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Сведения об авторах

Тегза Александра Алексеевна – доктор ветеринарных наук, профессор кафедры ветеринарной медицины Костанайского регионального университета им А.Байтұрсынова, 110000 г. Костанай, ул.Маяковского 99/1, тел. 87142558568; e-mail: tegza.4@mail.ru.

Хасанова Мадина Асылхановна – доктор PhD, старший преподаватель, Костанайского регионального университета имени А.Байтұрсынова, 110000 г.Костанай, ул. Маяковского 99/1, тел. 87076647578; e-mail: has1205@mail.ru.

Яблочкова Гульмира Сабыржановна – магистр ветеринарных наук, преподаватель кафедры ветеринарной медицины Костанайского регионального университета им А.Байтұрсынова, 110000 г.Костанай, ул.Маяковского 99/1, тел. 87479222923; e-mail:Gulmi.85@mail.ru.

Тегза Александра Алексеевна – в.ғ. докторы, Ахмет Байтұрсынов атындағы Қостанай өңірлік университеті, ветеринарлық медицина кафедрасының профессоры, 110000 Қостанай қ., Маяковский к. 99/1, тел. 87774435275; e-mail: tegza.4@mail.ru.

Хасанова Мадина Асылхановна – PhD докторы, Ахмет Байтұрсынов атындағы Қостанай өңірлік университеті, ветеринарлық медицина кафедрасының аға оқытушысы, 110000 Қостанай қ., Маяковский к. 99/1, тел. 87014968802; e-mail: has1205@mail.ru

Яблочкова Гүлмира Сабыржановна – в.ғ. магистрі, Ахмет Байтұрсынов атындағы Қостанай өңірлік университеті, ветеринарлық медицина кафедрасының оқытушысы, 110000 Қостанай қ., Маяковский к. 99/1, тел. 87479222923; e-mail: Gulmi.85@mail.ru.

Tegza Aleksandra Alekseevna – Doctor of Veterinary Sciences, Professor of the department of Veterinary medicine Kostanay Regional University named after Akhmet Baitursynov, 110000 Kostanay, Mayakovskiy st.99/1, phone: 87774435275; e-mail: tegza.4@mail.ru.

Khassanova Madina Asylkhanovna – Doctor PhD, Senior Lecturer of the department of Veterinary medicine Kostanay Regional University named after Akhmet Baitursynov, 110000 Kostanay, Mayakovskiy st.99/1, phone:87014968802; e-mail: has1205@mail.ru.

Yablochkova Gulmira Sabirzhanovna – Master of Veterinary Sciences, Senior Lecturer of the department of Veterinary medicine Kostanay Regional University named after Akhmet Baitursynov, 110000 Kostanay, Mayakovskiy st.99/1, phone:87479222923; e-mail:Gulmi.85@mail.ru.

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FERTILITY OF COWS UNDER HEAT STRESS

Tegza A.A. – Doctor of Veterinary Sciences, Professor of the department of Veterinary medicine Kostanay Regional University named after Akhmet Baitursynov.

Dzhulanov M.N. – Doctor of Veterinary Sciences, Professor of the Department of Obstetrics, Surgery and Reproduction Biotechnology of the Kazakh National Research University Almaty.

Baimbetova N. – Master of Veterinary Sciences, Senior Lecturer of the department of Veterinary medicine Kostanay Regional University named after Akhmet Baitursynov.

Akhmetchina T.A. – Master of Biology Sciences, senior lecturer of the Department of Theory and Practice of Physical Culture and Sports (TPPCS), Kostanay Regional University named after Akhmet Baitursynov.

In Olzha Agro LLP – a farm in Sadchikovskoye village and Saryagash LLP – a farm in Pereleski village, Qostanai region, carried out the effect of ambient temperature on the fertility of cows from 2018 to 2020. The studies were conducted within the framework budgeting program “Improving the genetic potential of dairy cows 2018-2020”. The research material was Holstein cows aged 4-7 years, with the dairy productivity of 5000-9000 kg. The results of 313 cows from Sadchikovskoye LLP and 486 animal from Saryagash LLP were studied. We established the following: Average annual reproductive parameters in the farms for 2018-2020: Sadchikovskoye LLP: 1882 productive inseminations of cows, 419 calves, insemination rate – 3. Saryagash LLP: 3504 productive inseminations of cows, 1004 calves, insemination rate – 1.6. The

lowest fertility occurred during the period of sharp deviations in ambient temperature. There were deviations in the production of estradiol and progesterone hormones in summer and winter periods after calving. A sharp increase in stress hormone Adrenaline was registered in summer and winter periods.

