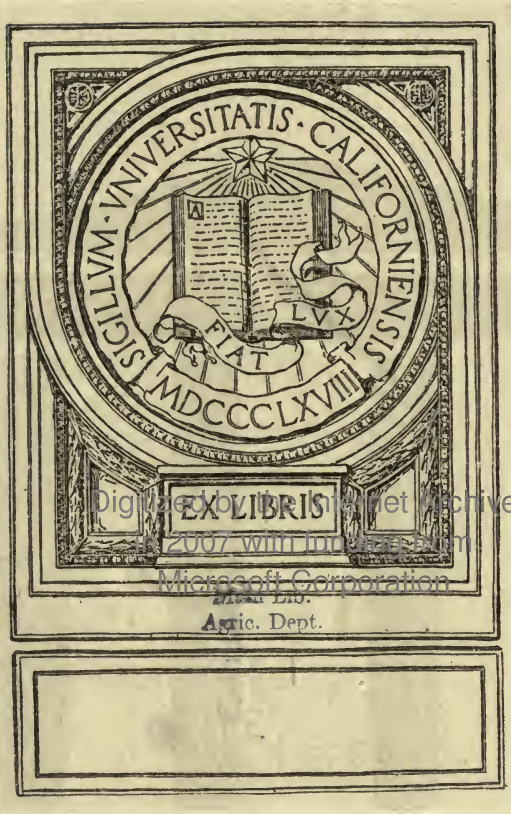

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THE COMPARATIVE RATE OF DECOMPOSITION IN DRAWN AND UNDRAWN MARKET POULTRY.

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THE COMPARATIVE RATE OF DECOMPOSITION IN DRAWN AND UNDRAWN MARKET POULTRY.

SCOPE AND PLAN OF THE INVESTIGATION.

During the season of 1909–1910 a series of studies was made to determine the relative rate of decomposition in undrawn poultry as compared with that from which the viscera had been either completely or partially removed. The conditions of the experiments were strictly commercial. That is, the fowls were killed and dressed by the regular employees of a poultry packing house; they were shipped in the usual commercial one-dozen-to-the-box package in a car-lot of dressed poultry. They were received by a wholesaler and handled side by side with his stock. They went to the retailer when he purchased fowls from the same car-lot and were kept in his shop for the period which the market happened to require for their sale. Observations of the usual sort, commonly called "inspections," were made in the packing house, at the end of the railroad haul, when the fowls left the commission man, and during retailing. Thermographs accompanied the shipment from the time the newly killed chickens entered the chillroom in the packing house until the last sample left the retailer. Descriptions of surroundings and records of the practices and vicissitudes of marketing were kept in full detail.

Visual inspections vary with the individuals making them, even those by the same person differing somewhat from day to day. Neither have we any accurate method of stating the findings based on the color of the skin, the odor, etc. To obviate this difficulty, and to establish a series of observations acquired by a uniform method and expressed in accordance with scientific usage, each sample was subjected to an examination in the laboratory. This consisted in estimating the amount of free acid in the fat,[a] since the rise in the acidity of fat is an excellent index of the progression of general flesh changes and in estimating the amount of ammonium salts in the muscle tissue,[b]

[a] Pennington and Hepburn, The determination of the acid value of crude fat and its application in the detection of aged foods, J. Amer. Chem. Soc., 1910, *32* (4): 568.

[b] Pennington and Greenlee, An application of the Folin method to the determination of ammoniacal nitrogen in meat, J. Amer. Chem. Soc., 1910, *32* (4): 561.

these compounds, also, forming an index of decomposition. The number of bacteria in a given quantity of flesh is of importance in the consideration of decomposition, as well as the general character of the organisms present. The number of bacteria in the tissues lining the body cavity were of especial importance in the problem under discussion, since the viscera, and especially the intestines, have been held to be a source of contamination.

Accordingly, the number of bacteria in 1 gram of tissue removed from the body wall of the fowls has been determined. This tissue consisted of the thin muscle coat which forms the wall of the abdomen as well as the mucous membrane which lines the interior of the body cavity, and which comes into direct contact with the intestines in the undrawn bird, and is subjected to mechanical contamination when evisceration is practiced.

The results obtained in the laboratory have been considered in the light of temperature, time, general surroundings, and visual findings. A correlation of the various facts gathered with the conditions observed has shown that the chemical and bacteriological examinations of the laboratory are more accurate and more reliable than mere observations of color, odor, texture, etc., and, in addition, they eliminate the personal equation and yield a fundamental series of facts by which the soundness of chicken flesh can be graded. Some such facts have been obtained from a series of shipments of eviscerated and partially eviscerated fowls.

These shipments extended over a period of six months, from January until June, inclusive; hence atmospheric temperature had a wide range. All the birds were mature hens, large and fairly fat. They were killed by cutting, from inside the mouth, the blood vessels of the neck and by puncturing the brain through the skull just below the eye. Only well-bled birds were selected for these experiments, because incomplete bleeding causes accelerated decomposition and is being investigated on its own account. Here the endeavor was to keep the main problem unhampered by side issues.

Dry picking was used for the same reason, since scalded birds decompose more rapidly under any circumstances.

CONDITIONS OF THE EXPERIMENT.

METHODS OF DRESSING.

The dressing of the carcasses was done according to three methods known respectively as "full drawn," "wire drawn," and "Boston drawn." For the "full drawn" specimens the body cavity was opened by a transverse cut across the abdomen, and the vent was removed by cutting around it. The head was cut off and the intestines and viscera completely removed. The heart, liver, and cleaned

gizzard, as well as the excess body fat, were put back into the body cavity. The shanks and feet were removed and the hocks were thrust through the opening in the abdomen and the vent.

"Wire" drawing consists in pulling out a loop of intestine by inserting the finger through the vent; cutting the loop, and drawing out the gut by careful traction until it breaks at the gizzard. The vent of a bird so drawn presents a normal appearance; the only indication of drawing is the collapsed abdomen.

