The Welsh Food Microbiological Forum and the all-Wales Shopping Basket Sampling Program: A Model for the Surveillance of the Microbiological Quality of Ready-to-Eat Foods

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Abstract
In the United Kingdom, the monitoring of microbiological food quality and the prevention of food borne disease is the responsibility of a number of different organizations. In 1993, to develop and extend on-going local collaborations within selected local food groups in Wales (comprising of Local Authorities and the Public Health Laboratory Service), the Welsh Office invited all local food groups in Wales to create a forum to coordinate both the sampling and examination of ready to eat foods and the centralized collection of results for the whole of Wales. This paper describes the development, structure and aims of this forum, discusses the outcomes of the first nine years of its activities, describes the randomized sampling program for ready to eat foods that has been developed and assesses the benefits that have resulted.
Introduction
The prevention and investigation of food borne disease and the monitoring of microbiological food quality is the responsibility of a number of different interlinked public bodies, the food industry and other related organizations. Figure 1 illustrates the general activities required to enhance food safety and reduce food borne disease incidence. In the United Kingdom, monitoring and enhancement of food safety and microbiological food quality is the duty of Local Authorities, the Food Standards Agency (FSA), since its creation in 2000, and the Public Health Laboratory Service (PHLS). Local Authority functions include periodic inspections of all registered food premises, enforcement, education and response to public complaints. In recent years, education and advice to food producers and caterers has become a major function of Local Authorities. The FSA also has a major role in the provision of food safety advice to food producers, caterers and the public, and works in tandem with Local Authorities to ensure concerted action in the area of advice provision. The PHLS examine samples of food routinely submitted by Local Authorities for microbiological quality and the presence of specific pathogens. It also provides advice and training to Local Authorities and the FSA on microbiological food quality, provides reference laboratory facilities, carries out applied research and participates in both food surveys and in outbreak control teams, as required.

Wales is a country with a population of approximately three million. It is part of the United Kingdom, but since 1999 has had a devolved local government named the Welsh Assembly Government that deals with legal and constitutional issues related to Wales. Prior to this date, local government issues in Wales were managed by the Welsh Office, an office of the UK parliament. The country is divided up into twenty-two Local Authority areas.
This paper describes the creation of a collaborative forum in Wales that represents organizations with an interest in enhancing food safety, including Local Authorities, FSA Wales and the PHLS in Wales. It highlights the advantages of having a multi-agency forum that coordinates sampling, examination and the centralized collection, analysis and utilization of results. The paper also discusses the structured, randomized shopping basket program that was developed by the forum.
The development, constitution, aims and activities of the forum

A previous paper describes the development of structured ready to eat food-sampling programs in South East Wales during the early Nineties (Widdows, Ribeiro, & Brown, 1996). These programs were organized by the local food groups, consisting of representatives of Local Authority Environmental Health Departments and the PHLS in Wales. Experience of these local arrangements demonstrated the benefits of collaboration and the added value obtained from focusing the efforts of a number of Local Authorities.

It was suggested in 1993 that broader coordination of routine sampling could be beneficial and the Welsh Office invited all local food groups in Wales to extend the initiative and consider collecting data for the whole of Wales. At an exploratory meeting in 1993, it was agreed that this collaboration be initiated and coordinated through the formation of a multi-disciplinary and multi-agency group, which would be named the Welsh Food Microbiological Forum (WFMF).

The WFMF was formally created in 1993 by agreement between the then all-Wales Chief Environmental Health Officers Panel, the Directors of Public Health Laboratories in Wales, the Communicable Disease Surveillance Center (CDSC) Wales and the Welsh Office. The overall purpose of the WFMF is to promote coordination and support of agencies concerned with improving the microbiological quality of ready to eat food in Wales. Its specific aims are to use standardized methods of food sampling and testing across Wales, to propose common food types for the all Wales sampling program, to develop an all Wales database for monitoring and recording the microbiological quality of ready to eat food at the point of sale, to collate and analyze results of food testing throughout Wales, to propose
criteria for foods not included in the PHLS guidelines and to produce and disseminate reports and papers on its findings.