Key words: cows, stress, reproduction, calves, inseminations of cows.

ҚОСТАНАЙ ОБЛЫСЫНДАҒЫ СИЫРЛАРДЫҢ ФЕРТИЛЬДІЛІГІНЕ ЖЫЛУ КЕРНЕУІНІҢ ӘСЕРІ

Тегза А.А. – в.ғ. докторы, Ахмет Байтұрсынов атындағы Қостанай өңірлік университеті, ветеринарлық медицина кафедрасының профессоры.

Джуланов М.Н. – ветеринария ғылымдарының докторы, Алматы Қазақ ұлттық зерттеу университетінің акушерия, хирургия және биотехнология кафедрасының профессоры.

Баимбетова Н. – в.ғ. магистрі, Ахмет Байтұрсынов атындағы Қостанай өңірлік университеті, ветеринарлық медицина кафедрасының аға оқытушысы.

Ахметчина Т.А. – биология магистрі, А. Байтұрсынов атындағы Қостанай өңірлік университетінің ДШСТП кафедрасының аға оқытушысы.

Қоршаған орта температурасының сиырлардың жыныс мүшелерінің ұрықтану қабілетігіне (фертильділігіне) әсерін зерттеуді Қостанай облысы, Садчиковское ауылы "Олжа Агро" ЖШС-де және Қостанай облысы, Перелески ауылы "Сарыағаш" ЖШС-де 2018-2020 жылдар кезеңінде жүргізілді. Зерттеулер "2018-2020 сүт сиырларының генетикалық әлеуетін арттыру" бағдарламалық мақсатты қаржыландыру аясында жүргізілді.

Зерттеу материалы 4-7 жас аралығындағы Гольштейн сиырлары, және сүт өнімділігі 5000-9000 кг болды. Тәжірибеде барлығы "Садчиковское" ЖШС-де 313 сиырдан және "Сарыағаш" ЖШС-де 486 бастан деректер зерттелді. "Олжа Агро" ЖШС мен "Сарыағаш" ЖШС-да температуралық фактор мен сиырлардың жыныстық белсенділігі нәтижелерінің әсерін зерттеу нәтижесінде біз мынаны анықтадық: Қостанай облысының шаруашылықтарында 3 жыл ішіндегі өсімін молайту сапаларының орташа жылдық көрсеткіштері 2018-2020: "Садчиковское" ЖШС-де: 1882 сиырды жемісті ұрықтандыру, 419 бұзау, ұрықтандыру жиілігі-3. "Сарыағаш" ЖШС-де: 3504 сиыр ұрықтандырылды, 1004 бұзау, ұрықтандыру жиілігі-1,6. Ең аз жыныстық белсенділік және сиырларды ұрықтандырудың ең аз мөлшері қоршаған орта температурасының күрт ауытқу кезеңінде болды. Төлдегеннен кейін жазғы және қысқы кезеңдерде эстрадиол және прогестерон гормондарын өндіруде ауытқулар байқалды. Жазғы және қысқы кезеңдерде адреналин стресс гормондарының күрт жоғарылауы тіркелді.

Түйінді сөздер: сиырлар, күйзеліс, өсімін молайту, бұзаулар, сиырларды ұрықтандыру.

ФЕРТИЛЬНОСТЬ КОРОВ ПРИ ВОЗДЕЙСТВИИ ТЕПЛООВОГО СТРЕССА

Тегза А.А. – доктор ветеринарных наук, профессор, Костанайский региональный университет имени А. Байтұрсынова.

Джуланов М.Н. – доктор ветеринарных наук, профессор кафедры Акушерства, хирургия и биотехнология воспроизводства Казахского национального исследовательского университета, Алматы.

