Mini Review

Pharmaceutical BIOPROCESSING

A Review on Microbial Community during Fermentation

Xian Hu*

Kweichow Moutai Group, Guizhou, China

*Author for correspondence: huxian@rediff.com

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Abstract

During the solid-state fermentation (SSF) of Maotai-flavor Baijiu, the microbial makeup and environmental conditions can have a significant impact on community succession. The dominating microorganisms and the development of the microbial community structure during the early fermentation of Maotai-flavor Baijiu were identified in this study using high-throughput sequencing. For the link between physicochemical elements and fermented microorganisms, a correlation study was conducted. The findings demonstrated that throughout the heap fermentation process of Maotai-flavor Baijiu, microorganisms were visibly increased and the variety of bacteria and fungus showed a negative trend. The variety of fungus in the pit fermentation process did, however, grow. In the first fermentation of Maotai-flavor Baijiu, Lactobacillus, Pichia, and Saccharomyces were the predominate bacteria. In the heap fermentation, lowering sugar was the primary driving force for microbial succession, while acidity, alcohol, and temperature were the primary driving forces in the pit fermentation, according to the redundancy analysis. In the first fermentation of Maotai-flavor Baijiu, this study demonstrated the microbial succession and its associated environmental conditions. This information will improve our understanding of the process of solid-state liquor fermentation.

Keywords: Fermented foods • Food microbiology • Koji • Microorganisms

Introduction

Miso is a well-known, traditional Japanese cuisine that has undergone fermentation. It has a distinctive savoury flavour and scent and is most commonly used as a condiment in miso soup. In order to create koji, a mould like Aspergillus oryzae is first injected into a substrate during the two-stage fermentation process that produces miso. When the koji is added to a salt and soybean mash and the miso is allowed to ferment for up to 2 years, fermentation takes place, this time by bacteria and yeast. The distinctive flavour, texture, and nutritional composition of miso are all attributed to its microbial community. Very little research has been done to characterise and describe the microbial process, despite the significance of microorganisms in the manufacture of miso. In this study, we give an overview of the two-stage fermentation process, discuss the present state of knowledge on the microbial communities involved, and take into account any possible health advantages of miso consumption as well as issues with food safety. Understanding the microbiological processes at play will help to ensure that miso is produced in a safe and delicious manner around the world as its popularity grows and it is produced in new environmental settings [1-4].

Through the action of enzymes, the metabolic process of fermentation modifies the chemical composition of organic molecules. It is specifically described in biochemistry as the process of obtaining energy from carbohydrates without the presence of oxygen. It may more broadly refer to any method used in food production when the action of microbes results in a desired modification to a food or beverage. The field of zymology studies fermentation. Anaerobic breakdown of organic materials occurs during fermentation, which is the main process by which bacteria produce adenosine triphosphate (ATP). Since the Neolithic era, humans have employed fermentation to create foods and drinks. For instance, fermentation is used to preserve food by creating the lactic acid that is present in sour foods like pickled cucumbers, kombucha, kimchi, and yoghurt. It is also used to create alcoholic beverages like wine and beer. All animals,

including humans, have digestive systems that undergo fermentation. The process of using microbes for the mass manufacture of chemicals, biofuels, enzymes, proteins, and medications is known as industrial fermentation. The enzymatic breakdown and utilisation of food by bacteria, particularly sugars, is known as fermentation. All animals' gastrointestinal tracts undergo fermentation; however the amount of fermentation depends on the amount of microbes present, which is typically highest in the large bowel. Having the exception of species having forestomachs (ruminants), the large intestine is therefore quantitatively the most significant location of fermentation. Furthermore, the contribution of fermentation to the energy production of various species varies significantly. Fermentation produces very few calories in omnivores like humans and omnivores like dogs and cats, while fermentation is a natural process in herbivores [5].

