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# THE SENSORY AND INDUSTRY OPPORTUNITIES OF UTILIZING NOVEL PRODUCE IN A WATER KEFIR FERMENTATION:

# A REVIEW

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## Introduction

Water kefir belongs to a group of fermented beverages which are naturally low in alcohol and high in probiotics. According to consumer reports, low-alcoholic beverages are becoming a sought-after product due to the rise of health-conscious consumers during the COVID-19 pandemic. However, current research on the consumer acceptability of novel produce substrates for water kefir is scant.

## Background and Process Flow Diagram

Kefir is a fermented product which is composed of kefir grains known to ferment fruits, vegetables, molasses, milk and other available sucrose-based sugar solutions often consumed for probiotic properties (Corona, 2016). Kefir grains are a natural matrix of exopolysaccharides, or kefiran, which is primarily composed of lactic acid bacteria (LAB) within the lactobacillus genus consisting of *Lactobacillus paracasei, Lb. hilgardii, and Lb. nagelii* as well as varying yeast species and/or acetic acid bacteria (Lynch, 2021; Azizi, 2021). With fermentation substrate versatility, kefir grains are broadly grouped into two separate groups based on the substrate: milk kefir and water kefir. Kefir made from milk can provide antioxidant and antimutagenic activity, which are helpful to treat tuberculosis, gastrointestinal disease and cancer (Gulitz, 2011). Nonetheless, it still has limitations. For those who follow a vegan diet and those who are lactose intolerant, alternatives to milk are needed. Therefore, water kefir fulfills a need.

Water kefir is composed of three main ingredients, kefiran, sugar, and water. In order to improve the taste of water kefir, fresh and dried fruits are traditionally added into the water kefir (Azizi, 2021). The fermented product is a drink with a certain degree of turbidity and carbonation, fruity, acidic, sour, and slightly carbonated, with low alcohol content and high content of lactic and/or acetic acid, containing microorganisms. The production of water kefir must take place within certain conditions, such as the fermentation temperature between 25 and 30°C. In addition, the pH drops throughout the fermentation process, from the initial pH of about 7 to a final range of 3.0 to 4.5 (Martinez-Torres, 2017). It should be noted that kefir grains can adapt to a substrate, to a certain extent, allowing for the production of new probiotic products (Tzavaras, 2022). This adaptation can be affected by many parameters both in the grains and in the fermented product due to substrate composition, temperature, agitation rate, time, and storage conditions (Laureys, 2021, Ribeiro, 2020, Mustafa, 2019, Laureys, 2019).

Juices (from fruits and vegetables) can provide an alternative means for creating probiotic cultures because they are considered healthy products and are recommended to be more regularly consumed (Aspri, 2020). In addition, fruit juices are rich in sugars, minerals, and vitamins, which are used as a substrate by probiotics and in combination with a rapid passage through acidic stomach conditions result in the high viability of probiotic cells (Dias, 2018). Besides fruits and vegetables, water kefir has many positive effects on human health. Several of the different live microorganisms in water kefir grains have probiotic properties that exert beneficial health effects to the host when sufficiently consumed (Koh Wee Yin, 2018). As the evidence for the positive effects of water kefir on health increases, the number of scientific studies on water kefir is increasing. Nevertheless, there are very few studies on the use of fruits and vegetables in water kefir fermentation and how this inclusion effects the sensory characteristics on the beverage.

