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Experiments in Cooking Poultry for Pre-Cooked Poultry Products

COOKING FOWL WITH VARIOUS SALTS AND IN PLASTIC CONTAINERS

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Experiments in Cooking Poultry for Pre-Cooked Poultry Products

O. J. KAHLENBERG AND E. M. FUNK

INTRODUCTION

Rapidly growing acceptance of precooked frozen and canned foods and the entry of large processors in the field indicate this method of processing will become increasingly important for both poultry and red meats. It is essential for the poultry industry to have its products used to the fullest extent in these precooked frozen foods. Continued use of poultry products among these convenience-food items is dependent upon the development and improvement of commercial processing methods.

It is generally known that the keeping qualities of precooked frozen meats depend upon the methods of cooking and packaging, types of seasoning, and storage temperatures. Much of the research reported in the literature on quality of chicken meat as affected by cooking methods has been with young chickens. A number of papers have described palatability of mature birds cooked with water but basic data are not available for recommending commercial cooking methods. Hanson *et al.* (4)* reported that the older, less tender chickens of good quality could be utilized successfully in precooked frozen foods for a more flavorful product than that obtained from younger birds. Simmering or pressure-cooking was recommended to give the meat the desired degree of tenderness. Vail and Conrad (11) describe a procedure of disjointing hens and cooking the parts by simmering for three hours. Swickard, Harkin, and Paul (9) determined the relationship of steaming, simmering, and pressure-cooking as applied to home preparations. They found that the meat of steamed and simmered hens was generally rated higher than that of pressure-cooked hens by panel evaluations, shear force, and press-liquid tests. Steamed and simmered light meat was significantly more tender than pressure-cooked light meat.

*Numbers refer to a list of references in the back of this bulletin.

Woodroof and Shelor (13) reported that chicken when cooked with moist heat could be satisfactorily frozen and stored for one year or more, while turkey could be held for from 3 to 6 months. Working with turkeys, Hanson and co-workers (4) observed that the roasting method had no advantage over simmering or pressure-cooking in producing a product with a typical "roast turkey flavor." Roasting had the disadvantage of accelerating development of fat rancidity.

In studies on red meat, Deatherage (2) reported that the water-holding capacity of meat proteins was directly related to shrinkage on cooking, drip on freezing and thawing, and tenderness. Wierbicki, Cahill, and Deatherage (12) found that the chlorides of sodium, potassium, calcium, and magnesium when added to ground beef prior to heating increased the water-holding capacity of meat proteins when heated to 70° C (158°F). The juice expressed on heating was less for the calcium and magnesium chlorides than for the sodium and potassium chlorides. Magnesium chloride showed the most pronounced effect. Tims and Watts (10) reported on the value of phosphates for red meats in decreasing cooking losses. It seemed appropriate to extend some of these findings to poultry meat.

OBJECTIVES

Objective of this investigation was to compare the cooking losses, degrees of tenderness in the breast meat, and the amounts of fat in the thigh meat when old fowl were cooked by various methods: (1) With and without the incorporation of salts in the cooking water and (2) in plastic bags and tubes.

EXPERIMENTAL PROCEDURES

Sixteen to 20-month old White Leghorns. from the University Poultry Farm were killed, scalded, warm eviscerated, chilled in ice water, drained, and packaged in Cryovac bags. The packaged birds were frozen at -20° F in a blast tunnel, then stored at 0° F for 1 to 17 months before used. Birds were removed from the freezer and thawed in a 38° F cooler the day before they were to be cooked. Individual weights were taken of the thawed eviscerated carcasses, without necks and giblets, both before and after cooking.

Comparisons were made of various cooking procedures on these old fowl, with and without the incorporation of salts in the water, for cooking losses and degree of tenderness in the breast meat. The salts studied initially were 2.0 and 4.0% sodium chloride, 0.75 and 1.50% potassium chloride, 0.60 and 1.20% calcium chloride, 0.50 and 1.00% magnesium chloride, 2.0 and 4.0% sodium hexametaphosphate, 2.0 and 4.0% sodium tripolyphosphate and 2.0% sodium orthophosphate. Methods of cooking were boiling, simmering, and pressure-cooking. Boiling consisted of a rolling boil for 90 minutes, simmering consisted of cooking 1 hour and 45 minutes at 200° F followed by an additional 45 minutes at

210° F, and pressure-cooking meant cooking in an aluminum pressure-cooker at 15 pounds pressure (250° F) for 20 minutes allowing an additional 25 minutes for cooling before the lid of the pressure-cooker could be removed. After cooking, the birds were allowed to drain at room temperature for 10 minutes. Carcasses were weighed and allowed to cool in a 38° F cooler for 45 minutes before samples were removed for tenderness studies.

Since these procedures were for developing methods of processing fowl for commercial precooked frozen and canned products the birds were not sized according to weight and cooked for different time periods. Birds held for varying storage periods were grouped together for these studies.

The degree of tenderness of the breast meat was measured with the Kramer shear press described by Kramer, Burkhardt, and Rogers (5), using the hydraulic ram adjusted to 225 pounds for the 3000 pound proving ring. Samples of breast meat were trimmed from either end of the longitudinal axis of each side of the breast to fit the shearing cell, and then placed in the cell so that the meat fibers were at an axis opposite the cross grooves of the cell. Measurements were made of the force required to shear across the grain of the meat. Separate readings were taken from both the left and right sides of the cooked breast meat of each bird, the average of the two being taken as the tenderness value of each cooked bird. The trimmed portion was weighed in grams. The shear force values were calculated as pounds per gram of sample of meat. A low shear value indicates tender meat. Shannon, Marion, and Stadelman (7) reported a correlation coefficient of 0.86 between Kramer shear press values and organoleptic panel scores of poultry meat.

Determinations of pH were made on the salt solutions and on the broth after cooking. When broth fat was measured, it was removed with a separatory funnel and weighed. The thigh meat, without skin, was removed from the bones, placed in glass jars, sealed, and frozen. The frozen meat was further prepared in a 0° F room by grinding it three times in a hand-operated meat chopper. The ground samples were put back into the same glass jars and kept in the freezer locker for later analyses of fat and moisture. Moisture and fat determinations were made on duplicate samples of thigh meat by the University of Missouri Experiment Station chemical laboratories, using the official methods of A.O.A.C. (1)

The plastic bags and tubes selected for these studies were Cryovac, type 300 (W. R. Grace & Co); Visten, R.B.P. #12 (Visking Co., Division of Carbon Carbide Corp.); conventional high pressure polyethylene #12, 1.5 ml. thickness, Mylar-polyethylene laminated (Flexible Packaging Division, Continental Can Co.); and Du Pont Mylar-polyester 50 H.S. (Bagcraft Corporation of America). The methods of cooking a bird in a bag or tube were boiling, simmering, and pressure-cooking. For the plastic container studies, "boiling" represented a rolling boil for 3 hours, "simmering" consisted of cooking for 3.5 hours, and pressure-cooking consisted of cooking the birds on a tray set on a rack in an autoclave at either 15 pounds pressure (250° F) for 45 minutes or 10 pounds pressure for 75 minutes, followed by an additional cooling of 20 minutes before the door of the autoclave could be opened.

Significance of the results were calculated by analysis of variance according to Snedecor (8), Duncan's new multiple range test (3), and Fisher's "t" test as described by Love (6).

RESULTS AND DISCUSSION

A. COOKING FOWL IN SALT SOLUTIONS

Preliminary tests:

Total cooking losses were smallest when fowl was simmered in 2% tripolyphosphate solutions (Table 1). In general cooking losses were greater with pressure-cooking than with either boiling or simmering. In the majority of cases the breast meat of the pressure-cooked birds was more tender (lower shear values) than that from boiled or simmered birds. The most tender meat was obtained when birds were cooked by boiling in tap water alone and when cooked by either simmering or pressure-cooking in 0.75% potassium chloride solution. In general the pH values of the broth after cooking in the various salt solutions by boiling, simmering, or pressure-cooking were on the alkaline side (range 7.3 to 9.1). Similar broth pH values were obtained when fowl were boiled, simmered, or pressure-cooked in tap water alone. When the birds were cooked in either sodium hexametaphosphate or sodium orthophosphate however, the resulting pH both values were on the acid side (pH 5.3 to 6.3). When either 2% sodium orthophosphate or 4% sodium hexametaphosphate was added to the water, the flavor of the cooked meat was rated from "slightly acid to "acid." Flavor comments for the meat cooked in tap water and in the various salt solutions (except sodium chloride) were rated, generally, as "very flat." Birds cooked in 4% sodium chloride were considered as "slightly salty," but the 2% sodium chloride birds were satisfactory in flavor. In view of these results it was decided to limit the number of salt solutions to those containing potassium chloride, sodium chloride, and sodium tripolyphosphate, and at the same time to increase the number of birds for each study.

