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Examination of pH Fluctuations and Lipid Characteristics in Duck-Chicken Breast over Time

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Abstract

The quality and features of meat products in animals are determined by factors such as pH and lipid properties. In order to comprehend and maximize the flavor and lifespan features of meat, as well as to enhance the overall evaluation and customer acceptance of meals originating from birds, it is imperative to keep an eye on pH and lipid properties. In this paper, we analyze the pH, lipids in duck and chicken breast meat over time. We gathered the sample from thirty ducklings and thirty broilers that were forty-three days old.We measure the pH of meat specimens at different periods after death, as well as the features and fatty components of the meat at various storage times. The pH levels of the two breasts did not differ considerably until 40 minutes after the death, at which point the duck breast had a significantly lower pH than the chicken breast. We analyzed the redness (a*) and lightness (L*) values for both breasts. Then, over the course of the storage periods, we evaluate the loss of cooking, shear pressure, TBARS values and fatty acids.

Keywords: pH, lipid, fatty acid, chicken and duck

INTRODUCTION

The quality and consumer attractiveness of poultry products are influenced by the dynamic changes in the pH levels and lipid properties of duck and chicken breasts over time. Meat quality is evaluated in part by its pH level, which affects the meat's microbiological durability and softness. Both chicken and duck breasts undergo natural post-mortem activities following slaughter, which cause pH variations. The accumulation of lactic acid, a consequence of anaerobic glycolysis, is responsible for this change. It becomes essential to track these pH variations throughout time to evaluate the meat's overall accessibility and authenticity (1).

The distinctive qualities of chicken and duck breasts are attributed to their different lipid compositions. Particularly when it comes to duck meat, it contains more fat than chicken. Comprehending the historical development of lipid properties is crucial for evaluating oxidative sensitivity, which can impact flavor and nutritious worth (2). We investigate parameters including oxidation goods, fatty acid content and possible off-flavor formation to learn more about how stable and long-lasting these poultry products are.

The poultry business can benefit from an understanding of the temporal dimensions of pH and lipid dynamics. This information helps to minimize unfavorable changes in pH along with lipid quality by implementing ideal processing and storage settings (3). The industry can guarantee that the sensory qualities of duck and chicken breasts are preserved by implementing suitable storage and transportation procedures. This knowledge creates opportunities for the creation of novel processing methods that improve the overall taste and longevity of these goods, satisfying consumer demands for chicken options that are tasty, fresh and nourishing. The analysis of lipid properties and pH

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throughout the years helps chicken products to be continuously improved to satisfy the evolving requirements of customers (4).

The complicated combination of lipid properties, pH in duck and chicken breasts impacts the sense of taste that people get from the product. The arrangements of proteins in the meat are impacted by pH level changes throughout time, which affect flavor and softness. The general taste of chicken and duck breasts is dependent on the careful balancing act between acidity and alkalinity (5). Furthermore, these pH variations are not unique events rather they are a component of a complex biochemical chain reaction that takes place after death, deepening our knowledge of the dynamics of meat quality.

Analyzing the lipid properties over time provides information on the oxidative reactions influencing flavor and nutritious qualities. Duck meat has a particular richness that comes from increased fat content when compared to chicken meat. But duck's higher fat content increases its vulnerability to lipid oxidation (6). The possible shelf-life of these chicken items can be obtained by tracking the changes in the lipid content and the formation of oxidative products. This information is crucial for formulating plans to preserve the delicate equilibrium between crispness and the retention of desired lipid properties.

The effects of pH as well as lipid modifications transcend the lab yet have an impact on consumer decisions and business procedures. The changing nutritional composition of chicken and duck breasts over time can provide consumers with better options and a reason to choose them. Similarly, the poultry sector can use the knowledge to customize the processing and storage parameters so that final meats meet customer standards for safety and flavor (7). The continuous investigation of pH and lipid fluctuations advances scientific knowledge and directs the poultry sector toward environmentally friendly methods that satisfy the varied tastes of a discriminating customer base.

