Review Paper

Probiotics in animal production: action mechanisms and beneficial effects on animal husbandry

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Abstract

Objective: To analyze the use of probiotics in animal production, their action mechanisms and beneficial effects for animal husbandry.

Materials and Methods: An exhaustive bibliographic review was carried out. More than 80 publications related to the topic of probiotics in animal feeding were consulted. The scientific databases Google Scholar, PubMed, Scopus, Web of Science, Latindex and SciELO were used. Searches were performed on the basis of keywords related to the topic of study. To carry out this study, the selected papers were critically analyzed and relevant data were extracted.

Results: The analysis indicated that the indiscriminate use of growth-promoting antibiotics in animal husbandry induces residual microbial resistance and increases the risk of transmission of this resistance to human beings. Thus, probiotics appear as an alternative for improving animal productivity without adverse effects. They act as modulators of the intestinal biota, improve the immunological system and productive indicators and decrease greenhouse gas emissions.

Conclusions: Probiotics increase animal productivity by improving the immunological system, digestion and nutrient absorption, as well as the intestinal microbiota. In addition, they decrease health problems, for which they constitute a viable alternative to improve the efficiency of animal husbandry systems in different animal species, including monogastric ones and ruminants. However, for them to become an accepted option used in animal husbandry, it is necessary to continue researching and promoting their application.

Keywords: additives, antibiotics, swine, chickens, ruminants

Introduction

The increasing demand for food of animal origin is a challenge to ensure food and nutritional security of the population. However, the current economic period is characterized by low growths and unsustainable modes of production (FAO *et al*., 2019).

With regards to animal husbandry, the global situation makes it necessary to seek management and feeding options that, in addition to meeting the feed needs of the bovine mass, make efficient use of available resources. Among the alternatives that have been developed is the inclusion in diets of live microorganisms capable of favorably influencing the composition and functions of the intestinal microbiota and the modulation of intestinal epithelial cells. This type of supplements is grouped under the generic name of probiotics (Saro *et al*., 2017).

Research developed in recent years has ratified that probiotics have a positive effect on animal health and production (Ahumada-Beltrán, 2021) because, by improving the utilization of the fiber present in forages, they improve the feed conversion of grazing animals and allow saving concentrate feeds in production systems. In addition, it has been proven that in sheep as well as in cattle, they decrease the mortality of growing animals, actions that favor stability in the movement of the flock and the increase in the number of animals for sale at the end of the fattening cycle (Bhogoju and Nahashon, 2022).

Because of the residual effects caused by the inclusion of antibiotic growth promoters in feedstuffs and the resistance that pathogenic microorganisms, associated with diseases affecting humans and animals, have developed, their use is limited or prohibited in many countries, which has promoted the use of probiotics (Pérez-de-Algaba-Cuenca *et al*., 2022).

The European Union banned the use of antibiotics in animal feedstuffs since 2006 (Betancourt-López, 2020). As of January, 2017, the U.S. Food and Drug Administration Agency (FDA)

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abolished the use of growth promoters in animal feeding, except coccidiostats (CDC, 2019).

In Cuba, probiotics are not produced on an industrial scale. However, studies related to their isolation have been conducted in research centers, so microorganisms with these characteristics are available, mainly represented by yeasts and lactobacilli (Rondón *et al*., 2012). Research has also been conducted with probiotics from abroad.

The Pastures and Forages Research Station Indio Hatuey (EEPFIH, for its initials in Spanish) developed a research program to evaluate the effect of probiotics from the French company Sorbial® S.A.S. on the productive responses of sheep and cattle. Subsequently, the Flora & Fauna company, attached to the Ministry of Agriculture of Cuba, with the license of the firm Sorbial®, manufactured a probiotic for its accreditation in the country, under the name of Sorbifauna®.

Due to the importance of the implementation of clean technologies and production for the development of animal husbandry, this work was developed in order to analyze the use of probiotics in animal production, their action mechanisms and beneficial effects on animal husbandry.

