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The hygiene of slicing machines, carving knives and can-openers

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The work described in this paper was the outcome of requests to the Food Hygiene Laboratory for information concerning the effective cleaning of machines for slicing cooked meat in shops and cafés. It appears from the literature that data are not available although many bactericidal detergents and 'detergent/sterilizers' are advertised as being suitable cleaning agents. Information on the effective cleaning of large commercial can-openers and carving knives used for cutting cooked meat is also required.

The choice of detergents and detergent/disinfectants in the food and catering industries is governed by three factors: the efficiency of removal of a wide variety of food debris (in this case the protein and fatty materials associated with cooked, open packs or canned meats), the bactericidal activity of the substance(s) in solution, and the effect of the solution on the hands of personnel and on machinery.

The purpose of the work was not to compare the merits of commercial detergents and detergent/disinfectants but to find out the bacterial counts associated with slicing machines, can-openers and carving knives used for cooked or canned meats, to suggest a simple and effective method of cleaning these articles and to outline the methods available for testing the efficiency of cleaning.

The design and safety aspects of equipment were also considered. Whilst we accept that it is impossible to maintain sterility of food-handling equipment, more positive advice and information could be included in the Food Hygiene Regulations regarding methods for the cleaning of equipment and storage of cold meats. However, the Ministry of Health is at present preparing a code of practice entitled 'Hygiene in the Retail Meat Trade including Cold Cooked Meats and Meat Delicatessen'. This code of practice will include advice on the hygienic handling, storage and display of cold cooked meats, and on the cleaning of food slicing machines. A similar code of practice has been given by Hughes (1960).

MATERIALS AND METHODS

Bacterial counts from slicing machines, carving knives and can-openers before and after a simple cleaning procedure

An extensive survey was made at one modern large supermarket (Table 1, premises 1) by arrangement with the directors of the company and the manager.

The supermarket was clean and well organized and the staff had been instructed

in the importance of hygienic food handling. Twelve visits were made at weekly intervals. On the first eight visits cleaning procedures were carried out by the staff usually responsible for this work. On the remaining four visits all cleaning procedures were carried out by one of the authors (R.J.G.). The technique and cleaning materials used were the same as before but the time taken to complete the prodecure (8–10 min.) was generally less than that required by the shop staff (9–13 min.). These times included the filling of buckets with hot water, the stripping, cleaning and re-assembly of one slicing machine, and the cleaning of one carving knife and one can-opener.

A limited survey was also made in two other towns at three supermarkets, three transport cafés, two grocery shops and in the food department of one chain store. All these visits were made with Public Health Inspectors; the managers of these premises were not warned about the visits. Details of all the premises and the frequency of cleaning the slicing machines are given in Table 1.

Table 1. *Details of premises examined and frequency of procedure used for cleaning slicing machines*

Premises	Business	Slicing machine manufacturer	Normal frequency of cleaning procedure
1	Supermarket	Asco-Bizerba	Midday and evening
2	Grocery shop	Crypto	Midday and evening
3	Grocery shop	Berkel	Midday and evening
4	Supermarket	Berkel	Evening
5	Supermarket	Berkel	Evening
6	Transport café	Zet Zimmerman	Evening
7	Transport café	Berkel	Evening
8	Transport café	Crypto	Weekly
9	Chain store (food dept.)	Berkel	Evening
10	Supermarket	Berkel	Evening

The size of slicing machines varied between premises: the total area of the two sides of the cutting blade was usually about 200 cm.^{2}. Duplicate segments of area 30 cm.^{2} from the top and bottom surfaces of the blade were swabbed using two calcium alginate swabs (Higgins, 1950) for each segment. The first swab was moistened in 9 ml. of quarter-strength Ringer's solution, contained in small screw-capped bottles, rubbed over the appropriate area and then broken off into the Ringer's solution; the second swab was used to remove excess moisture and any remaining food debris in the swabbed area, and broken off into the same Ringer's solution. The bottles of Ringer's solution containing the swabs were placed in vacuum flasks at 4° C. before carriage to the laboratory. On arrival, 1 ml. of a 10 % solution of sodium hexametaphosphate was added to each bottle, the solution was shaken gently for a few minutes to dissolve the swabs and the suspension was used for making plate counts. The same technique was used for swabbing carving knives and can-openers. Four swabs were used for one side of a carving knife blade; particular attention was paid to the area around the joint between handle and blade. The size and shape of carving knives varied between

premises; the area swabbed measured 60–80 cm.^{2}. All the can-openers examined were mounted on working benches or tables. The areas swabbed were 1 cm.^{2} (blade) and about 4 cm.^{2} (area above the blade).

