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Vitamin losses in the drip from thawed poultry

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VITAMIN LOSSES IN THE DRIP FROM THAWED POULTRY

by

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Introduction

Several decades ago the consumption of poultry was seasonal. Today, because of promotion, improved marketing methods, and frozen storage, poultry is consumed the year round. In 1930 we had 10 million pounds of turkey in frozen storage compared to 127 million pounds in 1950 (1). This increase has not alone been typical of turkeys: increasing amounts of other poultry are also being frozen both for the market and for the home. Because of the increase in consumption of frozen poultry there is a need for knowledge regarding the affects of freezing upon the nutrients present in the poultry.

When poultry is allowed to thaw before cooking a blood like fluid not present in the fresh state exudes from the flesh. Does this fluid contain nutrients lost in thawing? A study made by Kotschevar (2, 3) on the nutritive values of drip lost through thawing muscle meats indicates that about the same amount or slightly more thiamine and niacin and about the same amount of riboflavin will be found in the drip as in the source of the drip before freezing. He also hypothesized that thiamine was labile to thawing. If this is true of muscle meats would it not also hold true of poultry?

Kotschevar found that the quantity of drip varied with the specie of the animal and that glandular meats excreted more drip than did muscle meats. The ratio of bone and fat to lean meat was another factor. Another factor was the

ratio of cut surface to volume of meat. The cut or type of meat formed a fifth factor in determining drip loss (2, 3).

Nichols and MacKintosh (4) found that both intra- and inter-cellular ice crystal formation contributed to the fragmentation of muscle fibers and, as the number of these broken fibers increased, drip increased.

Only 2 earlier studies have appeared dealing with the nutrient value of drip. Pearson et al (5) conducted an experiment in which paired steaks were tested. They found that approximately 10% of the B complex vitamins were lost by drip. Cook et al (6) found that the drip of thawing beef contained about 9% protein. No work to date has been done on poultry drip as far as can be ascertained.

Procedure

To obtain the data required 4 chickens were used in each test and each chicken test replicated 3 times. Two turkeys were used for each test and each turkey test replicated 2 times.

In order to obtain the quantity of B vitamins in the drip, lactic acid bacteria were used since certain of these bacteria are specific to the individual B vitamins in their nutritional needs.

Microbiological methods have proved their accuracy in comparison tests with animals both rat and chicken (7) and with chemical methods.

Thiamine was tested by using L fermenti 36 according to the method described by B. Connor Johnson (8). The

procedure for testing for the presence of niacin by using L plantarum (arabinosus) and riboflavin by using L casei Be-I was taken from the methods outlined in Methods of Vitamin Assay, (9) for these two vitamins.

All bacteria were purchased from George Washington University, Washington, D.C. Culture broths, basal mediums and inoculum broths were purchased from Difco Laboratories Inc., Detroit, Michigan. Each week new stab cultures were prepared. After the second week cultures were transfered from earlier stabs rather than from the purchased stock cultures.

The frozen poultry was purchased from a local wholesale purveyor who furnished with the poultry a summary of its storage history from the time of its packing to delivery at the laboratory. Chickens were cut up for frying at the time of freezing and were placed in waxed cardboard boses sealed in an outer coating of waxed paper. Storage period prior to testing was approximately 8 months. Their weight was listed as 2 lb 8 oz each. Turkeys varied in listed weight from 19 lb 2 oz to 21 lbs. They were eviscerated and stored wrapped in polyethylene wraps approximately the same length of time as the chickens.

The chickens were placed for thawing, after unwrapping and weighing, in large glass funnels which were covered with polyethylene wraps and secured around the funnel base. This prevented evaporation loss during thawing. Each funnel was placed in lettered, tared, colored Erlenmayer flasks to

collect drip and prevent evaporation loss. Chickens were allowed to remain at room temperature for 4 hours and then placed in a refrigerator set at 0°C for an additional 16 hours. At the end of the initial 2 hour period chickens were broken apart to facilitate thawing, care being taken to avoid drip loss. Turkeys were weighed and then allowed to thaw in stainless steel pans while covered with the original polyethylene wrap. They remained at room temperature 4 hours, then were allowed to finish thawing under refrigeration an additional 48 hours.

In calculating the percentage of drip the weight of the poultry as it came from the package was used as 100%. The amount of drip collected in each flask was weighed. Two 5 ml samples of drip were weighed in tared watch glasses and then dried in a dessicating oven during each replication to determine the percent of solids in drip. Only 2 samples of drip in each test were calculated for percent solids. The 2 samples selected for chickens were selected at random from the drip of 4 chickens in each replication.

