

Effect of phytase supplementation of rapeseed cake-containing diets on performance and skeletal development in broilers

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Abstract

Ninety nine broiler females were divided into 9 groups, 11 replicates in each group and fed isonitrogenous and isoenergetic diets with 100/150 g/kg of 4 different rapeseed cakes (RC) or control diet without RC. The level of Ca and available P in RC diets was as in control diet, while in RCP diets it was lowered by 7 and 12%, respectively. RCP diets were supplemented with 1000 U phytase/kg. The intake of RC diets was similar, while BWG lower in some and FCR 5% worse in all RC groups, than in the control group. The type of RC had no effect on tibia parameters, but affected significantly feed intake, BWG, thyroid and kidneys weight. Phytase addition to RCP diets increased thyroid weight ($P<0.01$) and lowered tibia ash content ($P<0.05$), but had no effect on tibia weight and its ultimate strength.

Introduction

Various phytase preparations have proved their efficiency in broiler nutrition. Total phytate P utilization in broilers consuming P-deficient corn-soybean meal diet were reported to reach a plateau around the dose of 500 U phytase/kg diet (Schöner et al., 1993), or to increase up to the dose of 12,000 U/kg diet (Shirley and Edwards, 2003). Information is scarce about the effect of rapeseed products, which are rich in phytate phosphorous, but also in condensed tannins on the activity of exogenous phytase in the digestive tract of chickens. Rutherford et al. (2002) found no effect of added phytase on ileal or total P digestibility in broilers fed rapeseed meal-based diet. The aim of the study was to evaluate the effect of phytase on performance and skeletal development in broilers fed diets containing different rapeseed expeller cakes.

Materials and Methods

Four rapeseed cakes (RC) used in experiment were cold-pressed from 00 rapeseed in different rural mills in Poland, RC 1 was additionally toasted, while RC 4 was additionally extruded. Glucosinolates content of rapeseed cake samples were determined using ISO 9167-1 method (1992). Three control wheat, maize and soybean meal-based diets, containing nutrients satisfying chickens requirements during starter (1-21), grower (22-35) and finisher (36-42 day of life) periods were prepared. Two sets of each experimental diets were prepared, in both starters contained 100, growers and finishers 150 g/kg RC and protein, energy, lysine and sulphur amino acids content was equalized with the respective control. RC diets were unsupplemented and had P and Ca content equal to the control diet, while RCP diets, due to lower amount of added dicalcium phosphate, contained 7% less Ca and 12% less available P than respective RC diets and were supplemented with 0.2 g/kg (1000 U) of Natuphos 5000 G (BASF) phytase (Table 1). All diets were cold pelleted. Real phytase activity in the feed samples was not measured.

Ninety nine day-old broiler females Cobb 500 were randomly allocated into 9 groups, 11 birds in group. For the first week of life chickens were kept in pens, at 8 d they were allocated into individual cages. Birds were given experimental diets *ad libitum*, body weight and feed intake was measured in weekly intervals. At the end of experiment all birds were killed, the abdominal cavity was opened and liver, thyroid glands, kidneys and abdominal fat were excised and weighed. The right tibia was collected, cleaned of all exterior tissue and frozen.

Tibias were weighed and analyzed for strength by the shear force measurement, with an Texture Analyser TA-XT2i (Stable Micro Systems). After the shear test, the tibias were dried, crushed and defatted in refluxing ethyl ether in a Soxhlet apparatus for 48 h. The defatted tibias were oven dried and ashed in ceramic crucibles for 24 h at 600°C. Ash content was expressed as a percentage of the fat-free, moisture-free tibia weight. The results were subjected to one-way and two-way analysis of variance (ANOVA) generated by Statgraphics® ver. 5.1 software.

