*fermentation*

*Review*

# Lactic Acid Bacteria in the Production of Traditional Fermented Foods and Beverages of Latin America

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**Abstract:** Traditional fermented foods are inherent to the human diet and represent an important part of the culture of each country. The fermentation process has been traditionally used as a method of food preservation. It allows modifying the technological, sensory, and nutritional attributes of raw ingredients. Latin America has a vast history with these products, but they are not always known worldwide. One of the most used microorganisms in fermented foods is lactic acid bacteria. This review aims to provide insight into the main attributes, benefits, and nutritional characteristics of traditional fermented foods and beverages from Latin America made with lactic acid bacteria. A bibliography analysis of the general aspects of fermented products from this region was carried out, focusing on the foods and beverages (with and without alcohol), their representation in native communities, nutritional value and effect on health, as well as the risk of their consumption. It is concluded that traditional fermented products of Latin America are usually prepared with specific ingredients of the region (such as cassava and corn), and that the lactic acid bacteria present in these foods are not always identifiable due to the inherent variability of artisanal production. The bacteria observed include *Lacticaseibacillus*, *Lactiplantibacillus*, *Lactobacillus*, *Limosilactobacillus*, *Leuconostoc*, *Streptococcus*, and *Weisella*, among others.

**Keywords:** fermentation; bacteria; health; nutritional characteristics; food industry; native foods; lactic acid



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## 1. Generalities of Fermented Foods and Beverages

Fermentation is a simple, low-cost, and versatile process that can be used to transform many food products, both solid and liquid. Fermented foods can be considered as "foods made through desired microbial growth and enzymatic conversions of food components" [1]. The fermentation activity of those microorganisms, including bacteria, fungi, and yeast, leads to several changes in sensory and technological characteristics of foods. The fermentation process is also useful to obtain diverse health and nutritional benefits. However, this process has been primarily used for preserving food by preventing the proliferation of undesirable microorganisms and by the inhibitory effect of the organic acids produced in the process [2].

The elaboration of fermented foods and beverages is inherent to the human diet, and each region of the world has its specific products. According to some authors, records of food fermentation date back more than 6000 years [3]. Fermented foods and beverages have been consumed for a long time by different civilizations and by various social classes [4]. Some well-known examples are beer, wine, and bread production, of which there are ancient archaeological records. Motivation to consume these products varies within communities; for example, native populations tend to choose fermented foods and beverages due to medical, dietary, or spiritual motives [5], whereas residents of industrialized areas consume them due to nutritional benefits and not for religious reasons. Some people follow specific trends, such as the "slow food" movement and the tendency to consume foods perceived as "more natural" [6,7]. In these cases, fermentation is attractive, since it is a slow process and appears to be a "natural" method in the eyes of consumers [8]. The sensory aspects of fermented foods and beverages can be attractive to other customers.

A broad classification divides the fermentation process according to the participating microorganisms as bacterial or yeast and mold fermentation. The first can be further divided into alkaline or lactic acid fermentation. Lactic acid bacteria (LAB) are responsible for lactic acid fermentation and can be classified into homolactic and heterolactic groups, according to the pathway used to ferment the sugars. Homolactic bacteria operate through glycolysis, using glucose as a carbon source, and produce only lactic acid. The heterolactic group decomposes glucose not only in lactic acid, but also in significant amounts of ethanol, acetate, propionate, and carbon dioxide, using other pathways besides glycolysis [9].

Morphological and physiological characterization of LAB describe them as gram-positive, acid tolerant, meso-aerophillic, non-spore forming, catalase negative, and morphologically either rod-shaped (bacilli) or spherical (cocci) bacteria that produce lactic acid as the major end product of carbohydrate fermentation [10].

