Effect of immunoprophylaxis on reproduction function of highly productive cows

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Abstract. The article describes a method of preventing postpartum obstetric-gynecological diseases and improving cow reproductive function due to the increase of body nonspecific resistance with the application of electropuncture and biopreparation Prevention-N-C (Chuvash State Agrarian University, Russia) and Salus-PE (Chuvash State Agrarian University, Russia). The cows of the 1st group were injected three times 45-40, 25-20 and 15-10 days before calving intramuscularly at a dose of 10 ml/head with the biopreparation Prevention-N-C, and the cows of the 2nd group were injected according to the same scheme and the same term with Salus-PE, and the cows of the 3rd group electropuncture was performed on the Vocal-B device (BIORS, Russia) immediately after childbirth, three times, after 48 h. The use of biopreparations during critical periods of cow steeliness reduced the risks of subinvolution of the uterus, endometritis and mastitis in the postpartum period and increased the reproductive qualities of cows. It has been shown that after the use of Salus-PE, 100% of cows are fertilized, 60% of which are fertilized in the first sexual hunt, and 40% – in the second. The insemination index was 1.4.

1. Introduction

Postpartum diseases, high productivity as stress factors contribute to the long-term restoration of the reproduction function of cows, the reduction of their dairy productivity and profitability up to the culling of the animal, which today is a significant problem in cattle breeding [1].

In maintaining the optimal level of dairy livestock, the correct organization of herd reproduction is fundamental. It includes a set of organizational and veterinary measures, which include the maintenance and exploitation of female cattle, starting with the cultivation of breeding young animals in compliance
with hygienic standards and sanitary rules, the preparation of balanced feeding diets, the qualified work of the operator for artificial insemination and other veterinary specialists [2].

In this regard the reproductive qualities and productivity of cows, as the main link in cattle breeding are under the close attention of veterinary specialists. According to a number of researchers, in the whole country the output of calves from 100 cows is in the range of 70 to 80 heads, and the service period reaches 100-140 days [3]. The duration of cow exploitation, today barely reaches the mark of 3-4 lactations. The reasons may be: year-round stall content of cows and hypodynamy, inadequate feeding of animals depending on their physiological condition for nutrients, vitamins and minerals, poor-quality veterinary services and violation of hygienic conditions of detention, illiterate exploitation of animals, errors in the organization of artificial insemination and technology for growing a repair herd and many others [4].

Changes in the last decade in reproductive performance, genetic merit, and societal concerns regarding animal welfare and the environmental footprint of dairy products warrant a critical review of decision making regarding dairy cattle productive lifespan. Management and housing may affect productive lifespan through improvements in health care and cow comfort. Short productive lifespans, especially as a result of much forced culling early in lactation, are often signs of reduced welfare. A simple model of the economically optimal productive lifespan illustrates the tradeoffs between herd replacement cost, maturity and aging costs, genetic opportunity cost, and calf value opportunity cost. Combined, these factors suggest that an average productive lifespan of approximately 5 years is warranted. In conclusion, increases in genetic gain, reproductive efficiency, cow comfort, and health care will increase the opportunity of herd managers to change productive lifespan to increase profitability, improve societal acceptance of dairy production, or both [5].

The reproduction function of cows is directly dependent on the genetic qualities of the livestock, competent breeding work, the course of childbirth and the postpartum period [6]. In order to systematically provide the market with animal products, there is a need to intensify the reproduction of the herd, this requires solving the problems of infertility, improving the reproduction of the mother stock and improving the safety of calves. Consequently, the main way to increase milk production is to reduce the level of obstetric and gynecological diseases and restore the reproductive function of cows in the postpartum period in physiological terms [7].

