Environmental Health Services

Food Issue

Notes from the Field

BC Centre for Disease Control
An agency of the Provincial Health Services Authority

Nitro cold brew coffee food safety risks

Request received from:	Interior Health Authority
Date of request:	September 12, 2017
Issue *(brief description)*:	Risk assessment of nitro cold brew coffee products

Summary of search information:

1. Internet sources: google scholar "nitro coffee", google "nitro cold brew coffee". Two researchers found and contacted during search (Sarah Lane, University of Victoria, BC; Niny Rao, Thomas Jefferson University, Philadelphia); Citation search of ICMSF reference for Frank (2001) from Ch.9 on coffee.
2. Ovid (define your search terms): n/a.

Background information:

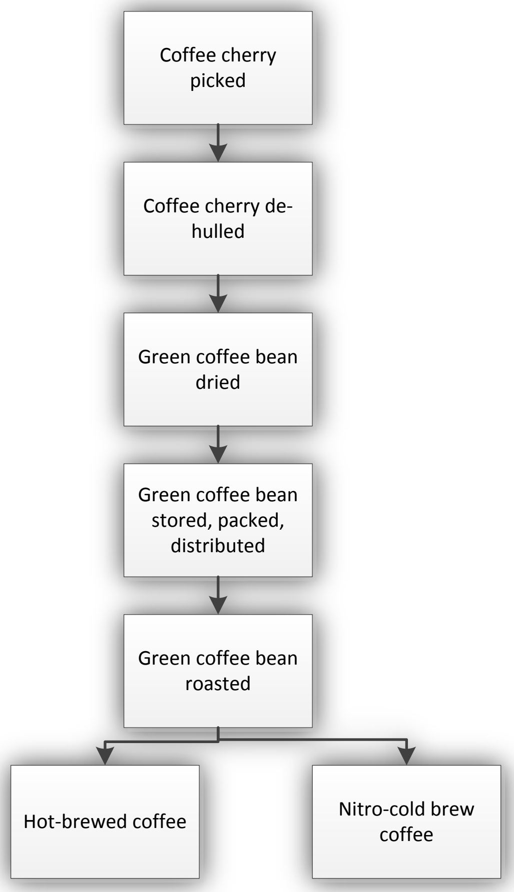
Nitro cold brew (NCB) coffee is an emergent food trend for ground, roasted coffee beans filtered slowly (steeped) through a cold, room temperature, or hot-bloom water brewing process for 8 or more hours (upper range reported as 36 hours).[1-3] The beverage is stored anaerobically in cans or stainless steel kegs, and charged with nitrogen gas. The nitrogen gas infusion is similar to the nitrogen widgets used for canned Guinness beer, and imparts small bubbles to the beverage which do not easily dissolve in water. This results in a creamy frothy head, imparting sweetness, less acidic taste and giving a fuller, thicker mouth feeling to NCB beverages when compared to regular coffee brews. [4]

NCB coffee is increasing rapidly in popularity. Starbucks© has reported that this beverage will be available in 1500 stores in 26 different markets by the end of 2017.[5] Recently, an application for manufacture of NCB has been requested in the Interior health authority. No supporting information was given to EHO at time of request from the operator, a general food risk assessment for this beverage was requested.

What are the risks associated with coffee bean processes

Before detailing risks of NCB, a brief review of coffee beans growth, harvest and normal processing risks follows. Coffee beans are reviewed in the ICMSF book, Microbial Ecology of Food Commodities.[6] Beans are picked from varieties and hybrids of coffee trees in the genus *Cafea.* The fruit of the tree is called a coffee cherry, with flesh of the fruit on the outside of the bean.[6]