Cooking Losses of Fowl in Salt Solutions

The cooking losses of each individual bird cooked with and without the various salt solutions are presented in Tables 10, 11, and 12 in Appendix A.

The correlation coefficients between body weight and percent fat loss, and body weight and percent non-fat loss were 0.35 and -0.27, for boiling, 0.76 and -0.23, for simmering, and 0.38 and 0.53 for pressure-cooking. The correlation coefficients between percent fat and non-fat losses were -0.85, -0.67, and -0.36

TABLE 1-AVERAGE PERCENT COOKING LOSSES AND KRAMER SHEAR VALUES OF FOWL WHEN COOKED IN VARIOUS SALT SOLUTIONS

Treatment	Boiling			Simmering			Pressure Cooking		
	No. of birds	Cooking loss	lbs. force per g. meat	No. of birds	Cooking loss	lbs. force per g. meat	No. of birds	Cooking loss	lbs. force per g. meat
		%			%			%	
Tap water	2	33.4	13.18	2	37.2	16.48	4	38.8	15.79
0.60% Calcium Chloride	2	38.4	18.76	2	34.5	21.20	2	40.2	16.30
1.20% Calcium Chloride	2	40.9	14.22	2	35.8	24.50	2	38.8	17.66
0.50% Magnesium Chloride	2	40.7	21.86	2	33.6	19.74	2	40.2	17.56
1.00% Magnesium Chloride	2	37.3	19.17	2	34.8	21.64	2	39.1	17.43
0.75% Potassium Chloride	2	36.9	16.87	2	36.6	13.66	2	41.6	12.56
1.50% Potassium Chloride	2	37.4	19.91	2	38.0	25.74	2	38.3	16.08
2.0% Sodium Chloride	2	36.8	15.94	2	37.9	17.61	2	40.7	19.76
4.0% Sodium Chloride	2	38.0	16.71	2	35.4	17.61	2	37.7	13.62
2.0% Sodium Hexametaphosphate	2	36.5	19.20	2	39.4	18.47	2	39.1	19.38
4.0% Sodium Hexametaphosphate	2	38.7	19.34	2	40.9	20.35	2	38.6	18.03
2.0% Sodium Orthophosphate	2	33.7	23.72	-	---	----	1	53.7	10.31
2.0% Sodium Tripolyphosphate	2	37.3	22.24	2	30.6	22.65	2*	36.5	17.55
4.0% Sodium Tripolyphosphate	2	39.5	16.22	2	36.8	17.79	1*	48.1	9.91

*Aluminum of pressure cooker corroded due to salt.

TABLE 2-AVERAGE PERCENT COOKING LOSSES AND KRAMER SHEAR VALUES OF FOWL WHEN COOKED IN VARIOUS SALT SOLUTIONS

Treatment	No. Birds	Avg. Carcass wt.	Boiling Cooking loss	Boiling lbs. force/ g. meat	No. Birds	Avg. Carcass wt.	Simmering Cooking loss	Simmering lbs. force/ g. meat	No. Birds	Avg. Carcass wt.	Pressure Cooking Cooking loss	Pressure Cooking lbs. force/ g. meat
		g.	%			g.	%			g.	%	
Tap water	7	1446	34.5	20.20	8	1489	37.5	18.33	8	1486	37.1	15.15
0.75% Potassium Chloride	6	1525	37.7	18.36	6	1270	36.1	19.20	12	1435	38.4	15.22
1.50% Potassium Chloride	6	1382	40.9	21.29	6	1313	40.7	21.62	6	1283	40.5	17.01
2.0% Sodium Chloride	6	1335	40.5	18.12	6	1474	39.1	19.36	6	1568	41.6	18.11
4.0% Sodium Chloride	7	1589	40.1	18.13	6	1829	39.0	15.22	6	1450	40.3	14.35
2.0% Sodium Tri-polyphosphate	6	1656	39.5	20.73	6	1760	37.4	17.49	2*	1153	36.5	17.55
4.0% Sodium tri-polyphosphate	6	1502	40.1	18.15	6	1547	37.3	18.00	2*	1509	47.9	11.03

*Aluminum of pressure-cooker corroded due to salt.

for boiling, simmering, and pressure-cooking, respectively. These relationships expressed as regression coefficients were -0.67 for boiling, -0.56 for simmering, and -0.26 for pressure-cooking. An analysis of covariance showed that the regression coefficients were significantly different from a common regression coefficient ($p = .10$) level. Differences between the methods of cooking after adjustment for differences in the fat of the bird were significant at the 0.03 probability level.

Since the relationship between percentages of fat and non-fat losses were significantly different between the cooking methods, a single regression coefficient could not be used for the entire group. Using the statistical regression coefficient for each cooking method, the percentage of non-fat losses were adjusted to account for the differences in fatness of the birds. Differences in fatness were so great in these experimental birds that they would have covered up expected differences due to the type and level of salt. The analysis of variance of the non-fat cooking losses adjusted for variations in fat content among the birds cooked by each method is shown in Table 3.

TABLE 3-ANALYSIS OF VARIANCE FOR NON-FAT COOKING LOSSES ADJUSTED FOR VARIATIONS OF FAT OF BIRD

Source of Variance	d.f.	m.s.	f-value
Salt	3	5.97	0.36
Level w/n salt	3	16.81	1.06
Method w/n level w/n salt (Treatment)	12	15.92	2.06*
Error	67	7.72	
Total	85		

*Significant at the 0.05 level

Studentized Ranges for a 5% New Multiple Range Test

Treatment	Boil	Pressure-cook	Simmer
Non-fat cooking loss means	28.5	27.4	26.7
	- - - - - -	- - - - - -	
		- - - - - -	- - - - - -

Means not underscored by the same broken line are significantly different. Means which are underscored are not significantly different.

Differences in non-fat cooking losses among either the "salt" or "level within the salt" in Table 3 were not significant. The differences due to "treatment" were significant at the 5 percent level. Student's Duncan Multiple Range test shows that simmering had significantly lower non-fat cooking losses than boiling. The non-fat cooking losses were 26.7 percent for simmering, 27.4 percent for pressure-cooking, and 28.5 percent for boiling. The differences between boiling and pressure-cooking were not significant. It should be borne in mind that the cooking losses attributed to the three cooking methods could also be partially due to the length of cooking time. It is not known for example if simmering for 2½ hours and boiling for 1½ hours are equivalent from a time-temperature relationship.

Kramer Shear Values of Fowl Cooked in Salt Solutions

The Kramer shear force values of each individual bird cooked with and without the various salt solutions are presented in Tables 13, 14, and 15 in Appendix A. An analysis of variance for Kramer shear force values (Table 4) shows that shear values due to the salts themselves and to the "level within salt" were not significant but that "treatment" was very significant. Student's Duncan Multiple Range test showed that pressure-cooking gave significantly lower shear force values of the cooked breast meat than boiling or simmering (Table 4). Although their experimental conditions were different from these studies, Swickard, Harkin, and Paul (9) reported that the simmered and steamed light meat as measured by the Warner-Bratzler shear values and palatability scores was significantly more tender than the pressure-cooked light meat, and that simmered dark meat was significantly more tender than pressure-cooked dark meat. Table 4 indicates that differences of shear force mean values of the breast meat as a result of either boiling or simmering were insignificant.

TABLE 4-ANALYSIS OF VARIANCE FOR KRAMER SHEAR VALUES

Source of Variance	d.f.	m.s.	f-value
Salt	3	11.1506	0.22
Level w/n salt	3	51.8129	1.13
Method w/n level w/n salt (Treatment)	12	45.9533	3.69**
Error	107	12.4669	
Total	125		

**Significant at the .01 level

Studentized Ranges for a 1% level New Multiple Range Test

Treatment	Boil	Simmer	Pressure Cook
Shear Force Means	19.28	18.45	15.81

(Boil and Simmer means underscored by the same line.)

