EFFECTS OF SELECTED THAWING, HEATING AND HOLDING CONDITIONS ON VITAMIN B_6 CONTENT OF TURKEY MUSCLE

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INTRODUCTION

Vitamin B_6 (pyridoxine, pyridoxal and pyridoxamine) is essential for the metabolism of proteins, fats and carbohydrates. Since muscle meats are one of the best dietary sources of vitamin B_6, efforts should be made to conserve as much of the vitamin B_6 as possible during preparation.

No information was found in the literature concerning vitamin B_6 retention in turkey muscle during defrosting and subsequent cooking. However, Larson (1956) noted defrosting losses of up to 50% of the thiamin, riboflavin and niacin content of frozen poultry and suggested cooking poultry from the frozen state to minimize those losses. However, this method of preparation is not always suitable. Spattering, sticking and uneven distribution of heat are problems encountered with chicken fried from the frozen state. More fuel and time are required when meats are cooked from the frozen state.

Kotschevar (1955) suggested that cooking partially thawed meat might circumvent some disadvantages of cooking frozen poultry, and at the same time prevent defrosting losses of B vitamins. He observed that during the thawing process the rise in temperature to -1.7°C was fairly rapid, then a large amount of heat was needed to melt the ice crystals. When this heat was gained, the temperature began to rise again and drip was formed. He hypothesized that if the meat were cooked when the internal temperature reached -1.7°C a more nutritious product would be obtained.

The first part of our study was designed to determine the effects of roasting from the frozen, partially frozen and thawed states on vitamin B_6 retention in turkey muscle.

Present trends in food service to shorten labor hours and to utilize facilities to a maximum have resulted in frequent holding of food products after preparation. Cooked meats are often held in warming ovens and on steam tables or refrigerated and reheated before service. The holding and/or reheating process may result in further losses of B vitamins. Although vitamin B_6 is thought to be fairly stable to heat, acid and alkali, exposure to light and oxygen during holding may result in loss of vitamin B_6.

Little or no destruction of thiamin and riboflavin during holding and reheating of meat and meat products has been observed (Rice and Beuk, 1945; Vail and Westerman, 1946; Erikson and Boydon, 1947; Causey and Fenton, 1951; West et al., 1959; Bowers and Fryer, 1972). However, LaChance et al. (1973) reported an 18% decrease in thiamin content of chicken pot pie filling during holding on a simulated steam table (82°C for 30 min) compared with a 7% loss during heating of the filling. No information was found in the literature concerning the vitamin B_6 retention of meat during holding and/or reheating.

The second part of our study was designed to determine the effect of reheating and holding on vitamin B_6 retention in turkey muscle.

REVIEW OF LITERATURE

Little information is available on retention of vitamin B_6 in muscle but other B vitamins have been studied more extensively. Several factors, including aging before freezing, the freezing process and length of frozen storage, cooking from the frozen or thawed state, methods of thawing and cooking methods, have been shown to affect the retention of B vitamins in meat.

Aging before Freezing

Aging pork no longer than one week prior to frozen storage had little effect on the stability of thiamin, riboflavin, niacin and pantothenic acid (Westerman et al., 1955). Ripening up to 42 days had no significant effect on the vitamin B_6 content of beef longissimus dorsi or semimembranosus muscles (Meyer et al., 1966). In contrast, Lehrer et al. (1951) found that pork loins ripened only one day had less niacin than those aged three to seven days.

Freezing and Frozen Storage

Vitamin B_6 has been found to be fairly stable during frozen storage. Richardson et al. (1961), utilizing the rat growth procedure, found that beef liver retained 82% (11.25 µg/g) and boned chicken 77% (4.6 µg/g) of the vitamin B_6 content after 15 mo frozen storage.

No consistent trend has been observed in relation to the length of storage of meat and retention of thiamin, riboflavin, niacin and pantothenic acid. Thiamin losses during frozen storage have ranged from approximately 40% after six months storage in pork chops (Lehrer et al., 1951) and eight months storage in the dark meat of chicken (Millares and Fellars, 1949) to very small or negligible losses in pork (Westerman et al., 1952), chicken (Morgan et al., 1949) and lamb chops (Lehrer et al., 1952) stored for periods of at least six months.

Riboflavin losses have followed a pattern similar to thiamin. Fairly large losses (approximately 30%) have been reported in lamb chops stored for six months (Lehrer et al., 1952), sliced liver stored for two months (Kotschevar, 1955) and pork chops stored for three months (Lehrer et al., 1951). Other investigators have found high retentions in poultry during the

first nine to twelve months of frozen storage with a trend toward greater losses following those periods (Morgan et al., 1949; Cook et al., 1949). Westerman et al. (1952) observed no relationship between the storage time (up to 72 weeks) or storage temperature (10°F to -20°F) and riboflavin retention in pork.

Several workers have reported negligible losses or increases in niacin content of meat after frozen storage up to 12 months (Lehrer et al., 1951; Westerman et al., 1952; Morgan et al., 1949; Cook et al., 1949; Millares and Fellars, 1949; Lehrer et al., 1952; Kotschevar, 1955). However, Morgan et al. (1949) found a definite loss of niacin in chicken leg muscle after 12 months of storage.

Only limited information was available concerning pantothenic acid retention during frozen storage. Westerman et al. (1952) determined that there was no relationship between storage conditions and pantothenic acid retention in pork muscle.

The rate of freezing had little effect on the retention of thiamin, riboflavin and niacin in pork chops (Lee et al., 1954) and in beef cuts (Lee et al., 1950). No information was found relating the rate of freezing and vitamin B_6 retention.

Cooking from the Frozen State

A wide range in percentage retention of B vitamins have been reported when meat was cooked from the frozen versus the thawed state. Causey et al. evaluated differences in nutritive value of beef (1950b) and lamb (1950c) patties cooked from the frozen and thawed states. No differences were found in the retention of thiamin and riboflavin. Pork chops cooked from the frozen state retained 19% more thiamin and 14% more riboflavin than did those cooked

after thawing (Lehrer et al., 1951). Niacin retention was not affected. Kotschevar (1955) examined the retention of thiamin in liver cooked from the frozen and thawed states. Both treatments resulted in a loss of thiamin, although smaller losses were observed when the meat was cooked from the frozen state.

No information concerning vitamin B_6 retention in meat cooked from the frozen state was found in the literature.

Thawing

Thiamin, riboflavin, niacin, pyridoxine, pantothenic acid and folic acid usually are stable to most thawing conditions, however considerable transfer of the vitamin from the muscle to the drip occurs. Except for pantothenic acid, vitamins recovered in the drip from defrosted frozen beef (Pearson et al., 1951) and pork (Pearson et al., 1959) ranged from four to 15% of the vitamins in the meat. Thirty-three percent of the pantothenic acid in beef was found in the drip. Singh and Essary (1971a) examined the thiamin, riboflavin and niacin content of drip after subjecting chicken broilers to four thawing methods (refrigerator, warm or cold water or room temperature). The only difference ($P<0.05$) observed was more riboflavin in drip from broilers thawed in the refrigerator or at room temperature than in those thawed in warm or cold water.

