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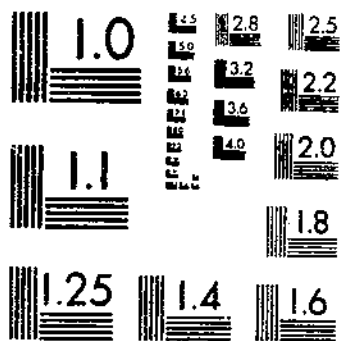
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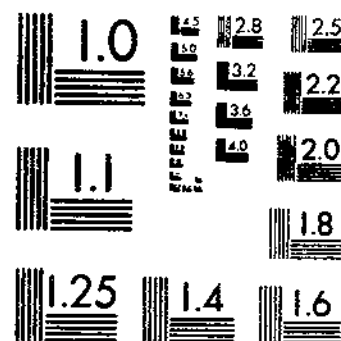
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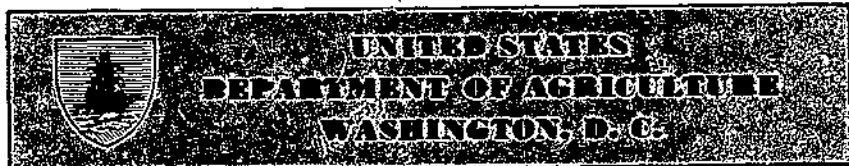
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Palatability and Nutritive Value of Home-Canned Chicken

Prepared by different methods for processing¹

By **GLADYS I. GILPIN** and **ELSIE H. DAWSON**, food specialists, **EDWARD W. TEPFER**, food chemist, and **HELEN W. WARREN**, chemist, Bureau of Human Nutrition and Home Economics, Agricultural Research Administration²

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SUMMARY

To provide information for evaluating the practicability of home canning as a means of utilizing cockerels and unproductive hens culled from laying flocks, studies were carried out to determine the effect on quality of home-canned chicken, of kind of bird used, method of preparation for packing, length of storage, and method of preparing canned chicken for serving.

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² Acknowledgment is made to the Bureau of Animal Industry for advice in planning this investigation and for providing dressed birds for these studies. Appreciation is expressed to Edmund H. McNally of the Bureau of Animal Industry and to the late Sophie Marcuse for their help in planning the studies; to Elsie F. Dochterman and Albert B. Parks for assistance in the statistical interpretation of data; to Katherine Ebner, Olivia Hammerle, Alice Harkin, and Elizabeth Stokes for major contributions in the laboratory work and compilation of data; and to Violet Brooks, Eleanor Geissenhainer, Mary Smith, and Patricia Trimble for assistance at various times during the course of the studies.

Quality determinations included panel evaluations of chicken flavor, off-flavor, juiciness, and tenderness, and chemical analyses for moisture, fat, free fatty acid, ash, and thiamine content on selected samples.

Methods of preparation for canning included packing raw and packing after the following types of precooking: (1) Precooking in water, (2) precooking in broth, (3) browning in a fry pan on top of range, (4) browning in oven, and (5) browning on broiler.

Method of preparation for packing in some instances affected the palatability of canned chicken. Chicken packed raw generally scored as high as or slightly higher than chicken precooked by any of the methods used in these investigations. Canned chicken samples prepared for packing by precooking in water or in broth were similar in palatability and compared favorably with the raw pack. Canned chicken lightly browned in a fry pan before packing also rated almost as high as the raw pack when mature hens or cockerels were used; there was a tendency for canned young hens browned in a fry pan to rate lower. Chicken lightly browned in the oven or on a broiler before packing scored lower than the other packs, particularly on chicken flavor and juiciness.

The kind of bird—cockerels, young or mature hens—had little effect on the quality of the canned product when it was packed raw, precooked in water or broth, or lightly browned on a broiler. Canned cockerel appeared to be slightly more satisfactory in flavor when browned in the oven before packing than parallel packs made from 6- or 16-month-old hens.

Though canned chicken was considered acceptable after storage for periods up to a year, intensity of chicken flavor decreased and off-flavors increased as storage time lengthened. Juiciness and tenderness of canned chicken were affected less consistently by storage. Raw-packed chicken appeared to have better keeping quality than either that precooked in water or that lightly browned on a broiler before canning.

The kind of meat—breast or thigh—influenced scores for all palatability factors studied except off-flavor. Thigh had more chicken flavor and was juicier but less tender than breast meat.

The method used for preparing canned chicken for serving—heating chicken in its own juice or frying—affected the palatability of the chicken. In general, fried chicken was more moist and tender than parallel samples heated in their own juice, and off-flavors were less noticeable in fried samples. Scores for intensity of chicken flavor were similar for the two methods of serving in almost all cases.

The percentage of moisture, fat, and ash in canned chicken was affected little by preparation methods. The amount of free fatty acids in the chicken fat increased somewhat during preparation for packing, processing, and storage but not sufficiently to indicate definite progressive rancidity.

Thiamine content was approximately the same for freshly canned cockerel and mature hen, ranging from 0.016 to 0.021 milligram per 100 grams edible portion. Chicken packed raw retained more thiamine than that precooked in water or lightly browned on a broiler before canning. For canned cockerel there were some losses of thiamine upon storage for 8 or 12 months; for canned hen, there was no indication that thiamine content decreased during storage.

INTRODUCTION

Saving for future use the seasonal culls from poultry flocks—the old hens, the least productive young hens, the cockerels—is of economic importance to many households. If canning is to compete with other methods of preserving poultry, simplified procedures to make canning more convenient and refinements in methods to improve palatability and nutritive value of canned chicken are needed.

Directions from popular literature for preparing home-canned chicken generally include a statement that plump, mature hens are the best for flavor. Several authors (8, 9, 10, 13, 15, 17)³ mention lack of flavor and overcooked texture as problems in canning young birds. Packing young chicken raw and precooking older birds is suggested by Tarrant and Truax (16). T. Crosbie-Walsh (5) says that both cockerels and hens are suitable for canning commercially.

Lack of agreement concerning the advisability of pre-frying chicken is evidenced by diverse directions for home-canned chicken found in popular publications. In some cases, directions for browning meat in a fry pan are given; in others, pre-frying either is not mentioned or is not recommended.

Though several studies on nutritive value of chicken have been reported, relatively few have dealt with the effect of canning. Millares and Fellers (14) found that significant amounts of thiamine are destroyed during processing of chicken, the amount lost varying with pH, and the time and temperature of the processing period.

No studies on the retention of thiamine in canned chicken during storage were found in the literature. However, studies with foods of quite different character, such as canned pork luncheon meat (7) and canned vegetables (8) indicate that both temperature and duration of storage affect the retention of thiamine.

Popular directions for canning chicken usually call for storage in a cool, dry place but do not mention storage life or quality losses due to storage. Studies to determine the effects of storage have been needed to help plan for the quantity to be canned and best use of the canned product.

SCOPE AND PLAN OF WORK

The investigations reported here were undertaken to determine the effects on palatability and nutritive value of canned chicken, of method of preparation for processing, type of bird, and length of storage. In addition, an attempt was made to determine whether frying for serving is a satisfactory method of heating canned chicken from different types of birds prepared for canning by various methods.

Palatability studies included three separate investigations which had several points of similarity but different main objectives. One investigation compared five preparation methods: Packing raw; and pack-

³ Italic numbers in parentheses refer to Literature Cited, p. 26.

ing after four types of preheating, (1) precooking in water, (2) precooking in broth, (3) light browning in a fry pan on top of range, and (4) light browning in oven. Parallel tests were made for three types of birds, 6- and 16-month-old hens and 3-month-old cockerels. One canner load of seven quart jars was prepared by each method for each type of bird. Four replications consisted of four quart jars of chicken from each canner load, opened for palatability studies after 3 months in storage at room temperature (approximately 75° F.). The remainder were used for training the judges or were held in reserve as replacement samples if needed.

The second investigation concentrated on browning as a method of precooking. Five-month-old hens were packed raw and after browning in a fry pan to three degrees of brownness: (1) Light, (2) medium, and (3) dark. Five quart jars of chicken were prepared by each method. Two replications consisted of two jars of canned chicken prepared by each method for palatability studies soon after processing and two others for each method opened after 6 months' storage at room temperature (approximately 75° F.).

The third investigation was planned primarily to study the effect of storage on canned chicken. Parallel studies were made in two successive years, the first on 16-month-old hens, the second on 3-month-old cockerels. Three preparation methods were employed: Packing raw, packing after precooking in water, and packing after light browning on a broiler. For this investigation, there were three replications, each consisting of one canner load of seven quart jars of chicken prepared by each method.

Studies on nutritive value were carried out parallel to those on palatability of canned chicken as affected by storage. One jar from each canner load was used for the palatability studies and chemical analyses soon after processing and one jar each after storage for 4, 8, and 12 months at room temperature (approximately 75° F.). Chemical determinations included moisture, fat, free fatty acids, ash, and thiamine content. Analyses were made on raw and precooked samples as well as on the processed chicken. Details of methods used for chemical analyses are included in the appendix (p. 36).

Chickens for all investigations were of Rhode Island Red breed from the Animal Husbandry flock of the Bureau of Animal Industry. They were range-reared and had the same previous history of management and nutrition. Within each type all were of like weight. After the birds were slaughtered, they were cooled in the air and held at 35° F. until prepared for canning. A total of 537 chickens was used in the preparation of 345 jars of chicken processed in 47 canner loads.

A standard reference sample was canned by the raw-pack method from breast and thigh pieces of 1-year-old hens. This sample was stored at 32° F. and served both as a coded control and as a labeled reference sample (6) for the palatability studies.

Methods employed in canning followed procedures given in Department publications, Technical Bulletin 930 and AWI-110 (18, 19), except where preliminary work in investigations reported here made changes seem advisable or where procedures had not been established, as in the case of raw-packed chicken. Information on the method used for establishing the processing time for raw-packed chicken is included in the appendix (p. 29). Within the restrictions of lab-

oratory technique, canning was done as nearly as possible as it would be done in the home.

Details as to preparation methods, packing, and processing are given in the appendix, as are procedures for preparing the samples for serving and for selecting and training the judging panel. Samples of breast and thigh meat were heated for serving by heating in broth or by frying in fat (p. 29). Heated samples of canned chicken were presented to a panel of four trained judges who scored them on chicken flavor, absence of off-flavor, juiciness, and tenderness, on 5-point rating scales (see score card, p. 23).

RESULTS AND DISCUSSION OF PALATABILITY STUDIES

Comparable data from the three investigations are discussed in this section consecutively under each topic. Analysis of variance was used in evaluating the results with due allowance for missing values. When interaction terms were found in general to be nonsignificant, means shown on a combined basis in the tables are used as the basis for discussion.

METHOD OF PREPARATION FOR CANNING

Presented in tables 1, 2, and 3 are palatability scores for canned chicken from 5-, 6-, and 16-month-old hens and 3-month-old cockerels prepared for canning by a number of different methods, including packing raw, precooking in water or in broth, and browning in the oven, the broiler, or in a fry pan.

Method of preparation was found to influence some of the quality characteristics of canned chicken from all types of birds included in table 1 (6- and 16-month-old hens and 3-month-old cockerels). Raw-packed chicken was one of the high-scoring samples on all palatability factors rated: Intensity of chicken flavor, absence of off-flavor, juiciness, and tenderness. Canned chicken precooked in water or in broth compared favorably with that packed raw; practical differences among these packs were not found in any of the quality factors.

The mean score for all types of birds lightly browned in a fry pan before packing were almost as high as scores for canned chicken packed raw or precooked in water or in broth. However, further data, which will be discussed later (p. 19), indicate that for young hens pre-frying may be less satisfactory than packing raw. Chicken lightly browned in a fry pan on top of the range was rated higher than chicken browned in the oven, probably because of the shorter time required. The differences between these two methods of browning in their effect on chicken flavor and juiciness were statistically significant.

