PROCESSING FACTORS AFFECTING THE QUALITY OF PHEASANT MEAT

by

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INTRODUCTION

As population pressures on recreation facilities increase, the availability of land, and wild game birds such as quail and pheasant, will tend to decrease. Hunters and their families who no longer have the time nor facilities for hunting still enjoy the flavor of a properly prepared pheasant. Many individuals who are willing to pay for processed pheasant, plus the growing demand from top restaurants provide an available market with excellent potential for expansion.

Pheasant production in the United States for 1966 has been estimated at 150 million birds, with 50 million of these birds designated for food consumption. McCluney (1967) reports a present movement to increase junior pheasant production, which would be used strictly for food. Jenkins (1967) is one such promoter of this new product. MacFarlane (1967) hatches approximately 1,000,000 pheasants per year which are sold strictly to shooting preserves and for food markets. Suter (1967) of South Dakota Pheasant Company processes about 30,000 per year. These producers have been expanding production to take advantage of the new market opportunity provided by the American consumer who desires ever different and varied food products, and is willing to pay the price for a high quality meat product.

The expansion of pheasant production into the food industry increases the need for specific processing information that will aid the processor in producing a desirable processed pheasant. This study was designed to determine whether scalding temperatures and water aging temperatures affected pH, lactic dehydrogenase activity and total protein concentration

of the raw meat, on the tenderness, juiciness, cooking losses, per cent total moisture, and expressible moisture of the cooked product. It was also desired to know which of these factors, if any, were dependent upon or related one to another.

REVIEW OF LITERATURE

At present, material concerning pheasant processing is not available. The literature cited concerns mainly experimental work with chickens and turkeys. The review deals with the factors most critically involved in the development of tenderness and juiciness in breast meat of poultry.

Tenderness of meat is perhaps the most important factor concerned with consumer acceptability of meat (Goodwin et al., 1962) and would appear even more important when dealing with a bird that has gained its reputation largely as a game bird.

Scalding is a factor which influences tenderness in turkeys and chickens. Klose et al. (1959) reported greater toughness in turkeys scalded at 140° F than those scalded at 126° F. Wise et al. (1961) also found that excessive scalding at high temperatures caused toughening of turkey hens. Shannon et al. (1957) found that chickens scalded at 150° F (66° C) or over, were significantly tougher than those scalded at 120° or 135° F (49°, 57° C). Scalding times of 80 seconds and 160 seconds decreased tenderness except at 120° F, while any time less than 40 seconds produced no significant effect upon tenderness. Shannon et al. (1957) concluded that time was more critical than temperature.

Two pheasant processors, South Dakota Pheasant Company (1967), and MacFarlane Pheasant Farm (1967), report using scalding temperatures of 150° F or higher. South Dakota Pheasant Company (1967) reported a scalding time of 30 seconds for very young birds and 45 seconds for fully matured birds.

Ease of picking accompanies variations in scalding temperatures, and the removal of pin feathers has been reported (Suter, 1967) as a problem

in pheasant processing. Shannon et al. (1957) working with chickens, found that even 180 seconds was not sufficient time for easy removal of feathers at 120° F, but 75 to 80 seconds was sufficient at 135° F.

Temperature and water play an important part in post-mortem tenderization of poultry meat. Klose et al. (1961) noted that turkeys chilled in ice slush for 20 hours were most tender; birds receiving no chilling were least tender, and birds chilled 1-2 hours in slush ice were intermediate--approaching the tenderness of birds receiving no chilling. Shannon et al. (1957) concluded that 10 hours may be required for maximum tenderness of white meat and 24 hours or more for thigh muscles. van den Berg and Kahn (1964) found tenderization of breast meat to be complete in 1 to 1½ days, and tenderization of leg muscle required 2-5 days. May et al. (1962) found that chickens aged in 0° C water for 4 hours were more tender than birds aged the same length of time in 37° C water.

The shear values for tenderness were equal for 0° and 37° C water after 8 hours of aging. de Fremery et al. (1960) found no significant difference in tenderness between birds aged at various temperatures from 0° to 40° C. Dodge and Stadelman (1959) found temperature of media to be highly significant ($P = .01$) in its effect upon tenderness. Using 14 week-old chickens in water ranging from 0° C to 22° C the chickens ranged from the most tender in 0° C water to the least tender in 22° C water. There was a significant positive correlation between aging from 2 to 8 hours and tenderness.

Data reported by Dodge and Stadelman (1960) and Swanson et al. (1962) indicated that the amount of water absorbed during aging does not influence tenderness, juiciness or other palatability factors, but it does add approx-

imately 5-7 percent to the weight of the processed birds. Swanson et al. (1962) reported a significant increase in water absorption from 12 to 24 hours; moisture increased from 5.76% to 6.35% during that time period. Thomson (1961) reported a slight increase in water absorption when the aging water was near 70° F, compared to slush ice media. Brant (1963) reported conflicting results in the effect of scalding temperature on the amount of water absorbed, and suggested there was no significant effect.

Obtaining values of tenderness, that correspond to consumer tastes, may be recorded by sensory or mechanical means. Koonz et al. (1954), Shannon et al. (1957), Paul et al. (1959), Palmer et al. (1965) and Pangborn et al. (1965) found excellent correlation between mechanical shear resistance and taste panel evaluations.

Cooking losses, expressible moisture, total moisture, pH, lactic dehydrogenase activity, and protein content are all factors which are interrelated in their effects on the tenderness and juiciness of meat.

de Fremery and Pool (1963) reported that several post-mortem treatments such as freezing, thawing, beating, elevated temperatures, cutting of the muscle, and exhaustive electrical stimulation will accelerate the onset of rigor mortis. In living muscle a high level of adenosinetriphosphate (ATP) and creatine phosphate (a reservoir of phosphate-bond energy) is maintained by the oxidation of organic compounds, but when the animal dies this process of maintaining ATP is possible only by anaerobic glycolysis. Whitaker (1959) states that after death ATP is continually synthesized at the rate of 1.5 moles for every mole of lactic acid produced in normal muscle. As long as there is sufficient glycogen and optimum pH for the synthesis of ATP, the muscle does not pass into rigor. When the glycogen

is exhausted or inactivated by decreased pH, the rate of ATP breakdown will exceed the rate of synthesis and rigor mortis will set in. Whitaker (1959) stated that as the pH decreased, the enzymes of the glycolytic system, most of which had pH optima close to 7, became inactive. It appeared that pH was the limiting value; beyond this, glycolysis was completely inhibited even though glycogen may have been present.

The production of lactic acid from glycogen causes the pH of poultry meat to fall from pH 7 to approximately 5.5 to 6.0 as reported by de Fremery and Pool (1960). They found that rapid onset of rigor mortis and rapid disappearance of ATP did not cause toughness in chicken muscle, but that the lactic acid developed from an increased rate of glycolysis may be involved in the cause of toughening. This was felt possible since acids affect the stability of proteins. Wierbicki et al. (1954) stated that although connective tissue contributed to tenderness, changes in the muscle plasma contribute more to meat tenderness, and intracellular muscle constituents are largely protein, which serve physiologically the functions of contraction and relaxation.