Various thawing conditions (refrigerator, running tap water, warming oven or room temperature) had no appreciable effect on the thiamin, riboflavin and niacin content of beef steaks (Westerman et al., 1949) and ground pork meat (Causey et al., 1950a). Thawing conditions had no effect on the thiamin and riboflavin content of chicken broiler meat (Singh and Essary, 1971b).

Broilers thawed at room temperature, however, retained less niacin than those thawed in warm or cold water or in the refrigerator.

Cooking Methods

Amounts of most B vitamins are similar for moist and dry cooking methods if the amount of vitamin in both the meat and drip are considered. More vitamins are transferred to the drip when moist heat rather than dry heat is used, perhaps because of the leaching action of steam.

Only small losses of heat stable B vitamins (riboflavin and niacin) occur during cooking, but heat labile vitamins (thiamin and pantothenic acid) are destroyed to a great extent during cooking. Vitamin B_6 usually is classified as heat stable. However, early research did not support this claim (Henderson et al., 1941; McIntire et al., 1944). Retentions ranged from 14 to 42% of the amount in uncooked muscle dependent on the cooking method utilized. Drip obtained on roasting was not analyzed. Lushbough et al. (1959) reported 42 to 67% retention in muscle with 1 to 13% of the vitamin B_6 in the drip. Values more consistent with the heat stable nature of vitamin B_6 were reported in oven-roasted beef loin and oven-braised beef round (Meyer et al., 1969). Retention in the loin averaged 72% with 16% in the drip. Retention in the round averaged 49%, and 34% was found in the drip.

No consistent trend has been observed in vitamin B_6 retention of microwave-heated muscle. Microwave-heated chicken breasts retained more ($P<0.05$) vitamin B_6 (on a dried weight basis) than did chicken roasted conventionally (Wing and Alexander, 1972). Turkey breast muscle retained more ($P<0.01$) vitamin B_6 when heated in a microwave oven on a cooked weight basis, but not on a moisture free basis (Bowers et al., 1974a). This difference is probably due to the greater moisture loss of the microwave heated muscle. Differences

in vitamin B_6 in pork muscle were small when calculated on a cooked weight basis. However on a dried weight basis, more ($P<0.10$) vitamin B_6 was retained by muscle heated in a conventional than in a microwave oven (Bowers et al., 1974b).

Reheating and Holding

Excellent retention of thiamin and riboflavin in meats and meat products that have been refrigerated or frozen and then reheated has been observed (Vail and Westerman, 1946; Erikson and Boyden, 1947; Causey and Fenton, 1951; West et al., 1959; Bowers and Fryer, 1972). Conflicting evidence concerning thiamin retention in meat held on a steam table or under simulated steam table conditions has been reported. Retention of 91% of the thiamin in pork roasts (Vail and Westerman, 1946) and 82% in nutrified chicken pot pie filling (LaChance et al., 1973) held for 30 min were the only values found in the literature.

Information concerning effects of reheating and holding meat on other B vitamins, including vitamin B_6, was not found.

EXPERIMENTAL PROCEDURE - EXPERIMENT I

Treatments

Thirty-six frozen paired halves from 18 turkey hens (12-14 lb) were obtained locally. At each of nine evaluation periods four turkey halves from two turkeys were subjected to the following randomly assigned treatments: (a) uncooked; (b) roasted from the frozen state; (c) roasted from the partially frozen state; and (d) roasted from the thawed state (Table 6, Appendix). The experimental design was a balanced incomplete block design with nine

replications of each treatment. One turkey represented a block and each treatment appeared with every other treatment three times (Cochran and Cox, 1968).

Internal temperatures of the pectoralis major (PM) muscle of halves to be cooked from the partially frozen state were allowed to rise to -2°C before roasting. Halves that were cooked from the defrosted state were thawed at room temperature (25°C) for 16 hr to an approximate internal temperature of 0°C.

Halves were roasted in a rotary hearth electric oven maintained at 177°C to internal temperatures of 80°C in the PM muscle. The PM muscle and a composite of thigh muscles were removed and ground in a Kenmore Electric Food Grinder (1/8-in. plate) for objective measurements. Samples to be analyzed for vitamin B_6 were freeze dried (Virtis Unitrap 10-102). Drip from thawing and roasting was collected, the volume and weight recorded, and held frozen until analyzed.

Objective Measurements

Cooking time. Total cooking time in minutes was recorded, and cooking time in min/kg was calculated based on the weight of the uncooked half bird.

Cooking weight losses. Percentage total, drip and volatile losses, based on the weight of the uncooked half bird were calculated.

Total moisture of muscle. Percentage total moisture was determined by drying duplicate samples of ground muscle (approximately 2 g) in a vacuum oven at 102°C for 16 hr.

Ether extract of muscle. Percentage ether extract of ground muscle was determined by extracting duplicate dried samples with diethyl ether for 16 hr on a Goldfisch extraction apparatus.

Total moisture and ether extract of drip. Percentage ether extract of drip was determined by a combination of physical and chemical separations. The layer of lipid that collected at the top of the drippings on cooling was liquified in a boiling water bath and removed. Collected lipid was dried in a desiccator for a minimum of 16 hr before weighing.

The remainder of the drip was extracted with petroleum ether to provide separate ether and water soluble fractions. The volume of petroleum ether used was dependent on the amount of lipid present in the sample. Ether was distilled from the sample using a Goldfisch extraction apparatus. After the distillation of the ether, the residue was dried a minimum of 16 hr in a desiccator and weighed to determine lipid content of the extract.

Total ether extract was obtained by combining the weight of lipid determined by both the physical and chemical separations. Percentage total moisture of the drip was determined by drying the water soluble fraction in a Brabender Moisture Tester at 121°C for 120 min.

Vitamin B_6 assay. Total vitamin B_6 content of muscle and drip was determined by the method of Toepfer and Polansky (1970) based on the growth response of the yeast Saccharomyces uvarum (Appendix, p. 29-33). No attempt was made to separate the three forms of vitamin B_6. Breast and thigh muscle and drip from thawing and cooking were sampled in duplicate, five dilutions of each sample prepared and vitamin B_6 in each dilution determined in triplicate.

Analysis of Data

A balanced incomplete block design (Cochran and Cox, 1968) with nine replications of each treatment was used. One turkey represented a block and each of the four treatments appeared with every other treatment three times.

Vitamin B_6 content of muscle was analyzed by the following analysis of variance:

Source of Variation	d.f.
Blocks (unadjusted)	17
Treatments (adjusted)	3
Intrablock Error	15
Total	35

Adjusted treatment means were calculated.

Cooking losses and time and the vitamin B_6 content of the cooked drip was analyzed by the following analysis of variance:

Source of Variation	d.f.
Treatments	2
Error	24
Total	26

When F-values were significant, least significant differences (LSD) at the 5% level were determined.