Results and Discussion

The tibia ash content was reduced ($P < 0.05$) but tibia weight or its ultimate strength was not affected in groups fed RCP in comparison with RC diets (Table 1). It indicates, that exogenous phytase allows on lower inorganic phosphate supplementation, what is in agreement with the results obtained with soybean meal and maize based diets supplemented with phytase (Schöner et al. 1993; Shirley and Edwards, 2003). However, despite the equal protein energy and amino acids content in diets, FCR in groups fed RC diets was worse, than in control group, while BWG was lower only in groups RC 1 and RC 3 (Table 1). Press cakes (1 to 4) contained 16.8; 13; 12 and 15.8 mM glucosinolates/kg, respectively. It was surprising, that thyroids were significantly enlarged, in comparison with the control only in RC 2 group and that supplementation of RCP diets with phytase induced in all groups enlargement of thyroids. In grains and oilseeds various complex interactions between phytate, minerals, starch, protein and other components occur. The effects of phytase on the improvement of Ca and P utilization in broilers is well documented (Schöner et al. 1993; Shirley and Edwards, 2003), some authors (Rutherford et al., 2002) reported, that in broilers in the presence of exogenous phytase amino acid digestibility in different feedstuffs increased. The significantly ($P < 0.01$) enlarged thyroids in RCP groups, in comparison with respective RC indicated, that exogenous phytase may either release some glucosinolates from complexes or by releasing some nutrients in lower part of intestinal tract may enhance bacterial fermentation and induce glucosinolate hydrolysis to goitrogenic compounds.

References

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Table 1. Effect of rapeseed cake (RC) and phytase on performance, organ and tibia weight, tibia ash content and tibia ultimate strength in 42 day old chickens

Item	Control ^a	Unsupplemented ^a					Supplemented with phytase ^b					Significance ^c	
		RC 1	RC 2	RC 3	RC 4	RC 1 P	RC 2 P	RC 3 P	RC 4 P	RMSE ^c	Type of RC	LP + Phytase	Interaction
BWG, g	2404	2303*	2332	2210*	2362	2218*	2225*	2244*	2359	103	0.001	0.079	0.098
Feed intake, g	3903	3938	3951	3881	4066	3840	3783	3890	4091	228	0.013	0.254	0.477
FCR, g feed/g BWG	1.63	1.71*	1.69*	1.75*	1.72*	1.73*	1.70*	1.73*	1.73*	0.07	0.259	0.777	0.829
Thyroids ^d	20.4	19.7	40.2*	28.8	27.4	20.9	63.7*	32.1	45.0*	16.8	< 0.001	0.003	0.098
Liver ^e	2.33	2.49	2.31	2.30	2.57	2.51	2.48	2.14	2.28	0.41	0.177	0.475	0.283
Kidneys ^e	0.60	0.59	0.70*	0.73*	0.60	0.65	0.78*	0.69*	0.60	0.07	< 0.001	0.146	0.073
Abdominal fat ^e	1.32	1.21	1.10	1.24	1.14	1.27	1.19	1.06	1.22	0.34	0.814	0.926	0.535
Tibia weight, g	20.1	18.4	19.5	18.3	20.0	18.8	19.5	18.4	19.4	2.00	0.082	0.992	0.874
Tibia ash, % ^f	45.8	46.5	46.2	46.3	45.7	45.2	45.6	45.9	44.7	1.40	0.224	0.012	0.731
Tibia ultimate strength, N	14.8	15.5	14.3	15.3	15.2	14.2	14.9	14.2	12.8	2.66	0.774	0.080	0.331

^a Ca content 9.4; 9.3; 9.1 g/kg; P_{available} 4.4; 4.1; 4.0 g/kg; ^b Ca content 8.8; 8.7; 8.4 g/kg; P_{available} 3.9; 3.9; 3.5 g/kg (in starter, grower and finisher diets, respectively); ^c root of mean square error (two-way ANOVA for groups with RC only); ^d mg/100 g LBW⁻¹; ^e g/100 g LBW⁻¹; ^f on fat-free, moisture free basis

* significantly different from control group (one-way ANOVA; P<0.05)