LAB are one of the most widely used microorganisms for fermented foods. Because of their capacity to produce lactic acid and other compounds, they contribute to extending the shelf life of products, improving the nutritional profile of ingredients, and modifying certain physicochemical characteristics of the food (including a decrease in pH). They are considered GRAS (generally recognized as safe) substances. The US Food and Drug Administration (FDA) classifies food ingredients according to the GRAS label, which identifies those substances that are "generally recognized, among qualified experts, as having been adequately demonstrated to be safe under the conditions of its intended use" [11]. One of the best-known applications of LAB is the production of fermented dairy foods. However, LAB can grow correctly in different food matrices including fruits, vegetables, and grains [12–14], and a wide variety of strains have been isolated from various indigenous fermented foods and beverages [15].

All regions of the world have traditional fermented foods and beverages that are part of their culture. Asian countries have a vast tradition in this subject, possessing in their culture a large number of different foods and typical drinks, some of them well-known worldwide (e.g., kimchi, kombucha, miso, tempeh, soy sauce) [16–18]. Other parts of the world have their typical fermented foods and beverages, such as beer, wine, cider, yogurt, kefir, or sauerkraut in Europe. Different ingredients used for traditional fermented foods led to developing a diversity of microorganisms, including a variety of LAB [19]. These ingredients and bacteria are typical of each geographical area and contribute to the development of distinctive characteristics, such as typical textures and flavors [19,20].

In some regions, such as Latin America, the knowledge about their traditional fermented products is not so widespread, but they still represent an important nutrient source [20]. Latin America includes the countries of South America, Central America, Mexico, and the Caribbean islands, where a language derived from Latin is spoken. The majority of these countries are considered developing areas with nutrient deficiency representing an important problem. According to [21]. traditional fermented products made with LAB can be considered as nutraceuticals with interesting health benefits for these populations. The objective of this review is to summarize the main characteristics of fermented foods and beverages made with LAB traditionally elaborated by the native population of Latin America. In addition, the benefits and risks of these products, as well as the possibility of developing new fermented foods and beverages from traditional ingredients, are addressed.

## 2. Fermented Foods and Beverages of Latin America

Latin American countries have a long history of people who have elaborated fermented foods and beverages over the years from certain typical ingredients of the continent. According to some authors, a large variety of fermented foods and beverages in Latin America come from native inhabitants that traditionally elaborate these kinds of products using empirical information [5]. Among these populations, fermentation was and is still used mainly as a food preservation method. To elaborate fermented foods and beverages, microorganisms can be added on purpose (as starter cultures) or unintentionally (naturally present in the food). In most cases of native populations, fermented foods and beverages are produced through spontaneous fermentation, considering the process involves different unknown microorganisms present not only in the ingredients but also in the atmosphere or in different materials used during their elaboration [2]. Ingredients used to produce traditional fermented foods and beverages in Latin American countries include cereals (like maize), animal products (meats from beef, lamb, llama, or guanaco, and cheese), certain tubers, fruits, and vegetables [5,22]. It is common for different countries to prepare similar fermented products, sometimes under different names with small variations. This includes changes in elaboration steps or the use of region-specific seasonings. Teachings on how to produce fermented foods and beverages were commonly transferred from generation to generation, and subsequently, loss of information often occurred. The production of these foods was adapted due to the geographic and seasonal availability of ingredients. Due to these factors, different recipes and ways of preparation have come about [5,8].

A big part of the solid fermented foods consumed in Latin America are made with typical ingredients of the region and are part of the culture of the native communities. However, other fermented foods produced in this region were introduced by European immigration, such as cheeses and dried sausages, and are commonly consumed. This section will focus on those products prepared with traditional ingredients of Latin America, leaving aside those fermented foods resulting from immigration.

Traditional Latin American beverages include alcoholic and non-alcoholic products, whose recipes are passed from generation to generation. People often consume alcoholic beverages for religious or spiritual purposes, whereas recreational motives are probably the main reason in industrialized populations. Some authors suggest that most of the fermented beverages elaborated by American natives involve the use of LAB [23,24]. Studies show both bacteria and yeast are commonly used in the elaboration of fermented beverages [24]. In such cases, these two microorganisms have a symbiotic relationship, stimulating each other's growth. In fermented beverages, the development of LAB is probably augmented by the substances produced by yeast, while the latter is stimulated by the production of acid generated by the bacteria [5].

