European Journal of Food Science and Technology
Vol.9, No.2, pp.1-8, 2021
Print ISSN: ISSN 2056-5798(Print)
Online ISSN: ISSN 2056-5801(online)

RISK-BASED ROUTINE INSPECTION PLANNERS FOR FOOD PREMISES AND IMPORTED CONSIGNMENTS

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ABSTRACT: *Existing risk-based inspection plans use descriptive terms to categorize the food establishments according to their risk levels, hence inspection visits are planned. The current paper hypothesized the reliance of the number of the yearly routine inspection visits to a food establishment on its risk level and a predetermined fixed inspection confidence level of 95% , accordingly a routine inspection visits planner and an inspection frequency calculator were developed. Similarly, a calculator was developed to predetermine the number of consignments to be inspected at the ports of entry of countries. Following the use of the risk levels between 99% and 1% and according to the obtained number of yearly visits to an establishment, 12 risk groups are reported with a corresponding frequency of inspection range from as minimum as 30 days to as high as 365 days. The findings will reform the risk grouping of food establishments from a static to a dynamic figure-based one thence help allocating resource and focus on the riskiest establishments. The imported consignments planner could easily be used and adjusted to suit calculating the approximate number of consignments to be inspected at the ports of entry based on any risk category.*

KEYWORDS: establishment, consignment, food, inspection plan, risk level, routine inspection

INTRODUCTION

Everyone has the right to have access to safe and nutritious food (FAO, 1996). Ensuring the safety of the accessed food is classically manoeuvred by inspection. Guidelines for sampling food commodities and inspecting food establishments were set (FAO/WHO, 2004a). Risk analysis concept is an old one, nonetheless quantitative risk analysis tools became available only after the emergence of probability theory in the 17th century (Covello and Mumpower,1985), consequently the field of risk assessment and risk management could be considered a relatively young branch of science (Aven, 2016). Recently, risk-based approaches were adopted and implemented in planning for and conduction of both inspection and sampling (Orban, 2021; ADAFSA 2020; Hurtado, Griffin and Hong, 2020; Canadian Food Inspection Agency , 2019; Food Standards Agency, 2016; Nychas, Panagou and Mohareb, 2016; Maudoux et al, 2006; FAO, 2006a,b) however, risk grouping of establishments and frequencies of routine inspection visits are varying between authorities with the absence of a unified risk grouping and the existence of erratic inspection frequencies.

LITERATURE

The Right to Food (RtoF) had been defined by FAO (1996) as the right of everyone to have access to safe and nutritious food. The safety of food is assured by official

authorities and control bodies by inspection (Codex Alimentarius Commission, 2005; FAO/WHO, 2004a,2004b). although auditing became a common tool of food safety assurance to verify the compliance of the Hazard Analysis and Critical Control Point (HACCP) (Codex, 2003) and other food safety management systems.

The food establishment compliance percentage is recommended by Zaki et al (1977) to be a determining factor for setting its frequency of inspection visits. However, the effect of the number of the annual inspection visits to an establishment on its compliance percentage is a debating matter. Varying inspection visit numbers were recommended (Riben et al, 1994; Corber et al, 1984; Bader et al, 1978). FAO (2008) set an inspection matrix that prioritized inspection into low, medium, and high based on two profiles for both the product risk and the establishment compliance. Furthermore, the traditional regulatory inspection seeks only to obtain correction of food safety concerns that already exist rather than to prevent future violations from occurring (FAO 2008). Koutsoumanis and Aspridou (2016) mentioned that food safety classical hazard-based approaches relying on regulatory inspection and sampling regimes cannot ensure consumer protection sufficiently.

Despite its relatively young age (Aven, 2016), risk-based methodologies are considered advantageous over traditional ones in almost all fields of activities (Orban, 2021; Griffin, Bloem and Hurtado, 2020; Racicot et al, 2020; Canadian Food Inspection Agency, 2019; Kiely et al, 2019; Koutsoumanis and Aspridou, 2016; Sareen, 2014; Schwermer et al, 2009). Orban (2021) reported that the reduction in sample sizes would eventually be a systematic outcome upon adoption of risk-based sampling.

