

Is That Food RTE? Thoroughness of Cooking Instructions on Frozen Breaded Chicken Products and Frozen Microwavable Entrees

Ella Derby¹, Dale Chen², Lorraine McIntyre³

1 Lead Author, B. Tech Student, School of Health Sciences, British Columbia Institute of Technology, 3700 Willingdon Ave. Burnaby, BC V5G 3H2

2 Supervisor, School of Health Sciences, British Columbia Institute of Technology, 3700 Willingdon Ave. Burnaby, BC V5G 3H2

3 Contributor, Food Safety Specialist, British Columbia Centre for Disease Control, 655 West 12th Avenue, Vancouver, BC V5Z 4R4

ABSTRACT

Background: Rates of foodborne illness linked to consumers misinterpreting, or lack of proper cooking instructions on frozen food products continue to rise. With many recalls and outbreaks in the recent years surrounding frozen breaded chicken (FBC) products due to consumers not adequately cooking products and in turn becoming ill. However, it is not just frozen breaded chicken to blame, frozen microwavable entrees have also contributed to this problem. Therefore, the purpose of this project was to determine what was actually being displayed on the packaging of these frozen foods. Identifying whether or not frozen food products have clear, specific and consistent cooking instructions for the consumers is critical in identifying the risk of cooking and eating these foods.

Methods: Secondary data was obtained from the British Columbia Centers for Disease Control (BCCDC) of cooking instructions on FBC packaging, and primary data was collected through visiting grocery stores in the Metro Vancouver area by surveying cooking instructions on frozen microwavable entrees packaging. Four categories of data were assessed, 2008 and 2018 raw FBC products, 2018 cooked FBC, and 2019 frozen microwavable entrees. Parameters such as inclusion of internal cooking temperature, thermometer usage, microwave instructions, and additional food safety handling was gathered. Chi-square tests were used to analyze the results with the statistical software NCSS12.

Results: Of all categories surveyed 87.1% (n=122) said to cook the product to a minimum of 74°C, and 12.9% (n=18) did not state anything. 2018 raw FBC always stated an internal cooking temperature (100%), whereas 58% of the 2008 raw FBC stated an internal temperature and 89% of both the 2019 frozen entrees and 2018 cooked FBC did. Out of all 140 products surveyed across categories only 8% stated to use a thermometer when cooking to ensure food has reached proper internal temperature. The frequency of categories to display food safety was as follows, the 2018 raw FBC (82%) and the 2008 raw FBC (79%), followed by the 2019 frozen entrees (42%) and the 2018 cooked FBC (21%). For the microwave instructions the frozen entrees almost always stated this (81%), whereas the 2008 and 2018 raw FBC both never stated to use a microwave (0%). There was a significant association between products and the inclusion of the statement of internal cooking temperature and thermometer usage. This was based on the food product category itself, frozen breaded chicken or frozen entrees, or based on manufacturer of the product.

Conclusions: It was evident that the major gap lies in the consistency of instructions. Almost every manufacturer had their cooking instructions presented differently, which could in turn confuse the consumer. Instructions also rarely stated to use a thermometer to check the internal temperature, although almost always stated a specific temperature to cook to. A small portion of manufactures are diligent about displaying all necessary information to the consumer such as, Kraft, Conagra foods, and Olymel which adequately met all parameters assessed. In order to fix the gaps of inconsistency of instructions this information can be used as educational tools by the BCCDC to inform customers on what to look for in cooking instructions of frozen foods as well as by industry to improve the clarity and consistency of the cooking instructions on the packaging.

Keywords: *cooking instructions, frozen breaded chicken, frozen microwavable entrees, foodborne illness, food safety, public health, thoroughness, RTE*

INTRODUCTION

This research project evaluates the cooking instructions on frozen microwavable

meals and frozen breaded chicken products (FBC) to determine the depth of the instructions. The reason this study was carried out is because

there has been and continues to be a number of foodborne illness cases from consumers either not given proper cooking instructions or misinterpreting them and in turn consuming unsafe undercooked frozen food. Frozen breaded chicken products have mainly been to blame, but what about the other frozen meals that are also microwavable? (1-4) Research done by the BCCDC with regards to frozen breaded chicken products and their labeling and cooking instructions has led to this research question in order to determine the cooking instructions for other frozen meals on the market. This research will analyze information collected by the BCCDC on FBC products cooking instructions as well as data collected by this researcher of frozen microwavable entrees to determine the adequacy of cooking instructions.

Research Question

Do frozen food products, both frozen breaded chicken and frozen microwavable entrees state adequate cooking instructions?

*Adequate being:

- They state an internal cooking temperature
- They state thermometer usage
- They state microwave instructions and wattage value
- They state additional food safety handling

LITERATURE REVIEW

The Current Problem

For decades, there have been countless food recalls surrounding frozen food products. Cases of *Salmonella*, *E. coli*, and *Listeria* have all been found to be from frozen meals. However frozen breaded chicken products have claimed most of the attention, a majority of these outbreaks are from *Salmonella*, but not all. In Canada, frozen breaded chicken products have also been recalled for *S. aureus* toxin, *Listeria*, and even metal/pen fragment hazards all in the last 5 years (1-4).