Table 3 contains additional palatability data from other lots of 16-month-old hens and 3-month-old cockerels prepared for packing by three methods: Packing raw, precooking in water, and browning on a broiler. Scores for the two types of birds in this investigation were analyzed separately because the studies were made in different years.

TABLE 1.—Mean palatability scores for canned chicken prepared for packing by five methods

Description of canned chicken sample	Mean palatability score after 3 months' storage ¹											
	16-month-old hens			6-month-old hens			3-month-old cockerels			All chickens		
	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh
	Chicken flavor											
Heated in own juice for serving:												
Packed raw.....	4.4	4.7	4.5	3.9	4.3	4.1	4.8	3.8	4.2	4.4	4.2	4.3
Precooked in water.....	4.2	4.1	4.1	4.1	3.7	3.9	4.0	4.2	4.1	4.1	4.0	4.0
Precooked in broth.....	4.1	3.9	4.0	4.3	4.4	4.4	4.1	4.7	4.4	4.2	4.4	4.3
Lightly browned in oven.....	2.1	3.2	2.7	2.9	3.5	3.2	3.8	4.5	4.1	2.9	3.7	3.3
Lightly browned in fry pan.....	4.4	4.4	4.4	3.4	3.8	3.6	4.4	4.2	4.3	4.1	4.2	4.1
All preparation methods.....	3.8	4.1	4.0	3.7	4.0	3.8	4.2	4.3	4.2	3.9	4.1	4.0
Heated for serving by frying:												
Packed raw.....	3.8	4.4	4.1	3.8	4.2	4.0	3.8	4.8	4.2	3.8	4.5	4.1
Precooked in water.....	3.8	4.0	3.9	3.8	3.9	3.8	3.7	4.4	4.1	3.8	4.1	3.9
Precooked in broth.....	3.8	4.8	4.3	3.9	4.5	4.2	4.1	4.5	4.3	3.9	4.6	4.3
Lightly browned in oven.....	3.1	3.2	3.2	3.4	4.0	3.7	3.5	4.6	4.1	3.3	4.0	3.6
Lightly browned in fry pan.....	3.8	4.4	4.1	3.7	4.2	4.0	3.6	4.5	4.1	3.7	4.4	4.0
All preparation methods.....	3.6	4.2	3.9	3.7	4.2	3.9	3.7	4.6	4.1	3.7	4.3	4.0
Both methods of heating for serving:												
Packed raw.....	4.1	4.5	4.3	3.9	4.3	4.1	4.2	4.2	4.2	4.1	4.4	4.2
Precooked in water.....	4.0	4.0	4.0	3.9	3.8	3.9	3.8	4.3	4.1	3.9	4.0	4.0
Precooked in broth.....	4.0	4.3	4.2	4.1	4.5	4.3	4.1	4.6	4.3	4.0	4.5	4.3
Lightly browned in oven.....	2.6	3.2	2.9	3.1	3.8	3.4	3.6	4.6	4.1	3.1	3.8	3.5
Lightly browned in fry pan.....	4.1	4.4	4.3	3.6	4.0	3.8	4.0	4.4	4.2	3.9	4.3	4.1
All preparation methods.....	3.8	4.1	3.9	3.7	4.1	3.9	4.0	4.4	4.2	3.8	4.2	4.0

Absence of off-flavor

Heated in own juice for serving:

Packed raw.....	4.5	4.6	4.5	4.5	4.8	4.6	5.0	4.5	4.8	4.7	4.6	4.6
Precooked in water.....	4.6	4.4	4.5	4.8	4.4	4.6	4.3	4.4	4.4	4.6	4.4	4.5
Precooked in broth.....	4.2	4.1	4.2	4.5	4.8	4.6	4.3	4.7	4.5	4.3	4.5	4.4
Lightly browned in oven.....	2.4	2.9	2.6	3.5	3.7	3.6	4.4	4.7	4.5	3.4	3.8	3.6
Lightly browned in fry pan.....	4.4	4.8	4.6	3.6	3.7	3.6	4.5	4.4	4.4	4.2	4.3	4.2
All preparation methods.....	4.0	4.1	4.1	4.2	4.2	4.2	4.5	4.5	4.5	4.2	4.3	4.3

Heated for serving by frying:

Packed raw.....	4.6	4.6	4.6	4.6	4.8	4.7	5.0	5.0	5.0	4.7	4.8	4.8
Precooked in water.....	4.4	4.1	4.3	4.8	4.6	4.7	4.7	4.7	4.7	4.7	4.5	4.6
Precooked in broth.....	4.7	4.8	4.8	4.7	4.8	4.7	4.7	4.8	4.8	4.7	4.8	4.8
Lightly browned in oven.....	3.6	3.7	3.6	4.2	4.4	4.3	4.5	4.8	4.7	4.1	4.3	4.2
Lightly browned in fry pan.....	4.8	4.8	4.8	4.5	4.4	4.4	4.2	5.0	4.6	4.5	4.7	4.6
All preparation methods.....	4.4	4.4	4.4	4.6	4.6	4.6	4.6	4.9	4.7	4.5	4.6	4.6

Both methods of heating for serving:

Packed raw.....	4.5	4.6	4.5	4.6	4.8	4.7	5.0	4.8	4.9	4.7	4.7	4.7
Precooked in water.....	4.5	4.2	4.4	4.8	4.5	4.6	4.5	4.6	4.5	4.6	4.4	4.5
Precooked in broth.....	4.4	4.5	4.4	4.6	4.8	4.7	4.5	4.8	4.6	4.5	4.7	4.6
Lightly browned in oven.....	3.0	3.3	3.1	3.9	4.0	4.0	4.4	4.8	4.6	3.8	4.0	3.9
Lightly browned in fry pan.....	4.6	4.8	4.7	4.0	4.0	4.0	4.4	4.7	4.5	4.3	4.5	4.4
All preparation methods.....	4.2	4.3	4.2	4.4	4.4	4.4	4.6	4.7	4.6	4.4	4.5	4.4

See footnote at end of table.

TABLE 1.—Mean palatability scores for canned chicken prepared for packing by five methods—Continued

Description of canned chicken sample	Mean palatability score after 3 months' storage ¹											
	16-month-old hens			6-month-old hens			3-month-old cockerels			All chickens		
	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh
	Juiciness											
Heated in own juice for serving:												
Packed raw.....	3.4	3.9	3.7	3.7	4.1	3.9	4.0	3.8	3.9	3.7	3.9	3.8
Precooked in water..	3.6	4.1	3.8	3.9	3.8	3.8	3.3	3.8	3.6	3.6	3.9	3.8
Precooked in broth.....	3.8	3.7	3.7	3.8	4.2	4.0	4.0	3.8	3.9	3.8	3.9	3.9
Lightly browned in oven.....	3.3	3.8	3.5	3.0	3.8	3.4	3.1	3.9	3.5	3.1	3.8	3.5
Lightly browned in fry pan..	3.5	4.0	3.7	3.6	3.9	3.7	3.9	4.1	4.0	3.6	4.0	3.8
All preparation methods..	3.5	3.9	3.7	3.6	4.0	3.8	3.7	3.9	3.8	3.6	3.9	3.8
Heated for serving by frying:												
Packed raw.....	3.8	4.8	4.3	3.8	4.8	4.3	3.5	5.0	4.2	3.7	4.8	4.3
Precooked in water..	3.8	4.7	4.2	3.9	4.4	4.2	3.8	4.4	4.1	3.8	4.5	4.2
Precooked in broth.....	3.8	4.7	4.2	3.7	4.6	4.2	3.8	4.4	4.1	3.8	4.6	4.2
Lightly browned in oven.....	3.4	4.2	3.8	3.6	4.2	3.9	3.6	4.7	4.2	3.5	4.4	4.0
Lightly browned in fry pan..	3.9	4.8	4.3	3.6	4.8	4.2	3.6	4.8	4.2	3.7	4.8	4.2
All preparation methods..	3.7	4.6	4.2	3.7	4.6	4.1	3.7	4.7	4.2	3.7	4.6	4.2
Both methods of heating for serving:												
Packed raw.....	3.6	4.3	4.0	3.7	4.5	4.1	3.8	4.4	4.1	3.7	4.4	4.0
Precooked in water..	3.7	4.4	4.0	3.9	4.1	4.0	3.6	4.1	3.8	3.7	4.2	4.0
Precooked in broth.....	3.8	4.2	4.0	3.8	4.4	4.1	3.9	4.1	4.0	3.8	4.2	4.0
Lightly browned in oven.....	3.3	4.0	3.7	3.3	4.0	3.7	3.4	4.3	3.8	3.3	4.1	3.7
Lightly browned in fry pan..	3.7	4.4	4.0	3.6	4.3	3.9	3.8	4.4	4.1	3.7	4.4	4.0
All preparation methods..	3.6	4.3	3.9	3.7	4.3	4.0	3.7	4.3	4.0	3.6	4.3	4.0

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	Tenderness											
Heated in own juice for serving:												
Packed raw.....	4.6	4.1	4.4	4.7	4.2	4.4	5.0	4.2	4.6	4.8	4.2	4.5
Precooked in water.....	4.5	4.2	4.4	4.9	3.6	4.2	4.7	3.8	4.2	4.7	3.9	4.3
Precooked in broth.....	4.8	3.9	4.3	4.2	4.5	4.4	4.2	3.8	4.0	4.4	4.1	4.2
Lightly browned in oven.....	4.5	3.7	4.1	4.3	3.4	3.9	4.4	4.1	4.2	4.4	3.8	4.1
Lightly browned in fry pan.....	4.9	3.9	4.4	4.6	4.4	4.5	4.6	4.1	4.4	4.7	4.1	4.4
All preparation methods.....	4.7	4.0	4.3	4.6	4.0	4.3	4.6	4.0	4.3	4.6	4.0	4.3
Heated for serving by frying:												
Packed raw.....	4.9	4.8	4.9	4.8	4.8	4.8	4.8	5.0	4.9	4.8	4.8	4.8
Precooked in water.....	4.8	4.9	4.8	5.0	4.4	4.7	4.8	4.6	4.7	4.8	4.6	4.8
Precooked in broth.....	4.8	4.3	4.5	4.6	4.9	4.8	5.0	4.3	4.7	4.8	4.5	4.6
Lightly browned in oven.....	4.8	4.5	4.6	4.5	4.2	4.4	4.6	4.9	4.8	4.6	4.6	4.6
Lightly browned in fry pan.....	4.9	4.8	4.8	4.8	5.0	4.9	4.6	4.6	4.6	4.8	4.8	4.8
All preparation methods.....	4.8	4.6	4.7	4.7	4.7	4.7	4.8	4.7	4.7	4.8	4.7	4.7
Both methods of heating for serving:												
Packed raw.....	4.8	4.5	4.6	4.7	4.5	4.6	4.9	4.6	4.8	4.8	4.5	4.7
Precooked in water.....	4.6	4.6	4.6	5.0	4.0	4.5	4.8	4.2	4.5	4.8	4.3	4.5
Precooked in broth.....	4.8	4.1	4.4	4.4	4.7	4.6	4.6	4.1	4.4	4.6	4.3	4.4
Lightly browned in oven.....	4.6	4.1	4.4	4.4	3.8	4.1	4.5	4.5	4.5	4.5	4.2	4.3
Lightly browned in fry pan.....	4.9	4.3	4.6	4.7	4.7	4.7	4.6	4.4	4.5	4.7	4.5	4.6
All preparation methods.....	4.7	4.3	4.5	4.6	4.3	4.5	4.7	4.4	4.5	4.7	4.3	4.5

¹ Based on scores of 4 judges on 4 replicate samples of canned chicken. 5 was the highest possible score; 1, the lowest. Summary means are averages of original data.

