

**ADVISORY COMMITTEE ON THE MICROBIOLOGICAL SAFETY OF FOOD**

**INFORMATION PAPER**

**Microbiological status of ready to eat fruit and vegetables**

At the 55<sup>th</sup> meeting of the ACMSF in March 2005, the Health Protection Agency presented current data on the microbiological status of ready to eat fruit and vegetables to the Committee (paper ACM/729).

In light of comments from the ACMSF, the data in the paper was re-analysed and the revised information presented to the 56<sup>th</sup> ACMSF meeting in June 2005. Paper ACM/745 therefore replaces paper ACM/729.

**Secretariat  
July 2005**

## Microbiological status of ready-to-eat fruit and vegetables – Addendum to ACM/729

**Table 1: All general outbreaks of infectious intestinal disease (IID), foodborne general outbreaks of IID and foodborne general outbreaks of IID associated with the consumption of salad, vegetables or fruit\* ('SVF outbreaks') reported to CDSC, England & Wales, 1992-2003.**

Year	Outbreak type		
	All	Foodborne (% of all)	SVF (% of foodborne)
1992	373	224 (60)	21 (9)
1993	454	225 (50)	10 (4)
1994	490	192 (39)	19 (10)
1995	837	183 (22)	9 (5)
1996	740	169 (23)	18 (11)
1997	591	222 (38)	8 (4)
1998	610	121 (20)	9 (7)
1999	521	97 (19)	12 (12)
2000	657	98 (15)	10 (10)
2001	552	91 (16)	7 (8)
2002	1331	70 (5)	5 (7)
2003	502	71 (14)	7 (10)
<b>Total</b>	<b>7658</b>	<b>1763</b>	<b>135</b>

Source: GSURV database, EEDD – 06/05/05

\* More than one vehicle may have been reported for any single outbreak. The figures above represent the number of outbreaks in which at least one of the vehicles reported was a salad/vegetable/fruit product.

**Table 2: Inclusion/exclusion criteria**

Criteria	Appendix	No. of outbreaks (%)
Excluded – SVF was likely to be processed	1	34 (25)
Excluded – other pathogen more likely cause of illness	2	31 (23)
Excluded – SVF was a component of a meal	3	6 (4)
Remaining – ready-to-eat SVF (RTE SVF)	4	64 (47)
<b>Total</b>	<b>-</b>	<b>135</b>

Source: GSURV 05/05/05

\*\*Subsequent analysis compares the 64 raw ready-to-eat SVF outbreaks with 1631 non-SVF foodborne outbreaks (i.e. those excluded above are ignored)\*\*

**Table 3 & 3a: Implicated pathogens in foodborne general outbreaks of IID reported to CDSC, England & Wales, 1992-2003.**

Organism	Outbreak type (%)		Total
	RTE SVF	Others	
Bacterial	32 (50)	1259 (77)	1291
Viral	11 (17)	112 (7)	123
Toxin	0	52 (3)	52
Mixed	0	2 (<1)	2
Protozoal	0	2 (<1)	2
Unknown	21 (33)	204 (13)	225
Total	64	1631	1695

Source: GSURV 05/05/05

Fisher's exact  $\chi^2$  test for the association between RTE SVF and viral pathogens  
P=0.005

Organism	Outbreak type (%)		Total
	RTE SVF	Others	
<i>S. Enteritidis</i> PT4	6 (9)	477 (29)	483
<i>Cl. perfringens</i>	1 (2)	204 (13)	205
<i>S. Enteritidis</i> non-PT4	1 (2)	185 (11)	186
Norovirus	11 (17)	108 (7)	119
<i>S. Typhimurium</i>	3 (5)	107 (7)	110
Other salmonellae	3 (5)	72 (4)	75
Campylobacter	3 (5)	60 (4)	63
Scombrotoxin	0	51 (3)	51
<i>E. coli</i> O157	2 (3)	43 (3)	45
<i>B. cereus</i>	2 (3)	42 (3)	44
<i>Staph. aureus</i>	1 (2)	29 (2)	30
<i>S. Virchow</i>	1 (2)	18 (1)	19
<i>B. subtilis</i>	1 (2)	14 (1)	15
<i>Sh. sonnei</i>	2 (3)	3 (<1)	5
Astrovirus	0	3 (<1)	3
Cryptosporidium	0	2 (<1)	2
<i>Sh. flexneri</i>	2 (3)	0	2
Rotavirus	0	1 (<1)	1
Other	3 (5)	5 (<1)	8
Mixed	1 (2)	3 (<1)	4
Unknown	21 (33)	204 (13)	225
Total	64	1631	1695