The effect on plate counts of using various fluids for swabbing and dilution was examined: tests were also made to ascertain the effect of storage at 4° C. in quarter-strength Ringer's solution on plate counts. All plate counts were made on blood agar using a modified Miles & Misra (1938) technique with incubation for 48 hr. at 22° and 37° C.

Most of the slicing machines examined in the present study were of modern design, yet some of the machines lacked satisfactory safety devices such as preventive guards; one was about 15 years old, most of the mechanical parts, including the cutting blade, were well worn and the machine appeared to be in need of a complete overhaul. The commercial can-openers examined were satisfactory for the job they were designed to do but they were difficult to clean efficiently. Scrubbing with a nylon or plastic brush to remove food debris on the mechanical parts was necessary before the application of a cleaning solution.

The staff at premises 1–10 used a wide variety of detergents or detergent/disinfectants. The cleaning done by one of the authors (R.J.G.) at premises 1, 9 and 10 employed the detergent/disinfectant regularly used at premises 1. No tests were made after cleaning at premises 2–8.

Cleaning procedure

Approximately 68 g. of the detergent/disinfectant powder, measured by filling a conical paper cup, was placed in a 2 gal. plastic bucket containing water at 48–50° C. The solution contained about 20–22 p.p.m. available chlorine and had a powerful detergent action. Cloths, disinfected overnight by immersion in a bucket of water containing 50–80 p.p.m. available chlorine, were used to clean the slicing machine, carving knife and can-opener with the prepared solution.

The cleaning technique used for slicing machines was as follows:

(1) The machine was switched off and the power plug removed.

(2) The cutting number was returned to zero.

(3) Carrier guards and trays were dismantled and the knife centre disk removed.

(4) Surplus food debris was removed from both sides of the blade with a plastic scraper.

(5) Both sides of the blade were cleaned by drawing a cloth, wrung out from the prepared solution, from the centre to the edge of the blade rotated by hand.

(6) The remainder of the machine was cleaned with the same solution.

(7) All parts were rinsed with hot water (50° C.) and allowed to dry.

(8) The machine was reassembled.

Laboratory tests with the cleaning solution

A simple minimum inhibitory concentration test (Kelsey, Beeby & Whitehouse, 1965) was carried out to discover if the solution would provide sufficient disinfectant activity to prevent the growth of a variety of organisms. Five cultures of coagulase-positive staphylococci, eight strains of salmonella (*S. typhi* NCTC 786

and NCTC 3390, *S. paratyphi B*, *S. typhimurium* phage-type 15a, *S. typhimurium* (untypable), *S. eimsbuettel*, *S. panama* and *S. worthington*) and one unidentified strain each of *Bacillus* sp. and *Micrococcus* sp. were used. With the exception of the two strains of *S. typhi*, all the cultures were isolated in the laboratory from food. For each organism two sets of 5 ml. doubling dilutions of the cleaning powder in nutrient broth were made. One set of the dilutions was kept at room temperature (22° C.) for inoculation and the second set was heated in a water bath to 45° C. and inoculated immediately after removal from the bath. An overnight broth culture of the organism to be tested was diluted 1/10 with nutrient broth and one drop (0·02 ml.) was used to inoculate each dilution in the two series. The inoculum contained approximately 200,000 organisms in one drop. After inoculation all the dilutions were incubated at 37° C. for 72 hr.

In-use test

On one occasion an in-use test (Kelsey & Maurer, 1966) was carried out at premises 1. After the slicing machine, can-opener and knife were cleaned, samples of the used cleaning solution were taken from the bucket which contained the cloth. Two 1 ml. samples of the solution were removed with a pipette and added to separate 9 ml. quantities of quarter-strength Ringer's solution. Two more 1 ml. samples were taken and added to separate 9 ml. quantities of inactivator broth (0·5 % sodium thiosulphate in nutrient broth). After returning to the laboratory, drops from each Ringer's solution and from each inactivator-broth were placed on duplicate agar plates. One of each pair of plates was incubated at 37° C. and the other at 22° C. for 48 hr.

