Can Risk Rating Tool Results Be Used to Predict Results of Inspection Categories of Dairy Processing Plants?

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Background: Dairy products are consumed by a large portion of the population. The dairy processing plants (DPP) that produce these perishable products may create health hazards (chemical, physical, biological). In order to minimize any health risks from these products, DPP are inspected by regulating authorities. This study examined secondary data derived from the BCCDC dairy program's semi-quantitative risk ranking tool (RRT) to examine trends over time with DPP inspections, and to assess risk factors within the tool.

Methods: RRT based data from individual DPP inspections from 2015 through 2018 were entered into a master spreadsheet. The RRT has two overall risk categories, inherent and measured risk. Inherent risk categories in the tool were sourced from surveys of dairy plants, while measured risks in the tool were sourced from inspection visits (routine and in-depth), environmental and food result submissions from dairy plants and inspectors, and based on compliance and history. In total, 107 items were assessed within the eight categories. Descriptive analyses were conducted, and statistical analyses performed using NCSS 12 software (NCSS, 2018).

Results: A total of 128 inspection reports from 30 different DPP were included in this study. From these inspections, 65% were considered low risk, 12% moderate and 23% high risk. DPP that were located on-farm were found to have significantly higher overall inspection risk scores than dairy plants located off-farm (average on-farm inspection risk ranking score = 694; average off-farm inspection risk ranking score = 153; p=0.0003, power=95%). When the microbiological scores category, derived from environmental swabs and food submissions, were compared to the inspection score category, these categories were statistically significantly correlated (p=0.0000, power=100%); when inspection score increases, so too does microbiological score. Higher risk scores were also found in DPP producing more than one category of dairy product (comparing one product versus 6 or 7 products, p=0.009, power=76%).

Conclusion: Dairy inspections ensure DPP follow good manufacturing practices and therefore help to protect the population from disease outbreaks or other contaminations. This study demonstrated that there is increased risk of having a dairy processing facility located on-farm, that more complex dairy processing operations that produce more than one type of dairy product have higher risk rating scores and that higher inspection score violations positively correlated to positive microbiological scores. This study further showed that in the absence of microbiological results, a risk score could still be calculated by analyzing the inspection violations alone. The Food Safety Specialists at the BCCDC can use this data to focus their inspection time on higher risk areas and items to maximize time spent out in the field.

Keywords: dairy, processor, risk, British Columbia, inspection, BCCDC, milk, audit

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Introduction

The dairy industry in Canada plays an important role in the county's economy by contributing almost $20 billion, or 1.3%, to Canada's GDP through the farms themselves and the processing plants that transform the milk into products for the consumer (DFC, 2016). The Canadian dairy market is supply managed by the Federal government and production quotas are set for each province. British Columbia (BC) has 8.8% of the Canadian total milk quota and BC dairy farms are some of the largest in the country, with an average farm size almost 200 milking cows – the highest average dairy cow farm size in the country (Government of Canada, 2017). Milk is processed in licensed dairy processing plants (DPP) and subsequently sold to consumers and other milk product users.

Legislation, Licensing and Oversight

The British Columbia Milk Marketing Board (BCMMB) has the authority to promote, control and regulate the production, transportation, packing, storing and marketing of milk, fluid milk and manufactured milk products within the province. The raw milk is delivered to the dairy processors, as coordinated by the BCCMB, for further processing. Some DPP are considered "on-farm" and receive their own milk through agreements with the BCMMB. All DPP in BC are licensed provincially with the BCCDC, and any that exports product out of province is required to be registered federally with the Canadian Food Inspection Agency (CFIA). Provincially licensed DPP may also be referred to as "non-federally registered". Under the BC Milk Industry Act and Milk Industry Standards Regulation, dairy farms and processors are subject to regular inspections to ensure that operators work in an environment that promotes safe and clean milk production and handling practices.

The Ministry of Health's Public Health Act governs the entire spectrum of public health in British Columbia. With respect to food safety, health officers can use the Public Health Act to complement their powers under the Food Safety Act (Ministry of Health, 2018).

Why Dairy Processing Plant Inspections Are Required

The per capita consumption of dairy products in Canada is almost 107 liters annually (CDIC, 2018) and many vulnerable groups such as children, elderly, sick or immunocompromised consume dairy products because of its nutritious content.

