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THE STORAGE LIFE OF PRECOOKED FROZEN CHICKEN

George C. Walker, et al

Army Natick Laboratories
Natick, Massachusetts

October 1974

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TECHNICAL REPORT
TR-75-24-FEL

THE STORAGE LIFE OF PRECOOKED FROZEN CHICKEN

by
G. C. Walker
and
J. M. Tuomy

Project Reference: 1T762713A034

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Natick, Massachusetts 01760

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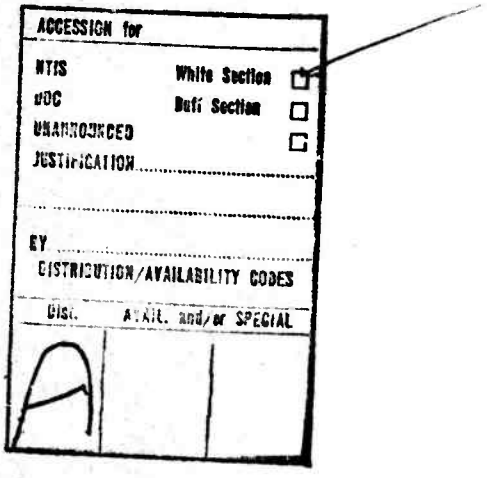

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HEATING	COOKING DEVICES	COLOR	CONSUMERS
OVENS	CONVECTION (HEAT TRANSFER)	ODOR	CONSUMER ACCEPTABILITY
ROASTERS	CONVECTIVE HEAT	FLAVOR	ACCEPTABILITY
DEEP FAT FRYING	TRANSFER	TEXTURE	FROZEN FOODS

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Two brands of commercially prepared fully cooked chicken were investigated. The chicken was stored at -12°C., -18°C. and -28°C. and withdrawn for evaluation at 0, 3, 6 and 9 months. The chicken was heat conditioned for serving by heating either in a convection oven or in a deep fat fryer. Both 10 member technological and 30 member consumer panels were used to evaluate the product. The consumer panel evaluated the chicken as part of a luncheon menu. Analysis of panel scores indicated that the brand of chicken was not significant when evaluated by itself. The method of heat conditioning prior to

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The average scores for chicken from the consumer panel luncheons ranged from 6.9 to 8.1. Only two scores fell below 7.5 on a 9-point scale.

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FOREWORD

The Armed Forces Recipe Service recipes L-137 Fried Chicken and L-138 Oven Fried Chicken and their variations require considerable manipulation of the ingredients before a ready-to-serve end item is obtained. Unsolicited items of precooked, frozen chicken were presented to the Armed Forces Product Evaluation Committee by suppliers of this type of product to the civilian institutional users. The committee requested that the U.S. Army Natick Laboratories investigate the applicability of this type of food product to military feeding. This investigation was undertaken under Project No. 1T762713A034 Military Food Service and Subsistence Technology.

We appreciate the effort of Miss Virginia White and Mrs. Jessie McNutt of the Experimental Kitchens Branch in preparing and serving the luncheons to the consumer panel.

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ABSTRACT

Two brands of commercially prepared fully cooked chicken were investigated. The chicken was stored at -12°C., -18°C. and -28°C. and withdrawn for evaluation at 0, 3, 6 and 9 months. The chicken was heat conditioned for serving by heating either in a convection oven or in a deep fat fryer. Both 10 member technological and 30 member consumer panels were used to evaluate the product. The consumer panel evaluated the chicken as part of a luncheon menu.

Analysis of panel scores indicated that the brand of chicken was not significant when evaluated by itself. The method of heat conditioning prior to serving had a significant influence on the flavor variance but no influence on any of the other organoleptic factors. The time in storage contributed to the variances found for color, odor, flavor and appearance, whereas, the temperature of storage influenced only the variance of the texture.

The average scores for chicken from the consumer panel luncheons ranged from 6.9 to 8.1. Only two scores fell below 7.5 on a 9-point scale.

INTRODUCTION

In 1971 the Armed Forces Product Evaluation Committee (AFPEC) received an unsolicited sample of precooked, frozen chicken. As a result of their preliminary evaluation the AFPEC requested that the US Army Natick Laboratories (USANLABS) undertake an investigation of this type of product.

