

Effect of different phosphorus sources in broiler diets on the chemical composition and breaking strength of bones

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Abstract

The aim of this work was to determine bone quality of broiler chickens fed ration contained three phosphorus sources: monocalcium phosphate, dicalcium phosphate and monoammonium phosphate. Availability of phosphorus from different sources was estimated through bone chemical composition and its strength parameters. The obtained results pointed out that different sources of phosphorus which were used in this trial had no significant influence on Ca and P content in the femur as well as on the parameters of bone strength.

Key words: phosphorus, bone, strength, composition

Introduction

Phosphorus plays an important role in many physiological processes which are necessary for normal growth, production and skeletal development of animals. The skeletal system is strongly stressed during intensive broiler production and the increased incidence of leg disorders in young chickens becomes a real problem (Kestin et al., 1992; Sanotra et al., 2001; Jamroz et al., 2004). Because of that, the purpose of present study was to determine some bone quality parameters of broiler chickens fed ration contained three phosphorus sources: monocalcium phosphate, dicalcium phosphate and monoammonium phosphate. Numerous previous studies demonstrated, that the availability of phosphorus from different sources can be measured through the chemical composition of the bone or bone strength parameters (Crenshaw et al., 1981; Huyghebaert, 1996; Park et al., 2003).

Material and Methods

The trial was conducted on 204 Hybro chicks (sex ratio 1:1) assigned in 3 groups with 4 replicates. The birds were housed in battery cages. Nutrient content of the three test diets were the same except on the replacement of the inorganic phosphorus source with monocalcium phosphate (MCP) in the first, with dicalcium phosphate (DCP) in the second and with monoammonium phosphate (MAP) in the third test diet. The level of Ca was 0.95% in starter, 0.90% in grower and 0.85% in finisher diets. The level of total/available P was 0.70/0.47% in starter, 0.67/0.45% in grower and 0.64/0.42% in finisher diets. Chickens were given starter (week 1-3), grower (week 4-5) and finisher (week 6) diets until 42 days of age.

At the end of the trial (42 days) 18 birds from each group were slaughtered, right femur, tibia and humerus were removed and bone parameters were estimated. Estimation of chemical composition was done on femur only. Mechanical measurements were taken on all three bones using INSTRON 4301 instrument and bone strength was calculated according to method described by Crenshaw et al. (1981).

Results and Discussion

The results showed no significant difference among the groups in the bone content of ash, Ca or P (Table 1).

Table 1. Average content of ash, calcium and phosphorus in femur

Source	Ash, %		Ca, %		P, %		Ca:P
	Mean	SEM	Mean	SEM	Mean	SEM	
DCP	44.35	1.14	14.00	0.69	6.87	0.25	2.03:1
MCP	44.20	1.50	14.23	0.55	6.94	0.20	2.05:1
MAP	45.65	0.58	15.00	0.09	7.10	0.12	2.11:1

Only very small differences in ash, Ca and P level in femur were stated. That implies that the availability of phosphorus did not differ according to the sources were used. These results are in line with the results of other authors (Filev i Šokarovski, 1985; Nelson et al., 1990) who reported similar values using same sources of phosphorus.

Estimated parameters of bone strength were only slightly affected by the different inorganic phosphorus sources (tab.2, 3).

Table 2. Maximum average force (N)

Source	Femur		Tibia		Humerus	
	Mean	SEM	Mean	SEM	Mean	SEM
DCP	230	8.92	344	15.49	187	6.60
MCP	223	8.86	319	17.79	198	8.88
MAP	228	10.55	319	11.54	197	9.63

Table 3. Average breaking force (N)

Source	Femur		Tibia		Humerus	
	Mean	SEM	Mean	SEM	Mean	SEM
DCP	214	11.00	330	17.75	180	9.87
MCP	210	11.50	308	18.65	180	12.38
MAP	230	13.74	301	14.34	184	16.89

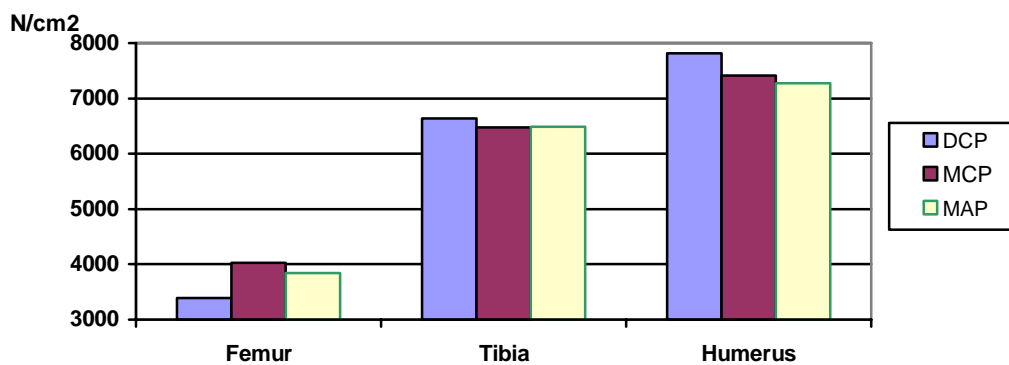
Values of estimated indices are in clearly relation to kind of bones. Maximum force and breaking force were significantly lower in femur as in tibia and the lowest values were estimated for humerus. These results are in agreement with other authors (Vitorović, 1992; Jamroz et al., 2004).

In spite of the fact that values for maximum and breaking force were the lowest for humerus, bone strength calculated as an effect of force on cm² of surface of bone, was the highest.

Table 4. Average bone strength (N/cm²)

Source	Femur		Tibia		Humerus	
	Mean	SEM	Mean	SEM	Mean	SEM
DCP	3394	361.98	6633	521.90	7812	512.98
MCP	4029	396.51	6475	595.94	7407	618.20
MAP	3843	313.21	6487	427.50	7271	538.38

The biggest differences between phosphorus sources were found in this trait, but none of examined sources showed the highest values in every three bones. That means that bone strength is not a sensitive criterion for estimating of the phosphorus utilisation in broilers and it depends on bone examined.



Graph 1. Bone strength

Conclusion

These results pointed out that different sources of phosphorus which were used in this trial had no significant influence on Ca and P content in the femur as well as on the parameters of bone strength. This implies that sources of phosphorus which are examined in this trial are equally effective when they are used in broiler nutrition.

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