Dairy inspections are needed to protect the population from disease outbreaks or other contaminations. Some of the dairy processor plant inspection goals are to:

- ensure that dairy products are processed under safe and sanitary conditions by identifying and requiring resolution to health and safety risks,
- measure the degree of regulatory compliance of dairy establishments,
- establish uniform procedures and national standards for plant inspection, and
- minimize duplication of inspection activities between government departments (CFIA, 2014).

On-farm processing operations are considered higher risk than other processing establishments due to environmental and cross-contamination concerns, and as such require clearer direction on what is required to produce a safe product (CFIA, 2016). Inspections at these facilities allow more education and consulting to take place to help ensure safe products are produced.

Dairy Plant Processor Inspection Overview

The CFIA published Dairy Establishment Inspection Manual states in section 6.2.1 that "each dairy plant should be subjected to an in-depth plant inspection at least once a year" and "since seasonal rotation of the plant's inspection dates is required, some plants may receive an in-depth only once every 18 months." In BC, the Milk Industry Act grants authority to the BCCDC, an agency of the Provincial Health Services Authority to inspect non-federally registered DPP. The target is to inspect each non-federally registered DPP three times per year by the BCCDC dairy food safety specialists (McIntyre, 2019).

Risk Based Inspection Approach

To increase the effectiveness of available resources involved in inspection and audits, a risk-based approach can be used (Van Asseldonk, 2014). The primary purpose of a risk-based inspection approach is to reduce the risk of foodborne illness by focusing the inspection program on higher risk DPP that require more frequent and through inspections than lower scoring DPP that should require less frequent inspections within a certain time period.

Provincial DPP Inspections

Provincial DPP inspections rely on the knowledge and expertise of BCCDC dairy food safety specialists who conduct on-site visits at every provincially licensed DPP to identify potentially high-risk processes/situations and assess sanitary conditions. DPP are also required to submit monthly finished product samples to an independent laboratory for microbiological and chemical testing to ensure that relevant dairy product standards are met (BCCDC, n.d.). Three types of inspections can occur:

1. Routine (scheduled, 2 to 4 hour duration)
2. In-depth (scheduled, 4 to 8 hour duration, food and environmental sampling)
3. Unscheduled (follow-up based on previous violations, complaints or positive sample results)

Methods and Materials

Data Sources:

This project involved the use of secondary data derived from the BCCDC dairy program. Dairy data was tabulated from several sources into a semi-quantitative risk ranking tool (RRT) shown in Table 1 (BCCDC, 2019). The BCCDC DPP inspection program risk ranking is based on eight categories, with each category assigned a score. The scores are entered into a formula, shown in the table, that generates an overall risk score for each DPP (Kovacevic, 2014).

Table 1. List of categories used in risk-ranking tool to assess perceived and measured risks in DPP.

	Category	Description	Number of items assessed
Inherent Risk	A	Type(s) of products processed	12
	B	Production volume of dairy plant	4
	C	Plant location and building structure	5
	D	Food safety management	6
Measured Risk	E	Inspection results	40
	F	Results from laboratory analyses	38
	G	Assessment of risk and compliance	1
	H	Plant history	1
OVERALL RISK = (A+B+C+D) + (E x F x G x H)			

Inherent risk categories in the tool were sourced from surveys of dairy plants, while measured risks in the tool were sourced from inspection visits, environmental and food result submission from dairy plants and inspectors, and based on compliance and history. In total, 107 items were assessed within the eight categories. The RRT tool auto-generates a risk rating based on overall scores and are categorized as: under 250 for low risk, 251 to 500 for moderate risk and 501 and greater for high risk.

From 2015 – 2018, routine and in-depth inspection reports from provincial DPP were analyzed using the RRT. Data from the RRT was entered into a master spreadsheet, created by the BCCDC (Aljoša Trmčić) for this purpose.

Descriptive and Statistical Analyses

Much of the research produced descriptive data which is described and discussed below. Other observations lead to hypotheses that were tested statistically. The data collected was inspection data, which is numerical continuous, and the tests run using NCSS 12 software were ANOVA, correlation and linear regression, as well as an independent samples t-test to determine if any trends could be detected or any statistically significant findings observed when analyzing data.