Frozen microwavable entrées have also been responsible for foodborne outbreaks. In 2007 there was a cluster of *Salmonella* outbreaks determined by the CDC, from frozen microwavable pot pies in the United States. This outbreak resulted in 401 cases of *Salmonella* across 41 states (5). In 2010 another outbreak of its kind was attributed to Cheesy Chicken & Rice single-serve frozen entrées. This outbreak resulted in 44 cases of *Salmonella* across 18 states (6).

These outbreaks helped identify a gap in consumer education and understanding of the cooking instructions on packaged frozen microwavable meals. Investigation done by the CDC revealed that the majority of people who became ill from the frozen pot pies cooked them in the microwave and were confused about the cooking instructions, which may have resulted in a failure to properly cook the product (5). Instructions for microwave cooking on packages were not standardized and lacking in microwave wattage values. Further, cooking instructions

were not followed by those who became ill. These outbreaks may not be occurring if the consumers were not confused about the instructions in the first place. However, these outbreaks helped identify that inadequate microwave cooking and labeling on cooking instructions of frozen meals were the main issue in these cases.

Food Safety Criteria

Every year approximately 4 million (1 in 8) Canadians will be affected by some form of foodborne illness (7). It is important that people know to cook their food to a safe internal temperature to avoid getting sick. Using a thermometer is the best way to ensure your food is fully cooked, however very few people use a thermometer when cooking (8, 9). Most people rely on the look of the food to ensure it is done, however using a thermometer is the only way to ensure the food has reached a safe internal temperature (8). A survey done by the USDA revealed that 46 percent of the participants never use a thermometer when cooking products which contain chicken, and 66 percent never use a thermometer when they cook hamburger products (10). The safe internal temperature for poultry products is 74°C, 71°C for ground meat products such as beef and pork, and for pieces of whole meat products such as beef and pork it is 63°C and 71°C respectively (8).

The CFIA requires ready-to-eat meat and poultry products or products that could be mistaken for RTE meat and poultry products to

be labeled accordingly. The packaging should include “comprehensive cooking instructions such as internal temperature-time relationship that, if followed, will, result in a ready to eat meat product” (11). The manufacture must provide instructions that when followed by the consumer will fully cook the product to achieve a 6.5 log reduction of salmonella in meat products other than poultry, and a 7-log reduction in products containing poultry (12). However, there is no indication in the requirements that this refers to frozen microwavable meals that contain meat products.

Microwave Cooking

Microwave ovens are a safe and convenient way to cook and heat up food (13). The majority of domestic microwave ovens power ranges from 500-1100 watts (13). There are many factors that affect the proper heating of food in a microwave, this includes frequency/wattage, dielectric properties, moisture content, mass, temperature, location of food, and thermal properties of the food (14). Foods with a higher fat content will also cook a lot more quickly due to its low heat capacity, whereas food with a high-water content must be cooked at a lower temperature and will take longer (15). The Government of Canada approves of the use of microwave ovens to cook food and provides instructions for the proper cooking of food in microwave ovens. This includes always using a thermometer to check the internal temperature of the food to ensure all

potential pathogens are killed and noting the lower the wattage of the microwave the longer it is going to take to cook (16). It is also suggested to rotate and stir the food throughout cooking, allow stand time, and adjust cooking time based on your microwaves wattage. However, 70% of people don't know their microwaves wattage, so how can they know if their food is being cooked safely (10)? The importance of proper microwave cooking is also stated in the Food Retail and Food Services Code.

“Potentially hazardous foods that are cooked or reheated in the microwave should be rotated or stirred throughout or midway during cooking to compensate for uneven distribution of heat, so that all parts of the food reach a temperature of at least 74°C (165°F). The food should be allowed to stand covered for a minimum of 2 minutes after cooking to obtain temperature equilibrium” (17 pg. 40).

This is because microwaves cook food rapidly, and the heating doesn't provide the same time and temperature relationship required for the removal of microorganisms as opposed to conventional cooking methods. Cold spots are also produced in microwave cooking; therefore, it is important to measure the food at multiple sites and allow stand time for thermal equalization through the product (17).

A study conducted by Schiffmann tested the preparation of not ready to eat food products (NRTE) in microwave ovens. Three different types of frozen meals were cooked in 8 different brands and wattages of microwaves to determine if the microwaves actually were the wattage they claimed to be and to determine if the food was

being cooked to a safe internal temperature. On all the frozen meals evaluated the cooking instructions stated to ensure the product is cooked to an internal temperature of 160°F, but despite these statements none of the boxes suggested to use a thermometer to actually check the temperature (18). The results also found that wattage claims advertised on the ovens were false, the ovens actually put out a much lower wattage when tested as opposed to what was advertised. Therefore, consumers food may not be being adequately cooked even if instructions are followed properly (18). Second the findings revealed that out of all 8 different microwave ovens tested at least one failed to cook the food to the proper temperature by following cooking instructions after every test run. Overall every oven failed at least once or more (18). Therefore, this study showed that frozen NRTE products cooked in a microwave and following the instructions doesn't necessarily meet the minimum criteria for internal safe temperature in every component every time.

