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С.Ю. Харлап¹, ✉
О.В. Горелик^{1,2},
С.Л. Сафронов³,
С.А. Гриценко⁴,
А.А. Белооков⁴,
В.В. Журавель⁴

¹ Уральский государственный аграрный университет, Екатеринбург, Российская Федерация

² Уральский федеральный аграрный научно-исследовательский центр Уральского отделения Российской академии наук, Екатеринбург, Российская Федерация

³ Санкт-Петербургский государственный университет ветеринарной медицины, Санкт-Петербург, Российская Федерация

⁴ Южно-Уральский государственный аграрный университет, Троицк, Российская Федерация

✉ proffuniver@yandex.ru

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Svetlana Yu. Harlap¹, ✉
Olga V. Gorelik^{1,2},
Sergey L. Safronov³,
Svetlana A. Gritsenko⁴,
Alexey A. Belookov⁴,
Vitaly V. Zhuravel⁴

¹ Ural State Agrarian University, Yekaterinburg, Russian Federation

² Ural Federal Agrarian Research Center of the Ural Branch of the Russian Academy of Sciences, Yekaterinburg, Russian Federation

³ St. Petersburg State University of Veterinary Medicine, St. Petersburg, Russian Federation

⁴ South Ural State Agrarian University, Troitsk, Russian Federation

✉ proffuniver@yandex.ru

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Взаимосвязь продуктивного долголетия и воспроизводительных функций у коров

РЕЗЮМЕ

Уральский тип отечественной черно-пестрой породы отличается высокими показателями продуктивности, хорошей пригодностью к использованию в условиях промышленной технологии молока. Повышение продуктивности привело к снижению у маточного поголовья воспроизводительных функций. В результате проведенных исследований установлено, что при длительном использовании удой коров закономерно изменяется, достигая наивысших показателей у полновозрастных животных к 3-й лактации, а затем постепенно снижается, оставаясь достаточно высоким и стабильным. Снижение составляет от 13 кг (4-я лактация относительно 3-й) до 663 кг (начиная с 4-й по 8-ю лактации), то есть на 132,6 кг в среднем за лактацию, или на 1,7%. Качественные показатели молока изменялись в сторону повышения с 1-й по 10-ю лактацию. Более изменчивыми оказались показатели по удою — они имели коэффициент изменчивости от 20,7 до 17,6, что говорит о достаточно широкой возможности отбора по этому признаку в стаде. Удой за лактацию не имеет взаимосвязи с длительностью сервис-периода и повышение воспроизводительных функций современного голштинизированного черно-пестрого скота не окажет отрицательного воздействия на удой коров.

Ключевые слова: коровы, молоко, продуктивность, удой, лактация, голштинизированная черно-пестрая порода, сервис-период

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Correlation of productive longevity and reproductive functions in dairy cows

ABSTRACT

The Ural type of the domestic Black-and-White mottled breed is characterized high milk-yield rates and good suitability for industrial milking technology. The milk yield increase led to a deterioration of reproductive functions in the livestock. As a result of the research it was found that in the process of prolonged using of the cattle, the milk yield of cows regularly changes, reaching the highest rates among the mature cows by the 3rd lactation, and then gradually decreases, remaining sufficiently high and stable. The decrease of the milk yield starts from 13 kg (in the 4th lactation in comparison with the 3rd lactation) and goes to 663 kg (from 4th to 8th lactations). That decrease makes on average 132.6 kg per lactation period, or by 1.7%. The quality indicators of milk changed to the better from the 1st to the 10th lactation. The indicators for milk yield turned out to be more variable; they had a coefficient of variability from 20.7 to 17.6, which indicates a quite wide possibility of selection in the herd by this trait. The milk yield per lactation is not related with duration of service period; and increase of reproductive functions in the modern Holsteinized Black-and-White mottled cattle will not provide a negative impact on the milk yield of the cows.

Key words: cows, milk, productivity, milk yield, lactation, Holsteinized black-and-whitebreed, service period

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Введение / Introduction

The food security in any country poses big tasks for farmers to increase production and improve the quality of agricultural products, including the food of animal origin [1–5]. Great importance is referred to the development of dairy farming as a branch of livestock husbandry, that provides milk — the valuable food product and raw material for the food industry [6–13].