Materials and Methods

This work was carried out by means of a bibliographic review of more than 80 scientific publications related to the use of probiotics in animal feed in different species (monogastric ones and ruminants). The definition of probiotics, their action mechanisms, their use as a promising alternative to antibiotics and their impact on the improvement of productive indicators in ruminants and monogastric animals, were analyzed.

This review focused on various prestigious databases (Google Scholar, PubMed, Scopus, Web of Science, Latindex and SciELO) and on keyword searches related to the topic. It was also considered that the microorganisms used as probiotics should be resistant to physical and environmental factors typical of food processing, that they should maintain their viability during processing, storage and handling, and that they should possess specific traits to exert their action. The selected publications were critically analyzed and relevant data were extracted for the preparation of this paper. Of the reviewed publications, 43 were in English, 32 in Spanish, one in French and one in Portuguese.

Results and Discussion

Conceptualization of probiotics. The word probiotic comes from the Greek language, where ‘pro bios’ means “for life” (Toumi *et al*., 2021). The use of probiotics began with the history of mankind, because such products as cheese and fermented milk were known to the Greeks and Romans, who without knowing the scientific basis of their benefits, recommended them for children and convalescent people (Anosike, 2022).

The concept of probiotic is more than a century old and the introduction of the term is ascribed to Fuller (1992), although it has been subject to multiple definitions. Perhaps the most appropriate definition is that proposed by Havenaar and Huis In’t Veld (1992), who state that probiotics are single or mixed cultures of live microorganisms that, when applied to animals or humans, benefit the host by improving the properties of the original intestinal microflora. Vuuren and Rochet (2003) add that they must be in a sufficient dose to modify, by implantation or colonization, the microflora in some compartment of the digestive tract.

The European Community considers this designation to be too general and decided not to use it due to legal issues (Caja *et al*., 2003) and because, from the registered products, few have shown evidence of efficacy above placebo (Yeoman and White, 2014).

This organization regrouped feed additives into five categories:

- Technological (preservatives and binders).
- Sensory (colorants and flavoring agents).
- Nutritional (vitamins and amino acids).
- Zootechnical (intestinal flora improvers and non-microbial growth promoters).
- Coccidiostats.

Probiotics appear in the category of “zootechnical additives”, which include microorganisms and enzymes.

According to the Food and Agriculture Organization of the United Nations and WHO (FAO and WHO, 2001), probiotics are live microorganisms that, when administered in adequate amounts, confer benefits to the intestinal ecosystem and host health.

According to the recommendation of the International Scientific Association for Probiotics and Prebiotics, probiotic terminology should only be used for products with appropriate live microorganisms and viable counts, well-identified strains, adequate reliability and proven benefits to host health (Hill *et al*., 2014).

Hill *et al*. (2014) propose three classes of probiotics: I) in foods or supplements without health claims (considered safe and needing proof of efficacy), II) foods or supplements with health claims (defined strain used, efficacy based on evidence from clinical trials or meta-analysis, use to boost natural defenses or reduce symptoms) and III) probiotic drug (clinical trials for specific indication or disease, defined strain used, risk-benefit justification and compliance with regulatory standards for drugs).

Probiotics constitute a broad group of microorganisms that includes, among others, bacterial cultures, fungi and even spore-forming and non-spore-forming microorganisms (Soares, 2022).

Most of the bacteria used in ruminants belong to the species *Lactobacillus*, *Carnobacterium*, *Bifidobacterium*, *Pediococcus*, *Lactococcus*, *Leuconostoc Enterococcus*, *Streptococcus*, *Propionibacterium* and certain species of *Bacillus*. Among fungi, *Aspergillus oryzae* and the yeast *Saccharomyces cerevisiae* stand out (Castillo-Barón, 2016). In general, bacterial cultures are used more in young animals (pre-ruminants), fungal cultures, fattening animals and lactating females (Carro-Travieso *et al*., 2014).

