SELECTED SENSORY, PHYSICAL, AND CHEMICAL CHARACTERISTICS OF PHOSPHATE-TREATED, WATER-TREATED, AND UNTREATED FRESHLY COOKED AND REHEATED TURKEY BREAST MUSCLE

by

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B. S., University of Kentucky, 1971

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Foods and Nutrition

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1972

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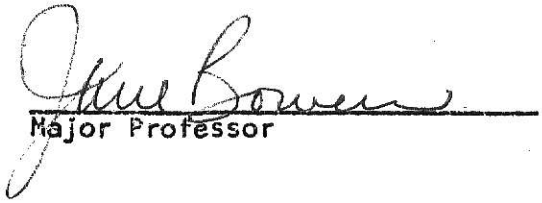

Major Professor

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INTRODUCTION

The use of cooked frozen turkey products is increasing as indicated by their availability commercially. Cathcart (1971) reported that more than one-third of the turkey processed in federally inspected plants in 1969 was cut-up or processed into convenience foods. In the ten-year period ending in 1966, turkey used in convenience foods increased 400% (Dawson, 1969). Even though the use of turkey in convenience foods has increased, turkey accounts for only one-fifth of the poultry meat consumed (Cathcart, 1971).

As the use of convenient turkey products increases there is a need to further investigate factors affecting the quality of those products. Maintenance of characteristic turkey flavor is a major consideration of product quality. The flavor of poultry is optimal immediately after cooking and deteriorates rapidly on storage (Cipra and Bowers, 1970; Harris and Lindsay, 1972). Flavor changes have been related to oxidation of tissue lipids and also may be associated with changes in water activity resulting from precooking and reheating. Polyphosphate salts have been used to retard flavor changes and are also useful as water binders to increase juiciness (Sato and Hegarty, 1971; Tims and Watts, 1958; and May et al., 1963).

The purpose of this study was to define the effect of added phosphate salts and water on the flavor and juiciness characteristics of freshly cooked and precooked, reheated turkey breast muscle. The effect of treatment on various determinations of moisture was measured and the relationship between those measurements and sensory impressions of juiciness was determined.

REVIEW OF LITERATURE

Flavor of Meat

Bouthilet (1951) determined that chicken broth could be fractionated into two flavor fractions. One, a sulfur-containing fraction was described as "meaty"; while the second possessed a characteristic "chickeny" flavor. Bouthilet further reported that the precursor of the "meaty" flavor appeared to be similar to glutathione. Work by Mecchi et al. (1964) indicated that both cystine and cysteine in the glutathione and protein fraction of muscle were precursors of the hydrogen sulfide released on heating. Hydrogen sulfide has been related to "meaty" flavor. Minor et al. (1965) removed sulfur compounds from cooked chicken volatiles and found an almost complete loss of "meaty" aroma.

The intensity of the "chickeny" fraction has been related to the carbonyl compounds formed during cooking. Carbonyls contribute to taste, aroma, and body and thus are important to over-all chicken flavor (Kazeniac, 1961). Removal of carbonyls from chicken volatiles resulted in loss of "chickeny" aroma (Minor et al., 1965).

Source of flavor. Several workers have investigated meat flavor but the source of that flavor has not been established. Crocker (1948), working with beef found that cooking developed a meaty flavor. He attributed flavor development to chemical changes in the fiber rather than in the juices. The meat flavor appeared to be caused by volatile substances detected as aroma, even though chewing was necessary to release the flavor. Peterson (1957) evaluated skin, whole blood, plasma, blood cells, fat, breast muscle, and leg muscle to

determine the source of chicken flavor. The muscle fractions produced a typical chicken aroma and flavor. Of the other fractions, only skin produced even a weak chicken aroma or flavor. Pippen et al. (1954) also observed slight chicken flavor in fat.

Kramlich and Pearson (1958) compared flavor development in raw beef fibers heated in water or in expressed meat juices. Those authors reported development of meaty flavor when raw juices were heated. They concluded that at least a part of the cooked meat flavor must be attributable to the juices of beef. Little information is available concerning the flavor- or aroma-producing capacity of turkey or chicken press fluids.

Juiciness and flavor perception. Although the water component of meat would seem to influence its flavor, juiciness, and tenderness, efforts to associate subjective impressions of meat quality with moisture content have not been entirely successful (Ritchey and Hostetler, 1964). Cipra and Bowers (1970) reported a positive correlation ($P < 0.05$) between juiciness and the degree of meaty-brothy flavor perceived in dark turkey meat. Limited data is available concerning juiciness and flavor perception. One method of controlling juiciness in poultry meats is the addition of phosphate salts.

Phosphate salts are useful as water-binders for poultry meat. Increasing the pH of meat through the addition of phosphate salts results in increased water-holding capacity of meat (Morse, 1955). Schlamb (1970) described poultry treated with phosphates as being more moist and succulent than untreated products. He defined succulence as a tender and juicy mouth feel.

May et al. (1963) chilled cut-up chicken in ice slush containing 0, 4, 8, or 10 ounces of phosphate salt per gallon. Phosphate treatment increased the mean rating for juiciness of both light and dark meat in direct proportion

to the phosphate level. Juiciness scores for light meat were significantly ($P < 0.01$) higher for the highest level of phosphate as compared to the lower levels. A study by Spencer and Smith (1962) provided similar results. Panelists scored phosphate-treated chicken more tender and juicy than control samples. Smith (1971) reported that the addition of polyphosphate salts to turkey roulades resulted in increased juiciness and flavor desirability.

Amino acids and flavor. Flavor of meat may be related to changes in amino acids during heating. Hornstein and Crowe (1960) related flavor development to the Maillard reaction between amino acids and reducing sugars. Pippen et al. (1954) reported similar findings in studies on chicken flavor. It has been observed that an increase in meaty flavor is accompanied by a decrease in total free amino acids (Hornstein, 1967). Those changes may be related to the Maillard reaction (Bender et al., 1958).

Kazeniac (1961) reported the isolation of several amino acids in chicken broth. Addition of certain of those, including arginine, lysine, α-alanine, glutamic and aspartic acids resulted in improved broth flavor. In a study with pork, Usborne et al. (1968) found relationships between flavor and various amino acids. Free glutamic acid, tyrosine, and aspartic acid were related ($P < 0.05$) negatively with cooked pork flavor, while serine and glycine were correlated positively ($P < 0.05$) with flavor. The specific effect of each amino acid on flavor components of pork was not determined.

Storage of Meat

Flavor changes. The flavor of precooked meat deteriorates rapidly during storage and reheating. Reheated meat has been described as "warmed-over," "stale," and "rancid" (Tims and Watts, 1958; Cipra and Bowers, 1971).

Precooked meat undergoes flavor deterioration with both refrigerated

and frozen storage. It appears that little time is required for the development of off-flavors. Harris and Lindsay (1972) found that panelists were able to detect significant ($P < 0.05$) differences between freshly fried chicken and chicken that had been reheated after only 2 hr refrigerated storage. Chang et al (1961) found that freshly cooked beef received significantly ($P < 0.01$) higher flavor scores than beef sliced 1, 2-1/2, or 4 hr before evaluation and reheated. Cipra and Bowers (1970) reported that freshly cooked turkey had more intense meaty-brothy flavor and aroma than meat reheated after 24 hr refrigerated storage. Those authors noted an unpleasant aftertaste in reheated turkey that may be related to the greater intensity of bitter and acid flavor components noted by the panel.

Frozen storage holds the rate of lipid oxidation below that of refrigerated meat but still above threshold levels (Watts, 1961). The development of rancidity in precooked sliced beef stored at 1° C or at -26° C was evaluated by 2-thiobarbituric acid (TBA) and odor tests (Chang et al., 1961). After one day at 1° C the beef had a TBA value of 11.5. After 11 days storage at the same temperature, the meat had a TBA value of 21.2 as compared to a value of 3.5 for beef stored 11 days at -26° C. Although both samples were unacceptable on the basis of TBA and odor evaluations, freezer temperatures did retard the development of oxidative changes.

Oxidation of tissue lipids has been established as one source of flavor change in reheated meat. Phospholipids constitute a major portion of tissue lipids and are involved in oxidation leading to the development of warmed-over flavor. Acosta et al. (1966) reported that 33 percent of the total lipid in turkey light meat and 40 percent in dark meat is phospholipid. Younathan and Watts (1960) suggested that the autoxidation of tissue lipids is heme

catalyzed. Although this theory generally is accepted, the mechanism by which warmed-over flavor develops is not understood.

Using ground beef, Sato and Hegarty (1971) studied the mechanism of off-flavor development. They found that heme compounds had little effect on the development of warmed-over flavor as indicated by TBA values and odor evaluations. The reaction apparently was catalyzed by non-heme iron and ascorbate in the system studied. The small amount of ascorbic acid naturally present in meat seems to function to keep part of the iron in the ferrous state. At higher levels ascorbic acid is known to be an antioxidant. The authors suggested that ascorbic acid may act as an antioxidant by upsetting the balance between ferrous and ferric iron or by serving as an oxygen scavenger. Liu and Watts (1970) found evidence that both heme and non-heme iron were functioning as catalysts of lipid oxidation in meat. After metmyoglobin was removed from cooked meat a significant amount of lipid oxidation was noted.

The 2-thiobarbituric acid (TBA) test is an objective measure of lipid oxidation (Tarladgis et al., 1960). TBA values (mg malonaldehyde per 1000 g meat) have been related to sensory evaluation of meat quality. Watts (1962) reported a TBA value of 1 as the point at which off-flavors become detectable. Mahon (1962) stated that a TBA value of less than 1 indicates cooked poultry with fresh odor and flavor while a value greater than 2 indicates an unacceptable product.

Effect of water activity on stability. Quinn (1967) discussed the forms of water found in various systems. Water can exist as a part of the material itself as chemically bound water, or in the form of a mixture as adsorbed liquid water. Between those two conditions exists absorbed water that

generally is held by molecular attraction. The absorbed water is available for chemical activity and regulates the moisture stability of the system.

Absorbed water exerts a vapor pressure dependent upon the freedom or activity of the water molecules. The effect of free water can be expressed as vapor pressure or a related term such as relative humidity (Quinn, 1967). Labuza (1971) divided the relative humidity reading by 100 and expressed that quantity as water activity.