At the same time, high productive qualities of cows are one of the main reasons for the occurrence of jellyfish, which reduces the profitability of livestock production, as milk yield is reduced, calves are not received from cows, and subsequently rejected. Treatment, maintenance and repeated unsuccessful insemination bring only losses to production [8]. At the current level of pastoralism development, the problem of preventing adverse effects on the body of factors that cause a decrease in the reproductive and productive qualities of animals is of particular importance, since it is known that highly productive cows with year-round stall content are more susceptible to metabolic disorders and reduced reproductive qualities [9]. Nonspecific resistance is important in maintaining animal health. It is the first actual barrier when a pathogenic agent enters the body, and it is on the state of this factor that the health and well-being of the herd depends. Adverse effect on animal body is reflected in hematological profile, indicators of which indicate state of nonspecific resistance of organism [10]. In this regard, special preventive and therapeutic methods should be used, certain veterinary and hygienic conditions of maintenance and operation, as well as animal feeding standards should be observed [11]. One way to prevent the negative impact of stress factors is to immunostimulate the body with biopreparation.

Thus, the goal of our studies was to examine the comparative efficacy of electropuncture and biopreparation in preventing postpartum complications in highly productive cows.

2. Materials and methods
Research on the prevention of postpartum diseases of highly productive cows and the realization of their bioresource potential was carried out in the conditions of the dairy farm LLC Krasnoye Sormovo of the Krasnoarmeysky district of the Chuvash Republic.

When performing scientific experience, the objects of research were cows that were in the dry-
standing period 45 days before calving. According to the principle of analogues, we formed four groups of glass dry-standing cows (control group, groups 1, 2, and 3) of 10 heads each. Cows of black and white breed, living weighing 500-550 kg, with a dairy productivity of 6000-6500 kg per year, contained in the stall in groups of 20-25 cows.

In order to prevent postpartum diseases of highly productive cows, restore the function of reproduction, as well as realize their productive qualities, the cows of the 1st group were injected three times 45-40, 25-20 and 15-10 days before calving intramuscularly at a dose of 10 ml/head with the biopreparation Prevention-N-C (Chuvash State Agrarian University, Russia), and the cows of the 2nd group were injected according to the same scheme and the same term with Salus-PE (Chuvash State Agrarian University, Russia).

The test pattern is shown in table 1. Prevention-N-C and Salus-PE is a biopreparation containing a polysaccharide mixture of \textit{Saccharomyces cerevisiae} immobilized in agar gel with inclusion of a benimidazole derivative and bactericides of groups of penicillins and aminoglycosides in an aqueous suspension. The invention is intended for increasing nonspecific resistance of the organism, prevention and treatment of gynecological disorders in cows. The developer organization is the Federal State Budgetary Educational Institution of Higher Education “Chuvash State Agrarian University” (Cheboksary, Russia).

For intramuscular injection, a 40 mm needle was used, with a sharp bevel, with an acute and straight, non-bent cannula. Blunt needles will give animals more pain. Disposable syringes were used for the procedure. Intramuscular injection of the cow was carried out according to the scheme. The area for injection was selected. Then, the needle insertion site was wiped with an alcohol solution. Further, syringe was brought to the animal's body at right angles prior to injecting a 2/3 depth needle. After that, the piston pushed the preparation out of the syringe, and the needle was removed from the body. Finally, the injection site was treated with iodine.

The procedure is fast. The cow does not have time to respond to the pain.

In the group 3, immediately after childbirth, electropuncture sessions were carried out using the Vocal-B device (BIORS, Russia) according to the prescription worked by us, BAT No. 7, 4, 5, 6, 15, 16, 17, 18. The duration of one session was 15 min, three times, with an interval of 48 h. The points were exposed to low-power currents by the Vocal-B device, which is designed to treat animals with pathology of reproductive function and other systems of the body. The device is a multiple electrode – a catalogue in the form of two set cylinders, in which needles in the form of teeth are mounted at a distance of 1.5 mm at the base and 7 mm between the tops. The needles are supplied with a multipolar pulse current with a frequency of 10 Hz. The cylinders are attached on the handle in which the device circuit, current regulator, operation monitoring indicator (LED) are located.

Needles were used to perform acupuncture in the treatment of animals, to syringes of the Lauer type with a diameter of 0.4 to 0.6 mm, a length of 4-5 cm. The thinner the diameter of the needle, the less trauma is applied to the animal, but too thin needles can curve when the muscles are reduced in large animals. During the acupuncture procedure, two to three times additional irritating actions were performed on the needles: rotation, shaking, tapping.

