

## Conference Paper

# Correction of Mineral Metabolism Disorders in Young Camels

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This article examines the effectiveness of the treatment of rickets in young camels bred in the Republic of Kalmykia with tricalcium phosphate and tricalcium phosphate with granuvite E. To determine the biogeochemical features of the Justinsky and Yashkulsky districts of the Republic of Kalmykia, we carried out an analysis of diets for nutritional value and balance, and a study of the soil, water, feed, and macronutrient content of camels' blood. The article presents data from the clinical examination, and the clinical, hematological and biochemical blood tests carried out before, during and after therapy. To enrich the body of experimental camels with missing macrocells (calcium, phosphorus) and vitamins (tocopherol), an experiment was carried out using tricalcium phosphate and tricalcium phosphate with granuvite E. From an economic point of view, it is more appropriate to use tricalcium phosphate (17.82 rubles) than tricalcium phosphate with granuvite E (15.54 rubles). However, as confirmed by laboratory studies (hematological and biochemical parameters), from a therapeutic point of view, the use of tricalcium phosphate for one month does not completely restore calcium-phosphorus imbalance, unlike when tricalcium phosphate is used with granuvite E. The use of tricalcium phosphate and granuvite E for therapeutic purposes once a month for young camels of 120 g and 2 g, respectively, has high therapeutic efficacy in treating osteodystrophy and normalizes the calcium-phosphorus ratio.

**Keywords:** young camels, therapy, mineral metabolism, tricalcium phosphate.

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## 1. Introduction

Disorders of mineral metabolism, especially its subclinical forms, were detected during clinical examination [1–3]. Its therapeutic phase includes the treatment and prophylaxis of animals that are clinically healthy but have laboratory deviations [4, 5, 6], which indicates the presence of metabolic disorders, as well as of clinically sick animals, in order to eliminate the disorders of protein, carbohydrate, fat, vitamin, mineral and

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endocrine exchanges. Also the therapeutic stage is aimed at treating sick animals [7–9].

Calcium and phosphorus are one of the main macroelements that significantly affect the mineral metabolism in the body. Hypocalcemia leads to osteodystrophy, rickets and other diseases [10–12].

A decrease in blood calcium is observed with prolonged insufficient intake of calcium with food, poor absorption due to a deficiency of vitamin D and parathyroid hormone, which ensure its absorption in the intestine and prevent urinary excretion, as well as due to impaired parathyroid, thyroid, pancreas and adrenal glands. The level of calcium in the blood during compensatory processes is maintained by mobilizing it from bone tissue. All types of metabolism in the body are associated with the conversion of phosphoric acid [13–15].

Literary sources do not mention the spread of calcium-phosphorus imbalance among camels in the Republic of Kalmykia. Veterinarians do not actually diagnose this disease and, accordingly, do not carry out therapeutic and preventive measures [16, 17].

## 2. Methods and Equipment

### 2.1. Methods

#### 2.1.1. Diagrammatic representation

The work was carried out in the Republic of Kalmykia on a herd of camels, at the Department of Therapy and Propaedeutics of the FSBEI of HE “Don State Agrarian University”, in the laboratory of “Vita” veterinary clinics chain in 2014-2017.

To determine the biogeochemical features of the Justinsky and Yashkulsky districts of the Republic of Kalmykia, we carried out an analysis of diets for nutritional value and balance, a study of the soil, water, feed, macronutrient content of camels' blood. The titrimetric method RD 52.24.403-2018 was used to determine the content of calcium ions in water (the studies were carried out in the laboratory of TLC of FBHI “Hygiene and Epidemiology Centre of Rostov Region”).

The calcium content in the soil was studied in literature.

The nutritional value of the feed was determined by tabular data characteristic of the steppe zone of the Republic of Kalmykia. The metabolism of animals was controlled by hematological and biochemical studies.

Hematological studies were performed on a Mindray BC-2800 Vet hematology analyzer. The number of leukocytes, erythrocytes, and hemoglobin level were determined. An automated biochemical analyzer Random Access A 15 was used to determine total protein, glucose, calcium and phosphorus; the reserve alkalinity was investigated with the Van Slyke gasometric method using the AR-3 apparatus. The content of vitamin E was studied by high performance liquid chromatography.

To enrich the body of experimental camels with missing macrocells (calcium, phosphorus) and vitamins (tocopherol), an experiment was carried out using tricalcium phosphate and tricalcium phosphate with granuvite E.

