Potential for Strengthening Immune Function and Sports Performance with *Lactobacillus pentosus* b240

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**PURPOSE:** Recently, functional beverages have played a crucial role in supplementing basic nutrition and providing performance-enhancing and health benefits. Among these beverages, those containing *Lactobacillus pentosus* strain b240 (b240) have been utilized to promote the health and performance of athletes. This study aims to provide an overview of recent research findings regarding the nutritional and physiological efficacy of a novel functional beverage containing probiotic b240 for enhancing sports performance and promoting health.

**METHODS:** This review collected and analyzed data from previous studies to evaluate the nutritional and physiological benefits of a novel functional beverage containing probiotic b240 for enhancing exercise performance and health. The studies were obtained through online databases and search engines, including PubMed, Web of Science, and Google Scholar.

**RESULTS:** Beverages containing b240 positively affect immune strengthening, offering significant physiological and nutritional advantages. These innovative conditioning beverages enhance sports performance through their biological benefits and promise to improve secretory immunoglobulin A (sIgA), promoting overall health. Additionally, the potential applications of b240 in enhancing the immune system and performance could be significant for public health, particularly given the common obstacle of time constraints to regular exercise.

**CONCLUSIONS:** These results indicate the need for deep insights into effective nutritional and exercise management strategies for enhancing immune function and sports performance. Further studies are required to investigate the effects of probiotic b240 conditioning beverages on exercise performance and healthcare.

**Key words:** b240, Probiotics, Immunity, Sports supplement, Functional beverages

**INTRODUCTION**

The immune function refers to the body’s ability to defend its internal environment against external antigens, constituting a robust defense system that protects the body. It has long been recognized as a crucial factor in maintaining homeostasis within the body. Regarding the relationship between exercise performance and immune function, it is generally understood that a well-designed exercise program, with regular exercise, can enhance immune functions [1-3]. However, excessive exercise intensity and volume can potentially impair immune function.

In particular, elite athletes engage in long-term, high-intensity training to consistently achieve peak performance, resulting in significantly elevated physiological stress levels for each athlete [4]. This heightened stress among athletes can compromise their immune system, increasing the likelihood of respiratory, endocrine, and other disorders and the risk of injury [5]. Research findings suggest that while high-intensity exercise may suppress the immune system, elite athletes should maintain low-to-moderate-intensity training during infections to improve immune function and physical fitness. Furthermore, it recommends avoiding high-intensity training during vaccination and employing nutritional strategies to support immune function during intense training periods [6] (Fig. 1). Considering the various conditions that excessively emphasize the importance of improving athletic performance, most athletes are highly likely to experience difficulties in maintaining bodily homeostasis, in-
including immune function, due to excessive training. Therefore, it is essential to conduct a thorough evaluation of athletes’ conditions, encompassing factors like intense training, immune levels, overall physical and mental well-being, as well as performance.

The importance of nutrition intake is being emphasized as a significant method to mitigate such immune suppression. Among these approaches, functional drinks and/or beverages designed to provide health benefits related to performance enhancement, basic nutritional intake support. Examples of functional drinks include sports drinks, energy drinks, ion beverages, amino acids, vitamins, minerals, as well as fruit or vegetable drinks. These functional beverages are gaining popularity among individuals seeking specific health benefits and performance improvements [7]. Lately, beverages containing Lactobacillus pentosus strain b240 (b240) with protein and/or electrolyte have been developed, and such immune-enhancing functional drinks are expected to contribute to the health and performance enhancement of athletes by promoting hydration, maintaining fluid levels, and facilitating recovery [8].

Recently, we investigated the effectiveness of immune-strengthening conditioning nutritional beverages consumed by elite athletes. A total of 107 athletes from various sports participated in an 8-week experiment, consuming the beverage daily and providing feedback through surveys. Results showed significant improvements in physical condition, mental stability, and performance after 4 and 8 weeks of intake. The study suggests that the beverage, containing probiotic b240 and protein, could enhance the performance and physiological utility of athletes, potentially gaining popularity among individuals seeking health benefits and improved exercise performance [9]. Therefore, this conditioning beverage supports the health and well-being of individuals striving to maintain optimal physical condition in daily life. Essentially, this novel conditioning beverage is a functional drink that could enhance immune function and support the health and well-being of athletes and individuals aiming to maintain optimal physical condition.

