Feed additives in feeding of highly productive lactating cows at 8-9 months of pregnancy

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Abstract. The influence of such vegetable crops, as table beet and fodder carrots, and natural coniferous extract in the diets of cows in 8-9 months of pregnancy is investigated. The use of food composition caused a decrease in the concentration of heavy and toxic metals in the milk of highly productive black-and-white cows with annual productivity of 6000 kg in the conditions of anthropogenic pollution. The type of feeding-silage-hay application was investigated. Against the background of the main diet animals of experimental groups are additionally fed is 30, 50 and 80 g per head per day of beets and a similar amount of carrots as fodder. Natural coniferous extract (liquid) in a dose of 5.0 ml/head was fed in a mixture with feed. Table beet, carrot and natural coniferous extract (liquid) with high antioxidant and sorption simultaneously properties in a mixture with feed rations. In this way, it is carried out to supplement the body of cows with a complex mixture of vitamin C, vitamin B, vitamin E, selenium, spicy-aromatic plants. This method allows more successfully solving the problems associated with metabolism, with the accumulation of heavy metals in the milk of animals with a year-round table method of maintenance. The studied phytogenic feed additives caused an increase in the digestibility of nutrients in diets, a significant decrease in the accumulation of Zn, Cu, Pb, Cd, As, Hg, Fe+2 in the body.

1. Introduction

For obtaining environmentally safe cow milk on farms and complexes in the conditions of anthropogenic pollution of the environment in the last 15-20 years, various phytogenic feed additives have been used [1, 2] with the use of medicinal herbs and mixtures in the diets and wild crops are grown in different regions of the country [3]. In addition to the studied crops, in the diet of highly productive dairy cows in the busy period of the production cycle at 8-9 months of pregnancy, vegetable crops in the form of table beets and fodder carrots, as well as a natural coniferous extract (liquid) is used. These ingredients are mainly used for prevention, purification of individual organs and tissues of the body from various toxins. The following properties of these products are also of great importance: improving metabolic processes, palatability of basic feed (hay, silage, haylage) [4, 5, 6]. The addition of these ingredients helps to increase productivity, product quality, especially with high anthropogenic load in the vicinity of modern large livestock farms, complexes and industrial enterprises [7, 8].

In specialized farms and complexes, rations of cows, modern conditions of milk production are advisable to use a broader range of local, easily accessible, the most effective, healthy feed additives with high antioxidant and sorption properties and produce finished products with a minimum content...
of heavy and toxic metals [9, 10]. The use of dried vegetable crops (table beet and fodder carrots) and natural coniferous extract in the diets of cows as antioxidants and adsorbent, are complex mixtures of vitamin C, B-vitamins, vitamin E, spicy-aromatic plants. This complex allows solving more successfully the problems associated with the stabilization of the quality of dairy products, increasing the digestibility of nutrients of diets and reducing the degree of localization of heavy metals in the body [11, 12]. The solution to this problem is of scientific and practical interest, especially in the year-round method of keeping animals on large farms and complexes. Previously, such research areas agronomy, veterinary and biological science was conducted.

The use of the studied vegetable crops and natural coniferous extract with high antioxidant and adsorption properties as part of the daily feeding rations caused not only an increase in metabolic processes in the body of highly productive lactating cows but also the intensity of excretion of heavy and toxic metals through the gastrointestinal tract and kidneys. This process significantly reduced the total content of toxic metals in milk [1, 13, 14]. The mixed-use of many water-soluble vitamins, vitamin E (fat-soluble) and selenium contributed to a significant cleansing of the body of cows from toxins [1, 4, 15, 16].

The study aims to improve the usefulness and quality of feeding cows at 8-9 months of pregnancy. The task was to study the effect of Phyto protectors used in the diet of cows to reduce the degree of contamination of milk and the body with heavy metals.

2. Material and methods of research

Conducted Conducted scientific, economic and physiological experiments on dairy cows of black-and-white breed on the farm agrotechnical College "Novgorod" Novgorod region. Groups of cows were formed by the method of groups-analogues taking into account age, live weight, productivity for the previous lactation over 6 thousand kg of milk, origin, breed and timing of insemination. Several cows on ten head in each group.

