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DESTRUCTION OF SOME FOOD-POISONING ORGANISMS IN MINCED MEAT AND CHICKEN BREAST COOKED IN CONVENTIONAL AND MICROWAVE OVEN

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SUMMARY

To assess the destructive effect of microwave and conventional cooking, strains of *S.typhimurium,* Staph. *aureus* and *C. perfringenes* were used to inoculate minced meat and chicken breast samples. Internal temperature was recorded after cooking procedures. Bacterial analysis were performed for raw and cooked samples cooked either by microwave or electric fan oven. Destruction rate (%) was calculated for each test organism, for aerobic plate count and for psychrotrophic flora count. The destructive effect of the conventional cooking was superior compared to microwave cooking. Decreasing of survival rates of bacteria were detected by increasing the cooking time.

INTRODUCTION

Cooking by conventional oven has been used and undergone little change except for modernized design features of the oven and improved temperature control. On the other hand, microwave cooking is rapidly becoming a popular form of food preparation at home and in commercial food establishments because it is a feasible means of reducing cooking time, conserving food preparation space and, when properly employed, reducing energy used in preparing food.

Despite the microwave cooking popularity questions have arisen as to the efficiency of this cooking method for microbiological safety of its food. One of the most concenrns of microwave cooking is uneven heat distribution which results in hot and cold spots in cooked products and leading to survival of microorganisms in the

cooked food, (Stanford 1990, Keefer and Ball 1992; and Schiffmann 1992). A great deal of researches have been conducted comparing the survival of bacterial species treated with microwaving and conventional cooking. The results of these studies seem to indicate that bacterial species survived differently after cooking either by microwave or conventional method. Dessel et al., (1960) reported that microwave oven cooking was slightly more effective than conventional oven method in destroying *Staph. aureus*. In contrast, Amannur (1979) found conventional heating was more effective in killing or reducing of *Staph. aureus* and *S. typhimurim* compared with microwave. On the other hand, Welt et al., (1994) concluded that the effect of microwave energy on viability of clostriduim sporogenes spores was indistinguishable from the effect of conventional heating). Survival of microorganisms when food is microwaved can be attributed to the quick rise in food temperature and therefore the shorter exposure of the present microorganisms to lethal temperature as mentioned by (Lindsay et al., 1986, Stanford 1990 Fakhouri and Ramaswany 1993).

The time used for cooking food by microwave oven at home is always that recommended by the manufacturers of these ovens. However, Fung and Cunningham (1980) found that using the manufacturer recommended time resultted in a substantial number of survivors in most examined food samples, while wrapping food during microwave cooking or a combination of microwaving and broiling resulted in total destruction of tested organisms. Wrapping meat in aluminum foil followed by a resting period after microwaving was another way used by Hollywood et al., (1991) to allow the temperature to equilibrate through conduction. Thus, giving a greater exposure to elevated temperature in the internal portion.

Although the hazards of inadequate microwave cooking are recognized, only few outbreaks of food poisoning from microwave cooking were reported, (Evans et al., 1995). The objective of this study was to determine and compare the efficiencey of microwave cooking in of destruction bacteria, including some commonly occurring foodborne pathogens, to conventional cooking.

MATERIAL AND METHODS

Samples of fresh minced meat and chicken breast with bone (200g) collected from retail markets in Giza Governorate were used in this study to determine the viability of some fod poisoning organisms in heat treated minced meat and chicken breast.

Organisms:

Stock culture of *salmonella typhimurium*, *Staphylococcus aureus* and Clostridium *Perfringens* were obtained from Food *Hygien Department*, Animal Health Research Institute and were grown on lactose broth (*S. typhimurium*), brain heart infusion (Staph. *aureus*) and *trypticase* soy broth for (CI. *perfringlenes*) at 37°C for 24h. A cell suspension to an approximate concentration of 10^6 CFU/ml was

prepared from each organism to be used in this study. Minced meat samples were manually mixed with different cultures while chicken breast samples were injected with broth cultures from the underside of the wing into the muscle. All inoculated samples were kept overnight at 7°C. Bacteriological examinations was performed before and after cooking procedures of the samples.

