

Original research

Risk factors of pathologies in Brown Swiss cows at a large industrial complex

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Received: 19 June 2024
Revised: 07 October 2024
Accepted: 25 November 2024

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Abstract. The large-scale development of animal husbandry has increased milk production, making the timely detection of cow health issues on large farms crucial to maintaining herd health and minimizing economic losses. This study analyzed data from veterinary, zootechnical, and breeding records of 94 Brown Swiss cows (first to fourth lactation) at the Ekaterinoslavsky dairy complex, Dnipropetrovsk region, from 2020 to 2024. Findings show that all cows in a large-group, industrial setting experienced at least one pathology during lactation. Mastitis was the most common condition, affecting 29.6% of first-lactation heifers and 35.3% of fourth-lactation cows. Reproductive organ diseases ranked second, with placental retention rates of 7.5% in first-lactation heifers, 35.4% in second-lactation cows, and 1.5–17.6% in third- and fourth-lactation cows. Metritis was unrelated to placental retention and absent in second-lactation cows, with no observed abortions in this group. However, abortions were recorded in 14.8%, 17.6%, and 10.5% of cows in the first, third, and fourth lactations, respectively. Lameness was prevalent among high-yielding cows, with rates of 11.8% in first, third, and fourth lactations but increasing to 22.6% in second lactation. Timely detection of pathologies allowed for relatively good reproductive performance: the service period averaged 136.1–155.8 days, the intercalving period 428.2–447.8 days, and the insemination index 2.00–2.32. Milk production was high, with yields ranging from 7714.3 kg in first-lactation heifers to 9023.9 kg in third-lactation cows. Milk fat production for completed lactations ranged from 510.4 kg to 762.9 kg, underscoring the productive potential of Brown Swiss cows.

Keywords: pathology; reproductive function; milk productivity.

Фактори ризику патологій у швіцьких корів на великому промисловому комплексі

Анотація. Виробництво молока розширюється з масштабним та інтенсивним розвитком тваринництва, за якого своєчасно виявляти проблеми зі здоров'ям корів на великих фермах є першочерговою задачею для забезпечення здоров'я всього стада та мінімізації економічних збитків. Методологічною основою наукових досліджень були методи їх проведення у зоотехнічній практиці. Дані ветеринарного, зоотехнічного та племінного обліку, були зібрані по коровах (n=94 гол.) швіцької породи різного лактаційного віку (першої–четвертої лактації) упродовж 2020–2024 рр. на МБК “Єкатеринославський” Дніпропетровської області. Встановлено, що упродовж лактаційного періоду швіцькі корови на великому промисловому комплексі та велико-груповому утриманні вражаються принаймні однією патологією. Незалежно від віку швіцьких тварин вим'я вражається маститом, що становить від 29,6 % стада первісток I групи та 35,3 % тварин четвертої лактації IV групи. Другим за значенням серед неінфекційних захворювань тварин у стаді припадає на хвороби органів відтворення: затримка плаценти після пологів коливається від 7,5 % у стаді первісток, до 35,4 % у корів другої лактації. При цьому, у швіцьких тварин третьої і четвертої лактації ця патологія відмічається на рівні відповідно 1,5 і 17,6 %. Виникнення метритів у корів напряду не пов'язано із затримкою плаценти. У тварин другої лактації цієї патології не виявлено, як і не спостерігалось випадків абортів. Натомість у швіцьких корів першої, третьої та четвертої лактації кількість абортів знаходилася на рівні відповідно 14,8, 17,6 і 10,5 %. На промисловому комплексі серед високопродуктивних корів значно поширена кульгавість. Якщо у тварин першої, третьої та четвертої лактації захворювання кінцівок не перевищує 11,8 %, то для тварин другої лактації цей показник знаходиться на рівні 22,6 %. Доведено, що своєчасно виявлена патологія з подальшим оперативним втручанням дає можливість тваринам мати відносно хороші показники відтворної функції: сервіс-період становить в середньому 136,1–155,8 доби; міжотельний період – 428,2–447,8 доби; індекс осіменіння – 2,00–2,32 одиниці. Функціональна активність вимені швіцьких корів була досить високою, що дало можливість лактувати аж до запуску: відносно найнижчий рівень удою був у первісток і становив в середньому 7714,3 кг, а найвищим удоєм характеризувалися тварини третьої лактації – 9023,9 кг. Виробництво молочного жиру за завершену лактацію коливалось від 510,4 кг до 762,9 кг, що підкреслювало продуктивний потенціал корів бурої швіцької породи.

