KnE Life Sciences

AgroSMART 2019
International scientific and practical conference
``AgroSMART - Smart solutions for agriculture''
Volume 2019

Knowledge E
enriching | engaging | empowering

Conference Paper

Ecological Aspects of microelements' and Vitamins' Salts Impact on Dairy Cows' Productivity and Reproductive Function in Mountain Territories of KBR

I K Taov, Ts B Kagermazov, and A M Khuranov

The Department of Veterinary Medicine, Faculty of Veterinary Medicine and Biotechnology, Kabardino-Balkaria State Agrarian University named after V.M. Kokov, Nalchik, Russia

Abstract

The article examining the implication for the microelements' salts -- cobalt and copper -- to milk production, vitamin A and trivitamin (vitamin A, D_3, E) to the cows' reproductive function in mountainous areas. The study is relevant due to the fact that when organizing cattle feeding, first of all, we care about the balance of rations for the main nutrients and only then for vitamins, minerals and micro minerals. That is why it becomes more important to provide the breeding stock with vitamins and increase the metabolism of the main substrate of life - protein, change its biological function. It is noteworthy that it is necessary to clarify the way that fat-soluble vitamins on cells act, so that their biological spectrum of action is wider than we realize. The purpose of this research is the further study of the biological role of trace elements and vitamins used in cattle breeding, considering the soil and climatic zones of mountainous areas. In our research, the mountainous farms cows' feeding with microelements favorably affected their milk pr76nv hghhjhhnhghjuo9huyoduction. So, in animals from the second group, milk yield was higher compared to the control by 0.95 kg of milk, the third -- by 1.28 kg and the fourth -- by 1.45 kg. Calves from cows that received vitamin A and trivitamin developed better during the embryonic period and their birth weight was 2.8--3.0 kg more compared to the control group. Within 90 days after calving, 87.5--92 % of cows from the experimental groups became enceinte, while in the control group it was only 75 %.

Corresponding Author:
I K Taov
laura07@yandex.ru

Received: 25 October 2019
Accepted: 15 November 2019
Published: 25 November 2019

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the AgroSMART 2019 Conference Committee.

1. Introduction

The implementation of the program for the further cattle breeding development is possible, first of all, on the basis of its intensification and animal reproduction process' purposeful management. Therefore, a significant increase in the productivity to fully meet the growing social needs in food and industry for raw materials remains to be the main agricultural task. Further cattle breeding development in the mountainous areas

conditions should ensure the production of high-calorie, biologically high-grade food products, especially meat and milk in such number as may be required.

Performance of the planned tasks is possible when using biologically adequate rations. Great importance is attached to the full diet supply with biologically active substances, including vitamins and microelements.

It is known that proteins form strong compounds with mineral substances (macro- and microelements). It is in the composition of these complexes that the latter fulfill their biological role. Microelements greatly influence the life of the organism, engaging in communication with organic substances synthesized in living cells [1]. We have established that in the mountainous farms, they have a positive effect on fertilization, development, growth and viability of the critter.

In the developing organism, mineral substances perform different functions: they provide the building of supporting skeletal tissues, support the osmotic environment of blood cells, participate in the formation of hormones, vitamins and enzymes, without which are indispensable for the organism existence [2]. In addition, macro- and microelements perform a biological function in maintaining the defense mechanisms, competence and activity of the immune system.

Metal ions that play the role of bridges between protein and substrate are involved in maintaining cellular functions, including those that provide resistance to the body [3].

Considering the copper role in the provision of various physiological mechanisms, including regulatory mechanisms, it should be noted that the liver plays a key role in the exchange of this element, and, above all, its main structures are hepatocytes. The copper that enters them initially binds to the protein metallothionein [4].

Copper is involved in biochemical processes as an integral part of electron transfer proteins that carry out the oxidation of organic substrates by molecular oxygen [5].

I. Iu. Fofanova [6] claims that in the metabolic processes and metabolism, it is not a single microelement that matters, but a complex of microelements and their balance, since there is an interaction between the mineral elements themselves in the body. Cobalt effectively acts on blood formation only in the presence of sufficient amounts of iron and copper, and magnesium increases the absorption of copper.

According to A.V. Kudrin and co-authors [7], V.M. Kodentseva, O.A. Vrzhesinskaia [8] microelements along with vitamins participate in metabolic processes by activating enzymes, hormones, vitamins and a number of proteins. It is established that the majority of enzymes for the manifestation of their activity requires microelements, otherwise they are generally inactive.

Moreover, there are numerous reports on the most important regulatory role of minerals in various mechanisms that ensure morpho-functional homeostasis in various animals and humans at different stages of ontogenesis, and above all in the embryonic period of development, when morphological foundations of the functional completeness of the organism are laid at all subsequent stages of ontogenetic development.

