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THE HOT VENDING OF MEAT PRODUCTS

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Introduction.

Vending machines for the delivery of 'hot' foodstuffs are beginning to make their appearance in England. The foodstuffs and beverages so far available are milk, tea, coffee, soups and various meat products such as sausage rolls, steak & kidney pies and Cornish pasties. Soups and the beverages are often prepared by the reconstitution of powder with hot water at the time of delivery; consequently, bacteriological hazards are probably slight. Meat products present an entirely different problem since they must be kept hot during their sojourn in the vending machine.

Little appears to have been written so far on the problems associated with the vending of hot perishable foodstuffs, but it is probable that this development of machine vending is still in its infancy. This is borne out by some figures recently published in "Food Engineering" for the 1959 estimated sales of automatic food vendors in the U.S.A. (1). Hot foods account for 21 million dollars' worth out of total sales amounting to 1,376 million dollars, and of this figure it is possible that some of these 'hot foods' which are not specified, may be freshly prepared. Recently "Food Manufacture" has sounded a welcome note of warning concerning the general hygienic hazards of food vending (2).

The opportunity arose to study the bacteriological condition of meat pies and sausage rolls in a hot vending machine situated in an arcade under a railway arch in a West country town. A number of vending machines are located together and there is an attendant to replenish the compartments as required.

I - General ObservationsMachine Vending

The machines, which had been in use for several months prior to this investigation, appear to have attracted little attention from the local health authorities, apart from a recommendation that the compartments should be kept at a minimum temperature of 147°F (64°C). Neither of two attendants had any inkling that any hazard might arise from improper storage, nor were there apparently any standing instructions concerning the removal of old stocks from the compartments or the maintenance of the machines. The task of the attendant is simply to refill the compartments as necessary. The manager of the organization running the arcade likewise was unaware that any risks were involved. The availability of hot vending machines was accepted by him as an indication of the propriety of this development. He had been told by the sanitary inspector that the temperature must be maintained at 147°F to prevent bacteria from growing, but the only means at his disposal for measuring the temperature was to place the bulb of a chemical thermometer on the shelf of the open compartment.

Temperature Distribution

The vending machine consists of three vertical piles, each composed of twelve compartments. The fronts of each compartment are closed by a door which can be opened on insertion of a coin. The backs of the compartments open into a narrow communicating space running the length of the stack since the whole stack is on a hinge enabling it to be swung out for servicing. Heating is effected by means of a heating mat at the rear of the compartment stacks. This construction, however, facilitates convection currents, which appear seriously to disturb the temperature distribution. As will be seen later, gross inequalities of temperature were found on each occasion. This was accepted as a commonplace by the attendant, who also complained that the heating elements were always failing. It is difficult to imagine that the design of these particular machines from the standpoint of temperature distribution was decided other than in an entirely arbitrary fashion.

The impression was also gained during several discussions with the attendant that these temperature variations might have some sales merit since some customers felt the outside glass window to select a pie at their preferred temperature.

Rotation of Stocks

The construction of the vending machine has some disturbing features in relation to turnover of stocks in the machine. It is usual to place, say, pasties in one vertical stack, steak pies in another and sausage rolls in the remaining one. To remove a pie from the lower compartments it is necessary for an adult to bend down quite low since the bottom compartment is only 15 ins. from the ground. Not surprisingly, therefore, pies are generally removed from the upper compartments first. This means that pies at the bottom of the machine may reside there for an indeterminate time, and this disadvantage can be aggravated by a vigilant attendant quickly replenishing the empty compartments. Furthermore, in addition to the dangers involved in the longer residence of pies in the lower compartments, the bacteriological hazard is enhanced because the faulty temperature distribution gave rise to predominantly 'tepid' conditions in the lower compartments of the machines under observations.

II - Experimental

Sampling

The meat products under examination were taken from the vending machines after lunch and during the early afternoon, which is a slack period. This ensured, so far as possible, that the pies had been in the machine sufficiently long to attain temperature equilibrium. It was not possible, however, to obtain any reliable information from the attendant concerning the period any pie had resided in the machine, and it was not practicable for us to spend the considerable length of time on observation, which the determination of this fact would have involved. It might have been preferable to have made the observations early in the morning since some pies certainly remained in the machine overnight, but this again was impracticable because the machines were 160 kilometres distant from the laboratory.

Temperature Measurements

A direct reading temperature-compensated galvanometer provided with contact and needle thermocouples was used, which made it possible to make rapid measurements of surface and internal temperature. By this means it was possible to ascertain roughly that the pies had been in the compartments long enough to attain thermal equilibrium. The measurements were made immediately upon removal of the pies from the compartment. The results are summarized in Table I.

