

CHANGES IN PROCESSING AND LABELLING OF FROZEN CHICKEN PRODUCTS AVAILABLE TO CONSUMERS IN VANCOUVER

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ABSTRACT

Background: Between May 2017 and May 2019, 18 *Salmonella* outbreaks in Canada were linked to raw chicken, resulting in the recall of 13 chicken products. Most of these products contained frozen raw breaded chicken, such as chicken nuggets, chicken fries, and breaded chicken burgers. (Public Health Agency of Canada, 2019) These products are especially risky for consumers because they may appear precooked, resulting in inadequate food safety measures being taken. (Catford, Ganz, & Tamber, 2017). Due to this concern, as of April 1, 2019, all frozen raw breaded chicken product manufacturers are required to follow one of four *Salmonella* control measures set out by the Canadian Food Inspection Agency (CFIA). The simplest option for processors is to precook their products to destroy *Salmonella* bacteria and produce a ready-to-eat product. (Government of Canada, Canadian Food Inspection Agency, & Food Safety and Consumer Protection Directorate, 2019a)

Methods: Data was collected from all frozen chicken products available at 14 retail locations in Metro Vancouver that were randomly selected in previous studies carried out in 2018 and 2019 by the British Columbia Centre for Disease Control (BCCDC) and British Columbia Institute of Technology (BCIT) students. The processing status of the products surveyed in this study (n=466) was compared to those collected in the previous studies done in 2018 and 2019, respectively (n=383; n=415). Other information collected included whether product packaging contained statements of internal temperature, requirements for thermometer use, and additional food safety instructions. Data on these parameters collected in the current study (n=466) were compared to similar data collected in 2008 (n=24) and in 2018 (n=67). Photos were taken of all product labels and relevant data from the photos was compiled in Microsoft Excel. Statistical analyses were done using chi-square tests performed using NCSS 2019 software.

Results: The proportion of surveyed frozen chicken products that were cooked as opposed to raw increased from 38% in 2018 to 41% in 2019 to 69% in 2020. The proportion of products containing statements regarding required internal temperatures increased from 58% in 2008 to 96% in 2018 and then decreased to 86% in 2020. 0%, 4.5%, and 1.7% of products surveyed in 2008, 2018, and 2020, respectively, included an indication to use a food thermometer. 79%, 57%, and 25% of products surveyed in the same years included additional food safety statements.

Conclusions: This study showed that the ratio of cooked to uncooked frozen chicken products available to consumers in the Metro Vancouver area has increased since the CFIA's *Salmonella* control measure requirements for frozen breaded chicken manufacturers were implemented in 2019. The 28% and 26% increase since 2018 and 2019, respectively, suggests that many frozen chicken product manufacturers are complying with the CFIA requirements by using a validated cook process to reduce *Salmonella* in their products. This study also showed that, since 2019, there has been a significant decline in the proportion of frozen chicken products that contain information about internal cooking temperatures and additional food safety information on their packaging.

Keywords: *frozen chicken, frozen breaded chicken, salmonella, salmonellosis, foodborne illness, food safety, public health, poultry products, food recalls, chicken processors, salmonella control*

INTRODUCTION

Non-typhoidal salmonellosis is the cause of an estimated 5% of all foodborne illnesses in Canada. The disease is estimated to cause 87 500 illnesses, 925 hospitalizations, and 17 deaths per year in Canada (Public Health Agency of Canada, 2016). Salmonellosis outbreaks linked to two of the most common *Salmonella* serovars, *Salmonella* Enteritidis and *Salmonella* Heidelberg, have been increasingly identified in Canada in recent years. (Morton et al., 2019)

Since Canada began using whole-genome sequencing (WGS) in outbreak investigations in May 2017, scientists have been able to recognize trends in what type of products have been responsible for a large number of outbreaks. This led to the discovery of 18 outbreaks with raw chicken identified as the source. As a result, 13 chicken products were recalled. Most of these products contained frozen raw breaded chicken, such as chicken nuggets, chicken fries, and breaded chicken burgers. (Public Health Agency of Canada, 2019) These products are especially risky for consumers partly because they are breaded and partially fried, causing them to appear precooked

when they are most often not (Catford, Ganz, & Tamber, 2017).