No information was found in the scientific literature relating to the evaluation of commercial precooked frozen chicken. The scientific literature does contain a considerable number of reports of the study of such aspects of processing and storage as: pre-cooking; batter composition; effect of freezing and reheating on shear press values and development of rancidity; flavor; shrinkage; moisture and other factors. We did not feel that the literature reviewed was particularly applicable to this investigation.

MATERIALS AND METHODS

Chicken. Two commercial brands of fully cooked frozen chicken were purchased directly from the suppliers for this study. The chicken was received within 30 days after the orders were initiated. The cost at the time of purchase was: Brand A - $6.60 per case of 24 quarters for heating in a deep fat fryer and $16.00 per case of 40 quarters for heating in an oven; Brand B - $13.60 per case of 48 quarters. Both brands were ready to serve after heat conditioning from the frozen state. Quarter portions were used in this investigation. Brand A, type 1, for deep fat frying, was described by the supplier as dry coated in lieu of batter coated. The color was off-white. Brand A, type II, for oven warming, was found to have a medium brown color. The coating of this type flaked off easily indicating coating after cooking. Brand B was a battered and breaded product with one type used for heat conditioning by both deep fat frying and oven warming. The color was a golden brown. The literature supplied with Brand B indicated that heating in an electronic oven followed by deep fat frying could also be used. The exigencies of time and lack of equipment precluded investigation of this method of heat conditioning.

Storage. Each brand and type of chicken portions was divided into three lots. One lot was stored at -12°C, one lot at -18°C and one lot at -28°C. Withdrawals were made at 0, 3, 6 and 9 months.

Heat conditioning. At each withdrawal the chicken was heat conditioned from the frozen state to serving temperature by: a) heating in all purpose vegetable shortening in a deep fat fryer for 5 to 6 minutes at 176.7°C, or b) by heating in a convection oven for 18 to 20 minutes at 218.3°C. Chicken from the -18°C and -28°C storage temperatures was tempered to -12°C prior to heat conditioning to standardize the amount of time used in heat conditioning. An internal temperature of 60°C to 65.6°C in the breast was obtained. The chicken was kept at serving temperature in a food warming unit set at 76.7°C during the testing period. The technological evaluation averaged about 30 minutes in length.

Evaluation. The chicken was evaluated in two ways. At each withdrawal product from each storage temperature and method of heat conditioning was evaluated by a 10-member panel of food technologists for quality of color, odor, flavor, texture and appearance. A 9-point scale was used where 9 equals excellent and 1 equals extremely poor. Chicken from the -18°C storage temperature was also evaluated by a 30-member consumer panel at a luncheon. The following menu was used at each luncheon: chicken*, chicken gravy*, buttered corn*, mashed potatoes, green and ripe olives, carrot strips, cranberry sauce, bread, butter, sponge-nut bars* and coffee. The items followed by an asterisk were rated by the luncheon panel members using a 9-point hedonic scale (like-dislike).

Analysis of results. The results from the technological panel were subjected to an analysis of variance and the percentage of variation of each factor was determined according to the method presented by Hicks (1956). The ratings from the consumer panel were averaged.

RESULTS AND DISCUSSION

Technological evaluation. Table 1 shows the average technological panel scores for the organoleptic factors studied. Table 2 shows the results of the analysis of variance and the percentage of variation attributable to the factors found to be significant.

Examination of color data for the heat conditioned chicken (Table 2) shows that the time in storage ($p > 0.01$) contributed almost 60% of the variance while the interaction between the brand of chicken and the method of heat conditioning ($p > 0.05$) contributed slightly less than 41%. Neither the brand of chicken or the method of heat conditioning significantly contributed to the variance when tested separately. A partial explanation of the interaction may be in the initial differences in the color of the chicken as it was received from the supplier, as well as to changes in the components of the coating during storage. Examination of the average panel scores shows that the greatest changes were detected by the panel members between 6 and 9 months at -12°C and -18°C.

Only the time in storage influenced the odor of the chicken ($p > 0.01$). The data in Table 1 shows that the changes in odor occurred mainly in chicken stored at -12°C with little change occurring in chicken stored at -18°C and -28°C between the initial evaluation and the evaluation after 9 months of storage.