EXPERIMENTAL PROCEDURE - EXPERIMENT II

Treatments

Sixteen frozen breast portions from 22-24 lb Grade A tom turkeys from the same lot processed under similar conditions were obtained from a local plant. Each breast was divided into two portions and randomly assigned to four treatments: (a) roasted; (b) roasted, refrigerated 24 hr, reheated electric oven; (c) roasted, refrigerated 24 hr, reheated microwave oven; and (d) roasted, sliced and held at 93°C 60 min and then at 79.5°C 15 min (Table 13, Appendix).

Breasts were thawed at room temperature (25°C) for 4 hr and then placed in a refrigerator (6°C) for 16 hr to continue thawing.

Two breast portions were heated to 80°C in a rotary hearth electric oven maintained at 177°C, cooled at room temperature (25°C) for 15 min, packaged in aluminum foil and refrigerated (6°C) for approximately 24 hr. The following day the refrigerated portions were skinned and deboned, wrapped in 3M Scotchpak Oven Service film and reheated. One portion was reheated to 55°C in the electric oven and the other to 55°C in an Amana Radarange (model RR-2) microwave oven. The microwave reheated portion was sliced immediately to minimize post-oven temperature rise. Two raw portions were roasted to an internal temperature of 80°C in the rotary hearth electric oven (177°C). One of the freshly roasted portions was sliced (1/4-in. slices) and held in the cooking drip in a warming oven at 93°C in a Pyrex baking dish (5x9 in.) covered with aluminum foil. The Pyrex baking dish was then uncovered and transferred to a General Electric warming tray, high setting (79.5°C) and held for 15 min.

The cooked meat was skinned, deboned, trimmed of browned surfaces and ground in a Kenmore Electric Food Grinder (1/8-in. plate) for objective measurements. Samples for vitamin B_6 analysis were freeze dried (Virtis Unitrap 10-102).

Objective Measurements

Objective measurements of cooking and reheating time and weight losses, percentage moisture and ether extract and vitamin B_6 content were made on muscle as described for Experiment I.

Analysis of Data

A randomized complete block design with eight replications of each treatment was used. Vitamin B_6 data was analyzed by the following analysis of variance:

Source of Variation	d.f.
Treatments	3
Birds (replications)	7
Error	21
Total	31

Reheating weight losses and times were analyzed as follows:

Source of Variation	d.f.
Treatments	1
Error	16
Total	17

When F-values were significant, least significant differences (LSD) at the 5% level were calculated.

RESULTS AND DISCUSSION - EXPERIMENT I

Vitamin B_6 content and other selected objective measurements of raw turkey and turkey roasted from the frozen, partially frozen and thawed state were evaluated. Breast and thigh muscle and drip collected during thawing and roasting were analyzed. Data for all replications are presented in Tables 7-12, Appendix.

Percentage Thawing and Cooking Weight Loss

Thawing and cooking weight losses were calculated on the basis of the weight of the uncooked half bird (Table 1). Differences in thawing loss were not expected as both the uncooked half bird and the half bird cooked from the thawed state were subjected to identical thawing procedures. Cooking losses (total, drip and volatile) and thawing losses plus cooking losses were similar for the three treatments.

Cooking Time

Meat cooked to 80°C from the frozen and partially frozen state required about 19% longer ($P<0.01$) cooking times than meat roasted from the thawed state (Table 1). Fulton et al. (1967) reported a similar increase in roasting time (17%) when turkeys were roasted from the frozen state to an internal temperature of 85°C.

Total Moisture of Muscle

As expected, uncooked breast and thigh muscle had a greater percentage moisture ($P<0.01$) than did those cooked by any of the three heat treatments. Muscle cooked from the frozen, partially frozen or thawed states had similar amounts of moisture. Variability ($P<0.01$) in moisture content was observed among birds.

Ether Extract of Muscle

Percentage ether extract in thigh muscle was higher than in breast muscle. Percentage ether extract in breast muscle was not affected

Table 1-Cooking time and losses, moisture and ether extract of turkey muscle and drip

Factor	Treatments				Significance of F-value[a]		LSD[b] for treatment differences
	Raw	Cooked from frozen state	Cooked from partially frozen state	Cooked from thawed state	Treatments	Birds	
Thawing loss, %	1.07	-	-	0.83	-	-	-
Total cooking loss, %	-	26.29	27.38	25.09	ns	-	-
Drip loss, %	-	5.05	5.71	4.47	ns	-	-
Volatile loss, %	-	21.19	21.67	20.62	ns	-	-
Cooking time, min/kg	-	65.38	63.03	53.09	**	-	6.34
Moisture, %							
Muscle							
Pectoralis major	74.05	68.65	68.93	68.49	**	**	1.61
Thigh	76.02	65.75	65.26	65.81	**	**	2.15
Ether extract, %							
Muscle							
Pectoralis major	1.59	1.74	1.83	1.51	ns	ns	-
Thigh	3.76	6.52	7.91	6.60	*	ns	2.32
Moisture, %							
Drip							
From thawing	94.5	-	-	96.2	ns	-	-
From cooking	-	8.21	19.95	15.15	ns	-	-
Ether extract, %							
Drip							
From thawing	0.17	-	-	0.06	ns	-	-
From cooking	-	80.1	64.9	71.0	ns	-	-

[a] **, significance at 1% level
*, significance at 5% level
ns, nonsignificant
[b] LSD, least significant difference at 5% level

significantly by treatment. Lack of significance may be attributable to the small variation in percentage ether extract observed in the breast muscle.

Raw thigh muscle had less ($P<0.05$) percentage ether extract than that cooked from the frozen, partially frozen or thawed states (Table 1). This difference is probably attributable to moisture loss during cooking making the percentage ether extract of cooked meat higher.

Total Moisture and Ether Extract of Drip

Large differences in composition between drip obtained on thawing and cooking were observed. Thawing drip was primarily water and cooking drip primarily lipids. Larson (1956) reported a mean value of 6% solids from drip obtained from turkeys on thawing. We observed slightly lower mean values (4.5% and 3.8% solids) in our study. We also observed wide variation in individual values within a treatment that may be attributable to turkey variation or to variability in the method utilized for moisture and lipid analysis.

Vitamin B_6 Content of Muscle

Vitamin B_6, like niacin and unlike thiamin and riboflavin (Cook et al., 1949), was more concentrated in the light than in the dark meat of turkey. Mean values for vitamin B_6 ranged from 5.50 to 7.18 µg/g in the breast and from 2.97 to 3.51 µg/g in the thigh. Bowers et al. (1974a) found slightly lower mean values for turkey breast muscle cooked in microwave or conventional ovens. Those values were calculated on a moisture free, but not a fat free, basis. No vitamin B_6 values for thigh muscle were found in the literature.