The "Boston" drawing is a modification of the "wire" in that a circular incision is made around the vent and the intestines pulled through until rupture occurs at the gizzard. The undrawn fowls were shipped with heads and feet on, and had no incisions except for bleeding and braining.

Dressing by either the "Boston" or the "wire" fashion is sure to contaminate the body cavity with intestinal contents to some extent. This contamination may be slight or extensive, depending upon when and where the rupture occurs. The irregularity in the results is a distinct disadvantage. The full drawn birds are seriously contaminated by the process of drawing unless that be conducted according to the methods developed in the bacteriological laboratory for the preservation of sterility. Even with those methods it has not been found possible to keep the body cavity absolutely free from contamination during transportation and marketing, though as shown by Boos[a] it can be done under laboratory conditions. It has not, as yet, been possible to adapt such methods, requiring scientific training and appliances, to the modern packing house and its corps of employees.

The feet of the fowls were scrubbed and the heads were wiped free from blood and wrapped in parchment paper. The evisceration of the full drawn birds was conducted with sufficient care to render washing unnecessary, so far as visual inspection could determine. Water would merely furnish another source of bacterial contamination, whereas the effort was to eliminate as many of these as was commercially possible.

CHILLING, PACKING, AND TRANSPORTATION.

Chilling was begun immediately after dressing and was done in a room artificially cooled, in which the temperature varied between 27° and 41° F., with an average of 34° F. After chilling, which required from twenty-four to forty-eight hours, the birds were wrapped and boxed, and, if the car lot had been collected and was ready for shipment, the experimental packages, accompanied by a thermograph, went immediately into the car. If, as was more commonly the case, the requisite number of pounds was not ready the boxes were "staggered" on the

[a] Chemical examination of drawn and undrawn poultry kept in cold storage. Thirty-ninth Ann. Rept., Mass. State Board of Health, 1907.

floor of a freezer maintaining temperatures well below freezing, generally about 12° F., and kept there for an average of three days before shipping.

The boxes were placed about center way of the car and not more than 4 feet from the floor. Sometimes the cars contained dressed poultry exclusively; sometimes they held eggs also. The cars were salted, as well as iced, and icing instructions were issued with them. The haul was about 1,700 miles, and the average time 7.5 days.

HANDLING BY WHOLESALER AND RETAILER.

When the car was received at the market the experimental packages were transferred to the wholesaler's chill room, where they were immediately inspected. In every instance the stock was excellent and it was very seldom that visual examination could detect any difference in condition due to the various sorts of dressing.

The wholesaler who handled the goods was provided with excellent chill-room facilities. The temperature averaged 32.6° F. From the wholesaler the boxes of fowls went to the retailer's by wagon, but the haul was short. It was arranged to have more than one retailer handle the chickens, because of the wide variation in their equipment and methods. Refrigeration at the retailer's was by ice box. In addition to holding in the ice box the birds were hung in the shop windows when the retailer made a display. The average temperature, including that of the window display, was 48° F. Generally, when this display was made the weather was cool, but occasionally the temperature was sufficiently high to hasten decomposition in all of the samples. The thermograph record gave a continuous story of the temperature conditions throughout all the transfers and holdings.

It will be observed that the routine of dressing, packing and shipping, and general handling in these experiments is far above the average. Indeed, if all our market poultry should be handled as well, the problem of decay would become insignificant. It was deemed just to give every advantage possible to all the specimens alike, letting the different forms of dressing stand on their own merit, under the same favorable circumstances.

GRAPHIC PRESENTATION OF AVERAGE RESULTS.

Individual shipments show a varying history and a considerable difference in decomposition time, as is to be expected. The industry, however, must meet a variety of conditions, and it is not the individual maximum or minimum result which should determine the course to be pursued in order to insure soundness in market stocks, but rather that procedure which gives uniformly the best results

when the contingencies of reasonable trade conditions are met. Therefore the laboratory findings on 11 shipments have been averaged and charted graphically for convenience of presentation.

The laboratory examinations began in the packing house, the first being made after the birds were chilled and ready for boxing. The results on the acidity of the fat and the number of bacteria in 1 gram of flesh from the body wall are shown in sample 1 of figures 1 and 3. As was to be expected, after only twenty-four or forty-eight hours under excellent conditions the four methods of dressing show prac-

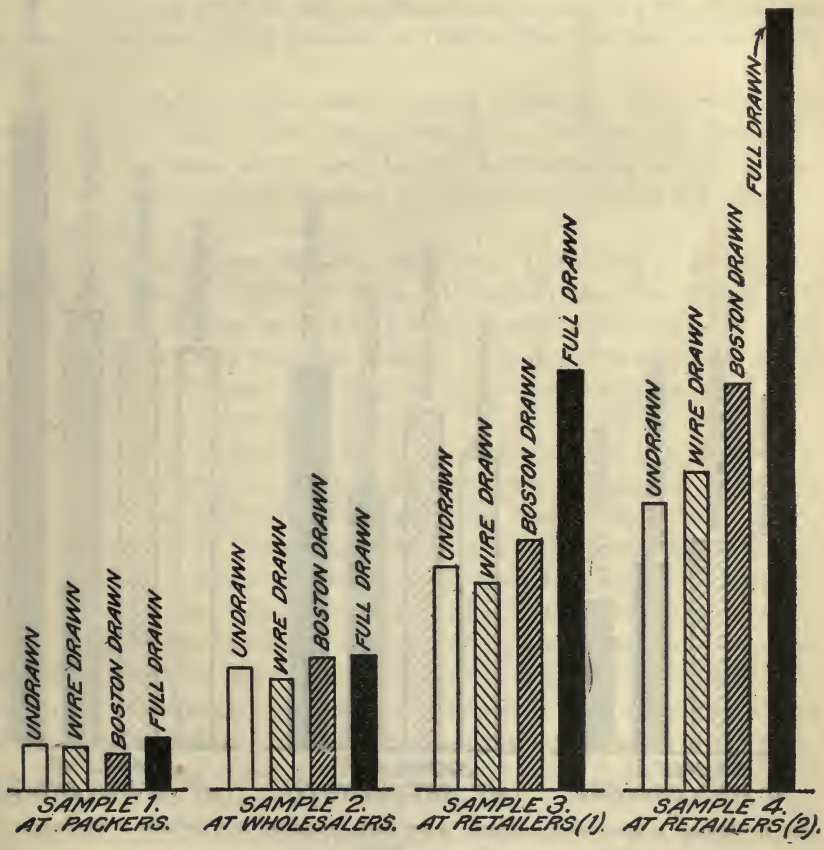

FIG. 1.—Changes in acidity of body fat, comparing four methods of dressing (average data).