Lactic dehydrogenase (LDH) is an enzyme of the glycolytic system that catalyzes the following reaction: pyruvic acid + diphosphopyridine nucleotide (DPNH) lactic acid + diphosphopyridine nucleotide (DPN). Thus, there would be a direct correlation between the amount of LDH and the pH of a muscle, i.e., a low concentration of LDH would indicate a relatively low pH, as a low concentration of LDH would give rise to a greater amount of lactic acid produced, in turn lowering the pH to more acidic values. Briskey (1964) reported a correlation between LDH activity and pH. The muscles (pork) with a low pH had a lower LDH activity.

Whitaker (1959) concluded that juiciness and tenderness were probably dependent upon a combination of factors including fat, and the water-binding capacity, which is largely determined by proteins. Water-holding capacity, as defined by Hamm (1960) means the ability of meat to hold fast to its own or added water during application of any force such as pressing, heating, or grinding. Most such methods are based on measuring the loose water liberated by applying pressure on muscle tissue. Hamm (1960) reported there was usually a correlation between pH and water-holding capacity. An excess of acid will decrease the water-holding capacity of the muscle. Deatherage (1963) reported an increase in water-holding capacity as the pH increased (less acidity). Bendal (1963) stated that a low pH leads to denaturation of the proteins and a loss of water-binding ability whenever rigor is allowed to occur at high temperatures, whether in rabbit, pig, beef, or whale. Froning (1965) in work with polyphosphates on chicken meat, increased pH values from 6.1 to 6.6 and in so doing increased the amount of total moisture in the cooked meat, and the water-binding properties of the meat. Froning and Norman (1966) found differing pH values for light and dark meat (light = 6.4, dark = 6.6) with the light meat having the lower pH and greater water retention than the dark meat. So pH was not the difference in water-binding capacity between light and dark meat.

Kauffman et al. (1964) working with pork muscle explained the reaction of acidity upon muscle proteins. As the pH approaches the isoelectric point of pork muscle proteins (about pH 5.5), they lose their electrostatic attraction for local water molecules, resulting in increased amounts of expressible water. He also stated that water may be released

by reduction of forces dependent on capillary action, surface tension, and water dipole interaction. He found a low pH caused more expressible moisture and also allowed more shrinkage upon cooking and processing, thus producing a drier and tougher muscle upon preparation for consumption. Hamm (1960) found meat to be drier and less juicy as the amount of expressible juice increased. He states this is true because the meat will be more juicy if the juice is not squeezed out immediately as chewing begins. Therefore, according to Hamm, it is the amount of water bound to the muscle which affects juiciness, not the amount of water expressed upon pressing. Hamm (1960) reported a correlation between water-holding capacity and tenderness, a correlation between total moisture and protein content, and one report of a negative correlation between water-holding capacity and protein content, but it is not explainable. Barrie (1964) found no significant correlation between total moisture and the juiciness of expressible moisture. There was also no correlation between tenderness and water-holding capacity. Bower (1963) found a correlation between expressible moisture of turkey rolls and the juiciness. Barrie (1964) found pH and flavor scores to correlate; as pH increased the flavor increased. Barrie also found the pH of hen turkeys to be lower than the pH of toms (hens = 5.86, toms = 5.90).

Khan and van den Berg (1964) found an increase in the extractability of myofibrillar proteins during post-rigor tenderization, which they felt may have been due to proteolysis of the bonds which bind myofibrils to the matrix of the muscle. Wierbicki, Deatherage et al. (1954) reported an increase in protein extractability with tenderness, but Deatherage (1963) later stated that further work with better temperature controls on extrac-

tion procedures found the amount of extractable protein to change very little. There was also little evidence for proteolysis during post-mortem tenderization. Weinberg and Rose (1960) found the amount of nitrogen extracted in chicken breast to increase when carcasses were held 24 hours at 4° C. This increase was attributed to an increase in the actomyosin fraction. Khan and Lentz (1965) working on pre-rigor, rigor, and post-rigor freezing tests found cooking losses at a maximum when the amount of buffer-extractable nitrogen was at a minimum. Scharpf and Marion (1964) found total nitrogen to decrease after storage at 5-10° C, for 48 hours, suggesting a decrease in protein as tenderness developed. Wise et al. (1961) attributed protein denaturation as one of the factors of toughness resulting from high temperature scalding of turkey hens. C. Radouco-Thomas, et al. (1959) reported proteins to increase as the pH became lower during the first 24 hours of aging of rabbit at 25° C. Use of epinephrine doses maintained a relatively high pH during rigor and subsequent aging accompanied by a slight increase in protein levels.

EXPERIMENTAL PROCEDURE

Forty-eight ring-necked pheasants (Phasianus colchicus), 24 males and 24 females were obtained for this study from the Kansas State University Poultry Research Center. Conditions of housing, feeding, and age (23 weeks) were the same for all birds. Males and females were processed on two consecutive days; all the males and half of the females were processed the first day, and the remainder the following day. All were processed in the University Poultry processing lab under identical procedures. Processing temperatures and method of dividing the pheasants are outlined on Fig. 1 and explained in the following paragraph.

The live weight was taken before the pheasants were electrically stunned with a 110 volt, Cervin Electric Stunner (Model FS) set at 7 amps. They were bled by slitting the jugler vein, and scalded in a gas-heated, Ashley Sure-Scald (Model SS36) scalder. One-half of the males and one-half of the females (12 in each case) were scalded 180 seconds at 123° F (50.5° C), and the remainder were scalded 90 seconds at 140° F (60° C). All the pheasants were picked for 1 minute in a Pickwick Company, Spin-Pik (Model JJA-2) picker, in groups of 8. One-half of the birds scalded at 140° F (six) were placed in 65° F (18.3° C) tap water, and the other half were placed in slush ice maintained at 38° F (3.3° C). The slush ice was unagitated. The birds scalded at 123° F were divided in a similar manner. All birds were aged for 22 hours, removed from the water and allowed to drain for 20 minutes before weighing and packaging in air evacuated plastic bags. They were placed immediately in a 0° F (-17.7° C) freezer and remained there until thawed for testing. All birds were allowed to thaw over-

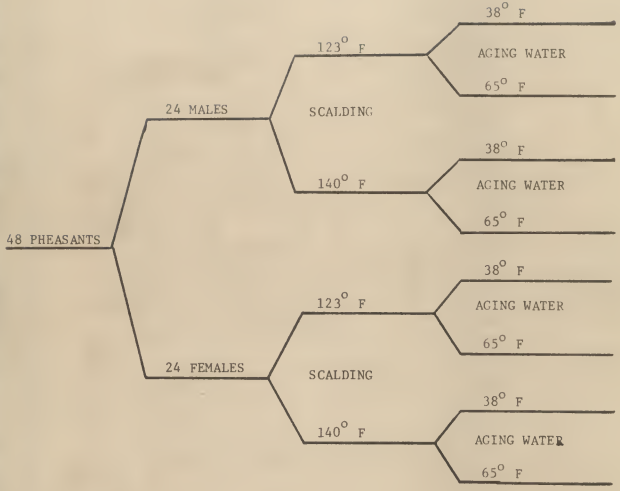

Fig. 1. Experimental design for processing.

night (10 hours) at a room temperature of 75-80° F (23.8-26.6° C), and weighed before the following experiments and procedures were performed. Four birds were thawed and tested per day.

