PUBLIC HEALTH ASPECTS OF ROTISSERIES IN MARKETS

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About a dozen years ago when the operation of rotisseries in markets was proposed to the Health Department, our Food Sanitation Advisory Committee brought together market operators, members of the meat-cutters union, representatives of the food service industry and equipment manufacturers to develop public health standards. Among the specific requirements developed were:

1. A separate work area and a work table not used for any raw meat or fish products shall be provided for the handling of cooked meats.
2. A separate storage cabinet shall be provided for keeping spits and supplies in a sanitary condition.
3. The following special facilities shall be provided for storing of barbecued meats:
   a. Barbecued meats to be sold "hot" shall be stored in a unit which automatically maintains temperatures above 140 F.
   b. Barbecued meat that is to be sold "cold" shall be stored in a portion of a refrigerator where it does not come in contact with, and is not subject to dripping or contamination from raw meat.

In the ensuing dozen years a number of suspected food-poisoning and food illness outbreaks have been attributed to products from these rotisseries. Perhaps cases of salmonellosis have been caused by this type of product without being reported to the Health Department. Within the past two years, in Los Angeles County, 17 outbreaks or single cases from these products were reported. Nine were attributed to chicken, four to spareribs, one to turkey, and three to barbecued pork. Three of the outbreaks appeared to have been from staphylococcus toxin, with laboratory data indicating millions of the *Staphylococcus aureus* in the food samples. Symptoms, onset time, and in some cases positive cultures of the same organism, in both food and stools, indicated that five outbreaks were caused by salmonellae and two were from *Clostridium perfringens*. In the other cases, not sufficient confirmatory evidence was obtained to conclusively indicate the specific cause.

The USPHS weekly report from the Communicable Disease Center for July, 1966, reported an outbreak in Spokane involving 24 different family groups, barbecued chicken from a market, inadequate cooking temperatures, 100 to 110 F holding temperatures, and *Salmonella typhyimurum* isolated from over 30 individuals. The report stated that the City Health Department temporarily suspended all barbecue operations at markets throughout the city.

A survey of cooking, holding and marketing practices in Los Angeles County indicated that better controls were needed to assure that all products are "pasteurized" during cooking and that operating practices and existing equipment failed to hold products at required temperatures. Among the problems observed were the following:

1. Attempts were being made to heat cold products in a "warming oven". These units should not be labelled "warming ovens" since they are most ineffective for warming. They should be considered hot-holding devices. In other words they are capable, when properly designed, operated and maintained, of maintaining foods warm but are incapable of warming cold products to appropriate temperatures within a reasonable period of time.
2. Wrapped products were commonly placed in warming devices or refrigerators. The insulation effects of the wrapping resulted in excessively long "incubation periods."
3. Units designed for heating with infra-red lights were modified by substituting incandescent bulbs which were relatively ineffective for the intended purpose.
4. Units intended for heating by radiation from below were rendered ineffective by covering the radiating surface with aluminum foil which is an excellent reflector and therefore an insulator.
5. Devices were frequently overloaded with stacked products. This was particularly objectionable in open units designed for heating by radiation.
6. Some units were without adequate thermostatic temperature control, without thermometers for indicating the appropriate setting, and without instruction to the operator on setting the thermostat.
7. On some units designed for circulating heat throughout an enclosed cabinet, the shelves were completely covered with aluminum foil or other material so as to block circulation.
8. Products left over at the end of the day were sometimes left in the warming ovens which were turned off, or were left in the wrappers and placed in the refrigerator over night where cooling times were excessively long.
9. In the morning products that had been refriger-

TABLE 1. EFFECT OF PLIOFILM VS. ALUMINUM FOIL WRAPPING ON TEMPERATURE OF FOODS REHEATED IN MODEL A—OPEN UNIT

	10:20 a.m.	11:00 a.m.	12:00 noon	12:30 p.m.
Pliofilm	45	102	133	142
Aluminum Foil	45	60	78	90