For milk production highly productive dairy cattle are used, which main share belongs to related breeds of Dutch origin — Holstein, black-and-white, mottled breed, etc. [14]. The genetic pool of the Holstein breed, which is considered the best dairy breed in the world, has been widely used for more than four decades, and it keeps being used to improve domestic livestock genetics, including the black-and-white mottled breed in order to increase high milk yield and improve technological parameters in industrial production of milk [15]. The large array of Holsteinized black-and-white mottled cattle has been derived, which type of cattle features high proportion of Holstein breed genes. These cows have peculiar economically useful traits and phenotypic characteristics depending on the breeding region and breed resources used for breed-crossing. The increase in milk yield led to decline of reproductive functions in the breeding livestock. In Sverdlovsk region, the Ural type of black-and-white cattle was created and officially registered [16]. Assessment of the relation between the milk yield capability of cows and their reproductive functions qualities, depending on the breed lineage, is relevant and has practical value [17, 18].

Материал и методы исследования / Materials and method

The objects of research were cows of Holsteinized black-and-white mottled cattle. The studies were carried out in breeding factories for breeding Holsteinized black-and-white mottled cattle of the Ural type of Sverdlovsk region on certain number of cows obtained from closely related breeding. The research included all lactating cows used in breeding farms. The data of zootechnical and veterinary records of the IAS “SELEX-Dairy Cattle” database were used. Milk yield for 305 days of lactation, MFF and MFP in milk were taken into account. The milk yield per lactation was assessed by control milking once a month, the quality parameters of milk were determined by the average milk sample from each cow once a month in the dairy laboratory of the Uralplemcenter. Reproductive functions qualities were assessed by the duration of the service-period and calving intervals, and expressed as the coefficient of reproductive capability (CRC).

Результаты и обсуждение / Results and discussion

Milk yield is the main selection trait in dairy cattle breeding. It's known that the higher is the milk yield — the higher is the economic efficiency of the cows. But even in case of milk yield of 10 000 kg per lactation, the profitability of milk production is low and increases together with an prolongation of productive periods. The decrease in reproductive functions in modern Holsteinized black-and-white mottled cattle has led to a decrease in their productive longevity down to 2.3–2.4 lactations, although there are cows in breeding farms that are used for quite long time. Milk yield for 305 days of lactation, depending on the duration of cows using, is shown below in Figure 1.

The table obviously shows that during prolonged use of cows the milk yield of cows regularly changes, reaching the highest rates among the mature cows by the 3rd lactations, and then gradually decreases, remaining sufficiently high and stable. The milk yield decreases from 13 kg (in the fourth lactation in comparison with the third lactation) to 663 kg starting from 4 to 8 lactations. That decrease makes on average 132.6 kg per lactation period, or by 1.7%. Further, a sharper decrease in milk yield is observed. This decrease reaches 377 kg from the 8th to the 9th lactations, and makes 1.007 kg at the 10th lactation. This confirms that the cows' physical conditions allow their long-term productive use.

As a result of the analysis, it was also found that the duration of the use of cows also affects the quality indicators of milk, which improve along with prolongation of livestock use (Figure 2).

With prolonged use of cows, MFF and MFP in cow milk fluctuated. These indicators increased and decreased from lactation to lactation. These changes were insignificant and untrustworthy, with the exception of MFF and MFP in milk of cows in the 9th lactation, when there was a significant decrease in MFF in milk and a significant increase in MFP in milk, in comparison with the 8th lactation ($P \leq 0.05$ for MFF and $P \leq 0.01$ for MFP) and in the 10th lactation when these indicators increased ($P \leq 0.01$ in favor of the 10th lactation).

During selection and breeding work, the cows undergo sorting, casting and selection. The selection possibilities depend to certain extent on variability of particular trait in the herd. Figure 3 below shows the coefficients of variability of milk yield capacities of cows depending on the duration of their use.