Labuza (1971) suggested that oxidative changes may be associated with changes in water activity of meat during pre-cooking and storage. Studies with model systems have indicated that there is an optimum moisture level for each food system. Labuza et al. (1970) have shown that lipid oxidation is most rapid at a water activity below the optimum for the system. As the water activity was increased to the optimum, the rate of lipid oxidation decreased. Above the optimum level, oxidation increased. Chang and Watts (1950) reported that as moisture was removed from a sodium chloride solution, the mixture first inhibited then hastened oxidation of fat as determined by peroxide values. Using methyl linoleate in a freeze-dried model system, Maloney et al. (1966) found that as the system was rehydrated up to about 50% relative humidity, the rate of oxidation was decreased.

Loss of moisture during cooking may partially explain why cooked meats deteriorate more rapidly during storage than raw meats. By controlling moisture loss during cooking it may be possible to retard off-flavor development during storage.

Effect of phosphate salts on flavor stability. Phosphate salts have been used to maintain freshly cooked flavor in pre-cooked poultry (Schlamb, 1970). Phosphate salts are thought to act as chelating agents for free radi-

cals that initiate lipid oxidation.

Chang et al. (1961) used sodium tripolyphosphate salt as an antioxidant dip for cooked sliced beef stored at 1° C or at -26° C. Phosphate-treated samples maintained TBA values below the threshold (TBA value of 1) for the duration of the storage (18 days refrigerated storage or 154 days frozen storage). Untreated samples had TBA values greater than threshold after one day at 1° C or 11 days at -26° C. Tims and Watts (1958) found various phosphate salts to have similar antioxidant effects on cooked pork, beef, chicken, lamb, and veal. All meats treated with pyro-, tripoly-, and hexametaphosphates had TBA values in the acceptable range after 7 days refrigerated storage. *Orthophosphate was not* an effective antioxidant.

Mahon (1962) reported that panelists consistently preferred phosphate-treated reheated chicken over control samples on the basis of aroma and flavor comparisons. Smith (1971) prepared turkey roulades from ground meat and skin wrapped in breast fillets. Reheated samples containing polyphosphate salt received significantly ($P < 0.01$) lower off-flavor and higher flavor desirability scores than reheated samples containing no phosphate.

EXPERIMENTAL PROCEDURE

Breast portions from 30 U. S. Grade A tom turkeys (24-26 lb) from one lot were obtained from a local wholesale plant. Breasts were thawed at 6° C for 24 hr. The pectoralis major (PM) muscles were excised retaining the skin.

Treatments

Six treatments were used to study the effect of added phosphate and water on the eating quality, physical, and chemical characteristics of freshly cooked and reheated turkey. Treatments-- (a) phosphate-treated, freshly

cooked; (b) water-treated, freshly cooked; (c) untreated, freshly cooked; (d) phosphate-treated, reheated; (e) water-treated, reheated; and (f) untreated, reheated --were assigned to experimental units (Table 5, Appendix). An incomplete block design was followed with 10 replications of each treatment. One turkey represented a block and each treatment was compared with each other treatment 2 times (Cochran and Cox, 1957).

Phosphate-treated muscles were injected with a 5% solution of KENA, a mixture of sodium polyphosphate salts (Calgon Corp.) at a level of 10% by weight (Fig. 1, Appendix). Water-treated muscles were injected with deionized water following the same procedure. The injected muscles were drained for 10 min and stored in plastic bags 2 hr at 6° C before freezing or precooking.

For precooking, PM muscles with skin were roasted in Pyrex dishes to an internal temperature of 71° C in a rotary hearth gas oven maintained at 350° F. Muscles were cooled 30 min at room temperature. Cooked and raw treatments were frozen in polyethylene bags in a household freezer at -13° C and held frozen for 5 weeks.

Evaluations and Measurements

Prior to each evaluation period muscles were thawed 24 hr at 6° C. Partially cooked muscles were reheated in oven-proof film (3M, Skotchpak) to an internal temperature of 55° C in a rotary hearth gas oven maintained at 350° F. Muscles for freshly cooked treatments were roasted in Pyrex dishes to an internal temperature of 80° C in a rotary hearth gas oven at 350° F. At each evaluation period, eating quality was evaluated and selected physical and chemical measurements were made (Fig. 2, Appendix).

Sensory evaluation. Center 1/4-inch slices from each PM muscle were assigned randomly (Table 6, Appendix) to enamel double boilers (coded 1 to 6)

and kept warm on an electric warming tray on "high" setting. A laboratory panel of 7 graduate students and faculty members evaluated samples in an organoleptic laboratory at individual booths. A set of samples was presented to each panel member in a series of warmed, covered glass snifters for aroma evaluation. Samples, placed on coded plates, were evaluated for flavor components, juiciness, and tenderness (Form 1, Appendix).

Following a rest period, three panel members evaluated aroma components of press fluids from each treatment (Form 2, Appendix). Samples maintained at 60° C in a water bath were presented to panelists in a room free from extraneous odors. Press fluid samples were presented in the same order as muscle samples.

Physical measurements. Total cooking losses were determined from weights of PM muscles taken before and after injection of treatment solution, after roasting, or after roasting and reheating. Cooking losses were calculated on the basis of both initial and drained weights. Initial weight was the weight of the sample before treatment solution was injected, and drained weight was the weight 2 hr after treatment solution was injected.

End portions of each muscle were ground in a Kenmore Electric Food Grinder (1/8-inch plates) and used for physical measurements.

Press fluids were obtained using the Carver Laboratory Press for 5 min at 15,000 lb pressure. The volume of fluid collected from a 75 g sample of ground muscle was recorded.

A container-type hygrometer was used to record the percentage relative humidity (RH) of a 10 g sample of ground tissue from each treatment. The hygrometer was kept in a desiccator over $CaCl_2$. Samples were placed in the hygrometer when the reading for the surrounding atmosphere in the desiccator

was below 10% RH. Samples were allowed to equilibrate 50 min, then the RH reading for that sample was recorded. The humidity reading of the atmosphere was subtracted from the reading for the sample and that quantity divided by 100 was recorded as the water activity (A_w) of the sample (Labuza, 1971).

The Brabender Semiautomatic Moisture Tester was used to determine percentage moisture of duplicate samples (10 g) from each treatment. Samples were dried at 121° C for 60 min.

Chemical measurements. The 2-thiobarbituric acid (TBA) test was used to determine oxidative rancidity according to the method of Tarladgis et al. (1960). Slurries were prepared from 6 g samples of ground tissue and optical density readings were determined with the Beckman DU Spectrophotometer at 538 mμ. Readings were multiplied by the factor 7.8 and divided by sample size to determine TBA value.

The method of Tallon et al. (1954) was followed to deproteinize samples (2 g) of ground tissue with picric acid. Ninhydrin reactive compounds were determined by the method of Yemm and Cocking (1955). Filtered samples (1 ml) of press fluids from each treatment were diluted to 100 ml and ninhydrin reactive compounds were determined by the same procedure. Optical density readings were determined with the Beckman Spectronic 20 at 570 mμ. Glycine standard curves prepared with each replication were used to calculate μm ninhydrin reactive compounds per g of meat.

The Beckman Expanded Scale pH Meter (Model 310) was used to determine pH of ground tissue and press fluids. Duplicate slurries were prepared from 10 g of tissue and 25 ml deionized water blended 30 sec at high speed in a Waring Blender. Duplicate 5 ml samples of press fluids also were used for pH measurement.

Analysis of Data

An incomplete block design (Cochran and Cox, 1957) was used to assign treatments to experimental units (PM muscles). There were 30 blocks (turkeys) and 10 replications of each of 6 treatments--each treatment occurring with each other treatment twice. Analysis of variance was run on data for each measurement according to the following:

Source of variation	df
Replication	9
Treatment	5
Block within replication	20
Intra-block error	25
Total	59

Adjusted treatment means were calculated and least significant differences (LSD) were determined when F-values were significant.

Simple linear correlation coefficients were calculated for data pooled after differences due to differences in adjusted treatment means were removed.

RESULTS AND DISCUSSION

Quality of freshly cooked and reheated, phosphate-treated, water-treated, and untreated turkey was evaluated by a sensory panel and by selected physical and chemical measurements. Effects of those treatments on quality of the meat are discussed. Correlation coefficients were calculated and relationships between selected factors are reported. Data for measurements for all replications are presented in Tables 8-24, Appendix.

Sensory Evaluation

Aroma. All aroma components were affected significantly ($P < 0.05$ or

< 0.01) by treatment. For both freshly cooked and reheated muscle, the addition of phosphate salts resulted in more intense meaty-brothy and less intense stale and rancid aromas. In freshly cooked turkey, the water-injected sample had higher intensity scores for stale, rancid, and acid aromas than other treatments. Other aroma components were affected significantly by additive treatment, but the differences were small and effects were inconsistent and probably not practically important (Table 1).

The intensity of meaty-brothy, stale, and rancid aromas was similar for freshly cooked and reheated phosphate-treated samples. Storage and/or reheating of water-treated and untreated samples resulted in less intense meaty-brothy and more intense stale and rancid aromas. Those results indicate that phosphate salts were effective in maintaining meaty-brothy aroma and retarding development of stale and rancid aromas as reported by other authors (Schlamb, 1970; Chang et al., 1961; and Tims and Watts, 1958). Within each heating treatment, sulfur aroma was more intense in the water-treated than in the other samples. For the water-treated sample, the sulfur component increased with reheating. Heating treatment appeared to have inconsistent effects on acid, and ammonia components of aroma (Table 1).