The variety of fermented beverages in Latin America is wide and many of them are prepared using cassava *(Manihot esculenta)* or corn *(Zea mays)* as a substrate [23]. A large part of them are alcoholic beverages and have an important role in these cultures Although the ethanol in fermented beverages is mainly due to the presence of yeasts (and these are not the object of study in the present review), they coexist with LAB, some of these bacteria being heterofermentative with the ability of producing ethanol. Fermentation time and alcohol content of traditional beverages varies significantly among products and also according to the country. This is the case of *chicha*, a general name for a drink consumed in different areas of Latin America. Every region that produces it, has its own variations in substrates, alcohol content, and form of elaboration [25]. Alcohol amount can change according to the fermentation time of the beverage. Inhabitants of Brazilian tribes can wait up to 5 days before consuming *caxiri*, a drink based on cassava, corn, and sweet potato, in order to have a product with a high alcoholic content.

The main bacteria genera described as being part of this kind of product include *Lacticaseibacillus, Lactiplantibacillus, Lactobacillus*, *Limosilactobacillus*, *Leuconostoc*, *Streptococcus*, and *Weisella* among others. It is common that sweet potato is used as an inoculum. Inhabitants of some native populations can chew this ingredient, and the obtained product serves as an inoculum for some beverages, including *calugi*, *caium*, and *chicha* [22]. Starch from the substrates used for fermentation is transformed into fermentable sugars by the action of this inoculum containing amylase enzyme and microorganisms [5].

Table 1 summarizes some of the main characteristics of traditional Latin American fermented foods and beverages (with and without alcohol) resulting from LAB fermentation.

**Table 1.** Traditional Latin American fermented foods and beverages (with and without alcohol) made using lactic acid bacteria.

| Food (F)/Beverage (B) — Country | Raw Material | Lactic Acid Bacteria Present | Fermentation Time | Ethanol (%) | Reference |
|---|---|---|---|---|---|
| Aloja (B) — Argentina | White carob *(Prosopis alba)* | *Lactiplantibacillus plantarum*, *Enterococcus faecium* | 2–3 d | 6.5–7.5 | [26] |
| Atole agrio (B) — Mexico | Corn *(Zea mays)* | *Lactiplantibacillus plantarum*, *Leuconostoc*, *Enterococcus*, *Weissella cibaria*, *Weissella confusa* | 6–12 h | 0 | [27] |
| Calugi (B) — Brazil | Cassava *(Manihot esculenta)*, corn *(Zea mays)*, rice *(Oryza sativa)* | *Lacticaseibacillus casei*, *Lacticaseibacillus paracasei*, *Lactiplantibacillus plantarum*, *Streptococcus parasanguis*, *Streptococcus salivarius*, *Weissella cibaria*, *Weissella confusa* | 48 h | 0 | [23,28,29] |
| Cauim (B) — Brazil | Cassava *(Manihot esculenta)*, corn *(Zea mays)*, cotton seed *(Gossypium)*, peanuts *(Arachis hypogaea)*, pumpkin *(Cucurbita)*, rice *(Oryza sativa)*, sweet potato *(Ipomoea batatas)* | *Lacticaseibacillus paracasei*, *Lactiplantibacillus plantarum*, *Lactobacillus pentosus*, *Leuconostoc pseudomesenteroides*, *Levilactobacillus brevis*, *Limosilactobacillus fermentum* | 48 h | 0 | [23,30] |
| Caxiri (B) — Brazil | Cassava *(Manihot esculenta)*, corn *(Zea mays)*, sweet potato *(Ipomoea batatas)* | *Lactobacillus helveticus*, *Limosilactobacillus fermentum* | 5 d | 10–11 | [22,31,32] |
| Chicha (B) — Argentina | Corn *(Zea mays)* | *Lactiplantibacillus plantarum*, *Leuconostoc lactis*, *Weissella viridescens* | 2–8 d | 0–10 | [22,33] |
| Chicha (B) — Brazil | Corn *(Zea mays)*, sugar cane *(Saccharum officinarum)* | *Weisella cibaria*, *Weisella confusa* | 36 h | 0 | [34] |
| Chicha (B) — Colombia | Corn *(Zea mays)* | *Lactobacillus*, *Leuconostoc* | 2–6 d | 2–12 | [35] |
| Chicha (B) — Ecuador and Peru | Cassava *(Manihot esculenta)*, corn *(Zea mays)*, rice *(Oryza sativa)* | *Lactobacillus acidophilus*, *Lactobacillus crispatus*, *Lactobacillus delbrueckii*, *Limosilactobacillus fermentum*, *Limosilactobacillus reuteri* | 48–72 h | 2–5 | [23,25] |
| Colonche (B) — Mexico | Red tuna *(Opuntia streptacantha Lem)* | *Lactobacillus*, *Leuconostoc* | 3–4 d | 4–5 | [36,37] |
| Masa agria (F) — Colombia | Corn *(Zea mays)* | *Lactiplantibacillus plantarum*, *Lactobacillus coleohominis*, *Lactobacillus gallinarum*, *Lactobacillus panis*, *Lactobacillus pontis*, *Lactobacillus* spp., *Limosilactobacillus fermentum* | 3–5 d | 0 | [35] |
| Masato de yuca (F) — Perú | Cassava *(Manihot esculenta)* | *Lactiplantibacillus plantarum*, *Limosilactobacillus fermentum*, *Weissella confusa* | NI | 0.2 | [38] |
| Polvilho azedo (or Almidón Agrio) (F) — Brazil, Colombia, Paraguay | Cassava *(Manihot esculenta)* | *Lacticaseibacillus casei*, *Lactiplantibacillus plantarum*, *Lactobacillus* spp. | 3–20 d | 0 | [39] |
| Pozol (B) — Mexico | Corn *(Zea mays)* | *Lactiplantibacillus plantarum*, *Leuconostoc*, *Streptococcus infantarius*, *Weissella confusa* | 2–7 d | 0 | [13,37,40] |