The indicators for milk yield happened to be more variable; the coefficient of variability ranged from 20.7 to 17.6, which indicates a fairly wide possibility of cows' selection by this trait in order to improve this indicator and increase milk yield on average for the herd in general. The

Fig. 1. Milk yield in 305 days of lactation, kg

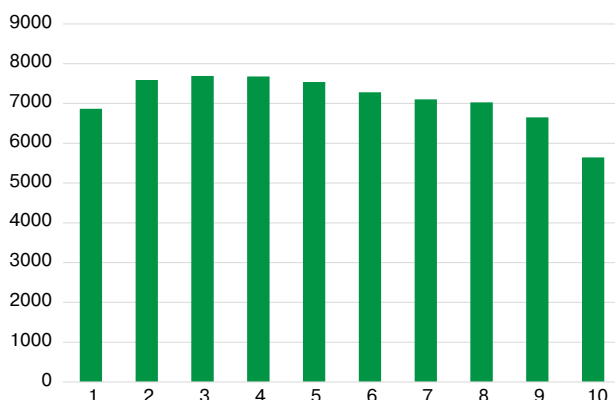


Fig. 2. Quality indicators of milk, %

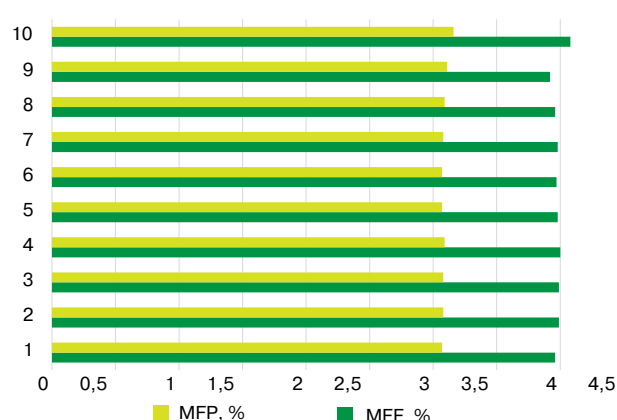
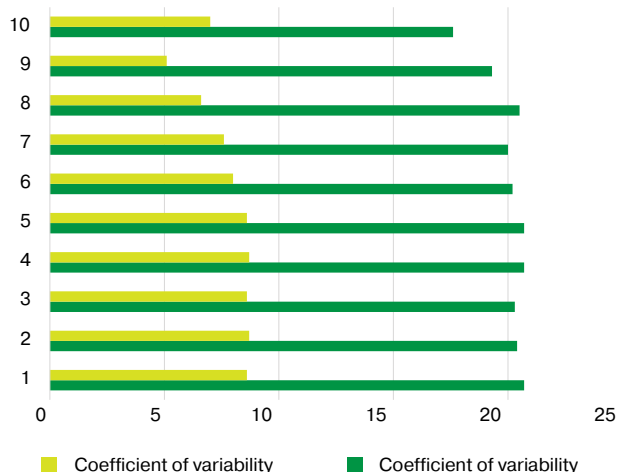
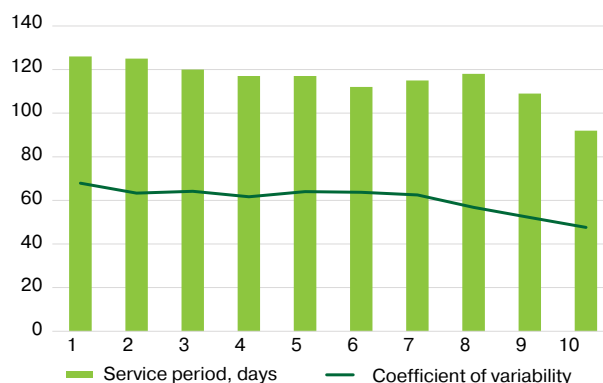
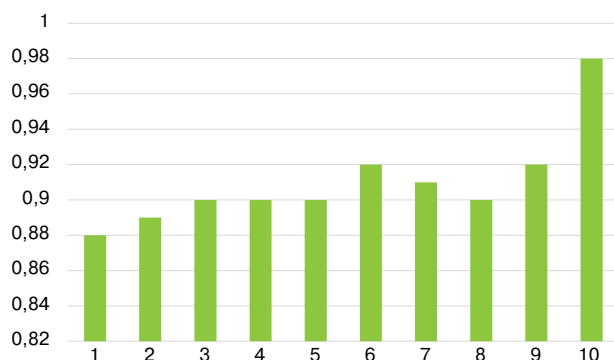
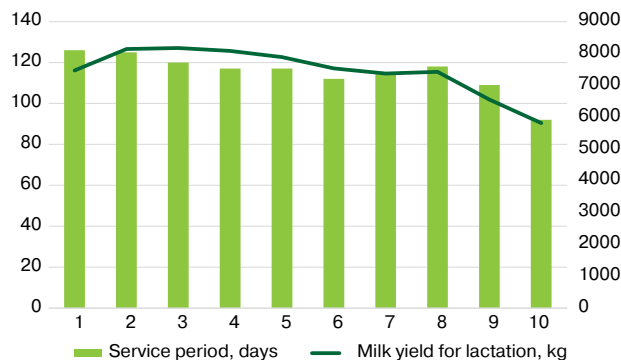