METHODOLOGY

The objective of the current paper is to develop formulae that estimate the yearly number of routine inspection visits , the frequency of these visits to a food establishment and the number of imported food consignments to be inspected at ports of entry according to risk methodologies and a fixed inspection confidence level of 95%.

Assumptions:

The first assumption of the current article is that 12 (Riben et al, 1994) is the maximum number of routine inspection visits to be conducted to a food establishment in a year. Further, the article accepts the fact that the number and frequency of inspection visits are proportional to the risk level of the establishment and the control authority predetermined confidence level of the inspection (Orban, 2021).

Inspection Confidence Level:

The common 95% confidence level (Hazra, 2017) is used as a fixed attribute to the inspection visit and imported consignments planners.

Inspection Visits Planner:

The number of the annual routine visits (n) a food establishment should be visited is calculated according to the following equation:

$$n = ceil\left(\left(RL_{est}^{\left(\frac{1}{1-insp_{err}}\right)}\right) * (12)\right)$$

Where:

n : number of visits the establishment should be visited routinely in a year

RL_{est} : risk level of the establishment.

$Insp_{err}$: inspection error, equals to 1 minus inspection confidence level (fixed at 95%), that is 1minus 95%

12 : number of months in a Gregorian year.

The arithmetical result of the calculation is rounded up to the next largest integer.

Frequency of Routine Inspection Visit:

The frequency of visits, in days, an establishment should be visited for routine inspection based on its risk level is calculated according to the following formula:

$$f_{insp} = (365/n)$$

Where:

f_{insp} : inspection frequency (days).

365 : days of a Gregorian year.

n *:* number of visits the establishment should be visited routinely in a year based on its risk level, obtained from the inspection visits planner.

Risk Level of Establishment:

For the calculation of the frequency of visits to an establishment based on its risk level, all the numbers between 99% and 1% were used as establishment risk level values.

Imported Consignments Planner:

The number of the annual consignments (n_{cons}) to be inspected from a total of imported consignments (N) is calculated according to the following equation:

$$n_{cons} = ceil\left(\left(RL_{x}^{\left(\frac{1}{1-insp_{err}}\right)}\right) * (N)\right)$$

Where:

n_{cons} : number of consignments to be inspected in a year

RL_x : risk level of the commodity, country or importing company.

$Insp_{err}$: inspection error, equals to 1 minus inspection confidence level (fixed at 95%), that is 1minus 95%

N : number of expected consignments to be imported via a port in a Gregorian year.

The arithmetical result of the calculation is rounded up to the next largest integer.

To test the planner, 5 risk levels for a fixed number of consignments (3,556) were selected from the numbers between 99 and 1 using a RANDBETWEEN function in excel, the resulting risk levels (90%, 69%, 62%, 38% and 15%) were sorted in a descending order for the easiness of visualization of the test result outcomes.

FINDINGS

Risk levels and Number of Routine Visits:

An objective of the current paper is to develop a formula that could be used in planning for annual routine inspection visits to an establishment based on its risk level, however upon testing the inspection planner using all the risk level figures between 99% and 1% , the resulting number of annual visits grouped food establishments into 12 risk groups as Table (1) shows. The number of risk levels contained in each of the groups was 6 for one group, 7 for seven groups and 8 for four groups. Annual inspection visits to the groups ranged between 12 visits to the first risk group and 1 visit to the last group.

Table 1. Number and Frequency of Routine Inspection Visits to Food Establishments According to the Developed Risk-Based Inspection Planner

Establishment Risk Level	Number of Routine Visits (visit/year)	Frequency of Inspection (Days)
0.99-0.93	12	30
0.92-0.85	11	33
0.84-0.77	10	37
0.76-0.69	9	41
0.68-0.60	8	46
0.59-0.52	7	52
0.51-0.44	6	61
0.43-0.36	5	73
0.35 - 0.27	4	91
0.26-0.19	3	122
0.18-0.10	2	183
0.09-0.01	1	Once a year

Frequency of Inspection Visits:

The second objective of the current paper is to develop a formula that estimates the frequency of inspection to a food establishment based on its risk level. Application of the obtained number of routine inspection visits obtained from the routine inspection planner resulted in inspection frequencies to establishments ranging from 30 days to 365 days as Table (1) depicts.