Descriptive charts over the four year period (2015 to 2018) were generated to illustrate (1) overall number of inspections per year; (2) risk scores averaged for all DPP per year; (3) categories of risk ratings (i.e. low, moderate or high) generated by the RRT inspections; (4) categories of violations (i.e. satisfactory, major, or critical) assigned during inspections and (5) risk scores for individual DPP.

Four issues were tested against risk rating scores and sub-sets of risk rating scores to examine the risk relationship between these items. (Issue #1) The sum of category F was calculated to provide an overall "micro" score for each DPP that included results from DPP food submissions, dairy inspector food and environmental swabs microbiological tests. This was compared against the sum of category E, the inspector violations with H_O – there is no association between inspection violations scores and microbiological results conducted by DPP and dairy inspectors in provincial DPP and H_A: higher inspection violation scores are expected to occur when microbiological tests of food and the environment with DPP also show deficiencies and are higher. (Issue #2) To examine if the location of the DPP was associated with higher risk ranking scores, on-farm and off-farm location was compared to total risk ranking scores for all plants with H_O: there is no difference between the overall risk rating score and the location of the DPP being on or off a dairy farm and H_A: higher risk rating scores in DPP will occur when DPP are located on a dairy farm. (Issue #3) To examine if the number of products made in the DPP was associated with higher risk ranking scores with H_O – there is no difference between risk rating score regardless of the number of product categories produced at the DPP and H_A: higher risk rating scores in DPP will be occur when producing a greater number of product categories. (Issue #4) The sum of categories A through D – inherent score – was compared against the sum of category F with H_O – there is no difference between inherent scores and microbiological results conducted by DPP and dairy inspectors in provincial DPP and H_A: higher inherent scores are expected to occur when microbiological tests of food and the environment with DPP also show deficiencies and are higher.

Results

This study used four years of DPP inspections. Overall, 128 inspection visits from 30 DPP were tabulated from the RRT into a master spreadsheet.

Descriptive and Inferential Statistics

An average of 32 ±7.4 routine and in-depth inspections occurred annually over the four-year period (Figure 1).

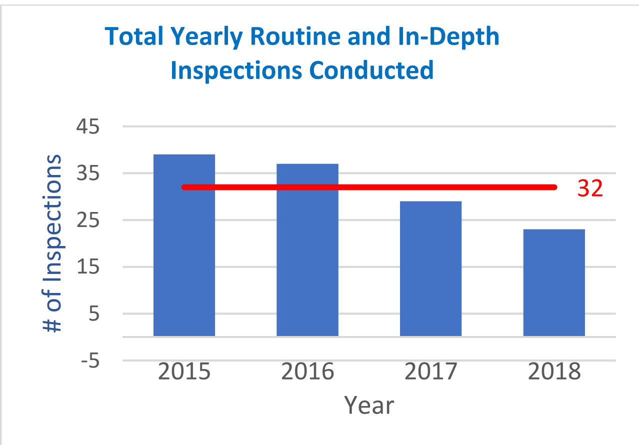

Figure 1 – Number of routine and in-depth inspections conducted annually.

The overall median risk score for all inspections over the four years (n=128) was 107, with a higher median score on 2018 (276) in comparison to the scores from the previous three years (87 in 2015; 150 in 2016 and 83 in 2017). For all years (Figure 2), considerable individual variation can be seen with overall scores ranging from a low of 5 (in years 2016 and 2017) to a high of 8302 (in year 2015).

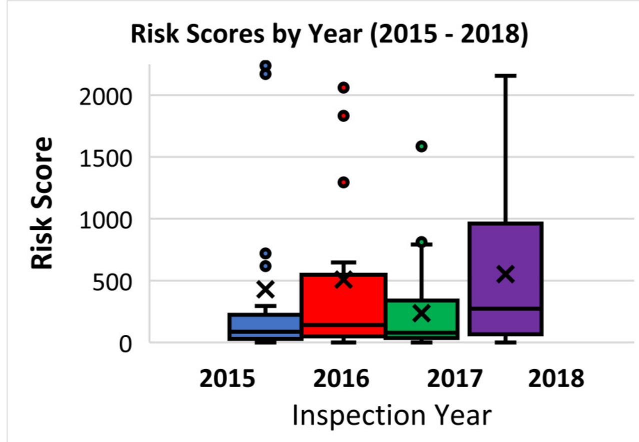

Figure 2 – Risk ranking tool scores summarized by inspection year.