Flavor. All flavor components except sweet and bitter were affected significantly ($P < 0.05$ or < 0.01) by treatment. For both freshly cooked and reheated treatments, the addition of phosphate produced a more intense meaty-brothy flavor. For both heating treatments, the water-treated and untreated samples had similar intensities of meaty-brothy flavor. Stale, rancid, and acid flavors were less intense and, as would be expected, salty flavor more intense in phosphate-treated samples than in water- or untreated samples. Freshly cooked, water-treated turkey had more intense sulfur and less intense

TABLE 1.--Adjusted mean sensory scores[1] for turkey muscle and press fluids

Components Factor	Freshly cooked treatments			Reheated treatments			Significance of F-values[2]	LSD
	Phosphate	Water	Untreated	Phosphate	Water	Untreated		
Aroma components of muscle:								
Meaty-brothy	2.9	2.3	2.5	2.9	2.1	2.2	**	0.14
Stale	0.6	1.0	0.8	0.6	1.2	1.3	**	0.15
Rancid	0.2	0.5	0.3	0.6	0.8	0.7	**	0.15
Acid	0.1	0.3	0.1	0.3	0.2	0.3	*	0.13
Sulfur	0.1	0.2	0.1	0.1	0.3	0.2	*	0.06
Ammonia	0.2	0.1	0.1	0.1	0.2	0.2	*	0.06
Flavor components of muscle:								
Meaty-brothy	2.9	2.7	2.5	2.7	2.3	2.5	*	0.21
Stale	0.2	0.5	0.5	0.6	1.1	1.2	**	0.12
Rancid	0.2	0.2	0.2	0.2	0.4	0.5	**	0.09
Acid	0.1	0.2	0.2	0.2	0.4	0.4	**	0.08
Sulfur	0.0	0.3	0.1	0.3	0.2	0.3	**	0.07
Sweet	0.1	0.1	0.1	0.1	0.1	0.1	ns	
Salty	0.4	0.0	0.1	0.2	0.1	0.0	**	0.07
Bitter	0.1	0.1	0.1	0.2	0.1	0.1	ns	
Aroma components of press fluids:								
Meaty-brothy	2.5	2.0	2.1	3.1	2.1	2.2	**	0.23
Stale	0.7	1.0	1.1	0.5	1.4	1.2	**	0.23
Rancid	0.1	0.3	0.4	0.1	0.2	0.4	ns	
Acid	0.2	0.2	0.1	0.3	0.3	0.2	ns	
Sulfur	0.3	0.2	0.1	0.4	0.2	0.1	ns	
Ammonia	0.4	0.5	0.5	0.2	0.4	0.6	ns	
Tenderness	5.2	4.7	4.4	5.0	4.4	4.7	ns	
Juiciness	4.6	3.7	3.6	4.0	3.6	3.5	**	0.33

[1] Intensity scores: 0, absent to 4, strong. Tenderness and Juiciness: 6, very juicy or tender to 1, very dry or tough

[2] **, significant at 1% level; *, significant at 5% level; ns, nonsignificant

salty flavor than the other freshly cooked treatments. For reheated turkey, the water-treated sample had the least intense sulfur flavor while the untreated sample had the least intense salty flavor.

Panelists often described flavor of the phosphate-treated samples as "soapy." Although "soapy" was not listed among the flavor components on the score sheet, panelists were asked to comment on any additional flavors they noted. Phosphate-treated, freshly cooked samples were described as "soapy" more frequently (18 of 140 responses) than phosphate-treated, reheated muscle (11 of 140). Although the recommended level of phosphate was used, it appears that the "soapy" flavor is attributable to the phosphate salts.

Intensity of meaty-brothy flavor was similar for the two phosphate-treated samples, indicating that heating treatment had little effect on those samples. The other reheated samples had less intense meaty-brothy flavor than the freshly cooked treatments. Reheating increased the intensity of stale and rancid flavors in water-treated and untreated samples; however, intensity of those flavor components in phosphate-treated, reheated turkey was similar to freshly cooked treatments.

Aroma of press fluids. Meaty-brothy and stale aromas were affected significantly ($P < 0.01$) by treatment. Phosphate-treated samples had higher scores for meaty-brothy and lower scores for stale aromas than water-treated or untreated samples. Ammonia, acid, sulfur, and rancid aromas were not affected significantly by treatment.

Press fluids from phosphate-treated, reheated muscle had more intense meaty-brothy aroma but similar intensity of stale aroma when compared with the phosphate-treated, freshly cooked muscle. The other additive treatments had similar intensity of meaty-brothy aroma for both heating treatments.

Water-treated and untreated samples developed more intense stale aromas as a result of storage and/or reheating.

More differences due to additive treatment were apparent in aroma of cooked muscles than in aroma of their press fluids; however, the intensity of most aroma components was similar for muscle and press fluids. Ammonia aroma was more intense in press fluids than in muscle. The source of meat flavor has not been fully established. Kramlich and Pearson (1958) reported the development of flavor when juice from raw beef was heated. It appears that aroma components also are present in the juices pressed from cooked meat.

In general, flavor and aroma components were affected similarly by treatment. Phosphate-treated samples had more intense meaty-brothy flavor and aroma than other treatments. Water-treated and untreated samples developed stale and rancid flavors and aromas and the meaty-brothy component became less intense as a result of storage and/or reheating. Other workers have reported similar development of off-flavors and aromas in precooked, stored meats (Tims and Watts, 1958; Cipra and Bowers, 1970; and Chang et al., 1961).

Heating treatment appeared to have less effect on phosphate-treated samples than on other treatments. Those results agree with the work of others who have found that the addition of phosphate salts reduced off-flavor development and maintained freshly cooked flavor in poultry meat (Tims and Watts, 1958; Mahon, 1962; Schlamb, 1969; and Smith, 1971).

A significant negative correlation ($P < 0.01$) was noted among meaty-brothy and stale and rancid aromas (Table 2). Stale and acid flavor and aroma components increased with increasing intensity of rancid aroma ($P < 0.05$)

TABLE 2.--Correlation coefficients among selected aroma and flavor components of turkey breast muscle

Component	Flavor components					Aroma components			
	Meaty-brothy	Stale	Rancid	Acid	Sulfur	Meaty-brothy	Stale	Rancid	Acid
Meaty-brothy	1.00**	-0.08	-0.15	-0.04	-0.01	1.00**	-0.50**	-0.57**	-0.10
Stale	-0.08	1.00**	0.38**	0.28	0.47**	-0.50**	1.00**	0.30*	0.16
Rancid	-0.15	0.38**	1.00**	0.34*	0.31*	-0.57**	0.30*	1.00**	0.33*
Acid	-0.04	0.15	0.34*	1.00**	-0.02	-0.10	0.16	0.33*	1.00**
Sulfur	-0.01	0.47**	0.31*	-0.02	1.00**				

**, significance at 1% level

*, significance at 5% level

and flavor ($P < 0.01$). Other investigators have indicated that loss of freshly cooked aroma in stored poultry is accompanied by increased staleness and rancidity (Cipra and Bowers, 1970). Sulfur flavor was positively correlated to stale ($P < 0.01$) and rancid ($P < 0.05$) flavor components, indicating that the sulfur note may be related to the development of off-flavor. Cipra and Bowers (1970) reported a similar correlation between rancid aroma and sulfur flavor ($P < 0.05$) and stale flavor and sulfur flavor and aroma ($P < 0.01$) for combined treatments for freshly braised and braised-reheated turkey. Sulfur-containing components have been identified in cooked chicken volatiles (Bouthilet, 1951; Minor et al., 1965; and Mecchi et al., 1964). However, the sulfur component was not related to the development of off-flavors by those authors.

The only significant ($P < 0.05$) correlation among aroma components of press fluids was a negative correlation between intensity of ammonia and sulfur aromas (Table 24, Appendix). Glutathione is thought to be the precursor of the volatile H_2S produced by heating poultry meat. Bouthilet (1951) stated that the sulfur component is a positive factor in the development of poultry flavor during cooking and that as meat is oxidized, a decrease in the sulfur component is accompanied by an increase in ammonia volatiles.

Juiciness and tenderness. Within each heating treatment, the phosphate-treated sample was significantly ($P < 0.01$) more juicy than the other treatments. Other workers have reported increased juiciness with the addition of phosphate salts (May et al., 1963; Spencer and Smith, 1962; and Schlamb, 1970). The water-treated and untreated samples received similar scores for juiciness. The water-treated samples might be expected to be more juicy; however, an average of only 34% of the water injected was retained by the

muscle 2 hr after injection (Table 7, Appendix).

Freshly-cooked, phosphate-treated turkey was significantly more ($P < 0.01$) juicy than the reheated treatments. However, frozen storage and/or reheating did not appear to affect the juiciness scores for water-treated or untreated samples. Reheated samples might be expected to be less juicy since they were heated for a longer time.

Tenderness was not affected significantly by treatment; however, panelists tended to score phosphate-treated samples as being more tender. May et al. (1963) reported increased tenderness of meat with added phosphate salts; however, Smith (1971) found that the addition of phosphate salts to turkey roulades did not affect tenderness.

A positive correlation ($P < 0.01$) was noted between juiciness and the intensity of meaty-brothy flavor perceived by panelists (Table 2). Cipra and Bowers (1970) found a similar relationship between juiciness and meaty-brothy flavor in dark turkey muscle. There was a positive correlation ($P < 0.01$) between juiciness and tenderness as might be expected from work by other authors (Cover et al., 1962; Gaddis et al., 1950; and Ritchey, 1965).

Physical Measurements

Percentage cooking loss. Calculation of cooking losses on the basis of both initial and drained weights indicated significant ($P < 0.01$) differences attributable to treatment (Table 3). Initial weight represented the weight of the PM muscle before treatment solution was injected. On the basis of initial weight, phosphate-treated samples in each heating treatment had less cooking loss than the other treatments. Schermerhorn and Stadelman (1964) reported that, in general, cooking losses were lower for phosphate-treated hens than for untreated hens. Using various phosphate salts to control loss, Tims and

TABLE 3.--Adjusted means of objective measurements for turkey muscle and press fluids

Factor	Freshly cooked treatments			Reheated treatments			Significance of F-value[1]	LSD
	Phosphate	Water	Untreated	Phosphate	Water	Untreated		
Cooking loss--initial wt. (%)	16.6	26.8	19.7	27.3	31.8	30.5	**	1.74
Cooking loss--drained wt. (%)	20.7	27.6	18.8	31.2	34.5	29.8	**	1.74
Total moisture (%)	68.9	65.9	66.3	65.7	63.9	64.3	**	0.47
Press fluids (%)	18.6	18.1	18.6	15.7	16.0	15.6	**	0.71
Water activity (A_w)	0.90	0.84	0.84	0.85	0.83	0.85	ns	
pH of muscle	6.5	6.3	6.2	6.4	6.2	6.2	**	0.03
pH of press fluids	6.6	6.5	6.5	6.6	6.6	6.6	ns	
TBA value	0.31	0.73	0.76	0.14	0.86	0.94	**	0.05
Ninhydrin reactive compounds--muscle (µm/g)	23.8	22.5	24.3	23.4	22.7	21.5	ns	
Ninhydrin reactive compounds--press fluids (µm/ml)	40.6	36.9	37.1	35.2	31.7	36.4	ns	

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

Watts (1958), found that for several ground meats, the addition of phosphate salts decreased cooking losses.

Water-treated freshly cooked turkey had the greatest cooking loss in that heating treatment. Cooking losses were similar for water- and untreated, reheated samples. As would be expected, the freshly cooked treatments as a group had lower percentage cooking loss than the reheated treatments.