Means not underscored by the same line are significantly different at the .01 level. Means which are underscored by the same line are not significantly different.

Fat Content of Thigh Meat of Fowl Cooked in Salt Solutions

Since it is generally known that fat and moisture content affect the juiciness of poultry meat, determinations were made for these factors in the thigh meat.

Results in Table 16 (Appendix A) and summarized in Table 5 show that the percentage of fat in thigh meat, on a dry basis, was consistently lower when carcasses were pressure-cooked than when birds were either simmered or boiled. An analysis of variance for fat in cooked fowl thigh meat (Table 6) shows that neither the salts themselves nor the "level within salt" were significant but that "treatment" was highly significant. Further statistical treatment of the means revealed that the thigh meat of pressure-cooked carcasses was significantly lower

TABLE 5-AVERAGE PERCENT FAT AND MOISTURE IN THIGH MEAT OF FOWL WHEN COOKED IN VARIOUS SALT SOLUTIONS

Treatment	Boiling				Simmering				Pressure Cooking			
	No. Birds	Fat	Moisture	Fat dry basis	No. Birds	Fat	Moisture	Fat dry basis	No. Birds	Fat	Moisture	Fat dry basis
		%	%	%		%	%	%		%	%	%
Tap Water	7	10.96	60.85	27.24	8	9.48	61.32	24.45	8	6.78	62.77	17.88
0.75% Potassium Chloride	6	11.87	59.71	29.21	6	7.92	62.25	20.98	12	6.17	62.29	16.30
1.50% Potassium Chloride	6	11.58	59.39	28.37	6	12.30	58.86	29.56	6	9.12	60.19	22.69
2.0% Sodium Chloride	6	9.98	60.49	25.18	6	10.73	60.50	26.86	6	10.55	60.03	26.09
4.0% Sodium Chloride	7	10.52	59.61	25.91	6	12.44	58.88	30.05	6	9.76	60.00	24.22
2.0% Sodium Tri-polyphosphate	6	10.44	60.55	26.19	6	12.32	60.01	30.60	--			
4.0% Sodium Tri-polyphosphate	6	10.24	60.08	25.53	6	12.17	59.61	29.74	--			

TABLE 6-ANALYSIS OF VARIANCE FOR FAT IN COOKED FOWL THIGH MEAT

Source of variance	d.f.	m.s.	f-value
Salt	3	162.1518	1.217
Level w/n salt	3	133.2552	1,134
Method w/n level w/n salt (Treatment)	12	117.5207	3.29**
Error	107	35.7219	
Total	125		

**Significant at the .01 level

Studentized Ranges for a 1% level New Multiple Range Test

Treatment	Simmer	Boil	Pressure Cook
Fat Means	27.33	26.79	20.44

(Simmer and Boil means are underscored by the same line.)

Means not underscored by the same line are significantly different at the .01 level.
Means which are underscored by the same line are not significantly different.

in fat than the thigh meat of birds which were either boiled or simmered. There were no significant differences in the fat content of thigh meat when birds were cooked by either simmering or boiling.

The results indicate that cooking fowl in the various salt solutions outlined in these studies had no advantage over cooking in water with respect to non-fat cooking losses, tenderness of breast meat as measured by the Kramer shear press, and the amount of fat in the thigh meat.

B. Cooking Fowl in Plastic Bags and Tubes

Preliminary Tests:

Trials with the Cryovac bag (type 300) utilizing 6 birds indicated that it would be necessary to cook old fowl for more than 5 hours in water at 170° F. Further studies on 6 additional birds at water temperatures ranging from 170-180° F for 5 hours resulted in 4 of the 6 bags bursting. The low water temperature range was necessary because of the heat lability of the Cryovac film. Use of the Cryovac bag in these particular studies of cooking old fowl was considered impractical because of the long cooking time required and the uncertainty of the functional properties of the bag under these conditions.

Trials were made next with 7 fowl placed in Visten bags (vinyl type Visten film RBP #12) and cooked in boiling water for a period of 3 hours. One bag burst during the cooking while another bag was punctured from a bone of the carcass All of the bags "ballooned" during cooking. This was caused by expansion of the air inside. In all of the studies on plastic materials the air was withdrawn from the filled bags with a vacuum pump. The bag itself was sealed shut with a clamp and dipped in hot water which caused the film to shrink uniformly around the bird. Detailed cooking losses and tenderness values are in Tables

17 and 18 (Appendix A) and summarized in Table 7. In the individual tenderness values (Table 18), a shear force value of 24.83 pounds per gram was observed on breast meat that was considered "done" as compared with values of 8.75 to 15.47 pounds force per gram on meat described as "almost done" and "precooked," respectively. An average value of 14.46 pounds force per gram of meat when compared with an average value of 20.20 obtained from meat of fowl boiled in tap water alone was not statistically significant. Although an average cooking loss of 30 percent as a result of cooking birds in a Visten bag was 4.5 percent lower than that obtained as a result of boiling birds in tap water, a "t" test showed this lower cooking loss to be insignificant. No off flavors were detected in the cooked breast meat when the Visten bag was used for cooking.

When 9 birds were placed individually in Visten bags and pressure-cooked at either 10 pounds pressure (240° F) for 75 minutes or 15 pounds pressure (250° F) for 45 minutes all of the bags fell apart.

The two types of plastic bags studied next were described as conventional high pressure polyethylene (1.5 mls thickness, #12 size) and Mylar-polyethylene laminated. When 5 carcasses were placed individually in each of 5 polyethylene bags, treated as previously described, and then put in boiling water for 3 hrs., all of the bags disintegrated. The Mylar-polyethylene laminated bags broke at the seams when birds were placed in them and cooked in boiling water for a period of several hours. Further tests were made with 5 birds in Mylar-polyethylene bags and pressure-cooking at 15 pounds pressure (250° F) for 45 minutes. All of the bags came apart at the seams.

Cooking Losses and Kramer Shear Values of Fowl Cooked in Bagcraft Tubes

The only type of plastic material which showed promise for cooking old fowl was the new Du Pont heat-shrinkable Mylar-polyester tubes designated as 50 HS Mylar and obtained from the Bagcraft Corporation. The tubes containing the carcasses were clamped at one end. A vacuum withdrew air from the other end before it, too, was clamped. The plastic tubes containing the birds "ballooned" or puffed up in simmered and boiled water but they remained intact without puncturing. None of the tubes disintegrated or "blew up" when birds were pressure-cooked at 10 pounds (240° F) for 75 minutes, but 6 out of a total of 16 of the sealed tubes burst when the birds were pressure-cooked at 15 pounds pressure (250° F) for 45 minutes. Cooking losses and degrees of tenderness of the meat utilizing the Mylar-polyester tubes are shown in Tables 17 and 18 (Appendix A) and summarized in Table 7.

Statistical treatment of the data showed that the correlation coefficients between body weight and percent fat losses, and body weight and percent non-fat losses were 0.27 and 0.32 for boiling, 0.29 and −0.20 for simmering, and 0.23 and −0.51 for pressure-cooking, respectively. The correlation coefficients between percent fat and non-fat losses were −0.63, −0.88, and −0.55 for boiling, simmering, and pressure-cooking, respectively. These relationships expressed as regression

TABLE 7-AVERAGE PERCENT COOKING LOSSES AND KRAMER SHEAR VALUES OF FOWL WHEN COOKED IN PLASTIC BAGS OR TUBES

Type Container	Boiling No. Birds	Boiling Cooking loss	Boiling lbs.force/ g. meat	Simmering No. Birds	Simmering Cooking loss	Simmering lbs.force/ g. meat	Pressure Cook 15 lbs. No. Birds	Pressure Cook 15 lbs. Cooking loss	Pressure Cook 15 lbs. lbs.force/ g. meat	Pressure Cook 10 lbs. No. Birds	Pressure Cook 10 lbs. Cooking loss	Pressure Cook 10 lbs. lbs. force/ g. meat
		%			%			%			%	
Visten Bag	5	30.0	14.46									
Bagcraft tube	7	30.2	17.57	6	29.9	17.91	10	33.7	18.41	6	33.8	21.41