The purpose of this paper is to determine whether the general quality of duck and chicken breast meat is correlated with biochemical changes, specifically in pH and lipid characteristics. The research intends to provide important insights into the variables impacting the meat quality in these poultry products.

Study (8) proposed liquid chromatography coupled with mass spectroscopy (LC-HRMS) was used for screening the blood lipidome of 17-day-old poultry from the two lines for pH indicators. The sets of proteins found help to create available pH indicators on live birds that can be helpful in selective breedingas well as they would help better understand the causal connection involving bloodstream lipid content and carcass quality.

Study (9) examined the detailed analysis of the protein and lipid division, as well as the alterations in the physical, chemical and meat-quality features of camels, cattle and lamb during a nine-day period of refrigeration storage.During the initial three days of storage, there was a noticeable degradation of the triglycerides in all the meat samples, particularly in the camel meat. Comparing fresh camel meat to mutton and beef, the flavor as well as texture of the former showed a decline on day three along with day 9, respectively, suggesting the destruction of the protein structures by proteolysis.

Study (10) examined the gum Arabic affected broiler breast meat characteristics, physical attributes, carcass traits and performances. Evaluations were conducted on the carcass's attributes, performance and tangible, qualitative in nature, including chemical signs of breast meat. Despite the exception of the intake of feed, which was less than at cont at T1, 2, 5, which stands for the results indicated that every treatment enhanced overall outcome ($p < 0.05$) in the areas of body weight, weight increase, feed transformation ratio and metabolic index.

Study (11) assessed the significance of severalkinds of lipids on the absorption of nutrients, efficiency, skeletal features and meat quality among European quails. Trial 2 employed a placebo-controlled format with a total of five treatments coupled with ten duplicates per treatment to assess the behavior of animals, carcass features and meat

quality. The percentages of metabolizability (CM %) and evident energy available for metabolism corrected by nitrogen (AMEn) among the lipid sources were not different, according to a statistical analysis.

The purpose of study (12) was evaluating and comparing the two most widely used strains of standard-yielding broiler chicken that are currently on the market in terms of chest flesh quality. For both strains and ages, the body's ultimate alkalinity was achieved three hours after the death. In conclusion, choosing the appropriate strain and gender pairings for poultry extraction required finding a compromise between the amount and quality of steak.

Study (13) investigated the way more gradual broiler chickens in a free-range farm environment responded to the presence of Medicago sativa (A), the plant trifoliumrepens (WC), lolium perenne (PR)along with the combination (Mix) in terms of growth efficiency, body features, organ weights and meat quality. Between 28 and 77 days, there was no discernible change in the chick live weight, feed utilization ratio, or livability among the grazing treatments, according to the data.

Study (14) explored the effects of dietary supplemented rutin on the capacity for antioxidants, muscular lipid composition and meat quality from native Qingyuan part ridge chickens in China.The average everyday gain, mean daily consumption of feed and food-to-gain ratio were shown to be different amongst the groups that were treated. However, dietary rutin treatment reduced drip loss in breast muscle, enhanced fat quantity and breast muscular performance.

Study (15) investigated the way the lipids, cholesterol levels and fat composition of wood chicken breast muscle changed after that were frozen for a period of 12 months. Meats impacted by wood chest myopathy, exhibited reduced amounts of polyunsaturated fatty acids, which were good for health. Longer storage (12 months) degraded this profile, meaning the consumer loses out on significant nutrients.

Study (16) compared the characteristics of meat quality between various chicken types. As the super freezing time in storage went on, both groups of chicks' pH and water retention rate (%) exhibited an upward trajectory toward decline. The study's findings suggested that Rajasri birds have superior grade meat features and could make a valuable supply of chicken due to their superior sensory qualities. It suggested that super chilling might be a useful technique for maintaining the recentness of meat while enhancing its quality attributes.