Vitamin B_6 content of breast and thigh muscle was similar for all four treatments when calculated on a wet weight basis (Table 2). When calculated on a moisture and fat free basis, uncooked muscle usually had more vitamin B_6

Table 2-Adjusted means of vitamin B_6 content (μg/g) of turkey muscle and drip

Factor	Treatments				Significance of F-value[a]		LSD[b] for treatment differences
	Raw	Cooked from frozen state	Cooked from partially frozen state	Cooked from thawed state	Treatments	Birds	
Muscle							
Wet weight basis							
Pectoralis major	5.96	6.35	7.18	5.50	ns	**	-
Thigh composite	3.51	3.27	2.97	3.14	ns	**	-
Moisture and fat free basis							
Pectoralis major	24.39	21.37	25.02	18.30	*	**	5.18
Thigh composite	17.31	11.87	10.97	11.73	*	**	4.23
Drip							
Wet weight basis							
From thawing	2.09	-	-	1.59	ns	-	-
From cooking	-	1.99	3.03	2.88	ns	-	-
Moisture and fat free basis							
From thawing	37.0	-	-	43.7	ns	-	-
From cooking	-	23.0	34.6	26.6	ns	-	-

[a] **, significance at 1% level
*, significance at 5% level
ns, nonsignificant
[b] LSD, least significant difference at 5% level

than cooked muscle. Greater moisture content (Table 1) of the raw muscle would explain the lack of difference in vitamin B_6 between cooked and raw muscle when calculated on a wet weight basis.

Breast muscle cooked from the partially frozen state contained more ($P<0.05$) vitamin B_6 (moisture and fat free basis) than did muscle cooked from the thawed state. Muscle cooked from the frozen state retained an intermediate amount of vitamin B_6. Vitamin B_6 content of raw thigh muscle (moisture and fat free basis) was higher ($P<0.05$) than for muscle cooked from the frozen, partially frozen or thawed states. There was greater variation in vitamin B_6 content (on both wet and moisture and fat free bases) among birds than among treatments.

No clear trend is evident from those data. We expected more vitamin B_6 in breast muscle cooked from the partially frozen state than from the thawed state, as there was no drip from the partially frozen meat prior to cooking. For the same reason vitamin B_6 content of meat cooked from the frozen state would also be expected to be significantly higher than meat cooked from the thawed state. We had postulated that vitamin B_6 would be transferred to the drip during thawing, resulting in lower retentions in muscle that was cooked after thawing. This was not observed in breast or thigh muscle except for the higher amounts of vitamin B_6 in breast muscle cooked from the partially frozen rather than the thawed state.

Differences observed between the raw and cooked treatments, in both breast and thigh muscle, would indicate that either vitamin B_6 is transferred to the drip or is unstable during cooking.

Vitamin B_6 Content of Drip

No significant difference in vitamin B_6 content of either thawing or cooking drip was observed when calculated on either a wet or moisture and fat free basis. When vitamin B_6 values of total drip loss were expressed as µg/100 g of uncooked bird (to eliminate differences in bird weight from the values) there were no significant differences in the amount of vitamin B_6 in drip of either the uncooked meat or the meat cooked from the three states (Table 3). If vitamin B_6 is stable to the cooking process greater amounts of the vitamin would be expected in the drip from the cooked birds as less vitamin B_6 was found in the cooked muscle. Since this was not observed we assumed that vitamin B_6 was unstable during cooking. The only exception to this trend was found in breast muscle cooked from the partially frozen state.

Table 3-Mean values of vitamin B_6 content (µg/100 g of uncooked bird) of drip obtained from thawing and cooking

	Treatments			
Factor	Raw	Cooked from frozen state	Cooked from partially frozen state	Cooked from thawed state
Drip from thawing	2.54	-	-	1.37
Drip from cooking	-	6.75	10.59	8.92
Drip from thawing and cooking	2.54	6.75	10.59	10.29

RESULTS AND DISCUSSION - EXPERIMENT II

Vitamin B_6 content and other selected objective measurements of freshly roasted turkey breast muscle and muscle reheated in either the electric or

microwave oven or held after roasting were evaluated. Data for all replications are presented in Tables 14 and 15, Appendix.

Percentage Reheating Weight Loss and Time

Reheating weight losses, based on the weight of the cooked muscle, were greater ($P<0.05$) for portions reheated in the microwave oven than in the electric oven (Table 4). Other workers have reported similar losses in poultry (Wing and Alexander, 1972; Bowers et al., 1974a). Muscle reheated in the microwave oven had greater volatile ($P<0.05$) but less drip ($P<0.05$) loss than did those heated in the electric oven (Table 4). Wing and Alexander (1972) and Bowers et al. (1974a) also observed greater drip losses with conventional cooking.

As expected, reheating time was less ($P<0.01$) for muscle reheated in the microwave oven. The microwave reheating method was approximately seven times faster than conventional reheating.

Table 4-Mean values of reheating weight losses and time of turkey breast muscle

Factor	Reheated electric	Reheated microwave	Significance of F-value[a]
Total reheating loss, %	5.92	9.03	*
Reheating drip loss, %	5.17	2.91	*
Reheating volatile loss, %	0.78	5.05	*
Reheating time, min/kg	109.88	15.13	**

[a] **, significance at 1% level
*, significance at 5% level

Percentage Total Moisture

Moisture content was greater ($P<0.01$) for muscles freshly roasted than for those roasted and reheated by either the microwave or electric oven or those sliced and held after roasting (Table 5). Although muscle reheated in the microwave oven had greater cooking losses than that reheated in the electric oven there was no significant difference in percentage total moisture between the two treatments. Those results are in contrast to those found by other investigators. Wing and Alexander (1972), Bowers and Fryer (1972) and Bowers et al. (1974a) observed a significantly lower percentage of moisture in poultry cooked in the microwave oven. However, we wrapped the meat in oven film before reheating while other investigators reheated the meat without wrapping.

Percentage Ether Extract

Percentage ether extract was not affected significantly by treatment. Our values were within the range reported in the literature.

Vitamin B_6 Content of Muscle

When vitamin B_6 was calculated on the basis of cooked weight no significant differences were observed among treatments (Table 5). However, when vitamin B_6 was calculated on a moisture and fat free basis, freshly roasted samples contained more ($P<0.05$) vitamin B_6 than did those that were reheated or held. Those differences are probably related to the higher moisture content of the freshly roasted samples. Greater variation in vitamin B_6 content was observed among birds than among treatments.

Table 5-Mean values of moisture, ether extract and vitamin B_6 content of turkey breast muscle

Factor	Roasted	Roasted reheated electric	Roasted reheated microwave	Roasted held	Significance of F-value[a]		LSD[b] for treatment differences
					Treatments	Birds	
Moisture, %	70.40	68.02	66.63	67.14	**	ns	1.87
Ether extract, %	1.49	1.35	1.96	1.68	ns	ns	-
Vitamin B_6, µg/g of muscle, wet weight basis	4.30	3.69	3.79	3.61	ns	**	-
Vitamin B_6, µg/g of muscle, moisture and fat free basis	15.57	12.12	11.78	11.57	*	**	3.14

[a] **, significance at 1% level
*, significance at 5% level
ns, nonsignificant

[b] LSD, least significant difference at 5% level

Mean values were slightly lower than those reported by Bowers et al. (1974a) and than those found in the first part of this study. Slight differences are probably attributable to the inherent variation of a microbiological method of analysis.