Foods or drinks that have undergone regulated microbial growth as well as enzymatic conversion of food components are referred to as fermented foods. Fermented foods have gained popularity recently, largely as a result of the claimed health advantages. The purpose of this study is to define common fermented foods (kefir, kombucha, sauerkraut, tempeh, natto, miso, kimchi, and sourdough bread), their mechanisms of action (including the impact on the microbiota), and the evidence supporting effects on human gastrointestinal health and disease. The potential probiotic effect of the microorganisms that make up fermented foods, the production of bioactive peptides and biogenic amines as a result of fermentation, the conversion of phenolic compounds to biologically active compounds, the decrease in anti-nutrients and the production of these compounds are all putative mechanisms for how fermented foods affect health. Kefir, sauerkraut, natto, and sourdough bread were among the fermented foods whose gastrointestinal effects had been examined in at least one randomised controlled trial (RCT). There are no RCTs looking at the effects of kombucha, miso, kimchi, or tempeh on digestive health despite extensive in vitro studies. Kefir is the fermented food that has received the most attention, and data from at least one RCT points to its potential benefits for treating Helicobacter pylori and lactose malabsorption. In conclusion, there is very little clinical data supporting the use of the majority of fermented foods in the treatment of gastrointestinal disorders. Clinical high-quality trials examining the health benefits of fermented foods are called for in light of the compelling in vitro results [6].

Discussion

Since ancient times, food has been altered and produced using the fermentation process. Whether by accident or purpose, people soon discovered that foods' properties changed as they were stored, and some of these changes produced enticing new flavour profiles that could be used to the food's advantage to preserve it. Almost any food product, including meat, fish, milk, grains, fruit, and vegetables, can be fermented. A variety of preserved foods are produced via fermentation, and their popularity is currently rising. It alters the nutrient content, digestibility, and sensory qualities of food. Since diverse meals have developed independently all across the world, fermented foods exhibit a tremendous geographic diversity. Globally, hundreds of variants have been identified. Each is influenced by the accessibility of different raw resources and regional preferences. Japan is no exception, as the country is the origin of several fermented goods, such as umeboshi and shoyu tsukemono (pickled vegetables). However, miso may be the most well-known of all the Japanese fermented food exports. A fermented soybean paste known as miso is most frequently used to flavour miso soup. Miso's distinctive savoury flavour is becoming more and more well-liked in Western cuisine, as chefs and cooks use it as a condiment, in marinades, and even in sweets [7-10]. "Foods or beverages produced through controlled microbial growth, and the conversion of food components through enzymatic action" are described as fermented foods. In the past, a wide variety of foods, including meat and fish, dairy, vegetables, soybeans, other legumes, cereals, and fruits, underwent fermentation. There are countless types of fermented meals thanks to the microorganisms, nutritional components, and environmental factors that all play a role in the fermentation process. Because the production of antimicrobial metabolites (such as organic acids, ethanol, and bacteriocins) lowers the danger of contamination with pathogenic bacteria, food fermentation has historically been used as a preservation technique. Some foods, like olives, are inedible without fermentation that eliminates bitterness, and fermentation is also used to improve the organoleptic features (e.g., taste and texture).

Conclusion

In conclusion, we used high-throughput sequencing methods to reveal the microbial diversity and composition during the first fermentation of Maotai-flavor Baijiu. In order to produce Baijiu with a Maotai flavour, the microbial community must be screened and enhanced using both heap fermentation and pit fermentation. Furthermore, temperature, acidity, and alcohol were the main driving factors in pit fermentation, whereas lowering sugar was the primary driving force for microbial succession in the heap fermentation. We believe that this is the first study to analyse the dynamic changes in microorganism during the first fermentation of Maotai-flavor Baijiu. Understanding the full ecology of Maotai-flavor Baijiu fermentation systems may benefit from investigating the microbial succession and its associated environmental conditions.

Fermented foods are becoming more and more popular among regular consumers, whether it's due to their alleged health benefits or distinctive flavour characteristics. Numerous of these more conventional fermented foods are produced entirely or in part using native bacteria found in the environment. It is crucial for producers to have a better understanding of the microbiological mechanisms at play when these formerly local ferments spread internationally and are generated in new environmental settings. This will enable the manufacturing of reliable and secure fermented food items all over the world. Outside of the locations where they were traditionally produced, fermenting has become simpler thanks to our global culture. Information about how to make several of these foods, including koji and miso, may be found online and in numerous publications. To ensure that the more traditional ferments produced around the world are both safe and delectable, research is needed to understand how the succession of microorganisms during the fermentation process varies depending on geographic location, starter culture use, climate, and environmental differences, both in homes and commercial production.

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