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RESEARCH ARTICLE

Diagnosis and Treatment of Hypophosphatemia in Young Turkeys

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ABSTRACT

This study was aimed to diagnose and to treat the disease of young turkeys showing hypophosphatemia symptoms in a farm. The material of this study was consisted of turkeys in both sexes, aged between 13-15 weeks. In the clinical examinations of the turkeys; weight loss, weakness, unwilling to walk, lameness and extremity fractures in some animals were determined. Blood samples were collected from 20 turkeys chosen randomly for biochemical analyses and mineral assays. Serum Ca, P, ALP, Mg, Cu, Zn, Fe, Mn and Co levels were analyzed. Phosphorus and Zn levels were found to decrease significantly whereas Ca, ALP, Mn levels and Ca/P ratio found to increase before treatment. For treatment purpose, phosphoric acid and vitamin D_3 were added to their drinking water. Clinical findings improved after treatment and biochemical parameters which were abnormal before treatment returned to normal values after treatment. As a result, hypophosphatemia was one of the most important reasons of foot problems and bone fractures during the growth period of the turkeys. It was also observed that adding phosphorus and vitamin D_3 in the drinking water for the purpose of treatment was considered to be beneficial.

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INTRODUCTION

The skeletal system disorders affect the quality of life of turkeys and cause significant economic losses (Hedstrom *et al.*, 1986; Ansar *et al.*, 2004). Compared with other mammals, it has been reported that bones of poultry are more sensitive to the development of the malformation (Leach and Gay, 1987). The main causes of skeletal system disorders are malabsorption, abnormal bone development, toxins, various environmental factors, genetic factors, poor nutrition and poor care (Rath *et al.*, 2000; Oviedo-Rondon and Ferket, 2005).

The rickets is an important cause of foot problem and characterized by poor bone mineralization in young turkeys (Huff *et al.*, 1999). It usually occurs in the absence of vitamin D_3 or insufficiency of the available phosphorus (Julian, 2005; Veshkini *et al*., 2011). It has also developed due to overall feeding mixture containing Ca, P, vitamin D and other vitamin along with mineral deficiencies (Roberson *et al.*, 2004; Rama Rao *et al.,* 2007; Dinev, 2009; Selle *et al.,* 2009).

The non phytate phosphorus contents in diet for growing turkeys can be reduced from 6.0 to 2.8 g/kg during a growth period of 24 weeks (Rodehutscord *et al.*, 2003). On the other hand, dietary requirement of turkeys for phosphorus and calcium has been reported to be higher than National Research Council recommendations (Hocking *et al.*, 2002; Godwin *et al.*, 2005). It has been reported that very low phosphorus concentrations could be associated with locomotors abnormalities (Sanders *et al.*, 1992). These abnormalities are cage fatigue, osteoporosis, decreased bone strength, the desire to eat wood, bones, rocks and other materials, weight loss, fatigue, irregularities in the feathers, reluctance to move, sag in wings, humpback, painful gait, lameness and extremity bone fractures in some animals (Karn, 2001; Webster, 2004; Waldenstedt, 2006).

For an effective treatment in cases of rickets, it was reported that the combined administration of dicalcium phosphate and vitamin D would improve disease usually within 1-2 weeks (Walser *et al.*, 1979). In addition, the water soluble vitamins and feed changes have also been reported to be useful in the treatment of rickets in turkeys (Riddell, 1982). The purpose of the present study was to diagnose and treat young turkeys which showing weight loss, weakness, unwilling to walk, lameness and extremity fractures in a turkey farm.

MATERIALS AND METHODS

The material of this study was consisted of turkeys aged between 13-15 weeks in both genders at Van SET-AS turkey farm having a capacity of 5-7 thousands. The sag in the wings, grogginess, weakness, fatigue, unwilling to walk, lameness and occurrence of fractures in the extremities of some animals were observed in this turkey farm. The farm management investigated several micro-biological causes. But they couldn't solve the problem. Then they applied to us. We thoroughly examined the farm conditions. According to our investigation; the farm obtained their water from an artesian well, and the feed they used for turkeys obtained from a private feed factory.