Another study by Pitchai et al. assessed the heating rate and non-uniform heating in domestic microwave ovens. It was found that the location of the food on the turn table, and dielectric properties of the food also played a role in the uneven heating of the food. Using a container designed with multiple heating compartments to assess heating rates it was found that food is most thoroughly heated placed on the edge of the turn table, heating was 3 times

faster on the edge of the turntable than on the center (19).

Overall microwave cooking of frozen foods is an acceptable form of cooking food, however one must be cautious and keep in mind the wattage, properties of food and length of cooking time all affect the food differently. Therefore, the only way to be sure food is safe is to use a thermometer.

Perceptions of Cooking Instructions

Past outbreaks have brought this topic into the spotlight about how important cooking instructions really are on frozen meals. Unclear or lack of cooking instructions on frozen food packaging is easily misinterpreted by the consumer or may be completely lacking all together. Research by the USDA determined that customers often look for labeling terms in cooking instructions of frozen meals such as “cook thoroughly” or “cook to an internal temperature of...” to indicate the meal requires proper cooking for food safety, therefore taking it more seriously. Whereas terms such as “ready to eat”, “fully cooked” or “heat and serve” were not taken as seriously when it comes to food safety (9). This goes to show the importance of specific and consistent cooking instructions needed across frozen food products. Therefore, indicating the proper internal temperature is one of the best ways to not have the instructions misinterpreted by the consumer. However even if this is stated, will it actually be followed, most people cooking frozen microwavable meals very

rarely or never use a thermometer to check if the food is adequately cooked (9), mainly because it is too time consuming and they believe that a portion of the meal is somewhat precooked.

Many consumers are unsure if frozen meals contain cooked, or raw meat as 31 percent of consumers say that **all** of the frozen products contain precooked meat, while 28 percent say **most** contain precooked meat, and 22 percent say **some** contain precooked meat (10).

Inconsistent labelling of cooking instructions seems to be the biggest frustration and confusion among people. However, a survey by the USDA revealed that consumers do know the importance of following cooking instructions on frozen meals, 83 percent believed that if they neglected to follow the instructions they would get sick (10).

MATERIALS AND METHODS

Materials

The materials used to complete this research project included a camera (a cell phone camera was used) to take the pictures and collect the data, a computer with Microsoft Excel to input the data, and the statistical software NCSS 12, which was used to complete the analysis of the collected data (20, 21). Only photos of the frozen microwavable entrees were taken, photos previously taken of 2008 and 2018 frozen breaded chicken (FBC) products were obtained from the British Columbia Centers for Disease Control (BCCDC).

Methods

The methods of data collection involved visiting a number of randomly selected big box grocery stores. The stores were randomly selected through a random number generator and a statistical method chosen by the BCCDC. This method was used by the BCCDC to decide which stores to collect the pictures of the FBC products from. The same stores were visited by this researcher to collect the photos of the 2019 frozen microwavable entrees. This random selection of stores ensured even representation of products. All of the stores were surveyed on January 12th, 2019. The stores surveyed are displayed below.

Table 1. Summary of stores surveyed

| Store | Address |
|--------------------------|---|
| Buy-Low Foods | 6095 Fraser St, Vancouver, BC |
| Costco Wholesale | 4500 Still Creek Drive, Burnaby, BC |
| Real Canadian Superstore | 350 SE Marine Drive, Vancouver, BC, V5X 2S5 |
| T&T Supermarket | 458 SW Marine Drive, Vancouver, BC, V5X 2R9 |
| Walmart | 3585 Grandview Hwy, Vancouver, BC V5M 2G7 |

Both primary and secondary data were collected and used throughout this research. Primary data, in the form of pictures, was collected from the stores by surveying the cooking instructions of frozen entrees. Pictures were taken of the front and back of packaging ensuring the cooking instructions were captured. Secondary data was obtained from the BCCDC of pictures of the frozen breaded chicken products cooking instructions. Once the picture data had been collected, data was input into

excel to organize and then transferred into NCSS 12 for the statistical analysis where a Chi-square test was performed (20, 21). All of this data was used to determine if internal cooking temperatures, and additional food safety instructions were present on the package or not. There were four separate data sets which were analyzed for their inclusion of internal cooking temperature, thermometer statement, microwave instructions, and additional food safety handling on the packaging. The product categories were 2008 raw FBC, 2018 raw FBC, 2018 cooked FBC, and 2019 frozen entrees. A total of 140 products were analyzed, 91 FBC products and 49 frozen entrees.

Inclusion and Exclusion

For all primary data, the products of frozen microwavable entrees found in the freezer section of the stores surveyed were included. These include products such as pastas, rice dishes, curries, meat and vegetable dishes, and pot pies. At least one product from each brand/manufacture displayed in the store's freezer section was collected to ensure even representation of what is on the market. All secondary data obtained from the BCCDC of frozen breaded chicken products cooking instructions was also included. This included products such as chicken nuggets, chicken strips, chicken burgers, chicken wings, chicken fillets, chicken bites, and stuffed breaded chicken breasts. All pictures obtained were analyzed

ensuring a variety of manufactures were included in the data.

