Product Description, Food Safety and Stability Evaluation
Important: About This Document. This document is intended as a starting point - not a definitive prescription. Each individual manufacturing process is unique, distinct brands have different goals, and industry, food science, and safety regulations continue to evolve. As a result, this document should only be used as a reference and as part of an overall food safety program designed specifically to meet the needs of your particular organization. Cold brew should only be produced under the guidance of qualified individuals. These materials have been produced by a committee of industry experts and are accurate and up-to-date at the time of publication and may be revised as new information becomes available.
Introduction

The cold brew coffee category of products is a well-established product platform. Consumers view it as a premium product, which offers both convenience and quality. Many businesses are considering cold brew as a potential revenue stream worth exploring, while others have already enthusiastically entered the market.

This report was produced by a working group of NCA members and experts from across the industry, in the interest of maintaining the integrity of cold brew as a method to craft premium quality and reliably safe beverages.

Our intent is to educate both the coffee industry and consumers on what cold brew coffee is (and is not), as well as provide best practices for preparation.

Cold brew coffee has unique food safety considerations. By identifying the extensive and evolving range of product formats in the marketplace, we can better understand the industry’s food safety and quality needs and develop educational and resource tools to aid in compliance with standards and regulations.

While this document focuses on cold brew coffee in the US, there are basic principles that can apply to international markets. Note that each country has its own regulations, standards, and customs that may also need to be taken into consideration, as appropriate.

The popularity of cold brew as a preparation method extends beyond coffee, to include products like tea, cascara, and cacao. The scope of this report is focused on coffee. Other products have their own safety concerns, which should be considered on their own. This document is not intended as legal advice and should not be relied upon exclusively to ensure compliance with applicable local, state, and federal laws.

Description of Cold Brew

Cold brew coffee is typically made with roasted and ground coffee. The roasted coffee is extracted with water at ambient or cooler temperatures.

In most cases, the brewing process trades time for temperature – instead of brewing with very hot water over a very quick duration, cold brewing typically uses ambient or cooler water and extended
periods of time to extract an optimal flavor profile and solids from the beans. Large variations in temperature may need to be controlled for to help guarantee consistency in extraction.

Factors such as contact time, temperature, roast level, grind size, pressure, or steeping method may all influence the final brew composition and flavor profile.

**Cold Brew FAQ**

At its core, cold brew is a *brewing method*, not a serving method. Here are some common questions to help clarify this concept:

**Is all iced or cold coffee considered “cold brew”?**
No. Coffee brewed with hot water extraction methods, whether served hot or cold, is not cold brew. Cold brew is not simply a marketing term. It does not refer to coffee that was extracted with hot water and then chilled prior to serving. Instead, it refers to coffee extracted at ambient or cooler temperatures. The resulting product can then be chilled or served over ice and be considered iced coffee or iced cold brew.

**Is all cold brew coffee served as a cold beverage?**
No. Cold brew coffee can be served hot. Again, cold brew refers to a brewing method, not a serving method. Historically in the United States, cold brew coffee was brewed as a concentrate, diluted with boiling water, and served primarily as a hot beverage. (This was prior to iced coffee becoming popular.) Cold brew coffee is also used as an ingredient in a variety of food and beverage products.

**How does cold brew extraction work?**
Cold brewing extracts at a lower temperature and generally for a longer time than conventional hot water extractions. This unique combination of cooler temperature and longer contact time may produce a unique sensory and quality profile in the finished beverage.

**What are the sensory and flavor characteristics that result from the cold brew brewing method?**
Flavor profiles of cold brew may vary significantly from coffees brewed at higher temperatures. Common traits typical to cold brew include: less bitterness, smoother taste, and the enhancement of more delicate flavors. The same coffee brewed by cold or hot methods can taste either very similar or drastically different when evaluated side-by-side.
Cold Brew Safety Considerations

Hot, brewed coffee has a long tradition of being a low-risk beverage for food safety. Even so, there are still important safety considerations for product preparation and manufacturing processes. Anyone who makes or serves cold brew has an obligation to follow the appropriate steps to ensure the safety of their product.

Additionally, the US Food Safety Modernization Act (FSMA) requires that certain establishments engaged in manufacturing, processing, or packing food or beverages (including cold brew) comply with a wide array of regulations and practices, such as completing a comprehensive food safety plan, conducting a hazard analysis, and following Current Good Manufacturing Practices (cGMP).

