PALL

Food and Beverage

Low Acid Beverage Producers Look to Microfiltration as Reliable Non-Thermal Process

Overview

In recent years, global consumption of coconut water has exploded driven by increased consumer demand for healthier and more natural substitutes to carbonated soft drinks. Packed with various nutrients including vitamins, amino acids and antioxidants, coconut water has the potential to boost the immune system and provide anti-aging and anti-cancer effects[1]. With growing consumer health awareness, this trend is expected to continue with coconut water sales projected to climb at a CAGR of 21% over the next five years[1].

With rising consumption and broadening distribution, attention to product quality and safety is also increasing. As a low acid food with typical pH greater than 4.6 and a water activity greater than 0.85[2], packaged coconut water can be a host for *Clostridium botulinum* bacteria which may release a life threatening neurotoxin that causes botulism. While the spores are generally harmless, the danger occurs when vegetative *C. botulinum* bacteria produce neurotoxins.

Regulatory agencies like the Food and Drug Administration (FDA) are now setting stricter standards for low acid food as a preventative measure. For example, all commercial processors of low-acid and acidified foods located in the United States and all processors in other countries who export low-acid canned food or acidified food products into the United States must register their processing plants with FDA[2].

Additionally, guidance from the FDA is now recommending that firms subject to the pathogen reduction provisions of the juice HACCP regulation incorporate validated control measures for all *C. botulinum* spores into their HACCP plans that will be applied in the processing facility, and that will ensure that *C. botulinum* growth and toxin production will not occur should the juice be kept unrefrigerated in distribution or by consumers[3].

The Challenge

To maintain quality and implement FDA guidance for low acid beverages as mentioned above (and in FDA Forms FDA 2541a and FDA 2541c), coconut water producers can control *C. botulinum* by any validated treatment method that is effective for this purpose. Methods implemented by coconut water producers include acidification of the product to a pH of 4.6 or below so *C. botulinum* will not grow, use of thermal treatment methods like flash pasteurization or a combination of High Pressure Processing (HPP) and thermal treatments with cold storage and distribution.

While these methods can be effective, the industry continues to look at alternate technologies to overcome the disadvantages. Acidification is not ideal for manufacturers wanting to label their product as “pure” coconut water, and thermal methods can have a negative impact on coconut water quality and flavor. Heat reduces the vitamin and nutrient content and causes oxidation which can result in color changes like pinking or browning. Additionally, labor and transport required for high pressure pasteurization processes can add significantly to operating expenses.

The Solution

Pall Corporation’s filtration products have been implemented in coconut water production as an alternative to thermal treatment and high pressure pasteurization for pure coconut water. A combination of crossflow filtration and cartridge membrane filters provide a reliable and economic solution. Unlike thermal and high pressure treatment methods, membrane filtration provides a reproducible, consistent barrier for contaminant removal at ambient temperature.

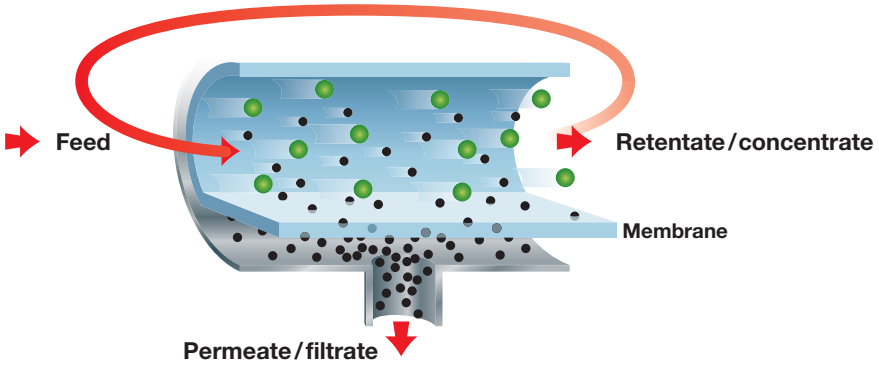
Coconut Water Clarification

After coconut cracking, raw coconut water can be clarified to reduce turbidity and suspended solids that can have an impact on downstream processing. Pall’s Membralox® ceramic crossflow system provides an excellent solution for achieving filtrate quality and high solids concentration for high yield and minimal losses.