As of April 1, 2019, all frozen raw breaded chicken manufacturers are required to implement control measures set out by the Canadian Food Inspection Agency (CFIA) in order to reduce the presence of *Salmonella* in their products (Government of Canada, Canadian Food Inspection Agency, & Food Safety and Consumer Protection Directorate, 2019a).

This project investigated changes in processing and labelling of commercially available frozen chicken products since the April 1, 2019 CFIA directive by comparing current product label information to information gathered by the British Columbia Centre for Disease Control (BCCDC) in 2018 and by British Columbia Institute of Technology (BCIT) students in early 2019.

LITERATURE REVIEW

Previous Studies

Various Canadian studies have been conducted to investigate the cause of increased cases of salmonellosis in the country. One study conducted in

Ontario aimed to investigate the rise in *S. Enteritidis* cases in the province from 2003 to 2010, during which time cases were also on the rise nationally. Processed chicken consumption was found to increase risk of *S. Enteritidis* by 3 times. (Middleton et al., 2014) Although this study considered processed chicken as a broad category, some of the specific strains identified were identical to strains identified in another study which sampled chicken nugget and strip meat from processing plants and supermarkets in Ontario and Manitoba (Middleton et al., 2014; Bucher et al., 2007).

In 2003, two similar studies were carried out: one in BC and another Canada-wide with most of the data coming from Quebec. Both studies reached the conclusion that consumption of chicken nuggets or strips prepared from frozen was a significant risk factor for *S. Heidelberg* infection. Study participants were surveyed and 30-40% revealed that they believed these products to be precooked, while 30-35% reported washing their hands less frequently while handling these products than they would with raw unprocessed chicken. In addition, 27.3% and 11% of participants in the BC and Canada studies, respectively, stated that they use a microwave when preparing the chicken nuggets/strips. (Currie et al., 2005; MacDougal et al., 2004)

Both the BC and the Canada-wide studies showed a connection between consumption of home-prepared processed chicken nuggets and strips and increased risk of *S. Heidelberg* infection, while a connection between these products and *S. Enteritidis* can be inferred from the Ontario study. The BC and Canada studies also showed that many Canadian consumers are largely unaware that products such as processed

chicken nuggets and chicken strips are generally raw. Cooking and hygiene practices reported suggest that many consumers may ignore or misinterpret label information and instructions provided on packaging of frozen raw breaded chicken products.

A Canadian survey on more general consumer cooking practices, called the Foodbook study, was carried out from April 2014 to April 2015. Many of the questions asked of respondents referred to raw meats, but based on the results of the 2003 studies it is possible that respondents did not think of processed frozen breaded chicken products when asked about raw meat handling. Despite the amount of time between the studies, the 2015 study showed that only 23% of respondents were aware that frozen chicken nuggets are a high-risk food when it comes to foodborne illnesses. One relevant piece of information that can be taken from this study is that 87% of respondents reported that they usually follow cooking instructions on packaging. (Murray et al., 2015) This is an increase from the 57% who reported the same practice in the 2003 studies. However, this difference may not be significant, as the 2003 study only asked that question of Quebec respondents and the choice of answer was “always” instead of “generally”. Overall, these studies show that at least most Canadian consumers follow label directions at least most of the time. Therefore, requirements for complete and accurate instructions could be one way to reduce the incidence of salmonellosis. The Foodbook study also determined that only an estimated 29% of consumers use a meat thermometer to check internal temperatures. Most other respondents reported using “visual inspection” to check if meat is adequately cooked; a method that is not reliable. (Murray et al., 2015) Of course the

percentage of consumers who use thermometers to check internal temperatures of foods such as chicken nuggets could be even lower if respondents did not consider these products to be raw.

Interventions

Food recalls are an effective way to prevent further illnesses, however, many cases of disease may occur before the cause of an outbreak is identified and many illnesses often go unreported. Therefore, preventative measures must be taken to reduce the burden of disease. Canada's Council of Chief Medical Officers of Health recognized this need after discovering the trend of salmonellosis outbreaks from frozen raw breaded chicken products. They responded by releasing a public statement outlining ways to reduce risk including:

- Cook raw chicken products to a minimum internal temperature of 74°C or 165°F as verified by a food thermometer.
- Ensure other food surfaces and equipment are cleaned and sanitized after coming into contact with raw chicken.
- Thoroughly wash hands before and after handling raw chicken products, as with any food.

