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Probiotic Application in Livestock Farming: A Prospective Review of India and Russia

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ABSTRACT

Livestock farming has been the backbone of food and livelihood security in India and Russian Federation. With the advancement in technology, more and more emphasis has been given to healthy and hygienic livestock production. Classically, antimicrobials and antibiotics were used to treat infections as well as growth promoters in livestock industry. However, rapid development of antibiotics resistance among pathogenic microorganisms, their residual effects in food products and environment has called for alternative and safe compounds with equivalent efficacy. Probiotics are such compounds that are now rapidly advancing and providing safe alternative for improvement of production potential and immune status of animals with no adverse effect on food chain or environment. India and Russian Federation has experienced an unprecedented growth in agriculture and animal husbandry in past two decades. Owing to the positive effects of probiotics their advancement and application is increasing in both countries to address variety of issues related with safe and sustainable animal production.

Key words: Animal Nutrition, Livestock Farming, Probiotics, Russian Federation.

Livestock farming has been an important aspect of food security throughout the world and with the increasing world population demand for meat, milk and eggs is going to increase. This increasing demand puts pressure on current livestock-rearing systems throughout the world and hence there is a need to implement and adopt new technologies for animal husbandry that can cater the future needs (Wicks *et al.,* 2019). The advancement in selection methodologies, genome-based breeding values, artificial insemination and embryo transfer, better nutrition, use of various growth promoters, supplements, vitamins as per specific requirements and usage of antibiotics as growth promoters during the last few decades has increased productive performance of livestock and poultry to a greater extent (Thorton, 2010). However, the utilization of antibiotics as growth promoters in animal feed has uncovered new problems for the environment: antibiotic residue and the development of antibiotic resistance in microbes. This has also increased foodborne allergies and rapid contamination of the food chain with residual compounds (Lipsitch *et al.,* 2002). The unknown effects of these residues on the environment and human health have called for alternate strategies for improvement in animal product quantity and quality. Probiotics are one such alternate feed ingredient that can be effectively utilized for improvement in animal production performance.

"Probiotics" is a term derived from Greek words "pro" and "bios", which means "for life" and was coined by Russian scientist Elie Metchnikoff in 1908. As per WHO, probiotics are defined as "live microorganisms which when administered in adequate amounts confer a health benefit on the host." Evidently, a microorganism can be called probiotic or can be a part of probiotic mixture only when it is nontoxic, non-pathogenic, has a viable cell count, can provide positive health benefit to the host and be able to colonize in the intestine and provide a positive functional effect (Al-Shawi *et al.,* 2020). Bacterial species like *Lactobacillus acidophilus*, *Lactobacillus lactis*, *Lactobacillus plantarum*, *Lactobacillus helveticus, Lactobacillus salivarius*, *Enterococcus faecalis, Streptococcus thermophilus, Escherichia coli* and fungal species like *Saccharomyces cerevisiae* and *Saccharom-yces boulardii* are few most used micro-organisms as probiotics. Variety of reports confirms that using probiotics as feed additives is beneficial in animal production system. They promote growth in farm animals (Chang *et al.,* 2001), provide intestinal immunity (Oyetayo *et al.,* 2003), produces