The efficacy of these microbial preparations depends on their ability to maintain their viability and physiological integrity, as they are usually administered with the feed or in the drinking water. Some additives are able to withstand high temperatures, such as those used in concentrate feed manufacturing processes (granulation, extrusion, among others). Other microorganisms cannot survive under these conditions and must be protected by treatments that ensure their effectiveness. It is of vital importance that the microorganisms remain viable until they are administered to the animal and, in the case of fungi, that they are accompanied by their culture medium (Carro *et al*., 2006).

Action mechanisms of probiotics. Probiotics used in animal feeding are varied, some employ a single microbial species, others are multi-species (Molina, 2019). In the latter classification, there are autochthonous probiotics, which use microorganisms from the native biota of the gastrointestinal tract of animals, such as bacteria belonging to the genera *Lactobacillus* and *Bifidobacterium*, and allochthonous probiotics that are not normally present in the digestive tract, as is the case of yeasts (Huang *et al*., 2022).

Bacteria used as probiotics in animal nutrition must meet certain characteristics. They cannot be pathogenic to the host; they must be resistant to the physical and environmental factors inherent to food processing: heat, desiccation, UV radiation. In addition, they must maintain their viability during processing, storage and handling (Shaffi and Hameed, 2023). To exert their action, probiotics must possess specific traits: resist gastric acids and bile salts, have the ability to adhere to the epithelial cells of the small intestine and exert antimicrobial effects by inhibiting the adherence of pathogenic microorganisms to the gastrointestinal system (Guimaraes *et al*., 2019).

Probiotics have, fundamentally, three ways of acting: they interact directly with the natural microbiota, establish enzymatic reactions and interact with the mucosa and epidermal cells of the intestine (Iñiguez-Heredia *et al*., 2021).

Some authors refer that the benefit of probiotics in animals is due to the fact that they promote and improve the microbial balance in the digestive tract. Among the action mechanisms are the increase in nutrient absorption by competitive exclusion of gastrointestinal pathogenic bacteria, increased tolerance to different feedstuffs, production of antimicrobial substances, hydrolysis of antigenic peptides in the intestinal lumen, modulation of intestinal permeability, reduction of systemic penetration of antigens and reduction of the risk of intestinal diseases (Saro, 2017).

One of the mechanisms of probiotics is to change the dynamics of the microbial population. The production of bacteriocins reduces the growth of pathogenic microorganisms in the digestive tract and promotes the growth of beneficial microbiota, an action that induces more efficient digestion and, consequently, benefits animal performance (Covarrubias-Esquer, 2020; Tierra-Carrasco, 2022).

They also act as protectors of the intestinal mucosa. When animals are subject to certain levels of stress, the cell populations of the line of defense are affected, which can influence the development of parasitic or bacterial infection (Hirakawa *et al*., 2020).

Probiotics are able to produce metabolites suitable to act as protective agents of the epithelial barrier: organic acids, indoles, bacteriocins and hydrogen peroxide (Cabello-Córdova, 2022).

Daşkıran *et al*. (2012) have pointed out that when lactic and acetic acids are absorbed by bacteria in the digestive system, it lowers the pH at the intracellular level which can be lethal for those that could be harmful to health. This absorption, by generating favorable conditions for the existing microbiota, reduces the risk of the digestive tract being colonized by pathogenic microorganisms.

A study by Dowarah *et al*. (2016) points out that some bacteria used as probiotics reduce the translocation of intestinal pathogens to other organs, such as the liver, spleen and lymph nodes, because they have the ability to decrease the permeability of the intestinal epithelium.

It is important to emphasize that in order to maintain the effectiveness of probiotics in their protective barrier functions against the entry of pathogens into the intestinal wall, it is essential that they are administered before the pathogens multiply in the digestive tract. Consequently, probiotics are a useful tool to prevent the development of diseases associated with the intestine, provided that adequate preventive measures are taken.