The statement also specifically stresses the importance of fully cooking frozen raw breaded chicken products, such as chicken nuggets, chicken strips, and breaded chicken burgers. (Public Health Agency of Canada, 2018) The CFIA requires that products such as these that may appear cooked, must clearly state on the front of the package close to the product name that they are “uncooked,” “raw,” or “must be cooked.” The packaging is also required to include sufficient cooking instructions. (Government of Canada, Canadian Food Inspection Agency, &

Food Safety and Consumer Protection Directorate, 2019b)

Public education and clear labeling is one way to help reduce the occurrence of *Salmonella* outbreaks, but steps must be taken earlier on to ensure frozen raw breaded chicken products do not contain disease-causing levels of *Salmonella* when they reach the consumer. As of April 1, 2019, all frozen raw breaded chicken product manufacturers are required to follow one of four *Salmonella* control measures set out by the CFIA (Government of Canada et al., 2019a). The first and simplest option for processors is to “include as part of the manufacture of the frozen raw breaded chicken products a cook process that has been validated to achieve a 7-log reduction in *Salmonella*, which will result in a ready-to-eat product” (Government of Canada et al., 2019a, p.4). Processors may alternatively test either the raw chicken starting products or the complete frozen raw breaded chicken product to ensure no significant amount of *Salmonella* bacteria is present (Government of Canada et al., 2019a). The final option is to use “a process or combination of processes that has been validated to achieve a 2-log reduction in *Salmonella* and implement a *Salmonella* sampling program for the raw chicken mixture” (Government of Canada et al., 2019a, p.11).

Recent Developments

A recently published British Columbia Centre for Disease Control (BCCDC) study compared the predicted risk reduction achieved by two of the CFIA's control measures: precooking the breaded chicken products and implementing a test-and-hold sampling program for the finished products. The cooking method was predicted to decrease the risk of

salmonellosis for British Columbians by one million-fold, while the test-and-hold measure was predicted to reduce the risk by less than 54-fold. Although the other two control measures were not included in the risk assessment, the study noted that the three measures with sampling requirements might be less effective at reducing risk than producing ready-to-eat products because *Salmonella* bacteria may be unevenly distributed throughout the product, and therefore samples will not be representative of the entire production lot. (Trmcic, Man, Tamber, Prystajecy, & McIntyre, 2020)

Both consumer survey results and microbiological results from outbreak investigations and research studies show that *Salmonella* in frozen raw breaded chicken products is a significant risk to public health for Canadians. Public education on safe food handling practices, while important, is not sufficient and cannot be the first line of defence. Therefore, the CFIA’s decision to require frozen raw breaded chicken processors to control *Salmonella* levels in their products to amounts that will not cause illness was necessary. Although the CFIA monitors processor compliance through inspections, data should also be collected at the retail level to ensure that the implementation and enforcement of policy leads to actual changes in the products being made available to the public (Government of Canada, 2019c).

MATERIALS AND METHODS

Between January 9th and January 23rd, 2020, photos were taken of all available frozen chicken products, excluding entrees, available in 14 retail locations across Metropolitan Vancouver. The following

locations were visited, as they were the same locations data was collected from in previous studies conducted in 2018 and 2019 by the BCCDC and by BCIT students (Food Protection Services, 2018):

Table 1. Data Collection Locations: Store Names and Addresses

1	Superstore	350 SE Marine Drive, Vancouver, BC, V5X 2S5
2	T&T	458 SW Marine Drive, Vancouver, BC, V5X 2R9
3	Walmart	3585 Grandview Hwy, Vancouver, BC V5M 2G7
4	Buy Low Foods	6095 Fraser St, Vancouver, BC
5	M&M Meat Shop	4639 Arbutus St, Vancouver, BC, V6J 4A 3
6	7-Eleven	304 Chesterfield Ave, North Vancouver, BC V5M 2G7
7	Canada Safeway	1170 27 Street E, North Vancouver, BC, V7J 1S1
8	No Frills	310 W Broadway, Vancouver, BC, V5Y 1R2
9	Costco	4500 Still Creek Drive, Burnaby, BC
10	Foody World	3000 Sexsmith Rd, Richmond, BC, V6X 4K9
11	Moel's Convenience Store	2085 Dundas St, Vancouver, BC, V5L 1J5
12	City Market	3185 Arbutus St, Vancouver, BC, V6J 3Z3
13	Nesters	4475 Main St, Vancouver, BC, V5V 0A2
14	Save on Foods	2308 Cambie St, Vancouver, BC, V5Z 2T 8