Then, 20 young turkeys having above clinical symptoms were randomly chosen. Blood samples were taken from the wing vein of animals to anticoagulant free serum tubes, three times, on days 0, 7 and 21 for biochemical analysis and to determine mineral substance concentrations. In addition, the direct radiographs of the animals which had broken extremities were taken.

The serums were separated from the collected blood samples through centrifugation (Rotofix 32®-Hettich) at 3000 rpm for 10 minutes. Serum calcium (Ca), phosphorus (P) levels and alkaline phosphates (ALP) were determined with the commercial test kits (Biolabo®, France) using spectrophotometer (Photometer 5010®-Boehringer Mannheim). Serum magnesium (Mg), copper (Cu), zinc (Zn), iron (Fe), manganese (Mn) and cobalt (Co) levels were checked with on atomic absorption spectrophotometer (SOLAAR® Termo, UK).

Eighty five percent phosphoric acid [H_3PO_4, Cat No: 7664-38-2] (100 ml to 1 ton drinking water) and 98% vitamin D_3 [cholecalciferol] (15 gr to 1 ton drinking water) were added to the drinking water of all animals for the treatment, and the treatment continued for 15 days. The statistical analysis was performed with SPSS 11.5 package program. In the statistical analysis, the simple paired t test with the SPSS package program was applied.

RESULTS

Clinical findings: In the conducted clinical examinations of the turkeys, the weakness, loss of appetite, the desire to eat wood, bones, rocks and other materials, irregularities in the feathers, sag in wings, humpback, reluctant to move, painful gait, lameness, growth retardation, and extremity bone fractures in some animals were determined. It was observed that the clinical findings started to improve 7th day after treatment and was completely recovered on 21st day which the animals started to gain weight.

Biochemical findings: The pre- and post-treatment serum Ca, P, ALP, Mg, Cu, Zn, Fe, Mn, Co concentrations and Ca/P ratios of turkey were given in Table 1. Significant reduction in the pre-treatment serum P levels ($P<0.001$, 3.71±0.60 mg/dl), slight increase in Ca concentrations (11.61±0.83 mg/dl), and significant increases in ALP concentrations (6372.20±642.35 U/L) and Ca/P ratios (3.13) were determined. On 7th and 21st days after the treatment, an increase in serum P level, slight decrease in Ca level, reduction in ALP and Ca/P ratios were determined.

Decrease in Zn level and increase in Mn levels at pre-treatment stage were significantly ($P<0.05$) different from those at 21st and 7th day post-treatment, respectively. On the other hand, concentration of Mg, Cu and Co and Fe levels showed non-significant difference at pre- and post-treatment days.

DISCUSSION

Phosphorus is crucial for skeletal integrity and growth performance (Selle and Ravindran, 2007). Phosphorus deficiency will cause reduction in bone mineralization and thereby impair calcium metabolism, which can lead to rickets (Olson *et al.*, 1980; Huff *et al.*, 1999; Julian, 2005). When there is usable P deficiency in the body, the required P is provided from bone and diminished bone strength (Webster, 2004). Thus, the deterioration in mineralization at bone and by the time being major clinical symptoms with concern to skeletal system emerges (Harris *et al.*, 2009).

Clinical findings observed in the present study were similar with the clinical findings given with concern to rickets by several researchers (Riddell, 1982). Furthermore, in the present study the turkeys were 13-15 weeks of age, and the problem occurred at winter season. So, the findings were in parallel with the literature information (Oviedo-Rondon and Ferket, 2005).

In the previous studies (Leach and Gay, 1987; Rath *et al.*, 2000; Waldenstedt, 2006), it has been reported that there were also changes in some other minerals apart from Ca, P and vitamin D in skeletal system disorders.