The method heat conditioning ($p > 0.01$), the time in storage ($p > 0.05$), the interactions between (a) the brand of chicken and the method of heat conditioning ($p > 0.01$) and (b) the brand and the time in storage ($p > 0.05$) all influenced the variance of the flavor. The method of heat conditioning and the time in storage accounted for 72.7 percent of the variance. The interaction between the brand of chicken and the method of heat conditioning accounted for almost 23 percent of the variance.

Overall, the chicken prepared for serving in the deep fat fryer was slightly preferred to the chicken heat conditioned in the oven. The data in Table 1 indicates that the panel scores for flavor tended to decline at storage temperatures of -12°C and -18°C but not at -28°C.

Texture was affected by the interaction of brand and method of heat conditioning ($p > 0.01$) and by the temperature of storage ($p > 0.05$). Examination of the data indicates that chicken held at -12°C had a less preferred texture than chicken held at the other temperatures. The texture of chicken prepared for serving by deep fat frying was preferred over that prepared by oven browning.

It stands to reason that chicken heated in moving air would be slightly drier and therefore of a slightly less tender texture than chicken heated by submersion in hot fat. The technological panel did not make specific comments concerning the texture.

The appearance of the heat conditioned product was affected by the time in storage ($p < 0.05$) and the interaction between the brand and the method of heat conditioning ($p < 0.05$). The appearance of the chicken prepared in the deep fat fryer for serving was preferred over that prepared by oven browning.

It should be noted that when evaluated as a separate factor the brand of chicken used in this investigation was not a significant influence on the variance of any of the organoleptic factors. Two "top of the line" brands of prepared frozen chicken were tested. If other brands had been used or more than two brands had been used in this investigation, then the brand may have proven to be a significant factor.

Table 3 shows the consumer ratings of the chicken when served as part of a luncheon. The ratings held up well for the entire storage period. One of the home economists conducting the luncheons suggested that a halo effect, whereby all menu items influence the rating each item receives, might explain the relatively consistent scores of the chicken. This implies that the chicken, if tested alone, might not rate as high as when tested with other foods. Examination of the flavor scores from the technological evaluation and the scores of the consumer panel of chicken stored at -18°C shows a declining trend in the average score. The amount of decline was greater, 0.5 point, in the data from technological panel than in the data from the luncheon panel, 0.2 point. The overall average score was higher for chicken served at the luncheons than for chicken evaluated by the technological panel.

Comparison of the scores for the deep fat heated chicken for Brands A and B shows no brand preference by the consumer panel. The chicken heated in deep fat was preferred to that heated in the oven. Leg portions were only slightly preferred over breast portions. This is probably because the breast (light) meat is naturally slightly drier than the leg (dark) meat.

Table 4 shows the weight ranges and the average weights of breast and leg portions. Chicken portions for oven heating (Brand A) were heavier than those portions for deep fat heating, averaging 28 and 46 grams heavier for breast and leg portions, respectively. The weight ranges show differences between low and high of 25 grams up to 82 grams. The lower weight portions might not provide enough meat to satisfy an active military person. No weight data was obtained for Brand B but it can be expected to compare closely to that of Brand A. The average weight shown for Brand B in the table was taken from the suppliers technical literature.

Table 5 shows the average ratings of all items evaluated by the consumer panel. It can be noted that the rating of the chicken fell below the rating of any of the other items evaluated only six times during the test period. This would seem to negate the "halo theory". The chicken was the only menu item withdrawn from storage. The other menu items were freshly prepared for each luncheon.

CONCLUSIONS

1. The results of this investigation indicate that fully cooked, frozen chicken has the stability and acceptability needed for the military services.

2. The simplicity of preparation and the varieties of ways the chicken can be prepared, conventional and electronic ovens and deep fat fryer, make it a desirable item for regular dining halls, fast food lines and specialty house menus.

3. Both brands investigated were equally acceptable to both technological and consumer panels.

REFERENCES

1. Hicks, C. R. 1956. Fundamentals of analysis of variance. Part II. The components of variance and the mixed model. Ind. Qual. Control 13:5.