Study (17) assessed the expression of relevant genes, meat quality, biochemical indicators and productive qualities in several duck breeds. There were eighty ducks used in the experiment. Based on the acquired results, it was possible to draw the conclusion that the highly productive features of mulard ducks can be associated to a variation in growth-related transcription factors. However, the increased activity of the calpain gene was responsible for the capital of Russia ducks' high-quality flesh.

Study (18) determined the way dietary supplements containing vitamin E, C and selenium, either separately or in conjunction, affected the oxidative security, the body features and features of the chest meat's flesh qualities from chickens that were subjected to cyclic extreme temperatures that stored under various circumstances.The results showed that vitamin E increased the quantity of a form and reduced the amount of malondialdehyde (MDA) in breasts flesh, either by itself or in combination with the antioxidant vitamins C and chrome.

Study (19) examined the carcasses and meat quality characteristics of two strains and to offer fundamental information for processing recommendations and pork quality enhancement. The body weight of thin Peking ducks was greater than that of fat Peking ducks, according to the results. Subcutaneous fatty tissue width, fat under the skin weight, subsurface fat percentage terms, belly fat percentage and stomach fat shear strength were considerably higher ($p<0.01$) than those of lean Peking ducks.

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The unusual appearance of wooden breast (WB) has been associated with oxidative damage and has a negative effect on the nutritional value of chicken meat has been evaluated in study (20). While the amount of lactate dehydrogenase production was reduced in wooden breast, superoxide dismutase, hypoxic stimulated factor one alpha and pyruvate dehydrator, kinase 1 had increased relative transcripts levels in woodenbreast. The results corroborate the hypothesis that oxidative stress was related to the modified dietary and technical characteristics of chicken meat in wooden breast.

METHODOLOGY

A traditional neck cut shocked killed thirty ducklings and thirty broilers that were forty-three days old.Following the post-mortem procedures, the breast meats were taken from each carcass after 20 minutes (four birds per species), 40 minutes (three birds per species) and one hour (full process of the remainder of birds). The breast muscle was preserved at 4°C in a cool storage facility and sealed in an apolythene bag. To assess the pH, 15 birds per speciesthree at each experiment throughout the post-mortem period were used. The color, the amount of fatty acids after one and seven days, shear stress value, cooking loss as well as TBARS were measured on the remaining 15 chickens at various storage durations. 24 hours after the birds were killed; proximate analysis was performed on them to determine pH.

pH

A pHmeter corrected daily using standardized pH buffers at 25°C that are 5.0 and 8.0 was used to determine the pH of meat sample.

Approximate ratio

The normal protocols were used to examine three samples of each type of meat for the moisture, fats, proteins and ashes.

Color assessment

Using a konica Chromameter, the outermost color lightness (L*) along with green and red tones (a*) of ducks as well as chicken breasts were determined. For every variety of meat, three arbitrary readings were obtained.

Measurement of fatty acids

The alcohol methanol and formaldehyde were used to extract the lipids in this manner. The samples were held at -40°C until the necessary analysis after being purified using an evaporator machine under nitrogen. An aliquot of 30 mg of phosphor-lipid extracted and a screw-capped vessel, 4 milliliters of 4%H_2SO_4in alcohol were combined to be tested for lipid digestion.After 20 minutes of boiling (100°C) water, the test tube was allowed to cool to room heat. After methylating, the resultant free fatty acids were left for 30 minutes at ambient temperature using 1 ml of 14% boron tri-fluoride was dissolved in a solution of 1 ml of water and 5 ml of solvent were applied. Samples underwent a 10-minute, 500xg centrifugation after that is vortexed. The content of fatty acids was ascertained by analyzing the upper layer of organic solvent.