Based on the BCCDC RRT risk categorization levels, 65% (n=83) of the inspections were low risk, 12% (n=16) were moderate and 23% (n=29) were considered high risk (Figure 3). The 29 inspections, representing 14 DPP, which scored over 500 in their inspection risk score would be under greater scrutiny because of their elevated "high-risk" status given by the BCCDC risk categorization. DPP #22 appears 4 times in the top 5 risk scores > 500.

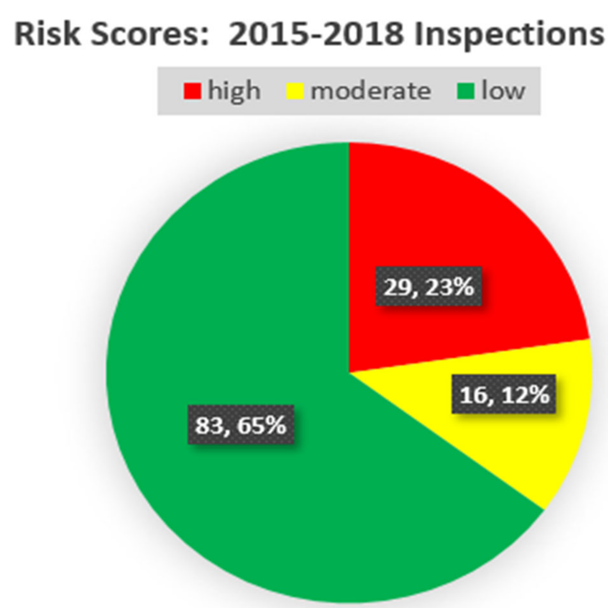

Figure 3. Percentage of risk scores that are high, moderate and low.

Violations were recorded by the inspectors from category E inspection results (Figure 4). Overall, the 128 inspections yielded 4,007 recorded observations with 89.9% satisfactory results (the best/lowest rating available), 10.0%

major violations, the first level of non-compliance and 0.1% critical violations – the least favorable inspection observation.

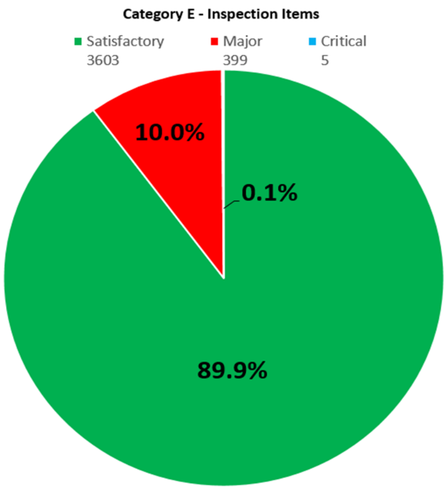

Figure 4. Category E (inspection items) categorized by risk observation.

A correlation and regression analysis between inspection violation score (category E) and microbiological testing score (category F) resulted in a correlation of 0.39. A significance test that the slope is zero resulted in a p value of 0.0000 and power of 100%. The regression equation is: Micro = (0.000) + (0.3119) x Inspection Violation Score. Hence an inspection violation score of 10 would result in a micro score of 0.0 + (0.3119 x 10) = 3.119.

Figure 5 shows the inspection results of the dairy plants plotted from highest average risk score to lowest. A mean trendline is also shown.

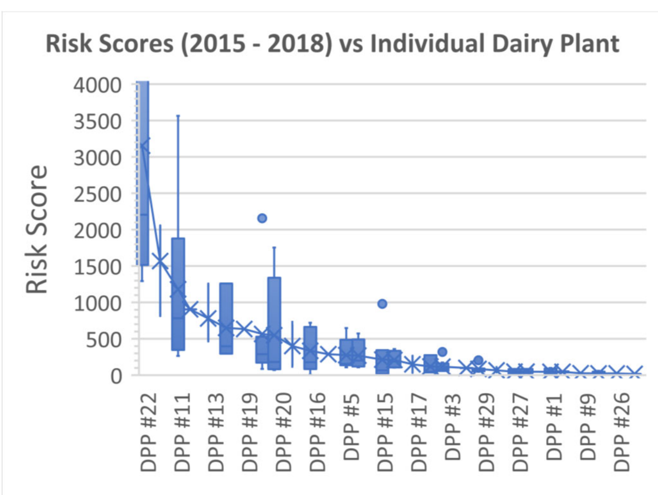

Figure 5. Risk scores for the individual dairy plants sorted from highest average risk score to lowest.