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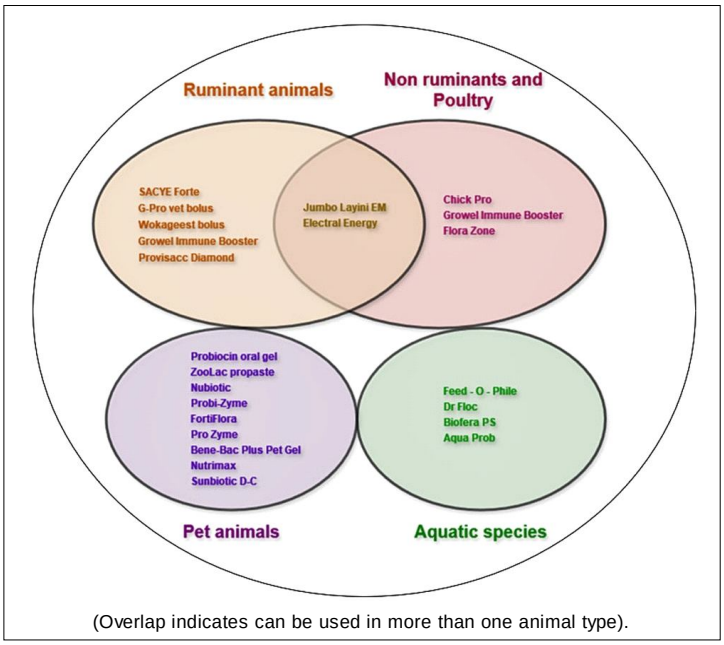
favourable gut environment (Ezema, 2013), improves nutrient bioavailability (Koop-Hoolihan, 2001) and have immunostimulatory effects (Aattour *et al.,* 2002).

Livestock farming is an integral component of economy, in India and Russia. Both the countries are experiencing increased demand for animal products and resultantly advances in animal farming system to cater the growing needs. Animal husbandry has been the backbone of Indian agriculture sector. With livestock sector contributing about 30.19% of total agricultural and allied sector product output of the country at constant prices (BAHS, 2023). In India, large ruminants like cattle and buffalo are reared for milk production, draught power and carabeef production. Small ruminants, like goat and sheep, are reared for meat, milk, hide, wool and poultry eggs and meat. Although India ranks first in milk production in world, with the growing population, demand for quality milk, meat and egg is going to increase. Currently, a major portion of Indian livestock resides in rural areas and is experiencing a low productive performance. A major cause of this low performance is the lack of quality nutrition given to the animals, which hampers the per animal production. As per the NDDB (National Dairy Development Board), only 30% of small livestock farmers can meet the nutritional requirements for their dairy animals (NDDB, 2018).

Probiotics, due to their production increasing and positive health effects, relative ease of administration and safety have gained significant popularity in Indian livestock sector as a feed supplement. Their incremental application in livestock nutrition reflected in growth in its market size. The Indian probiotic market size for livestock is expected to grow @ 5.71% from 2024 to 2029 with valuation of about USD 123.01 million. The largest consumer of probiotics in India is poultry segment, followed by cattle industry. Trends now indicate that utilization of probiotics is also increasing in aquaculture industry. Some common commercially available probiotic preparations are depicted in Fig 1. The agriculture and animal husbandry scenario of the Russian Federation shares some peculiar similarities with Indian counterparts. It has diverse climates, ranging from arctic conditions in the north to more temperate climates in the south. Animal husbandry practices need to adapt to these variations. In rural areas, especially in Siberia and other vast regions, extensive grazing is common. Animals like cattle, sheep and goats are allowed to roam freely for large parts of the year. Due to the harsh winter conditions in many regions, farmers need to prepare for winter feeding.

This often involves storing hay and other feed for the animals during the colder months. Historically, during the Soviet era, there were large state-owned farms which still play a significant role in animal husbandry. Dairy farming, products like milk, cheese and butter are essential components of Russian diet. Modernization of agriculture practices in recent times includes, the use of advanced breeding techniques, improved feed and more efficient management practices. Adaptation of modern tools for farming has paved way for widespread use of probiotics in Russian livestock industry. In 2019, the Russian Agricultural Ministry presented new feed and feed additives development program which emphasised the use of modern feeding technologies, high quality feed and feed additive utilization for better livestock production.

Livestock rearing and developmental trends in India and Russian Federation, is indicative of efficient and extensive utilization of probiotics for improvement in livestock productivity. The geographical ranges, climatic



(Overlap indicates can be used in more than one animal type).

Fig 1: Some commercially available probiotic preparations and their target species.

scenarios and animal husbandry practices of both the nations have common points which converges on efficient livestock production through nutritional improvement. This manuscript will focus on the theme of potential prospects and probable circumstances for efficient utilization of probiotic application in animal husbandry practices of India and Russia Federation.