TABLE 2.—Mean palatability scores for canned chicken prepared by frying to three degrees of brownness before packing compared to raw-packed chicken

Description of canned chicken sample	Mean palatability score ¹								
	Unstored			Stored 6 months			Unstored and stored		
	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh
	Chicken flavor								
Heated in own juice for serving:									
Packed raw.....	4.6	4.4	4.5	4.5	4.1	4.3	4.6	4.2	4.4
Prefried light brown.....	3.0	3.8	3.4	3.2	2.9	3.1	3.1	3.3	3.2
Prefried medium brown.....	3.2	3.4	3.3	2.1	2.1	2.1	2.7	2.8	2.7
Prefried dark brown.....	2.4	2.8	2.6	2.4	2.2	2.3	2.4	2.5	2.4
All preparation methods.....	3.3	3.6	3.4	3.1	2.8	3.0	3.2	3.2	3.2
Heated for serving by frying:									
Packed raw.....	3.6	4.5	4.1	4.0	4.2	4.1	3.8	4.4	4.1
Prefried light brown.....	3.5	4.2	3.9	3.4	3.4	3.4	3.4	3.8	3.6
Prefried medium brown.....	3.8	4.1	3.9	3.2	2.9	3.1	3.5	3.5	3.5
Prefried dark brown.....	3.4	3.9	3.6	2.8	3.0	2.9	3.1	3.4	3.2
All preparation methods.....	3.6	4.2	3.9	3.3	3.4	3.4	3.5	3.8	3.6
Both methods of heating for serving:									
Packed raw.....	4.1	4.4	4.3	4.2	4.2	4.2	4.2	4.3	4.2
Prefried light brown.....	3.2	4.0	3.6	3.3	3.1	3.2	3.3	3.6	3.4
Prefried medium brown.....	3.5	3.8	3.6	2.7	2.5	2.6	3.1	3.1	3.1
Prefried dark brown.....	2.9	3.3	3.1	2.6	2.6	2.6	2.7	3.0	2.8
All preparation methods.....	3.4	3.9	3.7	3.2	3.1	3.2	3.3	3.5	3.4

	Absence of off-flavor								
Heated in own juice for serving:									
Packed raw.....	4.9	4.9	4.9	4.6	4.8	4.7	4.8	4.8	4.8
Prefried light brown.....	3.2	4.6	3.9	3.8	3.5	3.6	3.5	4.1	3.8
Prefried medium brown.....	3.1	3.4	3.2	2.5	2.8	2.6	2.8	3.1	2.9
Prefried dark brown.....	2.1	2.5	2.3	2.5	2.5	2.5	2.3	2.5	2.4
All preparation methods.....	3.3	3.8	3.6	3.3	3.4	3.4	3.3	3.6	3.5
Heated for serving by frying:									
Packed raw.....	4.9	5.0	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Prefried light brown.....	4.1	4.9	4.5	4.0	4.4	4.2	4.1	4.6	4.3
Prefried medium brown.....	4.8	4.5	4.6	3.5	3.6	3.6	4.1	4.1	4.1
Prefried dark brown.....	4.1	4.1	4.1	3.6	3.5	3.6	3.9	3.8	3.8
All preparation methods.....	4.5	4.6	4.6	4.0	4.1	4.0	4.2	4.4	4.3
Both methods of heating for serving:									
Packed raw.....	4.9	4.9	4.9	4.8	4.8	4.8	4.8	4.9	3.1
Prefried light brown.....	3.7	4.8	4.2	3.9	3.9	3.9	3.8	4.3	4.1
Prefried medium brown.....	3.9	3.9	3.9	3.0	3.2	3.1	3.5	3.6	3.5
Prefried dark brown.....	3.1	3.3	3.2	3.1	3.0	3.0	3.1	3.2	3.1
All preparation methods.....	3.9	4.2	4.1	3.7	3.7	3.7	3.8	4.0	3.9

See footnotes at end of table.

TABLE 2.—Mean palatability scores for canned chicken prepared by frying to three degrees of brownness before packing compared to raw-packed chicken—Continued

Description of canned chicken sample ¹	Mean palatability score ²								
	Unstored			Stored 6 months			Unstored and stored		
	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh
	Juiciness								
Heated in own juice for serving:									
Packed raw.....	3.9	4.2	4.1	3.5	4.0	3.8	3.7	4.1	3.9
Prefried light brown.....	3.2	3.9	3.6	3.5	3.8	3.6	3.4	3.8	3.6
Prefried medium brown.....	3.6	3.9	3.7	3.1	3.8	3.4	3.4	3.8	3.6
Prefried dark brown.....	3.6	4.1	3.9	3.5	3.9	3.7	3.6	4.0	3.8
All preparation methods.....	3.6	4.0	3.8	3.4	3.8	3.6	3.5	3.9	3.7
Heated for serving by frying:									
Packed raw.....	4.0	4.9	4.4	3.9	4.8	4.3	3.9	4.8	4.4
Prefried light brown.....	3.8	4.5	4.1	3.5	4.2	3.9	3.6	4.4	4.0
Prefried medium brown.....	3.9	4.8	4.3	3.5	4.0	3.8	3.7	4.4	4.0
Prefried dark brown.....	3.9	4.6	4.2	3.9	4.1	4.0	3.9	4.4	4.1
All preparation methods.....	3.9	4.7	4.3	3.7	4.3	4.0	3.8	4.5	4.1
Both methods of heating for serving:									
Packed raw.....	3.9	4.6	4.2	3.7	4.4	4.0	3.8	4.5	4.1
Prefried light brown.....	3.5	4.2	3.8	3.5	4.0	3.8	3.5	4.1	3.8
Prefried medium brown.....	3.8	4.3	4.0	3.3	3.9	3.6	3.5	4.1	3.8
Prefried dark brown.....	3.8	4.4	4.1	3.7	4.0	3.8	3.7	4.2	4.0
All preparation methods.....	3.7	4.4	4.1	3.5	4.1	3.8	3.6	4.2	3.9

	Tenderness								
Heated in own juice for serving:									
Packed raw.....	4.9	4.0	4.4	4.8	3.9	4.3	4.8	3.9	4.4
Prefried light brown.....	3.6	3.8	3.7	4.1	3.6	3.9	3.9	3.7	3.8
Prefried medium brown.....	4.0	4.0	4.0	3.6	3.8	3.7	3.8	3.9	3.8
Prefried dark brown.....	4.4	4.4	4.4	4.2	4.1	4.2	4.3	4.2	4.3
All preparation methods.....	4.2	4.0	4.1	4.2	3.8	4.0	4.2	3.9	4.1
Heated for serving by frying:									
Packed raw.....	5.0	5.0	5.0	5.0	4.6	4.8	5.0	4.8	4.9
Prefried light brown.....	4.9	4.9	4.9	4.4	4.0	4.2	4.6	4.4	4.5
Prefried medium brown.....	4.6	4.8	4.7	4.4	4.5	4.4	4.5	4.6	4.6
Prefried dark brown.....	4.5	4.9	4.7	4.5	4.5	4.5	4.5	4.7	4.6
All preparation methods.....	4.8	4.9	4.8	4.6	4.4	4.5	4.7	4.6	4.7
Both methods of heating for serving:									
Packed raw.....	4.9	4.5	4.7	4.9	4.2	4.6	4.9	4.4	4.6
Prefried light brown.....	4.2	4.3	4.3	4.2	3.8	4.0	4.2	4.1	4.2
Prefried medium brown.....	4.3	4.4	4.3	4.0	4.1	4.1	4.2	4.2	4.2
Prefried dark brown.....	4.4	4.6	4.5	4.4	4.3	4.3	4.4	4.5	4.4
All preparation methods.....	4.5	4.5	4.5	4.4	4.1	4.2	4.4	4.3	4.4

¹ 5-month-old hens were used in this study.

² Based on scores of 4 judges on 2 replicates. 5 was the highest possible score; 1, the lowest. Summary means are averages of original data.

TABLE 3.—Mean palatability scores for canned chicken prepared for packing by three methods and evaluated before and after storage at room temperature

Description of canned chicken sample	Mean palatability score ¹																	
	Unstored			Stored 4 months			Stored 8 months			Stored 12 months			Stored only			Unstored and stored		
	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh
HEN, 16-MONTH-OLD																		
Heated in own juice for serving:																		
Packed raw.....	4.2	4.1	4.2	4.5	4.3	4.4	4.0	4.0	4.0	4.3	4.1	4.2	4.3	4.1	4.2	4.3	4.1	4.2
Precooked in water.....	4.5	4.2	4.4	4.2	3.7	3.9	3.8	3.9	3.8	3.3	3.6	3.5	3.8	3.7	3.7	3.9	3.9	3.9
Lightly browned on broiler.....	4.0	4.1	4.0	3.6	3.5	3.5	3.2	4.0	3.6	2.9	3.2	3.0	3.2	3.6	3.4	3.4	3.7	3.6
All preparation methods.....	4.2	4.1	4.2	4.1	3.8	4.0	3.7	4.0	3.8	3.5	3.6	3.6	3.8	3.8	3.8	3.9	3.9	3.9
Heated for serving by frying:																		
Packed raw.....	3.8	4.5	4.1	4.0	4.2	4.1	3.5	4.1	3.8	3.6	4.2	3.9	3.7	4.2	3.9	3.7	4.3	4.0
Precooked in water.....	3.8	4.1	3.9	3.8	4.7	4.2	3.6	4.1	3.8	3.7	3.9	3.8	3.7	4.2	4.0	3.7	4.2	3.9
Lightly browned on broiler.....	3.3	4.2	3.8	3.8	4.4	4.1	3.5	4.2	3.9	3.5	4.0	3.8	3.6	4.2	3.9	3.5	4.2	3.9
All preparation methods.....	3.6	4.3	3.9	3.9	4.4	4.2	3.5	4.1	3.8	3.6	4.0	3.8	3.7	4.2	3.9	3.6	4.2	3.9
Both methods of heating for serving:																		
Packed raw.....	4.0	4.3	4.1	4.2	4.3	4.3	3.8	4.0	3.9	4.0	4.1	4.0	4.0	4.2	4.1	4.0	4.2	4.1
Precooked in water.....	4.1	4.2	4.1	4.0	4.2	4.1	3.7	4.0	3.8	3.5	3.8	3.6	3.7	4.0	3.8	3.8	4.0	3.9
Lightly browned on broiler.....	3.7	4.2	3.9	3.7	4.0	3.8	3.4	4.1	3.8	3.2	3.6	3.4	3.4	3.9	3.7	3.5	4.0	3.7
All preparation methods.....	3.9	4.2	4.1	4.0	4.1	4.1	3.6	4.1	3.8	3.6	3.8	3.7	3.7	4.0	3.9	3.8	4.1	3.9
COCKEREL, 3-MONTH-OLD																		
Heated in own juice for serving:																		
Packed raw.....	4.2	4.4	4.3	4.1	4.4	4.3	3.5	4.1	3.6	4.0	4.2	4.1	3.9	4.2	4.1	4.0	4.3	4.1
Precooked in water.....	4.4	4.3	4.4	4.2	4.1	4.1	4.0	4.2	4.1	3.1	3.8	3.4	3.8	4.0	3.9	3.9	4.1	4.0
Lightly browned on broiler.....	3.7	4.4	4.0	4.2	4.3	4.2	3.8	4.0	3.9	3.6	3.7	3.6	3.8	4.0	3.9	3.8	4.1	4.0
All preparation methods.....	4.1	4.4	4.2	4.2	4.3	4.2	3.8	4.1	3.9	3.6	3.9	3.7	3.8	4.1	4.0	3.9	4.2	4.0
Heated for serving by frying:																		
Packed raw.....				4.5	4.5	4.5	4.5	4.2	4.4	4.5	4.6	4.5	4.5	4.4	4.5			
Precooked in water.....				4.4	4.2	4.3	4.1	4.3	4.2	3.6	4.2	3.9	4.0	4.2	4.1			
Lightly browned on broiler.....				4.0	4.3	4.1	4.4	4.5	4.5	3.5	3.9	3.7	4.0	4.2	4.1			
All preparation methods.....				4.3	4.3	4.3	4.3	4.3	4.3	3.9	4.2	4.1	4.2	4.3	4.2			
Both methods of heating for serving:																		
Packed raw.....				4.3	4.5	4.4	4.0	4.1	4.1	4.2	4.4	4.3	4.2	4.3	4.3			
Precooked in water.....				4.3	4.1	4.2	4.1	4.2	4.2	3.4	4.0	3.7	3.9	4.1	4.0			
Lightly browned on broiler.....				4.1	4.3	4.2	4.1	4.3	4.2	3.6	3.8	3.7	3.9	4.1	4.0			
All preparation methods.....				4.2	4.3	4.3	4.0	4.2	4.1	3.7	4.1	3.9	4.0	4.2	4.1			