Approximately 15 g of raw muscle were removed from the left side of the pectoralis major of each pheasant and placed in separate beakers containing cold (approximately 40° F or 4.4° C) distilled water. The raw muscle was used for experiments I, II and III which were pH, LDH, and total protein determinations, respectively.

Experiment I. pH determination

Ten g of the muscle were placed in a Waring blender with 100 cc of glass-distilled water (pH 7.0) and mixed for 2 minutes. The pH of this slurry was then determined immediately with a Beckman Zeromatic pH meter. This procedure was recommended by Hooper (1967).

The following procedure, developed by Coles (1967), was used to prepare the muscle tissue for a lactic dehydrogenase and protein determinations.

1. Two g of the raw muscle was chopped very finely with scissors.
2. The minced tissue was suspended in 18 ml of cold, glass-distilled water and mixed well. This was then centrifuged at 810 x g (at the tube tip) or 1900 RPM, for 10 minutes.
3. The supernatant was poured off, resuspended in 18 ml of cold, distilled water and centrifuged again for 10 minutes. The supernatant was again poured off and the tissue suspended in 18 ml of phosphate buffer (0.1M, pH 7.5; see Appendix, p. 36).
4. This buffer-tissue mixture was homogenized for 3 minutes at high speed in a Virtis "23" Homogenizer.

5. The homogenate was then centrifuged for 20 minutes at 810 x g, giving a relatively clear supernatant which was ready for LDH and total protein analysis.

Experiment II. Lactic dehydrogenase analysis

The amount of lactic dehydrogenase (LDH) was determined by the following procedure described by Calbiochem (1967), using LDH Calsuls which were pre-packaged kits of individual test reagents specifically designed to provide optimum conditions for this type of determination. The test is based on the reaction of Pyruvate + reduced NAD* (or DPN) Lactate + NAD, which is catalyzed by LDH.

1. The contents of one LDH Calsul were tapped into a cuvette containing 2.90 ml of glass-distilled water.
2. One-tenth ml of serum (as prepared from the muscle extract) was added and gently mixed with the water.
3. The temperature was brought to 30° C in a water bath, and the initial absorbance was read against water as a blank at 340 mU. If the water bath was not exactly 30° C, a temperature correction factor supplied by Calbiochem was used (see Appendix, p. 37).
4. Immediately after reading, the solution was incubated at 30° C for exactly 3 minutes.
5. At the end of exactly 3 minutes the final absorbance was read. The final reading was subtracted from the initial reading to obtain the change in absorbance.

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*(NAD = Nicotinamide-Adenine-Dinucleotide). (DPN = Diphosphopyridine nucleotide).

6. The observed change in absorbance was multiplied by 1610 x F x D ("F" = the temperature correction factor and "D" = the dilution factor which was always one in this case) to obtain the LDH activity in International milli-units, mU/ml of serum. One International Unit (I.U.) is that amount of LDH which will catalyze the reduction of 1 micromole of pyruvate per minute. One International Unit (I.U.) = 1000 International milli-units (mU). Values are read as X number of International milli-units per milliliter of serum. International milli-units may be converted to spectrophotometric units by multiplying by 2.074.

Experiment III. Protein determination

The unused serum from the LDH analysis was used for the total protein analysis; total protein was determined by the use of a Biruet reagent. All of the serum from the muscle extracts was saved and frozen until all 48 pheasants had been tested. The serum was then allowed to thaw and all 48 samples were tested the same day. The following "improved" biuret method for total protein, supplied by Dade Reagents, Inc.* was used.

1. Five-tenths ml of serum was pipetted into a 12 ml test tube.
2. Nine and one-half ml of 0.85% NaCl was added and mixed by inverting the tube several times.
3. Two ml of this solution was pipetted into a cuvette made for a Coleman spectrophotometer.
4. STANDARD: Into a second cuvette, 2 ml of Lab-Trol (control serum

*Dade Reagents, Inc., Miami, Florida, distributed by Scientific Products; division of American Hospital Supply Corporation.

with a known protein value) diluted 1:20 with saline was added.

5. BLANK: Into a third tube, 2 ml of 0.85% NaCl was added.
6. Eight ml of Biuret reagent (see Appendix, p. 36) was added to each tube and mixed by swirling.
7. The tubes were allowed to stand for 30 minutes at room temperature.
8. The absorbance was read at a wave length of 540 mU.
9. Using tables provided by Dade Reagents, Inc., the protein was calculated and recorded in grams. The following formula could also be used to calculate the grams of total protein:

$$\frac{\text{density of unknown}}{\text{density of Lab-Trol}} \times \frac{\text{total protein}}{\text{value of Lab-Trol}} = \text{total protein in grams.}$$

Experiment IV. Cooking loss

The pheasants were placed on wire racks and roasted breast-down in a National Manufacturing Company Electric Rotary Oven, set at 325° F (162.8° C). A final internal temperature of 80° C was determined by a thermometer placed in the right side of the pectoralis major. The roasted birds were weighed and the difference between raw and cooked weights was used to calculate the percent cooking loss.

Experiment V. Expressible moisture

Approximately one g of cooked meat was removed from the right side of the breast to provide three, o.3 g samples of meat to be used for calculating the amount of expressible moisture. A modified method of that reported by Briskey et al. (1959) was used. Each 0.3 g sample was placed on a 6 x 6 inch Whatman No. 1 filter paper, previously cut so that the grain-line of all the papers was the same, and stacked between four 6 x 6 inch

plexiglass plates (Clear Plex G., 3/8 inch thick). All the samples from the four birds tested that day were stacked in the preceding manner, and placed in a Carver Laboratory Press. Ten thousand pounds of pressure was exerted for a 3 minute period. The pressure caused two distinct rings to be formed; one represented the outside circumference of the pressed meat; the second ring was the outermost edge of the expressed moisture. The circumference of the meat was traced with a pen, and the pressed meat removed; the ring left by the moisture was stained permanently by its own juice (see Fig. 2). The filter papers were dried and measured with a compensating polar planimeter (Keuffel & Esser Co., model 620000). The area of the expressed moisture was found by measuring the area of the pressed meat and subtracting its area from the total area of the expressed moisture. The area was recorded in square inches. The average of the three, 0.3 g samples from each bird gave an expressible moisture value proportional to the amount of loose moisture found in the cooked breast muscle. High values indicate a large amount of expressed moisture and thus a value that indicates a high water-binding capacity through the cooking stage.