**Table 1.** *Cont.*

| Food (F)/Beverage (B) — Country | Raw Material | Lactic Acid Bacteria Present | Fermentation Time | Ethanol (%) | Reference |
|---|---|---|---|---|---|
| Puba flour (F) — Brazil | Cassava *(Manihot esculenta)* | *Lactiplantibacillus*, *Lactobacillus delbrueckii*, *Lactobacillus perolans*, *Lactobacillus* sp., *Leuconostoc* sp., *Levilactobacillus brevis*, *Limosilactobacillus fermentum* | 3–7 d | 0 | [22,41,42] |
| Pulque (B) — Mexico | *Aguamiel (maguey sap)* | *Lactobacillus acidophilus*, *Lactobacillus hilgardii*, *Lactobacillus paracollinoides. Lactobacillus sanfranciscenci*, *Lactococcus* sp., *Leuconostoc citreum*, *Leuconostoc gasicomitatum*, *Leuconostoc kimchi*, *Leuconostoc mesenteroides* | 7–28 d | 5–7 | [43] |
| Tarubá (B) — Brazil | Cassava *(Manihot esculenta)* | *Lactiplantibacillus plantarum*, *Leuconostoc lactis*, *Leuconostoc mesenteroides*, *Levilactobacillus brevis* | 8–15 d | Dependent on the fermentation time | [5,23,31,44] |
| Tejuino (B) — Mexico | Corn *(Zea mays)* | *Lactiplantibacillus plantarum*, *Limosilactobacillus fermentum* | 24 h | 0 | [39,45] |
| Tocosh (F) — Perú | Potato *(Solanum tuberosum)* | *Lacticaseibacillus casei*, *Lactobacillus farciminis*, *Lactobacillus sakei*, *Leuconostoc mesenteroides*, *Levilactobacillus. brevis*, *Limosilactobacillus fermentum* | 12 m | 0 | [22] |
| Yakupa (B) — Brazil | Cassava *(Manihot esculenta)*, sweet potato *(Ipomoea batatas)* | *Lactiplantibacillus plantarum*, *Limosilactobacillus fermentum*, *Weissella cibaria*, *Weissella confusa* | 24–48 h | 0 | [23,31,46] |

h = hours; d = days; m = months; NI = not informed.