TABLE 2. TEMPERATURE REDUCTION IN FOODS COOLED IN WRAPPED AND UNWRAPPED CONDITION

	10:30 a.m.	11:00 a.m.	12:00 noon	1:00 p.m.	1:30 p.m.
Chicken No. 1 Unwrapped	140	88	55	40	37
Chicken No. 2 Wrapped in Aluminum Foil	144	118	82	56	54
Chicken No. 3 Wrapped in Card-Board Carton	135	100	70	50	49

TABLE 3. COMPARISON OF TEMPERATURE REDUCTIONS IN FOODS COOLED IN ALUMINUM AND IN PLIOFILM WRAPPING

	3:00 p.m.	3:30 p.m.	4:00 p.m.	4:30 p.m.	5:00 p.m.
Aluminum Foil	140	130	118	100	82
Pliofilm Wrap	138	120	106	85	72

ated or allowed to stand at room temperature over night were placed or left in a warming oven in their wrappers and hours were required to warm up the product.

10. Some operators did not have the food-testing thermometer required by State law and others who had thermometers were not properly using them.

FIELD STUDY

Details of the field study follow. Three open model warmers and one closed model manufactured by three companies were observed during the study.

The Model A—Open Unit has six 250 watt infra-red lamps under a hood approximately two feet above the displayed product. Radiant heating elements are also located beneath the product. The thermostat temperature settings may be adjusted by the operator but the control is unmarked.

The Model B—Open Unit is of similar design to the Model A—Open Unit except that is is provided with regular light bulbs above and has a heating element at each side as well as below. The thermostat can be set by the operator.

The Model C—Open Unit is similar to the Model A and Model B—Open Units but is designed for non-removable infra-red tube lights above and heating elements below.

The Model C—Closed Unit is an enclosed cabinet with a thermostatically controlled electrical heating element and has a number of shelves.

WRAPPING MATERIALS

Various wrapping materials were tested for their effect on reheating a cold cooked product. Chickens wrapped in pliofilm on an aluminum pan and chickens wrapped in aluminum foil were placed in a Model A—Open Unit with the heat control on full (unmarked) and all overhead infra-red bulbs on. The temperature of the chickens was 45 F when placed in the warmer. After two hours and ten minutes the chicken wrapped in pliofilm was 142 F while the chicken wrapped in aluminum foil was only 90 F. Temperatures at various time intervals are shown in Table 1. (Temperature readings in all tables are in degrees Fahrenheit.)

Similar results were observed when cold, pre-cooked chickens were reheated in the Model C—Open and Closed Units.

Three cooked chickens were taken from a warmer at temperatures from 135 to 144 F and placed in a refrigerator with a temperature of 35 F. From one the wrapping was removed, one was wrapped in aluminum foil and the third was in a cardboard carton with a transparent window. After two hours the unwrapped chicken temperature was 45 F while the chicken in the cardboard carton was at 60 F and the one in aluminum foil was at 70 F. After three hours the temperature of the chicken wrapped in aluminum foil was 54 F. Rate of temperature reductions are shown in Table 2.

In another test a chicken at 138 F in pliofilm wrapping cooled somewhat more rapidly but was 72 F after being in a 38 F refrigerator for two hours. (Table 3).

Aluminum foil is too efficient an insulator for use for wrapping foods to be heated or cooled. Wrapping, in general, also seriously retards cooling of products that are warm or hot when refrigerated.

EFFECT OF STACKING

To study the effects on the temperature of stacking two or more layers on the single shelf of a Model C—Open Warming Unit, six chickens at 162 to 171 F were placed in two layers in the warmer. The chickens in the bottom layer were wrapped in aluminum

foil, pliofilm and cardboard carton (transparent window). On the top layer was a chicken wrapped in aluminum foil and two wrapped in pliofilm. The heating element under the unit was turned to the maximum setting of 200 F and all of the three overhead infra-red bulbs were on. The top layer apparently acted as insulation to the bottom layer and after one hour and 45 minutes chickens wrapped in pliofilm on the top layer were 14 to 18 degrees warmer than the chicken in pliofilm on the bottom layer. Chickens in aluminum foil on the top layer were at 137 F while those on the bottom layer were 146 F. Temperature changes are shown in Table 4. The chicken in the cardboard carton removed directly from a heating oven and placed on the bottom layer dropped from 170 to 137 F in one hour and 45 minutes.

