

Draught Lines and NABs

Written on behalf of the MBAA Brewery & Food Safety Committee by
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Introduction

The rapid growth of the non-alcoholic beverage (NAB) market represents a significant opportunity for breweries and taprooms to diversify draught offerings and attract new consumer segments. Globally, the NAB market is projected to rise from \$1.41 trillion in 2025 to approximately \$2.68 trillion by 2034, reflecting a robust compound annual growth rate (CAGR) of 7.34% [1]. In the United States alone, the market is expected to grow from \$1.58 trillion in 2025 to \$2.76 trillion by 2034, with a CAGR of 6.4% over the same period [2]. As health-conscious and moderation trends drive increased demand for NABs, industry stakeholders are expanding draught systems to capitalize on this evolving market. However, non-alcoholic

beverages present unique food safety challenges compared to traditional fermented products. Unlike beer and other alcoholic beverages, NABs lack ethanol's natural antimicrobial properties and often have higher pH. This absence increases their vulnerability to microbial contamination and spoilage within draught systems. As a result, implementing heightened microbial awareness and tailored sanitation practices is essential for maintaining the quality and safety of draught NABs. Addressing these vulnerabilities is critical to ensuring consumer safety and sustaining the long-term success of NAB draught programs.

Why Draught NABs are a Higher Risk

Recent research by Dr. Grzegorz Rachon and colleagues at Campden BRI highlights unique microbiological challenges in non-alcoholic beers (NABs), particularly when served on draught. Their study of over 50 UK-market NABs found no typical foodborne pathogens in commercial samples, but multidrug-resistant microbes were detected in keg samples. Challenge tests showed that key pathogens like *E. coli* and *Salmonella* could survive at higher pH (4.2–4.6), especially under low CO₂ and elevated O₂ conditions, while bitterness had minimal impact. This confirms the critical role of maintaining low pH, adequate carbonation, and low total package oxygen to inhibit pathogen growth in NABs [3].

Refermentation is an ongoing risk in draught NABs due to residual sugars combined with yeast or bacteria present in kegs and draught lines. Factors such as fluctuating temperatures, oxygen ingress, and biofilm formation encourage microbial growth and fermentation restart, leading to unintended alcohol production, off-flavors, and spoilage. Unlike bottled or canned NABs, draught lines are harder to clean and are replaced less often, making strict sanitation and cold chain management essential to prevent refermentation and ensure safety.

Draught NABs face elevated food safety risks due to several intrinsic and extrinsic factors. The absence of ethanol removes a key antimicrobial barrier, leaving

NABs vulnerable to contamination by pathogens and spoilage microbes like *E. coli* and *Salmonella*, which can survive and multiply under certain conditions [4] [5]. Higher residual sugars and added flavorings create nutrient-rich environments that promote microbial growth. Unlike conventional beers, which rely on multiple hurdles, including low pH, hops, and limited nutrients, NABs can lack these combined defenses, increasing susceptibility [6].

Cold chain integrity is also critical; any refrigeration failure accelerates microbial proliferation and spoilage [7]. Additionally, inadequate temperature control can enable residual yeast or bacteria to ferment sugars, unintentionally raising alcohol levels and adding risk. Draught line conditions exacerbate these issues, as biofilms readily form and protect microorganisms from cleaning. Complexity and inconsistent sanitation of draught systems, along with longer residence times from slower turnover of NAB kegs, further heighten contamination potential. These factors demand rigorous, tailored sanitation and monitoring practices to safeguard draught NAB quality and safety.

Common Microbial Hazards

Draught NABs are susceptible to a range of microbial hazards that can compromise both product quality and consumer safety. Common spoilage organisms include mold, yeasts such as *Zygosaccharomyces bailii*, *Saccharomyces Cerevisiae*, *Brettanomyces*, *Pichia*, and *Torulaspora*, as well as lactic acid bacteria like *Lactobacillus* and *Pediococcus*, and obligate anaerobes such as *Pectinatus* and *Megasphaera*. These microorganisms can cause defects such as turbidity, off-flavors, ropiness, and abnormal fermentation, all of which negatively impact the sensory and stability characteristics of the beverage [8] [9].

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Pathogenic risks are heightened in NABs due to the absence of ethanol, a traditional barrier to microbial growth. In many traditional beers, lower pH and higher hop content also create inhospitable environments for many microorganisms. However, in some NABs, reduced hop content and less pronounced acidity may compromise these natural defenses, making the product more susceptible to microbial spoilage and pathogen growth. Recent studies have shown that pathogenic bacteria, including *E. coli* and *Salmonella*, particularly when storage temperatures are elevated, pH is higher, alcohol content is low, and levels of carbon dioxide and hop bitterness are reduced, can survive and even grow in non-alcoholic beer under specific conditions, particularly when storage temperatures are not strictly controlled [4] [10] [11]. This is in stark contrast to traditional beer, where the presence of alcohol and other intrinsic hurdles typically inhibits these pathogens. While the risk of pathogens exists, the risk can be well managed with the right processes in place.

