

Guidelines for the microbiological quality of some ready-to-eat foods sampled at the point of sale

A working group (RJ Gilbert, J de Louvois, T Donovan, C Little, K Nye, CD Ribeiro, J Richards, D Roberts, FJ Bolton) of the PHLS Advisory Committee for Food and Dairy Products

Summary: *These guidelines for the microbiological quality of ready-to-eat foods represent a revision and expansion of guidelines first published by the PHLS in September 1992 and revised in March 1996. The latest guidelines incorporate many of the constructive comments received from food examiners and other microbiologists within and outside the PHLS and from environmental health officers throughout the United Kingdom. This document reviews the changes and the reasons they were made and sets out the new guidelines. It also clarifies the role of food examiners in interpreting the microbiological results of formal samples.*

Key words:
food
food inspection
food microbiology
guidelines

Commun Dis Public Health 2000; 3: 163-7.

Introduction

Background

Most food samples submitted to public health laboratories are informal samples for surveillance and monitoring purposes. A small number of samples are sent during outbreak investigations and as formal samples for statutory examination. For over 50 years the PHLS has provided microbiological advice and scientific expertise on the examination of food samples for local authorities and their environmental health

departments in England and Wales. The interpretation of results is often the most difficult aspect of the food examination process. The purpose of the original microbiological guidelines for ready-to-eat foods sampled at the point of sale¹ was to standardise the interpretation of the results from the microbiological (bacteriological) examination of foods by providing peer reviewed guidelines for use by food microbiologists.

The precision and reproducibility of many microbiological tests are variable, and interpretation of the results can be difficult unless there is agreement on what is achievable or desirable. The original guidelines were produced at a time when standard methods were not in place in all public health laboratories. The introduction, throughout the PHLS, of standard operating procedures (SOPs) for most of the key parameters in the guidelines has thus significantly improved the value of food examination results from the PHLS. The PHLS food method SOPs will continue to be reviewed, updated, and implemented as changes in European directives demand. It should also be stressed that these guidelines are for bacteriological parameters only. Criteria for viruses and enteric parasites are excluded due to the present lack of diagnostic methods and procedures for their detection.

Microbiological guidelines

The original provisional microbiological guidelines for some ready-to-eat foods sampled at the point of sale¹ and the first revision² were well received and put to practical use by microbiologists and environmental health officers throughout the United Kingdom (UK) and in Ireland. During the three and a half years since the 1996 revision many helpful comments have been received from users, some of whom have asked for the guidelines to cover wider ranges of foods and of microorganisms. A working group of the PHLS Advisory Committee for Food and Dairy Products

RJ Gilbert, D Roberts, FJ Bolton
Food Safety Microbiology Laboratory
PHLS Central Public Health Laboratory

J de Louvois, C Little,
Environmental Surveillance Unit
PHLS Communicable Disease Surveillance Centre

T Donovan
London Food, Water, and Environmental Unit
Food Safety Microbiology Laboratory
PHLS Central Public Health Laboratory

K Nye
Birmingham Public Health Laboratory

CD Ribeiro
Cardiff Public Health Laboratory

J Richards
Norwich Public Health Laboratory

Address for correspondence:
Professor Eric Bolton
Food Safety Microbiology Laboratory
PHLS Central Public Health Laboratory
61 Colindale Avenue
London
NW9 5HT
tel: 020 8200 4400 ext 4117
fax: 020 8200 8264
email: fbolton@phls.org.uk

BOX 1 Food examiners

The *Food Safety Act 1990*⁴ established the role of the 'food examiner' to perform the statutory function of microbiological examination of food. The qualifications and experience needed for registration as a food examiner are detailed in the *Food Safety (Sampling and Qualifications) Regulations 1990*⁷. Food examiners, therefore, are the individuals to whom an enforcement officer must submit any samples taken for examination for enforcement purposes (that is, formal samples the results of whose examination may be introduced as evidence in legal proceedings under the *Food Safety Act*). The aims of this provision in the Act are to ensure that the microbiological examination of food is performed to a high standard and, by specifying their required qualifications, to ensure the competence of food examiners asked to give evidence during any legal proceedings. PHLS and other laboratories that are designated as official testing laboratories⁸ that examine food samples must have designated food examiners. When required, food examiners are expected to be witnesses of fact in respect of any examination that has been conducted, including their results.