According to Corrales-Benedetti and Arias-Palacios (2020), another important effect of probiotics on health is the stimulation of host defenses. Huang (2022) points out that they activate the immune response in the respiratory system. Ma and Suzuki (2018) indicate that they provide safety against diseases affecting the gastrointestinal tract. When the microbiota is in an optimal state, it helps the host by proper functioning of immunity through molecular patterns derived from catalysts and antigens. The immunomodulatory action of probiotics is known to promote phagocytosis and reproduction of immune cells (macrophages, monocytes and specialized cells, such as Tlymphocytes CD3+, CD4+and CD8 +), as well as the production of IgM and IgG immunoglobulins (Ajuwon, 2016). Probiotics are also reported to promote the release of an innate immune response, which responds to several common structures, such as C-type lectin, which generates interaction with so-called pathogen-associated molecular patterns and an adaptive immune response that relies on B and T lymphocytes specific for particular antigens (Statovci *et al*., 2017).

Probiotics increase digestion and absorption of nutrients in the intestine because they increase enzyme activity in the intestine (Murga-Valderrama *et al*., 2020). Elbaz *et al*. (2023) proved that amylase activity increases with the addition of *Lactobacillus* in broiler diets. Bajagai *et al.* (2016) found increases in sucrase and lactase activity when they added these same microorganisms to pig diets.

Thi-Lan-Anh *et al*. (2022) noted that *Bacillus* promote the production of a wide variety of extracellular enzymes, such as amylase, cellulase and protease, as well as antimicrobial compounds, vitamins and carotenoids. Studies developed by Chen *et al*. (2022) proved that *Bacillus* can degrade aflatoxin B1, a toxic mycotoxin that when found in food, or in concentrate feeds, causes great economic losses, in addition to representing a threat to human and animal health.

Maya-Ortega *et al*. (2022) found that the use of *B. subtilis* significantly increased feed conversion (FC) and cumulative weight gain (CWG) in broilers. In addition, they detected, with regards to the use of antibiotics, increases in intestinal allometry, improvements in villus height and decreases in crypt depth. These modifications favor productive performance and improve the development of digestive organs and histomorphology of the small intestine.

In summary, the modifications induced by probiotics and other live microorganisms in the composition or function of the intestinal microbiota, and in both, improve its functionality and resilience. In addition, having a stable gut community allows protection of the host against invading microorganisms and helps maintain homeostasis and immune regulation (Deehan *et al*., 2017).

Antibiotics vs. Probiotics. Different studies have proven the efficacy of probiotics as growth promoters and health enhancers in several animal species. The use of probiotics, instead of antibiotics, is a promising alternative. The observed beneficial effects depend on several factors: microbial species used, animal species, age and condition of the digestive tract flora prior to probiotic administration (Molina, 2019).

One of the main differences between probiotics and antibiotics is the time it takes for them to exert their action. Antibiotics act immediately on the microorganisms; while the action of probiotics is not so fast. It can take several days or even weeks (Pérez-de-Algaba-Cuenca, 2022).

In the case of antibiotics, they are substances (natural or synthetic) that delay the growth of bacteria or kill them, and are used in the treatment of infectious diseases in humans and animals (AMCRA, 2020).

Growth-promoting antibiotics were used for several years because of their proven efficacy in pathogen control, since they prevent enteritis, undesirable fermentations and enterotoxic excretions of harmful microorganisms present in the gastrointestinal tract. In addition, they preserve the optimal conditions of the intestinal epithelium and protect its ability to absorb vitamins, trace elements, amino acids and other nutrients (Karaliute *et al*., 2022).

However, their excessive use has led to the emergence of resistant bacteria and to their ineffectiveness at the usual doses (Martiani *et al*., 2022).

Mendel *et al*. (2022) warn of the serious consequences of these responses for human and animal health, without ignoring the fact that it is impossible to avoid the residual effects of antibiotics in animal products intended for human consumption.