Aluminum foil could be considered satisfactory for wrapping chickens after they were heated if they were to be placed in a single layer in an open unit. Pliofilm wrapping appeared to be the best if more than one layer of the product was used in an open unit with infra-red heating bulbs.

TABLE 4. EFFECTS ON TEMPERATURES BY STACKING FOODS IN VARIOUS WRAPPINGS IN MODEL C—OPEN WARMING UNIT

	1:25 p.m.	1:55 p.m.	2:25 p.m.	3:10 p.m.
Bottom Layer				
Pliofilm	171	163	157	148
Aluminum Foil	169	163	153	146
Cardboard Carton	170	154	142	137
Top Layer				
Pliofilm	162	166	168	162
Aluminum Foil	162	151	144	137
Pliofilm	163	170	165	166

SUBSTITUTION FOR INFRA-RED HEAT LAMPS

Many markets with warming units designed for infra-red heat lamps replace them with ordinary light bulbs so observations were made to determine the effect this practice. In a Model A—Open Unit, two of the six overhead 250W infra-red lamps were replaced with two 150W ordinary incandescent bulbs. The four infra-red bulbs on either side of the replacement bulbs were left on. The thermostat for the heating element under the product was set to maximum temperature. The temperature of the product under the infra-red bulbs and under ordinary bulbs was recorded hourly.

After four hours the temperature of the product had reached its maximum, and chicken under infra-red bulbs was 22 degrees warmer than those under the ordinary bulbs. Replacing infra-red bulbs with ordinary bulbs does significantly reduce the heating effect.

TABLE 5. EFFECT ON TEMPERATURE OF FOODS WARMED IN MODEL C—OPEN UNIT WITH BOTTOM HEATING ELEMENT COVERED WITH ALUMINUM COIL

	10:30 a.m.	11:30 a.m.	12:30 p.m.	1:30 p.m.
Chicken No. 1 in transparent wrapping with aluminum foil on heat element	144	138	138	138
Chicken No. 2 in transparent wrapping with no aluminum foil on heat element	141	158	158	158

USE OF ALUMINUM FOIL OVER HEATING ELEMENTS

The effect of covering the bottom and racks of warming units with aluminum foil was studied and two Model B—Open Units were used. The raised metal plate in the bottom of one of the units was covered with foil while the other was not. Each unit had been pre-heated for over one hour with the thermostat set at 350 F, at which time the setting was reduced to 275 F. The temperatures of chickens when placed in the warmers were 141 to 144 F and subsequent temperatures were recorded over a three-hour period as shown in Table 5, the temperature of the chickens in the unit where foil was used on the heating elements dropped six degrees in one hour. Chickens in the unit with no foil covering the bottom heating plate rose 17 degrees in temperature and then remained constant for the balance of the three hour test period.

Temperature readings were taken in an enclosed Model C warming unit to learn of the effect of covering shelves with aluminum foil. Temperatures were taken first with the shelves covered with foil and then with the foil removed. With or without foil, the temperature of the product on the top shelves was slightly lower. Covering shelves of closed unit with foil had little effect when foil did not restrict air circulation in unit. However, when the foil extended over the shelves to the sides in a manner to

TABLE 6. OPERATING PRACTICES IN HANDLING LEFT-OVERS

	Yes	No
Left-overs Refrigerated	33	2[a]
Placed Back in Warmer	23	12
Heated in Oven Before Placing in Warmer	11	24[b]

[a]Of the two not refrigerating left-overs, one placed them back in the warmer the next day after keeping them overnight in the meat cutting room and the other stated that they were thrown away the next day.