Mechanism of action of probiotics

Probiotics act in different ways in body to provide better health and productivity. They can be used as therapeutic agents, providing immunity, improving feed efficiency and improvement in production potential. One of the most widely used application of probiotics, including in human nutrition, is as immunity promoter. They are feed additives based on live microorganisms that improve intestinal microbial balance, metabolic and immune processes.

These are environmentally friendly and have no negative hygienic effects. Jonkers (2016) has suggested two basic pathways by which probiotics exert their positive effects on health of individual. First, is by production of antimicrobial compounds or inhibitory substances such as organic acids, H_2O_2, biosurfactants, bacteriocins *etc*., which inhibits the growth of pathogenic bacteria. Microorganisms included in the composition of probiotics, forms the beneficial microflora and synthesize vitamins such as B, C, D, E, K, amino acids, bacteriocins, which inhibit the development of pathogens and participate in the disinfection of toxins. For example, production of lactic acids and acetic acid that reduces the pH making environment unfavourable for pathogenic bacterial growth.

The second pathway includes direct cell to cell interactions, which, comprises establishment of probiotic bacteria in intestine by competitive colonization, thus making it un-available for pathogenic micro-organisms (Boirivant and Strober, 2007). The mode of action, however, is dependent on the strain of probiotic used as supplement. Apart from these two modes, some probiotics are known to interact with host, stimulating its natural defence mechanism. *Lactobacillus casei* and *L. paracasei* species are shown to induce immune system *via* polymorphonuclear cell recruitment, phagocytosis and increase in TLR-2 cells in experimental mice (Kourelis *et al.,* 2010; Galdeano and Perdigon, 2006). In turkeys, probiotic supplementation consisting strains of *Lactobacillus* spp., *Enterococcus* spp., improves the concentration of circulating IgG and IgM (Cetin *et al.,* 2005), *Bacillus cereus* supplementation increases intestinal IgA in pigs (Scharek *et al.,* 2007).

A similar effect of probiotics is observed in aquaculture. It seems improvement in innate defence mechanism is an important advantage of probiotic feed supplementation in diets. In fishes, diets supplemented with *Bacillus velezensis* improves expression and serum levels of alkaline phosphatase, glutathione peroxidase, acid phosphatase and local levels of interferon gamma, interleukin 4 and 10 in kidney and head (Yi *et al.,* 2018). Moreover, it is an established fact that *Lactobacillus*-based probiotics help to control intestinal pathogenic micro-organism populations *via* competitive adhesion mechanism. Thus, they can reduce the growth of *E. coli, Salmonella*, coliform bacteria, *Clostridium* spp. in intestine of livestock and poultry (Al-Shawi *et al.,* 2020).

Effects of probiotic supplementation

According to some authors it has been established that normal microflora of the gastrointestinal tract of an animal is of great importance along with balanced nutrition. Deficiency of normal microflora affects nutritional health and immunity of animal. Various factors of modern industrial technologies of animal breeding, such as: limited contact of young animals with their mothers, excessive density of livestock per unit area, unsanitary farms, antibiotic treatment, incomplete and unbalanced feeding rations, further leads to disruption of intestinal microflora. The disturbances in normal microflora leads to dysbacteriosis, reduction of natural resistance and productivity. Under such circumstances, inclusion of probiotics in animal diet seems to be most suitable solution to address variety of such problems (Ryadchikov, 2015). The use of probiotics in animal feeding favors the development of normoflora, contributing to the normalization of digestive processes, absorption of nutrients. Probiotics are also used in veterinary medicine for microbial correction of the intestinal environment after antibiotic and chemotherapy, as well as for stimulation of nonspecific immunity. Probiotic microorganisms, after entering the body, release biologically active substances that have direct and indirect effects on pathogenic microorganisms. This is manifested in the activation of specific and nonspecific defense systems of the microorganism.