Cattle's feeding is necessarily provided with a complete, balanced diet for the main nutrients, then for vitamins and minerals. In this regard, especially in the mountain farms, it becomes more important to ensure the breeding stock with vitamins and increase the metabolism of the main life substrate -- protein, change its biological functions (enzymatic, immunological, structural and educational) against the background of the vitamin-mineral preparations use. Therefore, it is necessary to clarify the way molecular mechanism of fat-soluble vitamins act on cells, their biological spectrum of action, including the vitamin's effect on the female organism -- the immunoreactivity severity and the speed of establishing mutual tolerance between the female and the embryo.

In recent years, a number of vitamins, hormonal and pharmacological preparations have been proposed, both to stimulate the sex glands' function and to restore the secretory function and the neuromuscular tone of the genitals. The effectiveness of these drugs is different. Improving the efficiency of the use of biologically active drugs in the mountain farms requires further clinical, physiological and biochemical study of certain issues of the cows' reproductive function, as well as these drugs impact on the animals. Often, drugs are used with no consideration to specific data on the state of the animal's body, the course of metabolic processes, as applied to the soil-climatic zones of mountainous areas.

Vitamin preparations are chosen considering the development of placental insufficiency, the level of steroidogenesis, the state of the sexual apparatus in certain periods of life, threatening the development of placental insufficiency [9].

The implementation of a complex of general economic, zoo-technical, veterinary and other measures allows in a short time significantly improving the indicators of herd's productivity and reproduction. These activities are possible only on the basis of targeted cultivation of a healthy and full-fledged maternal herd, ensuring an effective relationship between the maternal organism and the fetus during pregnancy, patterns of their integration and coordinated activities for optimal satisfaction of needs, as well as on the basis of measures for the certain deviations timely detection [10].

2. Methods of the Research

The experiment was conducted in the mountain farms of Kabardino-Balkaria, taking into account the soil and climatic zones of the republican mountainous areas, in two periods: a preliminary -- from February 11 to February 21 and an experimental -- from February 22 to May 11. During the preliminary period, all animals received the basic ration consisting of hay -- 6 kg, wheat straw -- 3 kg, corn silage -- 20 kg, fodder beet -- 10 kg, grass meal -- 2 kg, sunflower meal -- 500 g, mixed feed -- 5 kg, salt -- 90 g.

In the experimental period, all groups of cows were on the main diet. The first group of cows was the control. The second group of cows in addition to the basic diet received supplemental feeding with cobalt chloride (20 mg per head), the third -- cobalt chloride with copper sulfate (20 mg of cobalt chloride and 150 mg of copper sulfate per head) per day, and the fourth -- copper sulfate (150 mg per head). Trace elements were given daily mixed with loose salt. Milk productivity of cows was determined by the method of daily control milk yields. Control milk yield was carried out three times a month, and the percentage of fat in milk was determined daily. For the experimental part, when studying the effect of individual vitamin preparations on uterine structures and reproduction in cows, the corresponding groups of animals --- analogues in breed, age, and live weight --- were formed.

According to animal feeding standards, rations for animals were balanced in basic nutrients and minerals, except carotene (250--300 mg instead of 750--800 mg), in the blood serum of heifers and cows in March-April contained only 0.4--0.5 mg % carotene instead of 1.3--1.4 mg %, at the end of May and mid-June -- 0.8--0.9 mg % instead of 2.5 mg %.

Building on conducted work, we concluded that cows before calving and after calving with an interval of 5--7 days should be injected with vitamin A at a dose of 250--500 thousand IU, the second experimental group of cows were given subcutaneously trivitamin at the same time (vitamin A, D3, E) in a dose of 10 ml.

In the system of proposed activities, an important place is given to forecasting the terms that are critical for the development of placental insufficiency. Considering that today there is practically no such complex recommendations, we used the method of mathematical modeling, previously used for similar purposes in medical practice, which is based on the concept of cyclic variability of A.K. Makarov [11].

Biometric processing of the obtained data was performed by the method of N.A. Plokhinskii (1970). The significance of differences between groups was taken into account according to the criteria of Student and Fisher.

3. Results and Discussion

The studies found that feeding the cows in the mountainous areas conditions with the studied microelements had a positive effect on their milk production. Thus treating cows with microelements in experimental groups caused an increase in milk yields: when feeding with cobalt chloride per 0.95 kg of milk, when feeding with cobalt chloride with copper sulphate for 1.28 kg of milk, with feeding with copper sulphate at 1.45 kg of milk with a high confidence level.

A similar experiment was performed on four groups of cows. The first experimental group of cows before and after calving with an interval of 5--7 days was administered three to four times the oil solution of vitamin A (intramuscularly, 250--500 thousand ME each), the second experimental group was administered trivitamin at the same time (subcutaneously 10 ml each), the third and fourth groups served as controls.

Calves from cows that received vitamin A and trivitamin developed better during the embryonic period and their birth weight was 2.8--3.0 kg more than in the control group. Consequently, vitamin preparations, normalizing the mineral-vitamin and carbohydrate metabolism in the maternal organism, have a positive effect on the increase in the mass of newborn calves and their development.

