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UTILIZING FOOD WASTE TO CREATE PROBIOTIC-RICH TEPACHE

[1]HEMAVARSHINI M, [2] KAVYA T, [3]ADHISAKTHI S, [4]ABARNA R, [5]Ms ANJALI M

[1]MSc FOOD AND NUTRITION, [5]ASSISTANT PROFESSOR
[1]FOOD SCIENCE AND NUTRITION,
[1]Dr. N.G.P ARTS AND SCIENCE COLLEGE, COIMBATORE, INDIA

Abstract: Probiotics are live microorganisms that, when given in sufficient quantities, boost the host's health. The metabolites that the microorganisms produce are what give probiotics their "health-promoting" properties, which include boosting immunity, avoiding allergies, preventing eczema, and repairing the intestine. Made from pineapple peels, water, sugar (brown sugar or piloncillo, an unprocessed sugar cane), and spices (pepper and cinnamon), tepache is the most popular traditional fermented beverage. the possibility of making a probiotic-rich tepache out of food waste, particularly pineapple peels. The pineapple peels are converted into a cool, probiotic-rich drink by a straightforward fermenting procedure. In addition to being a sustainable way to reduce food waste, the resulting tepache has a distinct flavour combination and certain health advantages. By demonstrating the possibilities of upcycling food waste into useful, probiotic-rich goods, this creative method encourages a more sustainable and circular food system.

Index Terms - Probiotics, Tepache, Pineapple peel, Food waste.

I. INTRODUCTION

Fruit and vegetable peels, especially pineapple peels, are thrown away in large quantities in India. These peels are a great resource because they are high in fibre, minerals, and antioxidants. They wind up in landfills, though, as a result of poor use and ignorance, adding to waste and environmental problems. By using these peels, you may encourage sustainable agricultural methods, create revenue, and lessen waste. Making jams, pickles, and natural colours are a few creative ways to use these peels that can reduce waste and increase their value.

When eaten in enough amounts, probiotics—live bacteria—can have positive health effects. Probiotics have been around since the 1900s, when Russian scientist Elie Metchnikoff claimed that Bulgarian farmers' life was due to their use of fermented dairy products. Due to lactose sensitivity and vegetarianism, probiotics are now being replaced by non-dairy alternatives, such as fruit-based probiotics, rather than traditional dairy products. A viable substitute that increases fruit value and may have health advantages is fruit-based probiotics. (WHO/FAO, 2001).

Probiotics can help prevent and treat gastrointestinal illnesses, strengthen the immune system, and prevent mental health issues, among other health-promoting uses. Additionally, they are utilised in cosmetic products, animal feed, and fermented foods. All things considered, probiotics provide a safe, natural solution for general health and wellbeing, with advantages ranging from less IBS and IBD symptoms to better skin and mental wellness. (Mohit Manoj and Pawade, 2023).

Tepache, a traditional Mexican fermented beverage, has a rich history dating back to the pre-Hispanic era. Originating from the Aztecs and Mayans, tepache was made by fermenting pineapple pulp, creating a sweet and tangy drink. Over time, tepache evolved with the introduction of new ingredients and became an important part of Mexican culture. Despite a decline in popularity in the 20th century, tepache has experienced a recent resurgence, driven by the demand for artisanal beverages, and is now enjoyed globally for its unique flavour and potential health benefits. (Blanca Rosa Aguilar-Uscanga *et al*.,2024).

Tepache is a traditional Mexican fermented drink made from pineapple pulp, water, and sugar. It's prized for its unique flavour and potential health benefits, including probiotics, antioxidants, and anti-inflammatory agents. Tepache is produced through natural fermentation, giving it a tangy flavour and effervescent texture. It's a culturally significant beverage in Mexico, often consumed at social gatherings, and its popularity is growing globally. (Blanca Rosa Aguilar-Uscanga *et al*.,2024).

The probiotics, vitamin C, and anti-inflammatory qualities of tepache, a traditional Mexican fermented beverage, provide a host of health advantages. Vitamin C strengthens immunity and lowers oxidative stress, while the probiotics in tepache enhance digestion, immune system function, and gut health. Pineapple contains an enzyme called bromelain, which helps with digestion, lowers inflammation, and may help control blood sugar levels.