Specific Cold Brew Considerations

When evaluating for food safety risk, maximum control must be used to mitigate any potential risk of illness or death at every stop in the process – no matter how remote the risk may be.

Traditional roast and ground coffee (R&G) has a very long history of being safe. There has never been a food poisoning outbreak related to coffee.

The reasons for this are several-fold:

- The way that green coffee is grown and stored dry for long periods of time.
- Coffee is exposed to high heat during roasting (Bonnlander et al, 2013).
- Coffee grounds are exposed to near-boiling water during brewing prior to consumption, and hot brewed coffee is typically consumed rapidly (with leftovers discarded once cool).
- The anti-microbial compounds produced during roasting, and the (potentially) low level of nutrients present to support microbial growth (Daglia et al, 1994; Almeida et al, 2006; Arora et al, 2009; Martínez-Tomé et al, 2011).

The cold brew process removes exposure to hot, near-boiling water before consumption. As such, an initial assessment of food safety should be carried out by each manufacturer based upon their unique production process. A re-assessment should be followed after any changes are made to the facility, formula or recipe, or equipment.

Despite all these unknowns, there are some tried-and-true ways to ensure that cold brew coffee is safe for consumption:

- Robust cGMP’s should be in place in the facility that produces the product.
- A thorough risk assessment by an expert of the facility, ingredients, equipment, finished product, and process should be done (HACCP – Hazard Analysis and Critical Control Point, HARPC – Hazard Analysis and Risk-Based Preventive Controls, Challenge Studies).
A comprehensive change management program that adapts food safety controls to any new changes in facility, recipe, equipment, or process, and unique needs such as in a retail or manufacturing setting.

Ready-to-Drink Cold Brew Coffee

Ready-to-Drink (RTD) products are beverages that may be consumed as-is without dilution or further preparation. The RTD packaging and serving format offers convenience and accessibility to the consumer.

There are several key steps inherent to RTD, but important to cold brew processes in general, that must be taken to avoid a food-safety related incident:

- Potential food safety risks need to be identified (e.g. product characteristics, processing techniques, and storage & distribution temperature and time)
- Create and implement a food safety control plan to address identified risks
- Understand that the pH of the product must be closely controlled to mitigate the risk of Clostridium botulinum, a deadly pathogen, in hermetically sealed containers. pH control may occur by acidification or thermal processing.
- Hire a qualified Thermal Process Authority to write up a recipe and process that will adequately control for C. botulinum
- Follow the Thermal Process Authority’s instructions to the letter.
- If there is any deviation from the instructions provided, consult the Thermal Process Authority on their recommendations for disposing the finished product.
- Complete challenge studies, which involve testing the ability of unwanted microorganisms to grow in a product in use and abuse conditions (E.g., If a nitro cold brew is low-acid and processed under low-heat conditions, such as in pasteurization, and uses a refrigerated supply chain, a challenge study could assess for safety from spore-forming bacteria and compare against an existing formulation as a control.) Designing a challenge study for food safety determination is outside the scope of this document and should be managed by a qualified food safety professional.
- File the thermal process and any challenge study information with the FDA (FDA Site Registration): https://www.fda.gov/food/guidanceregulation/foodfacilityregistration/acidifiedlac-fregISTRATION/default.htm

In summary, traditional roast and ground coffee is safe, but cold brew coffee must be evaluated to prove it is safe. This is done by assessing the ingredients, brewing process, manufacturing facility, cleaning and sanitation practices, and the finished product’s shelf life.
A robust cGMP program will go a long way to reducing food safety risk. A competent risk assessment (HACCP, HARPC, Challenge Studies) of the facility, ingredients, equipment, finished product and process will significantly reduce food safety risk. A comprehensive change control program involving food safety controls around any new changes in facility, formula, equipment or process will account for almost all the remaining food safety risk.

RTD products are a special category of products which have special requirements, such as hiring a qualified Process Authority when manufacturing and understanding the role of pH in controlling C. botulinum and filing the thermal process with the US FDA.

Shelf-Life Testing, Storage & Handling

Shelf-life Testing Considerations

Initiating a shelf-life test of a cold brew product is important for understanding how different factors may affect product quality or safety over time. These can include formulation and ingredients, the manufacturing process, packaging type, or storage and distribution conditions.