Absence of off-flavor

HEN, 16-MONTH-OLD																		
Heated in own juice for serving:																		
Packed raw.....	4.2	4.4	4.6	4.8	4.8	4.8	4.2	4.5	4.3	4.1	4.6	4.3	4.4	4.6	4.5	4.5	4.6	4.5
Precooked in water.....	4.8	4.9	4.9	4.7	4.4	4.5	4.1	4.2	4.1	3.8	3.8	3.8	4.2	4.1	4.2	4.3	4.3	4.3
Lightly browned on broiler.....	4.2	4.6	4.4	3.8	3.7	3.7	3.5	4.2	3.9	2.9	3.2	3.0	3.4	3.7	3.5	3.6	3.0	3.8
All preparation methods.....	4.6	4.6	4.6	4.4	4.3	4.4	3.9	4.3	4.1	3.6	3.9	3.7	4.0	4.2	4.1	4.1	4.3	4.2
Heated for serving by frying:																		
Packed raw.....	4.8	4.8	4.8	5.0	4.8	4.9	4.5	4.2	4.4	4.6	4.8	4.7	4.7	4.6	4.7	4.7	4.6	4.7
Precooked in water.....	4.9	4.7	4.8	4.8	4.8	4.8	4.5	4.5	4.5	4.2	4.3	4.3	4.5	4.6	4.5	4.6	4.6	4.6
Lightly browned on broiler.....	4.2	4.6	4.4	4.4	4.5	4.5	3.9	4.4	4.1	4.1	4.2	4.1	4.1	4.4	4.2	4.2	4.4	4.3
All preparation methods.....	4.7	4.7	4.7	4.7	4.7	4.7	4.3	4.4	4.3	4.3	4.4	4.4	4.4	4.5	4.5	4.5	4.5	4.5
Both methods of heating for serving:																		
Packed raw.....	4.8	4.6	4.7	4.9	4.8	4.9	4.3	4.4	4.4	4.3	4.7	4.5	4.5	4.6	4.6	4.6	4.6	4.6
Precooked in water.....	4.9	4.8	4.8	4.7	4.6	4.7	4.3	4.3	4.3	4.0	4.1	4.0	4.3	4.3	4.3	4.5	4.5	4.5
Lightly browned on broiler.....	4.2	4.6	4.4	4.1	4.1	4.1	3.7	4.3	4.0	3.5	3.7	3.6	3.8	4.0	3.9	3.9	4.2	4.0
All preparation methods.....	4.6	4.7	4.6	4.6	4.5	4.5	4.1	4.3	4.2	3.9	4.1	4.0	4.2	4.3	4.3	4.3	4.4	4.4
COCKEREL, 3-MONTH-OLD																		
Heated in own juice for serving:																		
Packed raw.....	4.5	4.7	4.6	4.5	4.5	4.5	3.3	4.2	3.7	4.1	4.2	4.2	4.0	4.3	4.1	4.1	4.4	4.2
Precooked in water.....	4.5	4.5	4.5	4.8	4.6	4.6	4.4	4.5	4.5	2.8	3.8	3.3	4.0	4.3	4.2	4.1	4.4	4.3
Lightly browned on broiler.....	3.9	4.6	4.2	4.4	4.5	4.4	3.8	4.0	3.9	3.6	3.8	3.7	3.9	4.1	4.0	3.9	4.2	4.1
All preparation methods.....	4.3	4.6	4.5	4.6	4.5	4.5	3.8	4.2	4.0	3.5	4.0	3.7	4.0	4.2	4.1	4.1	4.3	4.2
Heated for serving by frying:																		
Packed raw.....				4.8	4.8	4.8	4.4	4.4	4.4	4.3	4.5	4.4	4.5	4.5	4.5			
Precooked in water.....				4.6	4.7	4.6	4.3	4.8	4.6	3.9	4.3	4.1	4.2	4.6	4.4			
Lightly browned on broiler.....				4.3	4.5	4.4	4.3	4.6	4.5	3.5	4.0	3.8	4.0	4.4	4.2			
All preparation methods.....				4.5	4.6	4.6	4.3	4.6	4.5	3.9	4.2	4.1	4.3	4.5	4.4			
Both methods of heating for serving:																		
Packed raw.....				4.6	4.6	4.6	3.9	4.3	4.1	4.2	4.4	4.3	4.2	4.4	4.3			
Precooked in water.....				4.7	4.6	4.7	4.3	4.7	4.5	3.4	4.1	3.7	4.1	4.5	4.3			
Lightly browned on broiler.....				4.4	4.5	4.4	4.1	4.3	4.2	3.5	3.9	3.7	4.0	4.2	4.1			
All preparation methods.....				4.6	4.6	4.6	4.1	4.4	4.3	3.7	4.1	3.9	4.1	4.4	4.2			

See footnote at end of table;

TABLE 3.—Mean palatability scores for canned chicken prepared for packing by three methods and evaluated before and after storage at room temperature—Continued

Description of canned chicken sample	Mean palatability score ¹																	
	Unstored			Stored 4 months			Stored 8 months			Stored 12 months			Stored only			Unstored and stored		
	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh	Breast	Thigh	Breast and thigh
Juiciness																		
HEN, 16-MONTH-OLD																		
Heated in own juice for serving:																		
Packed raw.....	3.8	4.0	3.9	3.8	4.2	4.0	3.6	3.7	3.6	3.6	3.8	3.7	3.6	3.9	3.8	3.7	3.9	3.8
Precooked in water.....	3.7	3.7	3.7	3.7	3.8	3.8	3.4	3.8	3.6	3.3	3.8	3.5	3.5	3.8	3.6	3.5	3.8	3.6
Lightly browned on broiler.....	3.5	3.8	3.7	2.8	3.8	3.3	3.1	3.8	3.4	2.8	3.8	3.2	2.9	3.8	3.3	3.1	3.8	3.4
All preparation methods.....	3.7	3.8	3.8	3.4	3.9	3.7	3.4	3.7	3.6	3.2	3.8	3.5	3.3	3.8	3.6	3.4	3.8	3.6
Heated for serving by frying:																		
Packed raw.....	4.0	4.9	4.5	3.8	4.2	4.0	3.9	4.7	4.3	3.7	4.5	4.1	3.8	4.4	4.1	3.9	4.6	4.2
Precooked in water.....	3.8	4.8	4.3	3.8	4.6	4.2	3.8	4.6	4.2	3.5	4.3	3.9	3.7	4.5	4.1	3.7	4.6	4.1
Lightly browned on broiler.....	3.8	4.8	4.2	3.8	4.4	4.1	3.6	4.4	4.0	3.6	4.2	3.9	3.7	4.3	4.0	3.7	4.4	4.1
All preparation methods.....	3.9	4.8	4.3	3.8	4.4	4.1	3.8	4.5	4.2	3.6	4.4	4.0	3.7	4.4	4.1	3.8	4.5	4.1
Both methods of heating for serving:																		
Packed raw.....	3.9	4.5	4.2	3.8	4.2	4.0	3.8	4.2	4.0	3.6	4.1	3.9	3.7	4.2	3.9	3.8	4.2	4.0
Precooked in water.....	3.8	4.2	4.0	3.8	4.2	4.0	3.6	4.2	3.9	3.4	4.0	3.7	3.6	4.1	3.9	3.6	4.2	3.9
Lightly browned on broiler.....	3.6	4.3	4.0	3.3	4.1	3.7	3.4	4.1	3.7	3.2	4.0	3.6	3.3	4.0	3.7	3.4	4.1	3.7
All preparation methods.....	3.8	4.3	4.0	3.6	4.2	3.9	3.6	4.1	3.9	3.4	4.1	3.7	3.5	4.1	3.8	3.6	4.2	3.9
COCKEREL, 3-MONTH-OLD																		
Heated in own juice for serving:																		
Packed raw.....	3.3	4.2	3.7	3.5	4.2	3.8	3.4	4.1	3.8	3.2	4.2	3.7	3.4	4.1	3.8	3.4	4.1	3.8
Precooked in water.....	3.3	4.1	3.7	3.7	4.2	3.9	3.5	4.2	3.9	2.9	3.8	3.3	3.4	4.1	3.7	3.3	4.1	3.7
Lightly browned on broiler.....	3.2	4.0	3.6	3.5	4.2	3.8	2.9	4.0	3.5	3.0	3.8	3.4	3.1	4.0	3.6	3.2	4.0	3.6
All preparation methods.....	3.3	4.1	3.7	3.6	4.2	3.9	3.3	4.1	3.7	3.1	3.9	3.5	3.3	4.1	3.7	3.3	4.1	3.7
Heated for serving by frying:																		
Packed raw.....				3.9	4.5	4.2	3.8	4.6	4.2	3.8	4.3	4.1	3.9	4.5	4.2			
Precooked in water.....				3.5	4.5	4.0	3.4	4.5	4.0	3.7	4.4	4.0	3.5	4.5	4.0			
Lightly browned on broiler.....				3.5	4.2	3.8	3.5	4.6	4.1	3.0	4.3	3.6	3.3	4.4	3.8			
All preparation methods.....				3.6	4.4	4.0	3.6	4.6	4.1	3.5	4.3	3.9	3.6	4.4	4.0			
Both methods of heating for serving:																		
Packed raw.....				3.7	4.3	4.0	3.6	4.4	4.0	3.5	4.2	3.9	3.8	4.3	4.0			
Precooked in water.....				3.6	4.3	4.0	3.4	4.4	3.9	3.3	4.1	3.7	3.4	4.3	3.9			
Lightly browned on broiler.....				3.5	4.2	3.8	3.2	4.3	3.8	3.0	4.0	3.5	3.2	4.2	3.7			
All preparation methods.....				3.6	4.3	3.9	3.4	4.4	3.9	3.3	4.1	3.7	3.4	4.3	3.8			

Tenderness

HEN, 16-MONTH-OLD

Heated in own juice for serving:

Packed raw.....	5.0	4.0	4.5	4.7	3.9	4.3	4.7	3.7	4.2	4.8	3.8	4.2	4.7	3.8	4.2	4.8	3.8	4.3
Precooked in water.....	5.0	4.0	4.5	4.2	3.8	4.0	4.0	3.8	3.9	4.8	3.8	4.2	4.3	3.8	4.1	4.5	3.8	4.2
Lightly browned on broiler.....	4.4	4.1	4.2	3.6	3.6	3.6	4.2	4.0	4.1	4.1	3.8	4.0	4.0	3.8	3.9	4.1	3.0	4.0
All preparation methods.....	4.8	4.0	4.4	4.2	3.8	4.0	4.3	3.8	4.1	4.5	3.8	4.2	4.3	3.8	4.1	4.5	3.8	4.1

Heated for serving by frying:

Packed raw.....	4.9	4.8	4.8	4.8	4.4	4.6	4.8	4.4	4.6	4.0	4.4	4.7	4.9	4.4	4.6	4.0	4.5	4.7
Precooked in water.....	5.0	4.9	5.0	4.8	4.5	4.6	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.7	4.7	4.8	4.8	4.8
Lightly browned on broiler.....	4.9	4.9	4.9	4.6	4.5	4.5	4.6	4.6	4.6	4.8	4.8	4.8	4.7	4.6	4.7	4.7	4.7	4.7
All preparation methods.....	4.9	4.9	4.9	4.7	4.5	4.6	4.8	4.6	4.7	4.8	4.7	4.8	4.8	4.6	4.7	4.8	4.7	4.7