Cooking Proceeduers:

Inoculated meat and chicken breast samples (18 samples each) were divided into two subgroups. The first subgroup (9 samples each) were cookd in a home microwave oven (ER 535 MD) to a time recommended by the model manufacturer. (6 min and 8.5 min respectively). The second subgroup (9 sample each) was cooked in the same microwave oven with 25% increase in cooking time (Cooking time was adjusted according to the weight of the sample). Another group of the same types of samples (18 each) were divided to be cooked in electric fan oven (MAX FOUR SEB) at 200°C for 40 min and for 50 min (25% increase). Internal temperatures of all cooked samples were recorded.

Bacterial Examination:

From each sample, (10 g) were homgenized with 90 ml of sterile peptone water (0.1%) diluent then serial dilutions were made in the same diluent. Aerobic plate count (APC) and psychrotrophic flora count (PFC) were done on plate count agar (PCA) medium incubated for 3 days at 30°C and at 4°C respectively as recommended by A.O.A.C.(1990). Enumeration of the test organisms were done using the spread plate technique adopted by Norttingham et al (1975). Brilliant green agar (BGA) was used for enumeration of *S. typhimuruim,* Baird Parker agar (BPA) for *Staph. aureus* and tryptose sulphite cycloserine (TSC) for *C. Perringenes.*

RESULTS AND DISCUSSION

The rise of internal temperature of minced meat and chicken breast samples cooked by microwave oven was much more rapid than those cooked by electric fan oven. Minced meat samples could reach 64°C and 72°C within 6 min and 7.5 min respectively. while, by conventional cooking the same type of samples reached 90°C and 97°C within 40 min and 50 min respectively tables (1,2). Nearly, the same results were obtlained regarding chicken breast samples (tablse 3,4). The acheived results indicated that time/temperature exposure received by the samples cooked by electric fan ovan was greater than that of microwaved samples. Similar results were oblainied by Hollywood et al., (1991).

The mean values (log_{10}) of Aerobic plate count (APC/g) and Psychrotrophic flora count (PFC/g) existed in raw minced meat samples were 7.91 and 6.62 respectively, table (1) while, they were 6.38 and 5 in raw chicken breast samples respectively, table (3), Conventironal cooking was adequate for reducing that numbers of bacteria, the surival rates of APC/g and PFC/g of minced meat were 0.01% and 0.05% respectively where as they were 1% and 2% in chicken breat

Table (1): Survival rates (%) of test organisms in minced meat samples cooked by microwave and conventiona ovens using recommend cooking time.

Orgainsms	Cooking procedure		Internal Temperature	Initial mean count log/g	Post cooking mean count iog/g	Rate of de-struction %
	Type	Time (min)				
APC	Microwave	6	64°C	7.91	6.48	96.3
	Convetional	40	90°C	7.91	3.91	99.99
PFC	Microwave	6	64°C	6.62	4.62	99.95
	Convetional	40	90°C	6.62	3.32	79.5
S.typhimurium	Microwave	6	64°C	6.57	4.97	97.5
	Convetional	40	90°C	6.57	<1	>99.99
S.aureus	Microwave	6	64°C	6.87	5.51	95.6
	Convetional	40	90°C	6.87	4.87	99.0
C.perfringenes	Microwave	6	64°C	6	3.60	99.6
	Convetional	40	90°C	6	<1	>99.99

APC: Aerobic plate count/g
<1 The organism was not detected in (101) dilution
PC: Psychrotrophic count/g

Table (2): Survival rates (%) of test organisms in minced meat samples cooked by microwave and conventiona ovens with 25% increase in recommend cooking time.

Orgainsms	Cooking procedure		Internal Temperature	Initial mean count log/g	Post cooking mean count log/g	Rate of de-struction %
	Type	Time (min)				
APC	Microwave	7.5	72°C	7.91	<1	>99.99
	Convetional	50	97°C	7.91	<1	>99.99
PFC	Microwave	7.5	72°C	6.62	<1	>99.99
	Convetional	50	97°C	6.62	<1	>99.99
S.typhimurium	Microwave	7.5	72°C	6.57	<1	>99.99
	Convetional	50	97°C	6.57	<1	>99.99
S.aureus	Microwave	7.5	72°C	6.87	4.87	99.00
	Convetional	50	97°C	6.87	4.35	99.99
C.perfringenes	Microwave	7.5	72°C	6	<1	>99.99
	Convetional	50	97°C	6	<1	>99.99

Table (3): Survival rates (%) of test organisms in chicken breast samples cooked by microwave and conventiona ovens using recommend cooking time.