The store locations are dispersed across North Vancouver, Vancouver, Burnaby, and Richmond, as shown in Figure 1 (Google Maps, 2018):

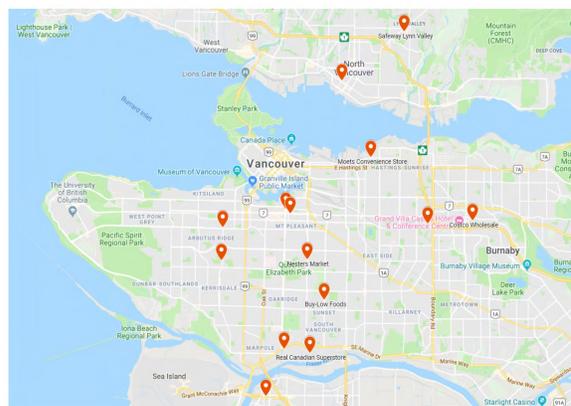


Figure 1. Visual Representation of Data Collection Locations

A total of 466 products were surveyed and information from the photos was recorded on a

Microsoft Excel spreadsheet. The information recorded included “cooked” or “uncooked” in reference to the processing status of the product and “yes” or “no” in reference to the inclusion of a statement indicating internal cooking temperature, a statement indicating the requirement for use of a food thermometer, and the inclusion of any other food safety instructions. Other food safety instructions were defined to be any food safety statements related to handwashing, proper food storage and separation, or refrigeration (Derby, 2019).

Processing status data from the 466 products was compared to data from 383 products surveyed by BCCDC in 2018 and 415 products surveyed by BCIT student Simon Jiang in 2019 (Jiang, 2019). The other data collected from the 466 products was compared to data compiled by BCIT student Ella Derby in 2019, which included 24 products surveyed in 2008 and 67 products surveyed in 2018 (Derby, 2019). Data was analyzed using chi-square tests performed by NCSS software (NCSS, 2019).

RESULTS

The proportion of frozen chicken products available at retail to consumers in Metro Vancouver that are precooked as opposed to raw has increased over the past few years, with a significant increase after the CFIA’s *Salmonella* control requirements came into effect on April 1, 2019. These results are shown in Figures 2, 3, and 4.

