Original paper

EFFECTS OF PHYTOGENIC FEED ADDITIVE AND ENZYME ON GROWTH PERFORMANCE OF BROILERS FED DIETS WITH REDUCED ENERGY CONCENTRATIONS

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Abstract

The effects of dietary supplementation with phytogenic feed additives (PFA) and enzyme (E) on performance parameters were investigated using Ross 308 as hatched broilers fed standard diets or diets with reduced energy concentrations. Birds were assigned to 5 treatments with 5 replications each and fed either a standard basal diet or a re-formulated basal diet with reduced energy concentrations. Reduction was made according to enzyme matrix (Ronozyme WX, DSM). Treatments were: (1) Standard diet; (2) Negative control (NC) – 4% reduction in ME (3) NC + E; (4) NC + PFA (5) NC + E + PFA. Body weight and feed consumption were recorded weekly. Mortality was recorded on daily basis. Foot pad lesions were scored at day 35 using scale from 0 (no lesion) to 2 (lesion extending through skin). The results showed that birds fed Negative control diets had a significantly lower body weights ($P<0.05$) compared to Positive control, Negative control + E and Negative control + E + PFA. Birds fed with Negative control + PFA had higher body weights compared to Negative control (+ 83 g on day 42), but the difference was not significant ($P>0.05$). Mortality and FCR did not differ significantly between treatments. Average foot pad lesion score was the highest in Negative control (1.05) and the lowest in NC+E (0.55).

In conclusion, re-formulation of diets for 4% energy reduction decreased broiler growth rate. Supplementation of diets with PFA improved live weight especially in combination with enzyme, hence confirming a growth-promoting effect of both phytogenics and enzymes in broilers.

Key words: *broilers, enzymes, performance, phytogenic feed additives*

Introduction

Use of antibiotics as growth promoters is no longer acceptable in EU and many other countries. Because of that it is necessary to offer other feed additives as an alternative such as enzymes or phytogenic feed additives which can have a beneficial effect on broiler performance even when added in feed with lower nutrient density. Studies reporting the positive effect of enzymes added to feed with lower energy content are very extensive and numerous authors have established that by application of enzymes production performances can be improved up to 10% (Acamovic, 2001; Cowieson and Ravindran

2008; Montahini et al., 2012). Also in recent years there has been growing interest in plant-derived substances as ingredients or supplements in broiler production. Essential oils contain a number of antimicrobial, antifungal and antioxidative compounds predominantly belonging to the groups of phenols, terpenes or aldehydes. An increasing number of scientific reports is available pertaining to the efficacy of essential oils in broiler production (Windisch et al., 2008; Perić et al., 2009; Wallace et al., 2010). It was hypothesized that, due to a nutrient-sparing effect, dietary supplementation with essential oils might compensate for a reduction in nutrient density in terms of growth performance in broilers.

The objective of this study was to determine the effects of phytogenic feed additives and enzymes on growth performance of broilers fed standard diets or diets with reduced energy concentration.

Materials and methods

The trial was carried out on 1050 Ross 308 broilers which were distributed in 6 groups with 5 replicates. Each replicate consisted of the floor pen with 35 birds per pen. Feed and water supply were *ad libitum* and birds were fed with Starter, Grower and Finisher diets (Table 1). The Positive Control diet was formulated to meet the actual breed standard. The Negative Control diets were formulated according to enzyme matrix. Used enzyme (Ronozyme WX, DSM) was added at level of 200 mg/kg and the phytogenic additive (Digestarom® Poultry) was added at level of 150 mg/kg. Feed was in the mash form for all groups.