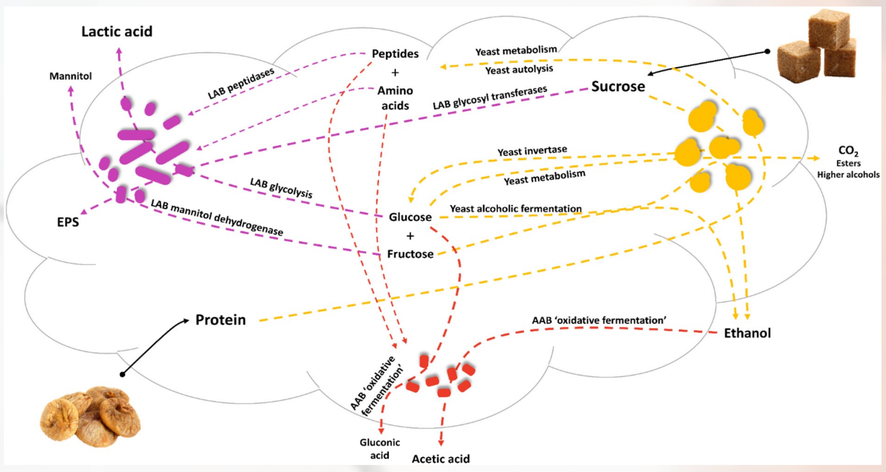


***Figure 1:*** Primary metabolites, interactions, and products within the water kefir kefiran (Lynch, 2021)

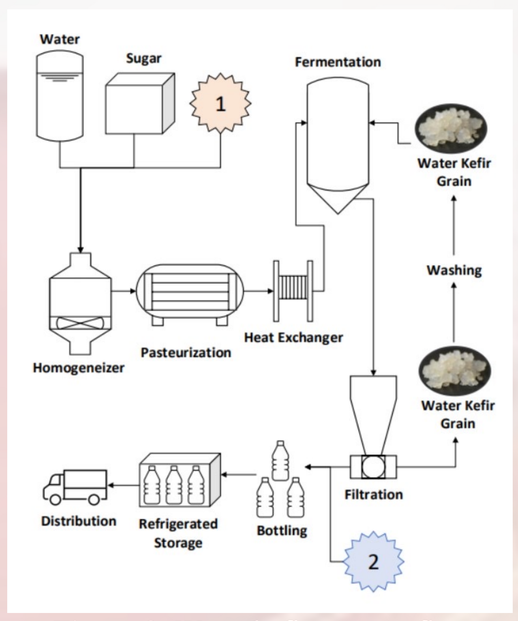


***Figure 2:*** Water kefir process flow diagram with numbered highlights for potential produce inclusions

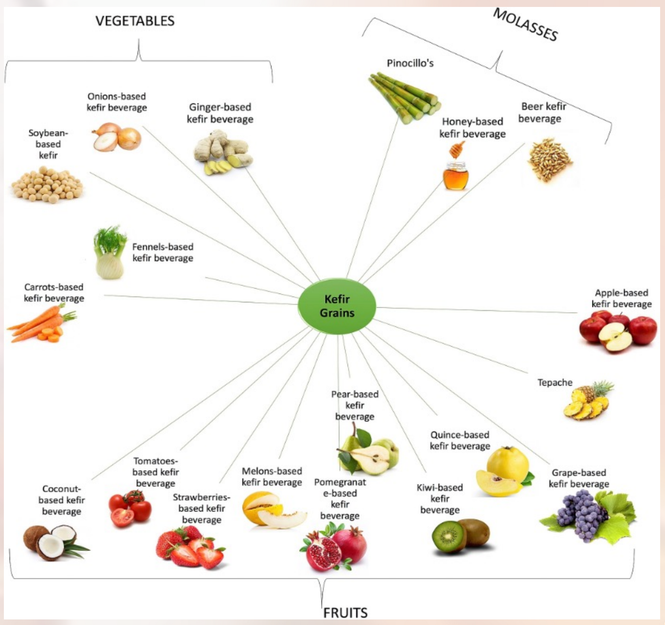


***Figure 3:*** Novel produce inclusions for water kefir drinks (Fiorda, 2017)

## Fruit Impacting Sensory

The consumption of fruits and vegetables is strongly encouraged by official authorities because of their functional properties such as reducing the risk of many diseases and anti-aging (USDA, 2021; Randazzo, 2016). Using fruits for water kefir fermentation (Figure 3 provides some examples) the production of new functional and probiotic beverages have been created (Tzavaras, 2022; Puerari, 2012). However, it is necessary to understand the sensory impact that probiotic cultures have on nondairy systems. These fruit and/or vegetable inclusions can ultimately effect the characteristics of the beverage produced in terms of the final beverage's aroma, taste, and texture. Optimizing the consumers acceptability for these novel produce fermented drinks can result in the western commercialization of a vegan probiotic alternative.

1

To ensure the safety of the end product and prevent contamination of the kefiran, novel produce will be pasteurized along with the sugar water to be fermented. Through the addition of novel produce during this step, the kefiran matrix metabolizes the substrate and produce new volatiles, acid concentrations, color, and varying mouthfeels (Koh Wee Yin, 2018; Tavares, 2021; Corona, 2016; Ozcelik, 2021; Puerari, 2012; Paredes, 2022; da Costa, 2018). It should be noted that during this step, the pasteurization time and temperature treatment should be optimized to limit as much Maillard browning product and degradation of temperature sensitive desirable compounds such as polyphenols (Randazzo, 2016)

2

Pasteurized novel produce inclusions might be best added after fermentation. This could be due to unwanted products from kefir fermentation such as increase acetic acid due to water kefiran containing more acetic acid bacteria compared to milk kefiran (Laureys, 2014). Additionally, adding produce at the end, specifically fruit, has been shown to reduce the perceived amount of acidity in the finished product (Bielska, 2021). However, due to the many health benefits of water kefir fermentation products, many choose to addback sugar post fermentation when compared to adding pasteurized juice(s).