Ключові слова: патологія; відтворна функція; рівень молочної продуктивності.

Cite this article: Pishchan, S. G., Pishchan, I. S., Lytvynshchenko, L. O. & Mykolaychuk, L. P. (2024). Risk factors of pathologies in Brown Swiss cows at a large industrial complex. *Theoretical and Applied Veterinary Medicine*, 12(4), 9–15. doi: 10.32819/2024.12017

Introduction

In recent decades, the technology of dairy production in developed countries has undergone profound transformations. Innovations such as cow activity monitoring systems and automated milking technologies are rapidly accelerating adoption (de Koning, 2010). These advancements, coupled with economic pressures and demographic shifts, have led to a reduction in the number of farms while increasing herd sizes and overall milk production. However, these changes profoundly impact the health, welfare, and management practices of dairy herds (Maltz, 2020).

The significant increase in milk yield per cow is attributed to advancements in feeding strategies and genetic selection. High genetic potential for productivity, combined with optimal feeding and management, ensures consistently high milk yields throughout the lactation period (Zobel et al., 2013; Fujiwara et al., 2018). Quantitative genetics, particularly the use of sexed semen, has played a pivotal role in accelerating genetic progress, supporting herd expansion and improving productivity metrics (De Vries et al., 2008; Butler, 2013).

In addition to productivity goals, the modern dairy industry faces increasing demands to strengthen food safety, enhance biosecurity, minimize antimicrobial use, and prioritize animal welfare. The global rise in organic dairy farming reflects these emerging priorities (Barkema et al., 2015). However, industrial systems characterized by high livestock density and limited opportunities for natural behavior, such as grazing and resting, raise concerns about animal welfare and comfort (Krueger et al., 2020; Nedosekov et al., 2021).

The European Union's "Farm to Fork" strategy highlights the importance of improving animal health and welfare, recognizing their critical role in sustaining productivity and extending economic use (Vasseur et al., 2012; Shepley et al., 2019). Nevertheless, intensive exploitation of dairy cows in large industrial complexes presents ongoing challenges. Suboptimal housing and management systems contribute to health issues, including lameness (Popescu et al., 2013), reproductive failures (Borchers et al., 2017), reduced productive potential (Bar & Ezra, 2005), and shortened productive lifespan post-recovery (Khan et al., 2015).

Early detection of pathologies and timely interventions are essential for maintaining animal health and productivity (Ellingsen et al., 2012). The increasing focus on genetic resistance to diseases represents a promising strategy for improving herd health and reducing susceptibility to infections (Berry et al., 2011). Livestock behavior, particularly rumination (averaging 9–12 hours daily), serves as a key indicator of welfare and health, reflecting both physiological and social states (Aikman et al., 2008; Beauchemin, 2018).

Pathologies in dairy cattle pose significant economic risks, not only through decreased productivity but also due to the financial burden of veterinary care and preventive measures (Fikadu et al., 2016). With the intensification of dairy farming, timely identification of health issues is critical to ensuring herd health and minimizing economic losses (Shinde et al., 2017; Nayeri et al., 2019; Li et al., 2022).

As the scale of industrial dairy farming continues to grow, addressing challenges related to animal welfare and health remains a priority. The development and implementation of strategies that balance high productivity with optimal animal care will be essential to the sustainability of modern dairy systems.

The aim of the study was the assessment of the productive qualities level realized in Brown Swiss cows of different ages experiencing short-term non-infectious pathologies.

Materials and methods

The study was based on methods applicable in zootechnical practice. Veterinary, zootechnical, and breeding records were

collected for 94 Brown Swiss cows of varying lactation ages (first to fourth lactation) from 2020 to 2024 at the Yekaterinoslavsky dairy complex in the Dnipropetrovsk region. The analysis included animals diagnosed with early-stage non-infectious pathologies, where timely medical interventions allowed them to remain in the herd and complete their lactation.