[b]Of the 24 not reheating left-overs in the oven, 12 placed the product back into the warmer for heating without first reheating in the oven for consumer "hot" sales, seven sold the product refrigerated, three made it into salad or sandwiches, while two said they threw it away or gave it away.

restrict air circulation, there was a more significant lowering of the temperature. In one such unit the product temperature was 120 F at the top and 150 F at the bottom.

ATTITUDES AND PRACTICES IN HANDLING LEFT-OVERS

Thirty five establishments using food warmers were surveyed to obtain the attitudes and practices of operators in handling left-overs. In addition, the opinions of equipment manufacturers and distributors were obtained.

In practice the majority of operators place left-over products in refrigerators overnight and place them back in the food warmer the following day (Table 6). Of these about one half (11) reheated the product in an oven to quickly raise the temperature. The others (12) move the product directly to the warmer from the refrigerator. Opinions as to the quality of the product, after reheating in the oven, were generally favorable. Some operators who were not reheating were adamant in their mistaken opinion that such "re-cooking" would dry out the product to be unsalable.

Manufacturers' recommendations are to reheat in the cooking unit for 15 to 20 minutes at approximately 350 F. Tests made during the survey showed this procedure will raise the temperature of the product from 34 F to 140 F.

Most of the operators who pre-heat left-overs in the oven remove the wrappers before refrigerating. Others leave the product wrapped and take it directly from the refrigerator to the warmer and vice-versa, thereby having two long periods at improper temperatures.

From observation, reheating for 15-20 minutes in the oven will bring the internal temperature of the product to 140 F or more and will not adversely affect the salability. From discussions with operators and distributors plus limited observations, excessive drying is due to keeping the product in the cooking unit too long or holding the packaged product at too high a temperature for too long a period.

Results of this study on attitudes and practices have been reviewed by the Los Angeles County Food Sanitation Advisory Committee and Health Officer's Rules were drafted to assure that cooked foods are kept at temperatures which prevent development of food poisoning bacteria. The study and instructions for the sanitary operation of commercial food warming equipment have been publicized to market operators through publication in trade journals.

OPERATING RULES AND REGULATIONS

In consultation with the Food Sanitation Advisory Committee, the following rules and regulations for the operation of rotisseries and handling of products were developed and subsequently adopted by the Los Angeles County Health Officer:

Temperature Control Procedures.

1. Rotisseried meats and poultry to be sold "hot" shall be stored in a unit which maintains the product at a temperature of 140 F or above.
2. An accurate "stick-in type" food testing thermometer shall be kept readily available in the market and used regularly.
3. Previously cooked meat or poultry which has subsequently been refrigerated or allowed to cool shall be pre-heated in cooking equipment to a temperature of 140 F before being placed in a warm food display or holding unit.
4. Prior to reheating or cooling the cooked meat or poultry, wrapping or packaging which would retard such process shall be removed.
5. Cooked meats and poultry shall be placed in the hot food holding device immediately after cooking. In display units not entirely enclosed, food shall be displayed in single layers unless it has been demonstrated the unit can maintain more than one layer of products at 140 F or above.
6. The thermostatic control shall be so set and the hot food holding unit so maintained that foods are maintained at 140 F or above.
7. Infra-red heat lamps shall not be replaced with ordinary light bulbs unless it has been demonstrated that the unit maintains foods at a holding temperature of 140 F or above with other than infra-red bulbs.
8. In either enclosed or open hot food holding units the heating plate or shelves shall not be covered with aluminum foil unless tests have shown that the unit maintains the food at a holding temperature of 140 F or above when such areas are covered. Shelf covering shall not extend to the sides of the unit when this prevents circulation of air to interfere with maintenance of proper temperatures.

Operational Rules.

1. The person in charge of the establishment shall make sure that employees properly operate the equipment and handle products as required herein.
2. Employees shall wash their hands before handling

cooked foods.