METHODS


Inclusion criteria followed were: 1) access to full-text articles, 2) published in English, and 3) designed as randomized control studies (RCTs). Exclusion criteria followed were: 1) accessed through conference abstracts and books, 2) published in languages other than English.

RESULTS

1. Introducing a novel conditioning beverage of lactic acid bacteria b240 for immune strengthening

_Lactobacillus_ pentosus strain b240 (b240) is a plant-derived lactic acid bacterium discovered from the fermented tea “Miyan,” traditionally consumed in northern Thailand. This tea, known locally for its health benefits, is prepared by fermenting tea leaves. It has been recognized for its role in supporting the maintenance of physical well-being and daily risk preparation [10]. The study evaluated the toxicity and genotoxic potential of b240, commonly found in fermented foods, in both viable and nonviable forms. Results indicated no mortalities or treatment-related effects, concluding that nonviable b240 was safe for consumption within the tested doses.

Additionally, a previous study assessed the safety of b240, commonly...
utilized in fermented foods, in both viable and nonviable forms. Testing conducted on rats over short-term and sub-chronic periods revealed no toxicity or genotoxic potential [11]. Furthermore, another study investigated the protective effect of orally ingested b240 against the common cold in elderly adults. Three hundred participants were randomly assigned to receive either a placebo, low-dose b240, or high-dose b240 tablets daily for 20 weeks. Results indicated that both the low-dose and high-dose b240 groups exhibited significantly lower incidence rates of the common cold compared to the placebo group. The study assessed the toxicity and genotoxic potential of b240, commonly employed in fermented foods, in both viable and nonviable forms. Results indicated no mortalities or treatment-related effects, leading to the conclusion that nonviable b240 is safe for consumption within the tested doses.

Additionally, general health perception improved dose-dependently in the b240 groups. These findings suggest that oral intake of b240 can effectively reduce the incidence of the common cold in elderly adults, potentially enhancing resistance to infection through mucosal immunity. No adverse effects were observed in general health, organ function, or histopathology, even at the highest dose tested, which was 2,000 mg/kg/day for nonviable b240. Mutagenicity tests also showed no concerns. Overall, these studies suggest that b240 is safe for consumption within the tested doses and forms.

2. Differentiating between two types of b240 conditioning beverages

Functional sports beverages must fulfill several primary functions, including hydration, electrolyte replenishment, glycogen replenishment, and protein supplementation. During prolonged exercise, the body experiences fluid loss and electrolyte imbalances. Merely drinking water to quench thirst can rapidly decrease plasma electrolyte concentrations and osmotic pressure, potentially leading to severe conditions such as hyponatremia, characterized by confusion, disorientation, and seizures. Moreover, beverages containing proteins and carbohydrates can help repair exercise-induced muscle damage, underscoring the importance of protein as a nutritional supplement. Additionally, novel conditioning beverages containing lactic acid bacteria b240 are available in two types tailored to meet the specific characteristics of electrolytes and protein.

The first type of beverage offers a convenient way to consume protective lactic acid bacteria b240 while also helping to balance electrolyte concentrations, supporting the health and well-being of individuals concerned with maintaining optimal physical condition [12] (Table 1). An other study examined the impact of a carbohydrate-electrolyte drink on voluntary fluid intake, effect, and self-selected exercise intensity during recreational exercise following fluid restriction. Participants were provided with either water or a carbohydrate-electrolyte solution (CES) during exercise [13]. The results indicated that CES intake led to greater fluid intake during exercise, resulting in more adequate hydration compared to water alone. Additionally, CES intake was associated with higher plasma glucose concentrations, increased pleasure ratings, and a 5.6% increase in mean power output during self-selected exercise intensity. These findings suggest that consuming CES during recreational exercise may enhance hydration, improve the affective experience, and increase exercise intensity in physically active adults. While b240 has demonstrated several health benefits, such as immune system enhancement and improved gut health, its direct impact on electrolyte balance has not been substantiated by empirical studies.

The other type of beverage is a food-based option containing basic b240 along with whey protein, and essential amino acids including BCAA, arginine, and citric acid, aimed at supporting the maintenance of physical condition against routine risks (Table 1).