In crossflow filtration, feed fluid continually sweeps across the membrane surface parallel to the filtration membrane. Separation takes place as permeate (filtrate) passes through the membrane and retentate is recirculated and concentrated. See Figure 1. Membralox membrane balances high

throughput capacity with filtrate quality for economic and reproducible protection of the downstream equipment.

Figure 1: Crossflow filtration principle



The ceramic membrane system is enclosed, limiting product exposure to the environment, contamination and oxidation. Ceramic technology operates without the need for filter aids and their associated storage, handling, and waste disposal costs. The membranes are regenerated with water rinses and chemicals for long service life.

Membralox IC ("intermingled channel") membranes were selected for coconut water clarification to provide the highest membrane area in the most compact footprint. Within the same module geometry, the IC membranes with their honeycomb design enable 39-47% higher filtration area than traditional ceramic membranes with concentric ring design. The result is highly compact modules, which has a positive impact on system configuration and cost of ownership.

Figure 2: Membralox IC Modules with their diamond shaped channels balance the goal of optimizing the high solids concentration with achieving highest possible filtration area.

Coconut Water Final Cartridge Filtration

After clarification, membrane cartridge filters can be used directly upstream of the filler in an aseptic packaging line. Aseptic processing ensures that product is packaged in a sterile container in a way that maintains commercial sterility to ensure no contamination from pathogenic or spoiling bacteria.

Final membrane cartridge filters are used extensively in the beverage industry to provide secure and reliable removal of spoilage microorganisms in a variety of applications. In many beverage applications, depending on the customer requirement, 0.45 micron membrane filters validated for removal of model organism *Serratia marcescens* or 0.2 micron sterilizing grade membrane filters provide a sterile effluent when challenged with at least 10^7 *Brevundimonas diminuta* per cm^2 of effective filtration area[4]. For validation of a specific low acid food process like coconut water for removal of *C. botulinum* spores, manufacturers should contact a representative of the FDA.

Pall's final membrane cartridge filters are available in a variety of standard sizes and configurations to accommodate flow rate and maximize throughput. The filters can be steamed in place (SIP) and hot water cleaned, without compromising their robustness or removal performance. To confirm membrane filter performance, a Palltronic® Compact Touch filter integrity test instrument can be used both prior to and after completion of each filtration batch (Figure 4). The Compact Touch instrument is a simple to use, portable device based on the principle of pressure decay integrity test. A pressure decay test consists of measuring a fixed starting pressure over a defined period as an indirect measurement of gas diffusion through the pores of a wetted membrane. The pressure decay value is correlated to a bacterial challenge test performed on the membrane filter as detailed in a Technical Performance Report. Results from the integrity test can be printed or downloaded to supplement Quality Assurance records.

Figure 3: Final Membrane Cartridge filter

Figure 4: Compact Touch Integrity Tester

The Benefits

With Pall's combined crossflow and membrane cartridge filters, coconut water producers have alternate processing options with the following benefits:

- Aseptically packaged product labeled as "pure" coconut water
- A reproducible, consistent barrier for contaminant removal at ambient temperature
- Non-thermal treatment which avoids the negative impact heat can have on vitamins and nutrients and oxidation
- Documentation of filter performance for quality assurance records with a simple integrity test

References

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2. Guidance for Commercial Processors of Acidified & Low-Acid Canned Foods, FDA, website: https://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/AcidifiedLACF/default.htm
3. CFR Code of Federal Regulations CFR, TITLE 21—FOOD AND DRUGS CHAPTER I—FOOD AND DRUG ADMINISTRATION DEPARTMENT OF HEALTH AND HUMAN SERVICES SUBCHAPTER B--FOOD FOR HUMAN CONSUMPTION, part 114 acidified foods, website: https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=114&showFR=1
4. FDA guidelines for aseptic packaging

About Pall Corporation

Pall Corporation is a global filtration, separation and purification leader providing solutions to meet the critical fluid management needs of customers across the broad spectrum of life sciences and industry. We work with our customers to advance health, safety and environmentally responsible technologies.

Pall Food and Beverage provides products and services to ensure product quality and maintain process reliability in beverage and food production. Our solutions also assist in consumer protection, waste minimization and reduction of operating costs.

*Better Lives. Better Planet.*SM

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Please contact Pall Corporation to verify that the product conforms to your national legislation and/or regional regulatory requirements for water and food contact use.

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