When it is appropriate to do so, the food examiner may also interpret the results of the examination of formal food samples by reference to the provisions of the *Food Safety Act 1990*⁴ dealing with microbiological quality. The *Food Safety Act 1990* (Chapter 16)⁴, however, contains specific wording with regard to foods of an unacceptable microbiological quality. A food fails to comply with the *Food Safety Act 1990*:

- if it is 'unfit for human consumption' (Section 8(2)(b)), or
 - if it is 'so contaminated that it would not be reasonable to expect it to be used for human consumption in that state' (Section 8(2)(c)).
- Also, under Section 14 of the Act, it is an offence to sell 'any food which is not of the nature or substance or quality demanded by the purchaser'.

The PHLS guidelines have no statutory standing and are not directly linked to the *Food Safety Act 1990*⁴. They therefore deliberately avoid the use of any of the above terms. It is the enforcement officer, assisted by legal advice, who is responsible for deciding under which section of the *Food Safety Act* a prosecution should be instituted. The food examiner may include the precise wording from the Act on a report or certificate of examination or may choose to express a personal opinion in different words. Food examiners should be prepared to express an opinion on the results of examinations whenever they feel in a position to do so. The opinion should be phrased in a form that is supportive to the enforcing authority in cases of prosecution.

The degree of involvement of the food examiner as an expert will depend on personal experience and the level of expertise with respect to the matter in issue. In some instances, food safety proceedings will require the additional specialist knowledge of an expert of national repute and long experience in this subject. If he/she is suitably qualified to express an opinion based on experience, the food examiner can provide evidence as an expert witness.

(ACFDP) has prepared this current revision, which is based on both the experience gained of the appropriateness of the guidelines in practice and a reassessment of the microbiological results for a wide variety of ready-to-eat foods held in the PHLS data bank. This data bank includes microbiological results from PHLS national and local surveys, joint Local Authority Coordinating Body on Food and Trading Standards (LACOTS)/PHLS coordinated food surveillance projects³, and the UK contribution to the European Community Coordinated Food Control Programme³.

The purpose of these guidelines, therefore, is to help food examiners (box 1)⁴ and environmental health officers to determine the bacteriological quality of various ready-to-eat foods at the point of sale and to indicate the level of contamination that is considered to represent a significant potential risk to health. The guidelines are not intended to be prescriptive and have no legal standing in their own right. They are also intended to reflect the increasingly high quality achieved by most of the ready-to-eat food industry in the UK. They represent the collective experience of the PHLS, which currently examines over 190 000 food samples per year. This body of information is now being collated to provide an evidence base for quantitative microbiological risk assessment⁵ and for the implementation of hazard analysis of critical control points⁶ systems for food safety.

The new guidelines

As in the previous guidelines^{1,2} the new guidelines identify five categories of food (table 1). The categories are based solely on expected aerobic colony counts, according to the type of food product and the processing it has received. There are four grades of

microbiological quality (box 2) – related to the actual aerobic colony count, number of indicator organisms, and the presence/number of pathogens determined by the microbiological examination of the food.

The microbiological limits given in table 1 are not statutory standards. They are guidelines only. Revisions will continue to be made at intervals as experience is gained of their value in practice and as additional information becomes available. The guidelines may not apply to every food type contained within a food category; interpretation should also be based on knowledge of the product components and the production process. Food microbiologists should undertake laboratory tests appropriate both to the type of food sample submitted and to the processing it has received. The guidelines are applicable only when an appropriate range of indicator and pathogen tests has been undertaken.