As widely recognized, whey protein is quickly absorbed and tends to contribute to the formation of body tissues such as muscles, supporting overall body composition [14]. A study examined the effects of whey protein ingestion on whole-body protein balance and exercise performance recovery following acute resistance exercise in trained men [15].

Table 1. Differentiating between two types of b240 conditioning beverages

<table>
<thead>
<tr>
<th>Drink type</th>
<th>Energy (kcal)</th>
<th>Protein (g)</th>
<th>Fat (g)</th>
<th>Carbohydrates (g)</th>
<th>Salt equivalent (g)</th>
<th>Potassium (mg)</th>
<th>Calcium (mg)</th>
<th>Magnesium (mg)</th>
<th>Electrolytes (mEq/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottle</td>
<td>90</td>
<td>0</td>
<td>0</td>
<td>22</td>
<td>0.65</td>
<td>100</td>
<td>10</td>
<td>3</td>
<td>Na+ 105, K+ 25, Ca2+ 5, Mg2+ 2.5, Cl− 82.5, Citrate3− 50, Lactate3− 5</td>
</tr>
<tr>
<td>Pouch</td>
<td>95</td>
<td>10</td>
<td>0</td>
<td>14</td>
<td>0.16</td>
<td>5</td>
<td>10</td>
<td>2,500</td>
<td>Leucine 1,000, Isoleucine 500, Arginine 500, Citric acid 1,250</td>
</tr>
</tbody>
</table>

Reference:
https://doi.org/10.15857/ksep.2024.00255
Participants underwent resistance exercise sessions followed by either whey protein or placebo consumption immediately post-exercise and the following morning. The results indicated that whey protein supplementation tended to improve net protein balance during overnight recovery and significantly enhanced net balance over 24 hours, primarily by reducing protein breakdown. While exercise initially decreased exercise performance measures, at 10 and 24 hours, whey protein supplementation showed small-to-moderate improvements in maximal strength and power output. Overall, whey protein supplementation appears to enhance whole-body anabolism and may improve acute recovery of exercise performance after resistance exercise.

3. Intake of b240 and enhancement of the immune system

Lactic acid bacteria b240 have been shown to fortify immune function, with the intake of lactobacillus resulting in increases in blood T-helper (Th) cell count and natural killer (NK) cell count, as well as enhancement of NK cell activity in elderly adults [16]. The aim of the study was to investigate whether supplementation with Bifidobacterium lactis HN019, a known immune-stimulating probiotic, could improve cellular immunity in elderly individuals. Thirty healthy elderly volunteers participated in a 9-week dietary supplementation trial. The results demonstrated that consumption of B. lactis HN019 led to increased proportions of T lymphocytes and NK cells in the blood, along with the enhanced phagocytic and tumoricidal activity of leukocytes. These improvements were particularly significant in subjects with poor baseline immune responses. Notably, both typical and low doses of B. lactis HN019 were equally effective. These findings suggest that B. lactis HN019 could be a beneficial probiotic supplement for enhancing cellular immunity in the elderly.

A study investigated the impact of b240 intake and physical training on salivary secretory immunoglobulin A (SIgA) secretion in elderly adults with low physical fitness. Saliva sampling and physical fitness tests were conducted before and at various intervals during the intervention. Results revealed significantly higher SIgA secretion in the b240 group compared to the placebo group. It is noteworthy that SIgA saliva flow rate and plasma cortisol concentrations are influenced by exercise, particularly the intensity at which exercise is performed, and circadian variation. Negative correlations between cortisol and saliva flow rate were observed, as well as positive correlations between cortisol and SIgA concentration at all time points for each exercise trial. Over time, saliva flow rate increased while SIgA concentration and cortisol decreased [5]. Additionally, there were no notable changes in physical fitness tests, but both groups showed increased daily walking activity post-intervention. These findings suggest that b240 intake, combined with appropriate exercise, can enhance salivary SIgA secretion in elderly individuals with low physical fitness [17].

In a study examining the impact of oral intake of b240 on SIgA secretion in elderly individuals, eighty healthy elderly participants were randomly assigned to receive either b240 or a placebo for 12 weeks. Saliva samples were collected every 2 weeks to measure the SIgA secretion rate. Results revealed a steady increase in salivary SIgA secretion rate in the b240 group, reaching a 20% elevation by week 4 and remaining stable thereafter. This increase was significantly greater compared to the placebo group. No significant differences in adverse events were observed between the two groups. The findings suggest that oral intake of b240 for 12 weeks can significantly enhance salivary SIgA secretion, potentially improving mucosal immunity and resistance against infection in the elderly [18].