The experience consisted of previous (10 days) and accounting (main, 60 days ) periods. The physiological experience was conducted against the background of scientific and economic experience lasting ten days.

Animals silage-hay type feeding both control and experimental groups in the diet included 7.5 kg of hay, 15.2 kg of silage from perennial grasses, 2.4 kg of grain concentrates (feed), 50 g of salt, 60 g of precipitate (dicalcium phosphate) feed. Animals of I experimental group were given additionally table beet – 30g/head/day, II experienced-50g/head/day, III experienced-80g/head/day, and carrots fodder - IV experienced group – 30g/head/day, V experienced – 50g/head/day, VI experienced – 80g/head / day. Cows VII experimental group in the diet included 5.0 ml/head/day of natural pine extract (mixed with feed).

The feeding rations of cows are balanced in nutrients and energy and correspond to the norms of feeding (M.,2003). The experiments were carried out by conventional methods (A. I. Ovsyannikov, 1976). All bio probe (feeds, supplements, milk and other food selections) was studied in the Central chemical laboratory of "Akron" in Novgorod region and the educational-research laboratory of quality of agricultural products IshipNovSU by atomic absorption spectrophotometry (USA Perkin Elmer, Analyst 400).

3. Research results and their discussion

When adding to the diet of the studied doses of table beet, fodder carrots and natural coniferous extract, a significant decrease in the content of heavy metals in milk was established (Table 1). The inclusion of vegetable crops (table beets and carrots) with high antioxidant and sorption properties in the system of optimization of cow nutrition during lactation damping (in the last two months of pregnancy) allowed reducing the content of heavy metals (in total) in milk. So, with metered use red beets, this figure compared with the control below 3.6-9.8 times, the carrot in 5.0-12.6 times and extract natural coniferous 5.7 times.
### Table 1. Effect of feeding table beets, carrots and natural coniferous extract on the content of heavy metals in the milk of cows, mg / kg

| Group of cows                        | Zinc    | Copper  | Lead    | Cadmium | Arsenic | Mercury | Iron    | Amount  |
|--------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| Control group (main diet)            | 0.60±0.04 | 0.24±0.02 | 0.01±0.001 | 0       | 0.02±0.002 | 0       | 7.96±0.38 | 8.83±1.26 |
| I experimental group (main diet + 30g beets) | 0.39±0.02 | 0.54±0.05 | 0.05±0.005 | 0       | 0.05±0.004 | 0       | 0.78±0.07 | 1.81±0.26 |
| II experimental group (main diet + 50g beets) | 0.20±0.01 | 0.10±0.01 | 0.05±0.005 | 0.04±0.003 | 0.03±0.003 | 0.10±0.01 | 0.20±0.02 | 0.9±0.01 |
| III experimental group (main diet + 80g beets) | 0.57±0.04 | 0.30±0.02 | 0.05±0.005 | 0.09±0.008 | 0.03±0.003 | 0.18±0.02 | 0.96±0.09 | 2.45±0.35 |
| IV experimental group (main diet + 30g carrot) | 0.57±0.04 | 0.47±0.03 | 0.02±0.002 | 0       | 0.03±0.003 | 0.05±0.004 | 0.60±0.06 | 1.74±0.58 |
| V experimental group (main diet + 50g carrot) | 0.56±0.05 | 0.23±0.02 | 0.03±0.003 | 0       | 0.02±0.002 | 0.02±0.002 | 0.65±0.06 | 1.51±0.21 |
| VI experimental group (main diet + 80g carrot) | 0.11±0.01 | 0.10±0.01 | 0.03±0.003 | 0.04±0.003 | 0.03±0.003 | 0.01±0.001 | 0.38±0.03 | 0.7±0.01 |
| VII experimental group (main diet + 5 drops of coniferous extract) | 0.46±0.03 | 0.42±0.04 | 0.03±0.003 | 0       | 0.02±0.002 | 0       | 0.60±0.06 | 1.53±0.21 |

Improving the physiological and biological status of cows under the influence of antioxidant, sorption properties of the studied feed additives

- has a positive impact on the ecology of dairy products,
- increases the functional activation of the entire digestive, immune and circulatory systems,
- improves the state of carbohydrate-fat, protein, vitamin and amino acid metabolism.