Both methods of heating for serving:

Packed raw.....	5.0	4.4	4.7	4.8	4.2	4.5	4.8	4.0	4.4	4.8	4.1	4.5	4.8	4.1	4.4	4.8	4.2	4.5
Precooked in water.....	5.0	4.5	4.7	4.5	4.1	4.3	4.4	4.3	4.4	4.8	4.3	4.5	4.6	4.2	4.4	4.7	4.3	4.5
Lightly browned on broiler.....	4.7	4.5	4.6	4.1	4.0	4.1	4.4	4.3	4.4	4.5	4.3	4.4	4.3	4.2	4.3	4.4	4.3	4.4
All preparation methods.....	4.9	4.4	4.7	4.4	4.1	4.3	4.5	4.2	4.4	4.7	4.2	4.5	4.6	4.2	4.4	4.6	4.3	4.4

COCKEREL, 3-MONTH-OLD

Heated in own juice for serving:

Packed raw.....	4.8	4.0	4.4	4.6	3.8	4.2	4.7	4.0	4.3	4.3	3.8	4.0	4.5	3.9	4.2	4.6	3.9	4.2
Precooked in water.....	4.6	3.8	4.2	4.5	4.1	4.3	4.5	3.8	4.2	3.9	3.4	3.6	4.3	3.8	4.0	4.4	3.8	4.1
Lightly browned on broiler.....	4.1	3.8	4.0	4.4	3.8	4.1	4.2	3.7	4.0	3.8	3.7	3.7	4.1	3.7	3.9	4.1	3.8	3.9
All preparation methods.....	4.5	3.9	4.2	4.5	3.9	4.2	4.5	3.8	4.2	4.0	3.6	3.8	4.3	3.8	4.1	4.4	3.8	4.1

Heated for serving by frying:

Packed raw.....				4.5	4.2	4.4	4.2	4.2	4.2	4.2	4.1	4.2	4.3	4.2	4.2			
Precooked in water.....				4.2	4.2	4.2	4.2	4.1	4.1	3.9	4.1	4.0	4.1	4.1	4.1			
Lightly browned on broiler.....				4.0	4.3	4.1	4.0	4.4	4.2	3.5	4.2	3.9	3.8	4.3	4.1			
All preparation methods.....				4.2	4.2	4.2	4.1	4.3	4.2	3.9	4.1	4.0	4.1	4.2	4.1			

Both methods of heating for serving:

Packed raw.....				4.6	4.0	4.3	4.4	4.1	4.3	4.3	3.9	4.1	4.4	4.0	4.2			
Precooked in water.....				4.4	4.1	4.2	4.4	4.0	4.2	3.9	3.8	3.8	4.2	4.0	4.1			
Lightly browned on broiler.....				4.2	4.0	4.1	4.1	4.0	4.1	3.6	4.0	3.8	4.0	4.0	4.0			
All preparation methods.....				4.4	4.1	4.2	4.3	4.0	4.2	3.9	3.9	3.9	4.2	4.0	4.1			

Based on scores of 4 judges on 3 replicates. 5 was the highest possible score; 1, the lowest. Summary means are averages of original data.

In general, these data bear out the findings of the previous study that method of preparation for packing made a difference in palatability of canned chicken. On most of the quality factors, raw-packed canned hen scored highest that precooked in water tended to score next highest, and the browned pack, lowest. Differences in the scores for the three packs were significant for chicken flavor, amount of off-flavor, and juiciness, largely because of the lower scores for the chicken browned on the broiler. All packs were, for practical purposes, equal in tenderness.

Differences in palatability scores were smaller for the three packs of canned cockerel than for the parallel packs of canned hen. The raw pack usually received a slightly higher score than the others, but differences in scores were not statistically significant for any of the quality factors.

From the standpoint of eating quality, raw-packed chicken from all types of birds of the ages studied (tables 1, 2, 3) was very good. In chicken flavor all samples were rated good. Very little off-flavor was noted in any instance. The meat was moderately juicy and very tender, except for one sample of canned cockerel, which was considered only moderately tender by the panel. However, the mean scores were 4.0 or above for all characteristics, indicating that canned chicken of good quality prepared by the raw-pack method was obtained from 3-month-old cockerels and 5-, 6-, and 16-month-old hens.

For packs precooked in water, the palatability data from 3-month-old cockerels and 6- and 16-month-old hens (tables 1 and 3) show that this method resulted in a satisfactory product. Canned chicken precooked in this way rated especially high with respect to tenderness and freedom from off-flavor, was fairly juicy, and had a moderately full flavor.

Canned chicken cooked in broth before packing was also good in eating quality. Scores show that this pack had moderately full flavor, very little off-flavor, and was moderately juicy and tender. Use of broth for precooking may be less desirable than water, however, because of the extra work in preparing the broth, as well as the possible chance of spoilage in case the broth must be held overnight.

Browning lightly in the oven before packing resulted in canned chicken of poorer quality than any of the other packs studied, particularly in chicken flavor and juiciness. Lack of chicken flavor in packs made from 6- and 16-month-old hens accounted for much of the effect on flavor, whereas canned chicken from all types of birds was somewhat dry when browned in the oven before packing. These packs were moderately tender.

For packs browned on a broiler, differences in scores for canned 3-month-old cockerel and 16-month-old hen were neither large nor consistent for any of the palatability factors. These packs had moderately full flavor, only slight off-flavor, and were moderately tender, but did show a tendency toward dryness.

When lightly prefried packs made from hens of different age were compared, 16-month-old hens scored higher on chicken flavor and absence of off-flavor than did the 5- or 6-month-old hens (tables 1 and 2). Packs from the older hens had moderately full flavor, whereas those from younger hens tended to be slightly weak flavored. Flavor scores for canned cockerel lightly prefried before packing were higher

than those for 5- or 6-month-old hens. An explanation may be that cockerels were approaching maturity and had considerable fat under the skin, whereas the young hens, nearing the age for egg production, were lacking in fat. Scores for juiciness of the lightly prefried packs made from the various birds were either slightly above or slightly below 4.0, indicating moderately juicy products. Tenderness scores were generally well above 4.0, denoting moderately tender to very tender canned chicken.

DEGREE OF BROWNING IN A FRY PAN

The amount of prefrying significantly affected chicken flavor, the amount of off-flavor, tenderness, and juiciness of canned chicken prepared from 5-month-old hens. However, data in table 2 indicate that the light- to dark-brown packs were not ranked in the same order for each quality factor. In chicken flavor the light-brown pack rated highest, and the medium-brown pack higher than the dark-brown. Little off-flavor was noticed in light-brown packs, slightly more in medium-brown, and the most off-flavor was found in dark-brown packs. On the other hand, the dark-brown pack was rated the most juicy and tender; the light-brown pack was similar to the medium-brown pack and both rated slightly lower than the dark-brown pack. Because scores for juiciness by individual judges were not consistent, the effect of frying on the quality factor, juiciness, may require further study.

If chicken is to be fried before it is canned, it seems preferable to fry to only a light-brown color since flavor is probably the most important quality factor, and since dark-brown chicken had the most off-flavor and the least chicken flavor. With young hens it may be better to use the raw-pack method, because even lightly browned 5-month-old hens received consistently lower scores than the raw pack for all four quality factors. This was also true for the 6-month-old hens used in the study of methods of preparation (table 1).

It cannot be predicted whether cockerels and mature hens would give the same results as young hens if studied under the conditions of this experiment, in which chicken browned to three varying degrees before canning were compared directly with raw-packed chicken. Considering the extra time and labor spent on prefrying and the fact that the eating quality of the pack is not improved over the quicker and easier raw pack method, the practicability of prefrying as a method of preparation for canning might be questioned.

KIND OF MEAT

There were highly significant differences between mean scores for breast and thigh meat in chicken flavor, juiciness, and tenderness. These differences were similar for canned chicken from different types of birds prepared by various methods for processing. Mean scores for all types of chicken combined, all preparation methods, and both methods of heating for serving, for thigh and breast meat, respectively, were 4.2 and 3.8 on chicken flavor, 4.3 and 3.6 on juiciness, 4.3 and 4.7 on tenderness (table 1). Thus thigh meat was found to have more chicken flavor and to be juicier but less tender than breast meat.

Differences in chicken flavor and juiciness of breast and thigh meat were more noticeable when the canned chicken was heated for serving by frying than when it was heated in its own juice. When prepared for serving by frying, the mean scores for all chickens and all preparation methods were 3.7 for breast and 4.3 for thigh on chicken flavor and 3.7 for breast and 4.6 for thigh on juiciness. Scores for parallel samples of canned chicken heated in its own juice for serving were 3.9 for breast and 4.1 for thigh on chicken flavor, and for juiciness 3.6 and 3.9, respectively, for breast and thigh meat.

Differences in tenderness, on the other hand, were greater when the canned chicken was heated in its own juice than when heated for serving by frying. Tenderness scores for canned chicken heated in its own juice were 4.6 and 4.0 for breast and thigh, respectively; when the chicken was heated for serving by frying, the scores were 4.8 for breast and 4.7 for thigh.

There was no appreciable difference between breast and thigh meat in the intensity of off-flavor found. Mean scores on absence of off-flavor—4.5 for thigh meat, 4.4 for breast—indicate that very little off-flavor was present in any of this canned chicken.

Table 3 includes further palatability data on breast and thigh meat from another lot of 3-month-old cockerels and 16-month-old hens. Results of this experiment substantiate fairly well the findings reported above that thigh meat had more chicken flavor and was juicier but less tender than breast meat prepared by either method of heating for serving. For chicken flavor the thigh meat of canned 16-month-old hen had a significantly higher score than breast meat. In the case of canned cockerel, thigh meat scored higher than breast meat on chicken flavor, but the difference was not significant. Differences in juiciness and tenderness of breast and thigh meat were statistically significant; differences for absence of off-flavor were not, although the differences between breast and thigh meat of cockerel appeared moderately large.

METHOD OF HEATING FOR SERVING

Whether canned chicken was prepared for serving by heating in its own juice or by frying made no significant difference in chicken flavor, but did have a statistically significant effect on the amount of off-flavor, juiciness, and tenderness. However, canned chicken prepared for serving by either method was acceptable.

The mean score for all chickens on chicken flavor of samples heated in their own juice and of fried samples was 4.0 in both cases (table 1). For off-flavor, samples heated in their own juice averaged 4.3, fried 4.6. These scores indicate that the canned chicken prepared by either method had moderately full chicken flavor, and, although more off-flavor was found in samples heated in their own juice than in those fried in preparation for serving, neither had strong off-flavors.

Mean score for juiciness of all samples of canned chicken heated in its own juice was 3.8, of fried samples, 4.2. Hence, most of the judges on the panel had rated the former slightly dry; the latter, moderately juicy.

Chicken heated in its own juice was slightly less tender (mean score, 4.3) than fried chicken (mean score, 4.7), but both were in the range of tender to very tender.

Table 3 gives additional data for 3-month-old cockerels and 16-month-old hens on the effect of method of heating for serving on palatability scores of canned chicken. The data for canned hen bear out the findings discussed in the preceding paragraphs. For cockerel, similar results were obtained for off-flavor and juiciness, but scores for chicken flavor were significantly better for fried chicken than for chicken heated in its own juice; no difference was noted in tenderness of the samples.

LENGTH OF STORAGE

When canned cockerel and mature hen were stored for 4, 8, or 12 months at room temperature, there were some losses in eating quality (table 3). Differences in scores generally were more noticeable in the samples heated for serving in their own juice than in those heated for serving by frying.

For canned cockerel prepared by heating in its own juice, decreases in combined mean scores for all preparation methods at different storage periods were significant for all four quality factors studied. For canned hen prepared for serving in the same way, decreases in scores for chicken flavor and amount of off-flavor during storage were significant, but analysis of mean scores for juiciness and for tenderness showed nonsignificance.

