The reduction of mineral phosphorus source in diets for broilers and addition of phytase in conditions of temperature stress

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Abstract
Possibilities of use of higher concentrations of microbial phytase in suboptimal conditions of nutrition and housing of broiler were investigated: mixtures for broilers with 0.25-0.27% of phytate phosphorus and reduced or completely excluded mineral sources of phosphorus from 1-42 days of fattening; increased ambient temperature from 22-35 days of fattening. Trial was carried out in period from 1-42 days of age, on 2500 broilers of both sexes divided into four groups. Broilers of control group were fed completely balanced diet, whereas diets for trial groups available phosphorus was reduced and phytase added (1000 FU/kg). In the period from 22-35 days chickens were exposed to ambient temperature of approx. 30°C. During trial gain, feed consumption and tibia strength were monitored. Strong reduction or complete exclusion of mineral sources of phosphorus from diet in spite of use of phytase has induced lower gain and feed consumption in broilers, especially during the period of increased environment temperature.

Introduction
Use of microbial phytase for release and utilization of phosphorus and other nutrients bound in phytate complex in diets for poultry and pigs was studied in numerous researches and broadly accepted in practice. Main conditions for correct and successful use of enzyme phytase are that diet should contain sufficient phytate phosphorus, and by use of phytase the need for additional mineral sources of phosphorus is reduced (Sebastian et al., 1998; Rosen, 2004). In conditions of temporary temperature stress which can occur in production conditions during extremely warm summer periods poultry's feed consumption decreases (Daghir, 1996), causing reduced daily intake of phosphorus. Therefore, it is necessary to study how the addition of phytase with reduction of concentration of phosphorus in diet in mentioned production conditions affects broilers.

Materials and Methods
Trial was carried out on 2500 Arbor Acres chickens of both sexes divided into 4 groups, 5 boxes with 125 chickens in each box. Broilers of control group were fed completely balanced forage mixtures of standard raw material and chemical composition, whereas in mixtures for trial groups of broilers (groups I, II and III) through minimal corrections, reduction or complete exclusion of dicalcium phosphate, amount of available phosphorus was reduced and phytase added (1000 FU/kg). Content of phytate phosphorus was equal in all mixtures (0.25-0.27%). Raw material and chemical composition of trial mixtures is presented in table 1.

Trial lasted from 1-42 days of age, with three periods: chickens had optimal environment temperature during first three weeks (1-21 days) and the last three weeks of trial (36-42 days), whereas from 22-35 days chickens were exposed to environment temperature maintained on approx. 30°C. During trial gain and feed consumption were monitored. After each period by method of random sample 6 male and 6 female chickens were taken from each group in order to determine the tibia bone strength. Breaking force was measured on apparatus IPNIS and expressed in kilograms necessary for bone to be broken (Mašić et al., 1985). Based on relation

between breaking force and surface of tibia diaphysis section specific breaking force was calculated.

Table 1. Composition of the starting, growing and finishing experimental diets

Ingredients, %	First period (1-21. Days)				Second period (22-35. Days)				Third period (36-42. Days)			
	C	I	II	III	C	I	II	III	C	I	II	III
Corn	54.7	53.2	54.9	54.4	58.4	58	58.6	58.5	62.1	62.3	62.4	62.6
Soybean meal (44% CP)	22	26	25	27	20	23	23	25	20	20	20	20
Sunflower m. (33% CP)	3	2	2	0	3	2	2	0	5	5	5	5
Sunflower m. (44% CP)	5	5	4	5	5	5	4	5	5	5	5	5
Fodder yeast	5	5	5	5	4	4	4	4	0	0	0	0
Fish meal	4	2	3	2	3	1	2	1	1	1	1	1
Fat	3	3	3	3	3	3	3	3	3	3	3	3
Fodder chalk	0.5	1	1.8	2.3	0.5	0.9	1.8	2.2	0.9	1.2	1.6	1.9
Dicalcium phosphate	1.5	1.5	0	0	1.8	1.8	0.3	0	1.5	1	0.5	0
Salt	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5
Vit. - min. mix	1	1	1	1	1	1	1	1	1	1	1	1
Phytase, 1000 FU/kg [1]	-	+	+	+	-	+	+	+	-	+	+	+
Total:	100	100	100	100	100	100	100	100	100	100	100	100
Crude protein (CP)	22.2	22.3	22.2	22.2	20.5	20.3	20.5	20.5	18.3	18.3	18.3	18.4
ME, MJ/kg	12.7	12.6	12.7	12.7	12.8	12.8	12.9	12.9	12.8	12.8	12.8	12.8
Calcium	1.01	1.07	1.03	1.03	1.01	1.03	1.02	1.03	0.93	0.90	0.91	0.89
Total phosphorus	0.85	0.79	0.55	0.46	0.85	0.79	0.55	0.46	0.71	0.62	0.53	0.45
Available phosphorus	0.41	0.36	0.20	0.11	0.41	0.36	0.20	0.13	0.29	0.22	0.16	0.10
Phytate phosphorus	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.24	0.27	0.27	0.27	0.28

[1]Phytase Novo CT

Results and Discussion

Observed production parameters, daily gain of broilers (table 2) and daily feed consumption (table 3), are considered reliable indicators of feed quality, especially when determining relative bio-availability of phosphorus in feed.