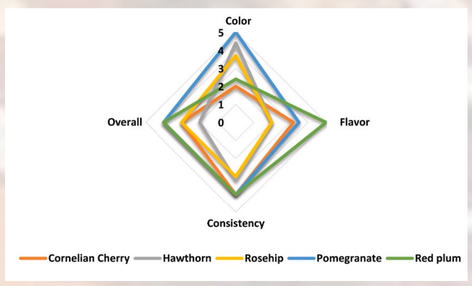


***Figure 4:*** Sensory analysis results of five water kefir drinks after 7 days storage (Ozcelik, 2021)

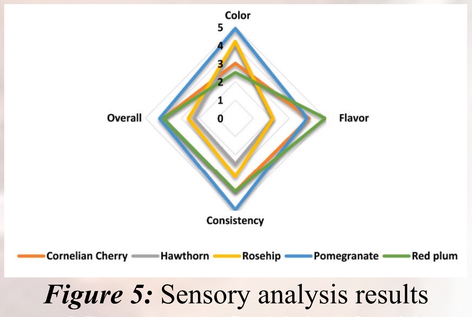


***Figure 5:*** Sensory analysis results of five water kefir drinks after 28 days storage (Ozcelik, 2021)

## Marketing Trends and Production Considerations

The functional foods industry is valued at $171 billion dollars as of 2021 with the probiotic market projected to reach $3.3 million dollars by 2025 (ResearchAndMarkets, 2021). However, probiotics including yogurt and milk kefir make finding a non-dairy alternative more difficult. In total, 75% of the world's population suffers from lactose intolerance (Panghal, 2018). Furthermore, the ongoing trend of vegetarianism, with an increasing number of vegan vegetarians, has established a massive worldwide importance of non-dairy probiotic products (Alcorta, 2021). Therefore, the production of a water-based probiotic, such as water kefir, would help meet the current demands of the consumer.

However, adding probiotics to fruit juices is more complex when compared to adding to the dairy matrix. The main challenges facing produce fermented kefir are due to some of its intrinsic properties, such as low pH and high concentration of organic acids which could negatively impact the viability of probiotics (Terpou, 2019). Other factors affecting this viability include storage time and temperature. Perspectives of the consumer have shown to be influenced to associate "healthy" foods with unacceptable flavors, assuming in their mind that sensory pleasure must be sacrificed to achieve a healthy diet (Tuorila and Cardello, 2002). Luckily, growing research is providing ways to combat many of these sensory problems from adding calcium into the fermentation water to aid in buffering capacity to increased gut microbiota to aid in fighting off infections and/or disease (Laureys, 2019; Antunes, 2020)

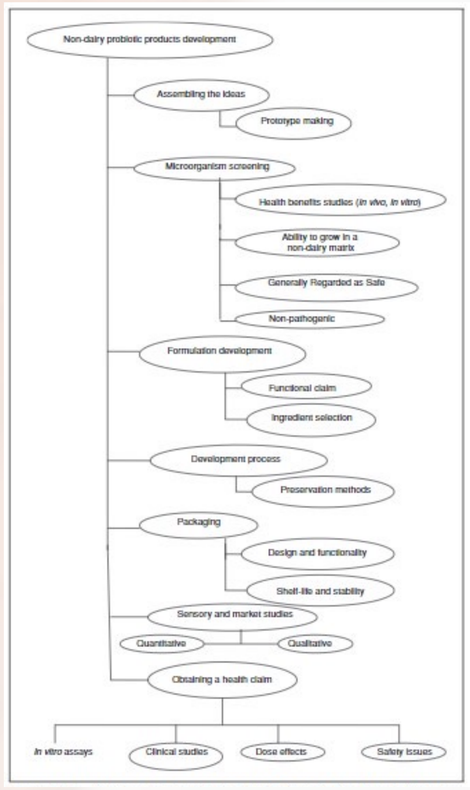


***Figure 6:*** Considerations for nondairy probiotic food producers for product development (Granato, 2010)

## Conclusion

Water kefir is a rich source of probiotics with potential medicinal benefitsfor all dietary needs. Additionally, the sensory effects from novel produce has broad applicability to numerous beverage fermentations – affecting the texture, aroma, taste and color.

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## For Further Information

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