## 3. Nutritional Profile and Health Benefits of Traditional Fermented Foods and Beverages of Latin America

As mentioned in other sections, the fermentation process provides several technological, sensory, and nutritional changes to the ingredients used as substrates, and one of the main reasons to consume fermented foods and beverages are the health benefits that come along with them. Functional foods are those that provide a health benefit beyond basic nutrition [47], and foodstuffs obtained by LAB fermentation represent a large part of functional foods [16]. Fermented foods continue to be staple meals for certain native inhabitants of Latin America, so it can be assumed that these products represent an important energy source and provide various essential nutrients in the diet of these people [5]. Some of the main modifications produced by LAB in the nutritional profile of food ingredients during fermentation include improving their digestibility and increasing the macro and micronutrient content.

It is known that several raw foods are indigestible to the human organism or are not sensory acceptable without proper processing (e.g., wheat, barley, corn). Fermentation can help in the production of adequate edible foods and beverages prepared with these ingredients [16,48]. Such are the cases of wheat, a cereal that can be transformed into bread, and malted barley, which is turned into beer. Lactic acid fermentation represents a useful alternative for people having lactose intolerance, since some of them can consume fermented milk products (e.g., yogurts, cheese) without reporting undesirable effects [48]. As can be seen in Section 2, the majority of ingredients used in Latin America to produce fermented products are sources of carbohydrates, including oligosaccharides that are non-digestible to humans [49,50]. When fermentation occurs, these carbohydrates are used by microorganisms as energy source, and this leads to an increase in food digestibility [5].

The production of fermented foods and beverages can increase the protein and amino acid content compared to raw ingredients [5], and LAB can produce peptides with biological activity [46]. Regarding minerals and vitamins, fermentation can be a key tool to increase their bioavailability. Certain anti-nutritional factors (i.e., phytates, oxalates, tannins) present in raw foodstuffs can be reduced by fermentation, increasing the bioavailability of minerals such as Ca, Fe, and Zn that would be otherwise quenched by these anti-nutrients [5]. In addition, LAB fermentation leads to a process of microbial biosynthesis, which in turn enhances the levels of certain vitamins, including vitamins of the B-group [51], and lactic acid, one of the main compounds produced during fermentation by LAB, has the potential to enhance the bioavailability of certain minerals and vitamins [52].

Nutritional improvements produced by LAB on raw food ingredients are summarized in Figure 1.