Experiment VI. Percent total moisture

Approximately 12 g of meat was removed from the right side of the breast immediately after cooking, and then ground. Exactly 10 g of the ground meat was weighed into a calibrated aluminum dish and placed in a C. W. Brabender Rapid Moisture Tester and allowed to dry for 60 minutes at 121° C (250° F). The percent moisture was read directly from the value indicated by the moisture tester.

Experiments VII, VIII and IX. Tenderness, Juiciness and flavor, respectively

Samples from the right side of each pectoralis major, 1 cm square,

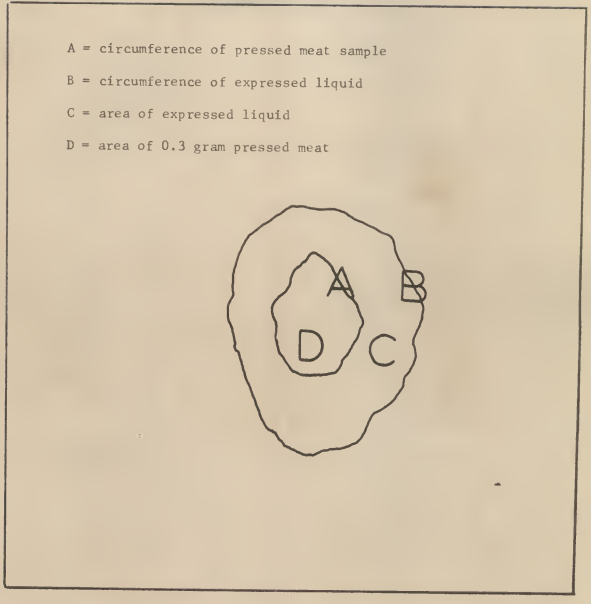

Fig. 2. Diagram showing circumference and area of a pressed meat sample and its expressible liquid as marked on filter paper.

were evaluated by 10 experienced judges. A standard score card was used as a basis for judging tenderness, juiciness and flavor. An example of the type evaluation sheet used and method of scoring is shown on fig. 3. In each instance the number 7 was most desirable and 1 was the least desirable. Tenderness was evaluated by each judge counting chews and then scoring the tenderness according to the 7-point scale. The data recorded for tenderness included only the score indicated from the 7-point scale--not the number of chews.

Type of meat: Dark _____ Judge _____

Light _____ Date _____

Sample No.	Flavor		Tenderness Based on Chews		Juiciness	Comments
	Intensity	Desirability	No.	Score		

FLAVOR

Intensity	Desirability	Tenderness	Juiciness
7. Very pronounced	7. Very desirable	7. Very tender	7. Very juicy
6. Pronounced	6. Desirable	6. Moderately tender	6. Juicy
5. Moderately pronounced	5. Moderately desirable	5. Slightly tender	5. Moderately juicy
4. Slightly pronounced	4. Slightly desirable	4. Slightly tough	4. Slightly juicy
3. Perceptible	3. Slightly undesirable	3. Moderately tough	3. Moderately dry
2. Slightly perceptible	2. Moderately undesirable	2. Very tough	2. Very dry
1. Imperceptible	1. Undesirable	1. Extremely tough	1. Extremely dry

Fig. 3. Evaluation sheet for pheasant meat.

EXPERIMENTAL DESIGN AND ANALYSIS

Four pheasants were evaluated at each cooking session, with a total of 12 cooking periods being needed for the evaluation of 48 male and female pheasants. Each experimental treatment was replicated six times for each sex, providing 12 replications of each treatment when males and females were combined. Birds chosen for each cooking session and subsequent evaluation were picked at random as to sex, scalding and aging treatments.

A three factor factorial analysis was used in these experiments, with the "F" test being employed to determine differences among treatment effects. An eleven place correlation matrix was utilized to determine significant correlations between the following eleven variables: (1) live weight, (2) percent cooking loss, (3) pH, (4) total moisture, (5) lactic dehydrogenase, (6) total protein, (7) tenderness, (8) juiciness, (9) intensity, (10) desirability, and (11) expressible moisture.

RESULTS AND DISCUSSION

Objective and subjective measurements were obtained to determine the effect of scalding and aging variations on some of the factors affecting the quality of pheasant meat. Subjective measurements were taken on the right half of the cooked pectoralis major in the form of taste panel evaluations. Objective measurements were taken on raw and cooked samples of the left and right halves of the pectoralis major, respectively. The "F" test was used to distinguish any differences in meat quality (tenderness, juiciness, pH, etc.) caused by variations in scalding temperature, aging temperature or sex. Correlation coefficients indicate any variables which appear to be related in their effect upon meat quality. Data presented in the tables represent mean values.

The first and most obvious result of these experiments was the effect of scalding temperature on picking. Pheasants scalded at 123° F were not picked adequately within one minute in the spin-picker. The wings and backbone areas were usually left with numerous feathers that were relatively difficult to pull by hand. At 140° F all the pheasants were picked well during the minute spent in the picker. No areas were visible that indicated any cooking of the exterior flesh at either 123° F or 140° F. For practical purposes only, it appeared that 140° F for 180 seconds was the more desirable temperature and time for scalding.

Live weight

The average weights of the pheasants were not significantly different according to sex or aging temperature, but those pheasants scalded at 123° F were significantly heavier (at the 5% level of probability) than those

scalded at 140° F (see Table 1, part A). In no case, however, was the scalding temperature ever significant in its effect upon the other variables, so the difference in weights did not alter the results. As can be seen from Table 1, part B, the only significant correlation concerning live weight was that between the live weight of the females and the percent cooking loss ($r = 0.4307$; $P = .05$).

The amount of water absorbed during aging did not differ significantly with scalding temperature or sex, but the temperature of the aging water was highly significant ($P = 0.005$). Those aged in 65° F water absorbed an average of 8.60% g of moisture based on the original dressed body weight, while those aged in slush ice gained an average of 7.96% g of water. The amount of water absorbed during aging did not affect the juiciness, tenderness, or cooking loss of the cooked pheasants. Any extra moisture absorbed was evidently lost during thawing. These results agree with those reported by Thomson et al. (1961), Swanson et al. (1962) and Brant (1963) who did experimental work on turkeys and chickens.

