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Changes in the physicochemical and microbiological properties of pork and chicken meats at ambient storage condition

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A b s t r a c t: Pork and chicken meat samples were collected from pre-selected slaughterhouses to characterize the pH, titratable acidity (%TA) and aerobic plate count (APC) from slaughter until end of shelf-life at ambient temperature (30±2°C). Results showed that the population of microorganisms on meat samples increased over the storage time. On the other hand, pH and % TA were variable, showing no statistically significant changes throughout the storage period. Based on microbiological analysis, the shelf-life of pork and chicken meats ranged from 8 to 12 h and 3 to 6 h, respectively. Pearson correlation revealed there was no significant relationship between APC and pH of pork ($r = -0.10$, $n = 278$, $p > 0.05$) or between APC and %TA of pork ($r = 0.053$, $n = 278$, $p > 0.05$). On the other hand, there was a weak negative relationship between APC and pH in chicken ($r = -0.165$, $n = 267$, $p < 0.005$) and a positive relationship between APC and %TA ($r = 0.401$, $n = 266$, $p < 0.005$). This showed that pH cannot be used as a good indicator of meat spoilage. Furthermore, the differences between fresh and obviously spoiled meat samples, for both pH and %TA, were not great enough for practical use.

Keywords: *Pork, Chicken, pH, Aerobic Plate Count, Titratable Acidity*

Introduction

Pork and chicken meats are among the most popular and widely consumed livestock meats all over the world (*FAO*, 2014). In the Philippines, pork meat had an average volume production of more than 2 billion kg annually in the period 2011–2016, which is the highest among all types of meat as recorded by the Philippine Statistics Authority (*PSA*, 2017). It was followed by chicken with an average volume production of more than 1.6 billion kg in the same period (*PSA*, 2017). Newly slaughtered meats such as pork and chicken are traditionally handled, distributed, and marketed in the Philippines at ambient temperatures in wet markets for a specified period of time within the day of slaughter (*National Meat Inspection Services*, 2012). According to *Tejada et al.* (2013), a lot of low-income Filipino consumers do not have refrigerators and rely only on wet markets for their daily freshly slaughtered meat supply, buying just in time for consumption on the same day.

Handling of fresh meat at ambient temperature is not widely accepted in some other countries. According to *Koutsoumanis et al.* (2006), temperature conditions higher than 10°C during transportation, retail storage and consumer handling can result in an unexpected loss of quality and a significant decrease of meat shelf-life. On the contrary, the local regulation reiterates that the traditional practice in the Philippines of handling and distributing of newly slaughtered meat has a historical record of safe consumption, having no public health problem traceable to the product (*NMIS*, 2012). As such, the Codex Code of Hygienic Practice for Meat (*CAC/RCO 58*, 2005), which recommends that meat be held at "temperatures that achieve safety and suitability objectives" is prescribed. We believe this recommendation is too non-specific, and thus could be open to several interpretations.

Temperature of meat during storage and initial microbial level are major factors affecting the shelf-life and quality of raw meat (*Koutsoumanis et al.*, 2006). Metabolic activities of microorganisms responsible for spoilage can produce metabolites that result in off-odours, greater exudate viscosity, and chemical modifications in the meat once the

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microbial population exceeds 7 log CFU g^{-1} (*Raab et al.,* 2008). Since freshness of meat is the main criterion that influences the purchasing decision of consumers, it is imperative to determine the end of shelf-life and to assess the quality changes of meat during storage conditions without strict temperature control, as this is commonly practiced by our target population.

Shelf-life determination and assessment of quality changes of meat are commonly done by chemical, microbiological, and sensory methods or their combinations. Although the microbial method is the most desirable from the theoretical point of view, this technique requires two days or more for incubation and results (*Dainty*, 1996). Alternatively, the strong relationship between spoilage from the growth of bacteria and chemical indices could be used as a supplementary technique in determining end of shelf-life and assessing meat quality (*Dainty,* 1996). Some literature studies recognize pH and % titratable acidity (based on lactic acid) determinations as essential indicators of microbial spoilage in meat (*Nassos et al.,* 1983; *Hernández-Herrero et al.*, 1999). The practical advantage of using the pH determination lies in its simplicity and rapidity (*Pearson*, 1968). Thus, the objective of this study was to come up with a profile of the changes in the microbiological and physicochemical changes in pork and chicken meats exposed to ambient temperature (30±2°C). This study also aimed at investigating the relationships of the measured quality parameters in the hope of coming up with a chemical change-based indicator of microbial spoilage.