Coffee cherries are picked then de-hulled either by hand or mechanically, and the green beans are dried and then stored.[6] During the period when the fruit flesh around the bean and during drying is when fungal hazards of mold and yeast occur and may contaminate the flesh, or penetrate to the interior of the bean. The drying conditions are thought to be an issue, particularly when drying occurs too slowly.[6] The principal hazard of concern identified during this process is the production of ochratoxin A (OTA) from fungal growth related to drying issues in areas of high moisture. Additional hazards include pesticide residues, and polycyclic aromatic hydrocarbons from the drying and roasting process.[7] Ochratoxin A as the main mycotoxin found in coffee is a concern as it has nephrotoxic, carcinogenic, immunosuppressive and teratogenic properties.[7] These hazards are regulated under EC Regulations 1881/2006 and 149/2008 of the European Commission.[7] Alternate methods of de-hulling include fermentation and washing steps that introduce new microbial communities that include yeasts and lactic acid bacteria.[8] The most common bacterial species found on coffee beans is *Bacillus*.[8,9] Some of these bacterial species have been associated with taste defects arising from fermentations.[8]



What are the risks associated with cold nitro brew coffee

Cold brew coffee, however, is additionally subject to potential contamination during further processing after the roasting step of green coffee. Following roasting it is expected that vegetative bacteria will be destroyed, and in fact roasting may also destroy or damage bacterial spores. Roasting temperatures have been reported between 215°C to 225°C (420°F to 437°F) for medium and dark roasts for 5 to 10 minutes. This is far higher than a 6-log reduction required for *C. botulinum*, according to the Food and Drug Administration, which reports at 100°C, 1 minute is required to inactivate non-proteolytic *C. botulinum* Type B.[10]

However, the process is considered as a low temperature long time brewing step. Even if the roasting process destroys bacterial spores, the long hold time during the steep at room temperature provides a condition that may allow for cross-contamination through inadvertent or accidental introduction of bacteria during the processing steps and handling. During this process many pathogens may grow, particularly psychrophiles, i.e., those bacteria able to grow in colder temperatures.[2]

These bacteria include cold-tolerant bacteria (*Listeria, Bacillus, Pseudomonas*), food handler bacteria (*Staphylococcus, E. coli*), and spore-forming bacteria (*Clostridium, Bacillus*) and spoilage bacteria.[2] Recently, a U.S. brand of NCB coffee was recalled for the risk of *C. botulinum*.[11] In the description of the voluntary withdrawal issued by the company, they stated that their current process could lead to the growth and production of botulin. Cornell provided oversight as the process authority, and it can be inferred that challenge testing showed the possibility that *C. botulinum* could grow.

An on-line review of pH values for NCB found values ranging between 4.9 and 6.0 from two sources.[12,13] Further discussions with research teams reviewing NCB processes found typical pH values in a Kona cold brew coffee between a pH of 5.4 and 5.63.[3]

Nitrogen gas is an inert material and commonly used to flush the headspace of beverages, or in modified atmospheric packaging to reduce oxygen for prolonged shelf-stability.[14] How the nitrogen gas is infused into the coffee, either added during dispensing from a large keg, or added to a canned beverage, or as a widget to be released when opening a canned beverage, should not affect the final pH of the product. From a food safety viewpoint, the gas acts to create a more anaerobic environment, and reduces spoilage organism growth. By removal of oxygen, this also increases risk for *C. botulinum*.

Previous guidance on cold nitro brew coffee from British Columbia

None.

Information and guidance about cold nitro brew coffee from elsewhere

There is very little peer-reviewed information published on cold-brew coffee, or the risks associated with nitro cold-brew coffee. Possible mitigation options outlined by Dr. Maya Zuniga,[2] in a you-tube video on food safety include control through pasteurization, acidity, or some combination of controls. In addition sanitation in the process to reduce cross-contamination coupled with aseptic packaging are required. She further asserts that there is no difference in the compounds extracted during hot and cold brew processing, which is additionally corroborated by other researchers (Sarah Lane and Josh Palmer, University of Victoria; Dr. Nina Rai and Megan Fuller, Thomas Jefferson University by personal communication).[1-3,15] Chlorogenic acids are bitter compounds found in coffee that beneficially act as antioxidants.[3] Cold-brew and hot-brew extractions provide mixed results with respect to quantities of caffeine and chlorogenic acids. Often, but not always, cold-brew coffee extracts are higher in caffeine and chlorogenic acids.[1,3] These acids are thought to be primary drivers towards increased acidity, so claims that cold-brew coffee is less acidic than hot-brew coffee are not substantiated by recent experiments.[1,3]