Cooking loss

Total cooking losses were determined and found not to be dependent upon the scalding temperatures. Differences due to sex and aging temperatures were significant. It was found that females had 4% more cooking loss (see Table 2, part A), and those pheasants which were aged in slush ice also had approximately 4% more cooking loss. There was a negative correlation between cooking loss and the percent total moisture in the cooked pectoralis major (Table 2, part B); the meat became drier as the cooking loss increased for males and females. The weight of the females increased as the cooking loss increased; since the males did not respond in the same

way the significance is not definitely explained. A possible explanation could be found in the fact that the pH of the females is significantly ($P = .1$) lower than the males (5.95, 5.86, respectively) and there is a significant negative correlation ($r = -0.5473$; $P = .01$) between an increase in acidity and an increase in cooking loss. The amount of total protein was low whenever cooking losses increased ($r = -0.4845$; $P = .01$). This agrees with the results found by Khan and Lentz (1965). There was a trend for the amount of lactic dehydrogenase to decrease as cooking losses increased with males and females alone, and was significant when they were combined. Since the pH was significantly lower as cooking losses increased it would be logical for the LDH to decline.

Kaufmann et al. (1964) working with pork also found the cooking loss increased as the pH declined. However, it is not understood why the pH of the females should have been less than that of the males since the overall scalding and aging treatments were the same and weights were not significantly different.

Juiciness and flavor showed a definite trend of decreasing as the cooking losses increased, but was not significant. Expressible moisture tended to decrease in the cooked meat as the cooking losses increased, but was not significant.

pH values

The scalding temperature was found to be non-significant in affecting the pH of raw breast muscle (Table 3, part A). The aging temperature of 38° F created a significantly lower pH ($P = .01$) than the birds aged in 65° F water. Females were found to have lower pH values which were significant at the 10% level of probability. This agrees with values found by

Barrie (1964) on turkeys. It is evident that cooking losses increased as the pH became lower; the amount of total protein in the raw muscle was also lower as the cooking losses increased. Over-all (males and females combined) the concentration of lactic dehydrogenase decreased or increased with pH values ($P = .05$), as did the amount of total protein ($P = .01$). Juiciness and pH corresponded directly with one another, though non-significantly. There was also a slight tendency for expressible moisture to increase as pH decreased.

Percent moisture

Neither temperature of scalding, temperature of aging, or sex directly affected the amount of total moisture found in the cooked pectoralis major, as revealed by the analysis of variance (Table 4, part A). Values of juiciness, recorded by the taste panel, correlate ($r = 5637$; $P = .01$) significantly with the moisture found with the brabender moisture tester in cooked samples. The total moisture was negatively correlated with the cooking loss ($r = 0.4994$; $P = .01$) which seems highly probable. The amount of expressible moisture found in the cooked meat was also significantly correlated ($r = .5718$; $P = .01$) to the amount of total moisture in the cooked samples, which indicated that the water was well-bound to the muscle through the cooking period at least. Juiciness appeared to release flavor stimuli, causing an increase in the intensity of the flavor; but this increase in juiciness and intensity did not improve the desirability of the meat according to taste panel reaction, indicating that a great amount of juiciness does not necessarily improve the quality of the meat. Several judges commented that overly juicy meat tended to be mushy and undesirably watery.

Lactic dehydrogenase (LDH)

The activity of lactic dehydrogenase (LDH) was unaffected by scalding which differs from Shrimpton's report (1960) of delayed accumulation of L-lactic acid caused by a delayed breakdown of alkali-soluble glycogen when scald temperatures were increased from 50° C to 60° C (2 min. and 0.75 min. scalding time, respectively). Aging also had no effect on LDH activity. LDH activity for females was significantly less than that of the males (6.77 to 8.98 mU, respectively, Table 5). It was concluded that since pH was significantly correlated to the concentration of LDH, pH was lower in the females due to greater production of lactic acid since more of the enzyme, LDH, was used in the over-all conversion of glycogen to lactic acid. The difference in pH between male and female was significant only at the 10% level of probability, but the difference in LDH concentration was significant at the 2.5% level, making it appear that the determination of LDH can detect differences in the state of muscle glycolysis at least as accurate as pH.

This could be seen by the significant (combined) correlations of LDH and cooking loss, pH, percent total moisture, and expressible moisture of the females (Table 5, part B). All of these areas should be affected by the pH, or other factors of glycolysis which are involved in the retention of moisture. Table 3, part B, reveals that in areas concerned with moisture, pH was correlated only with the cooking loss of the females while the LDH was correlated with several others as mentioned above. One factor not explained, however, is why pH and amount of total protein would be significantly correlated but not LDH and protein, and why LDH was not significantly different in the aging water.

Tenderness was not appreciably altered by LDH activity.

Total protein

Total protein contained in the pectoralis major before cooking was found to be greater in those birds aged in 65° F water, and also significantly greater in males than in females. Results indicated tenderness increased as the protein concentration decreased. The desirability also increased as the amount of protein decreased (Table 6, part B). The significant difference between protein content in males and females was greater than that indicated for the aging temperatures, but there was no corresponding difference in tenderness between males and females, indicating that the concentration of total protein was not an immediate factor in determining the tenderness. The pH was found to be higher as the protein concentration increased, indicating a possible connection between the acidity and the stability of proteins, as was suggested by de Fremery and Pool (1963). Although total protein may not have been an immediate cause affecting tenderness, the combination of 38° F aging water, and a positive correlation ($r = 0.3732$; $P = .01$) between pH and protein concentration must have contributed to the greater tenderness found in birds aged in the slush ice.

Tenderness

Tenderness, as evaluated by a panel of judges, was found to be greater in birds aged in 38° F water than in birds aged in 65° F water. These results agree with those reported by Dodge and Stadelman (1959) and Klose *et al.* (1961). The temperature of scalding had no effect, probably due to a difference of only 17° F, but mainly because of the reduced time of scalding at the 140° F temperature. This would seem probable as Shannon *et al.*

(1957) concluded that time of scalding was more critical than temperature.

Juiciness and desirability of flavor were very highly correlated with tenderness ($r = 0.6445$ and 0.7848; $P = .01$). These results indicated that pheasants aged in ice slush were more juicy, more tender and more desirable in flavor than those aged in warm water. Expressible moisture did not show a constant correlation between males and females, but the data indicated tenderness increased directly with expressed juice. There was no significant correlation between tenderness and the cooking loss or pH. The tendency was for a decrease in cooking loss to increase tenderness.

Juiciness

Juiciness, as evaluated by a taste panel, was found to be significantly affected by the temperature of the aging water. Thirty-eight degree water induced greater juiciness during aging than did water at 65° F. Scalding temperature was not significant (except at the 20% level of probability) but analysis of variance indicated juiciness was greater at a temperature of 123° F than at 140° F. As expected, the percent moisture in the cooked meat determined by a Brabender moisture tester correlated strongly ($r = 0.6058$; $P = .01$; Table 8, part B) with the juiciness indicated by the panel of judges. Tenderness and juiciness were even more strongly correlated, as evaluated by taste panel alone. Intensity and desirability of flavor were also correlated significantly with juiciness. These correlations suggest that juiciness in pheasant meat to a degree brings out the most desirable characteristics of good quality. Protein content was negatively correlated with juiciness, but not significantly.