The animal's wool cover was briefly cut and wiped with a wet tampon wetted with a disinfectant solution when applying the acupuncture method to the biologically active points. Acupuncture was performed at the same time, with fluctuations of ± 1.0 h.

The microclimate in animal houses was controlled monthly, three days in a row in three areas: the middle of the house, diagonal end corners (at the distance of 1.0-3.0 m from the walls; at the height of 0.6 and 1.2 m from the floor). Besides, the temperature, humidity and illumination intensity in the houses were measured using a TKA-PKM multimeter, Model 42 (LLC “TKA Scientific Instruments”, St. Petersburg, Russia), the air velocity was measured with a TKA-PKM thermoanemometer, Model 50 (LLC “TKA Scientific Instruments”, St. Petersburg, Russia), \textit{CO}_{2} content in air and \textit{NH}_{3} and \textit{H}_{2}S concentration were measured with the use of a YG-2 multipurpose gas analyzer (LLC “Promecopribor”, St. Petersburg, Russia), the microbial content and dust were measured using the Krotov apparatus (LLC “NIKI MLT-Povolzhye”, Penza, Russia), the natural illumination intensity was measured by calculating
the light factor (LF) and the daylight factor (DLF).

### Table 1. Experience diagram.

| Group          | Number of cows | Method of prevention                                      | Interval of procedures                        |
|----------------|----------------|-----------------------------------------------------------|-----------------------------------------------|
| Group 1        | 10             | biopreparation Prevention-N-C, intramuscularly at a dose of 10 ml/goal | 45-40, 25-20 and 15-10 days before birth      |
| Group 2        | 10             | biopreparation Salus-PE, intramuscularly at a dose of 10 ml/goal | 45-40, 25-20 and 15-10 days before birth      |
| Group 3        | 10             | Electropuncture using the Vokal-B device\(^*\)             | immediately after birth, three times, after 48 h|
| Control group  | 10             | preventive measures were not applied                       |                                               |

*BAT No. 7, 4, 5, 6, 15, 16, 17, 18 [12]

LF was determined with the ratio of the total area of all windows to the same of the cow house floor, and DLF was determined with the ratio of illumination inside the cow house to the outside illumination, and the factors were expressed in per cent:

\[
DLF = \frac{O_i}{O_e} \cdot 100, 
\]

where \(O_i\) is illumination in the cow house, \(I_x\); \(O_e\) is outside illumination (with diffuse sky light), \(I_x\).

The temperature of the animals was measured with a medical thermometer, the pulse rate was registered over the caudal artery by palpation, the number of breaths per minute – by counting the respiratory sounds in the lungs during breathing in and out using a phonendoscope by the auscultation method.

Prophylactic effectiveness of the used methods are determined according to the timing of separation of fetal membranes, the amount of detention of the aftermath of the duration of the lochial period, postpartum complications, including subinvolution of the uterus, endometritis, breast disease, as well as the timing of the first sexual hunt after childbirth, the number of inseminated animals fertilized, the fertilization index and the duration of infertility.

The digital material of the experiments was processed by the method of variation statistics on the validity of the difference in the compared indicators (\(P < 0.05-0.001\)) using a personal computer in the Microsoft Excel program.

The air basin indices in the cow house and maternity pen are given in table 2. The microclimate in the cow and maternity ward complied with the zoo-hygiene standards and the requirements of the Methodological Recommendations for the Technological Design of Farms and Cattle Complexes - RD-AIC 1.10.01.02-10 [13].

In order to prevent overheating of animals and heat shock, cows should be equipped with ventilation section curtains.

Increased humidity increases the risk of pulmonary diseases, increases heat transfer in the cold season, the animal is forced to spend energy on cooling or warming the body. The body of animals is negatively affected by too low air humidity. The humidity of the air for cows should not be lower than 40-50%. It increases the dust content of the air, as a result of which the incidence of animals increases.

Air pollution by microorganisms or gas contamination also negatively affects animals, causing poisoning and pathologies of the respiratory system.