Table 2. Daily gain *(mean ± standard deviation)* of broilers during trial, [g]

Group	Trial period, days			
	1- 21.	22-35.	36-42.	1-42.
K	27.43 ± 0.58 ^{x}	44.18 ± 1.36 ^{a}	61.87 ± 1.88	38.75 ± 0.60 ^{x}
I	26.91 ± 0.53 ^{xy}	44.11 ± 2.08 ^{a}	59.48 ± 3.11	38.07 ± 0.52 ^{x}
II	27.32 ± 0.36 ^{x}	41.41 ± 1.78 ^{ab}	60.98 ± 3.39	37.63 ± 0.83 ^{xy}
III	25.74 ± 0.58 ^{y}	40.65 ± 1.42 ^{b}	58.84 ± 3.19	36.23 ± 0.95 ^{y}

Table 3. Daily feed consumption (*mean ± standard deviation*) of broilers during trial, [g]

Group	Trial period, days			
	1- 21.	22-35.	36-42.	1-42.
K	46.42 ± 0.48	111.30 ± 2.88 ^{x}	145.60 ± 8.51	83.02 ± 1.16 ^{x}
I	46.49 ± 0.50	109.93 ± 2.53 ^{x}	146.28 ± 3.10	82.80 ± 1.27 ^{xy}
II	46.45 ± 0.51	106.54 ± 3.52 ^{xy}	142.62 ± 6.01	80.74 ± 1.76 ^{xy}
III	45.72 ± 1.25	102.90 ± 2.30 ^{y}	143.05 ± 7.44	79.40 ± 1.64 ^{y}

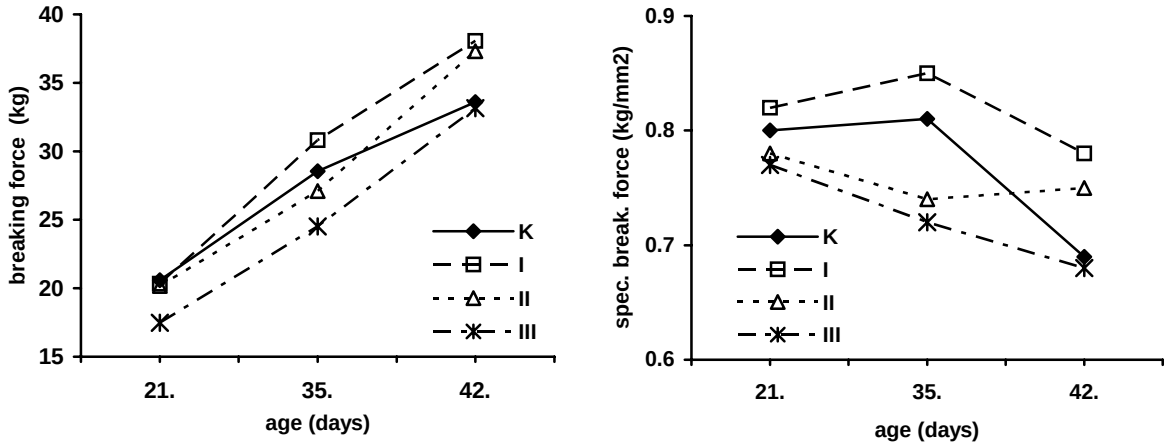
Values with different superscript in one column are statistically different (LSD test)

$^{a, b}$ $p<0,05$ $^{x, y}$ $p<0,01$

Obtained research results indicate that phytase is efficient in diets with quantity of available phosphorus of 0.36% (group I), which is in accordance with results stated by Huyghebaert (1997). Broilers fed diets containing lower concentration of available phosphorus by half (group II) compared to control, with addition of phytase have realized somewhat lower production results, especially in period of increased ambient temperature. Broilers fed diets without mineral sources of phosphorus (group III) in spite of added phytase had considerably lower gain and feed consumption during trial.

Analysis of results of investigation of the tibia strength (graph 1) indicates that tibia from boilers from group I was the firmest, whereas the same bone from boilers of group III was easiest to break, but significant differences weren't established due to the high variability of this parameter.

Graph 1. Breaking force and specific breaking force of tibia



Based on obtained results it can be concluded that moderate reduction of amount of available phosphorus with addition of phytase in diets for broilers and in conditions of increased environment temperature has no negative effect on observed production parameters and bone strength. More reduction or exclusion of mineral sources of phosphorus from diet in spite of increased concentration of enzyme phytase caused lower gain and feed consumption in broilers, especially in period of increased environment temperature.

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