Fig. 3. Coefficients of variability in milk yield, MFF and MFP in milk of cows by lactation**Fig. 4.** The duration of the service period and the coefficients of its variability for lactations**Fig. 5.** The coefficient of reproductive capability for lactations**Fig. 6.** The conjugation of milk yield per lactation and the duration of the service period of cows by lactation

coefficients of variability for MFF and MFP in milk indicate a significant leveling of the herd for them and an insignificant possibility of selection by this trait. In this case it is possible to change the quality indicators for the better mainly due to the selection of breeding bulls with high genetic potential by maternal ancestors.

It's necessary to note that the milk yield of cows in a herd for full lactation was higher than the milk yield for 305 days of lactation. It exceeded by 624 kg or 8.4% on average, while the coefficient of milk yield variability was 23.4 on average, or was higher than the average milk yield for 305 days by 6.0. Most often this is caused by prolongation of the lactation period due to the increase of service period duration. In our case it made 132 days on average for the herd and varied depending on lactation (Figure 4).

The figure shows that the service period decreases with age of a cow, but in general it is higher than necessary for normal reproduction rates. The optimal duration of service period is 45 to 80 days. If this period is longer, it indicates problems with reproductive system. The coefficient of service period variation is high, which makes it possible to select cows on this basis, as the issues of reproduction come out on the spotlight. Problems with reproductive system are also indicated by low rates of reproductive capability (Figure 5).

Despite the fact that the coefficient of reproductive capability increases with the age of cows from 0.88 to 0.92;

it corresponds to good reproductive functions in cows only by the 10th lactation.

The correlation between reproductive functions and milk yield of cows is of interest. The correlation is shown below in Figure 6.

The figure obviously shows that the milk yield per lactation is not related to the duration of the service period; and increase in reproductive functions of modern Holsteinized black-and-white mottled cattle will not give a negative effect on the milk yield of cows, especially since the milk yield was insignificantly higher than the milk yield in 305 days of lactation and showed a tendency to increase, which can most likely be explained by a longer lactation with an average daily milk yield in the last stage of lactation (over 305 days) equal to 5.8 kg.

Выводы / Conclusion

Thus, it can be concluded that the Ural type of Holsteinized black-and-white mottled cattle possesses high breeding qualities, which is confirmed by their milk yield, which naturally changes along with age. As a cow ages, the quality of milk increases. The cows of the 10th lactation do not have problems with reproductive function; definitely the reproductive capability of the livestock is better among the mature cows. Reproductive functions and milk yield of cows are not interrelated, which makes it possible to run selection of cows by these traits.

Все авторы несут ответственность за свою работу и представленные данные.

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All authors bear responsibility for the work and presented data.

All authors have made an equal contribution to this scientific work. The authors were equally involved in writing the manuscript and bear the equal responsibility for plagiarism. The authors declare no conflict of interest.