Vitamin B_6 is apparently more labile than thiamin and riboflavin to refrigerator storage and reheating. Under the conditions of this study it was impossible to determine if the greater loss of vitamin B_6 found on reheating was attributable to heat or light destruction, oxidation of the vitamin or other factors. The loss is probably not due to refrigerated storage conditions as similar vitamin B_6 values were observed in muscle that was refrigerated and reheated and that that was sliced and held after roasting. Muscle that was sliced and held was subjected to an extended exposure to heat, light and oxygen that may account for the lower values.

SUMMARY

Vitamin B_6 content of muscle and drip and other selected objective measurements from raw turkey and turkey roasted from the frozen, partially frozen and thawed states were determined using a balanced incomplete block design with nine replications of each treatment. Meat cooked from the frozen and partially frozen states had longer ($P<0.01$) cooking times than meat roasted from the thawed state. Uncooked breast and thigh muscle had greater ($P<0.01$) moisture content and uncooked thigh muscle had lower ($P<0.05$) ether extract than did muscle roasted from the frozen, partially frozen or thawed states. There were no significant differences in vitamin B_6 content of breast and thigh muscle calculated on a wet weight basis. More ($P<0.05$) vitamin B_6 was found in uncooked breast muscle and muscle cooked from the partially frozen state than in muscle cooked from the thawed state when calculated on a

moisture and fat free basis. Muscle cooked from the frozen state had an intermediate amount of vitamin B_6. More ($P<0.05$) vitamin B_6 was observed in uncooked thigh muscle than in muscle subjected to the three heat treatments.

In a second experiment, vitamin B_6 content and other selected objective measurements of freshly roasted turkey breast muscle and muscle reheated in either the electric or microwave oven or held after roasting were evaluated. A randomized complete block design with eight replications of each treatment was used. Reheating time was less ($P<0.01$) and total reheating weight loss was greater ($P<0.05$) for portions reheated in the microwave oven than for portions reheated in the electric oven. Muscles reheated in the microwave oven had greater volatile ($P<0.05$) but less drip ($P<0.05$) loss than did those heated in the electric oven. Moisture content was greater ($P<0.01$) for muscles freshly roasted than for those reheated or sliced and held. When vitamin B_6 was calculated on the basis of cooked weight, no significant differences were observed among treatments. However when calculated on a moisture and fat free basis, freshly roasted samples contained more ($P<0.05$) vitamin B_6.

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APPENDIX

PROCEDURE FOR VITAMIN B_6 ANALYSIS
(Toepfer and Polansky, 1970)

Reagents

Acid-hydrolyzed casein solution. Mix 100 g vitamin-free casein with 500 ml boiling HCl (208 ml concentrated HCl diluted to 500 ml with water) and reflux 8 hr. Remove HCl by distillation in a Rotary Flash Evaporator until very thick sirup remains, keeping water bath temperature less than 80°C. Dissolve sirup in water and concentrate again in the same manner. Redissolve sirup in water. Adjust to pH 4 with 40% NaOH, add water to approximately 600 ml, add 40 g activated carbon, stir 4 hr and filter with vacuum through buchner. Filter first through porous filter paper and follow by filtration through Whatman No. 1 paper. Solution should be clear and colorless. If not clear, repeat treatment with 10 g of activated carbon. When clear, dilute to 1 L with water. Before diluting solution to volume add 3 ml 6N HCl to deter microbial growth. Store in refrigerator.

Vitamin solution I. Dissolve 10 mg thiamin and 1 g inositol in approximately 200 ml water and dilute to 1 L. Store in refrigerator.

Vitamin solution II. Dissolve 10 mg biotin in 100 ml 50% ethanol. Store in refrigerator. Dissolve 200 mg calcium pantothenate and 200 mg niacin in approximately 200 ml water. Add 8 ml biotin solution. Dilute to 1 L. Store in refrigerator.

Salt solution I. Dissolve 17 g KCl, 10.3 g $MgSO_4 \cdot 7H_2O$, 100 mg $FeCl_3 \cdot 6H_2O$ and 100 mg $MnSO_4 \cdot H_2O$ in approximately 800 ml water. Add 2 ml concentrated HCl. Dissolve 5 g $CaCl_2 \cdot 2H_2O$ in approximately 100 ml water, add to solution and dilute to 1 L with water. Store in refrigerator.

Salt solution II. Dissolve 22 g KH_2PO_4 and 40 g $(NH_4)_2HPO_4$ in water and dilute to 1 L. Store in refrigerator.

Polysorbate 80 solution. Weigh 2.5 g polysorbate 80 (Tween 80) in small beaker. Transfer with warm (45°C) water and dilute to 500 ml. Store in refrigerator.

Citric acid solution. Dissolve 50 g citric acid in 50 ml water. Store at room temperature.

Ammonium phosphate solution. Dissolve 25 g $(NH_4)_2HPO_4$ in 50 ml water. Store at room temperature.

Pyridoxine, pyridoxal and pyridoxamine standard solutions. (1) Stock solution: Dissolve 12.16 mg pyridoxine·HCl, 12.18 mg pyridoxal·HCl and 14.34 mg pyridoxamine·HCl, respectively, in 1 N HCl and dilute to 1 L with 1 N HCl. Store in refrigerator in brown bottle. (2) Intermediate solution: Dilute 10 ml stock solution to 100 ml with water. Store in refrigerator in brown bottle. (3) Working solution: Dilute 5 ml intermediate solution to 500 ml with water and mix. Dilute 10 ml to 100 ml with water. Prepare fresh for each assay.

Mixed pyridoxine, pyridoxal and pyridoxamine solutions (for liquid broth culture). Pipet 2 ml of each intermediate solution into 1 L volumetric flask and dilute to volume with water.

Citrate buffer solution. Dissolve 100 g potassium citrate and 20 g citric acid in water and dilute to 1 L. Store in refrigerator.

Basal medium stock solution (for 200 tubes). To make 1 L medium, add to approximately 400 ml water: 100 ml citrate buffer, 100 ml hydrolyzed casein solution, 50 ml vitamin solution I, 25 ml vitamin solution II, 50 ml salt solution I, and 50 ml salt solution II. Dissolve 100 g glucose in this solution. Dissolve 22 mg DL-tryptophan, 27 mg L-histidine·HCl, 100 mg

DL-methionine, 216 mg DL-isoleucine, and 256 mg DL-valine in 10 ml 10% HCl and add to above. Add 20 ml polysorbate 80 solution. Adjust to pH 4.5 with citric acid or ammonium phosphate solutions. Dilute to 1 L with water. Steam 10 min in autoclave and cool. Prepare less than 24 hr before use.

Test organism - Saccharomyces uvarum (ATCC No. 9080). Maintain by weekly transfers on wort agar slants. Incubate freshly seeded slants 24 hr at 30°C and refrigerate.

Agar culture medium. Suspend 25 g wort agar in water (approximately 400 ml) in 1 L erlenmeyer flask. Dissolve by heating with constant stirring or shaking. Watch closely to avoid boiling over or scorching of agar. Adjust volume to 500 ml. Dispense hot agar in approximately 10 ml amounts into test tubes, plug with absorbent cotton and autoclave 15 min at 121°C. Tilt tubes to form slants and cool.