When the canned chicken was heated for serving by frying, some loss in quality due to storage was also noted; the changes were less marked for cockerel than for hen. Whereas an increase in off-flavor was the only statistically significant change for cockerel after a year in storage, differences in quality of canned hen stored 1 year were small but statistically significant for all palatability factors.

The various packs were found to respond differently to storage. Scores on chicken flavor for raw-packed samples of both canned hen and cockerel, heated in their own juice for serving, were almost the same after storage for 1 year as when scored soon after processing. The scores were generally 4.0 or higher, denoting moderately full to full flavor. Packs of both hen and cockerel precooked in water or browned on a broiler before packing were similar in chicken flavor to parallel raw packs when scored before storage, but after storage for 1 year were scored in the range of 3.0 to 3.6, indicating that they were slightly weak in chicken flavor.

Results of tests for absence of off-flavor in canned hen and cockerel heated in their own juice for serving were similar to those for chicken flavor. Little off-flavor was noticed after 1 year's storage in either canned hen or cockerel packed raw; slight to slightly strong off-flavors, in the other two packs.

Scores on samples heated in their own juice for serving showed that raw-pack canned cockerel did not change in juiciness during storage for 1 year, but the packs prepared by precooking in water and by browning on a broiler became slightly more dry on storage. Differences in scores for juiciness of the various packs of canned hen were in the same direction as for canned cockerel, but were not found to be statistically significant.

All stored samples of canned cockerel when heated in their own juice for serving were scored lower on tenderness than unstored

samples. The greatest loss in tenderness was noted in the pack that had been precooked in water before packing. For hens, scores for stored packs, though slightly lower, were not significantly lower than for unstored.

The differences in the samples of the various packs heated for serving by frying were in the same direction as those of samples heated in their own juice, but were of smaller magnitude.

Storage for 6 months affected also the quality of canned chicken prefried to three degrees of brownness. In general, chicken that was fried before packing changed more in storage than raw-packed chicken (table 2). Lightly browned chicken, when canned and stored for 6 months, scored higher on chicken flavor and absence of off-flavor than the other browned packs. Flavor scores for medium- and for dark-brown packs were especially low after storage; chicken flavor was weak and moderately pronounced off-flavors were noted. Considering this loss of quality during 6 months' storage, the practice of pre-browning chicken to a medium- or a dark-brown color is not recommended, and, as pointed out in the discussion on degree of browning, even light frying may be questionable in some cases.

RESULTS AND DISCUSSION OF NUTRITIVE VALUE STUDIES

Table 4 contains the data on the moisture, fat, free fatty acid, ash, and thiamine content of raw, prepared and precooked, canned, and stored-canned poultry, using 3-month-old cockerels and 16-month-old-hens.

MOISTURE, FAT, AND ASH

Percentages of moisture and ash in raw, precooked, and processed hens were similar to those for cockerels. Hens contained more fat than cockerels, both as raw and as canned products. These data were obtained in order to calculate, for purposes of comparison, the thiamine content on a moisture-fat-free basis and also to help characterize the composition of the meat studied.

FREE FATTY ACID

Although the amount of free fatty acids present generally increased during preparation and processing, it is questionable whether the difference is of practical importance or useful as a means of predicting development of rancidity. Changes in free fatty acids during storage of canned chicken were not sufficiently large or consistent to indicate progressive rancidity. However, palatability scores (table 3) indicated that judges found increasing amounts of off-flavor as canned chicken was stored for longer periods.

Other laboratories have found that judges could discern rancid flavors in samples of other foods, especially nuts (23), which chemical analysis failed to classify as rancid. This view is also held by Lowe and Stewart (12) and Vail and Conrad (21), who have concluded that it is not yet possible to relate quantitative chemical changes in fat during storage to flavor changes of meat or frozen poultry.

THIAMINE

Based on either the edible portion or the moisture-fat-free material, thiamine content of raw hen was approximately one-half that of raw cockerel. Whether calculated on the edible portion or calculated on the moisture-fat-free basis, retentions of thiamine following subsequent treatments of the chicken were similar. Precooking in water or browning on a broiler in preparation for canning had no significant effect on thiamine content.

Thiamine content of canned chicken shortly after processing was considerably lower than that of the raw chicken. For cockerels, thiamine retention after processing, calculated on the basis of edible portion, was 24 percent for the raw pack and 20 percent for the packs precooked in water or browned on a broiler. Hens, which contained less thiamine in the raw state, retained after processing a larger percentage than parallel packs of cockerel. Raw packs of hen retained 44 percent; packs precooked in water, 35 percent; and packs browned on a broiler, 40 percent.

Shortly after processing, average thiamine content of the raw pack, of that precooked in water, and of the browned pack of cockerel was 0.020, 0.016, and 0.016 milligram per 100 grams of edible portion, respectively. The difference between the value for the raw pack and those for the other two packs of cockerel was significant. Averages for corresponding packs of hen were 0.021, 0.017, and 0.019 milligram per 100 grams edible portion. These differences were not significant.

After storage for 4 months, thiamine content of the chicken was in some cases significantly different from that of the freshly processed chicken. Raw-packed hen and hen browned before packing decreased in thiamine content, during 4 months' storage, more than the pack precooked in water. Retention of thiamine in canned hen remained fairly constant from 4 to 8 months in storage. Less than 50 percent of the thiamine present in canned cockerel at the end of 4 months in storage remained after 8 months. There was no further decrease when canned cockerel was held for 12 months.

TABLE 4.—Moisture, fat, free fatty acid, ash, and thiamine content of raw, prepared, and canned chicken

Description of sample ¹	Moisture	Fat	Free fatty acid		Ash	Thiamine			
			Expressed as KOH per gram fat	Difference required for significance at 5 percent level		Content per 100 gm. edible portion	Difference required for significance at 5 percent level	Content per 100 gm. moisture-fat-free chicken	Difference required for significance at 5 percent level
COCKEREL, 3-MONTH-OLD									
Raw sample.....	70. 27	1. 28	0. 34	0. 355	0. 98	0. 082	0. 016	0. 287	0. 058
Packed raw:									
Prepared for packing.....	70. 27	1. 28	. 34	. 355	. 98	. 082	. 016	. 287	. 058
Canned:									
Freshly processed.....	67. 32	1. 30	2. 94	} 1. 177	. 96	. 020	} . 002	. 066	} . 012
Stored 4 months.....	69. 70	1. 01	2. 93		. 92	. 018		. 057	
Stored 8 months.....	69. 31	1. 97	1. 84		. 96	. 008		. 023	
Stored 12 months.....	68. 02	1. 07	2. 43		1. 06	. 008		. 032	
Precooked in water:									
Precooked for packing.....	67. 45	5. 06	. 36	. 355	. 90	. 065	. 016	. 238	. 058
Canned:									
Freshly processed.....	64. 61	1. 72	2. 63	} 1. 177	. 87	. 016	} . 002	. 048	} . 012
Stored 4 months.....	68. 96	. 98	3. 47		. 88	. 016		. 053	
Stored 8 months.....	67. 98	1. 92	2. 05		. 84	. 007		. 023	
Stored 12 months.....	65. 88	1. 57	2. 61		. 97	. 008		. 024	
Browned on broiler:									
Precooked for packing.....	63. 91	3. 89	. 16	. 355	1. 07	. 073	. 016	. 247	. 058
Canned:									
Freshly processed.....	65. 61	1. 33	3. 02	} 1. 177	. 99	. 016	} . 002	. 048	} . 012
Stored 4 months.....	68. 57	1. 24	4. 10		. 91	. 015		. 051	
Stored 8 months.....	67. 70	1. 72	2. 23		1. 01	. 006		. 023	
Stored 12 months.....	67. 16	1. 45	2. 92		. 99	. 009		. 030	

HEN, 16-MONTH-OLD									
Raw sample.....	66.83	4.63	1.14	3.00	1.04	.048	.018	.161	.048
Packed raw:									
Prepared for packing.....	66.83	4.63	1.14	3.00	1.04	.048	.018	.161	.048
Canned:									
Freshly processed.....	65.17	7.20	2.35	} 3.00	.92	.021	} .005	.075	} .023
Stored 4 months.....	67.36	4.44	2.30		.91	.016		.058	
Stored 8 months.....	68.24	5.13	4.65		.99	.018		.076	
Stored 12 months.....	70.57	6.51	2.14		1.03				
Precooked in water:									
Precooked for packing.....	70.47	3.72	2.80	3.00	.91	.048	.018	.176	.048
Canned:									
Freshly processed.....	71.47	3.84	3.10	} 3.00	.80	.017	} .005	.070	} .023
Stored 4 months.....	71.25	3.06	2.68		.74	.014		.061	
Stored 8 months.....	72.74	2.29	4.33		.83	.016		.060	
Stored 12 months.....	72.59	4.21	4.83		1.02				
Browned on broiler:									
Precooked for packing.....	68.14	6.20	2.04	3.00	1.02	.048	.018	.182	.048
Canned:									
Freshly processed.....	70.73	2.52	4.77	} 3.00	.97	.019	} .005	.073	} .023
Stored 4 months.....	70.70	2.92	2.71		.84	.014		.055	
Stored 8 months.....	64.32	2.25	3.42		.88	.015		.044	
Stored 12 months.....	69.52	4.81	3.74		.99				

¹ Raw and prepared samples were equivalent to the meaty pieces from one chicken; canned samples were equivalent to the meaty pieces from one-half chicken. 3 replications were made.

LITERATURE CITED

- (1) ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.
1950. OFFICIAL METHODS OF ANALYSIS. Ed. 7, 910 pp., illus. Washington, D. C.
- (2) BEERY, I., PRUDENT, I., and WILSON, E. D.
1949. FOUR METHODS OF DEFROSTING POULTRY STUDIED. Jour. Home Econ. 41: 203-204, illus.
- (3) BRIWA, K. E.
1948. HOW TO CAN MEATS AND POULTRY. Maine Agr. Col. Ext. Bul. 378, 20 pp.
- (4) CARLIN, F., LOWE, B., and STEWART, G. F.
1949. THE EFFECT OF AGING VERSUS AGING, FREEZING AND THAWING ON THE PALATABILITY OF EVISCERATED POULTRY. Food Technol. 3: 156-159, illus.
- (5) CROSBIE-WALSH, T.
1933. BRITISH POULTRY CANNING. Food Mfr. 8: 325-327, illus.
- (6) DAWSON, E. H., HARRIS, B. L., REDSTROM, R. A., and OTHERS.
1951. SENSORY METHODS FOR MEASURING DIFFERENCES IN FOOD QUALITY. REVIEW OF LITERATURE AND PROCEEDINGS OF CONFERENCE. U. S. Dept. Agr. Inf. Bul. 34, 134 pp.
- (7) FEASTER, J. F., JACKSON, J. M., GREENWOOD, D. A., and KRAYBILL, H. R.
1946. VITAMIN RETENTION IN PROCESSED MEAT . . . EFFECT OF STORAGE. Indus. and Engin. Chem. 38: 87-90, illus.
- (8) GUERRANT, N. B., FARDIC, O. B., VAVICH, M. G., and ELLENBERGER, H. E.
1948. NUTRITIVE VALUE OF CANNED FOOD, INFLUENCE OF TEMPERATURE AND TIME OF STORAGE ON VITAMIN CONTENT. Indus. and Engin. Chem. 40: 2258-2263, illus.
- (9) HUMPHREYS, G., and PRUDENT, I.
1943. FOOD PRESERVATION. W. Va. Agr. Col. Ext. Cir. 313, 66 pp., illus. (Rev. ed.)
- (10) IMLAY, F., and HAAK, P. J.
1943. HOME CANNING OF MEATS. Ky. Agr. Col. Ext. Leaflet 59, 8 pp.
- (11) LOWE, B. M., and HOFFMAN, K.
1939. MORE PALATABILITY STUDIES WITH POULTRY. U. S. Egg and Poultry Mag. 45: 212-214.
- (12) ——— and STEWART, G. F.
1947. SUBJECTIVE AND OBJECTIVE TESTS AS FOOD RESEARCH TOOLS WITH SPECIAL REFERENCE TO POULTRY MEAT, Food Technol. 1: 30-38, illus.
- (13) McALLISTER, M. L., and SCHOLZ, R.
1946. CANNING MEAT FOR THE HOME. N. C. Agr. Col. Ext. Cir. 284, 14 pp., illus. (Rev. ed.)
- (14) MILLARES, R., and FELLERS, C. R.
1949. VITAMIN AND AMINO ACID CONTENT OF PROCESSED CHICKEN MEAT PRODUCTS. Food Res. 14: 131-143.
- (15) TANNER, F. W. and ARMSTRONG, G. B.
1937. HOME CANNING OF FOODS FOR FAMILY USE. Ill. Agr. Expt. Sta. Cir. 394, 30 pp., illus. (Rev. ed.)
- (16) TARRANT, L., and TRUAX, D. N.
1944. CANNING MEAT AND POULTRY AT HOME. Pa. State Col. Ext. Cir. 248, 12 pp., illus. (Rev. ed.)
- (17) ——— and WINTERS, E. B.
1943. CANNING CHICKEN AT HOME. Pa. State Col. Ext. Leaflet 99, 4 pp.
- (18) TOEPFER, E. W., REYNOLDS, H., CHEPIN, G. L., and TAUBE, K.
1946. HOME CANNING PROCESSES FOR LOW-ACID FOODS DEVELOPED ON THE BASIS OF HEAT PENETRATION AND INOCULATED PACKS. U. S. Dept. Agr. Tech. Bul. 930, 28 pp., illus.
- (19) UNITED STATES BUREAU OF HUMAN NUTRITION AND HOME ECONOMICS.
1946. HOME CANNING OF MEAT. U. S. Dept. Agr. AWI—110, 16 pp., illus.