Three groups of young camels were created according to the principle of analogues to select a therapeutic dose of tricalcium phosphate and granuvite E (8 goals each, aged 16 months, weighing  $300 \pm 20$  kg). Young camels of the 1st experimental group received 60 g of tricalcium phosphate and 2 g of granuvite E in the main diet once a day for 30 days. Animals of the 2nd and 3rd experimental group received 120 and 240 g of tricalcium phosphate respectively and 2 g of granuvite E. We selected 3 groups of young camels according to the principle of analogs (1 control and 2 experimental), 8 animals each, at the age of 16 months, weighing  $300 \pm 20$  kg, for experiments on studying the therapeutic efficacy of the drugs used in young camels with disturbance of calcium and phosphorus exchange. The same conditions for feeding, keeping and caring for all experimental animals were created while maintaining the generally accepted daily routine.

Camels in the control group received the main diet (grass of wormwood-solyanka (semi-desert) pastures, hay of cereal and legumes, oat crushed grain); the 1st experimental group got the main diet and tricalcium phosphate at the rate of 120 g per capita daily for one month; animals of the 2nd experimental group received tricalcium phosphate 120 g per capita and granuvit E in a dose of 2 g per capita daily for one month additionally to the main diet.

The scientific and industrial experiment in group therapy lasted 30 days. According to the principle of analogues, two groups of young camels were formed, 40 animals each (age 16 months, weight  $300 \pm 20$  kg). One was control, another was experimental. We used tricalcium phosphate in a dose of 120 g per capita together with granuvit E in a dose of 2 g in the experimental group, and the control group did not receive drugs. The experimental animals were monitored throughout the experiment. Moreover, complete clinical studies and laboratory studies were carried out at the beginning, in the middle and at the end of the experiment.

### 3. Results

The clinical condition of the experimental camels before the experiment was the same and had no significant differences. Animals had average fatness, good appetite. The main physiological indicators corresponded to generally accepted physiological limits.

In the process of medical examination of camels, we found a reduced content of calcium ions in the aqueous extract from the soil, 0.13-0.38% (against 0.73% calcium content in podzolic soils from dry matter of the soil), 22.6 mg/l in water (according to the SanPiN norm calcium content for water of centralized drinking water supply systems is 25-130 mg/l) and 50.44 g per capita per day in feed according to the diet (against the required 52 g per capita per day). A biochemical blood test revealed that the camel organism had a calcium level of  $2.4 \pm 0.05$  mmol / l and a calcium-phosphorus balance of 1.26:1 that gave reason to attribute the surveyed farm to a biogeochemical province depleted in calcium. That necessitated feeding animals tricalcium phosphate feed additive. We examined the vitamin content in the blood of camels and noted that the amount of vitamin E was  $15.87 \pm 0.37 - 16.01 \pm 0.24$   $\mu\text{mol/L}$  (normal - 14-34  $\mu\text{mol/L}$ ). Therefore, we decided to increase the level of vitamin E with granuvit E, since we considered it the most suitable form of tocopherol for feeding camels, taking into account the keep of the animals. The choice of these drugs was also due to the lack of information about the use of them in camel breeding for the prevention of this pathology [10].

When determining the therapeutic dose of tricalcium phosphate and granuvite E, different doses of the drugs were tested taking into account the state of the animals and laboratory diagnostic data (values of red blood cells, white blood cells, hemoglobin, total protein, glucose, total calcium, inorganic phosphorus, their ratio and vitamin E). The hematological and biochemical data changes are shown in table 1.

According to the results of studies, we came to the conclusion that the optimal therapeutic dose of tricalcium phosphate for treating young camels with subclinical rickets is 120g per individual. Given that the content of vitamin E in the blood of young camels was from  $15.73 \pm 0.31$  to  $20.69 \pm 0.54$   $\mu\text{mol/L}$ , we used granuvit E in a dose, according to the instructions.

An experiment on the study of therapeutic efficacy in the treatment of subclinical rickets in young animals was carried out according to the scheme above. In the compared groups of animals: control; experimental 1, which received only tricalcium phosphate with food; and experimental 2, which received tricalcium phosphate in combination

with granuvite E, the general condition of the experimental subjects and the results of laboratory studies were taken into account.

The clinical parameters of the experimental animals at the beginning, during and at the end of the experiment were within the physiological deviations. The changes in hematological and biochemical data are shown in table 2.

The analysis of table 3 showed that the use of tricalcium phosphate within one month does not completely restore the calcium-phosphorus imbalance of 1.71: 1, but the use of tricalcium phosphate together with granuvite E within one month restores it from 1.54:1 to 1.84:1, increases the content of vitamin E to  $29.25 \pm 0.79 \mu\text{mol/L}$ , which contributes to an increase in the mass gain of young animals compared with the control by  $729 \pm 31.6 \text{ g}$  (3.26%) for the period of the experiment.

In the experimental group, biochemical parameters are within the physiological norm with an increase in total calcium, inorganic phosphorus, and vitamin E, while in the control group, their slight decrease occurs, or they remain at the same level. When analyzing these tables, we confirm that tricalcium phosphate with granuvite E should be used for therapeutic purposes in case of rickets of young animals.