The abuse of drugs in humans and animals accelerates the process of resistance by pathogenic bacteria. Infections that are difficult to treat are becoming more frequent due to the loss of antibiotic efficacy (Avilez-Velásquez and Briones-García, 2019).

Humans and animals share the same ecosystem, which implies that resistant bacteria can circulate in the same environmental niches. Bacteria can pass from animals to humans and vice versa, through direct and indirect contact (food, water, environment). This applies to commensal bacteria, which are often considered reservoirs of resistance due to their widespread presence, as well as to pathogenic and zoonotic bacteria (AMCRA, 2020).

Recent studies have shown that everyday consumer products derived from animal husbandry may contain multidrug-resistant bacteria and contribute to the transfer of resistant bacteria and genes (Arsène *et al*., 2021). In fact, the food chain is considered to be the main route of transmission. Several research works have shown that there is an increased risk of serious diseases and mortality due to the increase in the number of antibiotic-resistant pathogens ingested through food. This poses a problem for human and animal health (González-Román *et al*., 2019).

Regarding environmental risks, it has been proven that after antibiotic treatment, animals excrete a fraction of the administered dose. Hence the concern arises that they are responsible for the increase in resistant bacteria (AMCRA, 2020; Rodriguez-Fernandez *et al*., 2020).

Despite the important role of antibiotics in the reduction of diseases by microorganisms, the mortality rate in animals has increased due to bacterial and cross-resistance of microorganisms as a result of their excessive use as a preventive. To overcome these difficulties, alternatives have been researched to reduce the use of antibiotic growth promoters. Among them are probiotics, which have been identified, so far, as the best option, for being a natural and safe alternative to obtain functional foodstuffs that provide health, quality and innocuous food safety for consumers, because they do not leave residues in eggs or meat (Hernández-González *et al*., 2021; Ruiz-Sella *et al*., 2021; Yousaf *et al*., 2022).

Probiotics have the ability to control some bacteria, such as *Salmonella* sp. and *Escherichia coli*, fungi and protozoa. In addition, they strengthen the immune system, reduce mortality and shorten physiological and productive cycles, actions that improve feed conversion and reduce production costs (Gutiérrez-Castro and Güechá-Castillo, 2016).

The incorporation of probiotics in diets is in correspondence with the restrictions established in many countries, mainly in the European Union, with the use of antibiotics in livestock feedstuffs (Betancourt-López, 2020).

An important aspect that differentiates probiotics from antibiotics, and that raises current interest in their use, is that the former are immunostimulants, while the latter are immunosuppressants (García-Trallero *et al*., 2019). This contrast comes from the action mechanisms of probiotics, which are established through the creation of different defensive barriers, such as saturation of epithelial receptors, production of organic acids, stimulation of phagocytosis, differentiation of immunocompetent cells and production of antibodies.

Impact on the improvement of productive indicators in different animal species.

Monogastric animals. Many studies have shown that probiotics improve the productive indicators of these species, especially in the smaller ones, from which high productivity is expected in the shortest possible time. In poultry, probiotics have beneficial effects on the development of intestinal microvilli, which allows them to make better use of feedstuffs and thus improve productive indicators (Iñiguez Heredia *et al*., 2021).

Piad (2001), when evaluating the probiotic activity of an enzymatic hydrolyzate of distillers' cream in the gastrointestinal tract of replacement pullets, showed by means of fermentative and microbiological indicators that this compound optimized the immune and blood response, as well as hemoglobin and hematocrit values. In week 18, the supplemented birds achieved greater weight increases, more uniformity, better body condition, development of the reproductive apparatus and its indicators, with a close physiological relationship between body fat weight and infiltration in the liver.