- (20) UNITED STATES PHARMACOPOEIA.
1950. THE PHARMACOPOEIA OF THE UNITED STATES OF AMERICA. 14th
REV., 1067 pp., illus. Easton, Pa.
- (21) VAIL, G. E., and CONRAD, R. M.
1948. DETERMINATION OF PALATABILITY CHANGES OCCURRING IN FROZEN
POULTRY. Food Res. 13: 347-357.
- (22) WALD, A.
1947. SEQUENTIAL ANALYSIS. 212 pp., illus. New York.
- (23) WRIGHT, R. C.
1941. INVESTIGATIONS ON THE STORAGE OF NUTS. U. S. Dept. Agr.
Tech. Bul. 770. 35 pp., illus.

APPENDIX

EXPERIMENTAL METHODS

PREPARATION OF CHICKEN FOR PACKING

The chickens were killed, plucked, and held undrawn at 35° F. for 1 to 3 days until they could be processed. Eleven birds, required for one canner load, were eviscerated and cut up. Wings and legs were cut off at the joints; thighs and drumsticks were separated; the wishbone section was removed; and the breast meat was cut away from the bony carcass. After large lumps of fat were trimmed off, the meaty pieces of chicken were washed with tap water and wiped dry. They were held overnight at 35° F. Further treatment depended upon the type of pack as outlined below.

RAW PACK AND REFERENCE SAMPLE

The raw pieces of chicken were packed into jars with no added liquid and processed immediately without exhausting jars.

CHICKEN PRECOOKED IN WATER

The chicken for one canner load was divided by number and kind of pieces into four equal portions, which were cooked simultaneously in four identical white enameled 6-quart saucepans. Three cups of boiling distilled water was poured over the chicken in each saucepan and the meat was cooked until almost no pink color remained at the center of the pieces. The time required varied with size and type of chicken. The hot chicken was packed in jars and the hot broth from precooking was poured over the packed chicken, leaving 1 inch head space.

CHICKEN PRECOOKED IN BROTH

Chicken was divided, precooked, and packed the same as chicken precooked in water except that broth was used as the precooking medium. The broth had been prepared the previous day by simmering the bony pieces in distilled water for 1½ hours. The broth was drained off and stored in the refrigerator overnight.

CHICKEN BROWNED IN A FRY PAN ON TOP OF RANGE

Chicken was lightly browned in preheated number 8 cast-iron fry pans with 1½ tablespoons melted hydrogenated vegetable fat added to each pan. The gas flame was at full heat for 2½ minutes, then at simmer for 4½ minutes. Pieces of chicken were turned as they browned so all sides browned evenly. Chicken was packed hot into jars. One-half cup boiling distilled water was poured into each fry pan and then collected in one fry pan, reheated to boiling, and divided equally among the jars. Boiling distilled water was added to bring the liquid to within 1 inch of the top of the jars.

CHICKEN BROWNED IN OVEN

Chicken was browned in 350° F. ovens on lightly greased racks placed over broiler pans. Pieces were roasted until almost no pink color remained at the center, about 35 to 45 minutes, depending on the kind of chicken. The pieces were turned once during browning. Drippings were saved and used in the same way as for chicken browned in a fry pan.

CHICKEN BROWNED ON BROILER

Pieces of chicken were placed on a preheated broiler pan and browned for 15 minutes on each side with the broiler set at 350° F. Two breast halves were fitted together to make a thicker piece. The drippings were collected and used as in the other browned packs.

PACKING AND PROCESSING

Each jar was packed with three breast halves, three thighs, one drumstick, one wing, and one-half wishbone piece taken at random from the common sample. The drumstick and three thighs (with skin side out) were placed around the bottom half of the jar, with space left in the center for one breast half. The wing was fitted over the end of the drumstick; the wishbone piece was placed beside it on the left; and the remaining two breast halves were put in the center of the jar.

Hot-packed quart jars were processed 75 minutes at 240° F. A process for cold-packed chicken was developed, using the methods given in U. S. Department of Agriculture Technical Bulletin No. 930 (18). Heat-penetration data on six quart jars of chicken from each of two replicate canner loads were used for determining the process. The time required to give cold-packed chicken a process with a sterilizing value equivalent to that of the 75-minute process for hot packs in quart jars was found to be 80 minutes at 240° F.

A 7-quart aluminum pressure cooker, equipped with copper-constantan thermocouples sealed into the lid through stuffing boxes, was used for all processing. The thermocouples were connected to a recording potentiometer and the temperature inside the canner used as the basis for adjusting the flame to maintain the required temperature for processing.

SAMPLING FOR PALATABILITY EVALUATION AND CHEMICAL ANALYSIS

Jars of canned chicken were held in water at 55° C. for 5 minutes to soften the gelatin and fat and to loosen the pieces, which were then carefully removed and drained for 5 minutes in number 8 mesh copper sieves. Where samples were required for both palatability evaluation and chemical analysis, contents of each jar were divided in the following way. Two breast halves and two thighs to be rated for palatability were taken at random and weighed. The proportion of the total drained weight represented by this sample was determined. The fat was removed from the broth by running the mixture through a separatory funnel. Fat and the broth were weighed individually; for the palatability tests, portions of each were removed in the same proportion as for the meat. The remaining meat, fat, and broth, equivalent to one-half chicken, were used for chemical analyses.

Raw samples for chemical analyses were taken at random from the meaty pieces prepared for precooking. The size of the sample was equivalent to the meaty pieces from one chicken. Precooked samples, also equivalent to one chicken, were random samples from the meaty pieces taken after heating in water or on a broiler.

HEATING AND SERVING OF SAMPLES FOR PALATABILITY STUDIES

Samples for palatability study were prepared for serving in two ways—by heating chicken in its own juice and by frying.

For samples heated in their own juice, one breast half, one thigh, and 2 tablespoons of the broth from the same jar were heated for 5 minutes. Each piece of chicken was cut into four pieces, once crosswise and once lengthwise. This method of sampling was used to get an over-all estimate of the eating quality of pieces of chicken as served at the family table. Also, because canned chicken is very tender, it is difficult to separate individual muscles for evaluation, as has been done for freshly cooked or cooked frozen chicken (2, 4, 11, 21).

Samples were presented at random to the judging panel. Samples of breast meat were served at one time and samples of thigh meat at another time shortly before or after the breast meat samples. The order of presenting breast and thigh meat was changed at random. Coded warm samples were placed on white china plates, which had been warmed in a 250° F. oven. Samples were judged immediately.

Breast and thigh meat from a jar of the reference pack also was prepared by heating in its own juice. Each piece was cut into four parts to provide samples for reference use and for coded controls.

For fried samples, one breast half and one thigh from each jar were floured lightly. One-half cup of hydrogenated vegetable shortening was placed in each fry pan and the pans were preheated for 1½ minutes. To equalize the heat used under each pan, a system of rotation of burners was worked out. All pans were

preheated on the same burner; chicken was put in skin side down and the pan was moved to a second burner for 2½ minutes; chicken was turned, the pan was moved to a third burner, and the chicken was fried for 2½ minutes. Fried samples were held for a short time in heated covered pans. They were cut and served the same way as the samples heated in their own juice. Breast and thigh pieces from the reference pack were also prepared by frying for use as reference and coded control samples.

PROCEDURE FOR SELECTING PALATABILITY PANEL

Rancidity is probably the most common off-flavor in stored canned poultry; its presence warns of serious, progressive impairment of quality. Ability to recognize rancidity, especially in its mild beginning stages, is, therefore, an important qualification for members of a panel to evaluate the palatability of canned chicken. As some people have greater natural ability for distinguishing rancidity than others, a series of tests, adapted from Wald's method of sequential analysis, was given prospective judges (22). The judges were tested for reliability in detecting rancid flavors in canned chicken by serving them paired samples, one having natural canned chicken flavor and the other containing known proportions of natural-flavored and rancid chicken, with directions to indicate which sample was rancid. Use of ground chicken made it possible to vary the intensity of the rancid flavor by mixing various proportions of rancid meat with natural-flavored meat.

Several very rancid practice samples were paired with samples of good flavor, so that all the judges learned to identify rancidity before starting the actual test.

Rancidity was judged at six levels of intensity, the rancid samples for each level containing a given proportion of rancid chicken. Levels 1 through 6 contained, in consecutive order, 1/8, 1/6, 1/4, 1/3, 1/2, 2/3 rancid chicken.

The paired samples used for the first level (1/8 rancid chicken) represented a large flavor difference, one of each pair being very rancid and the other having a natural chicken flavor. In each succeeding series the difference in flavor of the paired samples was less, so that a keener sense of taste was required to detect the rancid samples as the test progressed.

Table 5 indicates the number of errors a subject may make and still be accepted as a judge, and the number of errors which will cause rejection as a judge at any point between 10 and 40 pairs of samples on the basis of a suitable taste threshold

TABLE 5.—Numbers of errors¹ used as basis for accepting or rejecting prospective judges when tested on ability to detect rancidity in paired samples of canned chicken

Pairs of samples judged	Errors permitted	Errors causing rejection	Pairs of samples judged	Errors permitted	Errors causing rejection
2-----	0	2	30----	2	7
3-9-----	0	3	31-36---	3	7
10-16-----	0	4	37----	3	8
17-23-----	1	5	38-40---	4	8
24-29-----	2	6			

¹ At each level of rancidity.

level of rancidity. These numbers are derived from an application of Wald's method of sequential analysis (22). In constructing such a table it is necessary to specify some acceptable range of judging ability, together with suitable levels for the risk of accepting a "poor" judge or rejecting a "good" judge. For the purposes of this panel, judging ability was assumed to be sufficiently well measured by the average proportionate number of errors to be expected of a judge who was attempting to detect rancidity over a long series of sittings. This "percent error," as mentioned above, would be expected to increase as the proportion of rancid meat in the samples was diminished. Accordingly, the specifications leading to the acceptance-rejection table were made as follows:

1. The risk of rejecting a judge whose error (as defined above) was 5 percent or less was set at 0.03.
2. The risk of accepting a judge whose error was 30 percent or more was set at 0.05.