Pathologies considered included udder diseases, reproductive system disorders, limb conditions, digestive diseases, technological injuries, displaced abomasum, udder injuries, ketosis, and respiratory diseases. Four groups of cows were formed based on lactation stage and pathology:

Group I: First-lactation heifers (n = 27);

Group II: Second-lactation cows (n = 31);

Group III: Third-lactation cows (n = 19);

Group IV: Fourth-lactation cows (n = 17).

Milk yield was monitored monthly for one week, and productivity was calculated for 305 days or the entire lactation. Milk quality was assessed using automatic sampling during milking with a "Parallel" milking system. Fat content (%) was determined during the 2nd–3rd month of lactation using automatic analyzers "AKM-98" and "Ekomilk 120 – KAM 98-2A," with validation by Gerber's acid method. Protein content (%) was measured using the refractometric method on the IRF-454 B2M apparatus.

Reproductive performance was evaluated using the following metrics: Service period (SP) – time from calving to effective artificial insemination (days); Intercalving period – interval between successive calvings (days); Insemination index – number of sperm doses per fertile insemination.

Reproductive coefficient (CoR): Calculated as $CoR = 365 / \text{Intercalving period}$, with optimal values ranging from 1.0 to 0.95.

In the industrial complex, an SP of 85 days is considered optimal, with values exceeding this indicating infertility. Infertility duration (I) was calculated as:

$$I = SP - 85$$

To estimate offspring losses due to infertility, a coefficient of offspring per day was calculated, assuming 0.0035 offspring/day (1 offspring/285 days). Loss of offspring (LoO) was calculated as:

$$LoO = I \times 0.0035$$

Data were statistically analyzed using a PC-based software package for statistical functions.

This methodology allowed for a comprehensive evaluation of productive and reproductive traits in Brown Swiss cows under conditions of short-term non-infectious pathologies.

Results

The research demonstrated that non-infectious diseases affect a significant portion of the herd in large industrial complexes, independent of the age or adaptation of Brown Swiss cows to intensive farming practices. During the lactation period, all cows, from first-lactation heifers to older animals, were prone to at least one pathology (Table 1).

Mastitis was the most prevalent condition, consistently affecting the udder across all age groups. Among first-lactation heifers (Group I), 29.6 % were diagnosed with mastitis. The prevalence was slightly higher in second-lactation cows (Group II) at 32.3 % and third-lactation cows (Group III) at 31.6 %. The highest occurrence was observed in fourth-lactation cows (Group IV), where 35.3 % were affected. These findings indicate that, regardless of age, Brown Swiss cows housed in large-group systems are highly susceptible to mastitis during the lactation period, with prevalence ranging from 29.6 % to 35.3 %.

Reproductive organ diseases ranked second among non-infectious pathologies in the herd. Placental retention after calving was recorded in all lactation groups. The lowest rates were observed in Group I (first-lactation heifers) and Group III (third-lactation cows) at 7.5 % and 10.5 %, respectively.

Table 1 – The dynamics of diseases of Brown Swiss cows of different lactation ages, %

Diseases	Group of animals by age in lactation			
	I, n=27	II, n=31	III, n=19	IV, n=17
Udder diseases (mastitis)	29.6	32.3	31.6	35.3
Diseases of reproductive organs:				
retained placenta	7.5	35.4	10.5	17.6
metritis	29.6	-	26.3	10.1
Diseases of the limbs (lameness)	11.1	22.6	10.6	11.8
Abortions	14.8	-	10.5	17.6
Other diseases (displacement of rennet, udder injuries, ketosis, respiratory diseases, etc.)	7.4	9.7	10.5	7.6
Total, %	100.0	100.0	100.0	100.0

The prevalence of placental retention was notably higher in fourth-lactation cows (Group IV), with an average rate of 17.6 %. The highest incidence occurred in second-lactation cows (Group II), where an average of 35.4 % experienced this condition.

These results highlight the significant impact of both mastitis and reproductive disorders on the health and productivity of Brown Swiss cows in industrial settings, emphasizing the need for effective management and prevention strategies.

Placental retention affected both young lactating animals and older cows already adapted to industrial farming practices. The highest rate was observed in second-lactation cows (Group II), affecting an average of 35.4 % of the herd.