Application of probiotics in animal feeding increases productivity by 15-20%, efficiency of treatment of gastrointestinal diseases by 30-40% and reduces morbidity of young animals by 20-30%. Deterioration of ecological and sanitary-epidemiological situation, the need of modern animal husbandry in stimulants of animal productivity, increases the prospects for the use of feed probiotics (Mironova and Kosilov, 2015).

Probiotics play an essential role in the maintenance of health by performing several functions of importance to the body. The first function of probiotics, from normal symbionts of the genera *Lactobacillus* and *Bifidobacterium*, is to regulate the stability of the microbiocenosis and prevent the colonization of the intestine by pathogenic microorganisms (Kovalchuk, 1995). Unlike antibiotics, the mechanism of action of probiotics is aimed not at destroying part of the intestinal microflora population, but at repopulating the intestine with competitive strains of probiont bacteria, which exercise nonspecific control over the number of opportunistic microflora by displacing it from the intestinal microbiocenosis or blocking the attachment of pathogens (Kovalchuk, 1995). Another function of probiotics is to optimize the processes of enzymatic

digestion of proteins, lipids, high molecular weight carbohydrates, nucleic acids and fiber. High enzymatic activity is characteristic of strains of bacilli belonging to the genus *Bacillus* (Morozova *et al.,* 2015). Probiotics based on normal microflora *Lactobacillus* and *Bifidobacterium* produce substances with antibacterial activity (Burmenskaya *et al.,* 2016). Useful bacteria, producing organic acids, volatile fatty acids and reducing the pH level of the intestinal lumen microenvironment, have a powerful antibacterial effect, especially on gram-negative pathogenic bacteria (Andreeva *et al.,* 2009). Undoubtedly, one of the most prominent effect of probiotics is to increase the immunologic reactivity of the organism which includes stimulation of the lymphoid apparatus, the synthesis of immunoglobulins, increase in the level of complement proteins, lysozyme activity and a decrease in the permeability of vascular tissue barriers to toxic products (Andreeva *et al.,* 2009).

The practical use of probiotics is associated with the correction of dysbacteriosis, regulation of microbiological processes in the digestive tract, prevention and treatment of gastrointestinal diseases of alimentary and infectious etiology. Therapeutic and prophylactic preparations based on live bacteria, especially lacto- and bifidobacteria, have been used for this purpose in medicine and veterinary medicine for several decades (Levakhin *et al.,* 2006). Probiotic preparations have the strongest effect on young animals. This is due to the bacterial sterility of newborn/ young animals and rapid colonization of the gastrointestinal tract by microflora, often pathogenic, at the time when microbiocenosis has not yet formed and their own immunity is very weak. Adult animals are less susceptible to colonization by intestinal pathogens than young animals because they have a more stable and diverse intestinal microflora that competitively excludes colonization (Antipov and Subbotin, 1980). The mechanism of action of probiotics is aimed not at the destruction of a part of intestinal microflora populations, but at the colonization of the intestine with competitive strains of bacteria - probionts, which exercise nonspecific control over the number of conditionally pathogenic microflora by displacing it from the intestinal microbiocenosis (Antipov and Subbotin, 1980). A new approach to the selection of probiotic active ingredient, based on the use of symbiotic acidophilic system of microbial strains, makes it possible to obtain a preparation for the treatment and prevention of dysbiosis with a wide range of antagonistic activity, high adhesiveness and resistance to a number of antibiotics in therapeutic doses. Probiotics play a huge role in cattle digestion, participating in nitrogen and protein metabolism. In the rumen of cows, probiotic microorganisms actively multiply, grow, produce useful metabolites as a result of their vital activity and, are digested and assimilated by the animal as high-quality protein (Vorobyev *et al.,* 2014; Kazantsev, 2012). Preweaning addition of probiotics have shown to improve growth performance in Holstein calves (Ülger, 2019).