Total moisture. Percentage total moisture in both freshly cooked and reheated turkey was greatest in the phosphate-treated sample (Table 3). By increasing pH, phosphates improve the water-binding capacity of meat, resulting in less cook-out of juice (Morse, 1955). The pH of phosphate-treated muscle was significantly ($P < 0.01$) higher than that of water-treated or untreated muscle. Water-treated and untreated samples had similar moisture content. The addition of phosphate salts to muscle to be reheated appeared to off-set moisture loss attributable to reheating. The water-treated and untreated, reheated samples had significantly ($P < 0.01$) less total moisture than the other four treatments.

Press fluids. An additional measurement of the moisture content of muscle was determined as the ml of press fluid expressed from 75 g muscle at a maximum pressure of 15,000 lb for 5 min (Table 3). Freshly cooked treatments had significantly ($P < 0.01$) greater volume of press fluids than reheated treatments; however, additive treatment appeared to have little effect on the volume of press fluid.

Water activity. Equilibrium relative humidity (ERH) of ground muscle was determined with a container-type hair hygrometer. ERH divided by 100 may be expressed as water activity (Labuza, 1971). Differences due to additive treatment were not significant; however, this may be related to the sensiti-

vity of the hygrometer used. Readings obtained for both freshly cooked and reheated samples usually exceeded 90% RH before the relative humidity of the atmosphere in the desiccator was subtracted. The hygrometer may have been less sensitive in that extreme range as suggested by Rockland (1964).

Water activity was measured and correlated to aroma and flavor components to investigate the relationship between water activity and oxidative changes suggested by Labuza (1971). Water activity was not related significantly to TBA value, the objective measurement of oxidative changes. Water activity was correlated negatively with meaty-brothy and sweet flavors and positively correlated with bitter flavor ($P < 0.05$). From those results it appears that increasing water activity was related to a decrease in positive flavor factors. This may indicate that samples were not stored at their optimal water activity (Labuza, 1971).

Relation of juiciness evaluation to moisture measurements. Relationships between subjective impressions of juiciness and objective measurements of moisture were noted (Table 4). Total moisture was correlated positively ($P < 0.05$) to panel scores for juiciness; however, panel scores for juiciness also were correlated with percentage cooking loss. Miller and Harrison (1965) reported a similar correlation for total moisture and panel impressions of juiciness. Ritchey and Hostetler (1965) defined juiciness as the impression of moisture running out of the meat as pressure is applied by the teeth. According to that definition, it is the free water that contributes to the subjective impression of juiciness. Press fluids, a measurement of free water and panel scores for juiciness were not correlated (Table 4). Gaddis et al. (1950) reported that there was no relationship between percentage of press fluids and scores for quantity of juice, and that juiciness was more

TABLE 4.--Correlation coefficients of physical and chemical measurements to selected flavor components, juiciness, and tenderness.

Measurement vs.	Meaty-brothy	Stale	Rancid	Sweet	Bitter	Juiciness	Tenderness
Cooking loss:							
initial weight	0.51**	0.16	0.13	0.16	0.15	0.33*	0.52**
drained weight	0.52**	0.12	0.07	0.27	0.09	0.34*	0.53**
Press fluids	0.01	-0.02	-0.06	-0.29*	-0.15	0.11	-0.18
Total moisture	0.38**	0.07	-0.08	0.07	-0.42**	0.34*	0.48**
Water activity	-0.29*	0.05	0.09	-0.31*	0.31*	-0.13	-0.23
TBA value	-0.27	-0.17	-0.10	-0.11	-0.30*	-0.21	-0.16
pH-- muscle	0.02	-0.16	-0.17	-0.09	-0.17	0.08	0.14
pH-- juice	-0.22	-0.04	-0.31*	0.19	-0.39**	-0.27	-0.36*
NRC-- muscle	0.01	0.08	0.06	-0.16	0.46**	-0.03	0.07
NRC-- juice	0.02	-0.02	0.05	0.05	0.22	-0.05	0.01

** , significance at 1% level
* , significance at 5% level
NRC, Ninhydrin reactive compounds

closely related to fat content of the juice than to volume of juice.

During heating, bound water is released and becomes free water; as the meat is heated to higher temperatures, the evaporative loss of free water exceeds the release of bound to free water and there is increased loss of total water. When the loss of free water exceeds the release of bound to free water a larger percentage of the total water within the muscle exists as bound water (Ritchey, 1965). Hamm (1960) suggested that the amount of water bound to the tissues rather than the amount of expressible juice may be related to the juiciness of the meat.

Chemical Measurements

TBA value. Both freshly cooked and reheated phosphate-treated muscle had significantly ($P < 0.05$) lower TBA values than the other treatments. TBA values of water-treated and untreated, freshly cooked muscle were similar. Storage and/or reheating resulted in significantly ($P < 0.05$) higher TBA values in water-treated and untreated samples but not in the phosphate-treated, reheated sample. Other investigators have reported similar increases in TBA values with storage and/or reheating of precooked meats (Harris and Lindsay, 1972; Chang et al., 1961; and Cipra and Bowers, 1970). As expected, the addition of phosphate salts to the muscle to be reheated resulted in significantly ($P < 0.01$) lower TBA values. The TBA value of the phosphate-treated, reheated treatment was significantly lower than all other treatments. Greene, (1969) reported that when phosphate salts are added to raw muscle and the muscle is stored, the phosphate groups are hydrolyzed by phosphatases in the muscle. This may explain why the phosphate salts were more effective in precooked than in freshly cooked muscle.

Ninhydrin reactive compounds. Ninhydrin reactive compounds (NRC) were

determined for both ground muscle and press fluids from freshly cooked and reheated turkey. Neither determination resulted in significant differences due to additive or heating treatment. McCain et al. (1968) noted increases in free amines during storage of raw meat and associated that increase with naturally occurring and/or microbial enzymatic degradation of protein. A positive correlation ($P < 0.01$) was noted between NRC of muscle and bitter flavor, indicating that there may be a relationship between flavor deterioration of stored turkey and increases in total ninhydrin reactive compounds.

SUMMARY

Quality of phosphate-treated, water-treated, and untreated, freshly cooked and reheated turkey was evaluated by a sensory panel and by selected physical and chemical measurements. A balanced incomplete block design with 10 replications of each treatment was used. Analysis of variance was run on data from each measurement and significant differences between treatments were determined by the F-test. Simple linear correlation coefficients indicated correlations among aroma components of muscle and press fluids and among flavor components of muscle. Correlations were noted between sensory impression of juiciness and selected moisture values.

In general, flavor and aroma components were affected similarly by additive treatment. Phosphate-treated samples had more intense meaty-brothy ($P < 0.01$ or < 0.05) flavor and aroma than the other treatments. Freshly cooked treatments had less intense stale, rancid, and acid aromas and flavors than reheated treatments. However, reheating had less effect on phosphate-treated than on water-treated and untreated samples. The addition of water appeared to have little effect on flavor and aroma characteristics of either

freshly cooked or reheated turkey. In most instances, the water-treated and untreated samples received similar scores. Phosphate-treated samples were rated more juicy than other treatments but were often described as having "soapy" flavor. Stale and rancid aromas were correlated negatively ($P < 0.01$) to meaty-brothy aroma. For both flavor and aroma, staleness was correlated positively ($P < 0.01$ or < 0.05) to rancidity and acidity. Sulfur flavor was related positively to stale ($P < 0.01$) and rancid ($P < 0.05$) flavors.

Percentage cooking loss, total moisture, and press fluids were affected significantly ($P < 0.01$ or < 0.05) by treatment. Phosphate-treated samples in both heating treatments had lower percentage cooking loss than other treatments, and the freshly cooked treatments as a whole had less cooking loss than the reheated treatments. Similar results were obtained for percentage total moisture, with phosphate-treated samples having greater moisture content. Freshly cooked treatments had more total moisture and larger volume of press fluids than reheated treatments. Addition of water to the muscle to be reheated did not affect the volume of press fluids, probably because only a part of the injected water was retained by the muscle. Percentage total moisture was related positively to panel scores for juiciness, but juiciness scores also were correlated positively to percentage cooking loss.

The addition of phosphate salts to muscle to be reheated resulted in significantly lower TBA values in that treatment. Freshly cooked treatments had significantly lower TBA values than water-treated or untreated, reheated samples. Neither NRC of muscle nor press fluids was affected significantly by treatment.

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ACKNOWLEDGMENTS

Appreciation is expressed to Dr. Jane Bowers, major professor and advisor for assistance, guidance, and patience in organizing this study and in preparing the manuscript.

Gratitude is expressed to Dr. Lucille Wakefield and the Department of Foods and Nutrition for providing the funds and facilities for this study. Thanks are extended to Dr. Jean F. Caul, Professor of Foods and Nutrition, and to Dr. Frank E. Cunningham, Associate Professor of Dairy and Poultry Science, for serving as members of the advisory committee and reviewing the manuscript. Appreciation is expressed to Dr. Holly C. Fryer, Head, Department of Statistics, for his assistance with the experimental design and to Dr. Kenneth E. Kemp, Associate Professor of Statistics, for the analysis.

Thanks are expressed to the graduate students and faculty who served on the sensory panel and to Miss Ruth Jacobs, Mrs. Louise Schwyhart, and Miss Wanda Couture for their assistance in the laboratory.

Appreciation is expressed to my parents for financial support and encouragement and to the graduate students who assisted in editing the manuscript.

APPENDIX

LIST OF ABBREVIATIONS AND TERMS USED FOR TABLES

** , Significant at the 1% level

* , Significant at the 5% level

ns , Nonsignificant

LSD, Least significant difference at the 5% level

Sensory scores:

Intensity of flavor and aroma components: 0, absent; 1, perceptible; 2, slight; 3, moderate; and 4, strong.

Juiciness and tenderness: 6, very juicy or tender; 5, moderately juicy or tender, 4, slightly juicy or tender; 3, slightly tough or dry; 2, moderately tough or dry; 1, very tough or dry.

THIS BOOK CONTAINS NUMEROUS PAGES WITH DIAGRAMS THAT ARE CROOKED COMPARED TO THE REST OF THE INFORMATION ON THE PAGE.