Visualization of the results illustrated in Table (1) from a perspective of descriptive risk grouping could result in 3 and 4 risk categories. Table (2) shows risk levels and inspection frequencies of the first 3 possible risk groups.

Table 2. A possible risk grouping of establishments according to the developed risk-based routine inspection planner

Risk Category	Risk Levels	Inspection Frequency (days)
High	99-69%	30-41
Medium	68-36%	46-73
Low	35-01%	91-365

Table (3) shows the risk levels and inspection frequencies of the 4 possible descriptive risk groups

Table 3. A possible risk grouping of establishments according to the developed risk-based routine inspection planner

Risk Category	Risk Levels	Inspection Frequency (days)
Very High	99-77%	30-37
High	76-52%	41-52
Medium	51-27%	61-91
Low	26-01%	122-365

Imported Consignments Planner:

Application of the imported consignments planner developed in the current paper on a fixed number of consignments (3,556) with presumed different risk levels revealed varying possible numbers of consignments to be inspected as Table (4) shows.

Table 4. Number of consignments to be inspected from a fixed number of imported consignments with different risk levels according to the developed Imported Consignments Planner

Number of Expected Imported Consignments in a year	Risk Level x	Number of Consignments to be Inspected in a year
3,556	90%	3,183
3,556	69%	2,407
3,556	62%	2,150
3,556	38%	1,285
3,556	15%	483

DISCUSSION

The developed formulae in the current paper assumed that an establishment will not be visited routinely more than 12 times a year, in addition, the number of annual routine inspections to a food establishment is reliant on its risk level and a fixed inspection confidence level of 95%. The risk groups obtained upon implementation of the developed routine inspection planner are not in line with the risk categorization set by ADAFSA (2020); Canadian Food Inspection Agency (2019) and Codex Alimentarius Commission (2005) which categorized food establishments and commodities into 6, 4 and 3 risk levels, respectively. This discrepancy could be attributed to the fact that the current developed planner recognizes individual establishment risk level numerically whereas the mentioned authorities adopt the descriptive risk grouping of high, medium, and low.

Although the risk groups reported in the current paper were easily collated into 3 and 4 descriptive risk groups as shown in Table (2) and (Table 3) respectively, however such

grouping will conceal the advantages of considering each establishment individually and overriding the current prevailing descriptive categorization.

The results of the imported consignments planner Table 4) clearly support the principle of risk-based sampling (RBS) with the perception that commodities or importing companies or countries of origin should be treated according to their risk levels. After determining the expected number of consignments to be inspected in a year, selection of the exact consignments from the total predetermined number could easily be done using different statistical and mathematical manoeuvres, the simplest of which is a RANDBETWEEN function in excel.

Implication to research and practice

The formulae developed in the current paper are science-based tools that official authorities and control bodies could confidently adopt and implement in their routine work. This will result in unification of the inspection parameters and methodologies between authorities and countries thence provision of a more realistic platform for benchmark between countries as well as an efficient use of international food safety indices.

CONCLUSION

The objective of the current paper is to develop risk-based planners that could be used for planning routine inspection visits to food establishments as well as to forecast the number of consignments to be inspected from the expected yearly total imported consignments. The obtained results strongly support the conclusion that adoption and implementation of the developed routine inspection planner will narrow the spectrum of risk categorization of establishments and transform the prevailing descriptive risk grouping into a numerical real time risk-based categorization specific to the individual establishment. This will strappingly help the official authorities and control bodies to allocate and rationalize resources to assure the safest accessible food.

FUTURE RESEARCH

The economic dimension of the adoption and implementation of the formulae developed in the current article by control authorities needs to be assessed. Further, the effect of implementing the formulae on the overall safety of the food consumed in the adopting countries needs to be reported.

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