Milk quality depends on several factors, including unsatisfactory sanitary condition of farms, violation of technology of milk production, primary processing and storage. However, the main source of milk contamination at the primary stage of milk production is cows with mastitis, which release microflora, including pathogenic microflora, somatic cells and residual amounts of drugs into the environment with milk (Kislyuk *et al.,* 2002; Lasygina, 2008).

The main problem in recent years is the wide spread of resistant forms of pathogenic microorganisms and a decrease in the therapeutic efficacy of a number of antibiotics. Fundamental research of modern biological and medical science has made it possible, to develop and introduce into practice, a new class of drugs - probiotics. They have a wide range of positive pharmacological effects and, in addition, they are much more environmentally friendly than many other drugs. According to Kovaleva *et al.* (2019) a relationship exists between pH and ruminal environment, udder diseases and milk quality. Diet imbalances, poor quality haylage, feed mycotoxins, low fiber content in the diet lead to suppression of digestion processes in the rumen, reduction in gram-negative bacteria population and exo- and endotoxins formation. Research confirms that the use of probiotics in livestock can improve intestinal epithelial function by increasing resistance to infection, thereby reducing, or eliminating the likelihood of antibiotic use (Kovaleva *et al.,* 2019).

Rumination plays an important role in the digestive process and thus in the gastrointestinal environment. The shift in acid-base balance, when lactic acid is formed intensively, leads to inhibition of pre-gastric motility. It has been observed that the use of probiotics, improves rumination and gastric motility 72% more than control (Kovaleva *et al.,* 2019). The advent and application of antimicrobials and chemotherapeutic agents, in particular antibiotics and hormones, although have improved health status and growth rates in production animals, the have also led to development of resistance at various levels. Uncontrolled use of antibiotics and other antimicrobial agents has led to quantitative and qualitative changes in the microflora of the gastrointestinal tract, accompanied by multiplication of opportunistic pathogenic bacteria (Smolyaninov *et al.,* 2008). Coupled with antibiotic application, restricted feeding to dams, deficiency in colostrum feeding, poor nutrition or poor quality nutrition to pregnant animal may not only affect the animal but also the developing fetus (Morozova *et al.,* 2015). These are some other areas where probiotics application could boost immunity as well as prevent calf mortality too, especially when probiotic formulations are prepared with consideration of bacterial strains involved and their intended action (Pyshmantseva, 2012).

Probiotic preparations improve animal appetite and decrease the proportion of pathogenic microorganisms in the pre-stomach. According to Ivashchenko (2014), the drug “Bacell-M” - a probiotic supplement consisting of microbial mass of spore-forming bacteria

Bacillus subtilis 945 (B-5225), bacteria *Lactobacillus plantarum* 52 (B-2347), *Enterococcus faecium* M-3185 (B-3491), beet molasses, skim milk and water was able to improve appetite in ruminants. The probiotics was found effective in improvement of live weight and average daily weight gain in young calves. The presence of this probiotic in the diet of bulls of Hereford breed during the fattening period @ 40 g per head, contributed to the average daily live weight gain of 948.6 g, which was higher than in the control group by 70.8% (Ivashchenko, 2014; Onoprienko and Onoprienko, 2017).