Aerobic colony count

The term aerobic colony count (ACC) has replaced the previous name 'aerobic plate count' and more accurately describes the test undertaken. There are enough microbiological data on the foods listed in table 2 to permit them to be classified on the basis of their ACC. If a specific ready-to-eat food is not included in table 2, food examiners and microbiologists should use their own judgment to assess where a product would fit – based on the type of product, the processing it has received, and the potential for microbial growth during storage.

When unsatisfactory aerobic colony counts are encountered microbiologists should attempt to identify the microorganisms that predominate. From these results, and additional detailed information about the

TABLE 1 Guidelines for the microbiological quality of various ready-to-eat foods

Food category (see table 2)	Criterion	Microbiological quality (CFU per gram unless stated)			
		Satisfactory	Acceptable	Unsatisfactory	Unacceptable/ potentially hazardous*
	Aerobic colony count[†] 30°C/48h				
1		<10 ³	10 ³ -<10 ⁴	≥10 ⁴	N/A
2		<10 ⁴	10 ⁴ -<10 ⁵	≥10 ⁵	N/A
3		<10 ⁵	10 ⁵ -<10 ⁶	≥10 ⁶	N/A
4		<10 ⁶	10 ⁶ -<10 ⁷	≥10 ⁷	N/A
5		N/A	N/A	N/A	N/A
	Indicator organisms[‡]				
1-5	Enterobacteriaceae [§]	<100	100-<10 ⁴	≥10 ⁴	N/A
1-5	<i>E. coli</i> (total)	<20	20-<100	≥100	N/A
1-5	<i>Listeria</i> spp (total)	<20	20-<100	≥100	N/A
	Pathogens				
1-5	<i>Salmonella</i> spp	not detected in 25g			detected in 25g
1-5	<i>Campylobacter</i> spp	not detected in 25g			detected in 25g
1-5	<i>E. coli</i> O157 & other VTEC	not detected in 25g			detected in 25g
1-5	<i>V. cholerae</i>	not detected in 25g			detected in 25g
1-5	<i>V. parahaemolyticus</i> [¶]	<20	20-<100	100-<10 ³	≥10 ³
1-5	<i>L. monocytogenes</i>	<20**	20-<100	N/A	≥100
1-5	<i>S. aureus</i>	<20	20-<100	100-<10 ⁴	≥10 ⁴
1-5	<i>C. perfringens</i>	<20	20-<100	100-<10 ⁴	≥10 ⁴
1-5	<i>B. cereus</i> and other pathogenic <i>Bacillus</i> spp [#]	<10 ³	10 ³ -<10 ⁴	10 ⁴ -<10 ⁵	≥10 ⁵

* Prosecution based solely on high colony counts and/or indicator organisms in the absence of other criteria of unacceptability is unlikely to be successful.

† Guidelines for aerobic colony counts may not apply to certain fermented foods – for example, salami, soft cheese, and unpasteurised yoghurt. These foods fall into category 5. Acceptability is based on appearance, smell, texture, and the levels or absence of indicator organisms or pathogens.

‡ On occasions some strains may be pathogenic.

§ Not applicable to fresh fruit, vegetables and salad vegetables.

¶ Relevant to seafood only.

If the *Bacillus* counts exceed 10⁴ CFU/g, the organism should be identified.

** Not detected in 25g for certain long shelf-life products under refrigeration

NA Not applicable

food sample, it should be possible to provide a more helpful interpretation of high aerobic colony counts.

Indicator organisms

Enterobacteriaceae

The test for Enterobacteriaceae has replaced the tests for coliforms that traditionally have been used as indicators of hygiene and contamination after processing. The major problems with the coliform tests are the variability in definition of the term coliforms (they are defined usually by the method used for their detection) and the fact that only lactose fermenting organisms are detected⁹. In comparison the family

Enterobacteriaceae is well defined taxonomically and methods for their enumeration are based on common properties^{10,11}. Furthermore, the methods also detect important non-lactose fermenting organisms such as salmonellas. The criteria listed for Enterobacteriaceae do not apply to fresh fruit and vegetables or to sandwiches containing salad vegetables because fresh fruit and vegetables often carry high levels of these organisms as part of their normal flora.