Placental retention was often accompanied by uterine inflammation, particularly metritis. Among first-lactation cows (Group I), 29.6 % developed metritis, while the prevalence was 26.3 % in third-lactation cows (Group III). In contrast, only 10.1 % of fourth-lactation cows (Group IV) were affected, and no cases of metritis were recorded in second-lactation cows (Group II). Thus, metritis was most prevalent in first- and third-lactation cows, with no occurrences in second-lactation cows.

High rates of abortions were noted in first-lactation cows (Group I) and fourth-lactation cows (Group IV), averaging 14.8 % and 17.6 %, respectively. Third-lactation cows (Group III) had a lower incidence of 10.5 %, while no abortions were recorded in second-lactation cows (Group II).

Limb diseases were a common issue due to the high body weight of Brown Swiss cows, hard flooring in recreation areas, and pathways leading to milking areas. Lameness was observed in 11.1% of first-lactation cows (Group I), 10.6 % of third-lactation cows (Group III), and 11.8 % of fourth-lactation cows (Group IV). Second-lactation cows (Group II) experienced the highest incidence of lameness, at an average of 22.6 %. Other non-infectious conditions, such as displaced abomasum, udder injuries, ketosis, and respiratory diseases, affected 7.4 % of first-lactation cows (Group I) and up to 10.5 % of third-lactation cows (Group III).

The reproductive qualities of the experimental (Table 2) Brown Swiss cows across all groups corresponded to the characteristics of highly productive animals in industrial systems. However, the service period exceeded the optimal range of 80–85 days in all groups.

The shortest service period was recorded in first-lactation cows (Group I), averaging 136.2 days. Fourth-lactation cows (Group IV) had the longest service period, averaging 155.8 days, which was 12.6 % longer than that of first-lactation cows. Second- and third-lactation cows (Groups II and III) had service periods of 141.1 and 143.5 days, respectively. These findings highlight the need for targeted management strategies to address health issues and optimize reproductive performance in industrial dairy systems.

The extended service period in the experimental Brown Swiss cows led to offspring losses due to infertility. In groups I–III, infertility lasted an average of 51.2–58.5 days. The longest duration was observed in fourth-lactation cows (Group IV), reaching 70.8 days, 27.7 % higher than in first-lactation cows (Group I). Considering that 1 day of infertility results in the loss of 0.0035 offspring, groups I–III lost 0.18–0.21 offspring, while group IV lost 0.25 offspring.

The prolonged service period also extended the lactation period across all groups. In groups I–III, the lactation period averaged 376.2–383.5 days, exceeding the standard 305 days by 1.23–1.25 times.

The intercalving period was similarly extended, averaging 428.8–447.8 days across the four groups, 1.17–1.23 times higher than the standard 365 days.

The long service period was linked to artificial insemination effectiveness. The lowest insemination index was recorded in group III, averaging 2.0 units. Group I had a slightly higher index at 2.04 units. In group II, the insemination index averaged 2.32 units, 12.1 % higher than in group I and 13.8 % higher than in group III. The highest insemination index was in group IV, averaging 2.56 units, 9.4 % higher than group II and 20.3 % and 21.9 % higher than groups I and III, respectively.

Table 2 – Reproductive qualities of Brown Swiss cows affected by a single pathology

Group of animals	Duration of the period, days				Coefficient	
	service period	infertility	lactation	period between calvings	insemination index	reproductive capacity
I, n=27	136.2 ± 5.81	51.2 ± 5.81	376.2 ± 5.81	428.2 ± 5.80	2.04 ± 0.185	0.86 ± 0.011
II, n=31	141.1 ± 7.83	56.1 ± 7.30	381.1 ± 7.33	433.1 ± 7.30	2.32 ± 0.211	0.85 ± 0.013
III, n=19	143.5 ± 8.83	58.5 ± 8.30	383.5 ± 8.33	435.5 ± 8.80	2.00 ± 0.279	0.84 ± 0.016
IV, n=17	155.8 ± 6.90	70.8 ± 6.89	395.8 ± 6.90	447.8 ± 6.89	2.56 ± 0.25	0.82 ± 0.012

Table 3 – Productive qualities of Brown Swiss cows for one disease during lactation