tically no differences in the acidity of the fat. The full-drawn fowls had a slightly higher acid figure, but the difference is very slight. The number of bacteria in the body walls varies widely with the mode of dressing, the undrawn having the lowest and the full drawn the highest number of organisms, even in the packing-house samples.

The second samples were examined after the fowls had reached the commission man. At this time there was still but little difference

between the four lots, so far as visual inspection could determine. The haul had been fairly prompt and the temperature sufficiently low to carry birds which had been previously well chilled or frozen in perfect condition, and the wholesaler's chill room maintained about the same temperature as the car. However, changes did go on, as the laboratory work shows plainly, though they were not extensive. The acidity of the fat is increased in all the samples and though the

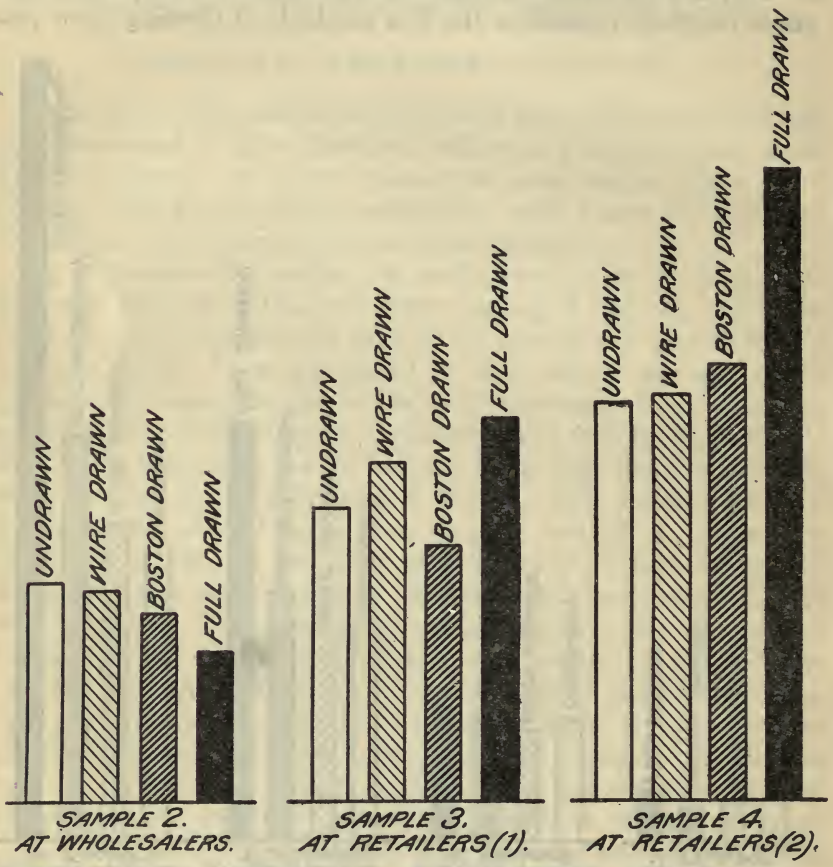

FIG. 2.—Changes in ammoniacal nitrogen in the flesh, comparing four methods of dressing (average data).

variation is slight the full drawn is a little in advance. Practically, however, all the forms of dressing are running parallel.

This is shown again by the amount of ammonium compounds in the flesh (fig. 2). The flesh of fresh, dry-picked, air-cooled chickens shows about 0.0120 per cent of these compounds. As aging progresses the quantity increases, but it does not increase so rapidly as the acid in the fat, nor so quickly. As indicated above, the amount of ammonium salts in the fresh samples is very small, and even when

deterioration is plainly visible the actual quantity, though increased as compared with the original ammonia content of the flesh, is still low.

Though the chemical analyses of the second samples indicate changes which are regular and slow, the number of bacteria in the body wall at this time shows that deterioration will go on rapidly if conditions prevail which are favorable to bacterial life. Even if the temperature be kept below 45° F., which is about the usual temperature of the retailer's ice box, the breaking-down processes gather force as they go, until finally, sometimes in a day or two, sometimes in just a few hours, they become so violent that the flesh is no longer wholesome.

Samples 3 and 4 were taken during retailing, No. 3 when the retailer's stock from the experimental car lot was at least half exhausted, the other at the very last of the marketing or a little later than the retailer's regular sales, if the general market happened to be dragging.

With one exception, the last samples of the undrawn fowls were still edible, though they were stale. Generally the wire drawn were close to the undrawn; while the Boston drawn were distinctly lower grade and sometimes were not edible. The full-drawn fowls at the end of marketing were not only in the worst condition, but only occasionally were they fit for food.