Fonseca-Hernández and Roa-Vega (2022) found that the inclusion of the probiotic *S. cerevisiae* in two types of broiler meal increased weight gains, total final weight and feed intake. Fuentes-Alvarado (2021) found that the incorporation of *Bacillus subtilis* as a probiotic promoted higher production rates and intestinal health. Zhang and Kim (2014) found significant increases in protein and fat, with significant weight gains and increases in calcium availability in poultry of the same animal category, which received *L. bulgaricus*.

In pigs, Bajagai *et al*. (2016) found increases in sucrose and lactase activity when *Lactobacillus* was added to the diet. (Kim *et al*., 2021) evaluated the dietary effects of different probiotics with a basal diet and multiprobiotic treatments with *Lactobacillus*, and observed that supplementation improved liver function and reduced cholesterol levels. Similar results were obtained by Magnoli *et al*. (2022) with the probiotic yeast indigenous to pigs *S. boulardii* RC009 and observed that this product positively influenced biochemical indicators, especially serum cholesterol levels.

Liu *et al*. (2014) when incorporating a probiotic based on different species of *Lactobacillus*, observed significant increases in daily weight gain and in the incidence of diarrhea, compared with the control group. Meanwhile, Ahmed *et al*. (2014) obtained with the same species of microorganisms increases in nutrient digestibility.

Solís-Véliz and Rivera-Cedeño (2022), when including the hydrolyzed *S. cerevisiae* probiotic in the diet of lactating sows, observed a significant probiotic effect with regards to the control treatment, in favor of the variables total births, live births, decreased mortality and increased weaning weight.

Liu *et al.* (2017) and Liu *et al.* (2018) recommend the use of probiotics in swine productions, when faced with situations such as the following:

- Piglets in the first days of life without an adequate microbiota in the gastrointestinal tract (GIT).
- Animals subject to situations that propitiate dysbiosis, such as weaning, transfers, vaccination and feeding changes, among others.
- Pigs with microbiota affected by pharmacological treatments.
- In case of ongoing infectious processes, both respiratory and digestive.
- Breeding sows in gestation and lactation stages.
- Clinically healthy animals to improve their bioproductive indicators.

The phases in which stress occurs are the most delicate in pig farms, and it is in them where the beneficial effects of probiotics are best appreciated, because these are the periods in which there is higher immune compromise and less secretion of digestive enzymes by the glands of the digestive tract (Lee *et al*., 2020).

Ruminants. In this species, microbial additives induce, in the rumen, increases in the number of anaerobic and cellulolytic bacteria and, with continuous supply, increases in their activities (Pimentel *et al*., 2022). As a consequence, there are increases in fiber degradation that result in higher intake levels and volatile fatty acid productions, actions that contribute to improve feed utilization efficiency (Carro *et al*., 1992). In addition, by stimulating the growth of ruminal bacteria, they increase the duodenal flow of microbial protein. One of the most interesting advantages is that these crops can use hydrogen and reduce methane production, with the resulting energy savings and the positive effect on the environment by reducing the emission of greenhouse gases (Reuben *et al*., 2022).

Ojeda *et al*. (2008) proved that the inclusion of the probiotic Sorbifauna® exerts positive effects on the growth of lambs, since the animals that received the probiotic had better gains ($p < 0,05$) than the control group (151 *vs*. 99 g/animal/day).

Lopez *et al.* (2012) also found significant differences ($p < 0,05$) in that category, in average daily gain (123,7 *vs* 101,1 g/animal/day) and mortality (2,6 *vs* 8,6 %) between treatments with and without the inclusion of the probiotic. The authors concluded that regardless of sex, from 60 days of birth, the inclusion of the probiotic Sorbifauna® promoted a positive effect on the growth of the lambs.

Nevertheless, Sánchez *et al.* (2015) when evaluating the inclusion of the probiotic Sorbifauna® in the milk production and quality of Holstein × Zebu cows grazing on an association of *Leucaena leucocephala* (Lam) de Witt cv. Cunningham and *Megathyrsus maximus* (Jacqs.) B.K. Simon & S.W.L. Jacobs cv. Likoni, found no significant difference in milk production (11,9; 12,1 and 12,2 kg/cow/day), when using doses of 60, 90 and 120 g of the additive/cow/day.