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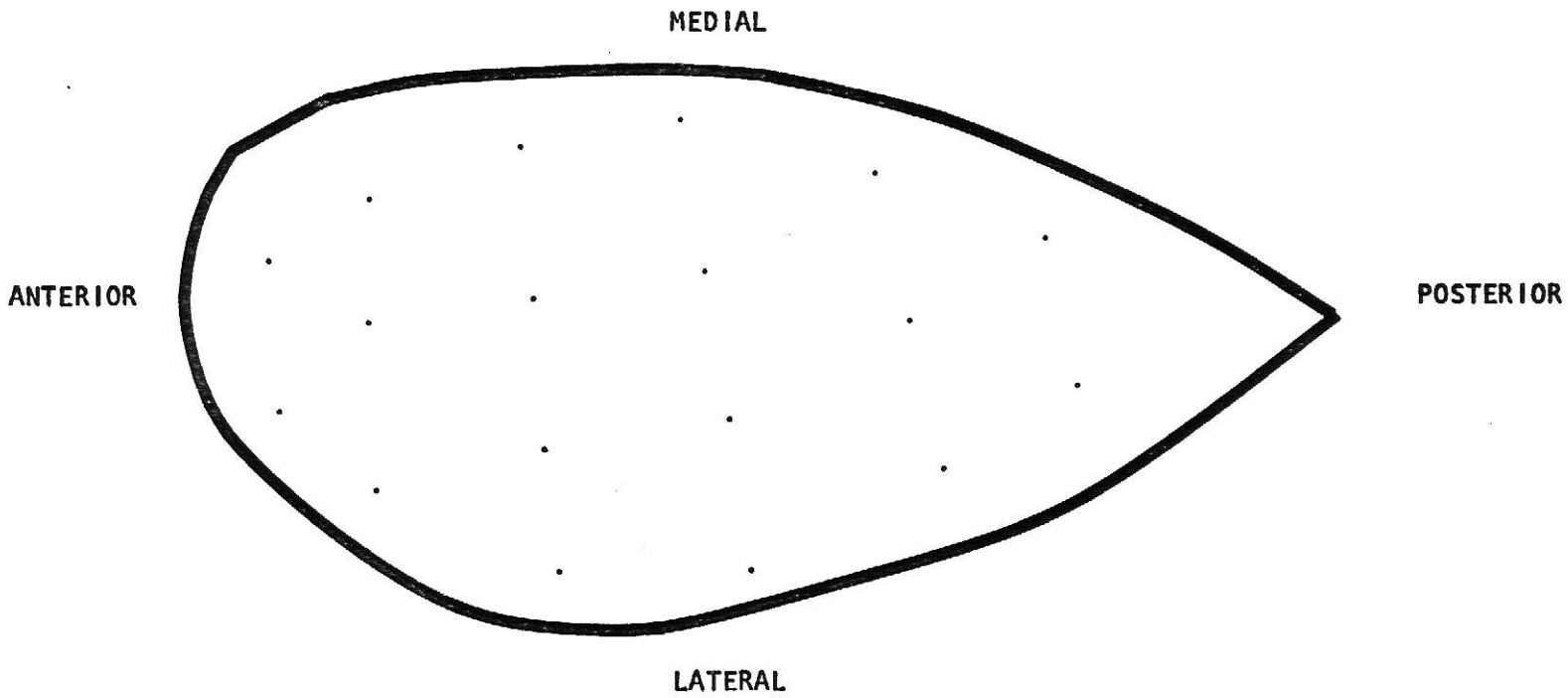

Fig. 1. Injection sites for pectoralis major muscle

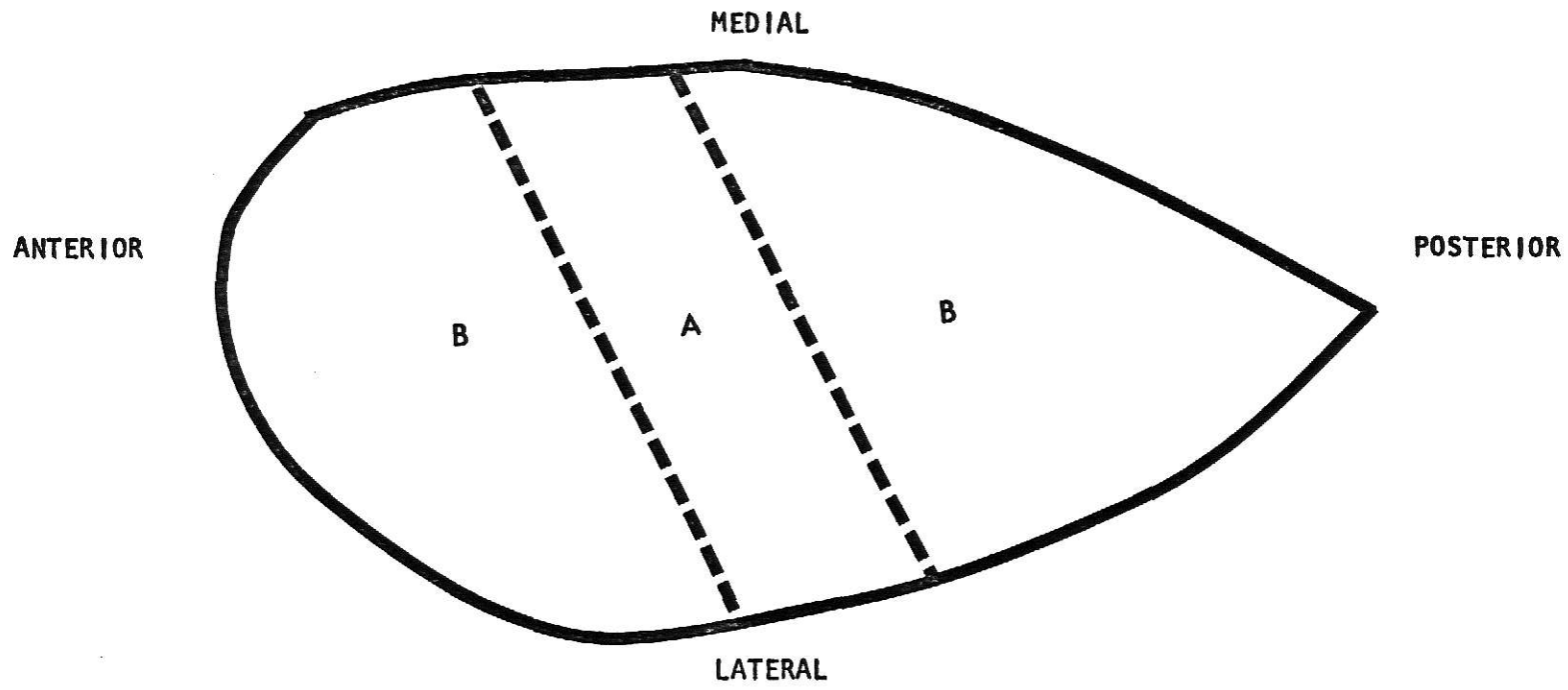

Fig. 2. Sampling plan for pectoralis major muscle

A, Sensory evaluation (1/4-inch slices)

B, Ground meat; used for physical and chemical measurements

Form 1. Scorecard for Turkey Muscle

I. Please score turkey samples for intensity of components listed below.

0, absent 1, perceptible 2, slight 3, moderate 4, strong

Components	AROMA						FLAVOR					
Sample	1	2	3	4	5	6	1	2	3	4	5	6
Meaty-brothy												
Stale												
Rancid												
Acid												
Ammonia												
Sulfur												
Sweet												
Salty												
Bitter												

II. Please evaluate turkey samples for tenderness and juiciness according to the following scales

6, Very tender	3, Slightly tough	6, Very juicy	3, Slightly dry
5, Moderately tender	2, Moderately tough	5, Moderately juicy	2, Moderately dry
4, Slightly tender	1, Very tough	4, Slightly juicy	1, Very dry

Components	Sample	1	2	3	4	5	6
Tenderness							
Juiciness							

Form 2. Scorecard for Turkey Press Fluids

Please score samples for intensity of aroma components listed below.

0, absent; 1, perceptible; 2, slight; 3, moderate; 4, strong

Components	Sample: 1	2	3	4	5	6
Meaty-brothy						
Stale						
Rancid						
Acid						
Ammonia						
Sulfur						

TABLE 5.--Assignment of treatments to experimental units (PM muscles)[1]

Replication	Turkey	PM Muscle	
		Left	Right
I	1	a	b
	2	c	d
	3	e	f
II	4	a	c
	5	b	e
	6	d	f
III	7	a	d
	8	b	f
	9	c	e
IV	10	a	e
	11	b	d
	12	c	f
V	13	a	f
	14	b	c
	15	d	e
VI	16	a	b
	17	c	d
	18	e	f
VII	19	a	c
	20	b	e
	21	d	f
VIII	22	a	d
	23	b	f
	24	c	e
IX	25	a	e
	26	b	d
	27	c	f
X	28	a	f
	29	b	c
	30	d	e

[1] a, phosphate-treated, freshly cooked
b, water-treated, freshly cooked
c, untreated, freshly cooked
d, phosphate-treated, reheated
e, water-treated, reheated
f, untreated, reheated

TABLE 6.--Order of presentation of samples to sensory panel[1]

Replication	Sample					
	1	2	3	4	5	6
I	e	c	f	a	d	b
II	a	d	b	e	f	c
III	f	b	e	c	a	d
IV	d	a	e	f	c	b
V	a	e	b	c	d	f
VI	e	f	a	c	d	b
VII	a	d	b	f	c	e
VIII	c	f	b	d	a	e
IX	f	c	b	e	d	a
X	e	a	b	c	f	d

[1] a, phosphate-treated, freshly cooked
b, water-treated, freshly cooked
c, untreated, freshly cooked
d, phosphate-treated, reheated
e, water-treated, reheated
f, untreated, reheated

TABLE 7.--Percentage[1] additive solution retained by muscle[2]

Replication	Sample[3]	Percentage Retained	Replication	Sample[3]	Percentage Retained
I	a	93	I	b	75
	d	78		e	50
II	a	70	II	b	32
	d	84		e	30
III	a	72	III	b	15
	d	84		e	50
IV	a	77	IV	b	65
	d	78		e	51
V	a	80	V	b	17
	d	94		e	48
VI	a	86	VI	b	8
	d	87		e	39
VII	a	89	VII	b	30
	d	66		e	20
VIII	a	86	VIII	b	50
	d	75		e	21
IX	a	85	IX	b	14
	d	35		e	27
X	a	78	X	b	12
	d	77		e	22
	average	79		average	34

[1]Data not analyzed statistically

[2]Based on drained weight--weight of sample 2 hr after treatment solution injected