REFERENCES

1. Rebezov M.B., Kudryavtseva T.M., Meshcheryakova G.V., Derkho M.A., Shakirova S.S., Gumenyuk O.A. Control of the stability of the results of studies of cadmium content using the method of additions in cow's milk samples. *IOP Conference Series: Earth and Environmental Science*. 2021; 677(5). DOI: 10.1088/1755-1315/677/5/052051
2. Sidra-Tul-Muntaha et al. Safety assessment of milk and indigenous milk products from different areas of Faisalabad. *Journal of Microbiology, Biotechnology and Food Sciences*. 2020; 9(6): 1197–1203. DOI: 10.15414/JMBFS.2020.9.6.1197-1203
3. Smakuyev D. et al. Acclimatization and productive qualities of american origin aberdeen-angus cattle pastured at the submontane area of the northern Caucasus. *Journal of the Saudi Society of Agricultural Sciences*. 2021; 20(7): 433–442. DOI: 10.1016/j.jssas.2021.05.011
4. Sarkar T. et al. The fuzzy cognitive Map–Based shelf-life modelling for food storage. *Food Analytical Methods*. 2021. DOI: 10.1007/s12161-021-02147-5
5. Gorelik A.S., Yarmukhamedova E.I., Sharipova A.F., Gazeev I.R., Kanareikina S.G. Comparative evaluation of composition and properties of milk from cows of different breeds in cheese production. *IOP Conference Series: Earth and Environmental Science*. 2021; 677(2). DOI: 10.1088/1755-1315/677/2/022109
6. Serikova A. et al. Development Of Technology Of Fermented Milk Drink With Immune Stimulating Properties. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*. 2018; 9(4): 495–500. WOS:000438848100062 publons.com/p/16977239
7. Gorelik V.S., Rebezov M.B., Lopaeva N.L., Smirnova E.S., Sultanova S.K. Morphological and biochemical parameters of cow blood when using chitosan preparations. *E3S Web of Conferences*. 2021; 254. DOI: 10.1051/e3sconf/202125408025
8. Smolnikova F. et al. Nutritive Value Of Curd Product Enriched With Wheat Germ. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*. 2018; 9(3): 1003–1008. WOS:000438847100131 publons.com/p/16977237
9. Morozova L. et al. Improving the physiological and biochemical status of high-yielding cows through complete feeding. *International Journal of Pharmaceutical Research*. 2020; 12: 2181–2190. DOI: 10.31838/ijpr/2020.SP1.319
10. Ponomareva L.F., Burakovskaya N.V., Rebezov Y.M., Bychkova T.S., Grunina O.A. Sensory method for the analysis of milk dessert from curd whey. *IOP Conference Series: Earth and Environmental Science*. 2021; 677(3). DOI: 10.1088/1755-1315/677/3/032042
11. Lavrov A.A., Gorelik A.S., Dogareva N.G., Mkrtchyan G.V., Lepekhina T.V. The influence of origin on milk productivity of cows. *IOP Conference Series: Earth and Environmental Science*. 2021; 839(3). DOI: 10.1088/1755-1315/839/3/032005
12. Temerbayeva M. et al. Technology of Sour Milk Product For Elderly Nutrition. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*. 2018; 9(1): 291–295.
13. Gorelik A.S., Nesterenko A.A., Arkanov P.V., Vagapova O.A., Melnikova E. Dairy productivity of cows - daughters of bull producers. *IOP Conference Series: Earth and Environmental Science*. 2021; 677(2). DOI: 10.1088/1755-1315/677/2/022113
14. Likhodeevskaya O.E. et al. Comparative assessment of productive qualities of holsteinized black-and-white cattle by lines. *IOP Conference Series: Earth and Environmental Science*. 2021; 848(1). DOI: 10.1088/1755-1315/848/1/012082
15. Fedoseeva N.A. et al. Productive qualities of holsteinized black-and-white cattle. *IOP Conference Series: Earth and Environmental Science*. 2021; 848(1). DOI: 10.1088/1755-1315/848/1/012068
16. Fedoseeva N.A. et al. Evaluation of the efficiency of using black-mottled cows of the ural type. *IOP Conference Series: Earth and Environmental Science*. 2021; 677(2). DOI: 10.1088/1755-1315/677/2/022105
17. Lebedko E.Y., Pilipenko R.V. Innovative conceptual model of an ideal type of highly productive dairy cow. *Agrarian science*. 2019; (11-12): 38–42. (In Russian)
18. Mitsurina E.A., Gamko L.N. Qualitative indicators of milk, the productivity of lactating cows and changes in blood composition when feeding mineral supplements. *Agrarian science*. 2021; 344(1): 26–29. (In Russian)