Examples of frozen microwavable entrees surveyed:



(22)



(23)



(23)



(23)

Examples of frozen breaded chicken products surveyed:



(24)



(25)



(23)



(26)

RESULTS

Overall there were 140 samples analyzed. 24 samples from the 2008 raw FBC,

39 from 2018 raw FBC, 28 from 2018 cooked FBC, and 49 from 2019 frozen microwavable entrees. To analyze this data NCSS 12 was used and a Chi-squared test was performed. The type of data this test analyzes is nominal and is commonly used in surveys (27). The data collected throughout this research was nominal, as the information analyzed was regarding descriptive statements of cooking instructions.

Descriptive Statistics

For the descriptive statistics many parameters were assessed regarding the adequacy of cooking instructions. These included if internal temperature was stated, if thermometer use was stated, if microwave instructions were given and if additional food safety handling was included. The results regarding the statement of internal cooking temperature within the products cooking instructions yielded that out of the 140 samples across categories 87.1% (n=122) said to cook the product to a minimum of 74C, whereas 12.9% (n=18) did not state anything, as seen in figure 1.

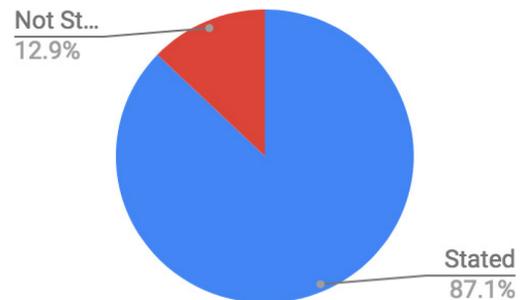


Figure 1. products state internal cook temperature, all categories

When each group was analyzed separately it was found that of the 2018 raw FBC products, 100% of the samples stated to cook the product to an internal temperature. For the 2018 cooked FBC products and the 2019 frozen microwavable entrees surveyed 89% of both categories stated to cook to an internal temperature. However, of the 2008 raw FBC only 58% of the products surveyed stated to cook to an internal temperature. Results are displayed in table 2 and figure 2 below.

Table 2. summary of internal cooking temperature statement on packaging

| Frozen Product | Internal Temp Stated (Yes) | Internal temp not stated (No) |
|---------------------|----------------------------|-------------------------------|
| 2008 Raw FBC | 58% (n=14) | 41% (n=10) |
| 2018 Raw FBC | 100% (n=39) | 0 |
| 2018 Cooked FBC | 89% (n=25) | 10% (n=3) |
| 2019 Frozen Entrees | 89% (n=44) | 10% (n=5) |

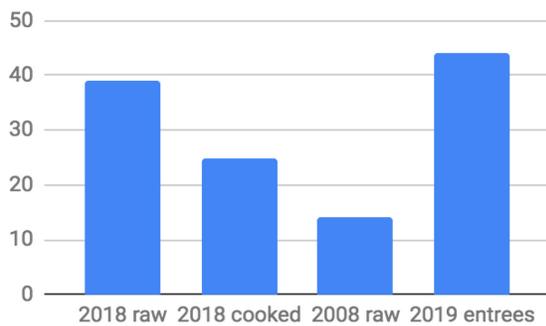


Figure 2. number of products which include internal cook temperature

As for the inclusion of adequate cooking instructions the other parameters assessed included if thermometer use was stated, if microwave instructions/wattage values were given and if additional food safety handling

advice was given. For the additional food safety handling advice, statements on the package such as cleaning, handwashing, separate raw from RTE, storage of leftovers and refrigeration were all considered to meet the requirements of additional food safety advice.

Out of all the 140 products only 11 (~8%) stated to use a thermometer, the product breakdown being 3 out of the 2018 raw FBC category and 8 out of the frozen entrees category. It was also found that only one product (in the 2018 raw FBC) across all categories stated in the cooking instructions that foodborne illness can occur if food is cooked improperly or mishandled. The most frequent category to display food safety handling was the 2018 raw FBC (82%) and the 2008 raw FBC (79%). Followed by the 2019 frozen entrees (42%) and the 2018 cooked FBC (21%). For the microwave instructions the frozen entrees almost always stated a cook time and wattage value (81%), whereas the 2008 and 2018 raw FBC both never stated to use a microwave. The details for each observed parameter are displayed in table 3.

Table 3. summary of additional food safety parameters assessed

| Product type | States/shows thermometer usage | | States wattage or microwave instructions | | States additional food safety handling | |
|-----------------|--------------------------------|--------------|--|-------------|--|------------|
| | Yes | No | Yes | No | Yes | No |
| Frozen Entrees | 16% (n=8) | 84% (n=41) | 82% (n=40) | 18% (n=9) | 43% (n=21) | 57% (n=28) |
| 2008 raw FBC | 0 | 100% (n=24) | 0 | 100% (n=24) | 79% (n=19) | 21% (n=5) |
| 2018 raw FBC | 7.7% (n=3) | 92.3% (n=36) | 0 | 100% (n=39) | 82% (n=32) | 18% (n=7) |
| 2018 cooked FBC | 0 | 100% (n=28) | 32% (n=9) | 68% (n=19) | 21% (n=6) | 79% (n=22) |

The data was also further split into manufactures of the products, so it could be easily understood as to what specific products cooking instructions stated in terms of adequacy based on the manufacturer.