TABLE 1: Hematological and biochemical blood parameters of young camels when establishing a therapeutic dose of tricalcium phosphate and granuvite E (n = 24)

Indicator	Unit	Tricalcium phosphate (20 g/100kg) granuvite E 2g		Tricalcium phosphate (40 g/100kg) granuvite E 2g		Tricalcium phosphate (80 g/100kg) granuvite E 2g	
		Before the experiment	After the experiment	Before the experiment	After the experiment	Before the experiment	After the experiment
Red blood cells	$\times 10^{12}/\text{l}$	$4.73 \pm 0.28$	$4.67 \pm 0.34$	$4.86 \pm 0.29$	$4.73 \pm 0.28$	$4.21 \pm 0.73$	$4.59 \pm 0.35$
White blood cells	$\times 10^9/\text{l}$	$14.79 \pm 1.23$	$14.15 \pm 1.19$	$14.81 \pm 1.06$	$14.73 \pm 1.29$	$13.32 \pm 0.98$	$14.28 \pm 1.19$
Hemoglobin	g/l	$117.49 \pm 10.78$	$116.51 \pm 10.63$	$118.63 \pm 11.15$	$117.27 \pm 10.93$	$101.7 \pm 10.14$	$109.38 \pm 9.89$
Total protein	g/l	$62.98 \pm 3.69$	$63.42 \pm 3.71$	$64.16 \pm 3.87$	$64.72 \pm 3.49$	$69.38 \pm 9.78$	$68.91 \pm 3.64$
Glucose	mmol/l	$5.27 \pm 0.59$	$5.25 \pm 0.57$	$5.30 \pm 0.43$	$5.29 \pm 0.58$	$4.61 \pm 0.69$	$5.03 \pm 0.47$
Total calcium	mmol/l	$2.69 \pm 0.06$	$2.87 \pm 0.06$	$2.71 \pm 0.05$	$3.85 \pm 0.06$	$2.98 \pm 0.06$	$4.07 \pm 0.06^{**}$
Inorganic phosphorus	mmol/l	$1.71 \pm 0.06$	$1.72 \pm 0.06$	$1.74 \pm 0.04$	$1.93 \pm 0.06$	$1.90 \pm 0.08$	$1.99 \pm 0.06$
Calcium/ phosphorus ratio	-	1.52:1	1.69:1	1.55:1	2:1	1.57:1	2:1
Vitamin E	$\mu\text{mol/L}$	$20.69 \pm 0.54$	$24.37 \pm 0.63$	$20.41 \pm 0.73$	$29.52 \pm 1.31$	$15.73 \pm 0.31$	$31.66 \pm 2.95^{***}$

Note:  $P < 0.05$  \*;  $P < 0.01$  \*\*;  $P < 0.001$  \*\*\*

TABLE 2: Hematological and biochemical blood parameters of young camels in the treatment of rickets with tricalcium phosphate and tricalcium phosphate with granuvite E

Indicator	Unit	Control group		Experimental 1		Experimental 2	
		Before the experiment	After the experiment	Before the experiment	After the experiment	Before the experiment	After the experiment
Red blood cells	$\times 10^{12}/l$	4.27 $\pm$ 0.12	4.19 $\pm$ 0.06	4.50 $\pm$ 0.18	4.32 $\pm$ 0.28	4.35 $\pm$ 0.26	4.21 $\pm$ 0.15
White blood cells	$\times 10^9/l$	13.38 $\pm$ 0.28	13.38 $\pm$ 0.23	13.49 $\pm$ 0.22	13.43 $\pm$ 0.20	13.36 $\pm$ 0.37	13.14 $\pm$ 0.22
Hemoglobin	g/l	121.25 $\pm$ 5.69	121.50 $\pm$ 2.88	122.50 $\pm$ 5.63	121.38 $\pm$ 5.78	122.38 $\pm$ 4.78	122.25 $\pm$ 7.75
Total protein	g/l	65.7 $\pm$ 2.19	66.8 $\pm$ 2.35	66.4 $\pm$ 2.21	66.9 $\pm$ 2.33	67.6 $\pm$ 2.31	67.9 $\pm$ 2.31
Glucose	mmol/l	4.19 $\pm$ 0.78	4.21 $\pm$ 0.51	4.19 $\pm$ 0.63	4.03 $\pm$ 0.55	4.07 $\pm$ 0.56	3.87 $\pm$ 0.64
Total calcium	mmol/l	3.86 $\pm$ 0.13	3.88 $\pm$ 0.13	3.87 $\pm$ 0.13	4.33 $\pm$ 0.14**	3.87 $\pm$ 0.13	4.64 $\pm$ 0.15***
Inorganic phosphorus	mmol/l	2.50 $\pm$ 0.11	2.52 $\pm$ 0.11	2.51 $\pm$ 0.11	2.53 $\pm$ 0.11	2.51 $\pm$ 0.11	2.52 $\pm$ 0.11
Calcium/phosphorus ratio	-	1.54:1	1.54:1	1.54:1	1.71:1	1.54:1	1.84:1
Alkaline reserve	V%CO <sub>2</sub>	53.25 $\pm$ 2.98	55.67 $\pm$ 3.31	54.29 $\pm$ 2.98	57.76 $\pm$ 3.12	56.74 $\pm$ 3.27	58.79 $\pm$ 3.82
Vitamin E	$\mu$ mol/L	20.84 $\pm$ 0.79	21.17 $\pm$ 0.93	21.92 $\pm$ 0.72	21.96 $\pm$ 0.67	20.99 $\pm$ 0.89	29.25 $\pm$ 0.79**