The risk of beer spoilers in NABs continues[HB1] [LT2] to be a challenge. For example, in 2020, cans of Guinness 0.0% non-alcoholic stout were recalled in both Ireland and Great Britain due to the possible presence of mold in the product, highlighting the potential for microbiological contamination in non-alcoholic beverages and the need for stringent quality control measures. [12] [13]. Such incidents reinforce the importance of robust sanitation and monitoring practices in draught non-alcoholic beverage systems, as well as in the production and packaging of canned NABs, to prevent spoilage and protect public health.

Draught System Sanitation Best Practices

Maintaining rigorous sanitation protocols is essential for draught NAB systems. Industry best practices recommend cleaning draught lines at a minimum of every 14 days, with some operators cleaning more frequently depending on product characteristics and system usage [14] [15] [16]. It should be noted that these recommendations were originally developed for systems dispensing alcohol containing beer. There is currently a lack of regulation around draught line cleaning in the United States[HB1] [LT2] , leaving adherence to these standards largely up to individual operators. This challenge is further complicated by the complexities of the three-tier distribution system in the U.S., which separates producers, distributors, and retailers, often resulting in unclear responsibility for draft system maintenance and inconsistent cleaning practices across the industry.

Cleaning should utilize both alkaline (such as sodium hydroxide-based) and acid-based solutions, alternating between them every few cycles to effectively remove organic and inorganic residues; in some cases, oxidizers may be used for additional microbial control [14] [16].

Selecting line materials that are smooth and non-porous, such as high-quality stainless steel or food-grade plastic, helps prevent biofilm formation and facilitates thorough cleaning [17]. Backflush procedures are critical for ensuring all film-forming residues are removed from the system, and these should be incorporated into the regular cleaning routine to prevent the accumulation of microbial harborage sites. These practices help preserve product quality and protect consumer safety in draught NAB systems.

Microbiological Monitoring

Effective microbiological monitoring is a cornerstone of food safety for draught NAB systems, where the absence of antimicrobial hurdles heightens contamination risk. Regular environmental swabbing with ATP (adenosine triphosphate) testing provides a rapid, objective assessment of surface cleanliness and helps detect organic residue or microbial presence in draught lines and dispensing equipment. In-process testing at the brewery, such as sampling from bright tanks and after flash pasteurization, ensures that critical control points are monitored for microbial load and process efficacy, reducing the likelihood of contamination before the product reaches the tap [18]. Shelf stability testing, typically involving plating techniques, evaluates the microbiological integrity of finished products over time and under various storage conditions, identifying potential spoilage organisms before they impact consumer safety. Additionally, leveraging third-party laboratory support can offer access to advanced genetic sequencing techniques, which are now commonly used to accurately identify spoilage or pathogenic microorganisms at the DNA level and offer greater precision compared to traditional plating methods. Furthermore, specialized instrumentation, such as Matrix-Assisted Laser Desorption/Ionization Time-of-Flight (MALDI-TOF) mass spectrometry [19], can also be utilized to reliably identify microbial contaminants, enabling faster corrective actions and enhanced product protection [20].

Draught System Design

Draught system design is critical in ensuring NABs' microbiological integrity and quality. One of the most effective strategies is using dedicated lines for NABs, analogous to the approach used for gluten-free products. This minimizes the risk of cross-contamination from other beverages or cleaning residues and ensures that only NABs flow through these lines. Temperature control is equally essential; maintaining consistent, cold temperatures throughout the system prevents temperature fluctuations that could promote microbial growth and spoilage. Using a closed dispensing system, where beverages are pushed from the keg using CO₂ or N₂ instead of ambient air, further reduces exposure to oxygen and airborne contaminants. This slows oxidative

deterioration and limits the introduction of spoilage organisms, helping to maintain product freshness and safety from tank to tap.

It is also important to recognize the heightened risk of yeast contamination when equipment is shared across the brewery, particularly in packaging operations. Yeast from alcoholic beer production can easily transfer to NABs through shared tanks, hoses, or packaging lines, potentially compromising product stability and quality. Implementing strict segregation protocols and thorough cleaning procedures is essential to mitigate this risk and safeguard the microbiological integrity of NABs.