A study investigated the mechanism underlying the immune-modulating effects of heat-killed b240 on the gut immune system [11]. Histological analysis revealed that b240 co-localized with dendritic cells (DCs) in the subepithelial dome region of Peyer’s patches. In vitro experiments demonstrated that b240 stimulated DCs to produce increased levels of interleukin-6 (IL-6), which in turn promoted IgA production. The enhanced IgA production by b240 was mediated by Toll-like receptor 2-dependent IL-6 production from DCs. Further experiments showed that TLR2-mediated IL-6 production from PP DCs activated B cells to produce IgA in a DC-B cell co-culture system. These findings suggest that heat-killed b240 can activate DCs via TLR2, leading to enhanced IgA production in the intestine [19].

4. Incorporating conditioning drinks in hydration regulation and exercise–induced changes

Water and Electrolyte Homeostasis (WEH) research has been a cornerstone of physiology for over 60 years, recognized by the American Physiological Society [20,21]. Initially focusing on body fluid regulation, WEH research has evolved to encompass a broader scope, integrating translational and systemic perspectives. This highlights how WEH research complements traditional organ-based physiological and pathophysiological concepts, serving as a balanced force within the field. Moreover, it underscores the diverse range of research conducted by WEH investigators, as evidenced by minireviews presented at the annual Data Diuresis session at Experimental Biology [20].
Hydration regulation is intricately controlled through the hypothalamus and renal function, with water intake having significant physiological impacts on the body. When considering water consumption, several factors come into play, including individual characteristics, level of physical activity, environmental conditions (such as temperature and humidity), and water loss. The body’s electrolyte balance is maintained through the actions of the antidiuretic hormone (ADH) from the hypothalamus and the renin-angiotensin-aldosterone system (RAAS) [22].

A decrease in blood electrolyte concentration causes a drop in plasma osmotic pressure, leading to increased water movement out of vascular tissue, thereby decreasing both blood and plasma volume. Although electrolytes typically do not directly facilitate enzyme activity, they are vital for normal physiological function and are necessary in many nutrient delivery systems. The sodium concentration gradient facilitates the movement of glucose, amino acids, and various ions across membranes [23].

The effects of branched-chain amino acid (BCAA) supplementation on fatigue, muscle damage, and energy metabolism markers following endurance exercise were investigated. Results revealed that the experimental group (EXP) exhibited decreased serotonin levels and increased ammonia levels during exercise compared to the placebo group (CON). Lactate levels were higher in EXP during exercise but lower post-exercise. EXP also showed decreased levels of creatine kinase (CK) and lactate dehydrogenase (LDH), markers of muscle damage, compared to CON. Glucose levels tended to decrease in EXP, while free fatty acid (FFA) levels increased, indicating enhanced lipid metabolism.

Additionally, correlations between markers suggested a relationship between muscle damage, energy metabolism, and fatigue. These findings suggest that BCAA supplementation may mitigate muscle damage and improve energy metabolism during endurance exercise [24]. The b240 conditioning drink and food have garnered a widespread following among athletes and individuals concerned about maintaining optimum physical condition and resilience.

CONCLUSION

This study delves into the practical effects of integrating lactic acid bacteria b240 into conditioning beverages, unveiling its physiological advantages. These innovative beverages not only enhance sports performance through their biological benefits but also show promise in improving overall health. Furthermore, the potential applications of b240 in enhancing the immune system and performance could be significant for promoting public health, particularly considering time constraints as a common obstacle to regular exercise. While the mechanisms underlying the interaction of b240 with electrolytes or protein may vary, further research is warranted to elucidate its efficacy and potential interventions for both the general population and athletes.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

AUTHOR CONTRIBUTIONS

Conceptualization: MC Lee; Data curation: MC Lee; Formal analysis: MC Lee; Funding acquisition: MC Lee; Methodology: MC Lee; Project administration: MC Lee; Visualization: MC Lee; Writing - original draft: MC Lee; Writing - review & editing: MC Lee.

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