[3]a and d, phosphate-treated
b and e, water-treated

TABLE 8.--Scores for intensity of meaty-brothy and stale aroma components of muscle[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Meaty-brothy	I	3.2	2.4	2.7	2.9	2.5	1.7
	II	3.3	1.6	2.2	2.5	2.1	2.4
	III	2.9	2.4	2.6	3.3	1.9	2.3
	IV	2.0	2.9	2.6	2.9	2.1	2.1
	V	2.9	2.5	2.4	2.9	2.1	2.1
	VI	3.5	2.0	2.4	3.1	2.4	2.6
	VII	2.6	2.1	2.7	3.0	1.9	2.6
	VIII	2.9	2.7	2.6	3.4	2.0	2.4
	IX	3.4	2.3	2.1	2.5	2.3	1.6
	X	2.9	2.4	2.7	2.6	2.0	1.9
	Adjusted mean	2.9	2.3	2.5	2.9	2.1	2.2
	F-value	12.96**					
	LSD	0.14					
Stale	I	0.0	0.6	0.1	0.4	0.9	0.9
	II	0.4	1.4	1.1	0.4	1.1	0.9
	III	0.6	1.1	1.0	0.6	1.0	1.6
	IV	0.9	1.1	0.9	1.1	1.4	1.4
	V	0.9	0.8	1.0	0.7	1.1	1.1
	VI	0.0	0.8	0.5	0.6	1.4	1.6
	VII	1.3	1.4	0.4	0.9	1.0	0.8
	VIII	0.6	0.6	1.3	0.3	1.5	0.9
	IX	0.1	1.0	1.3	0.4	1.1	2.1
	X	1.1	0.9	0.5	0.6	1.9	1.4
	Adjusted mean	0.6	1.0	0.8	0.6	1.2	1.3
	F-value	7.60**					
	LSD	0.15					

[1]See page 33, Appendix for explanation of scores

TABLE 9.--Scores for intensity of rancid and acid aroma components of muscle[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Rancid	I	0.0	0.6	0.2	0.2	0.1	0.5
	II	0.1	1.1	0.6	0.4	1.0	0.9
	III	0.0	0.1	0.1	0.3	0.5	0.4
	IV	0.7	0.1	0.4	0.0	0.7	1.0
	V	0.2	0.6	0.3	0.4	1.0	0.6
	VI	0.0	1.6	0.3	0.1	0.6	0.4
	VII	0.6	0.1	0.0	0.6	0.9	0.6
	VIII	0.4	0.1	0.6	0.0	1.3	0.9
	IX	0.0	0.6	0.3	0.3	0.6	1.1
	X	0.4	0.5	0.7	0.4	0.9	1.1
	Adjusted mean	0.2	0.5	0.3	0.3	0.8	0.7
	F-value	6.20**					
	LSD	0.13					
Acid	I	0.1	0.7	0.0	0.0	0.1	0.3
	II	0.1	0.3	0.0	0.0	0.1	0.0
	III	0.1	0.0	0.3	0.6	0.0	0.3
	IV	0.1	0.4	0.1	0.3	0.1	0.0
	V	0.1	0.3	0.4	0.9	0.1	0.6
	VI	0.1	1.1	0.3	0.4	0.4	0.2
	VII	0.0	0.1	0.0	0.3	0.5	0.3
	VIII	0.0	0.1	0.1	0.3	0.6	0.1
	IX	0.0	0.3	0.1	0.1	0.1	0.9
	X	0.0	0.0	0.0	0.0	0.3	0.1
	Adjusted mean	0.1	0.3	0.1	0.3	0.2	0.3
	F-value	1.93*					
	LSD	0.10					

[1]See page 33, Appendix for explanation of scores

TABLE 10.--Scores for intensity of ammonia and sulfur aroma components of muscle[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Ammonia	I	0.0	0.1	0.0	0.0	0.1	0.1
	II	0.3	0.3	0.0	0.0	0.1	0.0
	III	0.3	0.0	0.3	0.2	0.4	0.3
	IV	0.4	0.3	0.3	0.0	0.3	0.1
	V	0.0	0.0	0.0	0.0	0.3	0.0
	VI	0.1	0.1	0.0	0.0	0.3	0.1
	VII	0.4	0.0	0.1	0.0	0.1	0.1
	VIII	0.1	0.3	0.0	0.3	0.1	0.3
	IX	0.1	0.1	0.4	0.1	0.6	0.1
	X	0.1	0.1	0.0	0.0	0.0	0.6
	Adjusted mean	0.2	0.1	0.1	0.1	0.2	0.2
	F-value	2.02*					
	LSD	0.06					
Sulfur	I	0.1	0.1	0.7	0.3	0.2	0.1
	II	0.0	0.1	0.4	0.2	0.1	0.1
	III	0.2	0.2	0.0	0.0	0.3	0.3
	IV	0.0	0.0	0.0	0.4	0.4	0.3
	V	0.2	0.0	0.1	0.3	0.3	0.4
	VI	0.1	0.3	0.0	0.0	0.1	0.3
	VII	0.0	0.3	0.1	0.0	0.3	0.3
	VIII	0.3	0.4	0.2	0.0	0.6	0.3
	IX	0.4	0.0	0.1	0.0	0.3	0.1
	X	0.0	0.3	0.3	0.0	0.1	0.1
	Adjusted mean	0.1	0.2	0.1	0.1	0.3	0.2
	F-value	2.28*					
	LSD	0.06					

[1]See page 33, Appendix for explanation of scores

TABLE 11.--Scores for intensity of meaty-brothy and stale flavor components of muscle[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Meaty-brothy	I	2.9	2.8	2.8	2.6	2.1	2.1
	II	2.6	2.9	2.3	2.4	2.3	2.9
	III	3.3	2.5	3.1	2.7	2.1	2.0
	IV	2.8	3.0	2.6	2.8	2.4	2.6
	V	2.9	2.9	2.9	2.4	2.7	2.9
	VI	2.9	2.0	3.0	2.9	2.3	2.7
	VII	2.6	2.3	2.2	2.9	2.2	2.6
	VIII	2.9	2.7	2.6	3.4	2.0	2.4
	IX	3.4	2.3	2.1	2.5	2.3	1.6
	X	2.9	2.4	2.7	2.6	2.0	1.9
	Adjusted mean	2.9	2.7	2.5	2.7	2.3	2.4
	F-value	2.29**					
	LSD	0.21					
Stale	I	0.0	0.3	0.1	0.4	0.6	1.1
	II	0.0	0.6	0.8	0.4	0.6	0.7
	III	0.0	0.1	0.4	0.6	1.3	1.4
	IV	0.4	0.4	0.6	0.9	1.3	1.1
	V	0.4	0.0	0.6	0.7	0.6	0.9
	VI	0.0	0.9	0.3	0.2	1.1	1.1
	VII	0.4	1.1	0.6	0.8	1.7	1.1
	VIII	0.5	0.7	0.9	0.7	1.7	1.1
	IX	0.1	0.7	0.7	0.6	1.1	1.7
	X	0.6	0.4	0.4	1.0	1.0	1.3
	Adjusted mean	0.2	0.6	0.5	0.6	1.1	1.2
	F-value	19.02**					
	LSD	0.12					

[1]See page 33, Appendix for explanation of scores

TABLE 12.--Scores for intensity of rancid and acid flavor components of muscle[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Rancid	I	0.0	0.1	0.0	0.1	0.1	0.3
	II	0.1	0.1	0.3	0.0	0.0	0.4
	III	0.0	0.1	0.1	0.3	0.6	0.7
	IV	0.3	0.1	0.1	0.1	0.1	0.3
	V	0.2	0.2	0.0	0.6	0.7	0.7
	VI	0.0	0.9	0.0	0.0	0.4	0.3
	VII	0.6	0.3	0.1	0.4	0.4	0.4
	VIII	0.1	0.3	0.3	0.3	0.5	0.8
	IX	0.0	0.1	0.0	0.1	0.4	0.7
	X	0.1	0.0	0.7	0.5	0.6	0.7
	Adjusted mean	0.2	0.2	0.2	0.2	0.4	0.5
	F-value	4.59**					
	LSD	0.09					
Acid	I	0.0	0.0	0.1	0.4	0.4	0.4
	II	0.3	0.3	0.0	0.0	0.1	0.0
	III	0.3	0.0	0.3	0.2	0.4	0.3
	IV	0.1	0.2	0.4	0.1	0.1	0.4
	V	0.1	0.0	0.1	0.1	0.3	0.4
	VI	0.3	0.6	0.3	0.1	0.3	0.4
	VII	0.3	0.1	0.3	0.4	0.9	0.4
	VIII	0.0	0.0	0.0	0.3	0.1	0.6
	IX	0.0	0.3	0.3	0.4	0.4	0.6
	X	0.0	0.1	0.4	0.1	0.7	0.4
	Adjusted mean	0.1	0.2	0.2	0.2	0.4	0.4
	F-value	3.65**					
	LSD	0.08					

[1]See page 33, Appendix for explanation of scores

TABLE 13.--Scores for intensity of sulfur and sweet flavor components of muscle[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Sulfur	I	0.0	0.2	0.4	0.4	0.0	0.1
	II	0.0	0.3	0.3	0.1	0.3	0.3
	III	0.1	0.0	0.3	0.3	0.4	0.0
	IV	0.0	0.0	0.4	0.1	0.2	0.3
	V	0.0	0.3	0.1	0.5	0.1	0.3
	VI	0.0	0.4	0.0	0.0	0.3	0.1
	VII	0.3	0.7	0.3	0.1	0.4	0.3
	VIII	0.0	0.4	0.1	0.3	0.7	0.4
	IX	0.0	0.1	0.1	0.3	0.3	0.3
	X	0.0	0.2	0.0	0.3	0.0	0.6
	Adjusted mean	0.0	0.3	0.1	0.3	0.2	0.3
	F-value	5.58**					
	LSD	0.07					
Sweet	I	0.3	0.3	0.3	0.0	0.1	0.4
	II	0.0	0.1	0.0	0.1	0.1	0.0
	III	0.0	0.1	0.1	0.1	0.0	0.0
	IV	0.1	0.1	0.0	0.0	0.0	0.0
	V	0.0	0.1	0.2	0.0	0.0	0.0
	VI	0.1	0.1	0.0	0.0	0.0	0.0
	VII	0.1	0.1	0.0	0.1	0.1	0.0
	VIII	0.0	0.1	0.0	0.0	0.0	0.0
	IX	0.0	0.0	0.1	0.0	0.1	0.0
	X	0.1	0.0	0.0	0.0	0.0	0.1
	Adjusted mean	0.1	0.1	0.1	0.1	0.1	0.1
	F-value	0.81 ns					