The gas chromatograph with a flame-ionization sensor and an on-column injector outlet was used to examine fatty acid methyl ester. To separate the fatty acid methyl ester compounds, mixed-silica capillaries columns were utilized. The temperature of the gas chromatograph oven started.The operating temperatures of the sensor and injector port was adjusted to 250°C and 240°C, respectively. One milliliter of fatty acid methyl esters was injected into the split injection port. A helium gas carrier's flow rate was 50 milliliters per minute. Every fatty acid was identified using the requirements' length of retention.

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Loss of cooking

Samples of breast flesh were baked for 30 minutes at 90°C internally then they were vacuum cleaned and weighed. By calculating the mass of the prepared specimen (B) as the proportion of the mass of the already cooked specimen (A) after the process was carried out, cooking loss was identified as shown in Equation (1)

$$Loss\ of\ cooking\ (\%) = [(A-B)/(A)]x100 \quad (1)$$

TBARS test

A 5-gram sample of chicken was placed into a 50-milliliter test tube and a homogenizer was used for 10 seconds at its fastest speed to mix it with 15 milliliters of hydrogenated distilled water. One milliliter of homogenized meat was put into a single-use test tube together with the compound butylatedhydroxyanisole and thiobarbituric/trichloroacetic acid. To achieve the desired color, the liquid was agitated and placed in a bath of boiling water for 15 minutes. After cooling in icy water for ten minutes, the material was agitated once again and spun for fifteen minutes. At 534 millimeters, the absorption of the resultant supernatant solution was measured in comparison to a blank that contained two milliliters of TBA/TCA solutions and one milliliter of double-distilled water (DDW). The milligram of the substance per kilogram of meat was the unit of measurement for TBARS levels.

Analytical statistics

In order to identify the significant variations between means at the five percent threshold of importance, the data from the present study was examined using the statistical analyses Software Association (SAS) analysis of variances process and Duncan's approach was employed.

Shear pressure

The testing machine was used to measure the shear force. For the purpose of measuring shear force, an area as nearly as possible was cut from every cooked chicken breast sample. The meat specimens were positioned perpendicularly to the blade. The whole scale load was 60 kg and the crosshead rate was 100 mm/min.

RESULT AND DISCUSSION

There were no significant differences in pH comparing both birds at the same post-mortem time, with the exception of the first 40 minutes shown in Figure (1). At 30 minutes post-mortem, the pH of chicken meat was greater than that of duck meat ($p<0.05$). This variation implies that while the ultimate pH values of the two birds after a day are similar, the degree or composition of the pH declines right following aftermath assessment changes. Even though the pH level at the end was the same after 24 hours, it was observed that the chicken and duck breast muscles had distinct pHs after 40 minutes, 1 hour and 6 hours after death.Again, differences in pH were seen in identical muscles of different strains from a single genus. The breast meat of four broiler lines had different pH values at 20 minutes, 1 hour and 24 hours.

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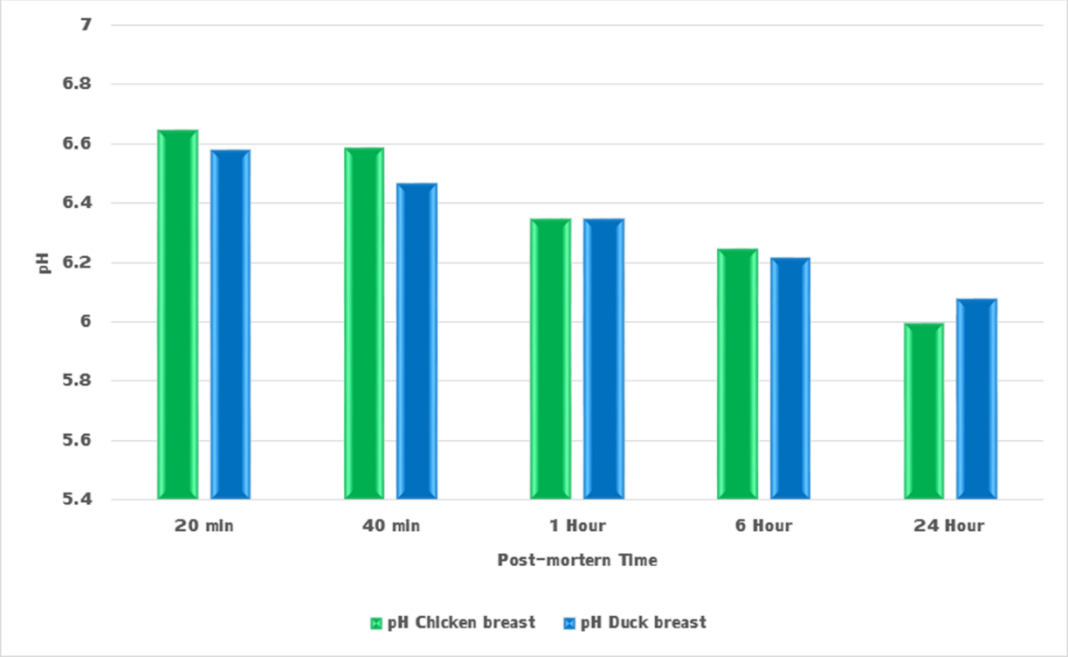

