



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

Environmental Health Services

Food Issue

Notes from the Field

Safety assessment for chocolate

Request received from:	Regional Health Authority
Date of request:	September 10, 2013
Issue (brief description):	In the farmer's market guidelines, remolded chocolate products are required to be heated to 71°C - is this restrictive wording necessary?

Disclaimer: The information provided in this document is based on the judgement of BCCDC's Environmental Health Services Food Safety Specialists and represents our knowledge at the time of the request. It has not been peer-reviewed and is not comprehensive.

Summary of search information

1. Internet sources, various.
2. Direct journal searches: Elsevier journals - Food Control, and Journal of Food Protection.
3. Previous consultation requests on chocolate in our files

Background information:

The current BCCDC temporary market guidelines list chocolate in Appendix 1 as a lower risk food with this restriction "Chocolate (provided it is used as an ingredient in a food that has undergone cooking to at least 71°C (160°F)". The way this is worded implies that chocolate baked into a product is acceptable, but remolded into a product, such as those shown below, would require the chocolate to be reheated to 71°C (160°F).

- Melt and pour chocolates at home
- Chocolate dipped nuts
- Chocolate dipped strawberries
- Chocolate dipped granola bars
- White chocolate pecan truffles
- Caramels
- Cappuccino cups
- Malted Milk centers (made with malted milk powder)
- Chocolate Pecan truffles

Pure chocolate is an emulsion of cocoa butter and cocoa powder (solids) that are first derived from nuts or seeds of the cacao tree. The seeds are fermented, dried, cleaned, roasted and ground, made into chocolate liquor, then into the component parts, cocoa butter and solids.¹ To create smooth chocolate, a process called conching is employed, where cocoa butter is evenly distributed and scraped with the cocoa solids to remove grittiness in the chocolate.¹ The presence of *Salmonella* during pre-processing steps in one study was found to be highest during the drying and storage steps (100% and 89% positive), although after roasting, only 1 out of 119 bean samples were found positive for *Salmonella*.² Roasting temperatures for chocolate generally range from 110 to 130°C.³

It is during the roasting step that the destruction of *Salmonella* and other hazards occur.⁴ After this step, strict attention to hygienic practice in the manufacturing plant is required to prevent reintroduction of microbial hazards to chocolate.⁴ There are at least two other process steps after the roasting step where chocolate is again heated, but only the conching step occurs at temperatures high enough and long enough to effectively remove microbial hazards.