It is during the sojourn in the shop of the retailer that the effects of dressing and handling show most decisively. Samples 3 and 4 as charted indicate decided increases in the compounds which signify decomposition, and these increases vary greatly with the dressing. There is a wide difference between the undrawn and full-drawn in favor of the former. Between these two extremes stand the wire and the Boston drawn, the latter showing the greater amount of decomposition. The wire drawn stand very close to the undrawn, and until retrograde changes in the flesh are established they show rather less change than the other lots. After the decomposition has well begun, however, the wire drawn are less desirable than those in which the intestines are left untouched. The irregularity of the behavior of the wire-drawn and Boston-drawn birds is evidenced by the variation in the different samples. There was also a wide variation in the condition of the different birds in a single sample, some being much better than others. Hence the analyses of fowls dressed according to these two methods show that sometimes one, sometimes the other, gave the better result. It is more instructive, therefore, to compare these data with those for the undrawn and the full-drawn birds rather than with each other.

The number of bacteria in the flesh multiply so enormously during retailing that arithmetic can scarcely keep pace with them, and the

graphic charting (fig. 3) of the increase on the same scale as was used for the packing-house sample, or even that of the wholesaler, is impossible. The figures showing the average number of bacteria per gram

FIG. 3.—Increase in bacteria in wall of abdominal cavity, comparing four methods of dressing (for 1 gram of flesh, average data).

of flesh from the body wall are given in Table III, the analytical average data on which the three graphic charts are based being here inserted for reference.

TABLE I.—*Changes, during marketing, in the acidity of the fat, comparing different methods of dressing.*

[Percentage of free acid; average for 11 shipments.]

Style of dressing.	Packing-house sample. (1)	Commission-house sample. (2)	First sample from retailer. (3)	Second sample from retailer. (4)	Percentage of increase.
Undrawn	0.47	1.25	2.27	2.90	517.02
Wire drawn	.44	1.12	2.10	3.20	627.27
Boston drawn	.39	1.33	2.51	4.09	948.72
Full drawn	.53	1.38	4.22	7.82	1,375.47

TABLE II.—*Changes in percentages of ammoniacal nitrogen present in the flesh during marketing, comparing different methods of dressing.*

[Average for 11 shipments.]

Style of dressing.	Commission-house sample. (2)	First sample from retailer. (3)	Second sample from retailer. (4)	Percentage of increase.
Undrawn	0.0129	0.0139	0.0153	18.60
Wire drawn	.0128	.0145	.0154	20.31
Boston drawn	.0125	.0134	.0158	26.40
Full drawn	.0120	.0151	.0184	53.33

TABLE III.—*Increase in number of bacteria per gram in the flesh of the body wall during marketing, comparing four methods of dressing fowls.*

[Plates incubated at 20° C.; average for 11 shipments.]

Style of dressing.	Packing-house sample. (1)	Commission house sample. (2)	First sample from retailer. (3)	Second sample from retailer. (4)
Undrawn	236	10,790	168,170	1,468,000
Wire drawn	68,864	82,648	5,481,640	50,759,300
Boston drawn	23,234	341,650	34,258,000	20,309,000
Full drawn	77,580	9,523,000	1,885,710,000	5,375,270,000

Chart 3 shows graphically the relative number of organisms at each stage of marketing and for each form of dressing. It is a better representation of each form of dressing than of the relative condition at the different marketing periods because of the necessity of changing the scale on which the results are plotted. Samples 3 and 4, however, are drawn to the same scale and may be directly compared. If the number of organisms in 1 gram of the flesh of the undrawn fowl is plotted on a scale of 136,900 to 1 millimeter, the line representing the bacteria in the flesh of the full-drawn specimen in sample 3 is 58.5 feet long; in sample 4 the line for the full-drawn would be 134 feet long. If charted on the basis of the number of organisms in the flesh of the undrawn chicken when examined in the packing house, the line would be 14.7 miles in length.

GRAPHICS OF THREE INDIVIDUAL SHIPMENTS.

Such are the results of the series of shipments when viewed as a whole. It may be instructive, however, to study a few typical shipments in detail.

SHIPMENT NO. 1027.

No. 1027 is a fair example of marketing, with June weather as an incentive to promptness. The fat changes and the increase in ammonium compounds are plotted. The temperature curve stands out plainly and covers the entire course of marketing. The figures 1 to 2 indicate the temperature of the packing-house chill room; 2 to 3 the temperature of the refrigerator car during transit; 3 to 4

the wholesaler's chill room; and 4 to 5 the retailer's ice box and shop window. The time covered by the marketing period in days is shown at the base of the chart. The packer's chill room held the birds for one day with an average temperature of 33° F. Then the carrier held the lot for six days at between 31° and 37° F. On the seventh day after killing they reached the wholesaler. The composition on the ninth day after killing is indicated at B. On this day they went to the retailer. In six days his stock was almost completely exhausted and the composition of the experimental lots is

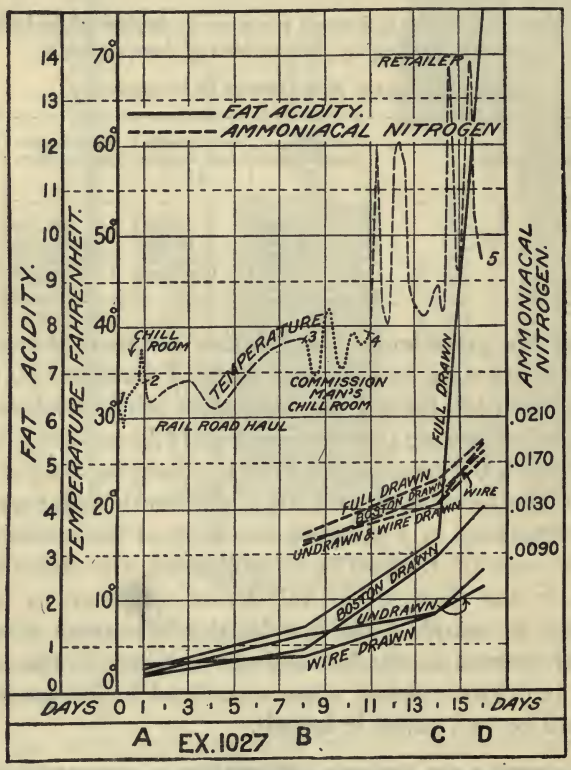

FIG. 4.—Changes in a single shipment (No. 1027), showing data for acidity and ammoniacal nitrogen.

shown at C. The full-drawn birds were low grade. In the two days which followed the Boston-drawn and full-drawn samples deteriorated so that they could not be used for food. The others were still edible, but distinctly low grade. This shipment required 16.5 days for marketing.