Inferential statistics

Data from two key parameters of the cooking instructions being, inclusion of internal cooking temperature and inclusion of thermometer use on product packaging was collected and analyzed in a Chi-square test to determine if there was an association between the statement of these parameters based on product type and manufacturer. A total of five Chi-Square tests were run. A breakdown of the five tests is as follows:

- 2008 raw FBC vs 2018 raw FBC regarding statement of internal cooking temperature
- 2018 raw FBC vs 2018 cooked FBC regarding statement of internal cooking temperature
- 2019 frozen entree manufacturers and the inclusion of the statement of internal cooking temperature
- 2019 frozen entree manufacturers and the inclusion of thermometer use
- All frozen breaded chicken (FBC) manufactures and the inclusion of thermometer use

The Chi-square test is commonly used to test relationships between two or more categorical variables (28). The data is summarized in table 4 below.

Table 4. Summary of inferential statistics

| Ho and Ha | Test used | P-Value | Interpretation |
|---|------------------|----------------|--|
| <p>Ho: there is no association between 2008 raw FBC and 2018 raw FBC products regarding the statement of internal cooking temperature</p> <p>Ha: there is an association between 2008 raw FBC and 2018 raw FBC products regarding the statement of internal cooking temperature</p> | Chi-Square | 0.00001 | Reject Ho and conclude there is a significant association between the type of frozen product and the statement of internal cooking temperature. No likely alpha error as the P-value is almost 0.00000. |
| <p>Ho: there is no association between 2018 raw FBC products and 2018 cooked FBC products regarding the statement of internal cooking temperature</p> <p>Ha: there is an association between 2018 raw FBC products and 2018 cooked FBC products regarding the statement of internal cooking temperature</p> | Chi-Square | 0.03648 | Reject Ho and conclude there is a significant association between the type of FBC product and the statement of internal cooking temperature. Potential alpha error as the P-value is close to .05. Reducing the cut off of the p-value to below .01 would minimize this error. |
| <p>Ho: there is no association between the frozen entrée manufacturer and the inclusion of the statement of internal cooking temperature.</p> <p>Ha: there is an association between the frozen entrée manufacturer and the inclusion of the statement of internal cooking temperature.</p> | Chi-Square | 0.00000 | Reject Ho and conclude there is a significant association between the frozen entree manufacture and the inclusion of the statement of internal cooking temperature. Very low chance of alpha error as P-value is 0. |
| <p>Ho: there is no association between the 2019 frozen entrée manufacturer and the inclusion of the statement of thermometer use.</p> <p>Ha: there is an association between the 2019 frozen entrée manufacturer and the inclusion of the statement of thermometer use.</p> | Chi-Square | 0.00001 | Reject Ho and conclude there is a significant association between the frozen entree manufacture and the inclusion of the statement to use a thermometer when cooking. No likely alpha error as P-value is almost 0.00000. |
| <p>Ho: there is no association between the manufacturer of FBC products and the inclusion of the statement of thermometer use.</p> <p>Ha: there is an association between the manufacturer of FBC products and the inclusion of the statement of thermometer use.</p> | Chi-Square | 0.00000 | Reject Ho and conclude there is a significant association between the manufacture of FBC products and the inclusion of the statement to use a thermometer. Very low chance of alpha error as P-value is 0. |

The results for all the Chi-Square tests determined that there was a significant association between products and the inclusion of the statement of internal cooking temperature and thermometer usage within the cooking instructions. This was the case for all samples based on the food product category itself, frozen breaded chicken or frozen entrees, or based on manufacturer of the product.

DISCUSSION

The results from all five Chi-square analyses conducted yielded a significant association between all samples, the results for each confirmed exactly what was or was not being displayed in the cooking instructions. For the 2008 raw FBC vs 2018 raw FBC analyses regarding statement of internal cooking temperature, the results showed a statically significant association between the product categories and the inclusion of an internal cooking temperature, this suggests that one of the categories is more likely than the other to include the statement of internal cooking temperature on the instructions. This could be attributed to the difference in date, as there was a 10-year difference between the two sample groups. Within the 10 years the inclusion of the internal temperature on raw FBC products jumped from 58% in 2008 to 100% in 2018. Suggesting that the inclusion of internal cooking temperature on frozen chicken products is improving with time. Although this may not be true, as there have been countless recent recalls

surrounding frozen breaded chicken from Salmonella, S.aureaus and Listeria all from manufactures sampled in this research (1-4).