Баимбетова Н. – магистр ветеринарных наук, старший преподаватель, Костанайский региональный университет имени А. Байтұрсынова.

Ахметчина Т.А. – магистр биологии, старший преподаватель кафедры ТуПФКиС Костанайского регионального университета им А. Байтұрсынова.

Исследования влияния температуры окружающей среды на фертильность коров проводили в ТОО «Олжа Агро» ферма село Садчиковское и в ТОО «Сарыағаш» ферма село Перелески Костанайской области в период с 2018 по 2020 год. Исследования проводились в рамках ПЦФ «Повышение генетического потенциала молочных коров 2018-2020».

Материалом исследований служили коровы голштинской породы в возрасте 4-7 лет, молочной продуктивностью 5000-9000 кг. В опыте были исследованы данные от 313 коров в ТОО «Садчиковское» и 486 голов в ТОО «Сарыағаш». Нами было установлено: Среднегодовые показатели воспроизводительных качеств в хозяйствах Костанайской области за 3 года 2018-2020: В ТОО «Садчиковское»: 1882 плодотворных осеменений коров, 419 телят, кратность осеменения – 3. В ТОО «Сарыағаш»: 3504 плодотворных осеменений коров, 1004 телят, кратность осеменения – 1,6. Наименьшая половая активность коров были в период резких отклонений температуры окружающей среды. Отмечены отклонения в выработке гормонов эстрадиола и прогестерона в период резких колебаний температур в летний и зимний периоды после отела. Зарегистрировано резкое повышение гормонов стресса адреналина в летний и зимний периоды.

Ключевые слова: коровы, стресс, воспроизводство, телята, осеменение коров.

Rationale. Heat stress in dairy cows leads to significant losses. In the world practice of dairy cattle breeding, cases of metabolic disorders, changes in the microflora of the rumen and other health problems are increasingly common. Recent studies by scientists have confirmed that in cows exposed to heat stress, the pH and concentration of acetate in the rumen decrease and the number of *Streptococcus*, and *Enterobacteriaceae*, which produce lactate, as well as bacteria that utilize soluble carbohydrates, *Ruminabacter Trepanoma*, increases [1, p.194].

Stress is a special biological state of the body that contributes to the mobilization of the body's defenses to counteract a harmful agent, a stressor.

With intensive and prolonged exposure to various stress factors, the animal body mobilizes defense mechanisms in order to maintain the state of homeostasis and sustain the main vital functions at a certain level due to secondary functions. In this case, the reproductive system is one of the first to suffer [2, p. 205].

The article Tegza A. and others, presents the results of assessment of reproductive qualities and identifying the causes of reproductive health disorders in cows of Kostanay region, carried out under the program "Improving the efficiency of breeding methods in cattle breeding" It is determined that the main reasons for the low fertility of cows and heifers of the black-and-white and simmental dairy breeds of productivity were violations of the maintenance and breeding of animals [3, p. 20].

Climate-induced abortion. Of the climatic factors, temperature stress is of the greatest importance; cattle and pigs are especially sensitive to it. The danger is sudden temperature changes, high or, conversely, excessively low ambient temperatures. For the life of the fetus, even a short-term increase in temperature in a pregnant female is dangerous. In areas with a hot summer climate, reproductive efficiency drops sharply, mainly due to embryonic losses. Abortions, especially in the early stages of pregnancy, can be caused by violations of the light regime: excessive insolation, continuous lighting, low light factor [4].

Depending on the severity of heat stress, the frequency of conception decreases during the colder months of winter and the hotter months of summer.

Heat stress affects egg growth and maturation, where it reduces egg development when exposed to elevated summer temperatures. It also leads to an increase in endometrial secretion of PGF-2 [5, p.209], and a decrease in estradiol secretion from the ovaries. It usually increases the production of free radicals, which leads to oxidative stress, which in turn leads to reduced fertility, increased embryonic mortality, preservation of the postpartum placenta, and premature calving.