Individual DPP inspection risk scores for the period of 2015 – 2018 (n=30 DPPs) showed that six, DPP #22, DPP #4, DPP #11, DPP #18, DPP #13, and DPP #19, had medians higher than the BCCDC high-risk cut-off of 501. Four dairies had their median score in the moderate range of 251 – 500 with the remaining 20 DPP in the low risk category – 250 or lower. DPP #22 had the highest single risk rating score of 8302 from an inspection in 2015 and its four-year median risk score was 2204. DPP #28 had the lowest median risk score of 18. The median risk score for all inspections over the measured four-year period was 107.

Figure 6 shows the risk score comparing DPPs located on-farm to DPPs that were located off-farm.

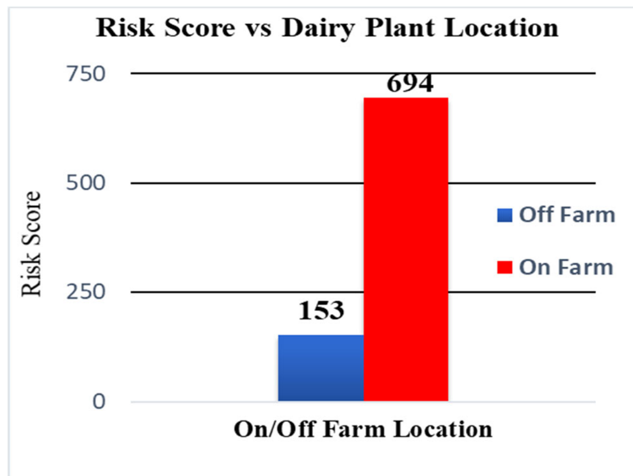

Figure 6. Risk score vs. on or off farm dairy plant location.

A 1-tailed Mann-Whitney U test showed a statistically significant difference between risk scores, $p = 0.0003$, power 95%. Hence on-farm DPPs have a statistically significantly higher risk score than off- farm DPPs. There is no likelihood or alpha nor beta errors with these results.

Figure 7 shows the inspection risk score based on the number of categorized products manufactured at each DPP.

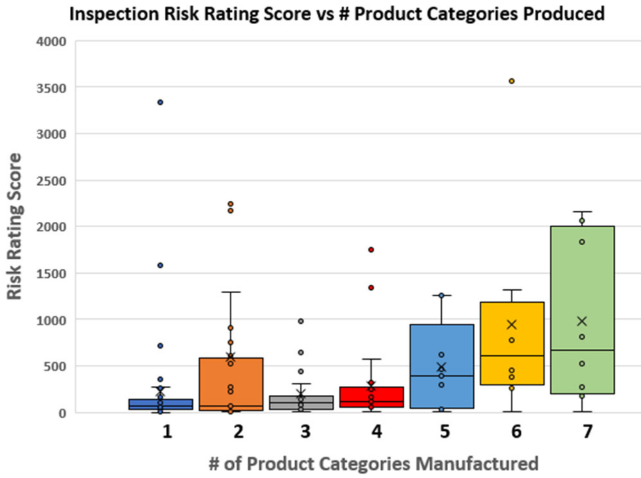

Figure 7. Inspection risk score vs number of product categories manufactured.

A Kruskal-Wallis H test showed that there was a statistically significant difference in producing different product categories, p = 0.01257 with power of 76%. A post hoc Tukey-Kramer multiple-comparison showed that producing one compared to six or seven products differed significantly (p = 0.009) and that producing two to five products compared to six or seven products differed significantly (p = 0.035); producing one product category was not significantly different from producing two to five product categories at p = 0.55. Overall, lower risk scores were observed in plants making one or three products. Although higher risk scores were observed in DPP making 6 or more categories of dairy products, there was no significant difference between plants making 1 vs 2 to 5, p = 0.546.