SHIPMENT NO. 1010.

No. 1010 shows a shipment in which the birds had been in the chill room of the packing house for two days and in the freezer for four days. The haul was eight days at a temperature of 23° to 27° F. The shipment remained in the wholesaler's freezer at 5° to 6° below

zero for six days, a total of twenty days before it reached the retailer. The composition of the birds when they left the wholesaler is shown at B on the chart. They were then hard frozen. After five days in the retailer's hands, three of which were required for thawing, they were again examined, as is seen at C. All were edible. Another examination two days later, after the last of the retailer's regular stock had been sold, showed the full-drawn and wire-drawn in "bad order." This shipment was in all twenty-seven days on the market.

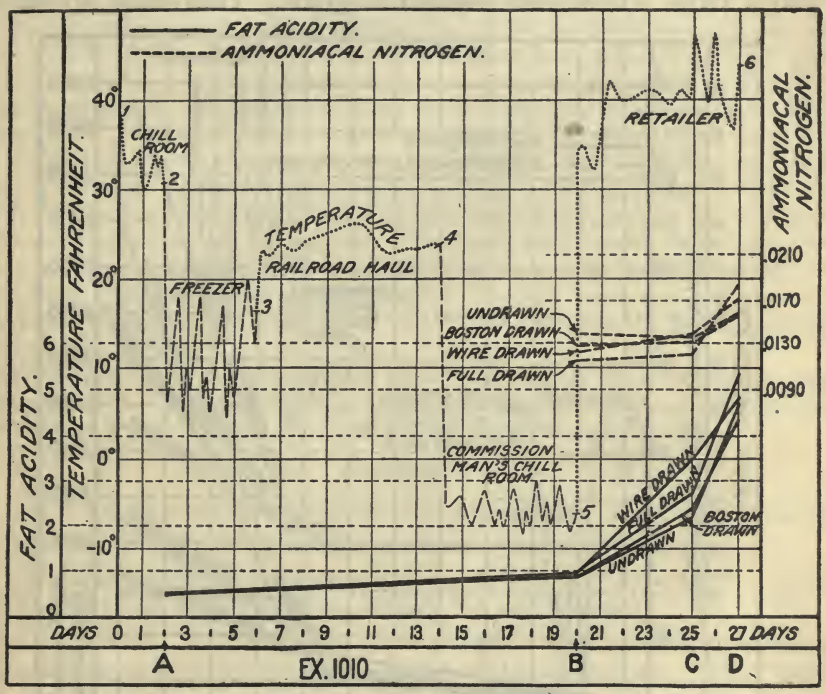

FIG. 5.—Changes in a single shipment (No. 1010), showing data for acidity and ammoniacal nitrogen.

The following report of market inspection of experiment No. 1010 is of interest in connection with the analytical data:

(1) *In the packing house.*—No difference could be distinguished between the various forms of dressing. The condition of all of the birds was very good.

(2) *When received at the commission man's.*—The birds were frozen. The color was excellent; extremely bright. No difference could be detected between the various forms of dressing.

(3) *First retailer's sample.*—The birds had thawed out but were in excellent condition. The fat in the wire and full drawn birds had deepened in color. The meat in these birds was turning slightly darker but there was not even a suspicion of greening, nor was there any unpleasant odor. The Boston drawn and the undrawn birds were excellent and looked nearly the same.

(4) *Second retailer's sample.*—The wire drawn and the full-drawn birds had developed a decidedly sour smell. There was no indication of mold or slime, but the fat was softer and much duller in color. The flesh, too, had softened somewhat. This might not have been noticed if the undrawn and Boston drawn had not shown up so far ahead of the other two.

SHIPMENT NO. 1029.

Experiment 1029 represents the changes taking place in a shipment under the conditions obtaining in the chill room, the freezer in the packing house, the usual railroad haul, the wholesaler's chill room, which the birds left on the fourteenth day after killing, and at the shop of the retailer after the lapse of two days more. At this time the stock was all in fair condition, no marked differences showing between the various forms of dressing, except in the case of the full-drawn birds, which were lowered in grade. Then came an undue

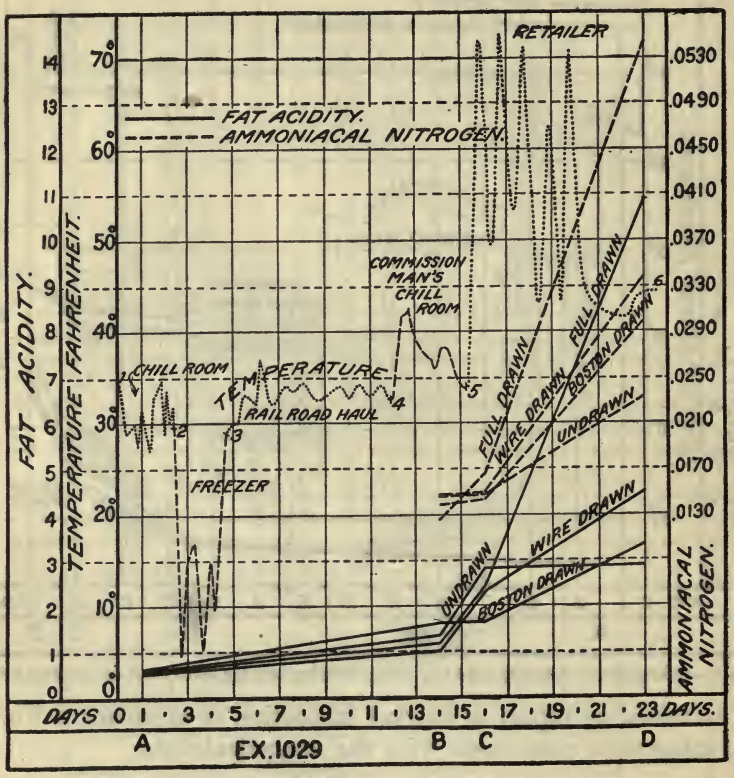

FIG. 6.—Changes in a single shipment (No. 1029), showing data for acidity and ammoniacal nitrogen.