Escherichia coli (total) and Listeria spp (total)

The criteria for *E. coli* (total) and *Listeria* spp (total) have been modified. Quantitative levels in the

BOX 2 Grades of microbiological quality

The terms used to express the microbiological quality of the ready-to-eat foods are:

- Satisfactory – test results indicating good microbiological quality
- Acceptable – an index reflecting a borderline limit of microbiological quality
- Unsatisfactory – test results indicating that further sampling may be necessary and that environmental health officers may wish to undertake a further inspection of the premises concerned to determine whether hygiene practices for food production or handling are adequate or not.
- Unacceptable/potentially hazardous – test results indicating that urgent attention is needed to locate the source of the problem; a detailed risk assessment is recommended. Such results may also form a basis for prosecution by environmental health departments, especially if they occur in more than one sample. Food examiners will wish to draw on their own experience and expertise in determining the advice and comments they wish to give and they will be required to do this if invited to give an expert opinion during legal proceedings.

TABLE 2 Colony count categories for different types of ready-to-eat foods

Food group	Product	Category
Meat	beefburgers	1
	brawn	4
	faggots	2
	ham – raw (Parma/country style)	5
	kebabs	2
	meat meals (shepherds/cottage pie, casseroles)	2
	meat pies (steak and kidney, pasty)	1
	meat, sliced (cooked ham, tongue)	4
	meat, sliced (beef, haslet, pork, poultry)	3
	pork pies	1
	poultry (unsliced)	2
	salami and fermented meat products	5
	sausages (British)	2
	sausages (smoked)	5
	sausage roll	1
	scotch egg	1
tripe and other offal	4	
Seafood	crustaceans (crab, lobster, prawns)	3
	herring/roll mop and other raw pickled fish	1
	other fish (cooked)	3
	seafood meals	3
	molluscs and other shellfish (cooked)	4
	smoked fish	4
	taramasalata	4
Dessert	cakes, pastries, slices, and desserts - with dairy cream	3
	cakes, pastries, slices, and desserts - without dairy cream	2
	cheesecake	5
	mousse/dessert	1
	tarts, flans, and pies	2
trifle	3	
Savoury	bean curd	5
	bhaji (onion, spinach, vegetable)	1
	cheese-based bakery products	2
	fermented foods	5
	flan/quiche	2
	homous, tzatziki, and other dips	4
	mayonnaise/dressings	2
	pâté (meat, seafood, or vegetable)	3
	samosa	2
	satay	3
	spring rolls	3
Vegetable	coleslaw	3
	fruit and vegetables (dried)	3
	fruit and vegetables (fresh)	5
	prepared mixed salads and crudités	4
	rice	3
	vegetables and vegetable meals (cooked)	2
Dairy	cheese	5
	ice cream, milk shakes (non-dairy)	2
	ice lollies, slush, and sorbet	2
	yoghurt/frozen yoghurt (natural)	5
Ready-to-eat meals	pasta/pizza	2
	meals (other)	2
Sandwiches and filled rolls	with salad	5
	without salad	4
	with cheese	5

unacceptable/potentially hazardous column (table 1) have been deleted because a prosecution based solely on indicator organisms in the absence of other criteria of unacceptability is unlikely to be successful. Total

counts of *Listeria* spp in previous versions of the guidelines^{1,2} excluded *L. monocytogenes*. This has been changed to include *L. monocytogenes* and hence the term is fully inclusive of all *Listeria* spp. The reasons for this are because of the changes to the quantitative criteria for *L. monocytogenes* explained below and to represent what happens in practice when examining food samples by the standard method. Although *Listeria* spp. other than *L. monocytogenes* are rarely implicated in illness they are indicators for the likely presence of *L. monocytogenes* and so concerns described below about the presence of low levels of *L. monocytogenes* in certain products also apply to other species of *Listeria*.