A correlation and regression analysis between inherent score (sum of categories A, B, C, D) and microbiological testing score (category F) resulted in a correlation of 0.61. A significance test that the slope is zero resulted in a p value of 0.0000 and power of 100%. The regression equation is: Micro = (0.000) + (0.0821) x inherent score. Hence an inherent score of 30 would result in a micro score of 0.0 + (0.0821 x 30) = 2.463.

Discussion

This project evaluated 128 routine and in-depth inspection records from 30 non-federally inspected British Columbia DPP between 2015-2018. Line items from the RRT from all inspections during this period were tabulated and correlation and regression, ANOVA and t-test analysis of the risk scores over the years were performed. To the author's knowledge, no other studies in Canada have assessed DPP risk ranking tools against microbiological data and inspection results. As such, there is limited available literature with which to discuss our results.

The number of inspections for non-federally inspected BC routine and in-depth inspections (n=128) averaged 32 ±7.4 per year since 2015. Fewer routine and in-depth inspections occurred since 2017. This may be attributable to the retirement of one of the BCCDC Food Safety Specialists (FSS) in early 2017, followed by recruitment delay of a new FSS, who was subsequently hired in May 2018 and undergoing field training during the latter half of 2018. Having two FSS conducting the dairy inspections, a temporary loss of one person in the department would have a significant short-term impact on inspection productivity.

When observing inspection scores by year (Figure 3), the three years from 2015 – 2017 had medians somewhat close, but the median for 2018 was noticeably higher than the previous three years (276). There is also a larger spread for 2018 compared to the other years, especially visible for the third and fourth quartiles. The change in the inspector staffing for 2018 would likely explain this, as it would be understandable for a new inspector to be more critical and thorough during a facility inspection when they haven't had the time to build a relationship with operating staff nor understand the history of the facility (Ball, Siemsen, & Shah, 2017).

During this four-year period, 23% of DPP inspections were given a high-risk rating score, 13% a medium risk rating score, and 65% a low risk rating score. Fourteen DPP (47%) contributed to the high risk (>500) inspection risk scores. Does this indicate that the threshold for high risk needs to be reevaluated or does it accurately reflect what the Dairy Specialists perceive to be higher risk inspections? To the best of the author's knowledge, there have been no other Canadian studies that looked at risk levels this way. Does 23% of DPP inspections having a high-risk rating raise a red flag?

The majority of inspected items (89.9%) assessed (category E), received a satisfactory score or the best rating available (Figure 4). These are under the direct control of the plant personnel, demonstrating overall compliance with good manufacturing practices. Only 10% received a major violation score and 0.1% received a critical violation score (the least favorable inspection observation). These category E inspection items included evaluating the raw milk receiving program, pasteurization records, annual calibrations, personnel habits, processing environmental controls, pest control, processing rooms, sanitation, non-milk ingredient storage, aging rooms (if used), finished product coolers, allergen control and the plant's food safety management program.

Altogether, this score will provide a good indication of the overall food safety culture of the DPP and compliance with accepted dairy plant operational standards. Having such high compliance (seen from the satisfactory observations) reinforces the low median risk rating of 107 for all inspections analyzed (n=128). This category of inspection items can lay the foundation of having either a poor or good overall inspection risk score. If a facility is lacking in the fundamentals of good manufacturing practices, the results can lead to further problems in production such as physical, chemical or microbiological contamination.

When examining the highest risk scoring DPPs, the author reviewed inspection criteria that may have been similar or representing itself disproportionately. One inspection item that was present in 70% of the ten DPP with the highest average inspection scores was the DPP being situated on the same property as the dairy farm that supplied its milk. The other DPPs were standalone and received milk in sanitary milk tankers from dairy farms not physically connected to a DPP. From this study, DPP that were located on a farm were found to have a significantly higher average risk score compared to those that were not located on a farm.

With a processing plant physically located on the same property as the farm, there is greater risk of employee cross contamination from manure which can contain pathogens and other spoilage bacteria (McIntyre, Wilcott, Naus, 2015 & Oliver, Jayarao, & Almeida, 2005). Another contributing factor to on-farm DPP having a higher risk score is the smaller volumes processed at on-farm dairies. Smaller dairies are usually family run compared to hiring dedicated specialized staff seen in larger more commercial dairies that will likely have a more structured food safety program in place.