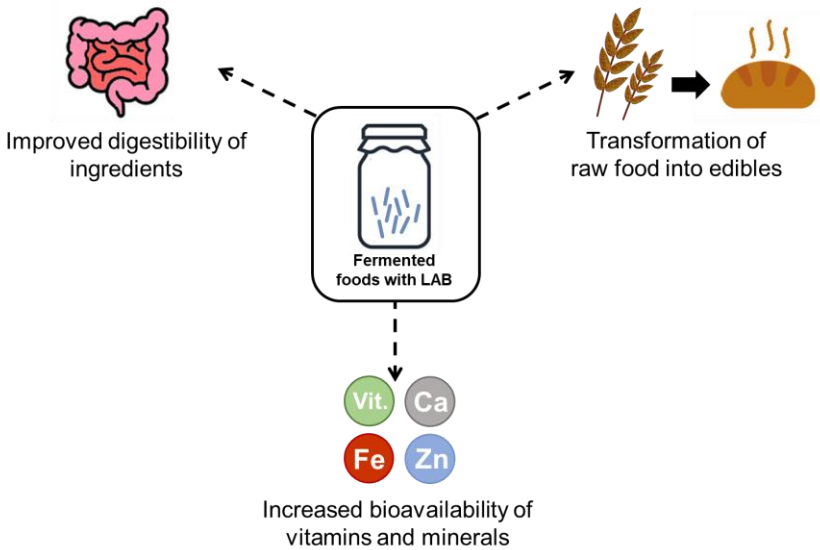


**Figure 1.** Nutritional improvements produced by lactic acid bacteria (LAB) on raw food ingredients.

The health effects of consuming fermented foods or beverages are diverse and affect various organic systems [53]. According to different authors, improvements in gastrointestinal, hepatic, and cardiovascular disorders are among the benefits obtained by the intake of these products. In addition, they could help in the prevention of pathologies such as obesity, diabetes, hypertension, osteoporosis, and certain allergies or intolerances [13,54,55]. Additionally, fermented products can be labeled as probiotics. It is important to clarify that not all foods and beverages elaborated through fermentation are considered probiotics. This term is limited to those cases when an established health benefit conferred by well-defined and characterized live microorganisms is demonstrated [56]. Non-viable microorganisms that confer a health benefit to the consumer (including parabiotics) are a matter of current research works, as after the application of standardized killing methods (e.g., heat, high pressure, ultraviolet, irradiation, sonication, drying, acid, pH changes), they can exert health benefits (e.g., inhibition of pathogens, immunomodulation, mucosal protection, among others) [57].

The fact that fermented foods provide a wide variety of health benefits may be useful for food industries seeking to attract consumers through health, functional, and nutraceutical labeling [13]. As mentioned, fermentation is used as a food preservation process, making it useful for those looking to conserve their food without the use of synthetic preservatives. However, certain health benefits of native fermented foods may still be unknown due to the fact that many foods contain unidentified but possibly very valuable strains [13]. In this sense, it is necessary to continue the investigations regarding these strains.

## 4. Risks of Fermented Foods' Elaboration and Consumption

Regardless of all the named benefits provided by the intake of fermented foods and fermented beverages, it is important to consider that the elaboration of these products has to follow certain steps in order to guarantee food safety and avoid food intoxication and long-term deleterious effects. In populations without access to basic services such as drinking water or electricity, sanitary conditions may be faulty. When fermented foods are prepared in these circumstances, great contamination can occur. Considering this, some investigations have focused on the existence of contamination of fermented foods in low-income populations. Diosma et al. [58] studied the production of kefir in Argentina in communities with low economic resources and observed that despite the existence of situations of vulnerability there was no cross-contamination of said food.

In the case of non-indigenous populations, a big part of the food products is industrially produced, and food quality and safety are ensured. However, with new food tendencies, more residents of industrialized areas are learning how to produce fermented foods domestically in order to obtain health benefits. Fermentation steps are simple and easily applicable domestically with little equipment, but a problem that can occur with this situation is inappropriate bacterial handling which can lead to food contamination. In particular, fermented beverage production is becoming a common procedure, with products such as kombucha and kefir representing one of the most incorporated trends in recent years. In addition, other drinks such as chicha in Argentina have become popular among the inhabitants of industrialized areas, which has led people to elaborate these drinks at home or purchase them online or in non-specialized stores. Although fermentation steps are simple and easily applicable domestically with little equipment, a problem that can occur with this situation is inappropriate bacterial handling which can lead to food contamination. At the domestic level, it is important to focus on safety issues when preparing or purchasing fermented beverages, as well as when acquiring the microorganisms for their preparation. Providing basic information and knowledge on good manufacturing practices can be a key tool for these cases.

Considering the ingredients of Latin American origin, fermentation is a suitable method of decreasing the risks associated with the consumption of cassava, a food product used traditionally in this region and of rapidly-expanding demand but containing high levels of cyanide, a compounds that may reduce nutrients' bioavailability when cassava is raw or not thoroughly cooked. Additionally, cyanogenic glycosides can cause poisoning and death in humans when cassava is not properly processed [59].

As mentioned in Table 1, there is a wide variety of fermented alcoholic beverages in Latin America. These traditional drinks, along with others consumed worldwide (like beer), can represent a significant portion of the population's diet. Based on this, it is especially relevant to evaluate whether the benefits obtained through the consumption of fermented alcoholic beverages outweigh the possible issues that may arise from alcohol intake itself. It is well known that moderate to excessive alcohol consumption can lead to various health problems, including liver, digestive, and cardiovascular pathologies, as well as overweight, hypertension, and addictions. In this sense, the low alcohol content per serving, as well as its moderate intake could help to achieve an adequate balance and to avoid undesirable effects.