Recommendations from BCCDC:

Cold-brew coffee has more risk than hot-brew coffee due to several process factors. (1) The cold-brew coffee is not heat pasteurized (is not made with hot-water), so any microbes encountered following the roasting step are not controlled. One possibility could be inadvertent contamination within a processing facility between roasted and un-roasted beans. (2) Brewing time is extended from a few minutes (in a hot-brew) to several hours or days in a cold-brew. During this time coffee present in the storage containers or dispensed through lines can encounter microbes, or, under non-refrigerated conditions, allow for outgrowth of sporulating bacteria if the right conditions are present (such as room temperature storage). (3) Cold-brew coffee that is not intended for immediate service, as hot-brew is intended, is also more vulnerable to microbe cross-contamination, and microbe out-growth, particularly if refrigerated storage conditions are required as a control for this product.

Coffee acidity is low, but not below a pH of 4.6, and therefore this food product is considered a PHF. Although the coffee beans are roasted, the risk of *C. botulinum* spores must be considered. This hazard may arise via cross-contamination within the processing environment, or from residual spore survival during the roasting process. To control for this risk, aseptic processing and packaging of the finished product is required. Low-acid canned foods aseptic processing and packaging have been described by the U.S. Food and Drug Administration as "some of the most complex of food manufacturing operations."[16] The processor must establish commercial sterility of the holding equipment, tubes that transport the product, all equipment downstream, the packaging equipment and the packaging material.[16]

According to guidance BCCDC has previously given on foods packaged in reduced oxygen atmospheres, refrigerated shelf-life is evaluated based on control for *C. botulinum.* If no other controls are present, a maximum refrigerated storage of less than 10 days is advised for products stored at 4°C and below.[17]

Several options exist for operators to control this product for *C. botulinum* and other hazards. Operators should consider

1. Heating and pasteurization following the cold-brewing process. This will not eliminate the *C. bot* risk, but will allow for prolonged refrigerated storage. A minimum pasteurization of 90°C for 10 minutes or equivalent is recommended. [17];
2. Reducing pH to 4.6 or below;
3. Ensuring aseptic processing;
4. Addition of preservatives; and
5. A combination of these controls.

Operators are responsible to establish shelf-life for their products, and to ensure risks and hazards in their product are controlled. Because this is a new emerging product, BCCDC recommends challenge studies are conducted to ensure that the *C. bot* hazard is controlled. These studies should also take into account the potential for end-user abuse, for example, if the product is canned and required to be refrigerated, the challenge study should take into account that consumers may leave the product at room temperature. An excellent resource to consult on how to conduct a challenge study and establish shelf-life is contained in the following reference by the National Advisory Committee on Microbiological Criteria for Foods, *Parameters for determining inoculated pack/challenge study protocols.*[18]

In summary the cold brew process does not control for the hazard of *C. botulinum.* Further, sealing this food product in cans constitutes a reduced oxygen atmosphere. The addition of nitrogen does not reduce the existing hazards, and although nitrogen is an inert material, it does not change the acidity and may slightly increase risk by creating further oxygen reduction in the can during the packaging step. Therefore,

- This product requires refrigeration as the only hurdle to control for *C. botulinum,* with a maximum refrigerated shelf-life of 10 days, unless other hurdles can be incorporated into the process.
- Consumer labelling must reflect that even though the product is marketed in a can refrigeration is required.

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