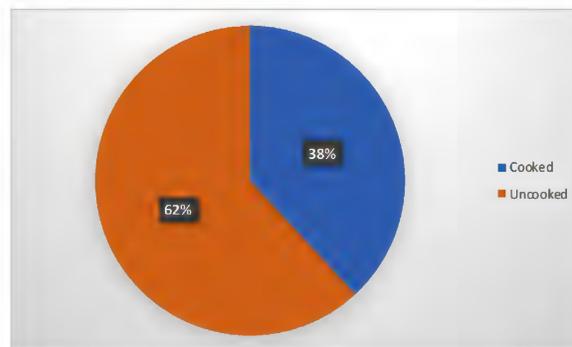


Figure 2. 2018 Frozen Chicken Products- Processing Status Results

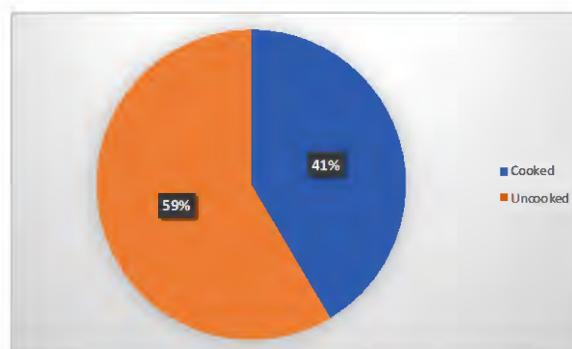


Figure 3: 2019 Frozen Chicken Products- Processing Status Results

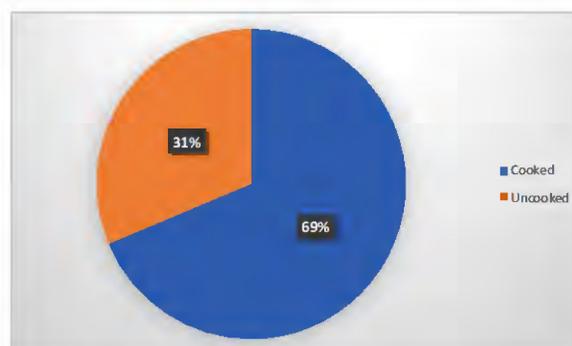


Figure 4: 2020 Frozen Chicken Products- Processing Status Results

Proportional results were also obtained for the three other tests. These results included whether there was a required internal temperature stated on the packaging, if there was any statement indicating that

a food thermometer should be used to verify that temperature, and if any other food safety instructions were included. Table 2 shows a summary of the proportion of products that included each of these elements in each study.

Table 2. 2008, 2018, & 2020 Frozen Chicken-Product Label Instructions

Year	Percent Including Internal Temperature Statement (%)	Percent Including Indication to use Food Thermometer (%)	Percent Including Additional Food Safety Instructions (%)
2008	58.33	0	79.17
2018	95.52	4.48	56.72
2020	85.62	1.72	25.11

DISCUSSION

The results of the first hypothesis tested in this survey revealed that the proportion of precooked frozen chicken products available to consumers in Vancouver increased from 38% of frozen chicken products sampled in 2018, to 41% in 2019, to 69% in 2020. This translates to an 82% to 68% relative increase in the proportion of frozen chicken products that are precooked since CFIA's new requirements for frozen breaded chicken manufacturers were implemented in comparison to 2018 and 2019, respectively. This suggests that manufacturers are making changes to the processing of their frozen chicken products and that many are opting to precook their products. However, since data for all three surveys considered both breaded and nonbreaded frozen chicken products, the increase in the proportion of precooked products cannot be fully attributed to compliance with the CFIA's *Salmonella* control requirements, which only apply to frozen raw breaded chicken products (Government of Canada et al., 2019a). Therefore, it is not entirely valid to interpret this study's results to indicate that there

have been significant changes to the processing of frozen chicken products as a direct result of the implementation of CFIA's control measures for raw frozen breaded chicken products. These changes may also be the result of marketing for changing consumer preferences. Regardless, an increase in the amount of frozen chicken products that are precooked is a positive change with regards to food safety and will hopefully result in fewer cases of salmonellosis in Canada.

Figure 2 below, shows trends in food safety instructions present on frozen chicken product packaging over the three years considered in this study. It is important to note that there was a large discrepancy in the number of products surveyed in each of the years that considered these parameters. Data was taken from 24 products in 2008, 67 in 2018, and from 466 products for the most recent 2020 survey. However, since Derby compiled data from a wide variety of products from randomly selected stores, it is possible that the 2008 and 2018 data still gives an accurate representation of all the frozen chicken products available at those times (Derby, 2019). Also, the same methodology was used in both studies, so comparisons can be made with some level of confidence.

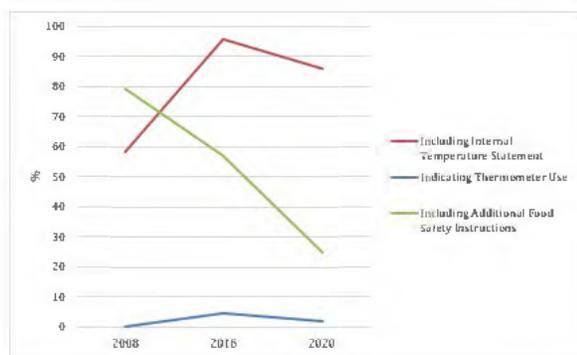


Figure 2: Proportion of Frozen Chicken Products Including Specific Food Safety Instructions on Packaging

The indication of thermometer use is one parameter that has stayed relatively constant throughout the studies, with the proportion of products containing such a statement never exceeding 5% of the total products sampled.