Stress affects the reproductive function of both sexes. As for females, stress reduces the percentage of fertility, the number and quality of embryos. In addition, there is a negative effect of stress on the quality and quantity of sperm in males.

Exposure to cold temperatures can limit the growth of an animal, especially when nutrition is scarce, combined with increased livestock costs. Hypothermia causes constriction of blood vessels to increase heat production, which negatively affects stress hormones, innate and adaptive immunity functions of animals. Cold stress leads to difficulties in regulating body temperature, which leads not only to a decrease in fertility, but also to serious diseases, injuries, permanent tissue problems and death [6, p. 145].

To overcome cold stress, it is necessary to provide protection from wind. Moreover, a diet such as increasing the energy and protein density of the diet to maintain a high efficiency of the rumen is one of the main rules for preventing the negative effects of heat stress.

Under conditions of chronic stress, violations of capacitation (the ability to penetrate the egg) of sperm in the reproductive tract of the female are detected, as well as violations of the development and promotion of an already fertilized egg (zygote) [7, p. 456].

According to Lobodin K.A, Nezhdanov A.G. after giving birth, cows experience a state of stress at the morphological and physiological levels. The animal organism uses the internal resources of vitamins and mineral elements as energy. There are a number of changes at the cellular level and in the properties of the blood. These changes contribute to an increase in phagocytic activity in cows in the postpartum period. The authors indicate that neutrophils increase up to 50% during this period. The same thing happens with the bactericidal activity of blood serum, it increases in postpartum uterus up to 31% [5, p. 145].

Efforts to lift reproductive efficiency of beef herds have traditionally focused on physical health and nutrition aspects, by extrapolating knowledge from dairy herds. However, animal welfare and stress on beef farms is of outstanding importance. Stress affects the economic sustainability of the farm directly by reducing productive and reproductive performance [8, p.23].

Work objective: Study the influence of deviations of the ambient temperature from the average indicator on the reproductive ability of cows on the farms of Kostanay region.

Research materials and methods. These studies were carried out within the framework of the joint result-oriented budgeting program of the Ministry of Agriculture of the Republic of Kazakhstan "Improving the genetic potential of dairy cows". The study of the impact of ambient temperature on the reproductive qualities of the breeding stock on farms in the village of Sadchikovskoye, Kostanay district, owned by Olzha Agro LLP

and a farm in the village of Pereleski, Denisov district, owned by Saryagash LLP, was carried out from 2019 to 2020. We conducted studies of the effect of ambient temperature on the fertility of cows at Olzha Agro LLP, a farm in the village of Sadchikovskoye and at Saryagash LLP, a farm in the village of Pereleski, from 2018 to 2020. These studies were carried out within the framework of the result-oriented budgeting program “Improving the genetic potential of dairy cows 2018-2020”.

We conducted studies of the effect of ambient temperature on the fertility of cows at Olzha Agro LLP, a farm in the village of Sadchikovskoye and at Saryagash LLP, a farm in the village of Pereleski, from 2018 to 2020. These studies were carried out within the framework of the result-oriented budgeting program “Improving the genetic potential of dairy cows 2018-2020”. On both farms, the research material was Holstein cows with a productivity of 5,000 to 9,000 kg. The fertility of cows in different seasons of the year in the conditions of Kostanay region was studied.

The object of research was the fertility indicators of Holstein cows at the age of 4-7 years. Data from cows in Sadchikovskoye LLP (n=313) and Saryagash LLP (n=486) were studied. The data of veterinary reporting and registration of calving and insemination of cows and heifers provided by farm specialists were studied. The analysis of the insemination index, the number of inseminations and the number of calves born in different seasons of the year was carried out. The ambient temperature was regularly recorded using thermometers.

To control the physiological state, namely stress, in animals during the period of sharp fluctuations in ambient temperature, blood was taken from the subcaudal vein in the morning before feeding and milking. A total of 20 unstabilized blood samples were studied in winter and 26 samples were studied in summer. The level of estradiol and progesterone in the blood serum was determined by enzyme immunoassay, as well as the concentration of stress hormones adrenaline in February (20) and July (26). Measurement and recording of the ambient temperature was carried out daily throughout the experiment. Samples of unstabilized blood (n=46) obtained from cows in different seasons of the year. Blood was taken from the subcaudal vein into a vacutainer.