Crespo *et al.* (2002) reported that, animals with fractures had lower Cu level, and higher Mn levels, but no change in Zn level. Although decreases in Cu and Co concentrations and increases in Fe level were also determined in the present study, these decreases and

Table 1: Some serum biochemical parameters, serum mineral levels (Mean±SEM) and Ca/P ratios in turkey

	Pre-Treatment	Post-Treatment		*P* value at Days		
	0 Day	7th Day	21st Day	0-7th	0-21st	7-21st
Ca (mg/dl)	11.61±0.83	11.01±0.60	11.30±0.76	*		
P (mg/dl)	3.71±0.60	6.68±1.19	7.24±0.94	***	***	
ALP (IU/L)	6372.2±642.3	4406.6±878.8	2043.6±1041.7	***	***	***
Mg (mg/L)	22.66±4.18	23.74±1.88	21.98±2.39			
Cu (mg/L)	0.69 ± 0.18	0.78 ± 0.27	0.83 ± 0.31			
Zn (mg/L)	1.05±0.42	1.09±0.39	1.23±0.47		*	
Fe (mg/L)	1.57±0.55	1.24±0.93	1.28±0.39			
Mn (mg/L)	0.58±0.16	0.42±0.16	0.50±0.15	*		
Co (mg/L)	0.24±0.16	0.32±0.19	0.30±0.15			
Ca/P	3.13	1.65	1.56			

SEM: Standard Error Means. *P<0.05, ***P<0.001

increases were not statistically significant. On the other determined in the present study, these decreases and increases were not statistically significant. On the other hand, decreases in serum Zn levels and increases in the Mn level were determined to be statistically significant in the present study.

In several studies (Riddell, 1982; Huff *et al*., 1999), with concern to rickets decreased P levels, increased ALP levels, and insignificant changes or slight increases in serum Ca levels have been reported. In the present study, serum P levels decreased significantly ($p<0.001$), serum Ca levels increased slightly ($p<0.05$), and ALP levels increased significantly ($p<0.001$). These findings were in parallel with the findings reported by some researchers (Olson *et al.*, 1980).

Huff *et al.* (1999) reported that therapy with only vitamin D alone cannot always be successful in the field rickets. Walser *et al.* (1979) have reported that the disorder would be recovered within 1-2 weeks with the addition of vitamin D_3 and dicalcium phosphate to their feed and water in the field rickets. Furthermore, in human cases of rickets due to hypophosphatemia, it was stated that oral P and vitamin D administrations would be useful in treatment practices (Evans *et al.*, 1980). Vitamin D_3 deficiency results in hypocalcemia and hypophosphotemia. The requirement for cholecalciferol varies according to the parameter evaluated and according to the dietary level of Ca or P (Oviedo-Rondon and Ferket, 2005). It has been suggested that cholecalciferol could improve the phytate P and Ca absorption by stimulating the hydrolysis of phytate (Karn, 2001; Rama Rao *et al.,* 2007). In the present study, 85% phosphoric acid and 98% vitamin D_3 were added to the drinking water. Ca, P and ALP levels obtained after treatment were in parallel with the results given by other researchers (Olson *et al.*, 1980; Huff *et al.*, 1999). After these treatments, clinical and biochemical findings returned to normal, therefore the cause of this outbreak could well be associated with feed.

It has been reported that Ca/P ratios are changed in commercially prepared feed to obtain maximum live weight gain and that the actual values were either lower or higher than the recommended NRC levels (Hocking *et al.*, 2002; Roberson *et al.*, 2004; Godwin *et al.*, 2005). Calcium has generally a relatively high availability from most sources, but the availability of phosphorus varies largely depending on the source, and considerable attention has been paid to the availability of this element (Waldenstedt, 2006; Rama Rao *et al.,* 2007). But with several reasons such as; inorganic phosphorus sources is limited, it is expensive and it pollute the environment (Rodehutscord *et al.*, 2003; Selle and Ravindran, 2007). Therefore, P is not used sufficiently in the feed thus the problems arise.

As a result; turkey breeding farms would benefit if they take more precautions in purchasing feed especially in the animals growing period. It was concluded that the hypophosphatemia is an important reason in the occurrences of foot problems and fractures of the extremities in the fast growing period of turkeys. When such problems occur, adding phosphorus and vitamin D_3 to poultry feed or water, they will be treated and beneficiary for the producers. This treatment can also be useful for the prevention of such problems in the farms.

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