Intensity and desirability of flavor

The only significant "F" value, as indicated by analysis of variance

for both intensity and desirability, was the relationship of 38° aging water to desirability ($F = 5.68$; $P = .025$); 38° F aged meat being more desirable than 65° F aged pheasant. The factors of sex, scalding temperature and aging temperature did not affect the intensity of flavor; and sex and scalding temperature did not affect the desirability of flavor. Intensity of flavor seemed to be linked closely with moisture in the meat; cooking loss, percent total moisture, and juiciness were all significantly correlated (Table 9) to intensity, as was the amount of tenderness. Desirability of the flavor was most influenced by tenderness and juiciness of the meat. Desirability tended to decrease as total protein increased.

Expressible moisture

As with many of the other variables, aging water temperature affected expressible moisture, while sex and scalding temperature were non-significant. Pheasants aged in 38° F water averaged 0.378 square inches of expressible moisture, compared to 0.352 square inches of moisture from birds aged at 65° F. Aging at 38° F created more moisture in the cooked meat, as there was a strong correlation ($r = 0.5718$ - females; $P = .01$; Table 10, part B) between percent moisture of the cooked meat and expressed moisture for all samples tested. There was a trend for juiciness and tenderness to increase with expressible moisture. The pH tended to decrease as expressible moisture increased but was also non-significant.

SUMMARY

Objective and subjective measurements were obtained to determine the effect of scalding and aging variations on factors affecting the quality of breast meat of 23-week-old ring-necked pheasants. Equal groups of 24 male and female pheasants were randomly selected to be scalded at 123° F and 140° F, followed by aging in either 38° F or 65° F water. Scalding at 123° F for three minutes did not allow for adequate removal of feathers from the wing tips and tails when picked for one minute in a rotary picker. Scalding at 140° F for 90 seconds removed all feathers during one minute of picking. Pheasants aged in 65° F water for 22 hours absorbed 0.64% more water than those aged at 38° F. Scalding temperature had no effect on water absorbed. Water absorbed did not affect any of the other factors determined. Females had a 4% greater cooking loss than males. This difference in cooking loss was believed to be due to a lower pH in females than in males (5.86, 5.95 pH, respectively). The reason for the difference in pH was attributed to a faster rate of glycolysis in females as indicated by a significant difference in LDH activity (males = 8.98 mU/ml serum; females = 6.77 mU/ml; Table 5).

The scalding temperatures were not found to be critical in any of the factors tested. There was a tendency for juiciness to be greater in pheasants scalded at 123° F but this was not significant. Scalding temperatures were non-significant due to the shorter scalding time required at 140° F (90 seconds as opposed to 180 seconds at 123° F) for adequate picking and because the difference in scalding temperatures was not extreme enough to be detrimental to tenderness, as compared to a 150° F

temperature (Shannon et al., 1957).

Aging temperature was of prime importance, influencing many factors. Tenderness was signficantly ($P = .025$) greater in pheasants aged in slush ice, as compared to 65° F water. Juiciness was also significantly greater ($P = .05$) in 38° F water, as was desirability of flavor ($P = .025$). The 38° F aging water caused a significant difference in pH of raw breast muscle, with the cooler water resulting in a pH of 5.83, while the 65° F water resulted in a mean pH value of 5.99 (significant at the 1% level of probability). Other factors believed attributable to aging in slush ice and subsequent drop in pH were: less total protein, greater cooking loss, and more expressible moisture found in the cooked meat of birds aged at 38° F. Significant differences were found between sexes, with females having a lower pH, less LDH activity, less total protein and a greater cooking loss. These differences were attributed to differing rates of glycolysis as indicated by LDH activity and lowered pH of females.

There were significant correlations between LDH concentration ($P = .05$) and pH, and between total protein and pH ($P = .01$). A negative correlation was shown between pH and cooking loss of females ($P = .01$), however, in males the correlations were non-significant. In a combined correlation of males and females, the amount of LDH was found to be significantly related to pH, cooking loss, percent moisture, and expressible moisture of females only. It is concluded that concentration of LDH activity is at least as accurate as pH readings, or more so, in determining the glycolytic state of muscle as it relates to moisture retaining factors of pheasant.

As cooking losses increased, total moisture was found to decrease as indicated by a negative correlation ($r = -0.4994$; $P = .01$). There were

high correlations between total moisture found in cooked breast meat and expressible moisture, juiciness, and intensity of flavor. Juiciness and desirability of flavor were both significantly correlated to tenderness, and the amount of expressible moisture tended to increase with tenderness.

Results indicated a more tender processed pheasant when scalding temperatures did not exceed 140° F for 90 seconds, preferably lower if it is still possible to pick the birds properly (not lower than 123° F). Aging should be in chilled ice water below 38° F and allowed to continue for at least 20 hours to insure the most juicy, tender product of desirable flavor. Tenderness or desirability of flavor were not affected by sex, as determined by this experiment. Although the results did not clearly explain why lower pH and high protein values provided the most tender, juicy and desirable pheasants when aged in slush ice, it is assumed from the results that this method of aging will produce improved quality processed pheasants.

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APPENDIX

BIURET REAGENT FORMULA

Take 30 g cystalline or use 20 ml of 15% copper sulfate; 12 g sodium-potassium tartrate; 2 g potassium iodide. Place in a 2 liter flask and dissolve in about 1000 ml distilled water.

With constant swirling, add 600 ml of 10% sodium hydroxide (prepared preferably from carbonate-free sodium hydroxide solution). Dilute to volume and mix. This reagent will keep indefinitely if stored in a pyrex or polyethelene bottle, but must be discarded if it shows signs of precipitating with a black or reddish percipitate.

PHOSPHATE BUFFER FORMULA

Fifteen ml of 0.1M monobasic phosphate ($K H_2PO_4$) per 100 ml of 0.1M dibasic phosphate (K_2HPO_4) gave a phosphate buffer solution of approximately pH 7.5.

TEMPERATURE CORRECTION FACTORS

FOR CALCULATION OF LDH ACTIVITY

Incubation Temp. °C	Factor	Incubation Temp. °C	Factor
22	1.79	30	1.00
23	1.67	31	0.93
24	1.55	32	0.87
25	1.44	33	0.81
26	1.34	34	0.75
27	1.24	35	0.70
28	1.16	36	0.65
29	1.07	37*	0.61

*Test not recommended above 37° C.

Table 1, part A. Mean values and analysis of variance of live weight.

Source	Means	D.F.	Mean square	"F"
Scalding temp.		1	387721.0	27.50****
123° F	867.29			
140° F	687.54			
Aging water temp.		1	3400.0	.241
38° F	785.83			
65° F	769.00			
Sex		1	3571	.253
Male	768.79			
Female	786.04			
Error term		40	1409735	

****Significant as the .05% level of probability.

Table 1, part B. Correlation coefficients between live weight and cooking loss, pH, moisture, lactic dehydrogenase, protein, tenderness, juiciness, flavor, and expressible moisture.