RESULTS

Table 2 shows the effect of using various diluents for swabbing areas of a slicing machine after use, and after the given cleaning procedure by shop staff in premises 1; the same diluents were used for making tenfold dilutions before plating. The results show that plate counts were very similar with all diluents used. Since each area was swabbed with a different diluent it was assumed that the distribution of food and micro-organisms was fairly uniform around the whole circumference of the blade. This assumption was verified in subsequent experiments when duplicate pairs of swabbed areas from the top and bottom surfaces of slicing machines usually gave similar plate counts. In all subsequent work quarter-strength Ringer's solution was used as diluent.

Because of the delay between swabbing and dilution and plating, experiments were made to determine the effect of storage of samples in diluent at 4° C. In two experiments initial dilutions were stored at 4° C., and further dilutions were made at various time intervals before plating; in two other experiments all dilutions were made at once, before storage at 4° C. and plating. Table 3 shows that plate counts were unaffected by storage of initial dilutions at 4° C. for 5 hr.

Table 4 shows the range of plate counts from swabbed areas of slicing machines in various premises after normal use and after the given cleaning procedure. Each result represents the mean from duplicate swabbed areas. Visits to premises 1–5,

9 and 10 were made between 11.00 a.m.–noon and to premises 6–8 between 2–4 p.m. All the slicing machines examined had been in use for at least 2 hr. before swabbing and, in most cases, various types of cooked and canned meats had been sliced: the most popular products sold sliced were ham, pork luncheon meat, corned beef, jellied veal, ox tongue, liver sausage, savoury sausage, salami and roast pork.

Two temperatures of incubation were selected to represent normal room temperature (22° C.) and the optimum growth temperature for pathogenic bacteria

Table 2. *Bacterial plate counts at 22° and 37° C. from a slicing machine swabbed with various diluents, before and after cleaning*

		Total viable counts/swabbed area			
		Before cleaning		After cleaning	
Expt.	Diluent*	22° C.	37° C.	22° C.	37° C.
1	A	137,500	135,000	6,625	2,875
	B	275,000	225,000	5,500	2,750
	C	225,000	137,500	5,750	2,500
	D	125,000	67,500	3,500	3,000
2	A	375,000	387,500	33,750	22,115
	B	375,000	275,000	27,500	20,000
	C	350,000	275,000	20,000	12,500
	D	225,000	200,000	12,500	10,000

* A, Quarter-strength Ringer's solution; B, water + peptone (0·1 %); C, water + peptone (0·1 %) + Tween 80 (0·1 %); D, water + peptone (0·1 %) + Tween 80 (0·1 %) + sodium chloride (0·85 %).

Table 3. *Effect of storage at 4° C. in quarter-strength Ringer's solution on the bacterial plate counts at 22° and 37° C. from swabbed areas of a slicing machine*

		Total viable counts/swabbed area	
Experiment	Storage time (hr.)	22° C.	37° C.
1*	1	2,250,000	2,250,000
	2	2,250,000	1,625,000
	3½	3,000,000	2,000,000
	5	3,250,000	2,120,000
2*	1	4,250,000	6,000,000
	2	4,500,000	5,750,000
	3½	7,250,000	5,500,000
	5	8,250,000	7,000,000
3†	1	1,750,000	1,100,000
	2	925,000	825,000
	3½	825,000	350,000
	5	875,000	475,000
4†	1	450,000	375,000
	2	350,000	300,000
	3½	250,000	275,000
	5	375,000	275,000

* Initial dilution stored at 4° C.; further dilutions made before plating.
† All dilutions made at once and stored at 4° C. before plating.

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(37° C.); counts were nearly always higher after incubation at 22° C. than at 37° C. As would be expected, the variations in plate counts were considerable. After incubation, plates were examined to determine the types of bacteria present. Before cleaning, micrococci, coliforms and aerobic sporing bacilli were usually found and, on several occasions, α-haemolytic and non-haemolytic streptococci,

Table 4. *Range of bacterial plate counts at 22° and 37° C. from swabbed areas of slicing machines before and after cleaning*