Source: GSURV 05/05/05

**Table 4 7 4a: Setting where food was prepared for foodborne general outbreaks of IID reported to CDSC, England & Wales, 1992-2003.**

Setting	Outbreak type (%)		Total
	RTE SVF	Others	
Commercial Catering Premises	47 (73)	950 (58)	997
Residential	1 (6)	214 (46)	215
Other	16 (25)	467 (29)	483
<b>Total</b>	<b>64</b>	<b>1631</b>	<b>1695</b>

Source: GSURV 05/05/05

Association between RTE SVF outbreaks and commercial catering premises  $\chi^2$  6.45 P=0.01

Setting	Outbreak type (%)		Total
	RTE SVF	Others	
Restaurant	20 (31)	384 (24)	404
Private	3 (5)	193 (12)	196
Hotel	10 (16)	185 (11)	195
Residential	0	169 (10)	169
Pub/bar	6 (9)	132 (8)	138
Shop retailer	2 (3)	100 (6)	102
Hall/caterers	4 (6)	77 (5)	81
Canteen	4 (6)	75 (5)	79
Club/centre	3 (5)	66 (4)	69
School	0	46 (3)	46
Armed services	1 (2)	37 (2)	38
Community	4 (6)	27 (2)	31
Hospital	2 (3)	28 (2)	30
Farm	0	27 (2)	27
Shop caterer	0	21 (1)	21
University/college	1 (2)	14 (1)	15
Mobile	0	10 (1)	10
Holiday camp	0	8 (<1)	8
Workplace	1 (2)	7 (<1)	8
Other	3 (5)	25 (2)	28
<b>Total</b>	<b>64</b>	<b>1631</b>	<b>1695</b>

Source: GSURV 05/05/05

**Table 5: Food handling faults\* thought to have contributed foodborne general outbreaks of IID reported to CDSC, England & Wales, 1992-2003.**

Fault	Outbreak type (%)		Total
	RTE SVF	Others	
Cross contamination	20 (38)	433 (25)	453
Infected food handler	13 (25)	184 (11)	197
Inappropriate storage	8 (15)	466 (27)	474
Inadequate heat treatment	2 (4)	476 (27)	478
Other fault	9 (17)	186 (11)	195
<b>Total</b>	<b>52</b>	<b>1745</b>	<b>1797</b>

Source: GSURV 05/05/05

\*NB More than one fault can be reported for any given outbreak

Cross contamination ( $\chi^2$  10.38; P0.001) and infected food handlers (Fisher's exact  $\chi^2$  test P=0.0003 ) were more likely to be reported in RTE SVF outbreaks than non-SVF outbreaks.

**Table 6: Implicated pathogens where 'cross contamination' was reported as the food handling fault in RTE SVF outbreaks, England & Wales, 1992-2003**

Organism	Number of outbreaks (%)
S. Enteritidis PT 4	4 (21)
Campylobacter	2 (11)
Norovirus	2 (11)
<i>Cl. perfringens</i>	1 (5)
S. Typhimurium DT 204b	1 (5)
S. Virchow	1 (5)
VTEC O157	1 (5)
Unknown	7 (37)
<b>Total</b>	<b>19</b>

Source: GSURV 05/05/05

**Table 7: Implicated pathogens where 'infected food handler' was reported as the food handling fault in RTE SVF outbreaks, England & Wales, 1992-2003**

Organism	Number of outbreaks (%)
Norovirus	5 (5)
S. Enteritidis pt 4	1 (1)
VTEC O157	1 (1)
Unknown	5 (42)
<b>Total</b>	<b>12</b>