Research results. Based on the thermometer data, two main periods of deviation of the ambient temperature from the optimum by 10-15 degrees were noted. (> +25). From June 2 to August 30, 2019, a significant increase in temperature was recorded. It ranged from +10 °C to +42 °C.

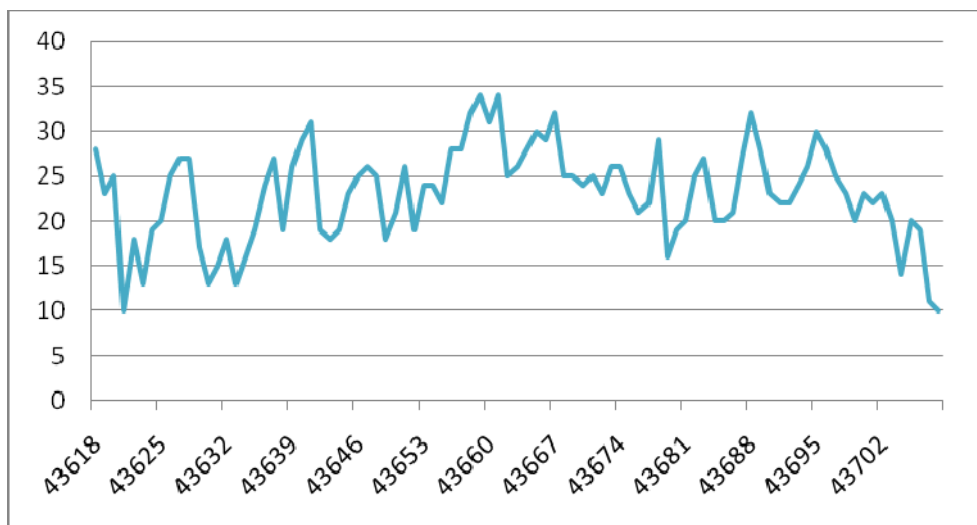


Figure 1 – “Temperature curve June-August 2019”

During 2019, the lowest temperature was recorded on February 6 (–37 °C). The highest temperature was recorded on July 13 and 15 (+42 °C). In 2020, during the summer period, the ambient temperature from June to August ranged from +12 °C to +34 °C. In January and December, temperature fluctuations ranged from –23 °C to –37 °C. An illustration of annual fluctuations in ambient temperature is shown in Figure 1.

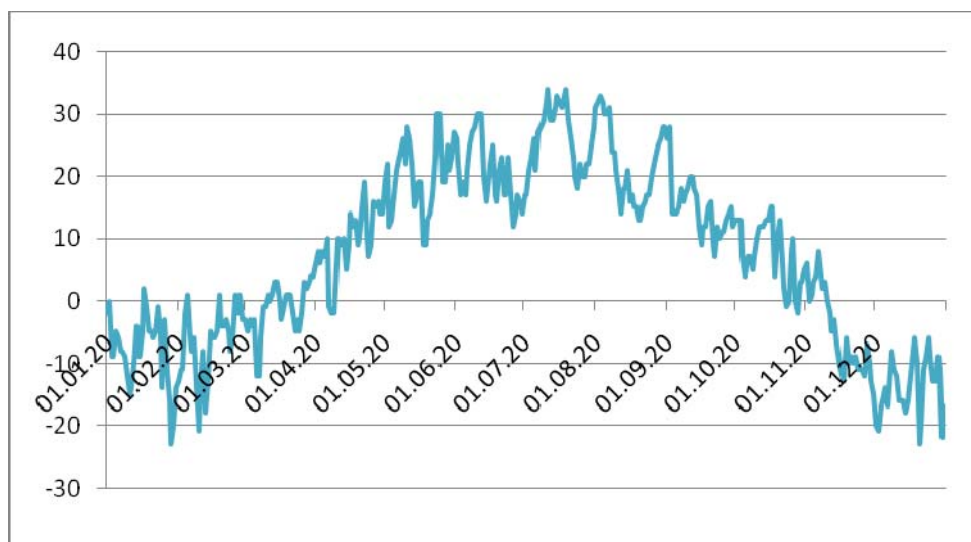


Figure 2 – “Temperature curve for 2020”

Against the background of fixed unstable readings and sharp fluctuations in ambient temperature, we analyzed the state of the reproductive qualities of the breeding stock on the above farms.