Conducting shelf-life testing can provide invaluable information for establishing the product best-by date, which is often determined by evaluating when a product fails to meet a minimum quality standard. This minimum standard is typically set by experienced and knowledgeable product formulators or is based on consumer data gathered from sensory testing and consumer complaint information.

The best-by date should not be determined based on food safety. Food safety should be based on following a comprehensive food safety plan and food safety principles.

This section will identify factors to consider in designing and conducting a shelf-life test to determine product stability and quality. Due to the complexity of regulatory requirements and the impact to human health, cold brew coffee manufacturers should conduct challenge testing using a qualified food safety expert. Designing such a test is outside the scope of this document.

When initiating a shelf-life test, variables to consider in the experimental design may include:

**Product Type:** Cold brew product formats are often present as dry grounds in roast and ground (R&G), in liquid form as concentrate, or ready-to-drink strength.

**Packaging Format and Material:** R&G is often sold in conventional cans, canisters, or bags, or pre-measured into filter bags or sachets, which is often marketed for at-home or food service preparation. Industrial liquid preparations are often bottled in plastic or glass bottles or dispensed into stainless steel kegs. Choices in packaging material are made for reasons such as cost, size and dimensions, barrier property for moisture or oxygen, recyclability and sustain-
ability, printability, and other functional attributes that are important to the retailer/customer and end consumer. Packaging can also contain plasticizer, or cause flavor scalping (i.e. migration of flavor components into packaging material).

**Temperature and Time:** The temperature at which a product is stored or exposed to over a specified duration of time can significantly affect product stability and food safety. When designing a shelf-life study, it is important to consider the range of temperatures the product may be exposed to, and for what duration of time. Test designs often evaluate product at the main storage temperature predicted for the life of the product, and then may also stress the product by high or low temperature to determine if key quality attributes change or are compromised. Results can then affect how a product shelf-life date is set, as well as storage, handling, and distribution specifications.

**pH:** The pH of a food or beverage product is a measure of its acidity, neutrality, or alkalinity. It can affect the storage stability of ingredients, the perception of sensory properties, and the favorability or inhibitory property of the food matrix to inhibit the growth or survival of microorganisms.

**Water Activity (aw):** The aw (or % Relative Humidity/100) is indicative of the presence of free water available in the food matrix. Differences in aw can affect product stability, such as accelerating losses in product quality. At higher levels, it can support the growth of microorganisms, such as molds and yeasts (Jay, 2005).

**Formulation Ingredients:** The addition of dairy or non-dairy whitener, sweeteners, acidulants, chemical preservatives, flavor systems, stabilizers, and other ingredients can significantly affect the quality and safety of a cold brew product, and its classification as cold brew. This includes ingredients derived from coffee that are not made from ambient or cool temperature brewing. The incoming quality and microbial load for each ingredient should be carefully reviewed and evaluated for potential effects on product stability. E.g. When formulating a flavored cold brew coffee product, consumers often desire natural flavors. A challenge in formulating is that natural flavoring components often degrade more rapidly than flavors containing artificial constituents. The flavoring carrier, such as in dry powder or liquid, can also significantly impact product quality and the characteristics of the flavor’s sensory profile or fidelity.

**Processing Conditions:** How a product is manufactured can have significant impact on quality and food safety. Factors to consider may include thermal processing time, temperature, holding conditions, impact of pressure, turbulent flow, exposure to light, oxygen, stabilizers, equipment make and model, and settings.

**Headspace Gas Composition:** Atmospheric gases such as carbon dioxide (CO₂), oxygen, or nitrogen can have varying impact on product stability. Fresh roasted coffee actively degases, giving off volumes of carbon dioxide (CO₂), carbon monoxide (CO), and volatile organic compounds (VOC). Oxygen exposure may also interact with the roasted coffee and contribute to product oxidation. An inert gas, such as nitrogen, flushed into the product headspace may help reduce the rate of oxidation.

**Light:** Light can contribute to sun-struck off-flavors and vitamin degradation in certain liquid beverage types. Its impact to RTD cold brew coffee is unknown.
An Example of a Shelf-life Test Experimental Design

Test Objective
To learn how storage temperature, time, and packaging material affect product quality through storage.