[1]See page 33, Appendix for explanation of scores

TABLE 14.--Scores for intensity of salty and bitter flavor components of muscle[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Salty	I	0.1	0.0	0.3	0.1	0.3	0.0
	II	0.2	0.1	0.1	0.1	0.3	0.1
	III	0.4	0.0	0.3	0.3	0.0	0.0
	IV	0.1	0.0	0.0	0.2	0.0	0.0
	V	0.9	0.0	0.0	0.0	0.0	0.0
	VI	1.0	0.0	0.1	0.4	0.0	0.1
	VII	0.4	0.0	0.1	0.4	0.0	0.0
	VIII	0.6	0.1	0.1	0.1	0.1	0.0
	IX	0.4	0.0	0.1	0.3	0.0	0.0
	X	0.1	0.0	0.1	0.1	0.1	0.0
	Adjusted mean	0.4	0.0	0.1	0.2	0.1	0.0
	F-value	9.77**					
	LSD	0.07					
Bitter	I	0.0	0.0	0.0	0.0	0.0	0.0
	II	0.1	0.0	0.0	0.0	0.1	0.0
	III	0.0	0.0	0.0	0.1	0.1	0.4
	IV	0.0	0.1	0.1	0.3	0.3	0.0
	V	0.3	0.1	0.1	0.3	0.1	0.3
	VI	0.4	0.1	0.0	0.3	0.3	0.1
	VII	0.3	0.3	0.1	0.1	0.1	0.3
	VIII	0.1	0.0	0.1	0.1	0.1	0.1
	IX	0.0	0.0	0.0	0.1	0.0	0.0
	X	0.1	0.0	0.0	0.1	0.0	0.0
	Adjusted mean	0.1	0.1	0.1	0.2	0.1	0.1
	F-value	1.74*					
	LSD	0.04					

[1]See page 33, Appendix for explanation of scores

TABLE 15.--Scores for juiciness and tenderness of muscle[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Juiciness	I	4.9	4.3	4.0	4.1	2.6	3.4
	II	4.7	3.6	3.6	3.3	3.6	3.1
	III	4.6	3.6	4.3	3.1	3.4	3.1
	IV	4.7	3.6	3.7	3.7	3.0	3.7
	V	5.0	3.3	3.6	3.8	4.1	3.0
	VI	4.0	3.1	4.6	4.9	4.3	3.4
	VII	4.6	2.9	3.7	4.9	3.1	4.0
	VIII	5.4	4.6	4.4	4.3	3.1	3.4
	IX	4.1	4.1	4.4	3.9	3.9	3.0
	X	4.4	4.4	4.1	4.3	5.0	3.9
	Adjusted mean	4.6	3.7	3.6	4.0	3.6	3.4
	F-value	3.64**					
	LSD	0.33					
Tenderness	I	6.0	5.4	5.0	4.9	4.6	4.1
	II	5.3	4.4	4.7	4.9	4.3	4.0
	III	5.3	4.7	4.1	5.2	4.0	4.4
	IV	5.3	5.1	5.1	4.6	3.7	4.4
	V	5.6	4.6	5.1	4.7	4.6	5.5
	VI	5.1	4.1	5.1	5.9	5.3	5.0
	VII	5.0	4.1	4.9	5.7	4.1	5.1
	VIII	5.3	4.3	5.1	4.5	4.0	4.7
	IX	4.4	4.7	4.4	4.3	4.6	4.7
	X	5.1	5.4	5.0	4.9	5.0	4.9
	Adjusted mean	5.2	4.7	4.4	5.0	4.4	4.7
	F-value	1.77 ns					

[1]See page 33, Appendix for explanation of scores

TABLE 16.--Scores for intensity of meaty-brothy and stale aroma of press fluids[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Meaty-brothy	I	2.5	2.0	2.5	2.2	2.2	2.5
	II	2.7	1.8	1.8	3.0	2.0	1.9
	III	3.2	2.0	2.7	3.3	2.3	2.8
	IV	1.5	2.3	2.5	3.5	2.7	2.2
	V	3.0	1.7	1.7	2.2	1.0	1.8
	VI	2.3	2.0	2.7	3.0	2.7	1.7
	VII	3.0	2.7	2.7	2.7	2.5	1.8
	VIII	2.0	2.3	2.8	3.7	2.0	3.3
	IX	2.7	2.0	2.0	3.5	2.3	2.3
	X	3.0	2.2	2.0	2.3	1.3	2.0
	Adjusted mean	2.5	2.0	2.1	3.1	2.1	2.2
	F-value	6.24**					
	LSD	0.22					
Stale	I	0.0	0.7	1.0	0.7	1.3	0.3
	II	0.7	1.0	1.3	0.0	1.0	1.0
	III	0.3	1.3	1.7	0.0	1.0	1.8
	IV	1.0	2.0	1.3	0.3	0.7	1.0
	V	0.3	1.3	0.3	1.7	2.3	1.3
	VI	0.7	0.7	1.0	0.7	1.0	0.8
	VII	1.3	1.3	1.0	1.3	1.8	2.0
	VIII	1.0	0.3	1.7	1.7	0.7	0.0
	IX	1.0	1.0	0.3	0.3	1.3	1.7
	X	0.7	1.3	2.0	0.3	2.3	1.6
	Adjusted mean	0.7	1.0	1.1	0.5	1.4	1.2
	F-value	4.36**					
	LSD	0.23					

[1]See page 33, Appendix for explanation of scores

TABLE 17.--Scores for intensity of rancid and acid aroma components of press fluids[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Rancid	I	0.0	0.3	0.0	0.0	0.0	0.8
	II	0.0	0.7	0.7	0.0	0.0	0.7
	III	0.0	1.3	0.0	0.3	0.0	0.0
	IV	0.3	0.0	1.0	0.0	0.0	0.3
	V	0.5	0.0	1.0	0.3	0.3	0.0
	VI	0.0	0.0	0.0	0.0	0.0	1.0
	VII	1.3	1.3	1.0	1.3	1.8	2.0
	VIII	1.0	0.3	1.7	1.7	0.7	0.0
	IX	1.0	1.0	0.3	0.3	1.3	1.7
	X	0.7	1.3	2.0	0.3	2.3	1.7
	Adjusted mean	0.1	0.3	0.4	0.1	0.2	0.4
	F-value	1.14 ns					
Acid	I	0.0	0.0	0.0	0.0	0.3	0.0
	II	0.0	0.0	0.0	0.3	0.3	0.0
	III	0.3	0.0	0.0	0.8	0.0	0.0
	IV	0.0	0.0	0.3	0.0	0.0	0.0
	V	0.0	0.0	0.0	0.0	1.0	0.3
	VI	0.0	0.7	0.0	1.3	0.7	0.7
	VII	0.0	0.0	0.0	0.0	0.0	1.3
	VIII	1.0	0.0	0.0	0.0	0.0	0.0
	IX	0.3	1.3	0.0	0.0	0.0	0.0
	X	0.0	0.0	1.0	0.3	0.7	0.0
	Adjusted mean	0.2	0.2	0.1	0.3	0.3	0.2
	F-value	0.30 ns					

[1]See page 33, Appendix for explanation of scores

TABLE 18.--Scores for intensity of ammonia and sulfur aroma components of press fluids[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Ammonia	I	0.0	0.0	0.0	0.0	0.3	0.0
	II	0.0	0.0	0.0	0.0	0.7	0.7
	III	1.0	0.0	0.0	0.0	0.7	0.3
	IV	1.0	0.3	0.0	0.0	1.0	1.0
	V	0.0	1.7	1.7	0.3	0.0	0.0
	VI	0.0	1.0	0.3	0.0	0.3	1.7
	VII	0.7	0.0	1.0	0.0	0.0	0.0
	VIII	0.3	0.7	1.0	0.0	0.0	0.3
	IX	0.7	0.7	0.7	0.0	0.3	0.7
	X	0.0	1.0	0.7	1.0	0.8	1.0
	Adjusted mean	0.4	0.5	0.5	0.2	0.4	0.6
	F-value	1.47 ns					
Sulfur	I	0.0	0.0	1.0	0.0	0.0	0.0
	II	0.0	0.0	0.7	0.0	0.0	0.0
	III	0.0	0.7	0.8	0.3	0.0	0.0
	IV	0.0	0.0	0.0	0.7	0.0	0.0
	V	0.0	0.0	0.0	1.3	0.0	0.0
	VI	1.0	0.0	0.0	0.3	0.0	0.0
	VII	0.3	0.3	0.0	0.0	0.7	1.0
	VIII	0.0	0.3	0.0	1.0	0.0	0.0
	IX	0.0	0.3	0.0	0.7	0.7	0.0
	X	1.0	0.0	0.0	0.0	0.7	0.0
	Adjusted mean	0.3	0.2	0.1	0.4	0.2	0.1
	F-value	1.43 ns					

[1]See page 33, Appendix for explanation of scores

TABLE 19.--Percentage cooking loss calculated from initial weight and drained weight[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Percentage cooking loss--initial weight	I	15.4	29.3	26.1	28.4	30.5	30.6
	II	23.5	25.1	19.6	28.0	34.4	32.7
	III	16.0	21.9	22.6	26.7	31.6	31.3
	IV	19.6	28.1	25.8	23.3	30.1	31.8
	V	14.7	28.1	27.1	27.8	32.2	30.3
	VI	16.4	29.6	18.6	25.4	32.0	30.9
	VII	15.8	33.5	23.2	28.9	35.3	32.6
	VIII	9.1	23.3	16.6	27.2	32.5	28.1
	IX	18.4	23.0	18.7	29.6	30.5	29.5
	X	16.7	25.3	24.6	28.5	29.3	27.8
	Adjusted mean	16.6	26.8	19.7	27.3	31.8	30.5
	F-value	24.27**					
	LSD	1.74					
Percentage cooking loss--drained weight	I	20.4	32.9	24.4	31.8	32.3	30.1
	II	26.0	26.2	18.9	31.8	35.9	32.1
	III	18.5	22.6	22.3	31.2	33.5	30.5
	IV	25.3	30.1	25.4	27.6	32.2	31.4
	V	19.0	28.6	26.3	31.8	34.2	28.9
	VI	22.1	29.9	17.7	30.1	33.5	30.3
	VII	19.9	31.7	22.7	32.2	36.1	31.7
	VIII	14.6	25.4	16.2	31.3	33.2	27.5
	IX	22.4	23.4	17.0	30.2	45.7	27.8
	X	20.5	25.8	21.8	31.0	29.9	26.4
	Adjusted mean	20.7	27.6	18.8	31.2	34.5	29.8
	F-value	22.00**					
	LSD	1.86					