In parts of Europe, one-time use draught beer lines, also known as "single-use" or "disposable line" systems, are increasingly being adopted to enhance hygiene and reduce the risk of microbial contamination, particularly for non-alcoholic beers and other sensitive beverages. With these systems, the draft beer line is replaced each time a new keg is tapped, virtually eliminating the threat of biofilm buildup and persistent contamination that can occur in traditional, reusable lines. Micromatic, a leading supplier of draft solutions, has developed specific systems for direct draw applications, where the keg is located near the point of dispense, such as at event venues, festivals, and smaller bars or restaurants. These systems provide a simple and effective method to maintain beverage quality and safety, especially in settings where frequent line cleaning is impractical or rigorous sanitation is critical for non-alcoholic products [21].

Training and Documentation

Training and documentation are essential components of a robust food safety program for draught NAB systems. Staff education must emphasize the unique cleaning requirements and heightened risk of spoilage associated with NABs, including instruction on proper cleaning techniques, the importance of dedicated tools or lines, and the ability to recognize early signs of contamination or spoilage. Developing and maintaining written standard operating procedures (SOPs) for cleaning and microbiological testing ensures consistency and accountability across all operations, providing clear guidelines for every step from line cleaning to product sampling. Comprehensive record keeping, such as logs of cleaning schedules, swab results, and any corrective actions taken, enables traceability and continuous improvement. These records support regulatory compliance and help identify trends, prevent recurring issues, and demonstrate a commitment to product quality and consumer safety.

Additional Considerations

Beyond standard cleaning, monitoring, and design, several advanced processing technologies can further enhance the safety and stability of draught NABs. Flash

pasteurization, high-temperature, short-time (HTST) processing, is applied for its ability to rapidly inactivate spoilage and pathogenic microorganisms while preserving sensory characteristics, making it a cornerstone for many NAB producers. UV-C treatment offers a non-thermal alternative, leveraging ultraviolet light to disrupt microbial DNA and reduce contamination levels, especially effective for clear beverages and as an adjunct to traditional pasteurization [22]. Membrane filtration can provide cold sterilization by physically removing microbes and particulates, though it is most effective with clear, filtered products and requires careful maintenance to prevent biofilm formation. High-pressure processing (HPP) is another emerging technology that uses intense pressure rather than heat to inactivate pathogens and spoilage organisms, maintaining product quality while extending shelf life [23]. Each of these methods can be integrated into a comprehensive food safety strategy, helping to ensure that draught NABs reach consumers in a microbiologically stable and safe condition.

Conclusion

In summary, the absence of alcohol in NABs removes a key barrier to microbial growth, necessitating proactive and rigorous food safety measures throughout the production of the product and especially in draught systems. As the market for NABs continues to expand, breweries and taprooms must treat these products with the same level of scrutiny as other perishable beverages. This means adopting dedicated lines, advanced processing technologies, robust cleaning and monitoring protocols, and comprehensive staff training.

The call to action is clear: serving NABs on draught requires a commitment to heightened food safety standards, ensuring that every pour is refreshing and flavorful, but also consistently safe for consumers.

By approaching draught NAB systems with diligence and care, the industry can confidently embrace this growing segment while safeguarding product quality and public health.

Disclaimer: This Food Safety Bite was prepared based on the most current and actionable information available at the time of writing. As research into draught dispensing systems and the microbiological risks associated with non-alcoholic beers continues to evolve, recommended processes and best practices may change accordingly. Readers are encouraged to stay informed on emerging findings and to adapt their safety protocols as new insights become available.

About the Authors

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Kayla Johnson is a Senior Advisor, Engineering Services with First Key Consulting, where she supports breweries and beverage manufacturers with quality systems, food safety, process optimization, operational excellence, capital project execution, and technical due diligence. With more than 15 years of brewing industry experience, she has worked across brewing, packaging, quality assurance, utilities, engineering, and supply chain leadership roles.

Prior to joining First Key, Kayla held several leadership positions with Anheuser-Busch InBev, including Senior Quality Assurance Manager, where she oversaw brewery food safety, quality management systems, and product quality performance. Throughout her career, Kayla has supported brewery startups, major capital projects, new product launches, operational improvement programs, and food safety and quality investigations.

Kayla holds a B.S. in Chemical Engineering from the University of North Dakota and is an active member of the Master Brewers Association of the Americas (MBAA) and International Society of Beverage Technologists (ISBT). She is passionate about helping breweries implement practical, risk-based approaches to food safety, quality assurance, and continuous improvement.

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Frances Tietje-Wang is a fermentation chemist, writer, and educator focused on the scientific and cultural dimensions of fermentation. Passionate about product quality and experience, their work focuses on how fermentation connects the brewing community while doing it well and safely.

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