Group of animals	Milk productivity during of the period				Production of fat and protein	
	standard lactation		full lactation			
	kg	σ	kg	σ	kg	σ
I, n=27	7714.3 ± 263.22	1367.7	9477.8 ± 435,41	2262.5	510.4 ± 17.13	89.0
II, n=31	8778.4 ± 154.28*	858.5	10640.0 ± 283.53**	1578.6	647.2 ± 13,05	72.7
III, n=19	9023.9 ± 135.81**	592.0	11018.5 ± 420.91**	1834.7	659.1 ± 15.22	66.3
IV, n=17	8681.3 ± 185.58*	765.2	10943.7 ± 328.77**	1355.5	762.9 ± 27.51	113.4

Notes: 1. * – P<0.01; 2. ** – P<0.001; 3. ** – P<0.05 to the I group.

The long service and lactation periods reduced the reproductive coefficient, which should normally be 1.0. The highest coefficient was 0.86 in first-lactation cows (Group I), while the lowest was 0.82 in fourth-lactation cows (Group IV).

Despite pathologies during lactation, milk productivity remained high (Table 3). Productive qualities corresponded to the adaptive properties of Brown Swiss cows. Milk yields for groups II and IV were similar, averaging 8,778.4 and 8,681.3 kg, respectively, exceeding group I by 12.1 % (P<0.01) and 11.1 % (P<0.01).

During 305 days of lactation, the highest milk productivity was observed in group III (third-lactation cows), which had adapted well to conditions, averaging 9,023.9 kg. This was 2.7 % and 3.8% higher than groups II and IV, respectively, and 14.5 % higher than group I (P<0.001).

The milk yield of Brown Swiss cows during full lactation exceeded the standard lactation rate by 17.5–20.7 %. In groups II and IV, the average milk yield was 10,640.0 and 10,943.7 kg, respectively, exceeding that of first-lactation cows in group I by 10.9 % (P<0.05) and 13.4 % (P<0.05).

The highest milk productivity was observed in third-lactation cows (group III), with an average yield of 11,018.5 kg, comparable to groups II and IV but 13.9 % higher than first-lactation cows in group I (P<0.05).

All groups produced substantial amounts of milk fat and protein throughout the lactation period, directly correlating with their milk productivity. In groups II and III, fat and protein production averaged 647.2 and 659.1 kg, respectively, while in group IV, these values were higher by 15.2 % (P<0.001) and 13.6 % (P<0.001). Milk fat and protein production in fourth-lactation cows (group IV) exceeded that of first-lactation cows (group I) by 33.1 % (P<0.01).

Discussion

The level of productivity has been a primary selection criterion for dairy cattle in recent decades, but it is genetically negatively correlated with disease resistance (Hooijer et al., 2001; Carlén et al., 2004; König et al., 2008). Consequently, genetic selection for improved health is now included in selection indices in most developed countries (Barkema et al., 2015).

Udder diseases, particularly mastitis, are the most common pathologies in high-yielding dairy cattle. Mastitis, caused by bacteria, viruses, or fungi, not only reduces milk productivity but also affects milk quality, presenting symptoms such as swelling, redness, and pain in the udder. Genetic correlations between somatic cell count and mastitis have been reported, ranging from 0.37 to 0.65 in first-lactation cows (Koeck et al., 2010; Mrode et al., 2012). Subclinical mastitis increases somatic cell counts in milk, further affecting quality (Grodzowski et al., 2022).

This study confirmed that udder diseases were the most prevalent pathology among Brown Swiss cows, affecting 29.6 % of first-lactation cows (Group I) and 31.6 % of third-lactation cows (Group III). Higher rates were observed in second-lactation cows

(Group II) at 32.3 % and fourth-lactation cows (Group IV) at 35.3 %. High rates of udder diseases are common in high-yielding herds (Koeck et al., 2014), and automated milking systems may reduce or exacerbate risks depending on their design (Hovinen et al., 2011; Klungel et al., 2000).

Placental retention is a significant postpartum complication, occurring when fetal membranes fail to detach within 12–24 hours after calving. In this study, placental retention ranged from 7.5 % in first-lactation cows (Group I) to 35.4 % in second-lactation cows (Group II), consistent with reported prevalence rates of 1.3–39.2 % (Muller et al., 1974; Qu et al., 2014; Rohmah et al., 2023). Placental retention often leads to metritis, affecting reproductive performance and productivity.