delay, not the ordinary procedure, and the last examination, made on the twenty-third day of marketing, showed all the birds to be in bad order; but the eviscerated specimens were the worst. As stated, the latter part of this record is not in accordance with the usual course of events, but is a happening such as may be expected and does occur when the market drags or warm weather comes suddenly. The following details of market inspection are of interest in this connection, as representative of the results obtained under such conditions:

In the packing house.—There was no difference visible, when the birds were compared, between the various kinds of dressing. All were in fine condition.

When received at the commission man's.—All in excellent state of preservation. No difference could be detected between the various forms of dressing. Skins were bright; flesh was firm; odor excellent.

First retailer's sample.—All the fowls had softened and had begun to darken in color. The *undrawn* fowls were in the best condition so far as color, brightness of skin, and firmness of flesh was concerned. The *wire drawn* were nearly as good in appearance as the undrawn, but they were a trifle darker. The *Boston drawn* were as good in color as the wire drawn, but the cut fat had begun to soften, although no distinctly sour smell was present. The *full-drawn* fowls had soft fat and were slightly sour inside. Their color was the worst of all. None of the fowls were slimy.

Second retailer's sample.—All of the birds were in bad condition, dark colored, and repulsive in appearance. The necks of the *full drawn* were dark and green here and there. There was stickiness under the wings. The skin around the incision was blackened and the body cavity inside was dark. There was a small amount of fluid present. A sour and even putrid odor was present. The *Boston-drawn* fowls had both heads and necks green struck; were sticky under wings and thighs, and there was a distinctly unpleasant odor from the interior of the body cavity. The *wire-drawn* fowls were brightest in color. The heads were blackened, the necks slightly discolored, and the flesh was very soft. They were sticky under the wings. One fowl was green struck around the vent. The *undrawn* fowls had a putrid odor around the head. The wings and thighs were sticky. The skin was poor in color and the flesh had darkened. The body cavity was in good condition but had a decidedly stale smell.

The Boston-drawn and the undrawn fowls could possibly have been sold as very low-grade stuff. The wire drawn and full drawn were not salable. All the birds were in such bad condition that tasting the flesh was dispensed with.

SUMMARY.

(1) Undrawn poultry decomposes more slowly than does poultry which has been either wholly or partially eviscerated.

(2) "Full-drawn" poultry, that is, completely eviscerated, with heads and feet removed, decomposes the most rapidly.

(3) "Boston drawn" and "wire drawn" stand midway between the undrawn and full drawn in speed of decomposition. The "wire drawn," which is most like the undrawn, is usually the better.

(4) The following deductions are based on eleven shipments of dry picked, dry chilled, dry packed, unwashed fowls, which have been studied at every stage of marketing, from the packer to the consumer, the marketing throughout being in the market sense "prompt." The effect of different methods of dressing in the case of delayed marketing is now under investigation.

APPENDIX.

The bacteriological technique employed in obtaining the following results is that outlined in Bulletin No. 115, Bureau of Chemistry, U. S. Department of Agriculture, page 75. The determination of ammoniacal nitrogen was made by the Folin method as adapted by Pennington and Greenlee to the work (see Journal of the American Chemical Society, 1910, vol. 32, p. 561). The determination of the acidity of the fat was made according to the method outlined by Pennington and Hepburn in the same journal, page 568.

Dressing, shipping, and marketing history of drawn and undrawn chickens.

Serial number and date.	Chill room.		Freezer.		Transportation.		At commission merchants.		At retailers.		Chemical analysis.								Total number of days for marketing.
											Ammoniacal nitrogen.				Acid value.[1]				
	Time in days.	Temperature.	Time in days.	Temperature.	Time in days.	Temperature.	Time in days.	Temperature.	Time in days.	Temperature.	Boston drawn.	Wire drawn.	Full drawn.	Undrawn.	Boston drawn.	Wire drawn.	Full drawn.	Undrawn.	
1910.																			
January.		°F.		°F.		°F.		°F.		°F.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	
1006																0.54	0.64	0.38	
1006-1	2		3	5-21	11	25-27	4	26-27			0.0129	0.0140	0.0149	0.0148	2.95	1.08	1.26	1.24	20
February.																			
1008															.35	.36	.63	.33	
1008-1	2	34-39	2	8-20	10	29-30	2	32			.0122	.0133	.0106	.0112	1.22	.94	2.18	1.93	16
1008-2	2	34-39	2	8-20	10	29-30	5	31-35			.0108	.0120	.0115		1.58	1.50	2.33	1.79	19
1008-3	2	34-39	2	8-20	10	29-30	5	31-35	4	40-54	.0136	.0129	.0136	.0143	2.84	2.98	6.85	2.66	23
1008-4	2	34-39	2	8-20	10	29-30	5	31-35	6	38-54	.0126	.0146	.0179	.0158	3.08	3.07	9.08	2.78	25
1010															.43	.38	.54	.44	
1010-1	2	30-39	4	5-20	8	23-27	6	5-6			.0132	.0126	.0119	.0143	1.00	1.05	1.10	1.04	20
1010-2	2	30-39	4	5-20	8	23-27	6	5-6	5	32-47	.0136	.0143	.0125	.0140	2.40	3.54	2.71	2.22	25
1010-3	2	30-39	4	5-20	8	23-27	6	5-6	7	32-49	.0161	.0174	.0188	.0160	4.19	4.84	5.45	4.74	27
1012															.56	.57	.63	.43	
1012-1	2	30-35	5	5-15	7	19-21	2	21			.0136	.0123	.0123	.0141	1.32	1.31	.90		16
1012-2	2	30-35	5	5-15	7	19-21	2	21	2	30-50	.0113	.0129	.0125	.0116	.95	1.32	1.64	1.26	18
1012-3	2	30-35	5	5-15	7	19-21	2	21	4	30-50	.0148	.0134	.0141	.0122	2.40	2.44	1.57	1.95	20
March.																			
1015															.34	.38	.38	.56	
1015-1	1	31-41	4	7-23	6	28-33	1	40-51			.0122	.0137	.0120		.81	1.11	1.26	.77	12
1015-2	1	31-41	4	7-23	6	28-33	10	37-43	4		.0143	.0162	.0153	.0153	1.96	1.43	3.56	3.30	25
1015-3	1	31-41	4	7-23	6	28-33	10	37-43	6		.0161	.0140	.0188	.0172	1.34	1.36	3.29	2.93	27
1016															.39	.45	.47	.45	
1016-1	2	35-41	¼	8-14	6	28-33	1	40-51			.0119	.0120	.0112	.0120	.89	.82	.96	1.10	9
1016-2	2	35-41	¼	8-14	6	28-33	13	37-43	2	43-66	.0140	.0161	.0153	.0134	3.65	1.62		2.60	23
1016-3	2	35-41	¼	8-14	6	28-33	13	37-43	4	43-66	.0148	.0162	.0204	.0162	6.41	5.54	16.60	2.79	25