Liquid culture medium. Pipet 5 ml mixed pyridoxine, pyridoxal and pyridoxamine solution in test tubes containing two glass beads, plug with absorbent cotton and autoclave 10 min at 121°C. Aseptically, add 5 ml steamed vitamin B_6-free basal medium. Store tubes in refrigerator.

Inoculum rinse. Pipet 5 ml water into test tubes, plug with absorbent cotton and autoclave 10 min at 121°C. Add 5 ml steamed vitamin B_6-free basal medium under aseptic conditions. Store tubes in refrigerator.

Assay Inoculum

Incubate cells for inoculum on agar 24 hr at 30°C. Transfer those cells to liquid broth culture tubes. Place in rotator in 30°C incubator for 20 hr. Replace cotton plugs with sterile rubber stoppers and centrifuge 1.5 min at 2500 rpm. Decant liquid and resuspend cells in 10 ml inoculum rinse. Centrifuge 1.5 min at 2500 rpm. Decant liquid and resuspend cells in second

10 ml inoculum rinse. Centrifuge 1.5 min, decant and suspend cells in third 10 ml inoculum rinse. This is the assay inoculum.

Preparation of Sample

Weigh approximately 4 grams of muscle or drip sample. Freeze dry muscle and hold frozen until analyzed. Quantitatively transfer sample to 500 ml erlenmeyer and add 200 ml 0.055 N HCl. Autoclave 5 hr at 121°C. Cool to room temperature in cool water bath and adjust to pH 4.5 with 6 N KOH. Dilute to 250 ml with water. Filter through Whatman No. 40 paper.

Assay

Prepare test tubes for assay by adding two glass beads to each tube to aid in mixing. To prepare standard curve, pipet 0.0, 0.0, 1.0, 2.0, 3.0, 4.0 and 5.0 ml freshly prepared standard pyridoxine working solution (1 ng/ml) into triplicate test tubes. Dilute filtered samples to contain approximately 1 ng vitamin B_6/ml. Dilute turkey muscle samples 1:100 and drip samples 1:20. Pipet 1.0, 2.0, 3.0, 4.0 and 5.0 ml diluted sample into triplicate tubes. Pipet water into all tubes to bring volume to 5 ml/tube. Cover tubes with aluminum foil. Autoclave entire set 10 min at 121°C. Cool tubes to room temperature. Punch holes in foil caps. Using a sterilized automatic pipet, dispense 5 ml steamed medium through hole in foil. Aseptically inoculate through hole in foil of each tube, except the first set of 0.0 level standards (uninoculated blank), with 1 drop assay inoculum of S. uvarum suspended cells. Cells settle easily so be careful to keep in suspension during inoculation. Incubate tubes on rotator in 30°C incubator for 22 hr. Steam tubes in autoclave 5 min, cool, and remove foil caps. Read percentage transmittance at 550 nm on spectrophotometer. Transfer all samples to matched spectrophotometer

tubes before reading. Set 100% T with water to read uninoculated blank. Set 100% T with uninoculated blank (mixture of three tubes) to read inoculated blank. Set 100% T with inoculated blank (mixture of three tubes) to read all other tubes.

Average readings of triplicate tubes and plot %T against ng standard pyridoxine/tube on semilog paper. Determine amount of vitamin B_6/tube by interpolation. Calculate vitamin B_6 content on a µg/g sample basis.

For best results:

1. Use only deionized, distilled water for all solutions and dilutions.
2. Work only in subdued light (vitamin B_6 is light sensitive).
3. Do not allow incubation temperature or time to vary.
4. All reagents must be vitamin B_6-free. All "Vitamin-Free Casein" is not vitamin-free. Do not use "Vitamin-Free Casein" designed for animal feeding studies as it contains more vitamin B_6 than the muscle sample.

Table 6-Assignment of treatments[a] to experimental units in Experiment I

Replication	Turkey	Turkey half	
		Left	Right
I	1	d	b
	2	c	a
II	3	d	a
	4	b	c
III	5	c	d
	6	b	a
IV	7	d	a
	8	b	c
V	9	a	c
	10	b	d
VI	11	a	b
	12	c	d
VII	13	b	d
	14	c	a
VIII	15	c	d
	16	a	b
IX	17	b	c
	18	d	a

[a] a, raw, thawed
b, cooked from frozen state
c, cooked from partially frozen state
d, cooked from thawed state

Table 7-Cooking weight losses and times for turkey roasted from the frozen (F), partially frozen (PF) and thawed (T) states

Factor	Evaluation period									Mean
	1	2	3	4	5	6	7	8	9	
Total cooking losses, %										
F	26.17	20.44	26.37	26.26	32.08	31.04	30.41	19.35	24.52	26.29
PF	20.45	28.34	25.89	29.50	24.51	23.76	26.30	37.72	29.95	27.38
T	19.31	25.28	30.05	22.91	27.90	20.10	22.35	29.09	28.79	25.09
Volatile cooking losses, %										
F	19.64	15.63	19.19	20.41	28.34	26.79	24.88	16.93	18.94	21.19
PF	17.27	22.37	17.80	22.94	22.86	20.71	19.63	28.25	23.20	21.67
T	14.30	17.98	20.16	20.25	24.47	17.91	21.13	23.42	25.97	20.62
Dripping cooking losses, %										
F	6.53	4.77	7.18	5.84	3.73	3.88	5.52	2.43	5.58	5.05
PF	3.19	5.97	8.09	6.56	1.65	3.04	6.67	9.47	6.75	5.71
T	5.01	7.30	9.89	2.66	3.43	2.19	1.22	5.67	2.82	4.47
Cooking time, min/kg										
F	76.53	57.20	62.45	58.85	76.19	72.78	60.51	62.30	61.57	65.38
PF	59.21	68.86	61.32	62.85	58.97	71.27	54.35	64.01	66.39	63.03
T	43.64	48.27	51.27	59.21	59.71	56.68	44.07	55.26	59.67	53.09

Table 8-Ether extract and total moisture for raw (R) turkey muscle and turkey roasted from the frozen (F), partially frozen (PF) and thawed (T) states

Factor	Evaluation period									Adjusted mean
	1	2	3	4	5	6	7	8	9	
Ether extract, %										
Pectoralis major										
R	2.75	1.44	0.94	0.71	0.35	0.86	0.72	1.13	1.91	1.59
F	1.73	1.39	1.88	0.87	2.58	1.41	1.67	2.41	2.69	1.74
PF	0.87	1.54	2.09	2.05	2.01	1.26	2.90	1.40	1.74	1.83
T	2.90	2.25	2.45	0.61	2.32	1.49	0.72	1.13	0.76	1.51
Thigh composite										
R	4.78	5.27	3.01	2.33	2.84	1.87	3.04	4.86	2.55	3.76
F	7.53	6.10	4.70	8.18	6.51	5.17	5.49	6.03	12.11	6.52
PF	7.69	5.83	12.79	6.48	8.22	5.58	10.70	7.61	10.02	7.91
T	8.11	6.46	7.33	4.56	6.75	5.36	5.89	6.05	5.51	6.60
Total moisture, %										
Pectoralis major										
R	73.68	74.36	73.43	75.36	75.05	74.28	73.73	73.67	73.19	74.05
F	68.75	72.04	68.75	70.34	66.80	67.69	68.50	67.67	68.06	68.65
PF	70.15	67.16	71.17	68.24	71.15	70.50	68.32	68.23	65.99	68.93
T	68.53	70.50	66.15	68.81	66.87	68.18	69.74	68.00	68.03	68.49
Thigh composite										
R	74.94	75.90	75.72	76.59	76.45	76.57	76.54	75.25	77.06	76.02
F	64.39	67.86	67.20	65.04	62.77	64.63	66.15	67.44	63.05	65.75
PF	67.10	65.86	63.44	66.82	66.53	67.02	64.00	62.41	63.44	65.26
T	67.12	68.25	64.09	68.14	64.88	67.75	65.74	64.23	65.12	65.81