TABLE 8-AVERAGE PERCENT FAT AND MOISTURE IN THIGH MEAT OF FOWL WHEN COOKED IN PLASTIC TUBES

Type Container	Boiling No. Birds	Boiling Moisture	Boiling Fat dry basis	Simmering No. Birds	Simmering Moisture	Simmering Fat dry basis	Pressure Cook 15 lbs. No. Birds	Pressure Cook 15 lbs. Moisture	Pressure Cook 15 lbs. Fat dry basis	Pressure Cook 10 lbs. No. Birds	Pressure Cook 10 lbs. Moisture	Pressure Cook 10 lbs. Fat dry basis
		%	%		%	%		%	%		%	%
Bagcraft Tube	6	59.78	29.45	6	60.50	26.07	10	60.31	24.72	6	61.27	26.52

coefficients were found to be -0.96 for boiling, -0.75 for simmering, and -0.53 for pressure-cooking. An analysis of co-variance showed that the regression coefficients were not significantly different from a common regression coefficient. The differences between the methods of cooking after adjustment for the differences in the fat of the bird were not significantly different. Using the statistical regression coefficient for each cooking method, the percentage of non-fat losses were adjusted to account for differences in the fatness of the birds. Analysis of variance of the non-fat cooking losses adjusted for variations in fat content among the birds showed that "treatment" or the method of cooking was not significant, but that cooking the birds with or without the plastic container was significant. The non-fat losses when birds were cooked in plastic tubes were 24.4 percent, compared to 28.3 percent when cooked in water without the tube.

An analysis of variance of the Kramer shear values of the breast meat of birds cooked either with or without the plastic tubes showed no significant differences in the tenderness of the meat when birds were boiled, simmered, or pressure-cooked at 15 pounds pressure (250° F). A "t" test showed significantly higher shear values of the breast meat when birds were pressure-cooked at 10 pounds pressure (240° F) in a Bagcraft tube as compared with the shear values on meat of birds pressure-cooked at 15 pounds pressure (250° F) without the tube.

No off-flavors were detected in the breast meat cooked in the plastic tubes.

Fat Content of Thigh Meat of Fowl Cooked in Plastic Tubes

Individual results recorded in Table 19 (Appendix A) are summarized in Table 8. An analysis of variance of fat in thigh meat shows that treatment was highly significant (Table 9). Student's Duncan Multiple Range test reveals that

TABLE 9-ANALYSIS OF VARIANCE FOR FAT IN THIGH MEAT OF FOWL COOKED WITH AND WITHOUT PLASTIC CONTAINERS

Source of Variance	d.f.	m.s.	f-value
A. Container for bird	1	70.86	1.65
B. Treatment	2	261.82	6.08**
Interaction A & B	2	76.56	1.78
Error	38	43.03	
Total	43		

**Significant at the .01 level

Studentized Ranges for a 1% level New Multiple Range Test

Treatment	Boil	Simmer	Pressure-cook
Fat means	30.21	25.26	21.30

(Boil and Simmer underscored by one line; Simmer and Pressure-cook underscored by another line.)

Means not underscored by the same line are significantly different at the .01 level. Means which are underscored are not significantly different.

when birds were pressure-cooked they contained significantly less fat in the thigh meat than birds cooked by boiling. The percentages of fat content of the thigh meat as a result of boiling, simmering, and pressure-cooking were 30.21, 25.26, and 21.30, respectively. Differences in fat content of thigh meat as a result of boiling and simmering, and simmering and pressure-cooking were not significant (Table 9).

SUMMARY AND CONCLUSIONS

Comparison of cooking losses, degree of tenderness in the breast meat, and amount of fat in the thigh meat were made on old fowl cooked by various methods, with and without salts in the cooking water, and in plastic bags and tubes. The cooking treatments consisted of boiling, simmering, and pressure-cooking.

An analysis of variance of non-fat cooking losses adjusted for variations in the fat content of the birds, showed that differences due to "treatment" were significant but that the salts themselves or "level within salt" were not significant. Simmering caused significantly lower non-fat cooking losses than boiling. The differences in non-fat cooking losses between boiling and pressure-cooking and between simmering and pressure-cooking were not significant.

An analysis of variance for Kramer shear values of the breast meat showed that only "treatment" was very significant. Differences in shear values due to the salts themselves or to the "level within salt" were not significant. Pressure-cooking gave significantly lower shear force values than either boiling or simmering. Differences of Kramer shear force values of the meat as a result of either boiling or simmering were not significant.

An analysis of variance for the fat content in the cooked thigh meat showed that neither the salts themselves nor the "level within salt" were significant but that "treatment" was highly significant. The thigh meat of pressure-cooked carcasses was significantly lower in fat than the thigh meat of birds which were either boiled or simmered. There were no significant differences in the fat content of cooked thigh meat when birds were cooked by either simmering or boiling.

Under the conditions of these studies it may be concluded that the cooking of old fowl in the salt solutions had no advantage over cooking in water with respect to non-fat cooking losses, tenderness of cooked breast meat as judged by the Kramer shear test, and the amount of fat in the cooked thigh meat.

Only one out of 5 plastic materials remained intact after a fowl was boiled, simmered or pressure-cooked in them. The only type of plastic material which showed promise for cooking old fowl under the experimental conditions outlined was the Du Pont Mylar-polyester tube (Bagcraft 50 Heat Sealable).

An analysis of variance for non-fat cooking losses adjusted for variations in the fat content of the bird showed that the birds cooked in plastic tubes in water had significantly less non-fat cooking losses than did the birds cooked in water without the tubes. Differences in non-fat cooking losses due to "treatment" were not significant.

No significant differences in Kramer shear values of cooked breast meat were found when comparisons were made with and without the plastic tubes when birds were either boiled, simmered, or pressure-cooked at 15 pounds pressure (250° F).

An analysis of variance of fat in thigh meat showed that treatment was highly significant. Pressure-cooked birds contained significantly less fat in the thigh meat than did birds cooked by boiling. The differences in fat content of the thigh meat between boiling and simmering, and simmering and pressure-cooking were not significant.

No off-flavors were detected in the breast meat cooked in the plastic tubes.

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APPENDIX

TABLE 10-PERCENT COOKING LOSSES OF FOWL WHEN BOILED IN VARIOUS SALT SOLUTIONS

Treatment	Bird No.	Carcass wt.	Carcass wt. after cooking	Total cooking loss	Fat loss	Total cooking loss	Cooking loss other than fat
		g	g	g	g	%	%
Tap Water	A-167	1110	700	410	0	36.9	36.9
	H-100	1181	722	459	153	38.9	25.9
	H-103	2027	1119	908	413	44.8	24.4
	N5106	1215	805	410	---	33.7	
	N5779	1226	820	406	---	33.1	
	N6490	1831	1166	665	---	27.5	
	N6163	1531	946	567	---	26.7	
Avg.		1446	899	546		34.5	
2.0% Sodium Chloride	N5010	1364	897	467		34.2	
	N3170	1298	788	510		39.3	
	H-114	1412	790	622	240	44.1	27.1
	H-115	1427	779	648	218	45.4	30.1
	H-116	1268	729	539	228	42.5	24.5
	H-118	1238	778	460	152	37.2	24.9
Avg.		1335	794	541		40.5	
4.0% Sodium Chloride	N3366	1739	1041	698		40.1	
	N2495	1627	1045	582		35.8	
	H-117	1225	752	473	88	38.6	31.4
	H-119	1519	900	619	172	40.8	29.4
	H-120	1495	918	577	71	38.6	33.8
	H-121	1764	999	765	165	43.4	34.0
	H-122	1756	1011	745	224	42.4	29.6
Avg.		1589	552	637		40.1	
2.0% Sodium Tripoly-phosphate	H-123	1840	1113	727	342	39.5	20.9
	H-124	1849	1059	790	403	42.7	20.9
	H-125	1661	975	686	293	41.3	23.7
	H-126	1682	1031	651	143	38.7	30.2
	A-140	1441	913	528	82	36.6	31.0
	A-141	1465	909	556	134	38.0	28.8
Avg.		1656	1000	656	233	39.5	25.9
4.0% Sodium Tripoly-phosphate	A-144	1879	1138	741	99	39.4	34.2
	A-145	1860	1226	734	164	39.5	30.6
	H-163	1592	953	639	211	40.1	26.9
	H-164	1566	918	648	216	41.4	27.6
	H-165	1054	599	455	149	43.2	29.0
	H-166	1059	670	389	48	36.7	32.2
Avg.		1502	917	601	148	40.1	30.1
0.75% Potassium Chloride	N2550	1546	946	600		38.8	
	N5867	1602	1039	563		35.1	
	A-127	1632	989	643	270	39.4	22.8
	A-129	1495	958	537	171	35.9	24.5
	A-131	1476	913	563	206	38.1	23.5
	A-133	1400	856	544	59	38.8	34.6
Avg.		1525	950	575		37.7	
1.5% Potassium Chloride	H-127	1531	934	597	112	39.0	31.7
	H-128	1564	868	696	317	44.5	24.2
	H-129	1331	799	532	131	40.0	30.1
	H-130	1373	726	647	193	47.1	33.1
	N6485	1258	798	460	---	36.6	---
	N5955	1234	762	472	---	38.2	
Avg.		1382	815	567		40.9	