Source: GSURV 05/05/05

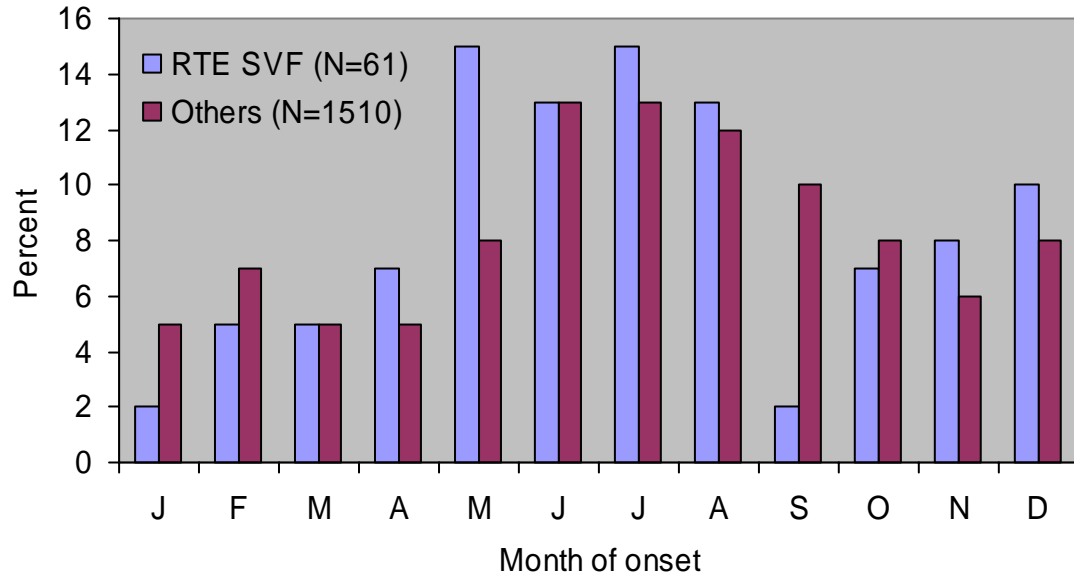
**Table 8: Evidence implicating food vehicles in foodborne general outbreaks of IID reported to CDSC, England & Wales, 1992-2003.**

Evidence	Outbreak type (%)		Total
	TRE SVF	Others	
Microbiological & Statistical	0	62 (4)	62
Microbiological only	9 (14)	242 (15)	251
Statistical only	34 (53)	290 (18)	324
Descriptive only	13 (20)	458 (28)	471
Not recorded	8 (13)	579 (35)	587
<b>Total</b>	<b>64</b>	<b>1631</b>	<b>1695</b>

Source: GSURV 05/05/05

Association between RTE SVF outbreaks and the provision of statistical evidence  
 $\chi^2$  49.73 P<0.0000001

**Figure 1: Seasonality of foodborne general outbreaks of IID reported to CDSC, England & Wales, 1992-2003.**



Source: GSURV 05/05/05

Appendix 1. Foodborne general outbreaks of IID associated with salad, vegetables or fruit reported to CDSC, England & Wales, 1992-2003. Outbreaks excluded on the basis that the salad/vegetable or fruit was likely to have been processed.

Year	Organism (suspected)	Place	Vehicles			Evidence
1992	<i>Cl. perfringens</i>	Restaurant	Chicken	Beef	Thai steam veg	-
	<i>Cl. perfringens</i>	Canteen	Chilli	Turkey	Potato (jacket)	S*
	<i>S. Enteritidis</i> PT 4	University/college	Peach flan			-
	<i>S. Enteritidis</i> PT UT	Armed services	Cheese toastie	Cabbage dish		S
1993	<i>Cl. perfringens</i>	Residential	Carrots & fish			S
	<i>S. Enteritidis</i> PT 4	Club/centre	Salad (potato)			S
1994	<i>Cl. perfringens</i>	Hotel	Courgettes	Cauliflower	Potatoes	S
	Norovirus	School	Vegetable soup			S
	<i>S. Typhimurium</i> DT104	Private	Tuna sandwich	Salmon sandwich	Salad (potato)	S
	<i>S. Typhimurium</i> UT	Shop retailer	Pease pudding			M <sup>†</sup>
1996	<i>Cl. perfringens</i>	Restaurant	Rice (pilau)	Vegetable curry		D <sup>‡</sup>
	<i>Cl. perfringens</i>	Restaurant	Chicken curry	Vegetable curry		S
	<i>Cl. perfringens</i>	Hall/caterers	Lentil dahl	Chicken drumsticks		S
	<i>Cl. perfringens</i>	Armed services	Pork curry	Chicken curry	Vegetable curry	D
	Norovirus	Hotel	Potato salad			S D
	<i>S. Enteritidis</i> PT 4	Restaurant	Haddock and potato mix			S
	<i>S. Enteritidis</i> PT 4	Hotel	Mushroom soup			S D
	<i>S. Enteritidis</i> PT 4	Hotel	Chocolate marquise	Potatoes		S
	Unknown (Norovirus)	Hotel	Potato salad			S
	Unknown ( <i>S. aureus</i> )	Private	Salad (mixed bean)			M
1997	<i>S. Enteritidis</i> PT 24	Restaurant	Cauliflower	Cheese sauce		S
	Unknown (viral)	Restaurant	Orange juice			S
1998	<i>S. Enteritidis</i> PT 4	Restaurant	Stuffed pepper	Spanish omelette		M D