The large dust content of the air of the premises has an extremely adverse effect on the entire body of the animal. Dust can act either mechanically, irritating the mucous membranes of the upper airways and eyes. That is why it is necessary to monitor this indicator.
Table 2. Basic microclimate parameters of the cow house and maternity pen.

| Parameter                        | Cow house       | Maternity pen  |
|----------------------------------|-----------------|----------------|
| Air basin temperature, °C        | 10.1±0.25       | 15.9 ± 0.37    |
| Relative air humidity, %         | 70.3 ± 1.14     | 66.0 ± 0.79    |
| Air velocity, m/s                | 0.31 ± 0.02     | 0.27 ±0.04     |
| Light factor (LF), E_in/E_out    | 1:14            | 1:13           |
| Daylight factor, %               | 0.63 ± 0.04     | 0.76 ± 0.03    |

Concentration of air polluants

|                | Cow house       | Maternity pen  |
|----------------|-----------------|----------------|
| NH₃, mg/m³     | 13.5 ± 0.63     | 8.8 ± 0.57     |
| H₂S, mg/m³     | 7.3 ± 0.27      | 4.7 ± 0.24     |
| CO₂, %          | 0.19 ± 0.01     | 0.16±0.02      |
| Microbial contamination, thous. m³ | 42.6 ± 1.41 | 31.2 ± 1.12 |
| Content of solid aerosols, mg/m³  | 4.1 ± 0.27     | 2.9 ± 0.23     |

The content of hydrogen sulfide, ammonia and carbon dioxide should be especially carefully checked in spring and autumn, since the speed of air movement during this period is minimal, and the relative humidity of the air exceeds the norm. To normalize the microclimate, ventilation curtains should be adjusted in a timely manner, both on the upper part of the roof and on the sides of the building.

3. Results and discussion

The clinical physiological indicators of cows’ organism condition are given in table 3. The body temperature of the cows of the control and experimental groups it was within the physiological norm. The pulse rate at cows of control, groups 1 and 2 for 35-30 – 10-5 days before calving increased from. In 3-5 days after calving it was established some reduction in the frequency pulse rate at animals in control and the group 2 respectively to 76±1.03 beats/min and 76±0.73 beats/min respectively (P > 0.05), and at cows of the 1st group it turned out at the previous level. The frequency of respiratory movements in cows of control and experimental groups varied between 21-22 movement per min, respectively (P > 0.05).

The obtained indicators stayed within the ranges of physiological standards in all experimental groups, with the difference between them being insignificant (P > 0.05).

Currently, highly efficient technologies are widely used in the production of livestock products, based on the use of mechanized and automated production lines. The use of these technologies is aimed at maximizing the biological and physiological needs of animals. Highly productive animals are characterized by intensive metabolism, reduced adaptation and increased stress sensitivity to changing technological conditions. To every deviations in technology, such animals react with metabolic disorders, poor health and reduced reproduction efficiency and productive longevity.

It is known that a violation of the technology of keeping milking cows is the cause of many deviations in the reproduction function from the norm. Low motor activity leads to a decrease in energy consumption, a decrease in the function of muscle fibers, and the cardiovascular system, degeneration, a change in metabolism, the effectiveness of feed use and a violation of the function of the central nervous system. All these processes affect the reproducibility of animals. Hypodynamy contributes to the death of primary follicles, swelling of the uterine mucosa, which prevents the implantation of zygote, reduced calves output per 100 cows, and the emergence of postpartum complications. The pathological course of childbirth and, as a result, the occurrence of obstetric and gynecological diseases in the postpartum period adversely affects the reproducibility of cows.

