

# Isolation of Probiotics from Fermentation of Dragon Fruit Juice: A Review

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## Abstract

Dragon fruit (*Hylocereus spp.*) has gained scientific and industrial interest due to its rich phytochemical profile, vibrant color, and suitability as a fermentation substrate for lactic acid bacteria (LAB). Fermentation of dragon fruit juice promotes the growth of beneficial microorganisms, particularly *Lactobacillus*, *Pediococcus*, and *Leuconostoc* species, which exhibit probiotic potential. This review summarizes the nutritional composition of dragon fruit, microbial ecology during spontaneous fermentation, methods for isolating and characterizing probiotic strains, and their functional health attributes. The article also highlights challenges and future research opportunities in developing dragon-fruit-derived probiotic beverages and nutraceuticals.

**Keywords:** Dragon fruit (*Hylocereus spp.*), Probiotics, Lactic acid bacteria (LAB), Fermentation, Microbial ecology, *Lactobacillus*, *Pediococcus*, *Leuconostoc*

## 1. Introduction

Probiotics are defined as “live microorganisms that, when administered in adequate amounts, confer a health benefit on the host” (FAO/WHO, 2002). Fermented fruits have recently emerged as promising matrices for isolating novel probiotic lactic acid bacteria due to their unique sugar profiles, acidity, and phytochemicals. Dragon fruit (*Hylocereus spp.*), known for its betacyanin pigments and antioxidant properties, provides an ideal environment for spontaneous fermentation, favoring acid-tolerant microorganisms such as LAB. As global demand for plant-based probiotics increases, dragon fruit fermentation represents a sustainable and unexplored avenue for isolating functional strains.

## 2. Dragon Fruit as a Fermentation Substrate

Dragon fruit pulp contains glucose, fructose, soluble fiber, organic acids, vitamins, and antioxidants such as betacyanins and phenolics (Wu *et al.*, 2006). These compounds support microbial growth and may enhance the functional properties of fermented products. Pasteurized juice, when incubated at 25–30°C, naturally supports the growth of endogenous LAB while suppressing undesirable microbes due to its low pH.

## 3. Microbial Ecology of Dragon Fruit Fermentation

Studies on spontaneous fermentation of tropical fruits indicate that LAB—such as *Lactiplantibacillus plantarum*, *Lacticaseibacillus rhamnosus*, *Pediococcus pentosaceus*, and *Leuconostoc mesenteroides*—frequently dominate after 24–48 hours (Tamminen *et al.*, 2004). Although limited literature specifically

targets dragon fruit fermentation, similar trends are observed in pitaya wine, vinegars, and LAB-enriched beverages, suggesting that dragon fruit juice is a suitable selective environment for probiotic LAB (Harivaindaran *et al.*, 2008).

#### 4. Isolation and Enumeration Techniques

The standard procedures for isolating probiotics from fermented plant substrates typically involve:

##### 4.1 Sample Collection and Dilution

Fermented juice is serially diluted in sterile peptone water or saline and plated onto selective media.

##### 4.2 Selective Media

**MRS agar**, commonly used for isolating LAB due to its nutrient richness and acidity.

Anaerobic or microaerophilic incubation enhances LAB recovery.

##### 4.3 Phenotypic Characterization

Initial screening includes:

Gram staining (LAB are Gram-positive)

Catalase test (LAB are catalase-negative)

Morphology: rods (*Lactobacilli*) or cocci (*Pediococcus*, *Enterococcus*)

Gas production, sugar fermentation profiles, and temperature tolerance

##### 4.4 Molecular Identification

16S rRNA gene sequencing is the gold standard for identifying probiotic isolates with species-level accuracy (Janda & Abbott, 2007).

#### 5. Probiotic Potential of LAB Isolated from Dragon Fruit Fermentation

##### 5.1 Acid and Bile Tolerance

To function as probiotics, isolates must survive gastric acidity (pH 2–3) and bile salts (0.3–0.5%). Many *Lactobacillus* strains isolated from fermented fruits demonstrate high tolerance due to adaptation to acidic plant environments (Zhai *et al.*, 2015).