As Table 2. shows, the proportion of products that included an internal temperature statement increased from approximately 58% in 2008 to 96% in 2018 and then dropped to 86% in 2020. Figure 2 shows a visual representation of this trend. It is possible that the increasing number of cases of salmonellosis in Canada prompted frozen chicken product manufacturers to include this information on more of their products from 2008 to 2018 for either ethical or legal reasons, while the CFIA's 2019 requirements resulted in an increase in the proportion of products that were cooked from 2018 to 2020. Manufacturers may have found internal temperature statements unnecessary for cooked products and therefore removed them when switching products from uncooked to cooked. This reasoning could also explain the 32% reduction in frozen chicken products that included additional food safety information on the packaging from 2018 to 2020. However, this does

not explain why the proportion of products containing additional food safety information also decreased by approximately 22% in the ten years from 2008 to 2018.

The results of this study can likely be extrapolated to include retail markets in most of Canada, even though data was only collected in Metro Vancouver. This is because data was collected from a wide variety of samples from various grocery and convenience stores. Most of the products considered were supplied by common brand names that could be found anywhere throughout Canada.

KNOWLEDGE TRANSLATION

Results from this study can be used to inform policy, practice, and guidelines; both on their own or when considered with results of other studies. For example, the increase in the ratio of cooked to uncooked frozen chicken products can be considered alongside recent or near-future statistics on outbreaks of salmonellosis in Canada to determine if this increase has resulted in a decrease in cases and outbreaks resulting from these products. If not, stricter guidelines or regulations may need to be considered for frozen chicken products. Such guidelines may require manufacturers to include more food safety instructions on their packaging. Specific instructions and wording regarding thermometer use, internal temperatures, storage, and handling may be required. If there is a significant reduction in cases and outbreaks associated with these products, this survey will support the effectiveness of the CFIA's control measures.

LIMITATIONS

Since no money, specialized equipment, or public participation was required for this study, the only limitation to primary data collection was time.

However, this was not significant, as all locations were able to be fully surveyed as planned. This was in part due to the methodology, which was proven effective in the previous surveys that secondary data was collected from. One way to improve upon the methodology used would be to survey a wider range of products. This could be done by surveying more stores, collecting data from product inventory sheets, or expanding the survey to include rural areas as well as locations in other provinces. These alternatives could be considered to improve external validity, however, they each have other limitations.

Although standard methodology was used and repeated for subsequent surveys, differences in interpretations of label indications were possible. The most likely parameter to have been measured differently was the inclusion of statements regarding thermometer use. During primary data collection, only direct statements of thermometer use were considered, whereas it is possible that previous surveys considered a picture of a thermometer on the packaging to be sufficient. Such an inconsistency could affect the data analysis portion of this study.

More robust conclusions may have also been made if data was analyzed separately for breaded products and nonbreaded products, however this was considered to be beyond the scope of this study.

FUTURE RESEARCH

Based on the results of this project, the following projects are recommended for future research:

- Test samples from randomly selected frozen chicken products for *Salmonella* serotypes and compare with BCCDC results from samples taken in 2018
- Analyze data from this and prior studies to determine relationships between manufacturer or brand and processing status and/or presence of food safety indications
- Survey of consumer knowledge, attitudes, and practices regarding handling of frozen chicken products
- Contact frozen chicken product manufacturers directly to determine which *Salmonella* control measures they are using and test corresponding samples to determine which control measures are most effective

CONCLUSIONS

This study showed that the ratio of cooked to uncooked frozen chicken products available at retailers in the Metro Vancouver area has increased since the CFIA's control measure requirements for frozen breaded chicken manufacturers were implemented in 2019. The 28% and 26% increase since 2018 and 2019, respectively, suggests that many frozen chicken product manufacturers are complying with the CFIA requirements by using a validated cook process to reduce *Salmonella* in their products. This study also showed that, since 2019, there has been a significant decline in the proportion of frozen chicken products that contain information about internal cooking temperatures and additional

food safety information on their packaging. Also, the 2018, 2019, and 2020 surveys all show that very few frozen chicken products clearly indicate on their packaging that a food thermometer should be used to check internal temperature. Further research is needed to determine if the CFIA's requirements for *Salmonella* control in frozen breaded chicken products are effective in reducing the number of cases of salmonellosis in Canada. Further research is also needed to determine if the lack of food safety instructions on frozen chicken product packaging is hindering any progress made by regulatory and educational strategies to reduce *Salmonella* risk associated with these products.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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