TABLE I

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Temperature Distribution within the Compartments recorded as Temperatures of the Goods

	<u>No. observations</u>	<u>Range</u>	<u>Mean</u>
Top Compartment	11	36°C - 74°C	58.9°C
Bottom Compartment	11	27°C - 55°C	42.9°C

Bacteriological Examinations

It was found that on removal from the machines the pies cooled rapidly to ambient temperatures which were in the 40°F range during the period of observation. They were delivered to the laboratory within about three hours of sampling, and either examined the same evening or refrigerated overnight and tested the next morning. The following bacteriological examinations were carried out:

- (1) Total colony counts at 37°C and 55°C
- (ii) Moulds and yeasts
- (iii) Coliforms
- (iv) Aerobic spore count
- (v) Anaerobic spore count
- (vi) Coagulase-positive staphylococci
- (vii) Salmonellae
- (viii) Enterococci

In none of these examinations were salmonellae, coliforms, enterococci or Coagulase-positive staphylococci found in 1 g. or anaerobic spores found in 0.1 gram. The highest aerobic spore count recorded was 30 per gram. None of the pies showed any visible moulding, and the counts were negligible. The total counts are summarized in Tables II and III, and for this purpose the meat pasties and the steak & kidney pies have been grouped together, whereas the data for the sausage rolls is given separately. This is because the counts on the sausage rolls were consistently lower, presumably because they were a drier product.

TABLE II

Bacteriological Examination of Meat Pies and Pasties from the Vending Machine

<u>Compartment</u>	<u>No. obs.</u>	<u>Total Colony Count/g</u>			
		<u>Mean</u>		<u>Range</u>	
		<u>37°C</u>	<u>55°C</u>	<u>37°C</u>	<u>55°C</u>
Top	11	46,300	22,600	<10 - 470,000	<10 - 188,000
Bottom	11	174,100	489	<10 - 1,700,000	<10 - 5,300

TABLE III

Bacteriological Examination of Sausage Rolls from the Vending Machine

<u>Compartment</u>	<u>No. obs.</u>	<u>Total Colony Count/g.</u>			
		<u>Mean</u>		<u>Range</u>	
		<u>37°C</u>	<u>55°C</u>	<u>37°C</u>	<u>55°C</u>
Top	7	6	243	<10 - 30	<10 - 1,700
Bottom	7	156	43	<10 - 770	<10 - 300

Examination of Controls

A number of pies which had not been in the vending machine were examined bacteriologically. Primary examinations were made as in the case of the vended goods but, in addition, samples were incubated for 48 hours at both 37°C and 55°C prior to examination. The results are shown in Table IV.

TABLE IV

Bacteriological Examination of Meat Pies and Pasties incubated for 24 and 48 hours at 37°C and 55°C.

<u>Incubation hour</u>	<u>No. obs.</u>	<u>Total colony count/g at:-</u>			
		<u>Mean</u>		<u>Range</u>	
		<u>37°C</u>	<u>55°C</u>	<u>37°C</u>	<u>55°C</u>
Initial	21	46	<10	<10 - 800	<10
24 hr. @ 37°	14	926,300	54,900	<10 - 5,420,000	<10 - 512,000
48 hr. " "	12	2,852,000	4,708,000	<10 - 43,000,000	<10 - 50,000,000
24 hr. @ 55°	16	1,496,000	346,000	<10 - 12,100,000	<10 - 50,000,000
48 hr. " "	13	3,300,000	3,900,000	<10 - 50,000,000	<10 - 50,000,000

In spite of the seemingly hazardous conditions prevailing, these bacteriological examinations did not prove particularly revealing. There are possibly two factors which account for this. In the first place, examination of the controls indicates that the pies supplied to the vending company were of a superior quality and, secondly, it seems likely that those examined may have been in the vending machine only a relatively short time.

Against this must be recorded the fact that a number of the pies examined showed a considerable drying-out as well as general chemical staling. Consequently, it may be that drying-out is a factor controlling bacteriological deterioration.

It is obvious that these bacteriological examinations reveal very little concerning potential bacteriological hazards, and the only justification for reporting these interim results is to direct attention to a matter which may assume considerable importance if this particular trend in vending develops further.

References

- (1) Food Engineering 1960. "Trend to Food - Vend Ticks of Speed"
(April) pp. 48 - 50.
- (2) Editorial 1960 Food Manufacture . 35 (60), 225.