The health advantages of tepache include:

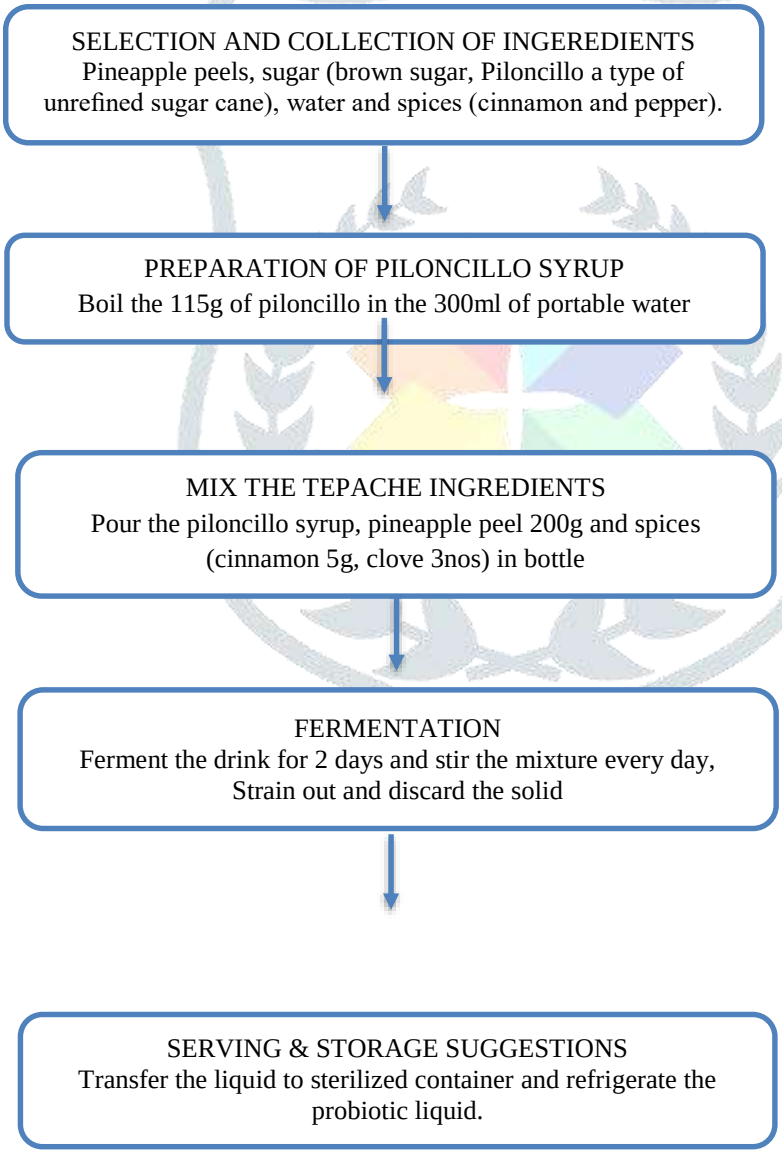
Boosting immunity and lowering oxidative stress
Promoting gut health and immunological function
Facilitating digestion and lowering inflammation
Controlling blood sugar levels, and
Offering hydration without consuming too many calories

Tepache is an excellent complement to a balanced diet because it is a low-calorie, nutrient-dense beverage that provides a cool substitute for sugary drinks.
(Novianti, T. et al., 2024).

II. METHODOLOGY

2.1 PREPARATION FOR THE PROBIOTIC DRINKS:

Tepache is a traditional Mexican fermented probiotic drink. Made from pineapple peel, sugar, water, and spices, it's rich in probiotics, antioxidants, and phytochemicals. Tepache supports gut health, immune function, and digestion. Its anti-inflammatory and antioxidant properties may reduce inflammation and chronic disease risk. A nutritious and sustainable option, Tepache utilizes discarded pineapple peel.



The first step in making probiotic tepache is choosing and gathering the materials, which include pineapple peels, water, sugar (Piloncillo, a kind of unrefined sugar cane), and spices (pepper and cinnamon). These components were picked with care because of their distinct qualities and tastes, which will enhance the tepache's overall personality.

Making the Piloncillo syrup is the next step, which is accomplished by boiling 115g of Piloncillo in 300ml of portable water. The sugar is dissolved in this procedure, producing a thick, syrupy liquid that will be the tepache's base.

The other components, such as pineapple peel, cloves, and cinnamon, are then combined with the syrup in a bottle. After that, the mixture is allowed to ferment for two days while being stirred every day to provide adequate aeration and mixing. Following the fermentation process, the sediments are filtered out and thrown away, leaving behind a flavourful and probiotic-rich beverage.