Table 1. *Feed composition*

Parmeters	Positive control			Negative control		
Days	1-14	15-28	29-42	1-14	15-28	29-42
Ingredients,%	Starter	Grower	Finisher	Starter	Grower	Finisher
Corn	37.75	37.61	35.57	46.51	42.82	43.81
Wheat	15	20	25	15	20	25
Wheat middlings	6	2.42	5.17	0	0	0
Soybean meal (47% CP)	18.14	17.58	11.83	29.45	26.32	23.25
Full fat soya	18.26	16.91	16.72	4.05	5.29	2.1
Soybean oil	0	1.5	2	0	1.5	2
Threonine L – 98	0.13	0.05	0.04	0.17	0.09	0.08
Lysine	0.27	0.1	0.07	0.33	0.15	0.14
Methionine DL-99	0.12	0.02	0	0.12	0.02	0
Monocalcium phosphate	1.14	0.91	0.75	1.13	0.88	0.73
Limestone	1.61	1.33	1.29	1.64	1.36	1.32
Sodium bicarbonate	0.19	0.12	0.1	0.24	0.15	0.15
Salt	0.2	0.25	0.26	0.16	0.22	0.22
CAPTEX	0.2	0.2	0.2	0.2	0.2	0.2
PREMIX	1	1	1	1	1	1
TOTAL	100	100	100	100	100	100
The chemical composition of mixtures						
Crude protein, %	22.00	21.00	19.00	21.85	20.85	18.83
ME, MJ/kg	12.65	13.20	13.40	12.14	12.69	12.84

Ca, %	1.05	0.90	0.85	1.05	0.90	0.85
P (total), %	0.82	0.75	0.71	0.78	0.72	0.67
P (available), %	0.50	0.45	0.42	0.50	0.45	0.42
Lysine, %	1.43	1.24	1.09	1.42	1.24	1.09
Methionine, %	0.72	0.61	0.57	0.72	0.61	0.56
Methionine + cystine, %	1.07	0.95	0.89	1.06	0.95	0.88

Average body weights per pen were measured weekly. Average daily feed intake per pen was recorded for the feeding periods (1-14 days (starter), 15-28 days (grower) and 29-42 days (finisher)) and for the whole period (1-42 days).

Average feed intake and average body weight per pen are used to calculate the feed conversion ratio (FCR). Mortality was recorded daily during inspection. Birds that died were noted and their bodyweight was used to adjust the FCR accordingly.

Foot pad lesions were recorded at 35 days of age using 4 birds/pen with a 0–2 scoring as:

0 – No lesions

1 – Small lesions affecting skin, no ulcers

2 – Lesions extending through the skin

Data were analyzed by ANOVA followed by Duncan's post hoc test using StatSoft software (STATISTICA 12).The level of significance to indicate differences stated in the ANOVA model are $P<0.05$

Results and discussion

Results of the average body weights of birds per weeks and per treatments are shown in Table 2.

Table 2. *Average body weight of birds, g*

Days	Treatments				
	Positive control	Negative control			
		-	ENZYME	PFA	E + PFA
7	169.5^{a}	156.9^{b}	167.9^{ab}	164.3^{ab}	170.1^{a}
14	437.3^{a}	382.9^{b}	428.2^{a}	422.8^{ab}	418.3^{ab}
28	1158^{ab}	1105^{b}	1187^{ab}	1157^{ab}	1193^{a}
35	1642^{ab}	1543^{b}	1671^{a}	1597^{ab}	1645^{ab}
42	2143^{a}	2008^{b}	2135^{a}	2091^{ab}	2187^{a}

$^{a-c}$ Values between row with no common superscript are significantly different ($P<0.05$)

Average body weights of birds fed Negative control (NC) diets were lower compared to Positive control (PC) and other experimental groups from the beginning of the trial. At the end of the trial (42 days) the difference was statistically significant ($P<0.05$) compared to PC, NC+ E and NC+ E + PFA. Birds fed with NC+ PFA had higher body weights compared to NC (+ 83 g on day 42), but the difference was not significant ($P>0.05$). It is obvious that energy reduction in Negative control group resulted in decreased body weights but the addition of enzyme either individually or in combination with PFA significantly improved final body weight. Addition of PFA without enzyme tended to

improve body weight of birds fed diets with insufficient energy content, but in slightly lower extent compared to combination with enzymes.