100 ml drip was digested with 1 N hydrochloric acid in an autoclave 15 minutes and 15 pounds pressure. Where the amount of drip was below 100 ml; 50 ml was used and amounts of all chemicals added, halved. After cooling to 37°C a solution of sodium acetate with the enzymes papain and taka-diastase were added and the solution was incubated at 37°C overnight. The next day each sample of drip was raised to 250 ml volume and filtered in the dark to prevent any ribo-

flavin loss. After preparation of the unknowns and the standards, all tubes were covered with aluminum foil and sterilized at 15 pounds pressure for 15 minutes. After cooling the tubes were aseptically inoculated with the appropriate bacteria and incubated at 37°C. Thiamine was incubated 16-18 hours, riboflavin and niacin were incubated 18-24 hours. All results were read turbidimetrically.

Results

Table I presents the results of the analyses.

Table I

The Physical and Thiamine, Riboflavin and Niacin Drip Losses in Thawing Chickens and Turkeys

Chicken	Total Weight gms.	Drip Weight gms.	Percent Drip	Percent Solids in Drip	Mg/100 gram Value of drip		
					B_1	B_2	Niacin
A.	1140.6	123.5	10.8		.05	.08	7.20
B.	1110.1	134.6	12.0	5.02	.04	.07	7.13
C.	1129.3	147.3	13.0	5.12	.05	.05	5.94
D.	1124.8	122.2	10.8		.05	.05	5.62
Mean*			11.6		.05	.06	6.48
A.	1128.1	122.5	10.8	5.30	.05	.09	6.17
B.	1125.0	95.5	8.5		.06	.09	6.81
C.	1125.4	100.3	8.1	5.15	.05	.09	6.05
D.	1133.2	96.7	8.0		.06	.07	6.22
Mean*			8.9		.06	.09	6.31
A.	1137.4	124.4	10.9	5.65	.05	.07	7.34
B.	1134.6	123.4	10.1	4.86	.05	.07	6.93
C.	1122.4	97.9	8.7		.04	.07	8.96
D.	1122.4	90.5	8.1		.04	.07	3.82
Mean*			9.4		.04	.07	6.76
Total Mean for Chickens			10.0	5.0	.05	.07	6.51
Turkey A.	9069.2	169.5	1.4	6.78	.06	.09	7.96
B.	9148.5	257.0	2.8	6.85	.05	.04	5.22
Mean*			2.5		.05	.05	6.59
A.	8127.9	517.1	6.4	4.04	.05	.08	5.67
B.	9497.5	172.0	1.8	5.98	.06	.09	5.76
Mean*			4.1		.05	.08	5.71
Total Mean for Turkeys			3.3	6.0	.05	.07	5.61

* The mean given is that obtained before rounding off the individual values for use in this table.

For chickens the mean drip weight was 10% of the total weight and of this drip approximately 5% consisted of solids. The drip contained appreciable amounts of thiamine, riboflavin and niacin.

While the percent of drip weight to total weight varied from 8 to 10% with the chickens, this percentage fell to a very small amount in the two turkey experiments bearing out the assumption that the ratio of cut surface area is a factor in governing the quantity of drip. However, the percentages of solids in the drip was higher. The excessive amount of drip in Turkey A in the last experiment with its accompanying lower percent of solids in the drip should be noted. Drip was made up of a considerable amount of water, residue from preparation of the bird for freezing. It would therefore be expected that the vitamin content of this drip would be less because of this dilution. It was, but not as great as expected. Thiamine content from the drip of Turkey A in the second replication was lowest of all turkeys tested. Riboflavin and niacin content were also less than that of turkey B in this replication. In the first turkey experiment there is some evidence of excess water being left in bird B although to a lesser extent. Judging from appearance of the drip, percentage of solids in drip, and amount of drip the amounts of water drained by the commercial processor from the poultry prior to freezing varied greatly. It was observed that processors of frozen poultry can increase the weight of the poultry by freezing a considerable amount

of water with the poultry. This should not be considered a legitimate practice.

From these estimates it is apparent that drip from frozen chickens contains an appreciable amount of vitamin which is lost when poultry is allowed to thaw completely and the drip disposed of prior to cooking.

It is also of interest to compare the results of this study with those of Kotschevar (2). Watt and Merrill (10) give the following values for the edible portion of raw broilers: .08 mg/100 g thiamine, .16 mg/100 g riboflavin, and 10.2 mg/100 g niacin. From the data obtained in this study it is indicated, as was found by Kotschevar, that while the drip from frozen meat will contain approximately the same percentage of thiamine and niacin as does the frozen source of the drip, the percentage of riboflavin found in the drip will be less than that of the frozen meat. It should be noted that riboflavin is much less soluble in water than the other two vitamins. It will be noted also that the loss of drip from chickens is somewhat within the same range as the loss of drip reported by Kotschevar for liver and muscle meats in his study (2, 3). However, it should be remembered that a part of the drip obtained in this present study was water which had been frozen with the poultry in processing.