For the analyses of 2018 raw FBC vs 2018 cooked FBC regarding statement of internal cooking temperature a significant association was observed. It was found that 100% of the raw 2018 FBC products stated the recommended internal temperature, whereas 89% of the cooked stated it. The lack of internal temperature on the cooked products could be attributed to the fact that pre-cooked products are viewed as less risky to eat. As demonstrated in a study conducted by Cates et. all for the USDA, which revealed that when a package states “fully cooked” or “heat and serve” consumers don’t take instructions as seriously when it comes to food safety (9). Since the products have been previously cooked there is a lesser chance of pathogen contamination, so perhaps this is why a small fraction of manufactures are not including it as often on cooked chicken products.

Frozen microwavable entrees were analyzed based on manufacturer in order to extrapolate reliable results, since there were no previous years of samples or similar groups to compare to. The analyses of 2019 frozen entree manufacturers and the inclusion of the statement of internal cooking temperature also revealed a significant association. Again, this could be that some manufacturers are more likely than others

to include the statement of internal cooking temperature within instructions. This was evident from the results as only 5 products surveyed in this category, out of 49, did not state an internal cooking temperature, all of which were manufactured by Amy’s Kitchen Inc. Which could be of concern as this manufacturer has had past recalls due to listeria (29).

For the two analyses regarding inclusion of thermometer usage based on manufacturers of both FBC products and frozen entrees all revealed a statistically significant association. For both tests ran it was evident that some manufacturers are more likely than others to recommend the usage of a thermometer within the cooking instructions. For the frozen entrees only 8 of the of the products surveyed included this, all 8 were either manufactured by Kraft or Conagra Foods. For the FBC products only one product recommended the usage of a thermometer in the cooking instructions, and that was manufactured by Olymel. It could be concluded that these companies are more diligent with food safety precautions than others, as they also met all or most parameters measured by the research question, being they stated adequate cooking instructions as they included internal cooking temperature, microwave advice, additional food safety tips and thermometer usage, as seen in table 1.

Table 1. manufacturers adequacy of instructions.

| Manufacture | States/shows thermometer usage | | Recommends microwaving and wattage | | States additional food safety handling | |
|-------------------------------|--------------------------------|----|------------------------------------|----|--|----|
| | Yes | No | Yes | No | Yes | No |
| Kraft Heinz (frozen entrée) | 2 | 2 | 2 | 2 | 4 | 0 |
| Conagra Foods (frozen entrée) | 6 | 0 | 6 | 0 | 6 | 0 |
| Olymel (FBC) | 3 | 0 | 0 | 3 | 1 | 2 |

It could be assumed that the reason other manufactures are not as diligent with including a thermometer statement on the package as they are with internal cooking temperatures could be that these products are convenience foods, most food preparation is already done, and it is implied that cooking these frozen products is relatively simple. Therefore, they are not identified as a potentially hazardous food. However past research by the USDA found that very few people actually use a thermometer when cooking food, instead they rely on looks (9). When cooking chicken products 46% of those surveyed said they didn’t use a thermometer (10). Therefore, it is not clear if the inclusion of this would provide any benefit to consumers. However, this is of concern given food borne illnesses are still occurring due to improper cooking of FBC and other frozen meals (1-4).

When microwave instructions and wattage values were assessed, it was found of the 2019 frozen entrees that 82% gave microwave instructions and/or wattage values to follow. The majority of the products stating this is reassuring, however even if the wattage is

included it may not be useful. The USDA study by Cates et. all on consumers perceptions found that 70% of people don't know their microwave wattage, therefore this information wouldn't be useful to the consumer (9). For the FBC products only the cooked 2018 products gave microwave instructions/wattage value. This is a good sign as cooking raw chicken in the microwave is not recommended as it doesn't properly cook the product, as seen with the recent outbreaks from FBC (1-4).

The findings of this research project agreed with past research, which also helped to explain how what is presented on frozen food packaging could be interpreted by consumers. The study by Schiffmann agreed with the results of this study as it found that all products stated an internal cooking temperature but also never stated to use a thermometer to actually check the temperature (18). This study also provided insight on what is presented on the packaging, as microwavable entrees were tested by cooking them following the instructions exactly and found that the foods were not cooked to the proper temperature, as the microwaves put out a lower wattage than advertised (18). Therefore, this is relevant to this projects results as it needs to be emphasized that people check the temperature of their foods before consuming. This study only confirms that internal temperature and thermometer statement need to be on the package to communicate the importance of food safety to the customer.

Another study conducted by CDC on an investigation of an outbreak from frozen microwavable foods revealed that the packages were not standardized, and sometimes lacked wattage values (5). This agreed with this research as the same gap was found when sampling, there was a huge variety in the positioning and depth of instructions on the packaging.

The results gained from this research are valid, however results can only be extrapolated to frozen food products available in British Columbia or Canada, as products and packaging vary with location. A methodological limitation could have been that of sample size. Perhaps if a greater number of stores or products were surveyed for each category the results may have been more accurate. As well as if there was a larger variety of stores surveyed, such as smaller local grocers opposed to big box stores.