[1]See page 33, Appendix for explanation of scores

TABLE 20.--Percentage total moisture and ml press fluids for freshly cooked and reheated muscle[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Percentage total moisture	I	70.0	66.1	63.4	65.0	64.0	64.2
	II	66.7	66.8	66.3	66.7	63.8	65.0
	III	68.8	67.0	67.1	66.5	62.1	65.0
	IV	71.5	66.8	65.8	64.7	63.8	64.4
	V	68.2	64.9	64.2	65.3	64.7	63.2
	VI	67.4	63.2	66.9	66.1	64.0	64.0
	VII	68.4	64.4	65.8	65.1	63.5	63.7
	VIII	70.3	66.6	68.3	66.6	64.9	63.7
	IX	69.9	65.0	68.0	64.7	65.3	64.8
	X	68.2	67.0	66.4	66.6	65.2	65.8
	Adjusted mean	68.9	66.0	66.3	65.7	63.9	64.3
	F-value	28.64**					
	LSD	0.47					
Ml press fluids	I	18.0	15.0	19.0	16.0	14.0	14.0
	II	19.0	20.0	19.0	16.0	15.0	17.0
	III	18.0	17.0	20.0	14.0	16.0	16.0
	IV	19.0	16.0	15.0	15.0	17.0	12.0
	V	20.0	20.0	15.0	15.0	17.0	15.0
	VI	18.0	17.0	23.0	16.0	16.0	18.0
	VII	20.0	18.0	17.0	15.0	16.0	15.0
	VIII	18.0	19.0	17.0	18.0	16.0	15.0
	IX	21.0	20.0	23.0	17.0	17.0	16.0
	X	18.0	19.0	18.0	15.0	16.0	18.0
	Adjusted mean	18.9	18.1	18.6	15.7	16.0	15.6
	F-value	9.39**					
	LSD	0.71					

[1]See page 33, Appendix for explanation of symbols

TABLE 21.--Water activity and pH of freshly cooked and reheated muscle[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
Water activity	I	0.82	0.82	0.92	0.80	0.80	0.78
	II	0.87	0.79	0.86	0.82	0.85	0.93
	III	0.79	0.85	0.76	0.80	0.83	0.95
	IV	0.85	0.86	0.86	0.94	0.83	0.92
	V	0.95	0.81	0.83	0.84	0.87	0.82
	VI	0.93	0.87	0.82	0.84	0.84	0.83
	VII	0.95	0.86	0.82	0.81	0.76	0.82
	VIII	0.82	0.81	0.87	0.81	0.80	0.85
	IX	0.89	0.81	0.87	0.85	0.85	0.82
	X	0.91	0.88	0.80	0.79	0.90	0.81
	Adjusted mean	0.88	0.84	0.84	0.85	0.83	0.85
	F-value	1.14 ns					
pH of muscle	I	6.8	6.5	6.2	6.4	6.1	6.1
	II	6.5	6.4	6.3	6.5	6.4	6.3
	III	6.5	6.3	6.2	6.5	6.3	6.2
	IV	6.4	6.3	6.2	6.4	6.2	6.2
	V	6.6	6.2	6.1	6.4	6.2	6.2
	VI	6.5	6.2	6.3	6.5	6.3	6.3
	VII	6.4	6.2	6.2	6.4	6.2	6.2
	VIII	6.6	6.3	6.2	6.5	6.2	6.3
	IX	6.5	6.1	6.3	6.2	6.3	6.3
	X	6.5	6.2	6.1	6.5	6.2	6.2
	Adjusted mean	6.5	6.3	6.2	6.4	6.2	6.2
	F-value	46.4**					
	LSD	0.03					

[1]See page 33, Appendix for explanation of scores

TABLE 22.--pH of press fluids and TBA values for freshly cooked and reheated turkey muscle[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
pH of press fluids	I	6.8	7.1	7.0	6.8	6.6	6.7
	II	6.8	7.0	6.8	6.8	6.8	6.9
	III	6.8	6.8	6.8	6.8	7.2	7.1
	IV	6.7	6.6	6.4	6.6	6.6	6.6
	V	6.4	6.5	6.4	6.2	6.0	6.1
	VI	6.2	6.1	6.4	6.4	6.5	6.4
	VII	6.6	6.4	6.4	6.5	6.5	6.4
	VIII	6.6	6.7	6.6	6.6	6.6	6.7
	IX	6.8	6.6	6.6	6.8	6.7	6.7
	X	6.5	6.2	6.1	6.6	6.3	6.4
	Adjusted mean	6.6	6.5	6.5	6.6	6.6	6.6
	F-value	1.26 ns					
TBA value	I	0.26	0.80	0.97	0.25	1.02	1.15
	II	0.79	1.12	1.38	0.15	1.07	0.99
	III	0.30	0.85	0.81	0.10	0.91	1.19
	IV	0.39	0.67	0.64	0.17	0.84	0.93
	V	0.07	0.64	0.65	0.08	0.94	0.71
	VI	0.08	0.60	0.57	0.09	1.00	0.99
	VII	0.36	0.57	0.60	0.07	0.80	0.65
	VIII	0.26	0.56	0.67	0.09	0.59	0.70
	IX	0.26	0.67	0.80	0.17	0.76	1.02
	X	0.28	0.69	0.72	0.06	0.87	1.01
	Adjusted mean	0.31	0.73	0.75	0.14	0.86	0.94
	F-value	102.66**					
	LSD	0.05					

[1] See page 33, Appendix for explanation of scores

TABLE 23.--Ninhydrin reactive compounds of press fluids and muscle from freshly cooked and reheated turkey[1]

Factor	Replication	Freshly cooked			Reheated		
		Phosphate-treated	Water-treated	Untreated	Phosphate-treated	Water-treated	Untreated
µM ninhydrin reactive compounds/gm muscle	I	26.49	23.18	24.17	14.82	15.26	14.31
	II	20.27	18.15	18.92	12.96	17.87	12.59
	III	18.86	18.67	21.64	12.10	23.38	10.40
	IV	20.93	16.72	31.74	19.32	35.52	32.31
	V	45.36	41.89	32.05	32.09	19.73	49.34
	VI	18.71	19.34	25.71	27.73	22.03	15.22
	VII	28.38	32.63	35.80	29.80	28.38	24.62
	VIII	31.00	20.35	25.46	27.35	25.32	22.36
	IX	18.36	17.12	19.45	33.97	17.93	19.09
	X	21.11	15.12	17.21	12.75	12.97	16.13
	Adjusted mean	23.77	22.52	24.31	23.44	22.70	21.50
	F-value	0.35 ns					
µM ninhydrin reactive compounds/ml press fluids	I	56.60	56.50	49.65	56.50	45.25	42.50
	II	17.50	32.50	23.50	13.00	12.25	17.00
	III	22.50	22.00	23.50	6.25	17.25	12.25
	IV	50.75	43.75	33.75	47.75	32.75	21.00
	V	80.00	49.25	52.50	55.75	61.50	67.00
	VI	30.00	42.25	44.50	47.50	12.00	24.50
	VII	34.25	47.25	45.00	38.00	53.25	67.50
	VIII	49.00	29.50	31.75	42.55	36.50	43.50
	IX	43.50	30.50	29.30	39.10	22.80	26.50
	X	27.00	19.00	25.50	20.00	23.50	31.30
	Adjusted mean	40.61	36.91	37.05	35.23	31.72	36.37
	F-value	1.08 ns					

[1]See page 33, Appendix for explanation of scores

TABLE 24.--Correlation coefficients among aroma components of press fluids[1]

Component	Meaty-brothy	Stale	Rancid	Acid	Sulfur	Ammonia
Meaty-brothy	1.00**	-0.11	-0.22	-0.20	0.08	-0.11
Stale	-0.11	1.00**	-0.06	0.19	0.22	-0.04
Rancid	-0.22	-0.06	1.00**	0.20	0.10	-0.20
Acid	-0.20	0.19	0.20	1.00**	-0.02	0.02
Sulfur	0.08	0.22	0.10	-0.02	1.00**	-0.29*
Ammonia	-0.11	-0.04	-0.20	0.02	-0.29*	1.00**

[1]See page 33, Appendix for explanation of symbols

SELECTED SENSORY, PHYSICAL, AND CHEMICAL CHARACTERISTICS OF PHOSPHATE-TREATED, WATER-TREATED, AND UNTREATED FRESHLY COOKED AND REHEATED TURKEY BREAST MUSCLE

by

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B. S., University of Kentucky, 1971

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Foods and Nutrition

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1972

The effect of added phosphate (0.5% by weight) and water on the flavor and juiciness characteristics of freshly cooked and reheated turkey breast muscle was studied. The relationship between moisture determinations and sensory impressions of juiciness also was investigated. Panelists evaluated the intensity of aroma and flavor components of freshly cooked and reheated muscle and aroma components of press fluids from that muscle. Physical measurements included percentage cooking losses, percentage total moisture, volume of press fluids, and water activity. TBA values, ninhydrin reactive compounds, and pH of muscle and press fluids were determined. Significance of differences attributable to treatments was evaluated by the F-test. Correlation coefficients indicated relationships among selected characteristics.

In general, flavor and aroma components were affected similarly by additive treatment. Phosphate-treated samples had more intense meaty-brothy ($P < 0.01$ or < 0.05) flavor and aroma than the other treatments. Freshly cooked treatments had less intense stale, rancid, and acid aromas and flavors than reheated treatments. Reheating had less effect on phosphate-treated than on water- or untreated samples. The addition of water appeared to have little effect on flavor and aroma characteristics of either freshly cooked or reheated turkey. Phosphate-treated samples were more juicy than other treatments but were frequently described as having "soapy" flavor. Intensity of stale and rancid aromas was correlated negatively ($P < 0.01$) with intensity of meaty-brothy aroma. For both flavor and aroma, intensity of staleness correlated positively ($P < 0.01$ or < 0.05) with intensity of rancid and acid components. Intensity of sulfur was related positively with intensity of stale ($P < 0.01$) and rancid ($P < 0.05$) flavors.

Percentage cooking loss, percentage total moisture, and press fluids

were affected significantly ($P < 0.01$ or < 0.05) by treatment. Phosphate-treated samples in both heating treatments had lower percentage cooking loss and higher percentage total moisture than other treatments. Freshly cooked treatments as a whole had less cooking loss and more total moisture than reheated treatments. As would be expected, percentage total moisture was related positively to panel scores for juiciness; however, panel scores for juiciness also were positively related to cooking loss.

The addition of phosphate salts to muscle to be reheated resulted in significantly lower TBA values in that treatment. Freshly cooked treatments had significantly lower TBA values than water-treated or untreated, reheated treatments. Neither ninhydrin reactive compounds of muscle nor press fluids was affected significantly by treatment.