## 5. Novel Fermented Products Using Traditional Ingredients

The availability of fermented products in the market has grown in recent years. The health benefits they provide are attractive for consumers and for food/beverage-producing companies that must adapt to new demands and trends. Part of the current trend is related to the production of food and beverages based on plants or suitable for the vegetarian/vegan populations. In addition, the demand for gluten- and lactose-free products has also increased. These interests can align with a sector of consumers in search of foods that provide health benefits. Research on fermented foods and beverages prepared with ingredients such as cassava, corn, quinoa, and potato (traditional from Latin America) represents an interesting way to meet these consumer requirements.

Production at the artisanal or household levels continues to be the most common way of making the majority of traditional fermented foods [8]. However, it is likely that the fermented foods market will increase appreciably due to the augmented consumption of products that provide health benefits, and that the monetary gain may be substantial for those who engage in this market. An increase of $846.73 billion in the size of the fermented food and beverage market is estimated between 2022 and 2027. This market is expected to grow at a CAGR (compound annual growth rate) of 7.16% in this period [60]. It would be important to consider the fact that a large part of the population of Latin America is in an economic situation of poverty. It is essential that when making fermented products on an industrial scale that the ingredients are used in quantities that do not lead to their overexploitation. In addition, it would be useful to investigate the possibility of making fermented products through the use of surplus or discarded foods. In this way, economic and environmental improvements would be achieved [61].

Different investigations at the laboratory level have focused on the elaboration of fermented products from traditional Latin American ingredients with innovative characteristics, including the use of new microorganisms and the production of foods with specific nutritional or sensory attributes. For instance, Menezes et al. (2018) [15] elaborated on a new functional fermented beverage made from an indigenous corn-based drink native to Brazil, combining LAB and yeasts. Carrizo et al. (2019) [62] studied the possibility of bio-enriching quinoa-based pasta by adding LAB and found that it was possible to obtain a product with improved bioavailability of minerals and vitamins.

This niche represents an interesting option for several companies. However, laboratory tests are not always transferable to an industrial scale. Established fermentation conditions, as well as the use of known microorganisms, are essential to the achievement of industrially fermented products that have adequate characteristics and are suitable for sale. These conditions are not always achieved when talking about traditional fermented foods and beverages, where the microorganism composition of these products can constantly change. In this sense, there is still much work to be done in order to achieve a good transfer of technology from laboratories to industry.

## 6. Conclusions

Latin American countries have a long tradition of fermented foods, some of them elaborated with LAB. The fermentation process represents a relatively simple and accessible tool for Latin American inhabitants. Different types of consumers can benefit from this versatile technique depending on the objective being pursued. In the case of many Latin American populations, even today, fermentation is probably used mainly as a conservation method or for spiritual purposes. It is undeniable that the consumption of fermented foods and beverages provides the human body with various benefits, so promoting those benefits is a useful strategy to improve the general population's health. However, it is also important to note that fermentation, like other food processing, carries certain risks. It is essential that the people who prepare this type of food carry out proper handling of the ingredients and microorganisms to avoid harmful effects in the short and long term. Additionally, the consumption of fermented alcoholic beverages can lead to the emergence of pathologies, so their intake must be cautioned. The elaboration of novel fermented foods and beverages using traditional ingredients of Latin America represents an interesting approach for (local) food industries, considering that many of these components have characteristics sought by different sectors of consumers, including the fact that some of these ingredients are suitable for populations with specific diseases like gluten-related pathologies and dairy intolerance. However, on an industrial scale, there are still several challenges to overcome, like the lack of knowledge and control of the microorganisms that participate in the fermentation of traditional products. In this sense, the large-scale production of these foods and beverages has the challenge of finding and using the appropriate strains that provide the greatest technological, nutritional, and sensory benefits while being safe for consumers.

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