Experimental Factors and Levels:
- Temperature (e.g. 40°F, 70°F, 110°F)
- Time (e.g. 0 days – 6 months)
- Packaging (e.g. Clear glass bottle, stainless steel keg with screw cap)

Quality Attributes to Evaluate at Sample Pull Date/Time:
- Sensory (e.g. A difference-from-control test, comparing against a control)
- pH
- Titratable Acidity
- Opacity or Turbidity

When starting a test, it is desirable to take product produced from commercial-scale trials whenever possible, as this is most likely to represent the real-world conditions under which sale-able product is produced, distributed, and consumed.

The experimental design may also often include controls, which help to compare effects produced by experimental factors or variables. The controls can represent both a negative control (i.e. a control group that is not subject to the experimental condition or intended to develop an effect) and/or a positive control (i.e. a control group that is subjected to the experimental condition and is expected to develop an effect). An action standard may also be set, setting a minimum benchmark against which other products need to perform at parity or better through the duration of a test. When a product consistently fails to meet minimum standards defined for safety or quality, then a product would generally fail the test. If a product is distributed and sold at ambient conditions, then a shelf-life test may often, but not always, be conducted to include a room temperature variant. When a product fails to consistently meet minimum standards after being held at these conditions, then a shelf-life determination can often be made from this evaluation. If a variant is stored at a higher temperature, then this may often be called stressed or accelerated testing conditions. A determination to relate high temperature to ambient testing conditions can only be made after the product type has been thoroughly evaluated at both temperatures and related for quality or safety attributes.

When determining the number of samples to put into the study, a common practice is to evaluate samples at each time point in duplicate or triplicate. This helps to control for any outliers and minimize sample error and variances.
Glossary

Ambient: Ambient or “room temperature” refers to the temperature of the surrounding air and is not necessarily correlated to a specific temperature range. For coffee brewing purposes, ambient temperature water is the same temperature as the surrounding air; ambient temperature brewing is brewing conducted at room temperature, or the same temperature as the surrounding air and environment.

Bag in Box / BnB / BIB: A type of container used for the storage or transport of liquids. It often consists of a strong inner bladder or bag, often composed of several layers of metallized film or plastic and seated inside a corrugated fiberboard box.

Best by date: Last date that guarantees optimal quality of the product.

Body: The way the beverage is perceived on the tongue. ‘Heavy’ body is like full fat milk. ‘Thin’ body is like water.

°Brix: The percent of soluble solids in a given solution, and where the main soluble solid is often dissolved sugars.

Challenge Studies: Microbiological testing of a product to determine its capability of supporting or inhibiting the growth of microorganisms. Testing can be performed at different aspects of a product’s lifecycle, e.g. from initial formulation, processing at a specific time/temperature condition, at a preventive control, or at shelf-life stressed or accelerated testing conditions.

Coffee Concentrate: Coffee that has been brewed stronger than typically consumed or otherwise had water removed, concentrating the solids; it is intended to be diluted prior to serving.

Coffee Extraction: Coffee extraction, or brewing, is the process of dissolving soluble flavors and compounds from coffee grounds into water.

HACCP: Hazard Analysis and Critical Control Point. A defined process in which potential hazards and means of controlling the hazards are identified. Hazards can be biological, physical, chemical, or radiological in nature.

HARPC: Hazard Analysis and Risk-Based Preventive Controls. A provision of the Food Safety Modernization Act (FSMA) that requires any entity handling food to identify hazards, implement controls to reduce the hazards, conduct verification activities to show that controls function, and implement corrective actions for any deviations that may occur in a process.

Iced Coffee: Coffee that has been brewed hot or cold and served chilled and/or over ice. Can also be cold brew coffee served over ice. Note: Iced coffee cannot be considered cold brew unless it is prepared following a cold brew process (i.e. methods described within this document using ambient or cool water in extraction).
**Low Acid Food**: “A low acid canned food is any food (other than alcoholic beverages) with a finished equilibrium pH greater than 4.6 and a water activity greater than 0.85, excluding tomatoes and tomato products having a finished equilibrium pH less than 4.7.” - https://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/AcidifiedLACF/default.htm

**Nitro Coffee**: Brewed coffee that has been infused with nitrogen gas.

**pH**: The concentration of hydrogen ions in solution; Also, a measure of how acidic, neutral, or basic a solution is. The pH of a food or beverage product is a measure of its acidity, neutrality, or alkalinity. It can affect the storage stability of ingredients, the perception of sensory properties, and the favorability or inhibitory property of the food matrix to inhibit growth or survival of microorganisms.