In terms of Local Authority membership, the WFMF initially included the secretaries of the local food groups in Wales, but following local government reorganization in 1996, local food groups were abolished and a Food Safety Technical Panel of the Society of Directors of Public Protection in Wales was created. The WFMF membership and reporting arrangements were amended accordingly. As well as the Local Authority presence, the WFMF currently has representatives of the PHLS in Wales, CDSC Wales, FSA Wales, Local Authorities Coordinators of Regulatory Services and an academic with expertise in HACCP. The WFMF comprises of a core of approximately thirty members at any one time. Observers from the National Assembly for Wales and the Society of Directors of Public Protection in Wales may also attend. Other relevant individuals can be co-opted as members. A chair and secretary are elected from the members of the WFMF. Between them, they represent the professional backgrounds of the membership and their terms of office are for a maximum of three years. Meetings are held at intervals of not more than seven months. The WFMF reports to each of the parent agencies represented by its members and liaises with other agencies and organizations as appropriate.
The shopping basket model

In general terms, there are six basic types of food survey; structured, unstructured, targeted, passive, shopping basket and enhanced. There are advantages and disadvantages to each format in terms of the cost, the robustness, the statistical significance and time taken to carry out such a survey. The choice of survey depends on the outcome required, determined by assessing the reasons for doing the survey and the audience for which the results are intended. The structured survey involves precise statistical sampling and is statistically significant and representative. The main disadvantages are that they can be expensive and may take months to set up and years to complete. The unstructured survey, where there is no predetermined sampling plan and where there may be very few samples taken, is the format with the least, if any, advantages and is unlikely to produce any conclusions that will enhance food safety or food quality. A targeted survey is one that focuses on a product or sector for an extended period. In this type of survey, resources are focused, but the studied area is narrow. The passive survey collects data from other surveys. The advantages are that it is cheap and data can be used for more than one purpose. The disadvantages are that they can be unstructured and methods may differ. Shopping basket surveys are where random samples are examined accordingly to a predetermined statistical plan. Advantages are that results are statistically significant and a wide product ranges can be covered. One of the disadvantages is that a large number of samples are required. Enhanced surveys combine data from all studies on a central database, which can cover the whole food chain and can be continuous. However, this type of survey may not involve standard methodology and may require IT expertise.

The shopping basket model used by the WFMF in Wales relies on a nominated list of foods that are randomly sampled throughout the year by all participating Local Authorities for twelve months, although foods of interest can be sampled for longer, as required. Foods to be
sampled are regularly reviewed at WFMF meetings and are usually selected as being those of
particular interest to Local Authorities, FSA Wales and the PHLS in Wales. Foods are
excluded when it is considered that there has been enough data collected, but may be
included again at a later stage. Foods in the basket are primarily, but not exclusively, foods
that are of interest on a UK level. There have been six shopping baskets to date, detailed in
Table 1. Foods in the shopping basket have differing priorities. Foods at the top of the list
have priority over those below. Having a shopping basket approach, with number of different
foods rather than just one in the sampling program, decreases the chance of a wasted
sampling visit and increases the range of foods and premises sampled.

It was recognized early in the process that taking samples on an ad hoc basis from premises
chosen by a sampling officer introduced sampling bias into the program and that some form
of randomized sampling needed to be introduced. As well as avoiding bias, random selection
of premises has also increased the variety of outlets sampled, to include restaurants, schools,
gas station shops and factory canteens. Sampling officers use a random number generator to
identify premises from their register of food premises. On a sampling day, the sampling
officer has the randomized list of premises to be visited and the prioritized list of foods to be
sampled. At the first food business on the list, the sampling officer will aim to sample foods
from the top of the list. The officer may take the maximum required number of samples or
may find none to sample and be required to move onto the next premises on the randomized
list. The intent is to ensure that not only are there fewer wasted visits, but that the number of
samples obtained from each premises is increased, thereby improving both the effectiveness
and the efficiency of the exercise.
Samples are delivered to one of the four PHLS laboratories in Wales that examine foods or to one of two PHLS laboratories in neighboring parts of England. The choice of laboratory is a matter of preference for the Local Authority concerned. Over the period of the shopping basket program, samples have been examined for a range of analytes, including aerobic colony count, *Escherichia coli, Bacillus, Clostridium perfringens, Staphylococcus aureus, Vibrio, Salmonella, Campylobacter* and *Listeria*.

The shopping basket model in Wales has evolved over the seven years that it has been in existence. As mentioned above, food types in the basket change annually in response to other survey results, outbreak information or specific local interests. The range of organisms tested for has also changed over the years. Tests for aerobic colony count, *Escherichia coli, Bacillus, Staphylococcus aureus, Salmonella* and *Listeria* have been maintained as the standard range of tests over the years of the program, whilst tests for other organisms have been introduced or removed at the request of the WFMF. For example, in 2000, *Campylobacter* testing was introduced, reflecting the increased importance of the organism, and *Clostridium perfringens* testing was phased out for routine shopping basket samples. The changes to both the content of the shopping basket and the organisms reflect the dynamic and evolving nature of the shopping basket.
**Provision and utilization of results**

The results of the examination of foods by the PHLS laboratories are returned to Local Authorities on a weekly basis. Local Authorities currently have the responsibility for inputting the microbiological results and associated sample information onto the WFMF database and electronically transmitting the data to CDSC Wales where it is collated for storage and analysis. Each sample is allotted a unique sample number to help identify any duplication. There is now a substantial database on the microbiological quality of food throughout Wales from 1995 to present at CDSC Wales. The results of approximately 15,000 samples have been collected up to the end of March 2002. To date, only the results from the period 1995 to 2000 have been fully analyzed and are available to Local Authorities, with the full analysis of the data from 2000 to present still pending at the time of writing.