Year	Organism (suspected)	Place	Vehicles			Evidence
1999	S. Enteritidis PT 4	Private	Lemon mousse (RSE)	Bean salad	Cheesecake	M D
	S. Enteritidis PT 6a	Hall/caterers	Potato salad	Mayonnaise		S
	Unknown	Restaurant	Chicken drumsticks	Onion bhaji		S
2000	S. Enteritidis PT 4	Restaurant	Egg fried rice	Sweetcorn soup		S D
	S. Enteritidis PT 6a	Hotel	Cooked turkey	Potato salad		S
	Unknown (viral)	Holiday camp	Brussel sprouts			S
2001	<i>B. subtilis</i>	Restaurant	Vegetable rice			M
	Campylobacter	Canteen	Orange juice	Pasta salad		S
	Norovirus	Pub/bar	Ham pease pud sandwich			S
2003	S. Enteritidis PT 4	Restaurant	Duck	Seaweed		M D
	<i>B. subtilis</i>	Restaurant	Peas and potato curry			M

\*, Statistical; †, Microbiological ; ‡, Descriptive

Source: GSURV 05/05/05

Appendix 2. Foodborne general outbreaks of IID associated with salad, vegetables or fruit reported to CDSC, England & Wales, 1992-2003. Outbreaks excluded on the basis that another reported vehicle was the more likely source of the infection..

Year	Organism (suspected)	Place	Vehicles			Evidence
1992	<i>B. cereus</i>	Hall/caterers	Rice salad			M* D <sup>†</sup>
	<i>S. Enteritidis</i> PT 4	Canteen	Prawns	Salmon	Pasta salad (RSE)	-
	<i>S. Enteritidis</i> PT 4	School	Milkshake (banana)			-
	<i>S. Enteritidis</i> PT 4	Private	Eggs (boiled)	Lettuce	Salad (pasta)	S <sup>†</sup>
	<i>S. Enteritidis</i> PT 4	Hall/caterers	Coleslaw	Egg mayonnaise		S
	<i>S. Enteritidis</i> PT 4	Community	Coleslaw			-
1993	<i>Campylobacter</i>	Canteen	Melon/prawn starter	Turkey escalopes		D
	<i>S. Enteritidis</i> PT 4	Pub/bar	Egg sandwiches	Salad		M D
	<i>S. Typhimurium</i> DT 104	Restaurant	Onion	Kebabs		M S
1994	<i>B. cereus</i>	Club/centre	Rice salad			M
	<i>Campylobacter</i>	Restaurant	Meat fajitas	Salad		D
	<i>S. Enteritidis</i> PT 12	Hall/caterers	Chicken salad	Salad (pasta)	Coleslaw	S
	Scombrototoxin	Canteen	Tuna pasta salad	Tuna mayonnaise		M D
1995	<i>S. Enteritidis</i> PT 1	Pub/bar	Chicken drumsticks	Rice salad		D
	<i>S. Enteritidis</i> PT 4	Restaurant	Turkey ham mixed salad	Game pie	Prawn & tuna salad	M S
	<i>S. Enteritidis</i> PT UT	Hotel	Prawns lettuce egg mayo			S
	<i>S. Typhimurium</i> DT 104	Hotel	Sandwiches ham beef	Sandwiches turkey	Sandwiches cheese & tomato	-
1996	<i>S. Enteritidis</i> PT 4	Private	Tuna & pasta salad	Coleslaw with onion		M S
	<i>S. Enteritidis</i> PT 4	Hotel	Raspberry Bavarois	Egg mayo	Fruit juice	S D
1997	<i>Cl. perfringens</i>	Hotel	Ham	Turkey	Salad (mixed)	M S
	<i>S. Enteritidis</i> PT 4	Hall/caterers	Rice salad	(coronation)		M
	<i>S. Enteritidis</i> PT 4	Restaurant	Pork loin	Mayonnaise (RSE)	Salad	D
1998	<i>Campylobacter</i>	Hotel	Curried meats	Prawn salad		S
1999	<i>B. cereus</i>	Hotel	Rice salad			S
	<i>Cl. perfringens</i>	School	Coronation chicken	Coleslaw, rice salad	Cooked chicken	M S
	<i>S. Enteritidis</i> PT 4, 5 & 7	Restaurant	Aromatic duck	Spring onion cucumber		M