In order to slow down fermentation and maintain the beneficial microbes, the probiotic tepache is then moved to a sterile container and placed in the refrigerator. This cool beverage, which offers a distinct taste combination and an increase in probiotic advantages, can now be served cold. (Jl. A. Yani Tromol Pos I., *et al* 2023).

III. FOOD WASTE

A large amount of food waste comes from the fruit and vegetable industry, making it a major global concern. Despite being one of the most eaten food items, fruits and vegetables are also highly perishable, which increases the likelihood of waste in the supply chain. Fruits and vegetables are lost or wasted from the farm to the table for a variety of reasons, such as consumer behaviour, handling and storage procedures, and cosmetic standards. (Kumar, P., *et al* 2017).

Food waste in fruits and vegetables has wide-ranging effects on the economy, the environment, and society. Water, energy, and land are among the major resources needed for the production, transportation, and storage of fruits and vegetables. The resources utilised to make these goods are also wasted when they are discarded. Additionally, because methane, a powerful greenhouse gas, is produced by the decomposition of organic materials in landfills, food waste increases greenhouse gas emissions. (Sharma, S., *et al* 2019).

A frequent culinary waste product, pineapple peel is a veritable gold mine of minerals and possible health advantages. Usually thrown away after eating a pineapple, the peel is a significant resource that shouldn't be squandered because it is high in fibre, manganese, and vitamin C. People can improve sustainability, cut down on food waste, and benefit from the nutritious value of this frequently disregarded byproduct by using pineapple peel. (Chandra, P., *et al* 2019).

Pineapple peel has a remarkable nutritional profile, including significant quantities of fibre, manganese, and vitamin C. It has been demonstrated that these nutrients enhance digestion, lower inflammation, and strengthen the immune system. Pineapple peel also contains a variety of phytochemicals and antioxidants that have been connected to a number of health advantages, such as antibacterial and anti-inflammatory qualities. (Chandra, P., *et al* 2019).

To reduce food waste and harness the nutritional potential of pineapple peel, individuals can explore various uses for this versatile byproduct. Pineapple peel can be used to make tea, added to smoothies or juices, or incorporated into baked goods and other recipes. Furthermore, pineapple peel can be used as a natural remedy for various ailments, such as digestive issues and inflammation. (Chandra, P., *et al* 2019).

In conclusion, pineapple peel is a valuable resource that should not be discarded as food waste. By embracing this nutritious byproduct, individuals can reduce waste, promote sustainability, and reap the nutritional rewards of pineapple peel.

IV. PROBIOTIC

Probiotics are live bacteria that, when taken in sufficient quantities, have positive health effects, including reducing the symptoms of gastrointestinal illnesses and strengthening the immune system. Since Elie Metchnikoff linked fermented dairy products to longer lifespans in the early 1900s, the idea of probiotics has existed. The formal definition of "probiotic" was established in 2013 as living microorganisms that help the host's health.

In addition to nutritional supplements, probiotics are present in fermented foods including yoghurt, kefir, and sauerkraut. The two most widely utilised probiotic microorganisms are Bifidobacterium and Lactobacillus. It has been demonstrated that probiotics can both prevent and treat a number of illnesses, such as allergies, mental health issues, and gastrointestinal issues. They provide an all-natural and secure means of enhancing general health and wellness. (Hill et al., 2014).

Fruit-based probiotic beverages are becoming more popular as a non-dairy substitute for conventional probiotic products. Fruit juices can be used as a vehicle for adding probiotic bacteria, offering a delightful and nutritious way to promote intestinal health. Fruits can have their market value raised and post-harvest losses avoided by producing probiotics from them. Fruit drinks can benefit from fermentation with probiotic bacteria to enhance their flavour and aroma while extending their shelf life. (I Syiemlieh, *et al.,* 2022).

Probiotics can be used to prevent and treat gastrointestinal illnesses, strengthen the immune system, and avoid allergies and mental health issues, among many other uses in enhancing human health and wellbeing. All things considered, probiotics provide a safe and natural way to support general health and wellbeing, and research into their use in fruit-based beverages and value-added products is encouraging. (Hill et al., 2014).