LIMITATIONS

Due to the nature of conducting surveys, time was a major limitation. At least half an hour or up to an hour was spent at each store surveying the products and taking pictures of the 2019 frozen entrees. Because of the limited amount of time to conduct this research only 5 stores were visited, this could have impacted the validity of the results. If there had of been a longer time frame to collect the results than more stores could have been visited, and therefore more samples collected. During the

sampling of the 5 stores for the 2019 frozen microwavable entrees only 49 samples were collected, as a lot of the stores had repeating products. To ensure a larger sample size and more variety smaller stores could have been visited instead of all big box stores. Further extrapolating the instructions off of each package of food and imputing results from both the primary and secondary data was extremely time consuming and tedious. Another limitation was that only stores in the Vancouver area were sampled so the results may only be representative as to what is available in this area.

KNOWLEDGE TRANSLATION

The results of this study indicated that most manufactures of frozen foods are diligent about including food safety parameters in the cooking instructions, however it was evident that the major gap lies in the consistency of instructions. Almost every manufacturer had their cooking instructions presented differently, which could in turn confuse the consumer. Since it would be difficult to implement legislation as to how thorough a products cooking instructions need to be, instead this information can be used as an educational tool. The BCCDC can use this information to create education pamphlets or to provide the consumers with what to look for on frozen food product packaging and emphasize the importance of checking the internal temperature of the food product before it is consumed. They can also create food safety notes on the topic which can be accessed by

EHO's or the public. Additionally, this information can be used by the industry or manufacturers of these products, so they can learn what on the packaging is unclear/confusing to the consumers, and what needs to be improved on to prevent people from misinterpreting the instructions and getting sick.

FUTURE RESEARCH

Based on this research a few other related projects can be carried out to help expand on these findings. These include

- Surveying other specific categories of ready-made meals, and the extent of their cooking instructions
- Conduct a knowledge, attitudes and practices survey regarding the importance of following instructions thoroughly before cooking and checking internal temperature of food, and knowledge of Foodborne illness from these products.
- Sampling a larger geographic area instead of just Vancouver, this would involve visiting other municipalities
 - As well as visiting smaller local stores, not just big box stores

CONCLUSION

Based on the findings of this study It is evident that the majority of manufacturers are taking proper preventative measures in terms of adequacy of cooking instructions, of both frozen breaded chicken and frozen microwavable entrees. Although some are still better than

others, such as manufacturers Olymel, Kraft, and Conagra Foods, all of which met all parameters analyzed, those being statement of internal temperature, thermometer, microwave instructions and additional food safety advice. Overall it was found that 87% of all products surveyed stated an internal cooking temperature. The majority of products most often also included microwave instructions and food safety advice. However, the major missing gap was that cooking instructions across all categories were very inconsistent and rarely stated to use a thermometer to check the internal temperature, although it stated a specific temperature to cook to. These results confirm that instructions are not consistent, and this can often lead to confusion among customers. In order to fix these gaps this information can be used as educational tools by the BCCDC to inform customers on what to look for in cooking instructions of frozen foods and can also be used by industry to improve the clarity and consistency of the cooking instructions on the packaging.

ACKNOWLEDGMENTS

The author would like to acknowledge Dale Chen and Lorraine McIntyre (BCCDC) for their knowledge and support throughout this research project. Thank you again Lorraine for the idea behind this research project.

COMPETING INTERESTS

The author declares that they have no competing interests in this study.

REFERENCES

1. Government of Canada CFIA. no name and Compliments brands frozen uncooked breaded chicken products recalled due to Salmonella [Internet]. 2015 [cited 2018 Oct 16]. Available from: <http://www.inspection.gc.ca/about-the-cfia/newsroom/food-recall-warnings/complete-listing/2015-07-01/eng/1435791777168/1435791779790>
2. Government of Canada CFIA. Maple Leaf brand Chicken Breast Nuggets recalled due to the potential presence of pieces of pen [Internet]. 2017 [cited 2018 Oct 16]. Available from: <http://healthycanadians.gc.ca/recall-alert-rappel-avis/inspection/2017/63774r-eng.php>
3. Government of Canada CFIA. Various breaded chicken products recalled by Maple Leaf Foods due to a toxin produced by Staphylococcus bacteria [Internet]. 2017 [cited 2018 Oct 16]. Available from: <http://www.inspection.gc.ca/about-the-cfia/newsroom/food-recall-warnings/complete-listing/2017-05-09/eng/1494380244038/1494380247021>
4. Government of Canada CFIA. - Recalls and safety alerts [Internet]. 2014 [cited 2018 Oct 16]. Available from: <http://healthycanadians.gc.ca/recall-alert-rappel-avis/inspection/2014/38561r-eng.php>
5. Centers for Disease Control and Prevention (CDC). Multistate outbreak of Salmonella infections associated with frozen pot pies-- United States, 2007. MMWR- Morbidity Mortal Weekly Rep. 2008 Nov 28;57(47):1277–80.
6. Centers for Disease Control and Prevention (CDC). Multistate Outbreak of Salmonella Chester Infections Associated with Frozen Meals -- 18 states, 2010. MMWR- Morbidity Mortal Weekly Rep. 2013 Dec 6;62(48):979–82.
7. Canada PHA of, Canada PHA of. Yearly food-borne illness estimates for Canada [Internet]. aem. 2015 [cited 2018 Oct 16]. Available from: <https://www.canada.ca/en/public-health/services/food-borne-illness-canada/yearly-food-borne-illness-estimates-canada.html>
8. Health Canada. Safe internal cooking temperatures [Internet]. aem. 2012 [cited 2018 Oct 16]. Available from: <https://www.canada.ca/en/health-canada/services/general-food-safety-tips/safe-internal-cooking-temperatures.html>
9. Cates SC, Carter-Young HL, Gledhill EC. Consumer Perceptions of Not-Ready-to-Eat Meat and Poultry Labeling Terminology. U.S. Department of Agriculture; 2001 Apr. Report No.: 07182.011.
10. Amy Lando, Ewa Carlton. 2010 Food Safety Survey [Internet]. Food and Drug Administration. 2010 [cited 2018 Oct 19]. Available from: <https://www.fda.gov/downloads/Food/FoodScienceResearch/ConsumerBehaviorResearch/UCM407008.pdf>
11. Government of Canada CFIA. Labelling Requirements for Meat and Poultry Products [Internet]. 2014 [cited 2018 Oct 16]. Available from: <http://www.inspection.gc.ca/food/labelling/food-labelling-for-industry/meat-and-poultry-products/eng/1393979114983/1393979162475?chap=15>
12. Government of Canada CFIA. Chapter 4 - Meat Processing Controls and Procedures [Internet]. 2013 [cited 2018 Oct 16]. Available from: <http://www.inspection.gc.ca/food/meat-and-poultry-products/manual-of-procedures/chapter-4/eng/1367622697439/1367622787568?chap=6>

