The Role of Food Preparation and Handling on the Propagation of Antibiotic Resistance

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An often misunderstood and overlooked factor in the propagation of antibiotic resistance is the role of cooking and food hygiene. Recent experimental work has shown that it is possible to transfer resistance genes to experimental animals via unpasteurized cheese. It also has been postulated that fermented sausages may likewise serve as medium for resistance transfer. Both resistant pathogenic organisms and resistance transfer genes are destroyed or greatly reduced by thorough cooking. This of course is true for the other kill steps in food preparation -- pasteurization, irradiation, water activity diminution, salting, microwaving, etc. Improper food preparation can result in the contamination of comestibles with potentially resistant organisms. These can then be transferred to susceptible animals or humans by contact or, perhaps, via consumption. Finally, the temperatures achieved during proper cooking or rendering can markedly reduce levels of antibiotic residues that may present in food. Reductions of 80-100% of chloramphenicol, tetracycline and penicillin have been demonstrated following cooking to 160 degrees F. No reduction of animoglycosides, fluoroquinolones and sulfonamides has been demonstrated as a function of cooking. Thus, an adequate thermal death rate (D value of 4 to 7) is protective against resistance transfer from foodstuffs, reduces the level of certain antibiotic contaminants, and of course diminishes the incidence of food borne diseases that could otherwise result in "blooms" of resistance organisms.

Various control measures that are now de riguer in the food processing industry offer even greater safeguards. This is especially so if one is concerned about bacterial contamination of foods providing a gateway for transfer of antimicrobial resistance via foodstuffs. The current concept of multiple barriers or hurdles is informing. Hurdle technology combines a number of factors at subinhibitory concentrations that effectively control microorganisms particularly in refrigerated foods. These commonly include physical elements such as refrigeration, modified atmosphere packaging, heat treatment and, as well, physicochemical factors including pH, preservatives and water activity. The important thing to know about these techniques is the additive even synergistic nature of them--when used together a lower intensity of each factor may be employed with efficacious results.

High temperature is of course the most used kill step in food processing. This procedure is so common that it is easy to disremember that it is a very effective physical lethal agent. Although it is likely that more exotic modalities such as ionizing irradiation, electron beam pasteurization and ohmic treatment will gradually become popular in food processing and preservation, high temperature will be the standard against which these must be judged. The clear advantage of these is that they accomplish bacterial reductions without cooking; these procedures are often collectively referred to as "cold pasteurization". There is a large number of studies on the efficacy of irradiation on microorganisms found in food. The most troublesome food borne bacteria--Salmonella, Shigella, Yersinia, Campylobacter and Listeria are most sensitive to radiation and can be reliably and safely eliminated by approved doses (between 1 and 3 kGy). Medium dose irradiation is also effective in the control of E. coli 0157:H7 as well as the other toxigenic strains that can cause disease. The possibility that irradiation might alter the properties of pathogens so as to make them unidentifiable with traditional detection methodology has been explored and found to not be the case. It also has not been found that genetic material remains following irradiation.

High temperature inactivation is primarily a function of time and temperature. Temperatures above the optimum for microbiological growth exert an inhibitory or lethal effect. The bacterial heat inactivation curve is a straight line in semi-log plot. The equation describing this curve is:

$$\text{Log } N_s = \text{Log } N_o - 91/D) * t$$

where 1/D equals k of the general equation and t is the time in minutes of treatment at a designated temperature marked T.D is the decimal reduction time at temperature T. And D100 is the time required at 100o C. to kill 90% of organisms.

In conclusion it must be stated that food processing and customary and usual food preparation offer a good deal of protection against the possibility of antibiotic resistance transfer through food. This is accomplished in two ways. First both cooking and freezing reduce levels of certain antibiotics. Secondly, most food preservation techniques lessen or eliminate the food borne pathogens that would most likely be the source of transferable antibiotic resistance.

Bibliography

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