The statistical data of postpartum obstetric-gynecologic diseases in cows and their reproductive indicators are reflected in table 4. It was established that if in the control group of animals the separation periods of the fruit shells averaged 13.2 ± 1.02 h, then in the 1st, 2nd and 3rd groups – 7.2 ± 0.58, 6.8 ± 0.66 and 8.4 ± 0.39 h, that is lower by 6.0, 6.4 and 4.8 h, respectively. At the same time, in 4 cows of the control group, the seedlings were recorded, and in animals of groups it was not detected.
### Table 3. Physiological cows’ organism condition indicators.

| Group of animals | Observation period, days | Body temperature, °C | Pulse, beats/min | Breathing, movements/min |
|------------------|--------------------------|----------------------|-----------------|------------------------|
|                  | before after              |                      |                 |                        |
|                  | calving                  | calving              |                 |                        |
| Control group    | 45 – 40                  | 38.2±0.14            | 76±1.16         | 21±0.81                |
|                  | 25 – 20                  | 38.0±0.10            | 77±0.87         | 22±0.55                |
|                  | 15 – 10                  | 38.1±0.06            | 77±1.03         | 22±0.40                |
|                  | 3 – 5                    | 38.1±0.09            | 76±1.03         | 22±0.32                |
| Group 1*         | 45 – 40                  | 38.2±0.13            | 75±1.56         | 22±0.68                |
|                  | 25 – 20                  | 38.0±0.10            | 76±1.24         | 22±0.51                |
|                  | 15 – 10                  | 38.2±0.09            | 76±0.93         | 22±0.51                |
|                  | 3 – 5                    | 38.2±0.11            | 76±1.02         | 22±0.58                |
| Group 2**        | 45 – 40                  | 38.3±0.13            | 76±0.93         | 21±1.16                |
|                  | 25 – 20                  | 38.2±0.12            | 77±0.71         | 22±0.93                |
|                  | 15 – 10                  | 38.2±0.09            | 77±0.86         | 21±0.51                |
|                  | 3 – 5                    | 38.1±0.12            | 76±0.73         | 22±0.24                |
|                  | 1                        | 38.1±0.12            | 75±1.78         | 22±0.55                |
|                  | 2                        | 38.1±0.09            | 76±1.12         | 22±0.28                |
| Group 3***       | 3                        | 38.1±0.09            | 76±0.93         | 22±0.32                |
|                  | 5                        | 38.1±0.09            | 76±0.93         | 22±0.32                |

* Injection of Prevention-N-C biopreparation: 45-40 days, 25-20 and 15-10 days before the estimated calving.
** Injection of Salus-PE biopreparation: 45-40 days, 25-20 and 15-10 days before the estimated calving.
*** Electropuncture using the Vokal-B device was carried out immediately after childbirth, three times, 48 h on the 1, 3 and 5 days after birth

Of the diseases of the postpartum period, subinvolution of the uterus was recorded in 3 cows of the control group, and it was accompanied with periodic delay of the lochs, alternating with abundant expiration from the uterus. This pathology was also detected in 1 cow in groups 1 and 3, but without isolation of lochs, while in the group 2, uterine subinvolution was not observed.

As a result of uterine follow-up detention and subinvolution, postpartum purulent-catharal endometritis was detected in 2 cows of the control group, while in groups 1 and 3 this gynecological disease was detected in only 1 cow. It should be noted that in the group 2 mucocatarrhal endometritis is not registered. In addition, mastitis was recorded in 2-year cows of the control group, while said breast disease was not detected in animals of experimental groups.

Consequently, the prevention of postpartum complications using electropuncture, the Prevention-N-C biopreparation previously tested, and the Salus-PE biopreparation developed and tested for the first time contributed to the reduction of follow-up time and prevented gynecological diseases.

It is known that the basis of acupuncture at biologically active points is the release of biologically active substances and their effect through skin exteroceptors on interoreceptors of vessels and nerves that correlate internal organs. The system of acupuncture points chosen by us for the prevention of functional disorders of the sexual apparatus is one of the links of neuro-humoral regulation of the function of the sexual system, which activates the release of biologically active substances and has a specific, targeted effect on the organs of the sexual system. The neurogumoral mechanism of physiological action relieves the effect of hypodynamy, activates uterine rigidity, processes of degeneration and regeneration of the uterine mucosa in the early postpartum period, stimulates ovarian function, prevents complications after childbirth and provides an optimal percentage of fertilized cows [14].