Year	Organism (suspected)	Place	Vehicles			Evidence
2000	S. Hindmarsh	Restaurant	Lamb doner kebab	Salads	Sauces	S
	S. Enteritidis PT 4	Community	Pasta salad	Coleslaw	Cheesecake (RSE)	M S
	S. Typhimurium DT 170	Pub/bar	Beef	Lettuce		M
	Unknown (Scombrototoxin)	Restaurant	Tuna salad sandwich			-
2002	S. Enteritidis PT 4	Club/centre	Egg/parfait	Fruit salad		M D

\*, Microbiological; †, Descriptive; ‡, Statistical

Source: GSURV 05/05/05

Appendix 3. Foodborne general outbreaks of IID associated with salad, vegetables or fruit reported to CDSC, England & Wales, 1992-2003. Outbreaks excluded on the basis that

Year	Organism (suspected)	Place	Vehicles	Evidence
1992	S. Enteritidis PT4	Private University/college	Rice salad	M*
1993	Unknown (norovirus)	e	Tuna salad	S <sup>†</sup>
1997	S. Enteritidis PT4	Hotel	Cheese salad	S D <sup>‡</sup>
1999	<i>Staph aureus</i>	Hall/caterers	Rice salad	M S D
	<i>Staph aureus</i>	Hall/caterers	Rice salad	M S D
	Unknown (viral)	Restaurant	Avocado crab crème fraiche	S D

\* , microbiological; <sup>†</sup> , Statistical; <sup>‡</sup> , Descriptive

Source: GSURV 05/05/05

Appendix 4. Foodborne general outbreaks of IID associated with salad, vegetables or fruit reported to CDSC, England & Wales, 1992-2003. Outbreaks included in the analysis.

Year	Organism (suspected)	Place		Vehicles		Evidence
1992	<i>Cl. perfringens</i>	Private	Coleslaw	Rice		-
1992	<i>S. Enteritidis</i> PT 4	Canteen	Salad			S*
1992	<i>S. Enteritidis</i> PT 4	Private	Prawn Fried Rice	Crab Meat	Beansprouts	-
1992	<i>S. Typhimurium</i> DT 170	Restaurant	Coriander			-
1992	<i>Sh. sonnei</i>	Hotel	Salad (Green)			S
1992	<i>Staph. aureus</i>	Restaurant	Chicken Salad			M <sup>†</sup>
1992	Unknown	Pub/Bar	Coleslaw			S
1992	Unknown (Norovirus)	Hospital	Lettuce/Tomato			-
1992	Unknown (Norovirus)	Hotel	Melon			S
1992	Unknown (Viral)	Pub/Bar	Coleslaw			S
1993	Norovirus	University/College	Melon & Papaya Cocktail			S
1993	Unknown (Norovirus)	Club/Centre	Coleslaw	Beef		S
1993	Unknown (Norovirus)	Hall/Caterers	Pate	Coleslaw		S
1993	Unknown (Norovirus)	Hotel	Cake (Wedding)	Fruit Salad	Water (Sparkling)	S
1994	<i>E. Agg E. coli</i>	Pub/Bar	Salad Items			S
1994	Norovirus	Club/Centre	Salad (Green, Pasta)	Coleslaw	Prawn Sand	S
1994	Norovirus	Hotel	Watercress			D <sup>†</sup>
1994	Norovirus	Private	Carrot (Raw)			D
1994	<i>S. Enteritidis</i> PT 4	Armed Services	Salad			S
1994	<i>Sh. Sonnei</i>	Community	Lettuce (Iceberg)			S
1994	Unknown	Restaurant	Salad			S
1994	Unknown (Norovirus)	Hotel	Salad (Green)			S
1994	Unknown (Norovirus)	Pub/Bar	Coleslaw	Salad		D
1994	Unknown (Norovirus)	Restaurant	Salad (Green)			D
1994	Unknown (Norovirus)	Workplace	Pasta	Pimento		S
1995	Norovirus	Hotel	Salad (Mixed)			S
1995	Norovirus	Restaurant	Salad (Raw)			-