3. Raw meats, fish and poultry shall not be placed on the same work surface as prepared foods. A separate work area and a work table shall be provided and used for handling cooked product.

4. Separate utensils shall be used in handling raw and cooked food or these shall be washed and sanitized before use on prepared products.

5. A separate storage cabinet shall be provided for utensils, spits and supplies.

6. Cooked foods intended to be stored below 140 F shall be placed in a refrigerator at a temperature of 50 F or below when the internal temperature of the food reaches 120 F.

7. Prepared foods shall be protected from contact with raw meat.

EDUCATIONAL PROGRAM

The rules and regulations and results of the study were utilized in developing a pamphlet which is being used by the sanitarian in on-the-job instructions at all markets where rotisseries are operated. A copy of the pamphlet entitled "Instructions for Sanitary Operation of Commercial Food Warming Equipment" is available from the Bureau of Environmental Sanitation, Los Angeles County Health Department, 220 N. Broadway, Los Angeles, California 90012.

This same information, together with an explanatory article, appeared in the Grocer's Journal which goes to practically all the markets in the area.

The instructions and advice concerning equipment and its operation have been furnished to all distributors of rotisserie devices. They will include pertinent Department rules in their instructions issued in connection with sale and servicing of their units.

SUMMARY AND CONCLUSIONS

Operation of rotisseries in markets has undoubtedly produced an appreciable number of cases and outbreaks of food-borne illness. As with most such outbreaks the causes are:

1. Inadequate cooking to destroy pathogens naturally present in the meat or introduced during processing.

2. Products subject to contamination, subsequent to the heat processing, are wrapped and then handled in such a way as to be kept at incubating temperatures for long periods of time.

3. Devices for keeping products hot are altered or improperly used and do not adequately perform their intended functions.

4. Attempts to refrigerate and heat wrapped products are ineffective and result in the product being held at incubating temperature for long periods.

Correction will necessitate more attention on the part of the Sanitarian and more education of the equipment dealers, market owners, and employees. Adequate equipment, constant supervision by management and on-the-job instruction for employees are essential factors in a control program.

PUBLICATIONS OF INTEREST

Editorial Note: Listed below are books, pamphlets and reprints on a variety of subjects considered to be of interests. Requests for material should be addressed to the source indicated. Note cost of books and certain items.

Cat. No. A 88.6:C 42—List of Chemical Compounds Authorized for Use Under USDA Poultry, Meat, etc. Inspection Programs. Rev. 1966. 45c.

Cat. No. FS 2.2:Sh 4/4—National Register of Shellfish Production Areas. 1966. 15c.

Cat. No. FS 16.2:W 29/2—Focus on Clean Water, An Action Program for Community Organizations. Rev. 1966. 15c.

Cat. No. A 1.75:307—Rain Traps for Intercepting and Storing Water for Livestock. 1966. 10c.

Cat. No. FS 2.6/2: P 26/2—Procedures for Testing Pasteurization Equipment. 1966. 25c.

Cat. No. FS 2.36/2:966—Public Health Service Film Catalog 1966. $1.00.

Cat. No. FS 2.6/2:B 96—Handbook on Sanitation of Buses, 1966. 15c.

Cat. No. Y 4.Sci 2:89-2/S – Environmental Pollution, A Challenge to Science and Technology. 1966. 20c.

Cat. No. FS 2.6/2:M 59/3—Fabrication of Single Service Containers and Closures for Milk and Milk Products, A Guide for Sanitation Standards. 1966. 15c.

pH Guide. A quick, non-technical introduction to pH. Bull. 92-1, Beckman Instruments, Inc., 2500 Harbor Blvd., Fullerton, Calif. 92634.

Pasteurizer-Sterilizer Equipment. Bull. No. D-1-400. St. Regis Paper Co., CP Div., 1243 W. Washington Blvd., Chicago, Ill. 60607.

Ultra-violet Air Conditioning. Manual describing forced-air Heating and cooling units. American Ultraviolet Co., 30 Commerce St., Chatham, N. J. 07928.