Table 1: Technological Panel Scores

Storage Temperature (°C)	Storage Time (Months)	Organoleptic Factor				
		Color	Odor	Flavor	Texture	Appearance
	0	7.2	7.2	6.9	7.0	7.1
-12°	3	7.0	6.8	6.6	6.8	7.0
	6	7.0	6.9	6.7	6.6	6.6
	9	6.7	6.6	6.1	6.4	6.4
	0	7.2	7.2	6.9	7.0	7.1
-18°	3	7.0	6.8	6.5	6.8	7.0
	6	7.1	7.1	6.8	7.0	6.9
	9	6.6	7.0	6.4	6.8	7.0
	0	7.2	7.2	6.9	7.0	7.1
-28°	3	7.0	6.7	6.4	6.8	7.0
	6	7.2	7.1	7.0	6.9	7.0
	9	7.0	7.0	6.9	6.8	6.8

Table 2: Analysis of variance (ANOV) and percentage of variation

Factor	Color		Odor		Flavor		Texture		Appearance	
	ANOV	percent	ANOV	percent	ANOV	percent	ANOV	percent	ANOV	percent
A Brand of chicken	n.s.	-	n.s.	-	n.s.	-	n.s.	-	n.s.	-
B Method of heat conditioning	n.s.	-	n.s.	-	*	42.52	n.s.	-	n.s.	-
C Time in storage	*	59.40	*	99.91	*	30.18	n.s.	-	**	41.57
D Temperature of storage	n.s.	-	n.s.	-	n.s.	-	**	42.01	n.s.	-
Interactions:										
AB	**	40.53	n.s.	-	*	22.88	*	57.98	**	58.36
AC	n.s.	-	n.s.	-	**	4.40	n.s.	-	n.s.	-
AD	n.s.	-	n.s.	-	n.s.	-	n.s.	-	n.s.	-
BC	n.s.	-	n.s.	-	n.s.	-	n.s.	-	n.s.	-
BD	n.s.	-	n.s.	-	n.s.	-	n.s.	-	n.s.	-
CD	n.s.	-	n.s.	-	n.s.	-	n.s.	-	n.s.	-
Not accounted for		0.07		0.09		0.02		0.01		0.07

NOTE *: $p > 0.01$

**: $p > 0.05$

n.s.: Not significant

Table 3. Consumer ratings of chicken portions served as part of a luncheon

	Brand A				Brand B			
	Deep fat heated		Oven heated		Deep fat heated		Oven heated	
Storage time (Months)	Breast portions	Leg portions	Breast portions	Leg portions	Breast portions	Leg portions	Breast portions	Leg portions
0	7.7	7.5	7.3	7.8	7.7	7.9	8.2	7.9
3	7.9	7.8	7.6	7.5	7.5	7.6	1/	1/
6	7.6	7.7	6.6	7.2	7.7	7.3	1/	1/
9	7.4	7.6	7.2	7.4	7.8	7.3	1/	1/

1/ Not tested after the initial evaluation

Table 4. Average weights and weight range (grams) of pre-cooked, frozen chicken

	Breast Portions			Leg Portions		
	Brand A			Brand A		
	For deep fat heating	For oven heating	Brand B	For deep fat heating	For oven heating	Brand B
Average	197	225	198	166	212	198
Range	183-208	225-307	1/	128-208	184-222	1/

1/ Not recorded

Table 5. Average ratings by the consumer panel (N=30) of the menu items evaluated at luncheons

Brand	Method of Preparation	Month chicken w/drawn	Chicken gravy	Buttered corn	Sponge nut bar	Chicken
A	Oven heated	0	7.6	6.8	7.1	7.6
		3	7.7	7.0	7.6	7.6
		6	7.5	7.9	7.3	6.9
		9	7.0	7.9	7.3	7.3
	Deep fat heated	0	7.0	7.2	7.5	7.6
		3	6.5	6.4	6.5	7.8
		6	7.3	6.7	7.6	7.6
		9	7.3	7.7	7.4	7.5
B	Deep fat heated	0	7.7	7.9	7.9	8.1
		3	7.3	7.6	7.4	7.6
		6	6.1	7.1	7.4	7.5
		9	6.2	7.2	6.9	7.6