that received the diet supplemented with AGP exhibited a much better growth rate and feed conversion ratio (FCR) than broilers that received the unsupplemented control diet (P < 0.05). Amongst the treatment groups, there were significant differences in feed conversion ratio (FCR) between 0 to 21, 22 to 42 and 0 to 42 day periods (P < 0.05). Throughout the experimental period, dietary supplementation with AGP, EOM and the OAB – EOM mixture significantly improved FCR, compared to the control treatment. The experimental treatments had no significant effect on the feed intake or mortality of broilers during the 42-day experimental period (P > 0.05). Gradually increasing the doses of OAB, EOM and the OAB – EOM mixture led to insignificant improvements in broiler performance, compared with their lower supplementation rates.

In conclusion, introducing EOM into the diets of broiler diets either alone or in combination with OAB significantly improved body weight and feed efficiency of broilers without affecting mortality. Similar results were observed with AGP. Our results raise the prospect of replacing AGP with novel alternatives, such as OABs and EOMs.

Key words

Broiler, nutrition, antibiotic, organic acid, essential oil, performance

Zusammenfassung

Einfluss des Einsatzes von Mischungen an ätherischen Ölen und organischen Säuren einzeln und in Kombination im Futter auf die Leistung von Broilern

In der Untersuchung wurden die wachstumsfördernden Effekte von antibiotischen Wachstumförderern (AGP), einer Mischung organischer Säuren (OAB), einer kommerziellen Mischung essentieller Öle (EOM) und der Kombination von OAB und EOM auf die Leistung von Broilern verglichen. Hierzu wurden einer Mais-Soja-Ration die verschiedenen Produkte in unterschiedlichen Dosierungen zugesetzt: AGP (Avilamycin, 10 mg/kg Futter), OAB (0.9, 1.8, 2.7 g/kg Futter), EOM (12, 24, 36 mg/kg Futter), Kombination von OAB und EOM. Zusätzlich war eine Kontrollgruppe ohne Zusätze vorhanden. Die mehlförmigen Futterrationen wurden an insgesamt 3300 Broiler der Herkunft Ross 308 verfüttert. Die 11 Behandlungen wurden jeweils sechsmal wiederholt. Die Mastdauer war 42 Tage.

Am 21. und 42. Lebenstag waren die Lebendgewichte der Broiler aller Zulagegruppen signifikant höher als in der Kontrollgruppe (P < 0,01). Entsprechend waren die Lebendgewichtszunahmen (BWG) zwischen dem 22. und 42. Lebenstag in der Kontrollgruppe am geringsten. Die Zulage von OAB, EOM und OAB + EOM zu den Starter- und Grower-Rationen hatte einen signifikanten, wachstumsstimulierenden Effekt. In ähnlicher Weise wiesen die mit AGP-Zusatz gefütterten Broiler eine bessere Wachstumsrate und Futterverwertung als die Kontrolltiere auf (P < 0,05). Die Futterverwertung der Behandlungsgruppen war zwischen dem 0. und 21., dem 22. und 42. sowie dem 0. und 42. Lebenstag signifikant unterschiedlich (P < 0,05). Über die gesamte Versuchsperiode führte der Zusatz von AGP, EOM sowie OAB + EOM gegenüber der Kontrolle zu einer signifikant besseren Futterverwertung. Dagegen haben sich die Behandlungen nicht auf die Futteraufnahme und die Mortalität über die Versuchsduauer von 42 Tagen ausge- wirkt (P > 0,05). Die stufenweise Erhöhung der Zulagen an OAB, EOM und OAB + EOM führte zu keiner signifikanten Verbesserung der Leistung gegenüber der niedrigsten Dosierung.

Stichworte

Broiler, Fütterung, Antibiotikum, Organische Säuren, Essentielle Öle, Leistung
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