Figure (1). pH of duck and chicken (Source: Author)

Table (1) displays the approximate ratio of chicken and duck meat along with additional flesh properties. The amount of moisture of meat taken from both specie's breasts didn't change ($p>0.05$). There were amounts of crude fatty acids protein and there were substantial variations in the total quantity of ash in meat samples between the two birds. Duck breasts had much more fat than chicken breasts, although chicken breasts had greater levels of protein in their crude form and ash.Compared to chicken breast meat, the flesh from ducklings had far higher moisture and fat content but lower amino acids, ash and calorie content. While there were no significant variations ($p>0.05$) in the moisture content of when comparing duck to chicken breast, the duck breast had a higher value overall. The lower protein and higher fat contents of the duck breast used in the research we conducted, however, was consistent with other findings.

Table (1). Approximate ratio (Source: Author)

Meat's origin	Wetness (%)	Ash (%)	Protein-rich (%)	Fats (%)
Chicken breast	75.47 ± 1.44	1.15 ± 0.06	23.45 ± 0.55	1.05 ± 0.30
Duck breast	76.41 ± 0.70	1.05 ± 0.15	21.78 ± 0.58	2.10 ± 0.12

As anticipated, the meat of ducks had a greater redness (a*) value than that of chickens, but less lightness (L*) value in Table (2). The greater reddish-colored fiber of tissues in duck in comparison to chicken could be connected to the greater a* appreciation in duck meat from the breast. The duck breast's a* value stayed constant throughout the duration of preservation, while the least amount of time was spent storing chicken breasts, at seven days.At 1 and 7 days of preservation, the yellowness (b*) of the chicken and duck breasts did not differ considerably. However, at 3 and 5 days, the b* value of the chicken breast was larger than that of the duck breast.

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Table (2). Values of redness, lightness and yellowness (Source: Author)

Storage Days	a*	b*	L*
Chicken Breast			
1	1.90 ± 1.10	5.60 ± 3.10	58.20 ± 6.20
3	2.70 ± 1.10	9.20 ± 1.80	55.30 ± 4.50
5	2.30 ± 1.50	8.50 ± 3.10	54.20 ± 3.70
7	1.40 ± 0.90	6.80 ± 1.70	58.10 ± 3.80
Duck Breast			
1	18.90 ± 1.20	5.10 ± 0.90	41.80 ± 1.30
3	19.60 ± 0.60	5.60 ± 1.70	43.90 ± 2.20
5	19.30 ± 1.50	6.20 ± 1.80	43.80 ± 2.80
7	19.60 ± 1.70	7.10 ± 1.40	45.40 ± 2.40

Figure (2) shows that over the entire storage period, the cooking loss (%) of duck chest was more than that of chicken breast.In comparison with chicken parts; duck muscles are less able to hold water, which causes more cooking loss and poorer emulsion stability. Additionally, it was discovered that the cooking output and emulsifier activity of duck meat patties were lower than those of broiler and discarded hen meat patties. This is because higher emulsion stability is associated with increased water and fat persistence in the meat matrix.