Figure 1 shows the dynamics of the reproductive function of cows in the village of Sadchikovskoye of Olzha Agro LLP for 3 years.

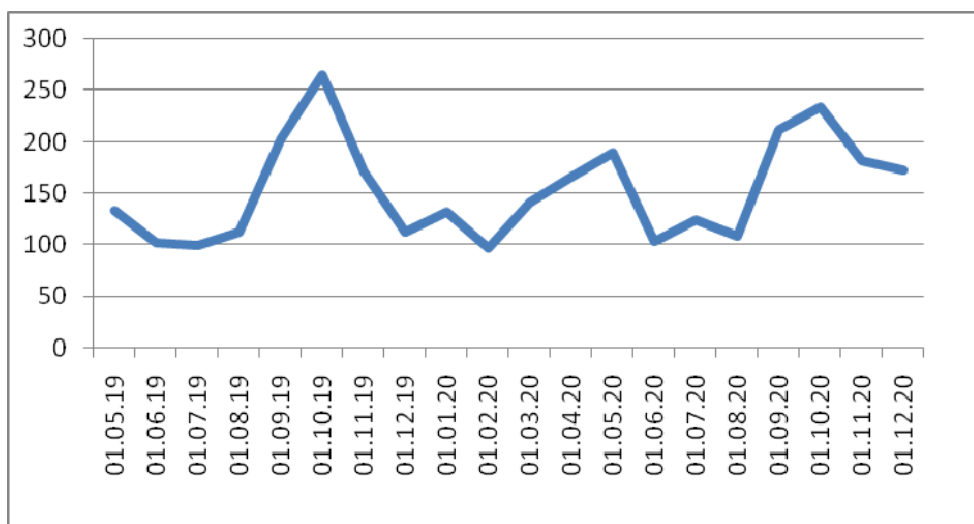


Figure 3 – The number of inseminations of cows on a farm in the village of Sadchikovskoye, Olzha Agro LLP for 3 years

As shown in Figure 3, the lowest number of inseminations of cows was recorded during the summer months, when a sharp increase in ambient temperature was recorded, up to +42 °C. Another decline and a record low number of inseminations was recorded in February. During this period, the ambient temperature lowered to -42 °C.

Based on the foregoing, it is natural that the index of insemination of cows in Sadchikovskoye LLP by season had the lowest value in the summer months. It amounted to 2 in June and July and to 1.9 in August.

When analyzing the number of born calves by seasons on the farm of Sadchikovskoye LLP, a low number of born calves was noted in March (n=31), April (n=37) and May (n=39). This is because the summer months had the fewest successful inseminations due to high ambient temperatures. Also, a decrease in the number of calving was noted in June, September and October 2020. This is the result of a low rate of fruitful inseminations in January and February.

The results obtained from the analysis of data on the farm of Saryagash LLP in Denisov district were similar. The graph “Number of inseminations in Saryagash LLP by seasons” shows the lowest number of successful inseminations in the summer months from June to August 2019 (Figure 4). The number of successful inseminations of cows was 223, 231, 238, respectively, against 370 in April 2019. This is due to the high ambient temperature (up to +42 °C).