Pathogens

Salmonella, campylobacter, and E. coli O157

It is the opinion of the ACFDP that ready-to-eat foods should be free from *Salmonella* spp, *Campylobacter* spp, and *E. coli* O157 and other Verocytotoxin producing *E. coli* (VTEC). Appropriate control measures during production, adequate hygiene standards, and appropriate cooking during final preparation should ensure that the end products are free from viable organisms and that the foods are therefore of good quality.

Ready-to-eat foods containing salmonellas or other pathogens may not always cause illness but there is good microbiological and epidemiological evidence that small numbers of pathogens in foods have caused illness¹². The ACFDP takes the view that there is no justification for processed ready-to-eat foods being contaminated with these organisms and that their presence, even in small numbers, results in such foods being of unacceptable quality/potentially hazardous.

***Vibrio* species**

Microbiological criteria for *Vibrio cholerae* have also been added to the guidelines because the European Commission has made several decisions in response to the isolation of this organism from various ready-to-eat foods, mainly fishery products and fruits and vegetables, imported into countries of the European Union¹³⁻¹⁶. *V. vulnificus*, although a pathogenic vibrio, is a rare cause of foodborne disease and has therefore not been included in this version of the guidelines. The quantitative microbiological quality levels for *V. parahaemolyticus* in seafood have been retained for further assessment.

Listeria monocytogenes

The quantitative microbiological quality levels for *L. monocytogenes* have been modified and the classification of 'unsatisfactory' is now not applicable in this case. Some quality standards require a zero level for *L. monocytogenes* at the production stage of a food¹⁷, thus 10² CFU/g at point of sale/consumption represents a potential risk to health. Counts of this level may also indicate a significant failure of hygiene standards in the preparation and /or storage of such foods. None of the figures within the guidelines can be said to carry an

absolute risk to health. Nevertheless, opinions and published reports support the contention that the numbers quoted in table 1 under the heading 'unacceptable/potentially hazardous' represent unacceptable microbiological quality and are a potential hazard to those who eat such food¹⁸.

On the basis of current information it is the opinion of the ACFDP that it is unacceptable that ready-to-eat foods contain any serogroup of *L. monocytogenes* at levels at or above 10² CFU/g. Some serotypes/phage types of *L. monocytogenes* may rarely be associated with human infection, but their presence represents an inadequate level of hygiene.

L. monocytogenes is widely distributed in the environment and is able to multiply slowly at 4°C. The shelf life of the foods listed in table 2 varies enormously. Certain foods – such as soft ripened cheese, vacuum packed pâté, and sliced meats – have a long shelf life under refrigeration, and the presence of *L. monocytogenes* at any level may be of significance due to its potential for growth during storage. The use of an enrichment procedure, in addition to enumeration, should therefore be considered to ensure that the organism is absent from the product.

Clostridium perfringens

The quantitative microbiological quality levels for *Clostridium perfringens* have been retained with only a minor modification to the lower limit. This has been changed from 10 CFU/g to 20 CFU/g to bring it in line with levels for other Gram positive pathogens.

Bacillus cereus and other pathogenic Bacillus spp

The microbiological criteria for '*Bacillus cereus* and other pathogenic *Bacillus* spp' have replaced the previously entitled '*B. cereus* and *Bacillus subtilis* group'. The quantitative limits, however, have remained the same.

Guidance to local authorities

As a requirement of the *Official Control of Foodstuffs Directive*^{19,20} local authorities have to report all unsatisfactory samples to the Food Standards Agency (previously to the Ministry of Agriculture, Fisheries and Food). Previous PHLS guidelines have not indicated which samples should be reported^{1,2}. This is the responsibility of the Food Standards Agency and guidance on which results should be reported will be issued.

Acknowledgements

The ACFDP is grateful to the members of the working group, Dr R Mitchell of the PHLS Environmental Surveillance Unit, and the many food examiners and environmental health officers for their helpful comments and constructive criticism during the preparation of these guidelines.