The riskiness of manufacturing multiple product categories in the facility was analyzed. DPPs producing multiple products had statistically significantly higher risk scores than those producing only one product. Producing more product categories should mean frequent equipment changeovers, greater employee intervention with equipment and processes, more training and sanitation opportunities. However, the results obtained were not clear. DPP that produced two products showed a higher average risk score than those producing five products. This was likely from DPP #22, which had four of the five highest risk overall scores and was also in the two-product category. Further analysis of the product types could examine what products were being produced as two product types of unpasteurized cheese may be considered riskier than producing seven pasteurized product categories. For example, product breakdown to type of product within the category could be evaluated further, however details of products being produced were not collected in the RRT so were not part of this study. The data from this study does, however, clearly show that DPP producing five or more products did result in higher overall risk scores when compared to DPP producing fewer products and that the risk rating score medians increased as the number of product categories produced increased.

The study also found a significant correlation between inspection violations score (category E) and microbiological scores (category F). During an in-depth inspection, finished product samples and environmental swabs are microbiologically sampled and then tested (BCCDC, 2014). The finished product is a post-process test, but results can still indicate whether a problem is present in the product or DPP. The environmental swabs are used as a possible predictive indicator of problems that could present themselves in the product via cross-contamination. Environmental swabs are sampled in four zones (Z1, Z2, Z3, Z4) as shown in Figure 8 (Broski, 2014). Zone 1 is direct food contact surfaces such as pipes, mixers, utensils and Zone 2 are areas directly adjacent to Zone 1 that exposed food products do not touch such as control panels, cat walks or tunnel sides directly above or beside a product path. Zone 3 surrounds Zone 2 and are non-food contact surfaces and Zone 4 are areas outside Zone 3 that are away from the production area like lunch rooms, loading bays and offices. Keeping Zones 2 and 3 pathogen free is critical to ensuring Zone 1 (food contact surfaces) is kept pathogen free.

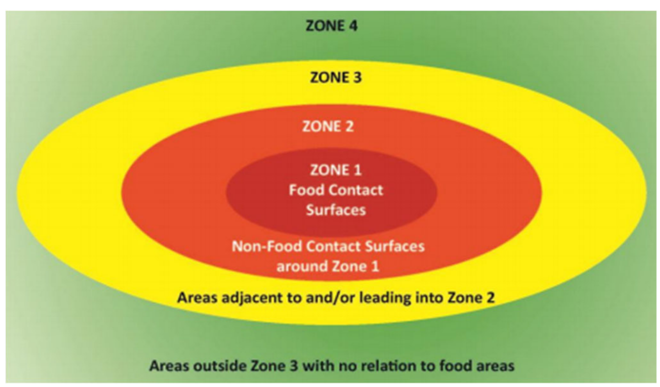

Figure 8. Category F – Environmental swabbing zones (Broski, 2014).

The results of the microbiological testing found *Listeria monocytogenes* in Zone 1 and 2 – in 9% of samples taken. Average inspection risk score for all inspections that tested positive for *L. monocytogenes* in these zones also had the highest overall risk rating values of 2,426. This result substantiates generally held knowledge that findings of *L. monocytogenes* in food contact and surrounding areas (i.e. in Zone 1 and 2) indicates inadequate sanitation practices. Raw milk contains many pathogens such as *E. coli* O157:H7, *Salmonella* spp. and *L. monocytogenes* (Jackson et al., 2012) and this study agrees with that previous research. The most frequently tested microbiological categories are the four environmental areas, representing 49% of the microbiological testing (n=743). This would reflect the importance of environmental testing as an indicator of the DPP's current and potential microbiological health (McIntyre, Wilcott, Naus, 2015). Unpasteurized cheese DPP also ranked high in both overall average inspection risk score and percentage positive results was not surprising as unpasteurized cheese would inherently have a higher risk since pathogen inactivation does not occur during its cheese making process (BCCDC, 2018). Generally, if a DPP is reporting negative results in Zones 2 through 4, there should be minimal risk for a positive Zone 1 sample.