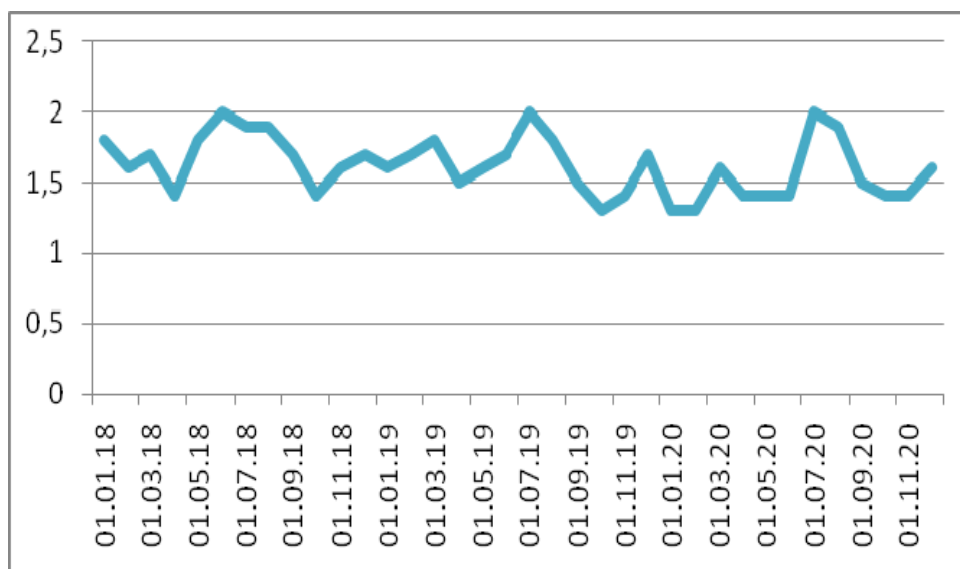


Figure 4 – the number of fruitful inseminations of cows in Saryagash LLP, Denisov district in 2018-2020

An analysis of the livestock of calves born in Saryagash LLP by season showed that the smallest number of calves was received in the spring months of 2020: 68 in March, 60 in April, 64 in May, against 106 calves born in September of the same year. Also, low birth rates were recorded in April 2019 (n=61) and 2020 (n=60).

Another period of low artificial insemination rates in January 2018 (n=89) and February 2019 (n=97) coincides with a period of sharp cooling and low ambient temperature (down to -42°C). It should also be taken into account that during this period there is an important factor – a high level of oxytocin in the blood of newly-calved cows. *Oxytocin prevents the embryo from attaching to the uterus.*

During the research period, along with recording the reproductive qualities of cows, we studied the level of sex hormones in cows

In the blood serum of cows in Sadchikovskoye LLP in the postpartum period in winter, the concentration of progesterone decreased by 2 times in the period from 20 to 30 days. The concentration of estradiol over the same period decreased by 7%.

In the summer period, the concentration of progesterone in the blood serum in the period from 20 to 30 days after calving decreased by 1.7 times. The content of estradiol, respectively, decreased by 9%.

Thus, after calving, the level of sex hormones in the blood serum of cows decreased by day 30. We did not observe an increase in the level of hormones in the blood serum of cows after calving. The most significant deviation of hormone concentrations was recorded in the summer period.

Conclusion: As part of the research, the effect of sudden changes in ambient temperature on the fertility of cows in the conditions of livestock farms in Kostanay region was studied. The following was found:

Sudden changes in ambient temperature affect the level of production of the stress hormone adrenaline in the blood and also directly affect the fertility of animals.

As a result of studies of the influence of the temperature factor on the body of dairy cows in Olzha Agro LLP and Saryagash LLP, we have found the following:

The average annual indicators of reproductive qualities on the farms of Kostanay region for 3 years, 2018-2020 were as follows: in Sadchikovskoye LLP – 1,882 fruitful inseminations of cows, 419 calves, insemination frequency – 3. In Saryagash LLP – 3,504 fruitful inseminations of cows, 1,004 calves, insemination frequency – 1.6.

The lowest sexual activity and the minimum number of inseminations of cows were registered during the period of sharp deviations in ambient temperature. Up to $+42^{\circ}\text{C}$ in summer and down to -37°C in winter.

Deviations were noted in the production of the hormones estradiol and progesterone in the summer and winter periods after calving.

A sharp increase in the stress hormone adrenaline was registered in summer and winter periods with an abnormal increase and decrease in air temperature.