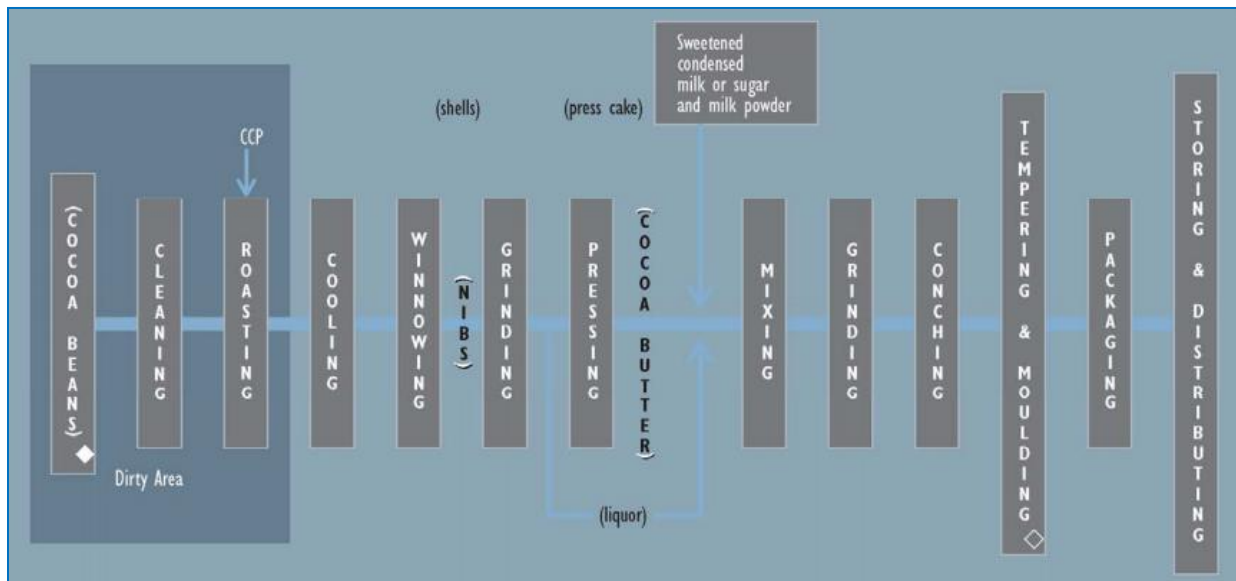


Figure 1

HACCP and process overview for milk chocolate manufacture

(sourced from National Confectioner's Association, www.candyusa.com/files/CocoaChocolateGMPs.pdf)

During conching, D-value calculations (D-value = the amount of time to reduce bacteria by one log at a specific temperature) and temperatures between approximately 50°C and 70°C required times ranging from 1292 min (approx one day) at 60°C to 584 min at 50°C, with higher temperatures showing bacterial strain resistance.³ Conching temperatures are slightly higher than the temperatures required to achieve tempering, another term applied to processes involving off-the shelf manufactured chocolate (post processing manipulations). In the tempering process, manufactured chocolate is melted, then reheated to give the chocolate a gloss and snap. During this process milk and dark chocolate is heated to between 45°C to 48°C, cooled down to 27°C, then back up to 30°C for milk chocolate and 32°C for dark chocolate. Tempering is a necessary step during post-processing steps to retain brightness and texture, however, the tempering process is tricky. Cocoa butter forms up to six types of crystals in chocolate, depending on how heating is done, with only Type V crystals being desirable.¹ Overheating chocolate (i.e. over ~50°C) can cause clumping and scorching resulting in an undesirable product.

Properly manufactured chocolate is considered a low-risk and low moisture food. Water activity values for chocolate lie between approximately 0.37 to 0.5.^{3,5} However, several *Salmonella* outbreaks have been tied to chocolate and chocolate products with very low numbers of the bacteria found in the implicated foods.⁶ In the majority of outbreaks, the root source of the outbreak was contaminated cacao

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seeds, and a failure to control *Salmonella* during roasting.⁴⁻⁶ Post-processing contamination in the manufacturing facility resulting from deficiencies in plant operations and inadequate quality control was also noted in at least one chocolate outbreak affected Canada in 1973.⁶ *Salmonella* have been documented to persist in contaminated chocolate at room temperature for greater than 9 months.⁵ However, reworking and post-processing controls are not effective after the chocolate is made. Heating or reheating a low moisture food such as chocolate to an internal temperature of 71°C would not destroy *Salmonella* if it were present. An experiment measuring the D-value for milk chocolate contaminated with *Salmonella* Typhimurium found that heating for 816 min (or 13.6 hours) would be required at 71°C.⁵ Therefore, the current BCCDC temporary food market guideline to reheat chocolate to 71°C, presumably to remove pathogens such as *Salmonella* if it were introduced during remolding and melting of chocolate, are not scientifically sound. Besides *Salmonella*, *E. coli* O157 and other verotoxigenic *E. coli* strains have also been demonstrated to survive and persist in artificially contaminated chocolate.⁷ These pathogens behave very differently in low moisture foods such as chocolate, peanut butter, and dried infant formulas, when compared to aqueous types foods, such as beef or chicken, where heating to 71°C will effectively eliminate pathogens.⁶

BCCDC has been consulted on at least one other occasion regarding remolding of chocolates. During this consultation (in 2012) it was decided that bulk chocolate should be avoided as it may become contaminated from unsanitary surfaces in the bulk bins, during cutting of the chocolate blocks into smaller portions for the bins, or from consumers touching the chocolate in the bins with bare hands. It was recommended that operators should source their chocolate from a supplier that has product specifications which include testing for potential hazards. These would include the absence of the indicator organisms, *E. coli* and absence of pathogens, such as *Salmonella*.