	22DF		46DF
	Males	Females	Both
1. % Cooking loss	.14496	.4307*	.1796
2. pH	.0728	-.2415	.0214
3. % Moisture	-.0100	.2271	.1997
4. Lactic dehydrogenase	.1736	-.3153	.0131
5. Protein	-.0692	-.2481	-.0823
6. Tenderness	.0591	.0415	.0395
7. Juiciness	-.1086	.0013	.1161
8. Flavor			
Intensity	.1920	.1098	.2362
Desirability	.0603	.1093	.1986
9. Expressible moisture	.0216	.0998	.0247

* Significant at 5% level of probability.

Table 2, part A. Mean values and analysis of variance of cooking loss.

Source	Means	D.F.	Mean square	"F"
Scalding temp.		1	1.407	0.074
123° F	40.66			
140° F	40.32			
Aging water temp.		1	181.817	6.286**
38° F	42.43			
65° F	38.54			
Sex		1	123.839	4.282*
Male	38.88			
Female	42.09			
Error term		40		

* Significant at the 5% level of probability.
**Significant at the 2.5% level of probability.

Table 2, part B. Correlation coefficients between cooking loss and live weight, pH, % moisture, lactic dehydrogenase, protein, tenderness, juiciness, flavor, and expressible moisture.

	22DF		46DF
	Males	Females	Combination
1. Live weight	.1449	.4307*	0.1796
2. pH	.1288	-.5474**	-0.2265
3. % Moisture	-.5179**	-.5050*	-0.4994**
4. Lactic dehydrogenase	-.3968	-.3153	-0.3399*
5. Protein	.3818	-.4845*	-0.0921
6. Tenderness	-.2363	.2029	0.0063
7. Juiciness	-.3517	-.2556	-0.2738
8. Flavor Intensity	-.2604	-.4169	-0.3296*
Desirability	-.2468	-.2787	-0.2353
9. Expressible moisture	-.1032	-.2264	-0.1671

* Significant at 5% level.
** Significant at 1% level.

Table 3, part A. Mean values and analysis of variance of pH.

Source	Means	D.F.	Mean square	"F"
Scalding temp.		1	0.0431	1.373
123^{o} F	5.94			
140^{o} F	5.88			
Aging water temp.		1	0.2729	8.691****
38^{o} F	5.83			
65^{o} F	5.99			
Sex		1	0.0901	2.869*
Male	5.95			
Female	5.87			
Error term		40	0.0314	

* Significant at the 10% level of probability.
****Significant at the 1% level of probability.

Table 3, part B. Correlation coefficients between pH and live weight, cooking loss, % moisture, lactic dehydrogenase, protein, tenderness, juiciness, flavor, and expressible moisture.

	22DF		46DF
	Males	Females	Combination
1. Live weight	0.0728	-0.2415	0.0214
2. Cooking loss	0.1288	-0.5474**	-0.2265
3. % moisture	-0.0856	0.2821	0.1355
4. Lactic dehydrogenase	0.1916	0.3967	0.3144*
5. Protein	0.3911	0.3401	0.3732**
6. Tenderness	0.0435	-0.0668	-0.0103
7. Juiciness	0.0600	0.3296	0.2415
8. Flavor			
Intensity	0.1675	0.1431	0.1829
Desirability	0.2002	0.0087	0.1271
9. Expressible moisture	-0.3063	-0.0490	-0.1907

* Significant at the 5% level of probability.
**Significant at the 1% level of probability.

Table 4, part A. Mean values and analysis of variance of per cent moisture.

Source	Means	D.F.	Mean square	"F"
Scalding temp.		1	3.9600	1.120
123° F	66.69			
140° F	66.12			
Aging water temp.		1	1.1900	0.337
38° F	66.77			
65° F	66.04			
Sex		1	6.4000	1.810
Male	66.56			
Female	66.25			
Error term		40	3.5350	

Table 4, part B. Correlation coefficients between per cent moisture and live weight, cooking loss, pH, lactic dehydrogenase, protein, tenderness, juiciness, flavor, and expressible moisture.

	22DF		46DF
	Males	Females	Combination
1. Live weight	-0.0100	0.2270	0.1997
2. Cooking loss	-0.5179**	-0.5050*	-0.4994**
3. pH	-0.0856	0.2821	0.1355
4. Lactic dehydrogenase	0.3674	0.2521	0.3177*
5. Protein	-0.3273	0.0690	-0.0920
6. Tenderness	0.3027	0.1064	0.1899
7. Juiciness	0.6058**	0.5203**	0.5637**
8. Flavor			
Intensity	0.1688	0.6075**	0.4234**
Desirability	0.2713	-0.0031	0.1348
9. Expressible moisture	0.4616*	0.5718**	0.5008**

* Significant at the 5% level of probability.
**Significant at the 1% level of probability.

Table 5, part A. Mean values and analysis of variance of lactic dehydrogenase.

Source	Means	D.F.	Mean square	"F"
Scalding temp.		1	12.454	1.34
123° F	8.38			
140° F	7.36			
Aging water temp.		1	0.856	.0922
38° F	7.74			
65° F	8.08			
Sex		1	58.985	6.35**
Male	8.98			
Female	6.77			
Error term		40	9.283	

**Significant at the 2.5% level of probability.

Table 5, part B. Correlation coefficients between LDH concentration and live weight, cooking loss, pH, moisture, protein, tenderness, juiciness, flavor, and expressible moisture.

	22DF		46DF
	Males	Fenales	Combination
1. Live weight	0.1731	-0.3153	0.0131
2. Cooking loss	-0.3968	-0.3154	-0.3399*
3. pH	0.1916	0.3967	0.3144*
4. Per cent moisture	0.3674	0.2527	0.3177*
5. Protein	-0.0489	0.1376	0.0613
6. Tenderness	-0.3461	0.0359	-0.1428
7. Juiciness	0.0859	0.1228	0.1416
8. Flavor			
Intensity	0.0571	0.0117	0.0652
Desirability	-0.2409	0.0343	-0.0477
9. Expressible moisture	-0.2119	0.4323*	0.1013

*Significant at the 5% level of probability.

Table 6, part A. Mean values and analysis of variance of cooking loss.

Source	Means	D.F.	Mean square	"F"
Scalding temp.		1	0.0023	0.385
123° F	0.405			
140° F	0.391			
Aging water temp.		1	0.0241	4.085*
38° F	0.376			
65° F	0.421			
Sex		1	0.0306	5.177*
Male	0.423			
Female	0.373			
Error term		40	0.0059	

*Significant at the 5% level of probability.

Table 6, part B. Correlation coefficients between total protein and live weight, cooking loss, pH, % moisture, LDH, tenderness, juiciness, flavor, and expressible moisture.