Metritis was detected in 29.6 % of first-lactation cows (Group I) and 26.3 % of third-lactation cows (Group III) but was absent in second-lactation cows (Group II). Giuliadori et al. (2013) emphasize that metritis can impair bacterial control in the uterus, significantly affecting reproductive function.

Limb pathologies were recorded in all groups, ranging from 10.6 % in third-lactation cows (Group III) to 22.6 % in second-lactation cows (Group II). These findings align with reports that limb diseases are the third most common cause of culling, following mastitis and infertility (Olechnowicz & Jaśkowski, 2011). Early diagnosis and treatment are essential to mitigate the progression of limb diseases (Miguel-Pacheco et al., 2016).

Abortions, defined as intrauterine deaths between 42 and 260 days of gestation, occurred in 14.8 % of first-lactation cows (Group I) and 17.6 % of fourth-lactation cows (Group IV). No abortions were recorded in second-lactation cows (Group II). Abortion rates in herds, although low at the animal level, represent a significant economic challenge (Canton et al., 2022).

Despite pathologies, Brown Swiss cows demonstrated high milk productivity. First-lactation cows (Group I) produced 7,714.3 kg on average during a 305-day lactation, while second- and fourth-lactation cows (Groups II and IV) produced 8,778.4 kg and 8,681.3 kg, respectively. Third-lactation cows (Group III) achieved the highest yield at 9,023.9 kg. These results align with the productive potential of high-yielding breeds under optimal conditions (Krajisnik et al., 2015).

The extended service (136.2–155.8 days) and intercalving periods (428.2–447.8 days) reduced reproductive efficiency, with coefficients of reproducibility ranging from 0.82 to 0.86. Effective herd management and early intervention are critical to minimizing these impacts, as highlighted by Bar & Ezra (2005), Gohary & LeBlanc (2018), and Mahnani et al. (2021).

The findings emphasize the importance of proactive management and targeted interventions to address health issues, maintain productivity, and ensure the welfare of dairy cows in industrial settings. Proactive measures, including nutritional optimization and early detection, are essential to mitigating the economic and reproductive impacts of common pathologies (Gilbert et al., 2005; Hadley et al., 2006; Wathes et al., 2008; De Vries et al., 2010; Nor et al., 2014; Charlton & Rutter, 2021; Henchion et al., 2022).

Conclusions

1. It has been established that intensive technological operations in large industrial complexes present various risks of pathologies in Brown Swiss cows, irrespective of their lactation age. The incidence of udder diseases (mastitis) ranges from 29.6% to 35.3% across the entire herd. Additionally, the rates of abortions and placental retention are observed at 10.5% to 14.8% and 1.5% to 35.4%, respectively, while limb pathologies occur in 10.6% to 22.6% of cases. Notably, in animals during their second lactation, no instances of placental retention or pregnancy termination were recorded.

2. The study demonstrates that when a pathology is detected at an early stage, Brown Swiss cows of varying ages exhibit strong reproductive performance. The service period averages no more than 155.8 days; the lactation period lasts for 395.8 days; the intercalving period is 447.8 days; the insemination index stands at 2.56 units, and the reproductive capacity coefficient does not drop below 0.82.

3. It was found that early diagnosis and prompt treatment of pathologies enable Brown Swiss cows of all ages to maintain lactation and milk production. First-heifers in group I produced an average of 9,477.8 kg of milk, while cows in their second lactation (group II) produced 10,640.0 kg. Cows in the third (group III) and fourth lactation (group IV) yielded 11,018.5 kg and 10,943.7 kg, respectively. The production of milk fat was lowest in cows of the first lactation at 510.4 kg, while the highest productivity was observed in cows of the fourth lactation, reaching 762.9 kg.

Acknowledgement

The authors would like to thank Hanna Perekhrestova, the chief technologist of the Yekaterinoslavskiy dairy production enterprise, for the opportunity to collect and interpret data on the productive qualities of Brown Swiss cows.

Authors' Contributions

SP and IP – writing, reviewing and editing the article; LL and LM – data collection and processing. We confirm that the manuscript has been read and approved by all authors.

Conflict of Interests

The authors declare no conflict of interests. The funders had no role in the design of the study, in the collection, analyses, or interpretation of data, in the writing of the manuscript, or in the decision to publish the results.

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