Table 9-Ether extract, total moisture, volume and weight of thawing drip losses from raw (TR) turkey muscle and turkey roasted from the thawed (RT) state and of cooking drip losses from turkey roasted from the frozen (CF), partially frozen (CPF) and thawed (CT) states

Factor	Evaluation period									Mean
	1	2	3	4	5	6	7	8	9	
Ether extract, %										
TR	0.41	0.24	0.47	0.13	0.06	0.07	0.04	0.15	0.003	0.17
RT	0.11	0.05	0.11	-[a]	0.10	-[a]	0.04	0.01	0.02	0.06
CF	83.4	94.2	94.0	69.9	83.5	78.5	77.3	76.8	63.6	80.1
CPF	74.0	96.9	83.2	-[a]	33.8	59.7	52.5	65.5	53.4	64.9
CT	73.5	91.6	78.5	52.0	59.8	-[a]	86.3	77.2	49.1	71.0
Total moisture, %										
TR	94.6	94.0	95.4	96.7	95.9	95.5	91.2	94.4	92.6	94.5
RT	94.5	97.7	95.4	-[a]	97.1	-[a]	95.3	97.6	95.7	96.2
CF	10.3	4.2	1.2	12.2	10.0	3.6	9.6	7.3	15.5	8.2
CPF	15.5	1.5	7.9	-[a]	26.7	21.2	40.8	18.8	27.2	20.0
CT	17.1	5.2	8.3	25.0	25.5	-[a]	5.0	11.1	23.4	15.2
Volume, ml										
TR	14	56	10	17	31	23	28	11	40	26
RT	30	46	19	6	10	6	8	29	36	21
CF	135	83	188	159	64	73	100	33	132	107
CPF	35	100	227	145	13	46	174	250	160	128
CT	97	166	273	44	64	25	95	119	45	103
Weight, g										
TR	13	55	10	17	36	22	28	15	41	26
RT	30	45	19	5	10	6	13	28	36	21
CF	119	72	169	143	57	68	93	30	119	97
CPF	31	88	210	134	11	42	156	228	147	116
CT	87	143	241	42	59	25	87	107	43	93

[a] Insufficient sample for percentage moisture and ether extract analysis

Table 10-Vitamin B_6 content of raw (R) turkey muscle and turkey cooked from the frozen (F), partially frozen (PF) and thawed (T) states

Factor	Evaluation period									Adjusted mean
	1	2	3	4	5	6	7	8	9	
Pectoralis major										
Vitamin B_6, µg/g of muscle, wet weight basis										
R	5.82	4.58	10.01	7.46	5.08	5.93	5.06	4.58	5.68	5.96
F	5.21	9.25	11.48	8.23	5.38	4.98	3.82	4.14	4.15	6.35
PF	7.01	10.81	11.65	9.66	5.91	3.98	4.16	6.00	2.97	7.18
T	5.64	8.54	10.99	6.57	4.79	3.88	3.41	5.08	2.97	5.50
Vitamin B_6, µg/g of muscle, moisture and fat free basis										
R	24.69	18.93	39.06	31.17	20.65	23.85	19.80	18.17	22.81	24.39
F	17.65	34.81	39.09	28.59	17.57	16.12	12.81	13.84	14.19	21.37
PF	24.19	34.54	43.57	32.51	22.02	14.09	14.45	19.76	9.20	25.02
T	19.74	31.34	35.00	21.48	15.55	12.79	11.54	16.46	9.52	18.30
Thigh composite										
Vitamin B_6, µg/g of muscle, wet weight basis										
R	3.39	6.32	5.60	4.92	2.93	2.23	1.71	2.71	1.57	3.51
F	3.00	3.68	5.73	4.46	3.28	1.74	1.39	2.82	1.71	3.27
PF	2.50	3.37	5.13	5.81	3.24	1.37	2.08	3.03	1.71	2.97
T	3.07	4.16	5.61	5.25	2.33	1.70	1.92	2.48	2.02	3.14
Vitamin B_6, µg/g of muscle, moisture and fat free basis										
R	16.72	33.56	26.33	23.34	14.15	10.34	8.37	13.62	7.70	17.31
F	10.68	14.13	20.39	16.65	10.68	5.76	4.90	10.63	6.88	11.87
PF	9.92	11.90	21.58	21.76	12.83	5.00	8.22	10.11	6.44	10.97
T	12.39	16.45	19.63	19.23	8.21	6.32	6.77	8.34	6.88	11.73

Table 11-Vitamin B_6 content of drip obtained from thawing and cooking from raw (R) turkey muscle and turkey roasted from the frozen (F), partially frozen (PF) and thawed (T) states

Factor	Evaluation period 1	2	3	4	5	6	7	8	9	Mean
Raw drip										
Vitamin B_6, µg/g of drip, wet weight basis										
R	2.37	4.21	1.72	0.90	2.01	1.13	2.13	2.33	2.02	2.09
T	2.84	1.46	1.92	2.35	0.89	0.97	1.00	1.94	0.92	1.59
Vitamin B_6, µg/g of drip, moisture and fat free basis										
R	40.9	67.9	33.7	26.5	47.9	24.6	24.2	40.2	27.3	37.0
T	50.7	60.8	40.9	-[a]	29.7	-[a]	21.3	80.8	21.4	43.7
Cooked drip										
Vitamin B_6, µg/g of drip, wet weight basis										
F	1.10	0.73	1.20	3.26	0.69	2.39	1.66	4.17	2.75	1.99
PF	1.99	0.78	2.80	3.32	8.88	3.22	1.85	2.82	1.59	3.03
T	2.58	0.78	2.26	4.30	3.49	3.23	1.44	4.22	3.65	2.88
Vitamin B_6, µg/g of drip, moisture and fat free basis										
F	6.5	0.7	8.4	73.8	2.3	23.8	17.7	13.2	60.3	23.0
PF	2.1	0.9	46.7	-[a]	20.7	19.6	24.0	85.6	36.3	29.5
T	17.8	3.1	66.1	29.8	23.9	-[a]	9.4	44.3	33.4	28.5

[a] Insufficient sample for percentage moisture and ether extract analysis

Table 12-Means of vitamin B_6 content (µg/100g uncooked bird) of drip from thawing and cooking from raw (R) turkey and turkey roasted from the frozen (F), partially frozen (PF) and thawed (T) states