TABLE 11-PERCENT COOKING LOSSES OF FOWL WHEN SIMMERED IN VARIOUS SALT SOLUTIONS

Treatment	Bird No.	Carcass wt.	Carcass wt. after cooking	Total cooking loss	Fat loss	Total cooking loss	Cooking loss other than fat
		g.	g.	g.	g.	%	%
Tap Water	N2681	1521	954	567		37.3	
	H-178	1440	905	535		37.2	
	A-136	1774	1135	639	215	36.0	23.9
	A-137	1830	1179	651	129	35.6	20.9
	A-154	1437	913	524	113	36.5	28.6
	A-155	1417	913	504	97	35.6	28.7
	H-105	1166	700	466	80	40.0	33.1
	H-111	1329	770	559	142	42.1	31.4
Avg.		1489	934	556	129	37.5	
2.0% Sodium Chloride	H-135	1203	777	426	20	35.4	33.7
	H-136	1216	698	518	93	42.6	35.0
	H-137	1714	974	740	298	43.2	25.8
	H-138	1673	1042	631	169	37.7	27.6
	no tag	1618	983	635		39.2	
	N2586	1418	899	519		36.6	
Avg.		1474	896	578		39.1	
4.0% Sodium Chloride	H-131	2159	1258	901	432	41.7	21.7
	132	2237	1381	856	453	38.3	18.0
	133	1854	1070	784	269	42.3	27.8
	134	1834	1089	745	270	40.6	25.9
	H1099	1461	947	514		35.2	
	N3224	1426	919	507		35.6	
Avg.		1829	1111	718		39.0	
2.0% Sodium Tripoly-phosphate	H-143	1659	975	684	259	41.2	25.6
	H-144	1711	1011	700	329	40.9	21.7
	H-147	1935	1108	827	362	42.7	24.0
	H-148	1920	1189	731	317	38.1	21.6
	A-148	1680	1261	419	338	24.9	20.1
	A-149	1657	1055	602	381	36.3	23.0
Avg.		1760	1100	661	331	37.4	22.7
4.0% Sodium Tripoly-phosphate	A-152	1365	859	506	182	37.1	23.7
	A-153	1320	839	481	153	36.4	24.8
	H-167	2081	1233	848	392	40.8	21.9
	H-168	2001	1218	783	294	39.1	24.4
	H-169	1299	869	430	59	33.1	28.6
	H-170	1217	766	451	119	37.1	27.3
Avg.		1547	964	583	200	37.3	25.1
0.75% Potassium Chloride	H-139	1153	723	430	89	37.3	29.6
	H-140	1137	692	445	56	39.1	34.2
	A-134	1268	852	416	76	32.8	28.4
	A-135	1253	823	430	54	34.3	30.0
	N3345	1396	867	529		37.9	
	N6331	1411	912	499		35.4	
Avg.		1270	812	458		36.1	
1.5% Potassium Chloride	H-141	1181	647	534	160	45.2	31.7
	H-142	1247	705	542	176	43.5	29.4
	H-145	1597	980	617	166	38.6	28.2
	H-146	1608	951	657	255	40.9	25.0
	N5690	1056	661	395		37.4	
	N-124	1189	731	458		38.5	
Avg.		1313	779	534		40.7	

TABLE 12-PERCENT COOKING LOSSES OF FOWL WHEN PRESSURE-COOKED IN VARIOUS SALT SOLUTIONS

Treatment	Bird No.	Carcass wt.	Carcass wt. after cooking	Total cooking loss	Fat loss	Total cooking loss	Cooking loss other than fat
		g.	g.	g.	g.	%	%
Tap Water	N5869	1378	836	542		39.3	
	N5218	1328	817	511		38.5	
	A-100	1450	872	578		39.9	
	A-101	1474	926	548		37.2	
	A-156	1736	1058	678	158	39.0	30.0
	A-158	1296	974	322	30	24.8	22.5
	H-102	2065	1116	949	354	46.0	28.8
	H-101	1159	785	374	25	32.3	30.1
Avg.		1486	923	563		37.1	
2.0% Sodium Chloride	H-149	1515	889	626	234	41.3	25.9
	H-150	1521	899	622	244	40.8	24.9
	H-151	1748	974	774	249	44.3	30.0
	H-152	1737	1014	723	267	41.7	26.3
	A-114	1483	839	644		43.4	
	A-115	1406	873	533		37.9	
Avg.		1568	915	654		41.6	
4.0 % Sodium Chloride	H-153	1280	750	530	163	41.4	28.8
	H-154	1297	765	532	169	41.0	28.0
	H-155	1411	837	574	193	40.6	27.0
	H-156	1418	803	615	216	43.4	28.0
	A-112	1618	1029	589		36.4	
	A-113	1675	1023	652		38.9	
Avg.		1450	868	582		40.3	
2% Sodium Tripoly-phosphate*	H-104	1193	754	439	87	36.8	29.5
	A-166	1112	709	403	0	36.2	36.2
Avg.		1153	732	421	44	36.5	32.9
4% Sodium Tripoly-phosphate*	H-158	1134	594	540		47.7	
	H-106	1884	978	906	353	48.1	29.4
Avg.		1509	786	723		47.9	
0.75% Potassium Chloride	N3416	1326	776	551		41.6	
	N3219	1369	801	568		41.5	
	A-116	1437	876	561		39.0	
	A-117	1406	863	543		38.6	
	A-120	1510	1005	505		33.4	
	A-121	1486	910	576		38.8	
	A-124	1328	853	475		35.8	
	A-125	1385	834	551		39.8	
	A-126	1611	977	634	230	39.4	24.4
	A-128	1509	993	516	226	34.2	19.2
	A-130	1461	865	596	111	40.8	33.2
	A-132	1387	866	521	56	37.6	33.5
Avg.		1435	885	550		38.4	
1.5% Potassium Chloride	H-159	1407	796	611	249	43.4	25.7
	H-160	1175	652	523	204	44.5	27.2
	H-161	1229	722	507	131	41.3	30.6
	H-162	1430	895	535	196	37.4	23.7
	A-106	1226	756	470		38.3	
	A-107	1231	759	472		38.3	
Avg.		1283	763	520		40.5	

*Aluminum of pressure cooker corroded due to salt.

TABLE 13-KRAMER SHEAR VALUES OF FOWL WHEN BOILED IN VARIOUS SALT SOLUTIONS

Treatment	Bird No.	Carcass wt.	Breast Meat: Sample wt. Left	Breast Meat: Sample wt. Right	Breast Meat: lbs. force Left	Breast Meat: lbs. force Right	Avg. lbs. force per g. Meat	Time in freezer storage
		g.	g.	g.				mo.
Tap Water	A-167	1110	34	26	1130	858	33.13	16
	H-100	1181	42	44	914	1007	22.34	1
	H-103	2027	60	58	985	961	16.41	1
	N5106	1215	46	44	499	499	11.09	16
	N5779	1226	39	33	555	545	15.28	16
	N6490	1831	74	68	1076	973	14.43	14
	N6163	1531	46	48	1281	1418	28.71	16
Avg.		1446	49	46	920	894	20.20	
2.0% Sodium Chloride	N5010	1364	43	45	678	678	15.41	16
	N3170	1298	53	50	937	774	16.61	16
	H-114	1412	44	38	1040	914	23.83	8
	H-115	1427	56	59	810	937	15.19	8
	H-116	1268	45	49	798	834	17.36	8
	H-118	1238	43	42	881	846	20.32	8
Avg.		1335	47	47	857	831	18.12	
4.0% Sodium Chloride	N3366	1739	53	46	881	786	16.84	16
	N2495	1627	55	57	937	937	16.73	16
	H-117	1225	40	39	654	798	18.38	8
	H-119	1519	56	54	892	1007	17.26	8
	H-120	1495	50	53	996	1076	20.12	8
	H-121	1764	44	41	949	961	22.47	8
	H-122	1756	44	48	714	678	15.13	8
Avg.		1589	49	48	860	892	18.13	
2.0% Sodium Tripoly-phosphate	H-123	1840	40	45	654	738	16.38	8
	H-124	1849	58	58	1150	1029	18.78	8
	H-125	1661	53	50	1130	1150	22.14	8
	H-126	1682	39	44	903	973	22.60	8
	A-140	1441	52	43	1174	925	21.88	16
	A-141	1465	45	42	925	1064	22.59	16
Avg.		1656	48	47	989	980	20.73	