The data obtained from studies of the influence of the temperature factor on the reproductive qualities of dairy cows allow us to advise the farm specialists to organize their work in such a way as to limit the number of inseminations during periods of sharp temperature changes. This is due to the fact that the number of successful inseminations during these periods is much lower, since heat stress in animals

reduces fertility in cows. We recommend taking this fact into account and, if possible, inseminating animals in more favorable periods. The results of studies of the effect of heat stress on the fertility of cows in different seasons of the year can be used to organize the reproduction of dairy cows.

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Information about the author

Tegza Aleksandra Alekseevna – Doctor of Veterinary Sciences, Professor of the department of Veterinary medicine Kostanay Regional University named after Akhmet Baitursynov, 110000 Kostanay, Mayakovskiy st. 99/1, phone: 87774435275; e-mail: tegza.4@mail.ru.

Dzhulanov Mardan Nurmukhamedovich – Doctor of Veterinary Sciences, Professor of the Department of Obstetrics, Surgery and Reproduction Biotechnology of the Kazakh National Research University 050010 Almaty, Abaja St. 8. phone: 87077711244; e-mail: mardan_58@mail.ru.

Baimbetova Nurgul – Master of Veterinary Sciences, Senior Lecturer of the department of Veterinary medicine Kostanay Regional University named after Akhmet Baitursynov, 110000 Kostanay, Mayakovskiy st. 99/1, phone:87076647578; e-mail: sonyk-86@mail.ru.

Akhmetchina Tolkyнай Akangalievna – Master of Biology Sciences, senior lecturer of the Department of Theory and Practice of Physical Culture and Sports (TPPCS), Kostanay Regional University named after Akhmet Baitursynov, 110000 Kostanay, Tauliesizdik st.118, phone: 87755317020; e-mail: tolkyunsun15@mail.ru.

Тегза Александра Алексеевна – ветеринария ғылымдарының докторы, Ахмет Байтұрсынов атындағы Қостанай өңірлік университеті, ветеринарлық медицина кафедрасының профессоры, 110000 Қостанай қ., Маяковский көшесі, 99/1, тел. 87774435275; e-mail: tegza.4@mail.ru.

Джуланов Мардан Нурмухамедович – ветеринария ғылымдарының докторы, Алматы Қазақ ұлттық зерттеу университетінің акушерия, хирургия және биотехнология кафедрасының профессоры, 050010 Алматы, Абай даңғылы, 8. тел: 87077711244; e-mail: mardan_58@mail.ru.

Байметова Нургул – в.ғ. магистрі, Ахмет Байтұрсынов атындағы Қостанай өңірлік университеті, ветеринарлық медицина кафедрасының аға оқытушысы, 110000 Қостанай қ., Маяковский көшесі, 99/1, тел. 87076647578; e-mail: sonyk-86@mail.ru.

Ахметчина Толкынай Аканғалиевна – биология магистрі, А. Байтұрсынов атындағы Қостанай өңірлік университетінің ДШСТП кафедрасының аға оқытушысы, 110000 Қостанай қ., Тәуелсіздік көшесі, 118, тел. 87755317020; e-mail: tolkyunsun15@mail.ru.

Тегза Александра Алексеевна – доктор ветеринарных наук, профессор кафедры ветеринарной медицины Костанайского регионального университета им А.Байтурсынова, 110000 г. Костанай, ул. Маяковского 99/1, тел. 87142558568; e-mail: tegza.4@mail.ru.

Джуланов Мардан Нурмухамедович – доктор ветеринарных наук, профессор кафедры Акушерства, хирургия и биотехнология воспроизводства Казахского национального исследовательского университета, 050010 Алматы, просп. Абая, 8 телефон: 87077711244; e-mail: mardan_58@mail.ru.

Баимбетова Нургул – магистр ветеринарных наук, старший преподаватель кафедры ветеринарной медицины Костанайского регионального университета им А.Байтурсынова, 110000 г. Костанай, ул. Маяковского 99/1, тел. 87076647578; e-mail: sonyk-86@mail.ru.

Ахметчина Толкынай Акангалиевна – магистр биологии, старший преподаватель кафедры ТиПФКиС Костанайского регионального университета им А.Байтурсынова, 110000 Костанай, ул. Таулиесиздик 118, тел. 87755317020; e-mail: tolkynsun15@mail.ru.