Premises	No. of weekly experiments	Cleaning done by	Range of total viable counts/swabbed area			
			Before cleaning		After cleaning	
			22° C.	37° C.	22° C.	37° C.
Object swabbed: top surface of blade						
1	8	Shop staff	105,000 to 10,500,000	53,750 to 7,875,000	5,125 to 275,000	3,500 to 146,250
1	4	R.J.G.	91,250 to 12,625,000	46,250 to 8,625,000	750 to 36,500	750 to 20,000
2–8	1	*	33,750 to 20,000,000	15,000 to 10,250,000	*	*
9, 10	1	R.J.G.	13,750 to 250,000	12,500 to 127,500	< 500 to 1,500	< 500 to 1,125
Object swabbed: bottom surface of blade						
1	8	Shop staff	387,500 to 5,750,000	140,000 to 4,625,000	27,500 to 337,500	13,750 to 221,250
1	4	R.J.G.	103,750 to 5,000,000	90,000 to 2,250,000	< 500 to 13,500	< 500 to 7,625
2–8	1		15,000 to 9,125,000	13,750 to 3,000,000	*	*
9, 10	1	R.J.G.	70,000 to 400,000	55,000 to 225,000	500 to 2,125	750 to 1,250

* No results available.

Klebsiella sp. and *Proteus* sp. were also isolated. No attempt was made to isolate salmonellas as these organisms are not usually found in cooked or canned meats, but on five occasions coagulase-positive staphylococci were found. The viable counts were greatly reduced after the cleaning procedure. The results indicate also that the cleaning carried out by one of the authors (R.J.G.) was more efficient than that of the shop staff. There was still a wide range of bacteria found but coagulase-positive staphylococci, *Klebsiella* sp. and *Proteus* sp. were not isolated.

Table 5 shows the range of plate counts from swabbed areas of carving knives

and can-openers in various premises after normal use and after the given cleaning procedure. All the carving knives examined had been used, before swabbing, for cutting and slicing various types of cooked and canned meats. All the can-openers examined had been used, before swabbing, for opening large containers (3–6 lb.) of canned meat. The results indicate that the cleaning procedure markedly reduced the total viable count and that cleaning by one of the authors (R.J.G.) was more efficient than that of the shop staff.

Table 5. *Range of bacterial plate counts at* 22° *and* 37° *C. from swabbed areas of carving knife blades and can-openers before and after cleaning*

Premises	No. of weekly experiments	Cleaning done by	Range of total viable counts/swabbed area			
			Before cleaning		After cleaning	
			22° C.	37° C.	22° C.	37° C.
Object swabbed: carving knife blades						
1	8	Shop staff	60,750 to 9,000,000	95,000 to 5,500,000	750 to 77,250	500 to 107,500
1	4	R.J.G.	62,500 to 10,000,000	55,000 to 8,750,000	< 500 to 1,250	< 500 to 2,000
2–7	1	*	17,750 to 3,000,000	10,250 to 2,150,000	*	*
9	1	R.J.G.	95,500	55,000	1,250	1,250
Object swabbed: can-openers						
1	8	Shop staff	8,500 to 3,500,000	6,500 to 3,250,000	500 to 12,500	< 500 to 7,500
1	4	R.J.G.	42,500 to 350,000	15,000 to 200,000	< 500 to 750	< 500 to 1,750
3–4, 6–8	1	*	10,000 to 100,000	5,000 to 65,000	*	*
9, 10	1	R.J.G.	65,000 to 4,250,000	42,500 to 1,750,000	4,500 to 5,000	3,000 to 4,500

* No results available.

The concentration of the detergent/disinfectant used at premises 1, 9 and 10 was 0·75 %. The results of the minimum inhibitory concentration tests in Table 6 showed this to be satisfactory. The difference in temperature at the time of inoculation did not affect the results. The in-use test plates showed no growth at all.

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Table 6. *Minimum inhibitory concentration tests with the commercial detergent/disinfectant used in premises* 1, 9 *and* 10

Organism	Laboratory reference no.*	Concentration of powder in cleaning solution†							
		Inoculated at 22° C.				Inoculated at 45° C.			
		0·75 %	0·375 %	0·187 %	0·093 %	0·75 %	0·375 %	0·187 %	0·093 %
Coagulase-positive staphylococcus	CI/62/10312	−	−	−	+	−	−	−	+
	CI/62/10701	−	−	−	+	−	−	−	+
	CI/62/12146	−	−	−	+	−	−	−	+
	CI/62/12148	−	−	−	+	−	−	−	+
	FH/67/8006	−	−	−	+	−	−	−	+
Salmonella typhi NCTC 786	—	−	−	+	+	−	−	+	+
Salmonella typhi NCTC 3390	—	−	−	+	+	−	−	+	+
S. paratyphi B	FH/67/4244	−	+	+	+	−	+	+	+
S. typhimurium phage type 15a	FH/67/2723	−	−	+	+	−	−	+	+
S. typhimurium (untypable)	FH/67/8101	−	−	+	+	−	−	+	+
S. eimsbuettel	FH/67/8415	−	−	+	+	−	−	+	+
S. panama	FH/67/8422	−	−	+	+	−	−	+	+
S. worthington	FH/67/8910	−	−	+	+	−	−	+	+
Bacillus sp.	FH/68/164	−	−	−	+	−	−	−	+
Micrococcus sp.	FH/68/166	−	−	−	+	−	−	−	+

− = No growth; + = growth.