Thus the selective relation of an organism of cows on 8-9 month of pregnancy to assimilating substances causes constancy of retention of heavy metals both in milk and in an organism.
4. Digestibility of nutrients in diets

When included in the diets of different doses of table beet (in dry form) – from 30 to 80 g per head per day, there is a tendency to increase the digestibility of dry matter compared to the control – by 2.9-3.58%, organic matter – by 2.49-3.21%, protein – by 0.98-2.01%, fibre – by 0.76-1.85%, fat – by 0.5-1.43% and BEV – by 0.11-3.62% (Table 2).

The use of the maximum dose of dried beet in the diet contributed to the increase of digestibility of the studied nutrients. This process is mainly due to increased peristalsis of the longitudinal and transverse muscles of the intestine and stimulation of digestive juices and bile. Table beet pectin (red), contained in large quantities (up to 50%), improves the digestibility of nutrients in diets and the removal of heavy metals from the body through the gastrointestinal tract and kidneys, as well as cholesterol. It contains almost all water-soluble vitamins and vitamins E, mineral macro-and microelements, protein rich in amino acids and easily digestible sugars, useful for the human body and dairy cattle organic acids.

All nutrients and biologically active substances contained in the beet canteen together stimulated the increase of digestibility of individual nutrients diets.

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| Group of cows | Dry matter | Organic matter | Crude protein | Crude fiber | Crude fat | Raw BEV |
|---------------|------------|----------------|---------------|-------------|-----------|---------|
| Control (main diet) | 68.80±0.48 | 71.15±0.61 | 60.04±0.56 | 50.62±0.38 | 62.9±0.39 | 79.31±1.05 |
| I experimental group (main diet + 30g beet) | 71.70±0.73 | 73.64±0.44 | 61.02±0.14 | 51.38±0.67 | 63.4±0.47 | 79.42±1.10 |
| II experimental group (main diet + 50g beet) | 72.15±1.16 | 74.33±1.18 | 61.15±0.28 | * | 63.81±0.61 | ** |
| III experimental group (main diet + 80g beet) | 72.38±1.24 | 74.42±0.46 | 62.05±0.30 | 52.47±0.66 | 64.33±0.55 | 82.93±0.74 |
| IV experimental group (main diet + 30g carrot) | 72.51±1.29 | 74.63±0.57 | 63.73±0.38 | 52.11±0.49 | 64.72±0.71 | 83.44±0.56 |
| V experimental group (main diet + 50g carrot) | 72.60±1.37 | 74.80±0.91 | 62.88±0.64 | * | 65.83±0.64 | 83.67±0.38 |
| VI experimental group (main diet + 80g carrot) | 72.75±0.83 | 74.39±0.62 | 62.91±0.55 | 52.83±0.44 | * | 65.9 | 83.67±0.61 |
| VII experimental group (main diet + 5 drops of coniferous extract) | 69.94±0.35 | 71.34±0.46 | 61.23±0.47 | 51.48±0.39 | 63.35±0.53 | 79.39±0.91 |

* P<0.05, **P<0.01, ***P<0.001

When using different doses of carrot (dried) from 30 to 80 g per head per day on the background of the main diet compared with the control group animals showed increased digestibility: dry matter – by
3.71-3.95%, organic matter – by 3.48-3.24%, protein – on 2.69-of 2.87%, fibre – by 1.82 3.0% and BEV – by 4.13-4.36%.

The wealth of easily digestible carbohydrates, full amino acids, provitamin A (carotene), protein, pharmacological properties, excellent taste and aromatic qualities, gained fame and invaluable benefit in improving the feeding system of animals.

The use of natural pine extract in a dose of 5 drops per head per day compared with the control stimulated an increase in the digestibility of dry matter by 1.14%, organic matter – by 0.19%, protein – by 1.19%, fibre – by 0.86%, fat – by 0.45% and BEV – by 0.08%.