Positive effect of enzymes added to feed with lower energy content is reported in many studies (Acamovic, 2001; Montahini et al. 2012; Zou et al., 2013). In the research reported by Cowieson and Ravindran (2008) it is stated that supplementation of both the standard and energy reduced diets with the enzyme improved weight gain and feed efficiency compared with the non-supplemented diets. However, some authors did not report a positive effect of enzymes on body weight of broilers when added into low feed with lower energy content (Iji et al., 2003, Zu et al., 2013). Studies examining the nutrient sparing effect of essential oils are also diverse. Perić et al. (2010) reported that supplementation of the standard diets with essential oils significantly increased ($P<0.05$) body weight of broilers at 42 days of age. Similar results were found by Windisch et al. (2008), Cross et al. (2008) and Bozkurt et al. (2012) who reported improved weight gain of broilers fed diets supplemented with essential oils. On the contrary, Buchanan et al. (2008) reported no improvement in final body weight by using a mixture of essential oils.

It has been suggested by many authors (Acamovic, 2001; Cross et al., 2007; Perić et al., 2009) that the results of the trials depend on the differences in the feed composition, level of energy or protein reduction, type and level of used enzyme or phytogenic additive, as well as environmental and management conditions.

Table 3. *Average daily feed consumption, g*

Period, days	Treatments				
	Positive control	Negative control			
		-	ENZYME	PFA	E + PFA
1-14	39.04	38.62	39.67	39.17	38.87
15-28	97.76	95.83	102.11	97.07	101.15
29-42	168.72^{a}	146.93^{c}	154.66^{bc}	155.98^{bc}	164.37^{ab}
Total, 1-42	100.85^{a}	93.89^{b}	98.82^{a}	97.24^{ab}	101.28^{a}

Feeding treatments significantly affected feed consumption. Birds from Negative control group consumed significantly ($P<0.05$) less feed compared to the others, except for the group NC+PFA. However, lower feed consumption had no significant effect on the feed conversion ratio (table 4). The same effect was established in the work of Perić et al. (2011) but Buchanan et al. (2008) reported a reduction in FCR (1.81 vs. 1.84) when a diet with standard nutrient concentration was supplemented with a mixture of essential oils.

Table 4. *Feed conversion ratio*

Period, days	Treatments				
	Positive control	Negative control			
		-	ENZYME	PFA	E + PFA
1-14	1.251^{a}	1.413^{c}	1.296^{b}	1.297^{b}	1.301^{b}
15-28	1.899	1.858	1.884	1.851	1.828
29-42	2.398	2.278	2.290	2.338	2.315
Total, 1-42	1.978	1.965	1.947	1.952	1.945

Mortality rate did not differ significantly between treatments and for all groups it was lower than 5%.

Table 5. *Mortality rate*

Mortality	Treatments				
	Positive control	Negative control			
		-	ENZYME	PFA	ENZ + PFA
No. of birds	6	4	8	5	7
%	3.43	2.29	4.57	2.86	4.00

Average foot pad lesion score was the highest in NC (1.05) and the lowest in NC+E (0.55). That could indicate that addition of enzymes has a positive effect on digesta viscosity and litter condition (Garcia et al., 2008). It is interesting that foot pad lesion score was lower in NC+PFA group compared to NC+E+PFA but the difference was not statistically significant.

Table 6. *Foot pad lesions*

Treatments	No. of birds	No. of birds with lesions			% of birds with lesions			Average score
		0	1	2	0	1	2	
Positive control	20	5	13	2	25	65	10	0.85
Negative control (NC)	20	3	13	4	15	65	20	1.05
NC+ Enzyme	20	9	11	0	45	55	0	0.55
NC +PFA	20	5	11	4	25	55	20	0.95
NC+ Enz+PFA	20	3	13	4	15	65	20	1.05

Conclusion

In conclusion, re-formulation of diets for 4% energy reduction decreased broiler growth rate. Supplementation of diets with PFA improved live weight especially in combination with enzyme, hence confirming a growth-promoting effect of both phytogenics and enzymes in broilers.

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