1017															.45	.36	.56	.59	
1017-1	2	33-40	1	12-24	7	29-32	6	32-38			.0133	.0140	.0132	.0137	1.43	1.48	2.45	1.74	16
1017-2	2	33-40	1	12-24	7	29-32	10	32-38	3		.0153	.0158	.0195	.0154	3.42	2.63	5.99	1.75	23
1017-3	2	33-40	1	12-24	7	29-32	10	32-38	6		.0134	.0160	.0253	.0157	4.60	2.94	7.28	2.94	26
1018															.42	.25	.36	.55	
1018-1	1	30-37	7	4-22	7	33-36	3	36-41			.0118	.0122	.0118	.0123	1.73	1.59	1.32		18
1018-2	1	30-37	7	4-22	7	33-36	6	36-41	3	40-57	.0123	.0151	.0154	.0154	2.84	3.40	4.39	2.56	24
1018-3	1	30-37	7	4-22	7	33-36	6	36-41	6	40-57	.0179	.0157	.0178		5.14	3.30	7.45		27
1021															.53	.48	.55	.39	
1021-1	2	28-36	7	5-19	7	31-37					.0125	.0112	.0109	.0116	.99	1.01	.93	.97	16
1021-2	2	28-36	7	5-19	7	31-37	9	39-43	4	28-66	.0143	.0143	.0162	.0123	2.86	1.99	9.74	3.53	29
1021-3	2	28-36	7	5-19	7	31-37	9	39-43	6	28-66	.0185	.0148	.0186		5.90	2.78	7.32		31
May.																			
1027															.33	.67	.50	.36	
1027-1	1	28-37	1/24	36	6	31-37	1	34-43			.0101	.0105	.0109	.0102	.95	.76	1.42	1.23	8
1027-2	1	28-37	1/24	36	6	31-37	3	34-43	4	40-61	.0140	.0130	.0154	.0130	2.98	1.48	3.39	1.48	14
1027-3	1	28-37	1/24	36	6	31-37	3	34-43	6	40-69	.0172	.0179	.0182	.0157	4.02	2.63	14.59	2.30	16
June.																			
1029															.46	.44	.56	.54	
1029-1	2	27-35	2	4-17	8	30-36	2	34-42			.0139	.0146	.0125	.0147	1.61	.98	1.15	1.32	14
1029-2	2	27-35	2	4-17	8	30-36	3	34-42	1	49-72	.0144	.0150	.0169	.0150	1.58	2.24	2.41	2.79	16
1029-3	2	27-35	2	4-17	8	30-36	3	34-42	7	42-73	.030	.0342	.0545	.0235	3.33	4.55	11.05	2.88	22
1031															.44	.43	.66	.54	
1031-1	2	31-36	8	5-19	8	15-44	8				.0144	.0146	.0139	.0125	2.33	1.74	1.35	1.33	26
1031-2	2	31-36	8	5-19	8	15-44	8		4	45-62	.0171	.0154	.0176	.0168	3.04	2.40	3.53	1.91	30
1031-3	2	31-36	8	5-19	8	15-44	8		6	45-62	.0202	.0196	.0218	.0196	4.17	1.61	3.93	3.71	32

[1] Expressed as milligrams of potassium hydroxid required to saturate the ree acids in 1 gram of sample.

Bacterial content of wall of abdominal cavity of drawn and undrawn fowls.

(All plates incubated at 20° C.)