TABLE 13-CONTINUED

Treatment	Bird No.	Carcass wt.	Breast Meat Sample wt. Left	Breast Meat Sample wt. Right	Breast Meat lbs. force Left	Breast Meat lbs. force Right	Avg. lbs. force per g. Meat	Time in freezer storage
		g.	g.	g.				mo.
4.0% Sodium Tripoly-phosphate	A-144	1879	51	52	949	985	18.78	16
	A-145	1860	69	76	973	1018	13.73	16
	H-163	1592	45	54	1270	1381	26.79	10
	H-164	1566	45	48	690	810	16.13	10
	H-165	1054	32	30	690	690	22.26	10
	H-166	1059	38	41	424	460	11.19	10
Avg.		1502	47	50	833	891	18.15	
0.75% Potassium Chloride	N2550	1546	50	55	1130	1064	20.90	16
	N5867	1602	56	58	714	726	12.63	16
	A-127	1632	52	43	903	762	17.53	16
	A-129	1495	56	47	1220	834	19.94	16
	A-131	1476	47	50	834	810	16.95	16
	A-133	1400	56	53	1130	1292	22.22	16
Avg.		1525	53	51	989	915	18.36	
1.5% Potassium Chloride	H-127	1531	57	55	1362	1076	21.77	8
	H-128	1564	47	44	996	1150	23.58	8
	H-129	1331	45	46	892	1076	21.63	8
	H-130	1373	40	47	870	949	20.91	8
	N6485	1258	42	40	834	690	18.58	14
	N5955	1234	36	38	846	726	21.24	14
Avg.		1382	45	45	967	945	21.29	

TABLE 14-KRAMER SHEAR VALUES OF FOWL WHEN SIMMERED IN VARIOUS SALT SOLUTIONS

Treatment	Bird No.	Carcass wt.	Breast Meat Sample wt. Left	Breast Meat Sample wt. Right	Breast Meat lbs. force Left	Breast Meat lbs. force Right	Avg. lbs. force per g. meat	Time in freezer storage
		g.	g.	g.				mo.
Tap water	N2681	1521	44	59	1140	762	18.47	16
	N-178	1440	54	58	810	834	14.68	16
	A-136	1774	52	57	925	881	16.57	16
	A-137	1830	71	67	1396	1292	19.48	16
	A-154	1437	53	48	1040	1040	20.59	16
	A-155	1417	54	47	1100	834	19.15	16
	H-105	1166	45	40	750	690	16.94	1
	H-111	1329	52	49	1007	1088	20.74	1
Avg.		1489	53	53	1021	928	18.33	
2.0% Sodium Chloride	H-135	1203	39	36	798	702	20.00	8
	H-136	1216	40	40	1018	1052	25.88	8
	H-137	1714	38	39	563	597	15.06	8
	H-138	1673	50	52	925	1100	19.85	8
	no tag	1618	43	45	846	726	17.86	8
	N2586	1418	58	53	996	949	17.52	16
Avg.		1474	45	44	858	854	19.36	
4.0% Sodium Chloride	H-131	2159	55	54	774	738	13.87	8
	H-132	2237	60	56	858	678	13.24	8
	H-133	1854	60	43	892	786	16.29	8
	H-134	1834	54	58	702	750	12.96	8
	N1099	1461	48	54	666	565	12.07	17
	N3224	1426	44	45	1052	985	22.89	17
Avg.		1829	54	52	824	750	15.22	
2.0% Sodium Tripoly-phosphate	H-143	1659	40	43	654	586	14.94	8
	H-144	1711	57	49	619	654	12.01	8
	H-147	1935	51	51	866	528	13.67	8
	H-148	1920	64	48	1150	1029	19.46	8
	A-148	1680	56	49	1338	1465	26.70	16
	A-149	1657	59	50	1088	892	18.16	16
Avg.		1760	55	48	953	859	17.49	

TABLE 14-CONTINUED

Treatment	Bird No.	Carcass wt.	Breast Meat Sample wt. Left	Breast Meat Sample wt. Right	Breast Meat lbs. force Left	Breast Meat lbs. force Right	Avg. lbs. force per g. meat	Time in freezer storage
		g.	g.	g.				mo.
4.0% sodium Tripoly-phosphate	A-152	1365	57	56	881	925	15.98	16
	A-153	1320	54	50	1088	937	19.47	16
	H-167	2081	59	57	1040	914	16.84	10
	H-168	2001	62	57	1120	834	16.42	10
	H-169	1299	45	42	822	666	17.10	10
	H-170	1217	49	43	1007	903	22.21	10
Avg.		1547	54	51	993	863	18.00	
0.75% Potassium Chloride	H-139	1153	37	35	858	870	24.00	8
	H-140	1137	38	35	892	798	23.15	8
	A-134	1268	47	55	1064	1130	21.51	16
	A-135	1253	45	46	810	925	19.07	16
	N3345	1396	50	57	925	870	16.78	17
	N6381	1411	51	53	525	586	10.68	14
Avg.		1270	45	47	846	863	19.20	
1.5% Potassium Chloride	H-141	1181	35	34	690	750	20.87	8
	H-142	1247	44	44	786	858	18.68	8
	H-145	1597	58	42	937	881	18.18	8
	H-146	1608	45	46	881	985	20.51	8
	N5690	1056	39	39	1130	881	25.78	14
	N-124	1189	47	45	1325	1040	25.71	17
Avg.		1313	45	42	958	899	21.62	

TABLE 15-KRAMER SHEAR VALUES OF FOWL WHEN PRESSURE-COOKED IN VARIOUS SALT SOLUTIONS

Treatment	Bird No.	Carcass wt.	Breast Meat Sample wt. Left	Breast Meat Sample wt. Right	Breast Meat lbs. force Left	Breast Meat lbs. force Right	Avg. lbs. force per g. meat	Time in freezer storage
		g.	g.	g.				mo.
Tap Water	N5869	1378	49	40	608	545	12.96	14
	N5218	1328	36	41	447	714	15.08	17
	A-100	1450	53	52	1007	846	17.65	1
	A-101	1474	53	48	985	714	16.82	1
	A-156	1736	64	59	714	690	11.41	16
	A-158	1296	47	40	810	762	18.07	16
	H-102	2065	72	63	1018	985	14.74	1
	H-101	1159	45	40	630	597	14.44	1
Avg.		1486	52	48	777	732	15.15	
2.0% Sodium Chloride	H-149	1515	40	45	424	512	11.01	8
	H-150	1521	50	45	1076	1150	23.43	8
	H-151	1748	42	48	750	750	16.67	8
	H-152	1737	44	48	822	822	17.87	8
	A-114	1483	57	50	1007	903	17.85	1
	A-115	1406	47	43	937	1029	21.84	1
Avg.		1568	47	47	836	861	18.11	
4.0% Sodium Chloride	H-153	1280	42	43	597	654	14.72	8
	H-154	1297	40	40	555	608	14.54	8
	H-155	1411	45	49	535	892	15.18	8
	H-156	1418	58	43	881	555	14.22	8
	A-112	1618	64	63	702	690	10.96	1
	A-113	1675	58	57	1052	846	16.50	1
Avg.		1450	51	49	720	708	14.35	
2% Sodium Tripoly-	A-166	1112	47	44	762	949	18.61	16
phosphate*	H-104	1193	51	46	892	690	16.48	1
Avg.		1153	49	45	827	820	17.55	
4.0% Sodium Tripoly-	H-158	1134	48	46	586	555	12.14	8
phosphate*	H-106	1884	44	58	436	575	9.91	1
Avg.		1509	46	52	511	565	11.03	