**Ready to Drink (RTD)**: A beverage that can be consumed as-is; no mixing or further preparation needed.

**Shelf Life**: The duration of time that the product maintains optimal quality.

**Titratable Acidity**: A measure of the total acidity in solution contributed by all constituents.

**Total Dissolved Solids (TDS)**: Inorganic salts and some organic matter dissolved in water.
References


https://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/AcidifiedLACF/default.htm

https://www.fda.gov/food/guidanceregulation/foodfacilityregistration/acidifiedlacfregistration/default.htm
Appendix: Common Methods of Preparation

Whether brewing at home, in a café or at a production scale, the basic preparation methods for making cold brew remain virtually the same. But if you look more closely at the brewing method, there are several variables that can be manipulated to greatly change the resulting extract. As we illustrate in the Definition section, some changes to the brewing parameters render the coffee materially different than cold brew coffee.

The primary variables in the brewing process are grind size, water temperature and steeping time. Let’s take a closer look at several common preparation methods to understand how these variables can be altered.

- **Full Immersion**: Cold brewing with full immersion is the process of steeping coffee grounds in water – quite a few brewing devices on the market utilize this concept in one form or another. With full immersion, the coffee and water stay in contact during the full duration of brewing; at the end of the brewing duration, the coffee extract liquid is filtered from the coffee grounds. The variables at play are typically:

  - **Grind Size**: Grind size can impact the extraction rates of various chemical compounds, and therefore can impact flavor profiles, total dissolved solids (TDS) and body.
  
  - **Brewing Duration**: Also referred to as dwell time, the amount of time that the water and ground coffee come into contact will impact the extraction of some compounds.
  
  - **Water Temperature**: Water temperature impacts the extraction of temperature-sensitive compounds, the release of gas from the grounds and impacts the water’s ability to permeate dry pockets of ground coffee.
  
  - **Ambient Temperature**: The temperature of the surrounding air and environment, often considered room temperature.
  
  - **Filtration**: The process of separating coffee liquid extract from solids through a porous medium, where the mesh or pore size can impact the amount of coffee solids, flavor, body, and shelf-life of the final extract.
  
  - **Agitation**: Creating motion by mixing, shaking, or stirring, which for coffee can impact the water’s ability to saturate all coffee grounds evenly, and can speed the release of gas from ground coffee and increase extraction rate.
  
  - **Pressure**: The amount of force exerted over a specified area and over which that force is then dispersed.
Drip Tower: Making cold brew with a drip preparation differs from full immersion in that drops of water pass through a bed of coffee grounds throughout the full duration of the brew. As the coffee grounds become saturated, the coffee extract exits the bed of coffee grounds drop-wise. The variables at play are typically:

Drip Rate: The speed of the drip impacts the amount of time that the water and ground coffee come into contact over the total duration of the brew and will impact the extraction of some compounds.

Batch Size / Vessel Size: Batch size and vessel size can change how long it takes to get all the coffee grounds wet enough to extract and therefore can also impact the total amount of time that water and coffee come into contact.

- Grind Size
- Water Temperature
- Ambient Temperature
- Filtration

Hot Bloom: Hot bloom is a modification on the above preparation methods where near-boiling water is added at the beginning of the brewing process to initiate a “bloom,” followed by a quick dousing of cold water to stop hot water extraction and transition to cold water extraction. This hybrid brewing method aligns with some parts of the cold brewing definition and still has many of the same inherent food safety concerns. The addition of hot water, however, puts the hot bloom preparation method into a brewing method gray zone, as it creates a significant departure from many of the common characteristics of cold brew coffee. This is differentiated from the cold brew preparation method, as cold brew uses ambient or cool water throughout the entire duration of the brew process. In cold brew, no hot water (or water greater than ambient in temperature) should come into contact with the grounds.

Continuous Extraction: A method by which coffee is extracted continuously for a set time.

Ice Brew: Brewing coffee hot and then flash chilling.

* Certain variables, such as the specific coffee beans selected, water quality, water-to-coffee ratios, and the cleanliness of the brewing equipment are relevant to all preparation methods. Many of these variables are also relevant in hot water brewing methods.