The total number of samples at each level of rancidity presented to any judge was determined by the number of errors the judge made. At each level each subject was given 10 pairs of samples. Additional samples were given, if required, to reach a decision as to acceptance or rejection at this level.

PREPARATION OF SAMPLES FOR TESTING PROSPECTIVE JUDGES

Freshly processed raw-packed chicken was used to exemplify natural flavor. Rancid flavors were developed by storing canned chicken at 55° C. for 6 weeks.

To prepare samples, pieces of chicken were removed from the jars and heated 20 minutes in the broth, with a small amount of water added if needed to keep the chicken from cooking dry. Liquid was drained off, skin and bones were removed, and the meat was put through a food chopper.

Natural-flavored samples were served with no further preparation. Rancid samples were prepared by thoroughly mixing various proportions of natural-flavored and rancid ground chicken.

The samples were served at room temperature. They were made up every day, so the meat was moist and palatable.

ANALYSIS OF PROSPECTIVE JUDGES' PERFORMANCE

Table 6 shows the number of errors made by each person tested on ability to recognize rancid flavor in paired samples of ground canned chicken.

Judges A and C were able to distinguish exceedingly small amounts of rancid flavor, making no errors until $\frac{1}{256}$ part rancid material was present in the natural-flavored meat. Judge A was rejected at this level because she made 7 errors in judging 10 pairs of samples. Judge C made too many errors to permit acceptance, but not enough for rejection until 29 samples had been presented.

Judge F was able to detect differences in the samples to the point where the rancid sample contained $\frac{1}{256}$ part of rancid meat in natural-flavored meat. The 1 error made in 17 pairs of samples at the second level was not serious.

Three judges, B, D, and E, were first rejected at the fourth level when samples contained $\frac{1}{16}$ part rancid meat in natural-flavored meat. Because judge D made 2 errors at the second level and 1 error at the third level, she might be slightly less reliable than judges B and E, who had perfect records until they reached the fourth level. Judge E made fewer errors than judge B at the fourth level.

Because errors were made by judge G at all levels of the test, she apparently was not as capable as the other judges in distinguishing rancid flavor in canned chicken.

A judge rejected at one level was rejected at each succeeding level; apparently the point of first rejection is below the threshold for detecting rancid flavors in canned chicken.

The subjects with the lowest thresholds for detecting rancidity were used for the regular judging panel; the others were used as substitutes when necessary.

TABLE 6.—Number of judges' errors in recognizing rancid flavor in paired samples containing rancid chicken in various proportions

Prospective judge	Proportion of rancid chicken											
	$\frac{1}{8}$		$\frac{1}{16}$		$\frac{1}{32}$		$\frac{1}{64}$		$\frac{1}{128}$		$\frac{1}{256}$	
	Paired samples	Errors	Paired samples	Errors	Paired samples	Errors	Paired samples	Errors	Paired samples	Errors	Paired samples	Errors
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
A-----	10	0	10	0	10	0	10	0	10	0	*10	7
B-----	10	0	10	0	10	0	*16	6	10	4	16	4
C-----	10	0	10	0	10	0	10	0	10	0	*29	6
D-----	10	0	24	2	17	1	*19	6	10	5	10	5
E-----	10	0	10	0	10	0	*16	4	10	4	10	4
F-----	10	0	17	1	10	0	10	0	*23	5	16	7
G-----	30	3	*10	4	27	7	23	7	10	7	10	4

*Point of first rejection.

TRAINING OF PALATABILITY PANEL

FLAVOR OF CANNED CHICKEN

Two factors, intensity and desirability, enter into the judgment of flavor of chicken.

To illustrate differences of the first kind, a sample of full-flavored chicken was compared with two samples of weak-flavored chicken. The full-flavored chicken was cooked in its own juice for 5 minutes. The other two samples were prepared by heating the canned chicken in water for $\frac{3}{4}$ hour and for $1\frac{1}{4}$ hours, changing the water once during the cooking. Samples of breast and thigh meat were rated by the judges on the official score card below. The judges, with the exception of C, detected a difference in flavor; that is, they graded the weak-flavored samples lower than the full-flavored one (table 7). After scoring, there was discussion in order to set standards.

SCORE CARD FOR CANNED CHICKEN

Judge Date

Quality factor	Sample number							
	1		2		3		4	
	Breast	Thigh	Breast	Thigh	Breast	Thigh	Breast	Thigh
Chicken flavor:								
5—full flavor.....								
4—moderately full flavor.....								
3—slightly weak.....								
2—very weak.....								
1—flavor absent or masked.....								
Absence of off-flavor—name any off-flavor detected:								
5—no off-flavors.....								
4—very slight off-flavor.....								
3—slightly strong off-flavor.....								
2—medium strong off-flavor.....								
1—very strong off-flavor.....								
Juiciness:								
5—very juicy.....								
4—moderately juicy.....								
3—slightly dry.....								
2—moderately dry.....								
1—very dry.....								
Tenderness:								
5—very tender.....								
4—moderately tender.....								
3—slightly tough.....								
2—moderately tough.....								
1—very tough.....								
Comments:								

TABLE 7.—Judges' scores¹ on intensity of natural flavor in canned chicken having full, slightly weak, and very weak flavor

Judge	Breast meat ²			Thigh meat ²		
	Full flavor	Slightly weak flavor	Very weak flavor	Full flavor	Slightly weak flavor	Very weak flavor
A.....	5	3	2	5	3	2
C.....	3	3	5	3	2	4
D.....	5	4	4	5	4	4
E.....	5	3	2	5	3	3
G.....	4	3	3	5	3	2

¹ The highest possible score was 5; the lowest, 1.

² Full-flavored samples were heated 5 minutes in own juice; slightly weak-flavored samples, $\frac{1}{2}$ hour in water; very weak-flavored samples, $1\frac{1}{2}$ hours in water.

The other phase of flavor to be judged was presence or absence of off-flavors. One sample was prepared by the minimum safe process; the other sample was processed 50 minutes over the minimum safe time.

All judges tasted off-flavors in the overprocessed meat, although there was some difference of opinion concerning the intensity of the off-flavor (table 8). Various judges described the off-flavors resulting from overprocessing as stale, strong, overcooked.

Judges already had considerable training in detecting small amounts of rancidity in the threshold tests, so further training was not done for this factor.

TABLE 8.—Judges' scores¹ on off-flavor in canned chicken having no off-flavor or off-flavors resulting from overprocessing

Judge	Breast meat ²		Thigh meat ²	
	No off-flavor	Off-flavors present	No off-flavor	Off-flavors present
A....	5	4	5	4
C....	5	2	5	3
D....	5	3	5	3
E....	5	4	5	4

¹ The highest possible score was 5; the lowest, 1.

² For chicken with no off-flavor, minimum safe process was used; for chicken with off-flavor, 50 minutes beyond minimum safe process time.

JUICINESS OF CANNED CHICKEN

Samples to illustrate varying degrees of juiciness were presented to the judging panel for training purposes. Samples of dry chicken were prepared by heating the sample in the oven at 450° F. for 45 minutes. This sample was compared with a sample of moist chicken from the same source prepared by heating in its own juice for 5 minutes.

The judges identified the dry sample fairly consistently. Only one judge graded the dry sample of breast meat higher than the more juicy one (table 9). Thigh meat dried out less than breast meat and the differences were not as pronounced as in the samples of breast meat.

TABLE 9.—Judges' scores ¹ for juiciness in canned chicken varying in juiciness

Judge	Breast meat ²		Thigh meat ²	
	More juicy	Less juicy	More juicy	Less juicy
A.....	3	1	3	2
C.....	3	1	3	2
D.....	4	1	5	3
E.....	3	4	5	4
G.....	3	2	4	3

¹ The highest possible score was 5; the lowest, 1.

² More juicy samples were prepared by heating in own juice for 5 minutes; the less juicy, by heating in oven for 45 minutes at 450° F.

TENDERNESS OF CANNED CHICKEN

It was difficult to obtain samples of canned chicken that showed a decided difference in tenderness. The long cooking during processing minimized differences in birds of different age. Twelve paired samples of young and old birds prepared as canned chicken were presented to the judging panel. The judges recorded the more tender sample of each pair.

From the number of correctly identified samples as shown in table 10, it appeared that the judges were able to distinguish only moderately well the difference in tenderness of canned chicken from young and old birds. In order to provide samples with a wider difference in tenderness, cooked rather than canned samples of young and of old chickens were used for further training. Five out of seven of the judges were able to distinguish differences in tenderness of the cooked samples

TABLE 10.—Number of times the judges correctly identified the more tender sample of 12 paired samples of tough and tender chicken ¹

Judge	Number of correctly identified samples		Judge	Number of correctly identified samples	
	Canned chicken	Cooked chicken		Canned chicken	Cooked chicken
A.....	7	10	E.....	5	10
B.....	8	9	F.....	7	12
C.....	8	11	G.....	6	6
D.....	8	8			

¹ Young chickens were used for the more tender samples and old chickens for the less tender samples.

STANDARD REFERENCE SAMPLE

Training sessions using the standard reference sample were also held. Discussion was held at the end of each session to clear up misinterpretations and insure better understanding of quality differences. The palatability scores of the judging panel were used to help establish the official score set on the reference sample.

PANEL PERFORMANCE ON STANDARD SAMPLE

In table 11 scores are given for the standard sample served with the experimental samples, both as a labeled reference and as a coded control sample. One lot was used the first year; another lot from comparable chickens prepared by the same method was used the second year.

Mean scores on each quality factor for the coded control samples were similar in all of the tests. Mean scores for the coded controls were not statistically different from the scores established for the reference samples.

TABLE 11.—Comparison of mean palatability scores for the standard sample when used as labeled reference and coded control samples

Description of sample	Mean palatability score ¹			
	Chicken flavor	Absence of off-flavor	Juiciness	Tenderness
Labeled reference, first year ² . . .	4.8	5.0	4.2	4.8
Coded control: ³				
Investigation 1	4.4	4.7	4.2	4.6
Investigation 2	4.7	4.7	4.0	4.4
Investigation 3 (first year)	4.3	4.4	3.9	4.4
Labeled reference, second year ²	4.8	4.8	4.4	4.4
Coded control: ³ Investigation 3 (second year)	4.2	4.4	4.0	4.3

¹ 5 was the highest possible score; 1, the lowest.

² Used at every judging session as a labeled reference sample with scores as shown here. Different reference samples were used each year.

³ Based on scores for 4 judges, 2 kinds of meat, 2 methods of heating for serving, 4 replicates and 1 storage period for investigation 1; 2 replicates and 2 storage periods in investigation 2; 3 replicates with 1 storage period the first year and 3 storage periods the second year in investigation 3.

PROCEDURES FOR CHEMICAL ANALYSES

Samples as received were weighed; inedible portions, such as bone, were removed; and the edible portion, including meat, fat, and broth, was weighed and then ground three times in a meat chopper until the broth and meat formed a homogeneous mixture. The uniformly ground mixture was divided into samples for thiamine determinations, fat extraction, and moisture and ash content.

The methods of analysis of the Association of Official Agricultural Chemists (1) were followed for moisture, fat, and ash determinations. Fat was extracted in a Soxhlet apparatus with petroleum ether. After the petroleum ether was evaporated, the fat was dried in a vacuum oven and weighed, and the free acidity of the fat was determined by titration with standard sodium hydroxide.

Thiamine was determined in well-mixed ground samples, using the thiochrome method (20). Weighed portions of the ground whole sample were blended with N/10 sulfuric acid and temporarily stored in brown glass containers in the refrigerator. At the time of assay, aliquots of the acid-suspended material were weighed into volumetric flasks. Digestion was carried out with pepsin at pH 2.0 at 37° C. for 2 hours, and with takadiastase at pH 4.5 at 37° C. overnight. The contents of the flasks were diluted to volume and filtered, and aliquots were taken for thiamine determinations by the thiochrome method.

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