Year	Organism (suspected)	Place	Vehicles		Evidence
1995	Norovirus	Restaurant	Salad		-
1995	Unknown	Restaurant	Mushrooms (Dried)		D
1995	VTEC O157	Pub/Bar	Lettuce/Tomatoes		-
1996	Campylobacter	Hotel	Lettuce	Tomato	S
1996	Norovirus	Club/Centre	Salad (Tomato & Cucumber)		S
1996	Norovirus	Hospital	Cold Food	Salad	S
1996	<i>Sh. flexneri</i>	Restaurant	Salad Vegetables		D
1996	Unknown	Canteen	Chicken	Salad	Ice Cream
1996	Unknown	Hall/Caterers	Chicken Roll Sandwich Cheese & Pineapple on sticks	Pork Pie	Lettuce
1997	<i>S. Enteritidis</i> PT 8	Hall/Caterers			S
1997	VTEC O157	Restaurant	Salad (Mixed)	French Fries Mayonnaise (Garlic) Cold Savoury	S
1998	Campylobacter	Restaurant	Lettuce		S D
1998	<i>S. Enteritidis</i> PT 4	Canteen	Sandwiches	Salad	S
1998	<i>Sh. flexneri</i>	Shop Retailer	Fruit Salad (Pick & Mix)		S
1998	Unknown (Norovirus)	Hotel	Fresh Fruit		S
1998	Unknown (Viral)	Hotel	Fresh Fruit Salad/Melon		S
1999	Norovirus	Restaurant	Salad	Cheese	S
1999	<i>S. Java</i>	Community	Desiccated Coconut		M D
1999	Unknown	Restaurant	Cheese	Beef	Salad
1999	Unknown (Viral)	Hall/Caterers	Salad		S D
2000	Campylobacter	Restaurant	Lettuce		D
2000	<i>S. Typhimurium</i> DT 104	Community	Lettuce		S
2000	<i>S. Typhimurium</i> DT 204B	Community	Lettuce		D
2000	Unknown (Norovirus)	Restaurant	Mixed Side Salad		D
2001	Mixed infection	Other	Roast Beef	Salad	Pots
2001	<i>S. Newport</i>	Shop Retailer	Pre Packed Salad		M D
2001	<i>S. Virchow</i>	Restaurant	Salad		D
2002	<i>B. cereus</i>	Restaurant	Dried Mushrooms		M
2002	<i>B. thuringiensis</i>	Restaurant	Rocket Leaves		M

Year	Organism (suspected)	Place	Vehicles		Evidence	
2002	Norovirus	Restaurant	Salad		-	
2002	Unknown (Norovirus)	Hotel	Fresh Fruit Salad		S D	
2003	<i>B. cereus</i>	Other	Stilton +Broc Quiche	Mushroom Quiche	Tomatoes +Lettuce	M
2003	<i>B. subtilis</i>	Restaurant	Mixed Veg	Bombay Pots		M
2003	<i>E. coli</i>	Restaurant	Salad/Lettuce			D
2003	<i>S. Braenderup</i>	Other	Iceberg Lettuce			D
2003	<i>S. Enteritidis</i> PT 4	Canteen	Rice Salad	Coleslaw		M
2003	<i>S. Enteritidis</i> PT 4	Pub/Bar	Salad			S D

\*, Statistical; †, Microbiological; ‡, Descriptive

Source: GSURV 05/05/05