Orgainsms	Cooking procedure		Internal	Initial mean	Post cooking	Rate of de-
	Type	Time (min)	Temperature	count log/g	mean count log/g	struction %
APC	Microwave	8.5	58°C	6.38	5.68	80
	Convetional	40	83°C	6.38	4.38	99
PFC	Microwave	8.5	58°C	5	5.08	88
	Convetional	40	83°C	5	3.30	98
S.typhimurium	Microwave	8.5	58°C	6.57	4.27	99.5
	Convetional	40	83°C	6.57	<1	>99.99
S.aureus	Microwave	8.5	58°C	6.73	5.03	98
	Convetional	40	83°C	6.73	4.20	99.7
C.perfringenes	Microwave	8.5	58°C	6.43	4.33	99.2
	Convetional	40	83°C	6.43	3.90	99.7

Table (4): Survival rates (%) of test organisms in chicken breast samples cooked by microwave and conventiona ovens with 25% increase in recommend cooking time.

Orgainsms	Cooking procedure		Internal	Initial mean	Post cooking	Rate of de-
	Type	Time (min)	Temperature	count log/g	mean count log/g	struction %
APC	Microwave	10.6	66°C	6.38		99
	Convetional	50	96°C	6.38	<1	>99.99
PFC	Microwave	10.6	72°C	5.00		99.06
	Convetional	50	97°C	5.00	<1	>99.99
S.typhimurium	Microwave	10.6	66°C	6.57	<1	>99.99
	Convetional	50	96°C	6.57	<1	>99.99
S.aureus	Microwave	10.6	66°C	6.73	4.73	99.00
	Convetional	50	96°C	6.73	3.73	99.9
C.perfringenes	Microwave	10.6	66°C	6.43	<1	>99.99
	Convetional	50	96°C	6.43	<1	>99.99

samples respectively. That finding agreed with White and Hobbs (1963) who stated that conventional cooking reduce the bacterial numbers in food to nondetectable levels.

On the other hand substantial numbers of (APC/g) survived in microwaved samples cooked according to the manufacturer's recomended time where the average destruction rates of APC/g were 96.3% and 80% for minced meat and chicken breast samples respectively while PFC/g destructed with average rates of 99% and 88% respectively. From the acheived, results we can conclude that microwave ovens are not as effective as conventional ones in reducing bacterial numbers in food. The same conclusion was reported by (Alexo et al. 1985, Choie et al. 1993 and Huang et al 1993).

S. typhimurium could not be detected in all samples of minced meat, and chicken breast, which cooked by conventional cooking procedure tables (1, 2, 3, 4) while, microwave cooking by the manufacturer's recommended time resulted in a survival rates for *S. typhomurium* by 2.5% and 0.5 in minced meat and chicken breast samples respectively. On the other hand the increase of the cooking time resulted in complete reduction of *S. typhimurium* and *C. perfringenes* in all examined minced meat and breast samples cooked either by microwave or conventionally. The obtained results agreed with that obtained by Baker et al (1983).

Regarding microwave cooking, the average survival rates of *Staph. aureus* inoculated in minced meat and chicken breast samples cooked according to manufacturer recommended time were 4.4% and 1% respectively. By increasing microwave cooking time, the average surival rates wee 1% for both minced meat and chicken breast samples. However, Page (1977) considered that 60°C for 20 to 30 min is required for the destruction of salmonella, shigella and E.coli and that 69°C for 10 to 20min will destroy *Staph auareus*. Dessel et al., (1960) found that microwave cooking is superior to conventional cooking in destroying *Staph. aureus*. In contrast, Lacey et al., (1965) and Culkin (1973) detected survival rates of *Staph. aureus* was not completely destroyed in all samples irrespective of cooking procedures.

The lowerd thermal reduction in viable counts of organisms obtained from microwaved samples may be related to the quick rise of temperature and as a result, the shorter exposure of the bacterial to lethal temperature as explained by (Stanford 1990 and Fakhouri & Ramaswany 1993). Also, the uneven heat distribution during microwave cooking which resulted in hot and cold spots in cooked food mentioned by Culkin & Fung 1975 and Schiffman 1992 may be the cause of bacterial survival rates obtained in this study.

In conclusion, the rapid increase in food temperature resulting from microwave cooking does not provide the same cumulative time - temperature relationship necessary for the destruction of microorganisms including potentially pathogenic species as do the conventional oven. This indicates the necessity

for an adequate cooking time when using the microwave method to insure food against remaining viable microorganisms.

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