Preparations containing *bifido*- and *lactobacilli* inhibit the development of pathogenic microflora through the formation of organic acids (lactic, acetic) and other antibiotic substances, increase the active acidity of intestinal contents and provide non-specific resistance of the body (Goldyreva and Skukovsky, 2010). Some of these preparations, such as bifidumbacterin (lyophilized biomass of active bifidobacteria) and lactobacterin (a combination of two strains of lactobacilli) are used for the prevention and treatment of gastrointestinal diseases of calves with 90-96% therapeutic efficacy, with subsequent production of vitamin B and a number of essential amino acids (Voronin *et al.,* 1990). The use of probiotics in growing young cattle promotes optimal development of beneficial intestinal microflora, prevents the occurrence of dysbacteriosis and diarrhea, regulates the course of microbiological processes in the gastrointestinal tract (Gorkovenko *et al.,* 2011). According to some studies, probiotics showed high efficiency when fed with the first portion of colostrum to newborn calves and helps in formation of beneficial intestinal microflora and prevent gastrointestinal diseases. In the treatment of dyspepsia diseased calves, the use of probiotics also showed a high therapeutic effect. The use of complex probiotic preparation consisting of a mixture of microbial mass from non-pathogenic bacilli of the genus *Bacillus* has a positive effect on the physiological state of calves and increases their resistance to gastrointestinal disorders. The use of new-generation probiotics in the treatment of dyspepsia in young cattle provides 100% recovery (Zinchenko and Pronin, 2000). In the early stages of life, the calf and it's microflora are not yet adapted to rapidly changing environmental conditions and is easily exposed to unfavorable effects. Feeding of colostrum partially compensates for the weak development of the immune system, regulation of physiological and biochemical functions of the organism. However, the calf's immune status remains low and is accompanied by a low concentration of its own immunoglobulins. The use of any drug, including antibiotics and sulfonamide preparations, do not have the proper effect, as the factors stimulating cellular immunity do not work in the body (Shevchenko *et al.,* 2013). Pathogenic bacteria (*Escherichia coli, Proteus, Salmonella, Pasteurella, Diplococcus*, *etc*.) viruses (rota-, corona-, adenoviruses, *etc*.), fungi, protozoa, *etc*. can hence, readily infect the young ones after birth. Probiotic preparations containing live microorganisms and their metabolites are now widely used as means for preventive therapy and preservation of animal health, just after birth. The most promising ones are lactic acid and propionic acid producing bacteria, bifidobacteria and bacteria of the genus *Bacillus*, *etc*., which exhibit selective antagonistic activity against pathogenic intestinal flora, effectively and quickly restoring intestinal microbiocenosis (Nozdrin *et al.,* 2011). The use of probiotics in young farm animals contributes to a more rapid formation of normal intestinal microbiocenosis in them due to the stimulation of growth of indigenic microflora and bactericidal activity against pathogenic microorganisms. Early application of probiotic preparations to newborn calves is of great importance, since normal intestinal microflora acts as the first and safe stimulator of the immune system in newborn animals (Basharov and Khaziakhmetov, 2012). Probiotics of dairy and swine origin have been described to have growth and immunity stimulating effects. Mixtures containing probiotic bacteria of dairy origin (*Lactobacillus acidophilus* NCDC-15) or swine based (*Pediococccus acidilactici* FT28) are reported to improve feeding, growth parameters and immunity parameters in grower finisher crossbred pigs (Joysowal *et al.,* 2021).

Prospects of probiotics application

Indian scenario

Animal Husbandry has been an important part of Indian agriculture system. Traditionally, agriculture farming is coupled with animal husbandry. However, as the country has stepped into the 21st century, organized and intensive animal farming is also become popular. The driving force for this change has been the increase in population, which is tapping animal husbandry as means of food and livelihood security. Another major factor that has bought animal husbandry in the focus is the exceptional breed diversity and population of domestic animals in India. This is making way for climate adopted and purposeful breeding goals. Although the country is placed very well among nations in production indices and values, the per animal productivity remains low. For example, average Indian cattle produce approximately 1426.76 kg milk annually, which is well below the world average of 2699 kg per year (FAOSTAT database). One of the main concerns for this low productivity is lack of proper quantity and quality of nutrition. Hence, within the last decade probiotics have gained attention in Indian livestock farming to promote animal health, enhance growth and improve overall productivity. Probiotics are often used to maintain the balance of microorganisms in the digestive system of livestock. India experiences high temperatures in many regions and heat stress is often a problem in livestock rearing. Probiotics are sometimes used to mitigate the impact of heat stress on animals by supporting their immune system and overall well-being. Kumar *et al.* (2023) reported supplementation of selenium and *S. cerevisiae*

improves digestion, feed efficiency without any generalized ill effects in tropical cattle. Thus, even in heat stressed conditions animals (both pure and crossbreds) were able to maintain their level of production. Similarly, growth of the young ones is one of the most affected traits that is hampered by poor quality nutrition. In India, it is often observed that crossbred calves had trouble in adopting with low quality fodder. Diets consisting of bacterial strains *Lactobacillus acidophilus* and *L. paracasei,* are reported to impart intestinal immunity to growing calves, the supplemented calves also showed better dry matter intake, better growth rate and no instances of diarrhoea during the probiotic feeding regimen (Chandra *et al.,* 2009).