The use of the maximum dose of dried beet in the diet contributed to the increase of digestibility of the studied nutrients mainly due to increased peristalsis of the longitudinal and transverse muscles of the intestine and stimulation of digestive juices and bile. Table beet pectin (red), contained in larger quantities (up to 50%), improves the digestibility of nutrients and diets removal of heavy metals from the body through the gastrointestinal tract and kidneys, as well as cholesterol. It contains almost all water-soluble vitamins and vitamin E, mineral macro-and microelements, protein rich in amino acids and easily digestible sugars, useful for the human body and dairy cattle organic acids.

5. Improving the metabolism of heavy metals in the body of cows

The use of antioxidant, antitoxic and sorption feed additives to cows (table beet flour, fodder carrots and natural coniferous extract (liquid)) had a positive impact not only on the environmental friendliness of dairy products but also caused when feeding them to cows. The results show increased activity of enzyme systems and enhanced detoxification function of the liver. Moreover, at the organizational level had an impact on a significant reduction in the concentration of heavy and toxic metals in the body by increasing the assimilation processes. This impact causes functional activation of the digestive system, along with an increase in enzyme and hormonal systems (Table 3).

**Table 3. Balances of heavy metals in cows**

| Indicator       | Control group (main diet) | I experimental group (main diet + 30g beet) | II experimental group (main diet + 50g beet) | III experimental group (main diet + 80g beet) | IV experimental group (main diet + 30g carrot) | V experimental group (main diet + 50g carrot) | VI experimental group (main diet + 80g carrot) | VII experimental group (main diet + 5 droppers of coniferous extract) |
|----------------|--------------------------|---------------------------------------------|---------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-------------------------------------------------|
| **Zinc**       | -218,360                 | -131,581                                    | -153,725                                    | -210,206                                      | -221,122                                      | -221,584                                      | -241,204                                      | -154,040                                        |
| **Copper**     | -226,384                 | -233,587                                    | -221,451                                    | -269,844                                      | -220,238                                      | -246,762                                      | -269,851                                      | -284,695                                        |
| **Lead**       | -144,805                 | -190,788                                    | -207,114                                    | -299,966                                      | -138,517                                      | -151,861                                      | -171,253                                      | -64,677                                         |
| **Cadmium**    | -110,975                 | -142,131                                    | -134,352                                    | -153,188                                      | -25,756                                       | -43,751                                       | -55,091                                       | -32,443                                         |
| **Arsenic**    | -2,444                   | -1,011                                      | -0,372                                      | -0,626                                        | -0,256                                        | -0,39                                         | -0,646                                        | -0,246                                          |
| **Mercury**    | -0,486                   | -0,09                                       | 0,64±0,03                                   | -0,636                                        | 1,00±0,05                                     | 0,86±0,04                                     | 1,75±0,06                                     | 1,88±0,07                                       |
| **Iron**       | -116,226                 | -16,898                                     | -16,208                                     | -23,152                                       | -70,426                                       | -49,14                                        | -84,07                                        | -91,65                                          |

Note. The balance (-) of heavy metals (HM) means the level of excretion (-) of them from the body, that is, excretion.
6. Conclusion
A valuable source of carbohydrate nutrition for the synthesis of microorganisms in the rumen of cows and improving the digestibility of nutrients in diets is the presence in a feed of an abundance of vitamin C, many other vitamins, organic acids in the coniferous extract.

The inclusion of vegetable crops (table beet, carrots) and liquid extract of coniferous natural in the rations of cows at 8-9 months of pregnancy contributed to the improvement of the exchange of heavy metals (Zn, Cu, Pb, As, Hg, Fe²⁺) by the body. With the use of these components, it is possible to increase the intensity of their release through the gastrointestinal tract and kidneys to obtain negative balances (HM) in the body, the ability to produce environmentally friendly dairy products at 8-9 months of pregnancy of cows.

Due to the use of phytogenic feed additives, there is a real opportunity to increase the digestibility of nutrients in diets, significantly reduce the concentration of heavy metals in milk (in total) and clear of toxicants. The inclusion of table beet, carrot and natural coniferous extract in the rations (in the indicated doses) caused the improvement of taste qualities of cows' milk in the conditions of year-round stall keeping.

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