Based on the results over this time period, the BCCDC Dairy Program may be able to leverage inspection risk scores (category E) and inherent risk scores (categories A to D) into predicting microbiological risk scores (category F). Using simple linear regression, category F (microbiological) score could be predicted from category E (Inspection) by the following formula: category F = 0.3119 x category E score ($p = 0.0000$, power = 100%). This formula could be useful in predicting the final risk score for a DPP during the lag period of waiting for the final microbiological results after the completion of an in-depth inspection. Category F (microbiological) score could be predicted from the inherent score (sum of Categories A – D) by the following formula: category F = 0.0821 x inherent score ($p = 0.0000$, power = 100%). A BCCDC staff member could use this formula to predict microbiological risk of a DPP if only inherent data is available, for example if it is a new DPP or is overdue for an inspection.

Limitations

As only a four-year period of data was analyzed, trending of the data over time is limited to this time frame. Further, the author found no other Canadian studies that looked at risk ratings is this manner, so comparisons on how to assess and view the data are limited. There were also limitations with the RRT used to assess DPP inspections over the four-year period. The RRT has had revisions since its creation. Version 1.2 of the tool was used to analyze the inspection reports, however not all of the data elements were collected to populate the tool until 2018. Future updates of the tool could change the risk ratings of future inspections, unless the prior inspections are reanalyzed in any new RRT versions. Updates have been made to the inspection criteria since 2015 resulting in some categories not being the same when compared to 2018 which could result in scoring variances. The RRT has built-in risk weighting for different categories, such as unpasteurized cheese given a risk score of eight compared to cultured dairy products risk score of one. Similarly, a DPP located on-farm, is assigned a risk score of five whereas a DPP located off-farm is assigned a score of zero.

Combining Zone 1 and Zone 2 category F results together may misrepresent the severity of a positive result, as Zone 1 is a food contact surface (FCS) and Zone 2 is a non-contact FCS. The author would recommend having separate reporting categories for Zones 1 and 2. The lag period, from taking and submitting the environmental samples and receiving the final results from the testing lab, which can be weeks or more, can cause a delay in calculating the final risk score and leaves room for human error when the manual task of calculating the final risk score is completed. In some instances, the prior microbiological test results may be temporary substituted until the current results are available. If proper attention isn't taken during this period, it is possible that incorrect results could be used in the final risk score calculation.

Knowledge Translation

Based on the statistical results of this study, the BCCDC food safety specialist can confidently place more scrutiny on DPPs that are located on-farm and/or process more product categories. Noting the decline of total inspections being completed since 2017, more resources could be allocated to the dairy inspection program to ensure adherence to the dairy inspection frequency goals of the BCCDC. The RRT could be evaluated to eliminate categories that were observed to be unused for all 128 inspections evaluated. These were category A – "soft unripened cheese – unpasteurized" and in category F – 11/40 (27.5%) of the measurable tests available had no results. This could simplify the RRT if these unused items were deemed to be not required and eliminated. Inspection practices could be modified based on the risk category scores and by using the eight scoring categories, summary results could be used to simplify the complicated dairy inspection process when presenting the results to stakeholders.

Future Research

- Enter inspection reports prior to 2015 into risk rating tool to generate more data for analysis.
- Additional linear regression analysis on variables (i.e. Environmental control or Personnel) in category E (inspection scores) to compare to category F (microbiological)
- ANOVA comparing DPPs that manufacture raw or pasteurized products to 1. Category F (microbiology risk score), 2. Overall risk score, 3. Category E (inspection violations score).
- Analyze DPP inspections that score in the high-risk category and see if any common factors emerge or not that drive the higher scores.

Conclusions

The per capita consumption of dairy products in Canada is almost 107 liters annually (CDIC, 2018). Many vulnerable groups such as children, elderly, sick or immunocompromised are end consumers of these products. Dairy inspections ensure DPP follow good manufacturing practices and therefore help to protect the population from disease outbreaks or other contaminations. This study demonstrated that there is increased risk of having a dairy processing facility located on-farm, that more complex the dairy processing operations that produce more than one type of dairy product have risk rating scores and that higher inspection score violations positively correlated to positive microbiological scores. This study further showed that in the absence of microbiological results, a risk score could still be calculated by analyzing the inspection violations alone. The Food Safety Specialists at the BCCDC can use this data to focus their inspection time on higher risk areas and items to maximize time spent out in the field.

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Competing Interests

The authors declare they have no competing interest.

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