Besides livestock, poultry is an important source of meat and egg in India. Poultry meat is relished in almost all parts of the country and it does not have any ban or religious taboo. In chickens, probiotics are believed to contribute to increased productivity in terms of growth rates and egg laying capacity. Probiotic supplementation in commercial Cobb diets, had showed better growth rates than the control group (Nyamagonga *et al.,* 2011). Earlier, Bansal *et al.* (2011) had concluded that broilers fed with probiotic diet showed better weight gain and meat quality. Another major concern among Indian livestock species is the rapid and widespread use of antibiotics, as growth promoters or as therapeutic agents, these are often used in indiscriminate manner. These activities are one of the major causes of antibiotic resistance in livestock as well as in humans through food chain (Taneja and Sharma, 2019). Probiotics are seen as an alternative to growth promoters as well as immunity providing agents, therefore they obviate the necessity of giving antibiotics. This is a major turning point in poultry industry where now probiotics are commonly being used in feed to enhance the growth and performance of broilers and layers.

In addition to traditional livestock, probiotics are also used in aquaculture in India. They can help maintain water quality, support the digestive health of fish and shrimp and reduce the risk of diseases (Hasan and Banerjee, 2020). Some farmers and researchers in India are exploring the use of locally isolated strains of probiotic bacteria, believing that these may be better adapted to the specific conditions in the region. It is important to note that while the use of probiotics in Indian livestock farming is growing, practices can vary among farmers and the effectiveness of specific probiotic formulations may depend on factors such as animal species, age and local environmental conditions. The adoption of probiotics is part of a broader trend in sustainable and bio secure animal farming practices in India.

Russian scenario

In Russian Federation, small scale agriculture plays an important role in development and food security of the nation. Major agricultural products of Russia include, grains, sugar beet, sunflower seeds, potatoes, vegetables, livestock, poultry, milk, eggs and wool. However, still most of the meat and milk products are imported to meet the growing demand. Statistical data shows that small-scale farms produced 33.8% of livestock, 49.7% of milk, 21.7% of eggs and 54.4% of wool, in 2014. Livestock rearing is traditionally an important aspect of rural livelihood and food security. The last decade has seen an increasing demand for animal products. Major dairy product is milk which is mainly contributed by cattle (80%) and only a small portion is from goat (12%). Increased demand has changed dairy sector towards more intense and organized farming gaining much popularity. Although, per capita milk consumption is Russia has dropped, the country needs to import a considerable amount of milk to meet its growing needs. A similar trend is seen in meat animals too, where, after the breakup of Soviet Union, the number of cattle and pig, experienced a downward trend. However, unlike cattle the trends in swine production have largely reversed. The Russian Federation is experiencing an upward trend in overall meat consumption (Abramovich, 2016).

Recently, the Russian Federation has been increasing sanitary and hygienic requirements for livestock products. These requirements include decreasing the antibiotic content as therapy or feed additive in livestock rearing, which leads to an increased demand for probiotics. When antibiotics are used, residual antibiotics accumulate in livestock products, antibiotic resistance develops in pathogenic microorganisms and dysbacteriosis occurs. They can be used to increase animal productivity, reduce costs per unit of production, feed digestibility and obtain environmentally friendly livestock products (Ryadchikov, 2015). Although most of the bacteria with probiotic properties are representatives of families of autochthonous or indegenic microflora (permanent inhabitants of the intestines of humans, animals and poultry - *Lactobacillus* and *Bifidobacterium*), bacteria of non-indegenic microflora that transit through the gastrointestinal tract and have no attachment sites to the intestinal mucosa - spore-forming bacteria, especially of the genus *Bacillus* - are increasingly used in this capacity (Ryadchikov, 2015).