In one BC food poisoning investigation, chocolate sauce contaminated with *Staphylococcus aureus* was confirmed to have caused at least one illness in 2004. While no details surrounding the manufacture of the chocolate sauce were collected, the product was canned in a glass jar and sold locally in Saanich, BC. Likely contamination was a result of poor hygienic handling during manufacture of the chocolate sauce, and not from contaminated cacao beans or manufactured chocolate.

BCCDC Recommendations for Chocolate Melting and Remolding

As properly manufactured chocolate is considered a low risk product and the most important critical control point in the manufacture of chocolate is the cacao seed roasting step (a step that is not performed by vendors melting and remolding chocolates); and as reheating of manufactured chocolate to 71°C would be ineffective to reduce contamination if introduced during post product processing, i.e. during melting and remolding of manufactured chocolate, the BCCDC offers these recommendations for melting and remolding of chocolate for products intended to be sold at farmers' markets.

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Chocolate purchases

- should be sourced from chocolate manufacturers and suppliers that verify their chocolate is tested and free from *Salmonella* and other indicators of contamination such as *E. coli*. A certificate of assurance should be provided by the supplier with the chocolate purchase.
- from bulk purchase bins are not allowed as contamination from (1) unsanitary bulk bin surfaces; (2) during cutting process of chocolate blocks; and (3) from consumer hands; may occur that cannot be controlled.
- Strict hygienic controls must be followed during any process involving melting and remolding of chocolates to avoid introducing potential contamination into the melted chocolate, and
 - Operators should be educated that pathogens such as *Salmonella* and *E. coli*, once introduced into melted chocolate products, may survive for a year or longer.
- Melted, remolded chocolate that is potentially exposed to contamination may not be used for any further remolded chocolate product, but could be used for either baking or production of hot chocolate beverages.
- The wording in the Temporary Food Markets Guidelines should be amended to:
 - remove the temperature requirement for reheating to 71°C;
 - add the requirement for purchasing, above; and,
 - review the requirement with Food Safety Managers prior to rewording the guideline and reposting on the web-site
- These recommendations do not apply to assessment of chocolate fillings or other formulations, and are intended only for melting and remolding of manufactured chocolate. Fillings and other chocolate candies or desserts should be assessed independently.

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References

1. Wikipedia. Chocolate. 2013 [cited 2013 Sep 13]; Available from: <http://en.wikipedia.org/wiki/Chocolate>.
2. da Silva do Nascimento M, da Silva N, da Silva IF, et al. Enteropathogens in cocoa pre-processing. Food Control. 2010;21(4):408-11.
3. Nascimento MdSd, Brum DM, Pena PO, et al. Inactivation of Salmonella during cocoa roasting and chocolate conching. International Journal of Food Microbiology. 2012;159(3):225-9.
4. Cordier JL. HACCP in the chocolate industry. Food Control. 1994;5(3):171-5.
5. Podolak R, Enache E, Stone W, et al. Sources and Risk Factors for Contamination, Survival, Persistence, and Heat Resistance of Salmonella in Low-Moisture Foods. Journal of Food Protection. 2010;73(10):1919-36.
6. Beuchat LR, Komitopoulou E, Beckers H, et al. Low Water Activity Foods: Increased Concern as Vehicles of Foodborne Pathogens. Journal of Food Protection. 2013;76(1):150-72.
7. Baylis CL, MacPhee S, Robinson AJ, et al. Survival of Escherichia coli O157:H7, O111:H- and O26:H11 in artificially contaminated chocolate and confectionery products. International Journal of Food Microbiology. 2004;96(1):35-48.

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