TABLE 15-CONTINUED

Treatment	Bird No.	Carcass wt.	Breast Meat Sample wt. Left	Breast Meat Sample wt. Right	Breast Meat lbs. force Left	Breast Meat lbs. force Right	Avg. lbs. force per g. meat	Time in freezer storage
		g.	g.	g.				mo.
0.75% Potassium Chloride	N3416	1326	53	50	834	499	12.94	17
	N3219	1369	45	41	575	486	12.34	17
	A-116	1437	36	42	499	525	13.13	1
	A-117	1406	46	51	738	822	16.08	1
	A-120	1510	50	50	666	702	13.68	1
	A-121	1486	49	41	678	630	14.53	1
	A-124	1328	59	63	1007	1052	16.87	16
	A-125	1385	46	49	822	858	17.68	16
	A-126	1611	60	68	985	1100	16.29	16
	A-128	1509	55	51	666	586	11.81	16
	A-130	1461	44	53	846	996	18.99	16
	A-132	1387	54	44	937	858	18.32	16
Avg.		1435	50	50	771	760	15.22	
1.5% Potassium Chloride	H-159	1407	47	52	619	654	12.86	8
	H-160	1175	30	29	563	535	18.61	8
	H-161	1229	39	39	678	786	18.77	8
	H-162	1430	49	44	881	949	19.68	8
	A-106	1226	51	52	925	750	16.26	1
	A-107	1231	44	37	630	654	15.85	1
Avg.		1283	43	42	716	721	17.01	

*Aluminum of pressure cooker corroded due to salt.

TABLE 16-PERCENT FAT AND MOISTURE IN THIGH MEAT OF FOWL COOKED IN VARIOUS SALT SOLUTIONS

	Boiling				Simmering				Pressure-Cooking			
	Bird No.	Fat	Moisture	Fat dry basis	Bird No.	Fat	Moisture	Fat dry basis	Bird No.	Fat	Moisture	fat dry basis
		%	%	%		%	%	%		%	%	%
Tap Water	A-167	1.63	66.50	4.87	N-178	11.05	59.98	27.61	N5869	8.65	62.00	22.76
	H-100	9.98	61.36	25.83	A-136	10.89	61.33	28.16	A-100	5.43	62.86	14.62
	H-103	15.33	57.73	36.27	A-137	9.25	61.74	24.18	A-156	6.96	63.43	19.03
	R4819	12.41	59.95	30.98	A-154	8.57	6103	21.99	A-158	3.78	64.50	10.65
	R4522	16.43	56.95	38.16	A-155	6.83	63.39	18.66	A-101	6.56	62.26	17.38
	N6490	9.26	62.87	24.94	H-105	8.02	61.01	20.57	N5218	5.60	63.31	15.26
	N6163	11.68	60.61	29.65	H-111	11.25	59.75	27.95	H-101	4.11	65.52	11.92
					N2681	9.99	62.31	26.51	H-102	13.12	58.25	31.43
Avg.		10.96	60.85	27.24		9.48	61.32	24.45		6.78	62.77	17.88
2.0% Sodium Chloride	R4844	7.58	60.96	19.42	H-135	6.62	62.62	17.71	A-114	8.53	61.03	21.89
	R4589	11.08	59.22	27.17	H-136	12.23	58.98	29.81	A-115	6.96	62.39	18.15
	H-171	13.26	59.31	32.59	H-137	16.36	57.65	38.63	H-149	9.89	61.94	25.99
	H-115	10.99	60.10	27.54	H-138	11.70	59.59	28.95	H-150	15.57	56.90	36.13
	H-116	8.93	61.53	23.21	no tag	9.70	61.65	25.29	H-151	10.09	59.48	24.90
	H-118	8.06	61.84	21.12	N2586	7.79	62.53	20.79	H-152	12.27	58.41	29.50
Avg.		9.98	60.49	25.18		10.73	60.50	26.86		10.55	60.03	26.09
4.0% Sodium Chloride	N3366	11.07	59.51	27.34	H-131	15.57	57.21	36.39	H-153	9.24	59.27	22.69
	N2495	8.61	61.54	22.39	H-132	16.45	56.60	37.90	H-154	8.80	61.26	22.72
	H-117	8.00	61.83	20.96	H-133	12.72	59.35	31.29	H-155	12.01	58.82	29.16
	H-119	12.19	58.22	29.18	H-134	11.13	59.92	27.77	H-156	12.77	57.77	30.24
	H-120	9.59	60.19	24.09	N1099	10.13	59.69	25.13	A-112	5.84	62.91	15.75
	H-121	13.27	56.69	30.64	N3224	8.62	60.48	21.81	A-113	9.90	59.97	24.73
	H-122	10.88	59.32	26.75								
Avg.		10.52	59.61	25.91		12.44	58.88	30.05		9.76	60.00	24.22
2.0% Sodium Tri-polyphosphate	R4921	14.59	57.50	34.33	H-143	11.59	60.32	29.21				
	R5492	13.94	58.43	33.53	H-144	10.96	60.31	27.61				
	H-125	9.04	61.04	23.20	H-147	11.83	60.33	29.82				
	H-126	8.77	61.98	23.07	H-148	17.32	56.31	39.64				
	A-140	6.19	63.19	16.82	A-148	9.72	63.81	26.86				
	A-141	10.13	61.17	26.09	A-149	12.49	58.98	30.45				
Avg.		10.44	60.55	26.19		12.32	60.01	30.60				

TABLE 16-CONTINUED

	Boiling				Simmering				Pressure-Cooking			
	Bird No.	Fat	Moisture	Fat dry basis	Bird No.	Fat	Moisture	Fat dry basis	Bird No.	Fat	Moisture	fat dry basis
		%	%	%		%	%	%		%	%	%
4.0% Sodium Tri-polyphosphate	A-144	10.22	61.09	26.27	A-152	11.23	60.88	28.71				
	A-145	10.45	59.53	25.82	A-153	7.50	62.71	20.11				
	H-163	11.09	58.98	27.03	H-167	18.05	55.92	40.95				
	H-164	11.55	58.54	27.86	H-168	14.90	57.93	35.42				
	H-165	11.42	59.45	28.16	H-169	9.06	62.30	24.03				
	H-166	6.69	62.90	18.03	H-170	12.29	57.90	29.19				
Avg.		10.24	60.08	25.53		12.17	59.61	29.74				
0.75% Potassium Chloride	N2550	15.70	57.88	37.27	N3345	8.64	60.83	22.06	N3219	6.01	63.22	16.34
	N5867	10.36	61.00	26.56	N6381	8.85	62.67	23.71	N3416	9.27	62.08	24.45
	A-127	15.78	56.96	36.66	H-139	7.21	62.70	19.33	A-116	7.02	61.44	18.21
	A-129	9.38	61.31	24.24	H-140	6.89	62.88	18.56	A-117	7.08	61.52	18.40
	A-131	11.78	59.89	29.37	A-134	8.50	61.75	22.22	A-120	4.99	61.49	12.96
	A-133	8.21	61.20	21.16	A-135	7.45	62.69	19.97	A-121	6.27	61.93	16.47
									A-124	3.35	64.69	9.49
									A-125	7.90	61.48	20.51
									A-126	5.17	62.33	13.72
									A-128	5.56	64.03	15.46
									A-130	7.77	60.71	19.78
									A-132	3.69	62.51	9.84
Avg.		11.89	59.71	29.21		7.92	62.25	20.98		6.17	62.29	16.30
1.5% Potassium Chloride	H-127	8.76	60.45	22.15	N5690	10.29	61.03	26.40	H-159	9.89	59.83	24.62
	H-128	16.12	56.17	36.78	H-141	11.33	58.66	27.41	H-160	10.46	58.49	25.20
	H-129	10.57	60.11	26.50	H-142	17.55	55.23	39.20	H-161	9.97	60.04	24.95
	H-130	10.30	59.89	25.68	H-145	9.82	60.22	24.69	H-162	12.85	58.31	30.82
	N6485	11.84	59.85	29.49	H-146	15.95	56.48	36.65	A-106	5.68	62.35	15.09
	N5955	11.90	59.85	29.64	N-124	8.86	61.53	23.03	A-107	5.85	62.10	15.44
Avg.			59.39	28.37		12.30	58.86	29.56		9.12	60.19	22.69