The first sexual hunting in cows in group 2 (29.0 ± 0.71 day) occurred earlier by 14.2 days (P < 0.05) than in control (43.2 ± 1.36 days). The insemination index of cows of the groups 1, 2 and 3 (1.6 ± 0.24, 1.4 ± 0.19 and 2.0 ± 0.2) was lower in 1.6 (P < 0.05), 1.8 (P < 0.01) and 1.3 (P < 0.05) times, respectively, than in animals of the control group (2.6 ± 0.43). The service period in cows of group 2 (58.6 ± 1.50 day), where the Salus-PE biopreparation was first used, was shorter by 28.4 days (P < 0.01) than in the control (87.0 ± 3.05
days). It was established that in the control group in 1 sexual hunt 20% of cows were fertilized, in the first and third groups – 50%, and in the second one – 60% of heads.

### Table 4. Gynecologic condition and reproductive qualities of cows.

| Parameter                     | Control Group | Group 1     | Group 2     | Group 3     |
|-------------------------------|---------------|-------------|-------------|-------------|
| Afterbirth expulsion time, h  | 13.2±1.02     | 7.2±0.58*   | 6.8±0.66*   | 8.4±0.39    |
| Onset of 1st estrus, days     | 43.2±1.36     | 31.6±0.93*  | 29.0±0.71*  | 44.01±2.8   |
| Conception rate               | 2.6±0.43      | 1.6±0.24*   | 1.4±0.19**  | 2.0±0.2     |
| Time from calving to          | 87.0±3.05     | 64.6±1.94** | 58.6±1.50** | 68.0±2.8    |
| fertilization, days           |               |             |             |             |
| Retention of afterbirth       | 4 (40%)       | -           | -           |             |
| Subinvolution of uterus       | 3 (30%)       | 1 (10%)     | -           | 1 (10%)     |
| Endometritis                  | 2 (20%)       | 1 (10%)     | -           | 1 (10%)     |
| Mastitis                      | 2 (20%)       | -           | -           |             |
| Fertilized cows:              |               |             |             |             |
| at 1st fertilization          | 2 (20%)       | 5 (50%)     | 6 (60%)     | 2 (20%)     |
| at 2nd fertilization          | 3 (30%)       | 4 (40%)     | 4 (40%)     | 5 (50%)     |
| at 3rd fertilization          | 5 (50%)       | 1 (10%)     | -           | 3 (30%)     |

| Numbers of cows (%) | n=10 |
|---------------------|------|
|                     |      |

*P<0.05; **P<0.01.

Thus, intramuscular administration of biologics to cows in experimental groups helped reduce the risk of postpartum complications and reduced the timing of genital tract repair, which contributed to their earlier and fruitful insemination.

### 4. Conclusion

The paper demonstrates the comparative efficacy of electropuncture and biopreparation Prevention-N-C and Salus-PE for the prevention of postpartum complications in highly productive cows were examined during the trial. Biopreparation were administered intramuscularly, at a dose of 10 ml, 45-40, 25-20 and 15-10 days before calving. Comparative analysis shows that intramuscular injection to cows of the group using a Salus-PE biopreparation at the dose of 10 ml per 45-40, 25-20 and 15-10 days before calving prevented gynecological diseases in the birth and postpartum periods and increased the reproductive function of the body. It was shown that 100% of the cows were fertilized after Salus-PE, where 60% were fertilized in the first sexual hunt, and 40% in the second one. The insemination index was 1.4.

Therefore, intramuscular injection of 10 ml Salus-PE biopreparation to cows before 45-40, 25-20 and 15-10 days before calving prevented gynecological diseases in the birth and postpartum periods and increased the reproductive function of the body.

In conditions of increasing pressure on the body, it is possible to maximize the productive potential of cattle by activating the nonspecific resistance of the body of cows with biostimulants that are harmless to the body, non-toxic, do not accumulate in livestock products and do not pollute the environment. Biologics activate protective-adaptation functions of organism to influence of ecological-technological factors of habitat and contribute to realization of bioresource potential of reproduction and milk productivity.

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