Cooking poultry from the frozen state will save nutrients. However, it has accompanying disadvantages. In frying chicken from the frozen state there is the problem of

spattering and the poultry tends to stick to the bottom of the pan. There is also the problem of separation of the cut up portions of frying chicken so that each piece will receive uniform heat. It is the present practice of purveyors of cut up frozen poultry to fit the smaller pieces of chicken into the back cavity and freezing the chicken in a block form which greatly inhibits thawing in cooking. It is felt that fitting the chicken together in a flat form would be of help in thawing during cooking.

In a recent test chickens were cooked from the fresh, thawed and frozen state and presented to a taste panel. The tests on flavor were not as extensive as those used by Kotschevar nor was the panel selected as large, nor should they be considered a laboratory or expert panel. Of the preferences expressed by the four judges who participated in the test 50% preferred fresh chicken, 50% frozen. No preference was indicated for chickens cooked from the thawed state. Kotschevar presented his panel with 10 paired muscle meats cooked from the frozen and the thawed state and 72% indicated a preference for those cooked from the frozen state (2).

Table II presents the methods used and results of the test. Evaluation was based on grading of Sutherland et al (11) with 50 possible points each for exterior appearance and texture and tenderness and 100 points for palatability.

Table II

Taste Preference for Chicken Cooked From the Fresh, Frozen and Thawed State

Fowl	Method of Preparation	Average Number of Points	Individual Indicated Preference
1	Frozen and thawed in cooking in 1/2 c fat, covered	159	1
2	Fresh	175	2
3	Frozen and thawed in cooking in 4 oz water, covered	172	1
4	Defrosted and cooked	156	0

In broiling chickens which are still frozen the outer surfaces which are still frozen becomes overdone by the time the interior portions are cooked and shrinkage, especially of the leg, detracts from the appearance of the bird.

Breading will not adhere if added while chicken is in the frozen state. Hanson (12) last year recommended that chicken be dipped in a batter and crumbs and browned in fat slightly before freezing.

Lowe and Keltner (13) have proved that cooking poultry from the frozen state requires more fuel than cooking after thawing, as well as requiring more time. However, the time for thawing must be considered in the preparation time. Lowe et al (14) suggests the use of foil for roasting turkeys which shortens cooking time and prevents spattering and loss of moisture. However, they suggest refrigerator defrosting of the turkey in its wrappings before cooking.

the drip can then either be added to the bird or saved to be used with the other drippings for gravy.

Summary

Losses of thiamine, riboflavin and niacin in the drip of thawed poultry was studied. The percentages of drip obtained were high enough in cut up chickens to indicate that losses by drip may be significant. This does not hold true for whole eviscerated turkeys.

References

1. Klose, A.A., Hanson, H.L., McNally, E.H., 1950-51 Year Book of Agriculture Separate No. 2256

2. Kotschevar, L.H. Nutritive Values and Flavor in Frozen Meat--A Review, J. Am. Diet. Assoc. 31:3:250 (1955)

3. Kotschevar, L.H. B Vitamin Retention in Frozen Meat J. Am. Diet. Assoc. 31:5:589 (1955)

4. McNichols, J.H. & MacKintosh, D.L., Structural Changes Occuring in Muscle Tissue During Repeated Freezing and Thawing. Food Tech. 6:170 (1952)

5. Pearson, A.M., Burnside, J.E., Edwards, H.M., Glasscock, R.E., Conha, T.J., Novak, A.F., Vitamin Losses in Drip Obtained upon Defrosting Frozen Meat. Food Research 16:85 (1951)

6. Cook, G.A., Love, E.F.J., Vickery, J.R., Young, W.S., Studies on the Refrigeration of Meat 1. Investigation into the Refrigeration of Beef, Australian J. Exper. Biol. & Med. Sci. 3:15 (1925)

7. Cook, B.F., Morgan, A.F., Smith, M.B., Thiamine, Riboflavin and Niacin Content of Turkeys as Affected by Storage and Cooking. Food Research 14:449 (1949)

8. Johnson, B.C., Methods of Vitamin Determination, Burgess Publ. Co., Minneapolis, Minn. (1946)

9. Assoc. of Vitamin Chemists, Methods of Vitamin Assay, Interscience Publ. Co., New York City (1951)

10. Watt, B.D., & Merrill, A.L., Composition of Foods, Raw, Processed, Prepared, Agric. Handbook No. 8, U.S. Dept. Agric. (1950) pg. 21

11. Sutherland, E. & Nelson, P.M., Food Preparation Principles and Procedures, 5th Edition, Wm. C. Brown Co. Dubuque, Iowa (1953)

12. Hanson, H.L. Research Makes Frozen Poultry Products a Reality, Poultry Processing & Marketing, June 1954

13. Lowe, B. & Keltner, F., Studies in Cooking Frozen Poultry, U.S. Egg & Poultry Mag. 40:296 (1937)

14. Lowe, B., Edgar, M., Schoenleber, F., Young, J. Cooking Turkey in Aluminum Foil. Iowa Farm Sci. 8:5:16 (1953)