ОБ АВТОРАХ:

Светлана Юрьевна Харлап,
Кандидат биологических наук, доцент,
Уральский государственный аграрный университет, ул. Карла
Либкнехта, 42, Екатеринбург, 620075, Российская Федерация
E-mail: proffuniver@yandex.ru
<https://orcid.org/0000-0002-3651-8835>

Ольга Васильевна Горелик,
доктор сельскохозяйственных наук, профессор,
Уральский государственный аграрный университет, ул. Карла
Либкнехта, 42, Екатеринбург, 620075, Российская Федерация
Уральский федеральный аграрный научно-исследовательский
центр Уральского отделения Российской академии наук, ул. Бе-
линского, 112а, Екатеринбург, 620142, Российская Федерация
E-mail: olgao205en@yandex.ru
<https://orcid.org/0000-0002-9546-2069>

Сергей Леонидович Сафронов,
доктор сельскохозяйственных наук, доцент,
Санкт-Петербургский государственный университет ветери-
нарной медицины, Черниговская ул., 5, Санкт-Петербург,
196084, Российская Федерация
E-mail: safronovsl@list.ru
<https://orcid.org/0000-0002-5478-9698>

Светлана Анатольевна Гриценко,
Доктор биологических наук, доцент,
Южно-Уральский государственный аграрный университет, ул.
Гагарина, 13, Троицк, 457103, Российская Федерация
E-mail: zf.usavm@mail.ru
<https://orcid.org/0000-0003-2334-4925>

Алексей Анатольевич Белококов,
доктор сельскохозяйственных наук, доцент,
Южно-Уральский государственный аграрный университет, ул.
Гагарина, 13, Троицк, 457103, Российская Федерация
E-mail: belookov@yandex.ru
<https://orcid.org/0000-0002-1083-5832>

Виталий Васильевич Журавель,
Кандидат сельскохозяйственных наук, доцент,
Южно-Уральский государственный аграрный университет, ул.
Гагарина, 13, Троицк, 457103, Российская Федерация
E-mail: zhu123456@mail.ru
<https://orcid.org/0000-0001-5212-6631>

ABOUT THE AUTHORS:

Svetlana Yurievna Harlap,
candidate of Biological Sciences, Associate Professor,
Ural State Agrarian University, 42 Karl Liebknecht, str.,
Yekaterinburg, 620075, Russian Federation
E-mail: proffuniver@yandex.ru
<https://orcid.org/0000-0002-3651-8835>

Olga Vasilyevna Gorelik,
Doctor of Agricultural Sciences, Professor,
Ural State Agrarian University, 42 Karl Liebknecht, str.,
Yekaterinburg, 620075, Russian Federation
Ural Federal Agrarian Research Center of the Ural Branch of the
Russian Academy of Sciences, 112a Belinsky str., Yekaterinburg,
620142, Russian Federation
E-mail: olgao205en@yandex.ru
<https://orcid.org/0000-0002-9546-2069>

Sergey Leonidovich Safronov,
Doctor of Agricultural Sciences, Associate Professor,
St.Petersburg State University of Veterinary Medicine, 5
Chernigovskaya str., St. Petersburg, 196084,
Russian Federation
E-mail: safronovsl@list.ru
<https://orcid.org/0000-0002-5478-9698>

Svetlana Anatolyevna Gritsenko,
Doctor of Biological Sciences, Associate Professor,
South Ural State Agrarian University, 13. Gagarin str., Troitsk,
457103, Russian Federation
E-mail: zf.usavm@mail.ru
<https://orcid.org/0000-0003-2334-4925>

Alexey Anatolyevich Belookov,
Doctor of Agricultural Sciences, Associate Professor,
South Ural State Agrarian University, 13 Gagarin str., Troitsk,
457103, Russian Federation
E-mail: belookov@yandex.ru
<https://orcid.org/0000-0002-1083-5832>

Vitaly Vasilyevich Zhuravel,
candidate of Agricultural Sciences, Associate Professor,
South Ural State Agrarian University, 13 Gagarin str., Troitsk,
457103, Russian Federation
E-mail: zhu123456@mail.ru
<https://orcid.org/0000-0001-5212-6631>