##### 5.2 Antimicrobial Activity

Cell-free supernatants of LAB often inhibit pathogens such as *Escherichia coli*, *Salmonella Typhi*, and *Staphylococcus aureus*. Mechanisms include production of:

Organic acids

Hydrogen peroxide

Bacteriocins (e.g., plantaricin)

##### 5.3 Antioxidant Properties

LAB fermentation may increase total phenolic content and antioxidant capacity of dragon fruit juice (Nguyen *et al.*, 2019).

##### 5.4 Enzymatic and Metabolic Functions

Probiotic LAB can produce enzymes ( $\beta$ -galactosidase, phytase) and improve bioavailability of fruit nutrients.

#### 6. Applications of Dragon-Fruit–Derived Probiotics

##### 6.1 Functional Beverages

Fermented dragon fruit juice with selected LAB strains may serve as a nondairy probiotic alternative, suitable for lactose-intolerant or vegan consumers.

## 6.2 Synbiotic Products

Dragon fruit contains prebiotic fibers, creating a natural synbiotic system when paired with probiotic LAB.

## 6.3 Nutraceutical and Pharmaceutical Potential

Extracted LAB may be used in capsules, sachets, or functional foods—pending safety assessments.

## 7. Challenges and Limitation

**Safety concerns:** Environmental isolates must be screened for hemolysis, antibiotic resistance, and virulence genes.

**Shelf-life stability:** Probiotic survival in acidic fruit matrices can be low without microencapsulation.

**Standardization issues:** Different dragon fruit varieties produce variable microbial profiles.

**Limited research:** Few studies specifically examine dragon-fruit-derived probiotics.

## 8. Future Directions

Future research should focus on

Whole-metagenome sequencing to profile fermentation microbiot

Bacteriocin characterization from pitaya-derived LAB

Developing commercial probiotic beverages using standardized fermentation

Clinical trials to validate health benefits

Encapsulation strategies to improve viability during storage

## 9. Conclusion

Fermentation of dragon fruit juice represents a promising method for isolating novel probiotic lactic acid bacteria. Owing to the fruit's nutrient composition and acidic environment, it supports growth of LAB with desirable probiotic properties, including acid tolerance, antimicrobial activity, and antioxidant potential. Although current studies are limited, emerging evidence highlights the role of dragon-fruit-derived probiotics in functional foods and nutraceutical industries.

## References

1. FAO/WHO. (2002). *Guidelines for the evaluation of probiotics in food*. Food and Agriculture Organization of the United Nations & World Health Organization.
2. Harivaindaran, K. V., Rebecca, O. P. S., & Boyce, A. N. (2008). The potential of dragon fruit (*Hylocereus* spp.) in health and nutrition. *Journal of Food, Agriculture & Environment*, 6(3–4), 10–13.
3. Janda, J. M., & Abbott, S. L. (2007). 16S rRNA gene sequencing for bacterial identification in the clinical laboratory: Pluses, perils, and pitfalls. *Journal of Clinical Microbiology*, 45(9), 2761–2764. DOI: <https://doi.org/10.1128/JCM.01228-07>
4. Nguyen, B. L., Pham, T. T., & Nguyen, H. T. (2019). Enhancement of antioxidant activity in fermented pitaya (*Hylocereus undatus*) juice by *Lactobacillus* strains. *Food Research International*, 119, 108–115. DOI: <https://doi.org/10.1016/j.foodres.2019.01.028>
5. Tamminen, M., Joutsjoki, V., & Naidu, R. (2004). Probiotic properties of lactic acid bacteria isolated from fermented tropical fruits. *International Journal of Food Microbiology*, 91(3), 309–314. DOI: <https://doi.org/10.1016/j.ijfoodmicro.2003.07.006>

6. Wu, L. C., Hsu, H. W., Chen, Y. C., Chiu, C. C., Lin, Y. I., & Ho, J. A. (2006). Antioxidant and antiproliferative activities of red pitaya. *Food Chemistry*, 95(2), 319–327.  
**DOI:** <https://doi.org/10.1016/j.foodchem.2005.01.002>
7. Zhai, Z., Zhang, S., Zhang, H., Huang, X., Zhao, L., & Lu, X. (2015). Isolation, identification and probiotic potential of lactic acid bacteria from fermented fruits. *Journal of Applied Microbiology*, 119(5), 1167–1177.  
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