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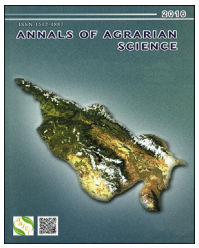

Impact of hypokinesia on some metabolic characteristics and gut microbiota composition of dairy cows

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ABSTRACT

In the field of animal-breeding the "stable keeping" has a negative effect on the overall functional state of the animal's organism. Hypokinetic conditions not only produce problematic effects upon the animals' immune status and metabolism, but also generate a range of economic damages relating to productivity and meat product quality and taste.

The influence of hypokinesia on some metabolic indexes and on titers of some gut commensals from Caucasus brown cows and their calves has been investigated.

The investigations testify that the changes in gut microbiota and in metabolic characteristics of the animals under the conditions of physical inactivity can cause an increased risk of infectious diseases of those animals.

Introduction

The scientific–technical progress sets new tasks before humanity. In addition to infections, hypokinesia causes great anxiety in agriculture [1]. The severe reduction of muscle activity and the decline of volitional function intensity are the basic and essential components of hypokinesia syndrome.

In the field of cattle-breeding the long-term keeping of animals at the household or other stockbreeding complexes or the so called "stable keeping" affects negatively both the animal's nervous system and the general functional state of its organism. Hypokinetic conditions have a negative impact on the animal's immune system, productivity and reproductive functions affecting also the meat product quality and taste. All of this arouses interest in the studies of hypokinesia consequences and the ways of its elimination. In the field of veterinary science, the animals are taken out for an "active walk" in households to prevent the negative effects of hypokinesia. However, these do not always provide an opportunity to have a "complete and long walk" and the existing cattle-breeding instructions about the active walk duration cannot ensure a thorough prevention from the negative effects of hypokinesia.

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On the other hand it is known that the human and animals' gut microbiota, being in harmonic ties with macroorganisms, plays an important role in the vital activity functions of host organisms [2,3]. Usually, the gut microbiota of young calves is established by the bacterial state of healthy animals' patrimonial ways. About 10^9–10^{10} cfu/g of bacteria are inhabited in age of 5–6 h animal's feces, where the predominant bacterial genera are: *Clostridium*, *Bacteroides*, *Ruminococcus*, *Akkermansia*, *Porphyromonas*, *Prevotella*, *Lachnospira* and *Enterococcus* spp. Gut microbiota takes an active part especially in the synthesis processes of B, C, D, E and K vitamins. It takes part in the synthesis of amino acids and the renewal of intestine wall cells, stimulates the withdrawal of toxicants borne as a result of metabolisms and promotes the growth and development of animals. The aliphatic acids with a short chain of carbohydrates stimulate energy processes and also the formation and development of large gut epithelium. A part of anaerobe bacteria produce butyrate, acetate and propionate. *Escherichia coli*, *Bacteroides*, *Enterococcus faecalis*, *Clostridium* and *Eubacterium* stimulate the dehydroxylation and deconjugation of bile acids.

Taking into account the above mentioned, the aim of current investigations was to assess some general clinical indexes and the quantitative changes in gut bifidobacteria, lactobacilli, commensal *E. coli*, enterococci and isolates of *Proteus*, *Klebsiella*, *Enterobacter* and *Citrobacter* from the gut microbiota of Caucasus brown cows and their calves under the hypokinesia conditions of those animals.

Objectives and methods

The studies were conducted in the "Balahovit" and "Voskehat" teaching-experimental farms of Armenian National Agrarian University and in "Agroholding- Armenia" LLC. The Caucasian brown cows and calves of Caucasian brown cows' were investigated in this study. The cows nutrition ration was green grass in the morning and dry grass in the evening (2–3,5 kg combined food daily). During the investigations the animals didn't get ill with infectious diseases, didn't take any medicine, including antibiotics and hadn't been vaccinated.

The animals for experimental and control groups have been selected on the principle of similarity. In order to limit the animals' movements, the animals were kept in cells. The cell size for an animal was 50 × 70 sm^2. Control group animals were kept in boxes: 60 × 220 sm^2 for an animal. Also, the controls had daily 2-h exercise (active exercise).

The blood for investigations has been taken from veins. The amount of blood glucose has been determined through the Gultman method.

The animals' stool samples were placed into plastic anaerobe jars with Pack Anaero sachets (Mitsubishi Gas Co.) and transported to the laboratory. 1 g fecal material was mixed with 9 ml of phosphate buffered saline (PBS) and vortexed for 2 min. The debris was removed by 5 min low-speed centrifugation and the supernatant was serially diluted in PBS. The dilutions were plated on MacConkey agar for preliminary identification of *Enterobacteriaceae*, with further analysis using the selective media and conventional biochemical testing [4,5]. The Vitek 2 Compact system (bioMérieux, France) used to characterize the bacterial isolates, too. The bacterial identification cards: ID-GNB, GN and ANC, for these purposes were used.

Statistical analysis was performed by Student's *t* test.

Results and discussion

The influence of hypokinesis on animals' some general clinical indexes

The clinical practice strongly needs the answer to such question as: hypokinesia of which duration can cause pathological phenomena to the animals which are expressed through the objective clinical symptoms?

The experiments have shown that the body temperature of the calves stricken by hypokinesia and grown in normal conditions is the same (Table 1), when the restricted mobility conditions affect the respiratory function of animals (Table 2). As show the results of experiments, the breathing frequency of the cows on the 90–120th day of hypokinesia has increased (approximately by 21.29% and 37.89%).

The significant increase of pulse frequency of calves as compared to the similar data of control animals has made up 6% on the 60th day, 20.05% on the 90th day and 22.12% on the 120th day (Table 3).

These changes testify about the functional violation of cardio-vascular and respiratory systems during hypokinesia.

The increase of respiratory rate, in all probability, is related to the decrease of pulmonary ventilation and to the reduction of coefficient of oxygen utilization by the tissues and organism's cells.

The increase of pulse frequency, in most probability, takes place as a result of the function tension of cardio-vascular system.

Table 1 – Changes in body temperature of 4-month-old Caucasian brown calves in hypokinesia condition (M ± m, $N_E = 29$, $N_C = 27$).

4-month-old Caucasian brown calves	Temperature, °C					
	Beginning of experiment	Days of hypokinesia				
		5	30	60	90	120
Control	39.10 ± 0.25	39.30 ± 0.10	39.30 ± 0.20	39.03 ± 0.10	39.20 ± 0.11	39.10 ± 0.10
Experiment	39.50 ± 0.19	39.45 ± 0.17	39.20 ± 0.13	39.30 ± 0.15	39.12 ± 0.02	39.30 ± 0.1

N_E – Number of calves stricken by hypokinesia.
N_C – Control calves.

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