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Composition, History, Health benefits of Water Kefir: A Review

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Abstract
Water kefir is a fermented beverage that is characterized by its carbonation and a somewhat sour taste. Lactic acid bacteria, yeast, and acetic acid bacteria are the primary microbial components that make up the sweet kefir grain. Yeast serves as the secondary component. The exopolysaccharide matrix that forms the kefir grain is produced by particular species of bacteria, in addition to other contributions. Yeast, on the other hand, provides a supply of nitrogen that the bacteria are able to absorb. It would appear that the makeup of the microbiota that is found in grains change depending on the location of the grains and the particular fermentation procedure that is being used. The aroma, flavor, and acidity of the beverage that is generated are all influences that are ultimately influenced by these parameters. The manufacturing of water kefir has traditionally been carried out on a very modest scale, and the utilization of defined starter cultures has not been widely spread. The development in popularity of water kefir as a beverage, on the other hand, can be related to the lifestyle trends of consumers as well as its reputation as a nutritious drink that may have potentially beneficial effects on health. Considering the increasing demand, it is essential to have a comprehensive grasp of the biology and dynamics of water kefir, in addition to putting into practice manufacturing procedures that are accurate and under control. The purpose of this review is to provide an update on the current understanding of water kefir from a scientific perspective.

Keywords: Water kefir, Fermented beverage, Yeast, Lactic acid bacteria, Fermentation

Introduction
Water kefir is a fermented beverage that is frothy and prepared with grains that are used to make water kefir. Kefir, also known as tibicos, California bees, Japanese water crystals, and a variety of other names, is thought to have originated in the late 1800s (Bourrie *et al*., 2016). It is prepared from sugar water and water kefir grains, water kefir is a distinctive alternative to the traditional kefir that is commonly consumed (Azizi *et al*., 2021). An individual fermentation process is produced by these grains, which are made up of a culture of bacteria and yeast (Nielsen *et al*., 2014). After the mixture has been fermented for a period ranging from twenty-four to forty-eight hours, the end product is a probiotic beverage rich in beneficial bacteria. Kefir made from water is not only a delicious and convenient beverage, but it also provides a multitude of health benefits and has the potential to be an important component of a diet that is both well-balanced and comprehensive in its nutritional content (Pihurov *et al*., 2021). A remarkable assortment of microorganisms, including yeast and bacteria, can be found in artisanal cultures that are discovered in the environment. A wide variety of yeasts, as well as lactic and acetic acid bacteria, are the components that make up these cultures (Plessas *et al*., 2016). Some examples of these cultures include the symbiotic culture of bacteria and yeast (SCOBY) and water kefir grains (WKG). Because of their metabiotics, which are the consequence of complex and synergistic interactions, as well as their metabolic functionality, products that have been fermented

with the assistance of the microbiome are able to be incorporated into functional products (Ding *et al*., 2022). This is because both of these factors contribute to the formation of functional products.

Overview of Water kefir

Kefir made from water is a naturally fermented beverage that is both refreshing and enticing, offering a wide range of flavors and textures (Singh *et al*., 2023). Sugar water is combined with water kefir grains, which are referred to as Symbiotic Colonies of Bacteria and Yeast (SCOBYs), and then the mixture is allowed to ferment for a period of time ranging from twenty-four to forty-eight hours (Yassunaka Hata *et al*., 2022). Sugars are turned into helpful acids during the process the grains undergo. These acids, in turn, release B vitamins and other enzymes that help with digestion and the absorption of minerals (Egea *et al*., 2020). This beverage can showcase a wide range of flavors, ranging from sweet to sour, as well as a diverse range of textures, ranging from light and effervescent to deep and yeasty. Depending on the length of time it is fermented for and the conditions that it is fermented under, the alcohol content can change. The consumption of water kefir is an excellent choice for individuals who adhere to a variety of dietary patterns or restrictions (Peluzio *et al*., 2021). The fact that it is completely devoid of dairy products and vegan makes it a versatile option.