Although relationship between probiotics and Russian Federation is not a new one and extensive research on probiotics, from the times of Soviet Union, had laid strong foundations in the country over their vast application. From the past two decades, dynamic changes in farming systems and increasing demand for quality animal products has throttled the use of probiotics in Russian animal husbandry. Russia has a diverse range of livestock, including cattle, sheep, pigs, poultry and others. The use of probiotics may vary across different types of livestock. Probiotics are commonly used to support gut health in livestock. They help maintain a balanced microbial population in the digestive system, improving nutrient absorption and overall digestive efficiency. Trukhachev *et al.* (2022) reported the use of multicomponent symbiotic (Kormomix®Rumin) in dairy herd of Russian Holstein cattle. They concluded that although the mix did not have significant impact on milk yields, it improved the rumen fermentation, leading to more efficient utilization of feed

and fodder. Like global trends, there is growing interest in using probiotics as alternatives to antibiotics. This is particularly important in addressing concerns about antibiotic resistance and promoting sustainable farming practices. Probiotics are often used in the poultry industry to enhance the growth and performance of broilers and layers. They may contribute to better feed conversion ratios and overall flock health (Grozina *et al.,* 2023). In ducks, a recent report concluded that supplementation of diet with *Bacillus* spp. based probiotic decreased the population of pathogenic and opportunistic bacteria like *Escherichia* spp. and *Shigella* spp., leading to better feed utilization and improved growth parameters (Naumova *et al.,* 2021). The use of probiotics is expected to contribute to increased productivity, including improved weight gain in meat-producing animals and enhanced milk production in dairy cattle. Russia's diverse climate, which includes extremely cold conditions in some regions, may influence the choice of probiotic strains used in livestock farming. Probiotics that are resilient to varying environmental conditions may be preferred. Ongoing research and innovation in Russia focus on developing effective probiotic formulations tailored to the specific needs and challenges of the country's livestock sector. In 2021, it was reported that Russian scientists have developed a probiotic based on rumen microbiota extracted from Reindeer (*Rangifer tarandus*).

This preparation was used as feed supplement in dairy animals and newly calved heifers. It was reported that the compound had positive effect on metabolic and immune profiles of the newly calved dairy animals (Litonina *et al.,* 2021). The adoption of probiotics in Russian livestock farming may vary among different farms and factors such as farm size, management practices and economic considerations can influence their use. Nevertheless, with the ban on in-feed antibiotics in Russia, from 2022, the scientists are continuously engaged in development of new effective probiotic mixtures that can be tailored for specific use in different classes of livestock species.

CONCLUSION

Probiotics have made their way into the new era of animal farming. Development of drug residues, resistance and decreasing efficacy on antimicrobials have made vacuum which is needed to be filled by compounds of equivalent or more efficacy with no residual adverse effects. Innovations in probiotics and their application are successfully filling this vacuum in animal husbandry. In countries like India and Russian Federation, where agriculture and animal husbandry is forming the backbone of economy and livelihood, widespread use of probiotics in place of indiscriminate use of antimicrobial compounds, can play an effective role in development of sustainable nutritional regimens for various livestock species. In both countries, the adoption of probiotics represents a commitment to advancing animal husbandry practices through responsible and justifiable means. The emphasis on research, regulatory compliance and the development of region-specific solutions underscores the importance of probiotics in supporting the health and productivity of livestock in diverse agricultural landscapes. The similarities between the livestock farming, increasing demand for animal protein, harsh climatic conditions and urge for self-reliance are the major driving factors for active usage and development of new probiotics for Indian and Russian livestock animals.

Conflict of interest

All authors declare that they have no competing interests and approves the final manuscript.

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