TABLE 17-PERCENT COOKING LOSSES OF FOWL WHEN COOKED IN PLASTIC BAGS OR TUBES

Treatment	Bird No.	Carcass wt.	Carcass wt. after cooking	Total cooking loss	Fat loss	Residue + water	Cooking loss	Fat loss	Residue + water
		g.	g.	g.	g.	g.	%	%	%
Visten bag Boiled 3 hrs.	V-11	1724	1155	569	175	280	33.0	10.2	16.2
	V-13	1528	1082	446	21	100	29.2	1.4	6.5
	V-14	1651	1194	457	100	404	27.7	6.1	24.5
	V-15	1186	839	347	26	323	29.3	2.2	27.2
	V-16	1597	1102	495	154	287	31.0	9.7	18.0
Avg.		1537	1074	463	95	279	30.0	5.9	18.5
Bagcraft tube Boiled 3 hrs.	BC-14	1669	1172	497	284	361	29.8	17.0	21.6
	15	1629	1218	411	102	250	25.2	6.2	15.3
	16	1408	973	435	75	237	30.9	5.3	16.8
	17	1681	1080	601	145	405	35.8	8.7	24.1
	18	1701	1212	489	97	315	28.8	5.8	18.5
	19	1732	1083	649	82	306	37.5	4.8	17.7
	20	979	752	227	54	183	23.2	5.5	18.7
Avg.		1543	1070	473	120	294	30.2	7.6	19.0
Bagcraft tube Simmer 3 1/2 hrs.	BC-10	948	673	275	4	61	29.0	0.4	6.4
	11	898	629	269	74	204	30.0	8.2	22.7
	12	1075	776	299	9	253	27.8	0.8	23.5
	13	1134	788	346	29	368	30.5	2.6	32.5
	R5233	1300	922	378	98	278	29.1	7.5	21.4
	R4566	1211	815	396	87	273	32.7	7.2	22.5
Avg.		1094	767	327	50	240	29.9	4.5	21.5
Bagcraft tube Pressure cook 45 minutes 15# pressure	BC-25	1226	878	348	21	277	28.4	1.7	22.6
	BC-26	1471	958	513	181	327	34.9	12.3	22.2
	R5203	1353	930	423	96	298	31.3	7.1	22.0
	R5744	1256	880	376	113	262	29.9	9.0	20.9
	R5253	1092	644	448	104	232	41.0	9.5	21.2
	R5616	1162	730	432	162	257	37.2	13.9	22.1
	R5312	1170	781	389	79	235	33.2	6.8	20.1
	R4507	1402	934	468	181	243	33.4	12.9	17.3
	R4670	1098	720	378	46	283	34.4	4.2	25.8
	H-172	937	621	316	94	189	33.7	10.0	20.2
Avg.		1217	808	409	108	260	33.7	8.7	21.4
Bagcraft tube Pressure cook 75 minutes 10# pressure	H-177	1395	917	478	140	310	34.3	10.0	22.2
	H-178	1270	662	608	190	390	47.9	15.0	30.7
	R5597	1925	1220	705	316	317	36.7	16.4	16.5
	H-179	1342	1030	312	25	270	23.3	1.9	20.1
	H-180	1230	910	320	52	218	26.0	4.2	17.7
	R-833	1225	802	423	85	318	34.5	6.9	26.0
Avg.		1398	924	474	135	304	33.8	9.1	22.2

TABLE 18-KRAMER SHEAR VALUES OF FOWL WHEN COOKED IN PLASTIC BAGS OR TUBES

Treatment	Bird No.	Carcass wt.	Breast Meat Sample wt. Left	Breast Meat Sample wt. Right	Breast Meat Lbs. force Left	Breast Meat Lbs. force Right	Avg. lbs. force per g. meat	Remarks
		g.	g.	g.				
Visten bag.	V-11	1724	59	48	881	774	15.47	Precooked
Boiled 3 hrs.	V-13	1528	60	51	512	642	10.40	Almost done
	V-14	1651	68	57	846	750	12.77	Precooked
	V-15	1186	33	39	937	858	24.93	done.
	V-16	1597	53	61	486	512	8.75	Almost done
Avg.		1537	55	51	732	707	14.46	
Bagcraft tube	BC14	1669	50	58	702	678	12.78	Well done
Boiled 3 hrs.	15	1629	39	48	525	678	13.83	Well done
	16	1408	30	30	486	642	18.80	Well done
	17	1681	32	34	555	512	16.17	Well done
	18	1701	36	40	903	690	20.96	Well done
	19	1732	39	40	512	499	12.80	Well done
	20	979	31	33	786	985	27.67	Well done
Avg.		1543	37	40	638	669	17.57	
Bagcraft tube	BC10	948	36	38	654	822	19.95	Done
Simmer 3 1/2 hrs.	11	898	30	29	597	690	21.81	Done
	12	1075	34	37	512	525	14.62	Done
	13	1134	30	29	608	654	21.39	Done
	R5233	1300	54	53	608	678	12.02	Precooked to done
	R4566	1211	45	46	892	714	17.65	Precooked to done
Avg.		1094	38	39	645	681	17.91	
Bagcraft tube	BC25	1226	47	49	597	630	12.78	Done
Pressure-cook	26	1471	59	62	1186	1064	18.60	Done
45 minutes	R5203	1353	59	60	973	914	15.86	Precooked
15# pressure	R5744	1256	55	54	575	714	11.92	Precooked
	R5253	1092	36	39	1052	996	27.31	Done
	R5616	1162	33	32	714	619	20.51	Done
	R5312	1170	50	45	961	1018	20.83	Done
	R4507	1402	40	30	903	702	22.93	Done
	R4670	1098	27	25	400	338	14.19	Done
	H-172	937	26	24	473	486	19.16	Done
Avg.		1217	43	42	783	748	18.41	
Bagcraft tube	H-177	1395	40	39	858	1076	24.48	Precooked
Pressure-cook	H-178	1270	43	43	642	565	14.05	Precooked
75 minutes	R5597	1925	47	39	750	642	16.19	Done
10# pressure	H-179	1342	38	45	1018	1396	29.08	Well done
	H-180	1230	34	42	870	1130	26.32	Well done
	R-833	1225	43	48	858	810	18.33	Almost done
Avg.		1398	41	43	833	937	21.41	

TABLE 19-FAT AND MOISTURE CONTENT OF THIGH MEAT OF FOWL WHEN COOKED IN PLASTIC TUBES

Bird No.	Treatment	Fat	Moisture	Dry Matter	Fat Dry Basis
		%	%	%	%
	Boil				
BC-14	Bagcraft Bags	10.87	60.09	39.91	27.24
15	3 hrs @ 212°F.	11.11	61.72	38.28	29.02
16		11.19	58.74	41.26	27.12
17		12.17	59.03	40.97	29.70
18		13.01	59.78	40.22	32.35
19		12.72	59.31	40.69	31.26
		11.85	59.78	40.22	29.45
BC-12	Simmer	8.13	62.14	37.86	21.47
13	Bagcraft bags	9.22	62.18	37.82	24.38
R5 233	3 1/2 hrs @ 200°F.	9.92	61.02	38.98	25.45
R4 566		11.79	58.92	41.08	28.70
R-866*		11.36	58.80	41.20	27.57
R5416*		11.56	59.95	40.05	28.86
		10.33	60.50	39.50	26.07
BC-25	Pressure Cook	6.11	61.26	38.74	15.77
26	15# pressure	13.77	58.52	41.48	33.20
R-5203	45 minutes	10.21	61.06	38.94	26.22
R-5744		11.52	60.48	39.52	29.15
R-4507		11.04	59.63	40.37	27.35
R-5253		9.56	60.37	39.63	24.12
R-5312		6.29	62.86	37.14	16.94
R-5616		15.32	57.18	42.82	35.78
R-4670		7.09	61.15	38.85	18.25
H-172		8.06	60.58	39.42	20.45
		9.90	60.31	39.69	24.72
H-177	Pressure cook	16.52	57.39	42.61	38.77
H-178	10# pressure	8.73	62.19	37.81	23.09
H-179	75 minutes	6.28	66.03	33.97	18.49
H-180		9.92	63.06	36.94	26.85
R-5597		13.51	58.67	41.33	32.69
R-833		7.63	60.30	39.70	19.22
		10.43	61.27	38.73	26.52

*R-866 and R-5416 replaces B-10 and B-11 which were lost.