Note: P <0.05 \*; P <0.01 \*\*; P <0.001 \*\*\*

## 4. Discussion

The therapeutic measures, which were taken in case of disturbance of calcium-phosphorus metabolism in young camels, testify to the positive effect of the use of the feed additive of tricalcium phosphate with granuvite E on the general condition of the organism of Bactrian camels, hematological and biochemical blood parameters.

Achieved not only therapeutic effect in improving and normalizing the physiological parameters in the body of camels, but also the economic effect. The economic effect of therapeutic measures with tricalcium phosphate was 17.82 rubles and using tricalcium phosphate with granuvite E was 15.54 rubles. Analyzing the information, we see that the application of both methods is economically feasible, since it makes it possible to get more than 1 ruble of economic effect per 1 ruble of costs.

Previous experience in studying the therapeutic effect of tricalcium phosphate with granuvite E in the subclinical form of rickets has established that this pathology can be eliminated by daily administration of these drugs in the diet for one month. Based on this, we decided to test the therapeutic effect of tricalcium phosphate with granuvite E more widely in a scientific and production experiment on the treatment of subclinical forms of rickets in young animals on a fairly large population.

Table 3 presents the clinical-morpho-biochemical blood parameters of the studied animals.

TABLE 3: Clinical, hematological and biochemical parameters of blood in the scientific and industrial experiment in group therapy of young animals (n = 30)

Indicator	Unit	Control group		Experimental 1	
		Before the experiment	After the experiment	Before the experiment	After the experiment
Temperature	° C	38.7±0.23	38.6±0.20	38.8±0.17	38.8±0.19
Pulse	beats/minute	53.40±1.15	53.67±1.11	54.27±1.62	54.60±1.31
Breath	breaths/minute	15.47±1.29	15.0±1.07	15.13±1.09	16.67±1.24
Red blood cells	×10 <sup>12</sup> /l	6.74±0.29	6.75±0.28	6.71±0.31	6.79±0.28
White blood cells	×10 <sup>9</sup> /l	13.64±0.31	13.62±0.17	13.57±0.20	13.12±0.33
Hemoglobin	g/l	124.60±4.11	124.93±2.89	125.33±3.26	127.27±4.19
Total protein	g/l	54.46±4.21	51.45±2.47	52.58±3.39	53.38±1.87
Glucose	mmol/l	5.13±0.29	5.26±0.27	5.22±0.26	5.15±0.18
Total calcium	mmol/l	2.70±0.20	2.62±0.17	2.71±0.17	3.97±0.35**
Inorganic phosphorus	mmol/l	2.04±0.21	2.01±0.18	2.01±0.19	2.08±0.12
Calcium/ phosphorus ratio	-	1.32:1	1.30:1	1.35:1	1.91:1
Alkaline reserve	V%CO <sub>2</sub>	52.24±1.02	52.22±1.42	51.60±1.08	51.86±1.56
Vitamin E	µmol/L	16.70±0.99	17.01±1.11	17.08±1.28	30.20±1.02**

Note: P <0.05 \*, P <0.01 \*\*, P <0.001 \*\*\*

## 5. Conclusion

From an economic point of view, the use of tricalcium phosphate (17.82 rubles) is more appropriate than the use of tricalcium phosphate with granuvite E (15.54 rubles). Moreover, from a therapeutic point of view, the use of tricalcium phosphate alone for one month does not completely restore the calcium-phosphorus balance, in contrast to tricalcium phosphate in conjunction with granuvite E. The combined use of tricalcium phosphate and granuvite E within one month restores the calcium-phosphorus balance, which is confirmed by laboratory research (hematological and biochemical parameters). The use of tricalcium phosphate and granuvite E for therapeutic purposes for young camels in the dose of 120 g and 2 g, respectively, once a day for a month has high therapeutic efficacy in the treatment of osteodystrophy and normalizes the calcium-phosphorus ratio.

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## Conflict of Interest

The authors have no conflict of interest to declare.

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