The database held by the WFMF is periodically audited for accuracy, a process that involves comparing the results in the forum database to the laboratory results held by the PHLS in Wales. This audit process is carried out on a regular basis, usually when enough new data has been electronically transferred from the participating Local Authorities. It is carried out prior to any data analysis or publication. The auditing of results ensures that the results held on the WFMF database are the same as those held by the PHLS in Wales and are not duplicated or incorrect. Any incorrect data entry is corrected and any duplicate entries removed. Samples which are either not in the shopping basket or have not been taken as part of the randomized program are also removed, as required.

The existence of an all-Wales database that is easily searched for particular analytes allows the sample results from the whole of Wales to be broken down by food type, by month or year, by Local Authority, by organism type and number or by laboratory. The database can
be searched for results that can be compared to the existing guidelines to determine the proportion of unsatisfactory foods, broken down by either food type or organism. An example of this type of analysis is an examination of the database for the genus *Bacillus*. From the four laboratories in Wales, there were 843 positive *Bacillus* results for the period 1995-2000, out of 10904 foods tested for this genus during this period. Of these 843 results, only 55 were equal to or greater than $10^4$ cfu/g, the level that is defined as unsatisfactory in the current PHLS guidelines (Gilbert et al., 2000). These 55 results can be further analyzed by food type. Six were from fruit and vegetables, twelve from meat and meat products, seventeen from bakery products (especially custard based products), fourteen from sandwiches, three from rice and three from desserts. These results clearly demonstrate two points. Firstly, *Bacillus* contamination in the ready to eat foods available to consumers in Wales is relatively low, with only 0.5% of samples being unsatisfactory for the particular period in question. Secondly, the results indicate those foods that have had the highest frequency of contamination with unsatisfactory levels of the genus, namely bakery products and sandwiches. This allows organizations involved with food safety in Wales to specifically focus on these higher frequency food products in an effort to reduce the numbers of ready to eat foods containing unsatisfactory levels of *Bacillus* contamination even further.

One other area that could involve the utilization of the WFMF data is in the evolution of existing guidelines for ready to eat foods. Following the publication in the UK of the Richmond Report (The Richmond Committee, 1990; The Richmond Committee, 1991) and the Food Safety Act (Ministry of Agriculture, Food and Fisheries, 1990), it was recognized that there was a need for microbiological guidelines for ready to eat foods that would assist in the interpretation of microbiological results and thereby help to pinpoint problem foods and outlets. It was clear that such guidelines would be useful in providing achievable levels for
the microbiological contamination of food that could be consistently applied across the UK. This need was answered, in part, by the production of guidelines for ready to eat foods by the PHLS food surveillance group (Public Health Laboratory Service, 1992; Public Health Laboratory Service, 1996). These guidelines have subsequently been updated (Gilbert et al., 2000). However, although extremely useful, there still remains the need for robust data to validate these guidelines and generate additional ones for foods not already covered. It may well be that the data collected by the WFMF and the randomized nature of the shopping basket model will help to establish microbiological guidelines for ready to eat foods that are based on robust data, thereby validating current guidelines and generating additional ones for foods not already covered.
Conclusion

It is important in food surveillance that the organizations involved work closely together to ensure that the sampling, examination and reporting of results are consistent and provide some value. The establishment of the WFMF and the subsequent development of the shopping basket approach to randomized food sampling in Wales illustrates an example of a multi-agency, multi-disciplinary approach to the sampling and examination of ready to eat foods. It could serve as a potential model for the development of other similar programs and highlights the ability of organizations involved in food safety to work closely together to develop a co-ordinated and randomized approach to sampling that is spread across a relatively large geographical area, approximately twenty Local Authorities and six Public Health Laboratories.

The amount of data accumulated from the last seven years of operation of the shopping basket model should help to inform any future developments of the guidelines for the microbiological quality of ready to eat foods in the UK by providing a statistically robust and fully audited database containing data on a wide range of ready to eat foods. The data can help to pinpoint problem foods and types of premises, helping to identify areas in which specific solutions are needed and helping to enhance food safety and reduce food poisoning incidence in Wales.

Already new developments for the shopping basket model are being planned and it is hoped that these improvements, which are primarily based upon improvements in the information technology support for the movement, storage and analysis of data, will ensure that the co-ordinated approach in Wales, successful for so long, continues for the foreseeable future.
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