All these points led to another positive fact -- cows of first heifers from the experimental groups, the fertilization rate from the first insemination increased, the duration of the service-period decreased by 26 and 16 days, the number of insemination for fertilization (insemination index) decreased by 0.6 and 0.5, during 87.5--92 % of the animals became 90 days after calving, while only 75 % in the control group.

Indicators of preventive measures effectiveness in placental insufficiency are reflected in Table 1.

The facts of the abortions absence, including stillbirths of calves, reduction in the percentage of cows with a childbirth pathology and the postpartum period in experimental cows against the background of the vitamin A and trivitamin use, established in our experiments, are consistent with the data of other authors [12], and once again proves the ability of vitamin preparations to normalize the metabolism and development of the body with an imbalance in the diets of such an important component as carotene.

The feasibility of applying pathogenetic therapy for various manifestations of placental insufficiency in cows in mountainous areas is based on the following provisions:

1) the need to prevent perinatal and postnatal losses, reducing the number of labor complications, reducing the difficult labor percentage, increasing the resistance of calves being born and enriching colostrum with a complex of vitamins;

Table 1: Indicators of preventive measures effectiveness in placental insufficiency.

Indicators of effectiveness	Groups of cows, n=50	
	I -- without the use of drugs	II (experimental) with drugs
Number of stillborn	4	--
Dying calves in the first 10 days after birth	7	2
Average live calf weight	26.7	29.5
The number of cows with placental insufficiency with complications in the form of detention of the afterbirth, endometritis, subinvolution	18	4
The average duration of rest	12	5
Average duration from calving to new fertilization (days)	56.7	40.8

2) the need to create conditions for accelerating the involution of the genitals, enhancing ovarian function, normalizing the structures of the endometrium, preparing it for the normal course of embryogenesis;

3) the need to improve the secretory activity of the uterine epithelium, the epithelium of the cervical canal, increase the neurohumoral background, contributing to the preservation and promotion of sperm in the genital tract, the flow of all stages of fertilization, further preparation of uterine structures to normal bearing, reduced phagocytic reaction, etc.;

4) the need to improve the immune and adaptive properties of all components of the mother-placenta-fetus system.

4. Conclusions

The obtained data showed that it is extremely important to provide the female's body with biologically active substances, including microelements, and if necessary, act on the genitals of the females with vitamin A and trivitamin (vitamin A, D3, E) to ensure an appropriate immune-biological state of the body and increase productivity and reproductive functions of cows in mountainous areas.

Further study of their biological role should be carried out taking into account specific data on the animal's body condition, the course of metabolic processes, as applied to the soil-climatic zones of animal breeding, especially in mountainous areas.

References

[1] Kovalskii, V.V. (1982). *Geochemical environment and life*. Moscow: Science, 77 p.

[2] Nesterin, M.F., Skurikhin, I.M. (1979). *Food industry. Chemical composition of food products*. Moscow, 189 p.

[3] Bolotnikov, IA, Konopatov, Iu.V. (1987). *Physiological and biochemical basis of immunity poultry.* Leningrad: Science,164 p.

[4] Ewans, G.W. (1973). *Physiol. Rev. Copper homeostasis in systematismammalium*, vol. 53. no. 3, pp. 535--570.

[5] Mazo, V.K., Gmoshevskii, I.V., Shirina, L.I. (2009). *New food sources of essential trace elements -- antioxidants*. Moscow: Miklos, 208 p.

[6] Fofanova, I.Iu. (2005). Gynecology. *The role of vitamins and microelements in preserving reproductive health*, vol. 7, no. 4, pp. 244--249.

[7] Kudrin, A.V., Skalnii, A.V., Zhavoronkov, A.A. (2000). *Immunopharmacology of trace elements*. Moscow, 456 p.

[8] Kodentseva, V.M., Vrzhesinskaia, O.A. (2002). *Gynecology*, vol. 4, no. 1, pp. 13--16.

[9] Taov, I.Kh., Kagermazov, Ts.B., Khuranov, A.M. (2014). Prevention placental insufficiency in cows. *Agrarian Russia*, no. 11. Moscow, pp. 24--25.

[10] Taov, I.Kh. (2018). *Placental insufficiency in cows. Prophylactic effectiveness of pathogenetic therapy.* LAP LAMBERT: Academic Publishing, 91 p.

[11] Makarov, A.K., Senkova, T.M. (1998). Ecology and Human Health. *Material of Interregional scientific and practical conference ``Technology and practical need to determine the phases of cyclic transformations of visceral organs in ontogeny, dedicated to 60th anniversary of the Stavropol GMA*, pp. 59--63. Stavropol.

[12] Gubanova, V.P. (1977). Immune responses of cows to exogenous antigens and the effect of vitamin. *Collection of scientific works. VIZH*, vol. 3, part 2, p. 54--59.