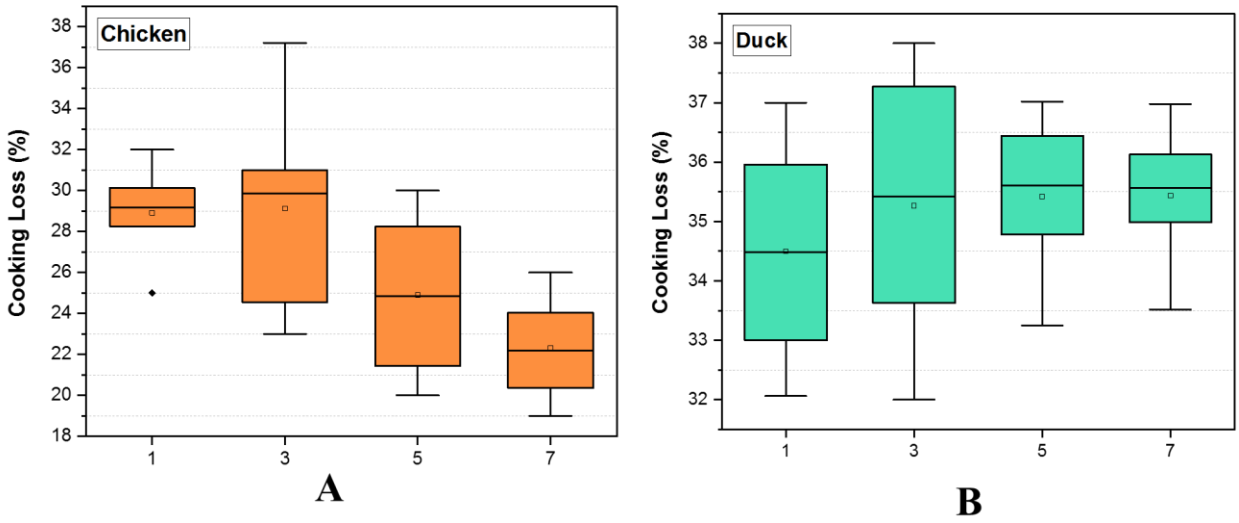

Figure (2). Loss of cooking of (A) chicken and (B) duck (Source: Author)

In our investigation, the shear force measurements for the two species breast meat were observed to differ significantly after 1 and 7 days. Nevertheless, at 3 and 5 days of storage, the outcomes of the duck breast were greater than those of the chicken. Since flesh becomes less tender with prolonged storage, the shear force value falls as storage duration increases. The shear force of duck and chicken are shown in Figure (3).

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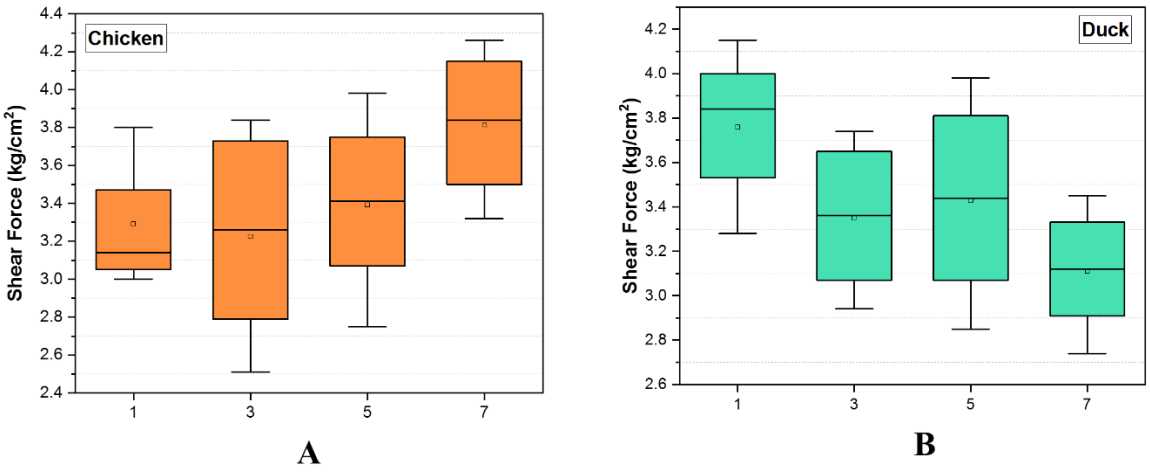