References

1. PHLS. Provisional microbiological guidelines for some ready-to-eat foods sampled at point of sale. Notes for PHLS food examiners. *PHLS Microbiology Digest* 1992; **9**: 98-9.
2. PHLS. Microbiological guidelines for some ready-to-eat foods sampled at the point of sale: an expert opinion from the PHLS. *PHLS Microbiology Digest* 1996; **13**: 41-3.
3. House of Commons Agriculture Committee. *Food Safety. Minutes of Evidence Tuesday 2 December 1997, Public Health Laboratory Service*. London: Stationery Office, 1997: 93-4.
4. *Food Safety Act 1990*. London: HMSO, 1990.
5. Codex Alimentarius Commission. *Draft principles and guidelines for the conduct of microbiological risk assessment*. Washington DC: Codex Committee on Food Hygiene 32 session, 29 November-4 December 1999. <www.fao.org/es/esn/codex/reports.htm>
6. Codex Alimentarius Commission. *Food quality and safety systems. A training manual on food hygiene and hazard analysis and critical control point (HACCP) system*. Rome: FAO, 1998.
7. *The Food Safety (Sampling and Qualifications) Regulations 1990*. SI 2463. London: HMSO, 1990.
8. Council Directive 93/99/EEC of 29 October 1993 on the subject of additional measures concerning the official control of foodstuffs. *Official Journal of the European Communities* 1993; L290/14-7 (24 November).
9. Edwards PR, Ewing HE. *Identification of Enterobacteriaceae*, 3rd edition. Minnesota: Burgess Publishing Company, 1972.
10. British Standards Institution. *Microbiological examination of food and animal feedingstuffs. Enumeration of Enterobacteriaceae*. London: BSI, 1993. (BS 5763: Part 10:1993 (ISO 7402: 1993))
11. British Standards Institution. *Microbiological examination of food and animal feedingstuffs. Detection of Enterobacteriaceae with pre-enrichment*. London: BSI, 1991. (BS 5763: Part 15:1991)
12. House of Commons Agriculture Committee. *Food Safety. Minutes of Evidence Tuesday 2 December 1997, Public Health Laboratory Service*. London: Stationery Office, 1997: 82-3.
13. Commission Decision 97/878/EC of 23 December 1997 concerning certain protective measures with regard to certain fishery products originating in Uganda, Kenya, Tanzania and Mozambique. *Official Journal of the European Communities* 1997; L356/64-5 (31 December).
14. Commission Decision 97/368/EC of 11 June 1997 concerning certain protective measures with regard to certain fishery products originating in China. *Official Journal of the European Communities* 1997; L156/57-8 (13 June).
15. European Community. Commission Decision 97/515/EC of 1 August 1997 concerning certain protective measures with regard to certain fishery products originating in India. *Official Journal of the European Communities* 1997; L214/52 (6 August).
16. European Community. Commission Decision 98/116/EC of 4 February 1998. Adopting special measures for the import of fruits and vegetables originating in or consigned from Uganda, Kenya, Tanzania and Mozambique. *Official Journal of the European Communities* 1998; L31/28-9 (6 February).
17. *The Dairy Products (Hygiene) Regulations 1995*. SI 1086. London: HMSO, 1995.
18. European Commission. Opinion of the Scientific Committee on Veterinary Measures relating to Public Health on *Listeria monocytogenes*, 23 September 1999. <europa.eu.int/comm/dg24/health/sc/scv/out25_en.html>
19. Council Directive 89/397/EEC of 14 June on the official control of foodstuffs. *Official Journal of the European Communities* 1989; L186/23-6 (30 June).
20. Ministry of Agriculture, Fisheries and Food. (1999) Guidance for business on regulations: Official Control of Foodstuffs. Notes for guidance on the completion of CPD 1-4. <www.foodstandards.gov.uk/maff/archive/aboutmaf/regulat/ocfood/cpdnotes.htm>.