Composition of Water Kefir

The microbiota that can be discovered in water kefir grains includes a wide variety of yeasts and bacteria (Van Wyk, 2019). Lactic acid bacteria, such as Lactobacillus species, such as Lactobacillus casei/paracasei, Lactobacillus hilgardii, and Lactobacillus nagelii, are included in this category (Cufaoglu & Erdinc, 2023). Yeasts, including Saccharomyces cerevisiae, are also frequently found in the environment. In certain instances, bifidobacteria such as Bifidobacterium aquikefiri and acetic acid bacteria such as Acetobacter fabarum can be discovered in lower quantities (Vilela *et al*., 2020). This is particularly the case when the fermentation process is prolonged or when oxygen is present. Sizeable amounts of Lactobacilli, in addition to Leuconostocs, Acetobacteria, Bifidobacteria, and various other bacterial genera and species, are included in the makeup of water kefir grains (Ganatsios *et al*., 2021).

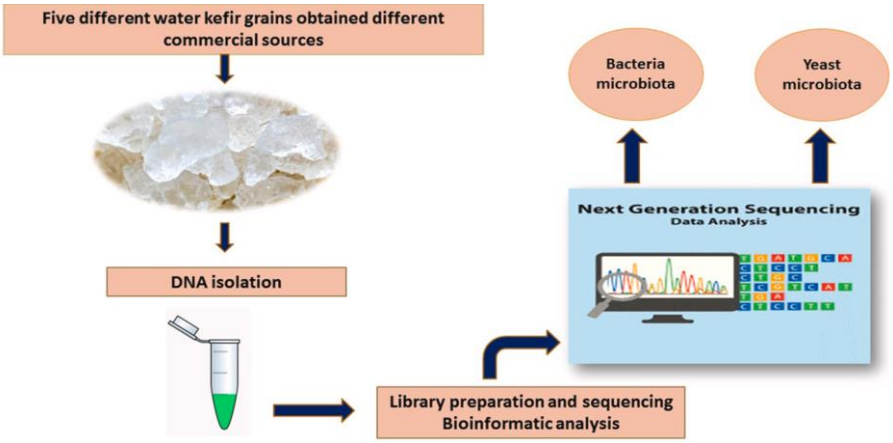

Figure 1: Water kefir: Metagenomic composition (Yerlikaya et al., 2022).

History of Water kefir

The history of water kefir is incredibly intriguing and captivating, just like the beverage itself (Marangoni Júnior et al., 2020). There is still a great deal of uncertainty surrounding the beginnings of this phenomenon, and numerous hypotheses are competing for prominence with regard to the period and location where it first appeared.

The tibicos culture, which is responsible for the production of water kefir grains, is thought to have developed on the pads of the Opuntia cactus and then been resurrected in a sugar-water solution at a later time (Baschali *et al*., 2017). At the end of the nineteenth century, there were documented instances of water kefir grains being utilized in a fermented beverage that was produced in Mexico from the juice of the prickly pear cactus that had been sweetened (Romero-Luna *et al*., 2017).

In a number of different places, including Tibet, the Caucasus Mountains, and the southern peninsula of Ukraine, water kefir grains have been discovered (Makwana & Hati, 2019). These grains are utilized and distributed in a variety of ways, and they are referred to by a number of different names. It has been difficult to pinpoint a definite origin due to the lack of previously documented history as well as the existence of several theories. Some reports even propose that Tibetan monks and European soldiers were the ones who used it.

The evolution of water kefir from its likely roots to its current status as a representation of well-being and tradition reveals the water kefir's enduring popularity and the cultural significance it holds in a variety of regions across the world (Melini *et al*., 2019).

Production of Water kefir

Water kefir, which is a fermented solution prepared from water, sugar, and dried fruits, is one of the potential sources that might be used as a starter culture (Cai *et al*., 2020). "Grains" are the macroscopic structures that are formed by the culture of microorganisms during the fermentation process. The majority of these structures are produced by yeasts and bacteria that produce lactic acid.

Water kefir can be produced more sustainably by using these grains, which are resistant to contamination and can be used to inoculate subsequent batches (Nicolescu *et al*., 2023).

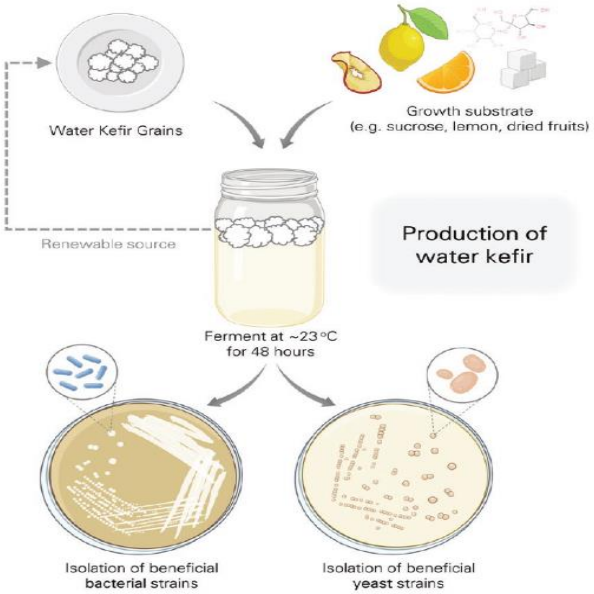

Figure 2: Water kefir production (Rodríguez et al., 2023).