* CI, Cross Infection Reference Laboratory, Colindale. FH, Food Hygiene Laboratory, Colindale.

† Concentration of powder in cleaning solution used at premises 1, 9 and 10 was 0·75 %.

DISCUSSION

There is a risk of cross-contamination between meats sliced by a machine. As many different meats may be sliced during the day, a contaminated product can constantly recontaminate the machine, thereby increasing the spread of the organism to other meats. In this way the number of persons infected can ultimately exceed those who consumed the original contaminated meat. Such an accident was likely in the Aberdeen typhoid outbreak (Report, 1964). Three hundred and sixty-two persons who contracted typhoid fever had eaten or purchased food from the cold-meat counter in the supermarket involved. Of these only 131 were known to have eaten or purchased corned beef, 138 were known to have eaten or purchased unspecified cold meats, but 93 were known to have eaten or purchased cold meats excluding corned beef. Slicing of meats at the supermarket was done on one of the two slicing machines available for this purpose or by knife.

Cross-contamination may also occur when contaminated can-openers and carving knives are used. Couper, Newell & Payne (1956) reported that in the Pickering typhoid outbreak (1954–5) thirty-two persons contracted typhoid fever after eating ox tongue. One other person contracted this fever after eating ham known to have been cut by the same knife used for slicing the ox tongue.

Unopened cans of meat such as corned beef and ox tongue submitted to the Food Hygiene Laboratory for bacteriological examination are usually sterile or contain < 500 organisms/g. Cans of ham are an exception, however, as these products only receive a pasteurization treatment. It is interesting therefore to study the results of the bacteriological examination of various sliced samples of cooked and canned meats in this laboratory (Table 7). All of the 147 samples were obtained by Public Health Inspectors from shops, supermarkets, cafés, restaurants, public houses and hospitals in three London Boroughs. Some of the samples contained faecal coliforms or coagulase-positive staphylococci and 53 (36 %) of samples gave general colony counts at 35° C. of > 10^6 organisms/g. Such high counts can be attributed only to poor hygienic measures such as unrefrigerated storage conditions or contamination from personnel and machinery in the premises concerned. High counts from 50 (18 %) of 282 samples of various cooked and canned meats have been reported by Hughes (1960).

Table 7. *Results of bacteriological examination of cooked and canned meats submitted to the Food Hygiene Laboratory for examination* (*Jan.* 1967–*Feb.* 1968)

(Figures in parentheses indicate percentages.)

	Ham	Pork luncheon meat	Corned beef	Roast pork	Ox tongue	Beef (brisket and silver-side)	Spam
No. of samples examined	93	22	10	7	6	5	4
No. of samples known to have been cut by							
Slicing machine	46	12	7	3	3	1	3
Knife	4	0	1	1	0	1	0
No. of samples containing							
Non-faecal coliforms	39 (42)	3	4	4	2	3	1
Faecal coliforms (*E. coli*)	19 (20)	0	2	2	2	2	0
Coag.-pos. staphylococci	14 (15)	0	0	1	1	0	0
No. of samples with general colony count/g. at 35° C.							
10^5–10^6	30 (32)	9 (41)	2	1	0	2	0
> 10^6	37 (40)	4 (18)	0	6	5	1	0

The Food Hygiene Regulations (1960) require that equipment used in connexion with food should be kept clean. Our results clearly indicate that the bacterial counts from slicing machines, carving knives and can-openers are often very high. Similar results have been reported by C. A. Bailey (personal communication) from thirty-three swabs taken from slicing machines and twenty-eight swabs taken from knives. Ideally all equipment should be cleaned thoroughly each time it is used, but this is obviously not practicable in so far as it would delay the serving of customers. Cleaning twice daily should be possible in all food premises. Some slicing-machine manufacturers are now recommending the use of certain oils for regular and efficient cleaning of their machines. An assessment of these products is now being made and will be published separately, but the results to date are

disappointing. The use of disposable paper and freshly laundered cloths instead of cloths disinfected overnight, as used in the present study, is also being investigated.