V. TEPACHE

Tepache is a traditional Mexican fermented beverage made from pineapple pulp, water, and sugar. It has been consumed for centuries in Mexico and has gained popularity globally due to its unique flavor and potential health benefits. Tepache has a rich history dating back to the pre-Hispanic era, with the indigenous people of Mexico fermenting pineapple pulp to create a sweet and tangy drink. The beverage has evolved over time, with the introduction of new ingredients and production methods. (Jl. A. Yani Tromol Pos I., *et al* 2023)

Tepache is produced through a natural fermentation process, which gives it a characteristic tangy flavor and effervescent texture. The beverage contains beneficial compounds, including probiotics, antioxidants, and anti-inflammatory agents, which may have positive impacts on gut health and chronic disease prevention. Tepache is an important part of Mexican cultural heritage, with traditional recipes and production methods passed down through generations. Its popularity is growing globally, driven by interest in artisanal and craft beverages. (Jl. A. Yani Tromol Pos I., *et al* 2023)

Tepache, a traditional Mexican fermented beverage, offers numerous health benefits due to its probiotic content, vitamin C, bromelain, and other bioactive compounds. The fermentation process enhances the bioavailability of nutrients, supporting gut health, immune function, and digestion. (R.I. Corona-Gonz´ alez1., *et al* 2013).

Tepache's probiotics, derived from the fermentation process, promote a healthy gut microbiome, aiding digestion and preventing gastrointestinal issues. The beverage also supports immune function due to its high vitamin C content, which aids in the production of white blood cells and neutralizes free radicals. The anti-inflammatory properties of bromelain in pineapple may contribute to immune support by reducing inflammation in the body. Additionally, tepache's ability to hydrate the body while being low in calories makes it a healthier alternative to sugary drinks.

Tepache may also play a role in managing inflammation, regulating blood sugar levels, and improving insulin sensitivity. Overall, tepache is a nutrient-dense, low-calorie beverage that offers a refreshing and healthful substitute for many sugar-filled drinks, supporting overall well-being. (Jl. A. Yani Tromol Pos I., *et al* 2023)

Pineapple peel, often discarded, is a nutrient-rich byproduct containing high amounts of vitamin C, manganese, and fiber. Research reveals that pineapple peel extract possesses anti-inflammatory, antimicrobial, and antioxidant properties, potentially protecting against chronic diseases like heart disease, diabetes, and certain cancers. The bromelain enzyme in the peel also offers anti-inflammatory and digestive benefits, making it a potential natural remedy for managing digestive disorders. (Pérez-Jiménez, J. et al. (2009).

Jaggery, an unrefined cane sugar, is a nutrient-rich natural sweetener that offers numerous health benefits. Unlike refined sugars, jaggery retains minerals like iron, magnesium, and potassium, making it a healthier alternative. Jaggery has been traditionally used to aid digestion, boost energy, and even help manage blood pressure and diabetes. Its rich antioxidant properties also help protect against oxidative stress and inflammation, promoting overall well-being. (Titta Novianti1., *et al* 2024).

Cinnamon, a sweet and aromatic spice, has been a prized ingredient for centuries, renowned for its distinctive flavor and numerous health benefits. Derived from the inner bark of the cinnamon tree, this ancient spice has been used in

traditional medicine, cooking, and rituals, offering a wealth of antioxidant, anti-inflammatory, and antimicrobial properties that have captivated the attention of researchers and health enthusiasts alike. (Titta Novianti1., *et al* 2024).

Clove, a versatile spice derived from the flower buds of the clove tree, has been prized for its medicinal and culinary properties for centuries. Rich in antioxidants, vitamins, and minerals, clove possesses anti-inflammatory, antibacterial, and antifungal properties, making it a natural remedy for various ailments. Clove has been traditionally used to alleviate toothaches, digestive issues, and respiratory problems, while its essential oils have been used to reduce stress, improve sleep, and boost immunity, showcasing its multifaceted benefits for overall health and well-being. (Titta Novianti1., *et al* 2024).

VI. CONCULATION

Food waste has serious negative effects on the economy, the environment, and society, especially in the fruit and vegetable industry. Vitamin C, manganese, and fibre are among the many nutrients and potential health benefits found in pineapple peel, a common food waste product that can strengthen the immune system, lower inflammation, and enhance digestion. Probiotics, which are present in fermented foods and supplements, provide several health advantages, such as enhancing immunity and easing gastrointestinal issues. Probiotics, antioxidants, and anti-inflammatory substances found in tepache, a traditional fermented beverage from Mexico, enhance immune system function, digestion, and gut health. In addition to offering a safe and natural way to support general health and well-being, using pineapple peel and eating tepache can decrease food waste, encourage sustainability, and give nutritional benefits.

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