

**STUDY OF THE USE OF CALCIUM COMPOUNDS IN EXPERIMENTAL  
OSTEOPOROSIS**

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**Abstract:** Osteoporosis (OP) is a systemic skeletal disease characterized by decreased bone density and microarchitectural deterioration, leading to increased bone fragility and fracture risk. The most severe consequence of OP is a hip fracture, which is associated with high disability and significant postoperative mortality. In some countries, this rate exceeds the global average, making OP a priority public health issue globally.

**Keywords:** Osteoporosis; Calcium alginate, Calcium chloride, Psychobehavioral activity, Experimental model, Ovariectomy, Bone metabolism

**Introduction**

The prevalence of osteoporosis increases with age, especially among postmenopausal women, due to decreased estrogen production and accelerated bone remodeling. Despite the availability of various prevention and treatment methods, the effectiveness of traditional treatments remains insufficient. One key reason is the lack of a personalized approach that takes into account individual characteristics, including differences in metabolism, hormonal levels, and behavioral status.

Of particular interest is the study of the role of psychobehavioral activity (PBA) in the development and progression of osteoporosis. It has been shown that an animal's behavior reflects its metabolic state: active individuals typically have an accelerated metabolism, which can contribute to more intense calcium leaching from bone tissue. Passive animals have opposite metabolic characteristics, which can determine differences in response to therapy and the absorption of calcium supplements [1].

Experimental models of osteoporosis are widely used to study the pathogenesis of the disease and evaluate the effectiveness of new therapeutic agents. The literature describes models using various laboratory animal species, from rodents to primates. Each model has specific advantages and limitations related to its anatomy, metabolism, and rate of bone remodeling, which requires a well-founded choice of animal species and method for modeling osteoporosis in each specific study [3, 4].

Given the growing interest in developing effective, safe, and affordable drugs for correcting mineral metabolism, particular attention is being paid to compounds of natural origin. One such compound is calcium alginate—a natural biopolymer widely used in the food industry and possessing high biocompatibility and the potential to improve calcium absorption by the body.

**Study Objective:** To conduct a detailed comparative study of the efficacy of calcium alginate and calcium chloride in experimental osteoporosis in rats, taking into account individual typological characteristics determined by the level of psychobehavioral activity.

**Research Materials and Methods:** Experiments were performed on 100 rats. The experimental osteoporosis model was reproduced using ovariectomy. After reproducing the experimental OP (ovariectomy), 33 animals were administered calcium chloride (comparison group) for 90 days at a dose of 2 ml/kg (2.5% solution at a rate of 18 mg/kg pure Ca) and 33 individuals were given calcium alginate, which was also administered for 90 days at a dose of 2 ml/kg (8.5% solution at a rate of 18 mg/kg pure Ca) (experimental group), 34 animals did not receive treatment. Each of these groups was divided into subgroups depending on their specific activity type (active, normal and passive animals). All experimental rats were divided according to individual typological

characteristics into groups with active, normal and passive psychobehavioral activity (PPA) according to the generally accepted behavioral test. The type of psychobehavioral activity was determined using the generally accepted Open Field Test, according to the method of Ya. I. Buresh and N. A. Lomteva. Total calcium and alkaline phosphatase (ALP) levels in the blood serum were determined by biochemical analysis using the HUMAM test systems (Germany). Measurements were performed on a VAZA semiautomated biochemical analyzer (Mindray, China). Statistical analysis of the study results was performed using Excel and Biostat software. A p value of 0.05 served as the statistical significance criterion.

Results of the obtained studies. A comparative analysis of groups with different levels of activity revealed certain differences. Thus, the highest calcium levels in the first group were recorded among active animals, while in the group with normal activity, calcium levels were, on average, one-third lower in passive animals. In animals with experimental OP, the highest serum calcium levels were found among animals with increased activity, which were one fifth and one quarter higher than in animals with normal and reduced PPA, which in turn may be associated with a higher intensity of calcium leaching from bone tissue with a high degree of metabolic processes in the body of experimental animals. With experimental OP, rats showed a decrease in calcium concentration, and if in animals with increased activity, the value of this indicator was reduced by 13.5% (p 0.05) compared with the baseline data, then in animals with intermediate (normal) PPA, an insignificant tendency to decrease was observed, in the absence of statistically significant changes, and in rats with reduced activity or a "passive" type of behavior, the calcium content decreased by 9.0% (p 0.05)

Moreover, the most pronounced increase in serum calcium, relative to its content in untreated animals and compared to animals treated with calcium chloride, was observed after administration of calcium alginate in "passive" animals with reduced PPA, and a slightly less significant increase among "normal" animals with an intermediate type of PPA.

**Conclusion.** The use of calcium alginate in experimental osteoporosis resulted in the greatest increase in serum calcium levels in animals with reduced PPA ("passive" animals).

Calcium alginate is a more effective calcium compound in the treatment of experimental osteoporosis compared to calcium chloride, especially in animals with low psychobehavioral activity. These results emphasize the importance of an individual-typological approach when selecting calcium-containing drugs for the treatment of osteoporosis.

#### **Conclusions.**

1. Calcium alginate is a more effective drug for correcting calcium metabolism disorders than calcium chloride in experimental osteoporosis.
2. The effectiveness of calcium alginate was most pronounced in animals with low psychobehavioral activity, indicating the influence of individual metabolic characteristics on treatment outcome.
3. The obtained data expand our understanding of the potential use of natural calcium compounds in osteoporosis treatment.

#### **Practical Relevance.**

The study data can serve as a basis for the development of new domestic calcium preparations with increased bioavailability. The established relationship between treatment effectiveness and patient psychobehavioral activity opens up prospects for the implementation of personalized osteoporosis treatment regimens in clinical practice. Calcium alginate can be considered a promising agent in the prevention and treatment of osteoporosis, especially in patients with low metabolic activity and a reduced metabolic rate.

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