Factor	Evaluation period									Mean
	1	2	3	4	5	6	7	8	9	
Drip from thawing										
R	1.00	9.16	0.65	0.57	3.25	1.03	2.28	1.44	3.47	2.54
T	3.54	2.50	1.26	0.46	0.33	0.24	0.57	2.24	1.20	1.37
Drip from cooking										
F	4.73	2.00	6.81	17.15	1.50	6.03	6.31	4.40	11.85	6.75
PF	2.55	2.86	19.49	17.81	4.17	5.60	10.32	23.65	8.82	10.59
T	9.33	4.24	18.87	7.13	7.59	3.34	5.46	18.62	5.68	8.92
Drip from thawing and cooking										
R	1.00	9.16	0.65	0.57	3.25	1.03	2.28	1.44	3.47	2.54
F	4.73	2.00	6.81	17.15	1.50	6.03	6.31	4.40	11.85	6.75
PF	2.55	2.86	19.49	17.81	4.17	5.60	10.32	23.65	8.82	10.59
T	12.87	6.74	20.13	7.59	7.92	3.58	6.03	20.86	6.88	10.29

Table 13-Assignment of treatments[a] to experimental units in Experiment II

Replication	Turkey	Treatments			
		Roasted	Roasted reheated electric	Roasted reheated microwave	Roasted sliced held
I	4	a	d	c	b
II	5	b	c	a	d
III	8	d	a	b	c
IV	2	c	d	b	a
V	1	c	d	a	b
VI	6	a	b	d	c
VII	7	b	a	c	d
VIII	3	b	a	d	c

[a] a, left anterior quarter
b, left posterior quarter
c, right anterior quarter
d, right posterior quarter
(Viewed from dorsal to anterior of bird)

Table 14-Ether extract, total moisture, reheating weight losses and times for freshly roasted (FR); roasted, reheated electric (RRE); roasted, reheated microwave (RRM); and roasted, held (RH) turkey meat

Factor	Evaluation period								Mean
	1	2	3	4	5	6	7	8	
Ether extract, %									
FR	1.71	1.18	1.44	2.80	1.95	1.21	1.05	0.58	1.49
RRE	1.82	2.05	1.42	1.25	1.79	1.04	1.02	0.39	1.35
RRM	2.34	3.16	-[a]	0.98	1.33	2.07	2.89	0.58	1.96
RH	2.05	1.08	2.67	2.74	1.40	1.78	0.47	1.22	1.68
Total moisture, %									
FR	70.23	68.69	69.05	68.37	69.10	69.82	73.18	74.76	70.40
RRE	68.56	67.14	69.00	65.83	68.76	68.53	66.23	70.08	68.02
RRM	62.67	64.29	68.30	69.23	67.71	68.94	64.79	67.11	66.63
RH	66.74	67.94	65.84	66.05	68.16	66.99	67.15	68.22	67.14
Total reheating losses, %									
RRE	5.45	10.34	8.58	1.21	3.82	5.12	7.24	5.58	5.92
RRM	12.64	10.22	9.21	5.06	6.11	11.61	6.65	10.70	9.03
Volatile reheating losses, %									
RRE	1.63	1.05	0.93	0.44	0.48	0.54	0.90	0.28	0.78
RRM	9.48	7.23	4.74	2.30	3.82	8.53	3.88	8.95	5.05
Dripping reheating losses, %									
RRE	3.82	9.28	7.66	0.77	3.34	4.58	6.33	5.57	5.17
RRM	3.16	2.99	4.47	2.76	2.29	3.08	2.77	1.75	2.91
Reheating time, min/kg									
RRE	115.45	107.59	104.41	99.12	119.33	110.51	97.29	125.35	109.88
RRM	24.43	16.21	14.59	11.04	11.45	14.22	13.85	15.28	15.13

[a] Missing data

Table 15-Vitamin B_6 content of freshly roasted (FR); roasted, reheated electric (RRE); roasted, reheated microwave (RRM); and roasted, held (RH) turkey meat

Factor	Evaluation period								Mean
	1	2	3	4	5	6	7	8	
Vitamin B_6, µg/g of muscle, wet weight basis									
FR	4.18	4.25	4.49	4.87	3.29	2.57	3.07	7.71	4.30
RRE	4.86	3.12	4.49	3.76	2.20	1.93	3.64	5.48	3.69
RRM	5.42	3.64	4.05	4.04	1.56	2.57	4.40	4.60	3.79
RH	4.11	3.06	3.43	4.65	2.67	1.78	4.52	4.68	3.61
Vitamin B_6, µg/g of muscle, moisture and fat free basis									
FR	14.90	14.11	15.22	16.89	11.36	8.87	11.91	31.27	15.57
RRE	16.41	10.13	15.18	11.42	7.47	6.34	11.11	18.56	12.12
RRM	15.49	11.18	-[a]	13.56	5.04	8.87	13.61	14.24	11.78
RH	13.17	9.88	10.04	14.90	8.77	5.70	13.96	15.31	11.47

[a] Missing data

EFFECTS OF SELECTED THAWING, HEATING AND HOLDING CONDITIONS ON VITAMIN B_6 CONTENT OF TURKEY MUSCLE

by

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B. S., Kansas State University, 1970

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Vitamin B_6 content of muscle and drip and other selected objective measurements from raw turkey and turkey roasted from the frozen, partially frozen and thawed states were determined using a balanced incomplete block design with nine replications of each treatment. Meat cooked from the frozen and partially frozen states had longer ($P<0.01$) cooking times than meat roasted from the thawed state. Uncooked breast and thigh muscle had greater ($P<0.01$) moisture content and uncooked thigh muscle had lower ($P<0.05$) ether extract than did muscle roasted from the frozen, partially frozen or thawed states. There were no significant differences in vitamin B_6 content of breast and thigh muscle calculated on a wet weight basis. More ($P<0.05$) vitamin B_6 was found in uncooked breast muscle and muscle cooked from the partially frozen state than in muscle cooked from the thawed state when calculated on a moisture and fat free basis. Muscle cooked from the frozen state had an intermediate amount of vitamin B_6. More ($P<0.05$) vitamin B_6 was observed in uncooked thigh muscle than in muscle subjected to the three heat treatments.

In a second experiment, vitamin B_6 content and other selected objective measurements of freshly roasted turkey breast muscle and muscle reheated in either the electric or microwave oven or held after roasting were evaluated. A randomized complete block design with eight replications of each treatment was used. Reheating time was less ($P<0.01$) and total reheating weight loss was greater ($P<0.05$) for portions reheated in the microwave oven than for portions reheated in the electric oven. Muscles reheated in the microwave oven had greater volatile ($P<0.05$) but less drip ($P<0.05$) loss than did those heated in the electric oven. Moisture content was greater ($P<0.01$) for muscles freshly roasted than for those reheated or sliced and held. When vitamin B_6 was calculated on the basis of cooked weight, no significant

differences were observed among treatments. However when calculated on a moisture and fat free basis, freshly roasted samples contained more ($P<0.05$) vitamin B_6.