	22DF		46DF
	Males	Females	Combination
1. Live weight	-0.0692	-0.2481	-0.0822
2. Cooking loss	0.3818	-0.4845*	-0.0921
3. pH	0.3911	0.3401	0.3732**
4. % Moisture	-0.3273	0.0690	-0.0920
5. LDH	-0.0489	0.1376	0.0613
6. Tenderness	-0.3492	-0.3462	-0.3464*
7. Juiciness	-0.1838	-0.2999	-0.2212
8. Flavor			
Intensity	-0.0368	-0.1325	-0.0654
Desirability	-0.2185	-0.3926	-0.2875*
9. Expressible moisture	-0.4010	0.0230	-0.2016

* Significant at the 5% level of probability.
**Significant at the 1% level of probability.

Table 7, part A. Mean values and analysis of variance of tenderness.

Source	Means	D.F.	Mean square	"F"
Scalding temp.		1	0.0000	0.0
123° F	5.123			
140° F	5.121			
Aging water temp.		1	4.2542	6.22**
38° F	5.419			
65° F	4.824			
Sex		1	0.4163	0.61
Male	5.028			
Female	5.215			
Error term		40	0.6844	

**Significant at 2.5% level of probability.

Table 7, part B. Correlation coefficients between tenderness and live weight, cooking loss, pH, moisture, LDH, protein, juiciness, flavor, and expressible moisture.

	22DF		46DF
	Males	Females	Combination
1. Live weight	0.0591	0.0415	0.0394
2. Cooking loss	-0.2363	-0.2028	0.0063
3. pH	0.0435	-0.0668	-0.0103
4. % Moisture	0.3026	0.1064	0.1899
5. LDH	-0.3461	0.0359	-0.1428
6. Protein	-0.3493	-0.3462	-0.3464*
7. Juiciness	0.6445**	0.6220**	0.6037**
8. Flavor Intensity	0.6708**	0.2572	0.4576**
Desirability	0.6515**	0.7848**	0.7063**
9. Expressible moisture	0.4382**	0.0584	0.2564

* Significant at the 5% level of probability.
**Significant at the 1% level of probability.

Table 8, part A. Mean values and analysis of variance of juiciness.

Source	Means	D.F.	Mean square	"F"
Scalding temp.		1	1.044	2.76
123° F	4.284			
140° F	3.989			
Aging water temp.		1	1.756	4.65*
38° F	4.328			
65° F	3.945			
Sex		1	0.190	0.50
Male	4.199			
Female	4.074			
Error term		40	0.378	

*Significant at the 5% level of probability.

Table 8, part B. Correlation coefficients between juiciness and live weight, cooking loss, pH, moisture, LDH, protein, tenderness, flavor, and expressible moisture.

	22DF		46DF
	Males	Females	Combination
1. Live weight	-0.1086	0.0014	0.1161
2. Cooking loss	-0.3517	-0.2556	-0.2738
3. pH	0.0600	0.3296	0.2415
4. % Moisture	0.6058**	0.5203**	0.5637
5. LDH	0.0859	0.1228	0.1416
6. Protein	-0.1838	-0.2999	-0.2213
7. Tenderness	0.6445**	0.6219**	0.6037**
8. Flavor Intensity	0.5964	0.6906**	0.6551**
Desirability	0.5703**	0.5557**	0.5799**
9. Expressible moisture	0.2534	0.1796	0.1903

**Significant at the 1% level of probability.

Table 9. Correlation coefficients between intensity and desirability of flavor and live weight, cooking loss, pH, moisture, LDH, protein, tenderness, juiciness, and expressible moisture.

	INTENSITY	DESIRABILITY
	Male & female	Male & female
1. Live weight	0.2362	0.1964
2. Cooking loss	-0.3296*	0.0705
3. pH	0.1829	0.1271
4. % Moisture	0.4234**	0.1348
5. LDH	0.0651	-0.0477
6. Protein	-0.0653	-0.2875*
7. Tenderness	0.4576**	0.7063**
8. Juiciness	0.6551**	0.5799**
9. Expressible moisture	0.1373	0.1244

* Significant at the 5% level of probability.
**Significant at the 1% level of probability.

Table 10, part A. Mean values and analysis of variance of expressible moisture.

Source	Means	D.F.	Mean square	"F"
Scalding temp.		1	0.000127	0.079
123° F	0.363			
140° F	0.367			
Aging water temp.		1	0.008216	5.11*
38° F	0.378			
65° F	0.352			
Sex		1	0.001825	1.13
Male	0.371			
Female	0.359			
Error term		40	0.001606	

*Significant at the 5% level of probability.

Table 10, part B. Correlation coefficients between expressible moisture and live weight, cooking loss, pH, moisture, LDH, protein, tenderness, juiciness, and flavor.

	22DF		46DF
	Males	Females	Combination
1. Live weight	0.0217	0.0998	0.0248
2. Cooking loss	-0.1032	-0.2264	-0.1671
3. pH	-0.3063	-0.0490	-0.1907
4. % Moisture	0.4616*	0.5718**	0.5008**
5. LDH	-0.2119	0.4323*	0.1013
6. Protein	-0.4010	0.0230	-0.2016
7. Tenderness	0.4382*	0.0584	0.2564
8. Juiciness	0.2533	0.1796	0.1903
9. Flavor Intensity	0.0114	0.3058	0.1373
Desirability	0.4735*	-0.1727	0.1244

* Significant at the 5% level of probability.
**Significant at the 1% level of probability.

PROCESSING FACTORS AFFECTING THE QUALITY OF PHEASANT MEAT

by

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B.A., Kansas State University, 1966

AN ABSTRACT OF A MASTER'S THESIS

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Objective and subjective tests of quality were conducted on 48 ring-necked pheasant hens and cocks, 23 weeks of age. Treatments included scalding at 123° F, 140° F, and aging 22 hours in 38° F and 60° F water.

The pheasants were roasted to an internal temperature of 325° F and evaluated for tenderness, juiciness, and flavor by a trained taste panel. Other determinations included: cooking loss, total moisture, expressible moisture, pH, lactic dehydrogenase activity, and total protein concentration.

Scalding at 140° F was found to be the most acceptable method of commercially processing 23 week old pheasants. Scalding at 123° F did not allow for adequate removal of feathers when picked for one minute in a rotary picker. The scalding temperatures were not found to be significant for any of the other factors tested. Aging temperatures influenced many factors. Juiciness was significantly greater in pheasants aged in 38° F water as compared to 65° F water. Juiciness and flavor were significantly. greater in 38° F water. Aging in 38° F water caused a significant difference in the pH of the raw breast muscle, with the cooler water resulting in a pH of 5.83, while the 65° F water resulted in a mean pH value of 5.99. Other factors believed attributable to the drop in pH were: less total protein, greater cooking loss, and more expressible moisture found in the cooked meat of birds aged at 38° F. Lactic dehydrogenase was found to be significantly correlated to pH, cooking loss, total moisture, and expressible moisture in the females only. Significant differences were found between sexes. Females had a lower pH, less lactic dehydrogenase activity, less total protein, and a greater cooking loss. These differences were attributed to differing rates of glycolysis as indicated by the lactic dehydrogenase activity and lowered pH of the females.