This could have been due to the high quality of the diet received, which combined a forage ligneous plant of high nutritional value and a pasture of excellent performance under shade, in addition to the fact that the animals received supplementation with concentrate feeds. In this type of diet, the grass represents between 85,0 and 90,0 % of the supply, and the ligneous foliage, from 10,0 to 15,0 % (López *et al*., 2015). Under these circumstances the animal ration has a CP content of 11,0-14,0 %; while the *in vitro* DM degradability is higher than 60,0 %, so there is a higher amount of nutrients accessible to rumen microorganisms and better pH stability in the rumen, which favors the efficiency of the digestive process and the non-specific immune response of the animals. All this influences the reduction of the possible effect of probiotics on fiber degradation and there are no substantial changes in milk production.

Abd El-Ghani (2004), when evaluating the responses in milk production by the inclusion of a *S. cerevisiae* culture in the ration of Zaraibi goats (6 g/day) showed that the animals that received this additive produced a higher ($p < 0,05$) amount of milk (0,98 *vs.* 1,15 kg/day). However, Salama *et al.* (2002) observed no effect on milk production and composition of Murciano-Granadina goats when they fed 6 g/goat/day of a commercial additive, composed of a mixture of *S. cerevisiae* and malate, but the goats that received the additive showed a greater ($p = 0,03$) increase in live weight during the experimental period.

In a review on the effect of probiotics and prebiotics on intestinal health, function and disease prevention in dairy calves during early life stages and at weaning, Cangiano *et al*. (2020) reported that probiotic supplementation in this animal category, mainly during periods of illness, has positive effects on health and growth. The authors concluded that probiotics are a low biological risk alternative with potentially positive benefits.

The use of the probiotic *S. cerevisiae* and the prebiotic mannanoligosaccharide in the feeding of lactating calves favored weight gain, weaning weight and feed conversion. In addition, as hematological values were elevated, this resulted in fewer cases of diarrhea and pneumonia. The best results were obtained with the combined use of both compounds (Fernández-Chauca, 2018).

Yeasts increase the productive expression of cows, because they modulate some metabolic processes, such as pH stability in the rumen, an action that favors the efficiency of the digestive process and the non-specific immune response of the animals. They also increase average daily weight gain, body condition and improve milk production and its quality, because they reduce the somatic cell count in milk (Suárez and Guevara, 2018).

Although probiotics show significant benefits in animal feeding and their responsible and adequate use can contribute to improve productivity, guarantee food safety and reduce negative environmental impacts, their use has not been generalized in Cuba. Factors such as lack of knowledge, limited availability, production costs and lack of regulation may be hindering their massive adoption. However, with greater dissemination, better access to the products and a clear regulatory framework, it is possible that probiotics will become a more widely accepted and used option in the Cuban animal husbandry industry, so it is essential to continue researching and promoting their application in animal husbandry to face current and future challenges in this field.

Conclusions

Probiotics increase animal productivity by improving the immune system, digestion and absorption of nutrients, as well as the intestinal microbiota. In addition, they decrease health problems, which makes them a viable alternative to improve the efficiency of animal husbandry systems in different animal species, including monogastric ones and ruminants. However, in order for them to become an accepted and used option in livestock farming, it is necessary to continue researching and promoting their application.

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Conflict of interests

There is no conflict of interests among the authors.

Authors' contribution

- Aramís Soto-Díaz. Conception and design of the study, search and selection of the literature, drafting of the manuscript and critical revision of the intellectual content.
- Ana Julia Rondón-Castillo. Search and selection of the literature, drafting of the manuscript and critical revision of the intellectual content.

- Jesús Manuel Iglesias-Gómez. Conception and design of the study, drafting of the manuscript and critical revision of the intellectual content.

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