Health benefits of Water kefir

The popularity of water kefir as a probiotic beverage can be attributed, in part, to the fact that it is known regarding the potential health benefits that it offers. The fact that it is a good source of antioxidants, which are known to play an important part in the process of supporting overall health and well-being, is widely acknowledged (Bengoa *et al*., 2021). According to (Barros *et al*., 2021), the

probiotics that are included in water kefir have the potential to improve digestive health, facilitate improved nutrient absorption, and enhance immunological function. Additionally, water kefir is a source of healthy bacteria that does not include any dairy, making it a wonderful choice for individuals who are unable to tolerate lactose or who adhere to a vegan diet (Farag *et al*., 2020). There has been research that has suggested that water kefir may have qualities that could potentially be used to fight cancer (Sharifi *et al*., 2017). Because of its vast range of health advantages, water kefir is a popular choice among those who are looking for a beverage that is both functional and beneficial to their health.

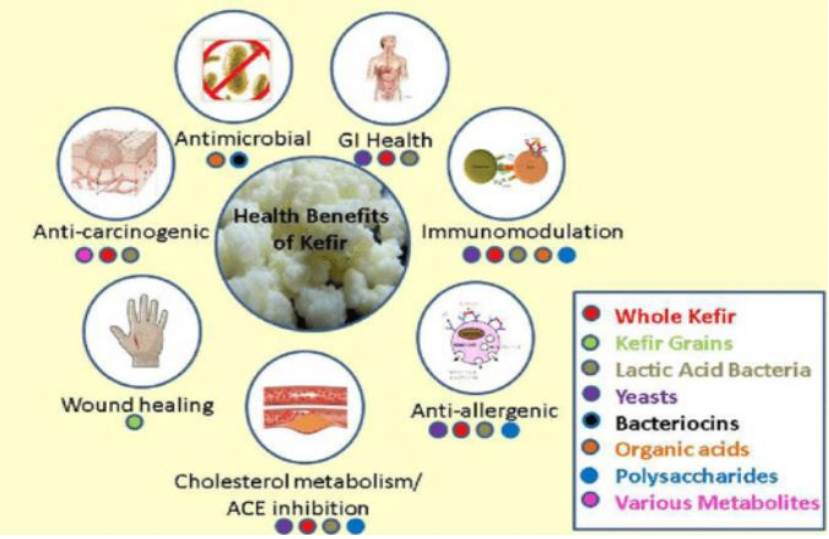

Figure 3: Kefir: Health benefits (Bourrie et al., 2016).

Conclusion

In conclusion, water kefir is a beverage that is developed through the process of fermentation. It is produced from water kefir grains, which are comprised of a culture of bacteria and yeast. It has a carbonation and a sour taste, which are its defining characteristics. Lactic acid bacteria, yeast, and acetic acid bacteria are some of the microbiotas that can be discovered in cereal grains made from water kefir. Depending on the location and the fermentation procedure, the microbiota can have a different composition than it would otherwise. Because of its reputation as a wholesome beverage that may have positive effects on one's health, water kefir has received a lot of attention recently. Because it does not include any dairy and is vegan, it is a versatile alternative. Although our knowledge of the history of water kefir is limited, it is generally accepted that it was first produced in Mexico in the late 1800s. Through the process of fermentation, a mixture of sugar water and water kefir grains is utilized in the creation of water kefir. There is a vast variety of flavors and textures available in water kefir, and the amount of alcohol that it contains might vary. It is well-known for the health benefits it provides, which include enhanced digestion, nutritional absorption, and immunological function and function. Additionally, it is an excellent source of antioxidants and may possess anti-cancer qualities when properly utilized. To summarize, water kefir is a well-liked option for individuals who are looking for a beverage that is both practical and advantageous.

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