The results of the minimum inhibitory concentration tests showed that, under the conditions of the test, the concentration of detergent/disinfectant in the cleaning solution was adequate. However, during the cleaning operations the time of contact between the solution and the organisms present is so short that little reliance can be placed on the disinfectant action. It is the detergent action of the cleaning solution which is all-important in removing the organisms present by loosening the coating of fat which holds them on the surface of equipment. Methods for assessing the cleaning and bactericidal efficiencies of detergents for use in the catering industry have been given by Hobbs *et al.* (1960). The Food Hygiene Regulations (1960) are rather widely drawn and no specific direction on methods of cleaning or on suitable detergents and disinfectants are given. It is unfortunate that disinfectants used in the food industry are often described as 'sterilants' or 'sterilizing agents'. None of these agents can in fact produce sterility. We do not, however, condemn the use of combined detergent/disinfectants but do condemn complete reliance on any disinfectant action. No attempt was made to test the effect of using a disinfectant after cleaning with a detergent as this was not a common practice in the establishments visited, because the managers considered that this would increase the time of cleaning. Our results indicate that the cleaning procedure and detergent/disinfectant used in the present study was satisfactory but the counts shown are still not as low as would be desirable.

The absence of all growth on the in-use test plates does not indicate that the cleaning solution was sterile after use, but that it contained less than 100 viable organisms/ml. A test of this kind, carried out at regular intervals, can be useful for the maintenance of cleaning cloths in a hygienic condition.

Several methods for testing the efficiency of a cleaning procedure have been described. The agar-sausage technique (Ten Cate, 1963, 1965) has been recommended as a simple method which is useful for Public Health Inspectors (Greig, 1966) and for hygienic control in the factory (Thomas, 1967). The sticky-film method introduced by Thomas (1961) as a diagnostic aid in dermatology has been used successfully by Mossel, Kampelmacher & van Noorle Jansen (1966), who compared the method with the agar-sausage technique and the direct swabbing method with calcium alginate swabs to verify adequate cleaning of wooden surfaces. Recovery of organisms from surfaces was significantly greater by the direct swabbing method. However, for regular inspection purposes the agar-sausage method is convenient especially when laboratory facilities are limited or absent.

RECOMMENDATIONS

I. All food handling equipment should be cleaned at least twice daily. For slicing machines, carving knives and can-openers cleaning at midday and in the evening would not seem an unreasonable minimum aim. Where possible it is also desirable that a whole can of meat be sliced at one time and the equipment cleaned again before re-use.

II. Too much reliance on the attributes of commercial bactericidal detergents or detergent/disinfectants may lead to false security and staff must be reminded that effective cleaning procedures depend on their personal effort.

III. Slicing machines are potentially dangerous to the personnel using them and stricter safety measures are desirable.

IV. The design of commercial can-openers should be modified to make efficient cleaning possible.

V. Large canned hams, and all cooked meats and canned meats after slicing, should be stored at below 5° C.

VI. Although the present work provides no relevant evidence, it is recommended that cooked and canned meats be sliced on a separate machine from that used for cured products such as bacon, since cooked and canned meats are unlikely to receive further cooking.

VII. Food hygiene education should be extended so that all staff, including managers and directors, are fully aware of its importance and necessity.

SUMMARY

Experiments have been made in several supermarkets, shops and cafés to determine the bacterial counts on slicing machines, carving knives and can-openers after contact with various cooked and canned meats, and to find a simple, quick and effective cleaning method for such articles of equipment. The importance of personal effort in cleaning rather than a reliance on the known attributes of detergent/disinfectants is stressed. The methods available for testing the efficiency of cleaning procedures are outlined.

In vitro tests have shown that the detergent/disinfectant used in the present study at a concentration of 0·75 % (w/v) was satisfactory. This concentration was the minimum inhibitory concentration for *Salmonella paratyphi B*, which was the most resistant of fifteen strains of bacteria studied.

The design of slicing machines and can-openers is discussed in relation to safety in use and ease of cleaning. Recommendations concerning the necessity of regular and effective cleaning of food-handling equipment and storage of cooked and canned meats before and after slicing are given.

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