13. World Health Organization. Electromagnetic fields & public health: Microwave ovens [Internet]. 2005. Available from: http://www.who.int/peh-emf/publications/facts/info_microwaves/en/
14. Jasim Ahmed, Hosahalli S. Ramaswamy. Microwave Pasteurization and Sterilization of Foods [Internet]. 2nd ed. 2007 [cited 2018 Oct 19]. 691-711 p. (Handbook of Food Perservation). Available from: <https://pdfs.semanticscholar.org/9b66/f695859ee344e74a26554a491c804c8519e8.pdf>
15. Government of Hong Kong- Center for Food Safety. Microwave Cooking and Food Safety [Internet]. 2005. (Risk Assessment Studies). Report No.: 19. Available from: https://www.cfs.gov.hk/english/programme/programme_rafs/programme_rafs_ft_01_02_mcfs.html#concl
16. Health Canada. Food safety tips for microwaves [Internet]. aem. 2011 [cited 2018 Oct 16]. Available from: <https://www.canada.ca/en/health-canada/services/general-food-safety-tips/microwaves.html>
17. Federal/Provincial/Territorial Food Safety Committee. Food Retail and Food Services Code [Internet]. 2016. Available from: <http://www.hss.gov.yk.ca/pdf/foodservicescode.pdf>
18. Schiffmann RF. Microwave ovens and food safety: preparation of Not-Ready-to-Eat products in standard and smart ovens. J Microwave Power Electromagnetic Energy. 2013;47(1):46–62.
19. Pitchai K, Birla SL, Jones D, Subbiah J. Assessment of heating rate and non-uniform heating in domestic microwave ovens. J Microwave Power Electromagnetic Energy. 2012;46(4):229–40.
20. Microsoft. Excel. Microsoft Corporation; 2016.
21. NCSS. NCSS 12 Statistical Software [Internet]. Kaysville, Utah, USA; 2018. Available from <https://www.ncss.com/software/ncss/>
22. Loblaws. PC Thai Red Curry Chicken [Internet]. n.d. Available from https://www.presidentschoice.ca/en_CA/products/productlisting/pc_thai_red_curry_chicken16772.html
23. Walmart. Frozen Dinners and Meals [Internet]. n.d. Available from https://www.walmart.com/browse/food/frozen-dinners-meals/976759_976791_1001412
24. Sofina Foods inc. Products [Internet]. n.d. Available from <http://www.janesfoods.com/our-products/>
25. Pinty's Foods. Pinty's P&G Buffalo Style Chicken Wings [Internet]. n.d. Available from <https://pintys.com/products/pinty-s-p-g-buffalo-style-chicken-wings>
26. Loblaws. PC Pub Recipe Breaded Chicken Nuggets [Internet]. n.d. Available from https://www.presidentschoice.ca/en_CA/products/productlisting/pc-pub-recipe-chicken-nuggets.html
27. Heacock H. Research Methods. ENVH 8400. Chi- Squared, x2, Test. 2018.
28. Statistics Solutions. Using Chi-Square Statistic in Research [Internet]. 2018. Available from <https://www.statisticssolutions.com/using-chi-square-statistic-in-research/>

29.

Lupkin S. Amys Kitchen Recall: What to Know About Spinach Listeria Outbreak. ABC News [internet]. 2015 March 25. Available from <https://abcnews.go.com/Health/amys-kitchen-recall-spinach-listeria-outbreak/story?id=29894726>