Figure (3). Shear force of (A) chicken and (B) duck (Source: Author)

Table (3) displays the TBARS readings for both duck breast and chicken breast meats as the storage duration increased. Throughout the course of the storage period, duck breast had higher TBRAS values than chicken breast.

Table (3). TBARS readings (Source: Author)

Storage time (Days)	TBARS value	
	Chicken breast	Duck
1	0.14	0.24
3	0.21	0.32
5	0.23	0.34
7	0.28	0.39

When comparing duck breast with chicken and Table (4) shows that the proportions of the fat acids C14:0, 16:0, 1, and 18:2, 3 were much higher, while C18:0 was considerably lower. After a total of seven days in storage, there was a considerable shift in the amount of fatty acids of the flesh from the chicken and duck breasts.

Table (4). Fatty acids (Source: Author)

Lipid Acid	Chicken (1 day)	Chicken (7 days)	Duck (1 day)	Duck (7 days)
C14:0	0.42	0.92	1.07	0.45
C16:0	18.17	23.76	23.08	23.22
C16:1	2.29	3.45	4.39	2.27
C18:0	19.19	11.19	11.12	15.41
C18:1	34.32	39.01	38.02	33.53
C18:2	14.95	17.64	20.34	16.02

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C18:3	0.56	0.64	0.90	0.56
C20:4	12.45	7.84	6.08	13.33
C22:5	1.00	1.05	0.76	0.92
C22:6	1.08	0.99	0.69	1.03
SFA	38.11	36.11	35.41	39.15
USFA	61.89	63.89	64.59	60.85
MUSFA	37.27	40.78	35.41	39.15

Only the duck breast between one and seven days of storage produced significant variations in the overall SFA, USFA and MUSFA. In duck breasts stored for seven days, SFA rosebesides USFA and MUSFA decreased. According to these findings, duck breast meat specimens observed a greater extent significant alteration in fatty acid content after storage than chicken breast meat samples.

CONCLUSION

Bird meat products characteristics and quality were influenced by lipid and pH characteristics. Monitoring pH and lipid characteristics is critical for understanding, optimizing meat's flavor, longevity, as well as improving customer acceptance and overall assessment of animal-based cuisine. We used 30 duck and chicken in this experiment and substantial variation in pH drop at 40 minutes after death suggests that the glycolytic metabolism of duck breast meat differs from that of chicken. The experimental finding, duck breast meat had a much greater redness (a*) value than chicken breast meat, as anticipated, but a smaller lightness (L*) value. Over the course of the storage period, duck breast had a larger cooking loss (%) than chicken breast. Shear force declined with longer storage times in the meat of chicken and duck breasts, it declined more quickly in the case of the duck breast than the chicken breast. Both chicken and duck breast meat had increasing TBARS levels with longer storage times and the TBARS values in the duck breast meat were clearly higher. When comparing duck breast to chicken, the percentages of the fatty acids C14:0, 16:0, 1, 18:2, 3were much greater, whereas C18:0 was considerably lower. During the seven days of storage, SFA increased in duck breast although USFA and MUSFA decreased.

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