Sample.	Number of organisms per gram.			
	Boston drawn.	Wire drawn.	Full drawn.	Undrawn.
Sample No. 1008:				
Packing house	662	39,444	5,377	152
Commission man	25,815	.....	.....	.....
First retail sample	.....	.....	229,600,000	.....
Second retail sample	38,970,000	384,000	33,800,000,000	.....
Sample No. 1010:				
Packing house	2,264	372	16,466	330
Commission man	630	27,200	936,000	9,000
First retail sample	19,683,000	39,000	34,290,000	37,000
Second retail sample	1,290,000	8,190,000	1,024,500,000	1,930,000
Sample No. 1012:				
Packing house	1,010	2,520	2,430	131
Commission man	37,900	91,000	935,000	45,000
First retail sample	78,000	39,000	.....	16,100
Second retail sample	540,000	17,100	154,940,000	.....
Sample No. 1015:				
Packing house	1,550	24,000	11,550	200
Commission man	1,808,000	.....	1,490,000	.....
First retail sample	3,090,000	3,516,000	.....	250,000
Second retail sample	1,030,000	5,410,000	589,400,000	28,400
Sample No. 1016:				
Packing house	8,100	5,020	2,600	14
Commission man	98,500	16,088	14,843,000	460
First retail sample	1,290,000	12,700,000	1,979,800,000	45,800
Second retail sample	2,602,000	41,380	200,190,000	.....
Sample No. 1017:				
Packing house	4,880	117,000	259,000	448
Commission man	.....	331,000	.....	17,600
First retail sample	101,000	2,165,000	2,905,000,000	551,000
Second retail sample	58,900,000	86,400,000	69,670,000	10,880
Sample No. 1018:				
Packing house	67,700	70,200	154,300	32
Commission man	.....	108,500	7,454,000	560
First retail sample	200,100,000	328,000	497,700,000	3,500
Second retail sample	40,910,000	60,500	1,310,000,000	.....
Sample No. 1021:				
Packing house	94,000	443,000	51,300	335
Commission man	810,000	.....	165,000	1,503
First retail sample	1,847,000	71,400	.....	88,800
Second retail sample	43,910,000	.....	.....	.....
Sample No. 1027:				
Packing house	.....	32,300	266,000	447
Commission man	1,860	28,900	49,300,000	1,410
First retail sample	24,400,000	34,700,000	1,095,000,000	16,700
Second retail sample	10,950,000	387,000,000	12,650,000,000	2,050,000
Sample No. 1029:				
Packing house	4,270	13,550	13,600	273
Commission man	291,000	16,800	.....	.....
First retail sample	491,000	203,000	8,260,000,000	222,800
Second retail sample	7,920,000	2,150,000	744,000,000	3,320,000
Sample No. 1031:				
Packing house	47,000	10,100	70,700	.....
Commission man	1,145	41,700	1,060,000	.....
First retail sample	91,500,000	1,055,000	84,300,000	450,000
Second retail sample	16,380,000	17,940,000	3,210,000,000	.....

Number of times coli-like organisms were found in the skin and in the walls of the abdominal cavity in 10 shipments of dressed fowls.

Sample.	In packing house.				Market—retailer's first sample.			
	Undrawn.	Wire drawn.	Boston drawn.	Full drawn.	Undrawn.	Wire drawn.	Boston drawn.	Full drawn.
Skin	2	5	5	7	3	4	4	4
Walls of abdominal cavity	0	8	8	8	3	8	1	9

COMMENT.

The foregoing tables give the detailed information on which the report on the comparative rate of decomposition in drawn and undrawn fowls is based. This work was done in the interests of wholesome food for the people, and the results have been reported in a form which, it is hoped, will be of service in educating the housewife and buyers in demanding good poultry, and also to the packer, shipper, and wholesaler in helping them to see the value of cold, clean, quick marketing, whether fowls are drawn or undrawn.

That the rate of decomposition might be based upon something more tangible than such visual inspections as have prevailed in the judging of the condition of market poultry, chemistry and bacteriology have been called to our assistance.

The studies of the composition of fresh chicken flesh and fat already made in this laboratory have given figures which can be taken as the standard of absolute freshness. What variations from this standard occur during the marketing, including railroad hauls, delayed marketing, etc., can only be determined by long and patient research, since no item in environment is too small to affect the final condition of the product. Such investigations will undoubtedly show that under certain specific conditions there may be either an exaggerated rise in the ammoniacal nitrogen of the flesh, or a noticeable regularity in its quantity, and these results will, doubtless, be closely connected with the number and kind of bacteria which are present. The causes of the rise in the acidity of the fat, even when, in all probability, bacterial life is not functioning, will then be explained and a more and more exact significance can be attached to these figures as far as the food value of flesh is concerned.

The effort which has been made to correlate such scientific findings with the conditions prevailing during two or three weeks of marketing, and over a distance of 1,700 miles or more, is new as far as meat products are concerned.

Looked at from an industrial viewpoint the findings are clear, concise, and convincing. Chemical and bacteriological laboratory work go hand in hand with the observations which the market has used to express the condition of the poultry, but the exactness of the scientific method has shown differences where, visually, none existed; and those differences have been confirmed, later, by the usual market inspection when the changes had progressed sufficiently to be apparent to touch, sight, and smell.

As has been stated, the handling in this experiment has far excelled that commonly practiced. It is commercially possible, with proper equipment and care throughout, for all packers to equal this standard at the present time, and undoubtedly, as our knowledge is extended by scientific research, the present "best" methods will be bettered and made commercially practical also. The foregoing results would indicate that any attempt to compel the marketing of poultry drawn under the conditions at present prevailing in the industry would be more detrimental to the consumer's interests than are the conditions shown by these findings, since these experimental lots were better handled than is the large proportion of dressed poultry.

Viewed from the critical scientific viewpoint the results obtained in the laboratory are full of suggestion for more work and closer, more numerous observations both on the conditions of marketing and on their results in flesh decomposition. Considering the newness and, speaking scientifically, the comparative crudeness of this line of work, it is of interest to observe how generally the acidity of the fat and the amount of loosely bound nitrogen in the flesh increase together as decomposition advances. A low fat acidity commonly means a small amount of loosely combined nitrogen, and the presence of but few organisms in the flesh also certifies to its good condition.

The number of individual bacteria has appeared almost overwhelming even when other findings still indicated the wholesomeness of the flesh. But it has been very suggestive to notice, also, with what strides decomposition progresses when bacteria

have once gained a firm foothold; and also that the rise in ammoniacal nitrogen which, we have been taught, is commonly the outcome of bacterial activity, does not appear until some time after it has been shown that bacteria are already numerous. Such observations furnish a fertile field for further research to determine the exact dependence of one finding on the other, as well as the kind of organisms present, and the chief lines along which decomposition progresses.