Materials and Methods

Preparation of meat samples

Pork loins, specifically the loin centre cut (approximately 5 kg), from newly slaughtered carcasses were obtained from a preselected slaughterhouse in Valenzuela City, Philippines. A total of eleven (11) pieces of pork loin was collected on six different sampling dates at 45 mins after slaughter. Each sampling date represents one (1) independent run while each piece of pork loin per run represents the internal replicate. Collected samples were packed in a sterile polyethylene (PE) bag, placed in a cooler box containing ice (1–4°C), and were immediately transported within 45 mins to the Food Processing Division (FPD) of Industrial Technology Development Institute (ITDI) to avoid further contamination. Upon arrival at FPD, the pork loins were deboned, and the skin and fats were trimmed under aseptic conditions. Pork loins were then cut into sample blocks of 3.0 cm × 3.0 cm × 2.0 cm (approximately 20 g), which were placed in sterile petri dishes. Meat samples were stored at ambient temperature (30±2°C) and were analysed every hour up to twelve hours.

Chicken breasts (approximately 500–600 g) were obtained from newly slaughtered broilers in a preselected poultry dressing plant in Valenzuela City, Philippines. About 3 kg, i.e., 6 pieces of chicken breast were collected randomly per run at 20 mins *post mortem*, and this was repeated on ten (10) different sampling dates. Collected chicken breasts were packed in sterile PE bags and were brought to the laboratory at FPD-ITDI in a cooler box containing ice. At the laboratory, chicken breasts were skinned and deboned. The resulting chicken breast fillets were then cut into sample blocks, stored, and monitored in a similar manner as pork loin samples.

Quality deterioration monitoring

For the pH determinations, 5 g of meat sample was mixed with 45 ml of freshly boiled distilled water (cooled in a closed container at room temperature prior to use) using a stomacher (Lab-blender 80, Seward, England) for 1 minute. The supernate was used for pH determination. The pH was measured using a digital pH meter (LAQUA-PH1100, Horiba Scientific, Japan) at room temperature. Each value is the mean of three repeated measurements (*Zhang et al*., 2012).

The titratable acidity (TA, % lactic acid) was determined following the procedure described by *Shelef and Jay* (1970). Meat (10 g) was mixed with 200 ml of distilled water using a stomacher. The supernate was transferred into a 250 ml volumetric flask and distilled water was added until the volume reached the 250 ml mark. The supernate was then filtered through Whatman filter paper No.1. A 25 ml volume of filtrate was added to 75 ml distilled water with three drops of 1% phenolphthalein indicator solution and was titrated against 0.1 N NaOH endpoint, indicated by a faint pink colour which persisted for 30 seconds. TA was calculated using the equation given below:

$$\text{A, \% lactic acid} = \frac{\text{ml of 0.1 N NaOH} \times 0.1 \times \text{meq wt of lactic acid}}{\text{weight of sample (g)}} \times \times 100 \times \text{Dilution Factor (1/10)}$$

The aerobic plate count (APC) of meat samples was determined using 3M™ Petrifilm™. Briefly, a 10 g portion of meat sample was aseptically transferred to a sterile stomacher bag and mixed with

90 ml of 0.1% sterile peptone (HiMedia, India). The mixture was stirred for 2 minutes using a stomacher. The resulting supernate was serially diluted up to 10^7 dilutions by transferring 10 ml of previous dilution to 90 ml of diluent for better enumeration. From the prepared serial dilutions, 1 ml of each dilution was pour plated in triplicate on APC petrifilms. The inoculated petrifilms were incubated at 35°C for 48 h (AOAC International, 2012). After incubation, colonies that emerged on the petrifilms were counted and interpreted using the interpretation guide provided by 3M™ Petrifilm™. APC were expressed as log CFU (colony-forming units) per gram of meat sample.

Statistical Analysis

Descriptive statistical analysis using minimum, maximum, mean and standard deviation was utilized to describe the pH, APC, and %TA of meat. Pearson correlation coefficient was computed to describe the strength and direction of the relationship between the measured quality parameters at $p<0.05$. Data obtained in the study was also subjected to one-way analysis of variance (ANOVA) to determine if there were statistically significant differences among samples during storage at $p<0.05$. The Tukey's test was used as the *post hoc* test for samples showing significant differences. All Statistical analysis was computed using the IBM Statistical Packages for Social Sciences (SPSS) Statistics 22 (SPSS, Inc. 2013, New York, USA) software.

Results and Discussion

Changes in pH, %TA, and APC in pork and chicken meats

The changes in pH, %TA and APC of pork loin and chicken breast fillet throughout the storage at ambient temperature for twelve hours are shown in Figures 1 and 2, respectively. The initial mean pH of pork was 6.22±0.37 and %TA was 0.81±0.19%. For chicken meat, initial pH and %TA values were 6.15±0.22 and 0.82±0.07%, respectively. pH values

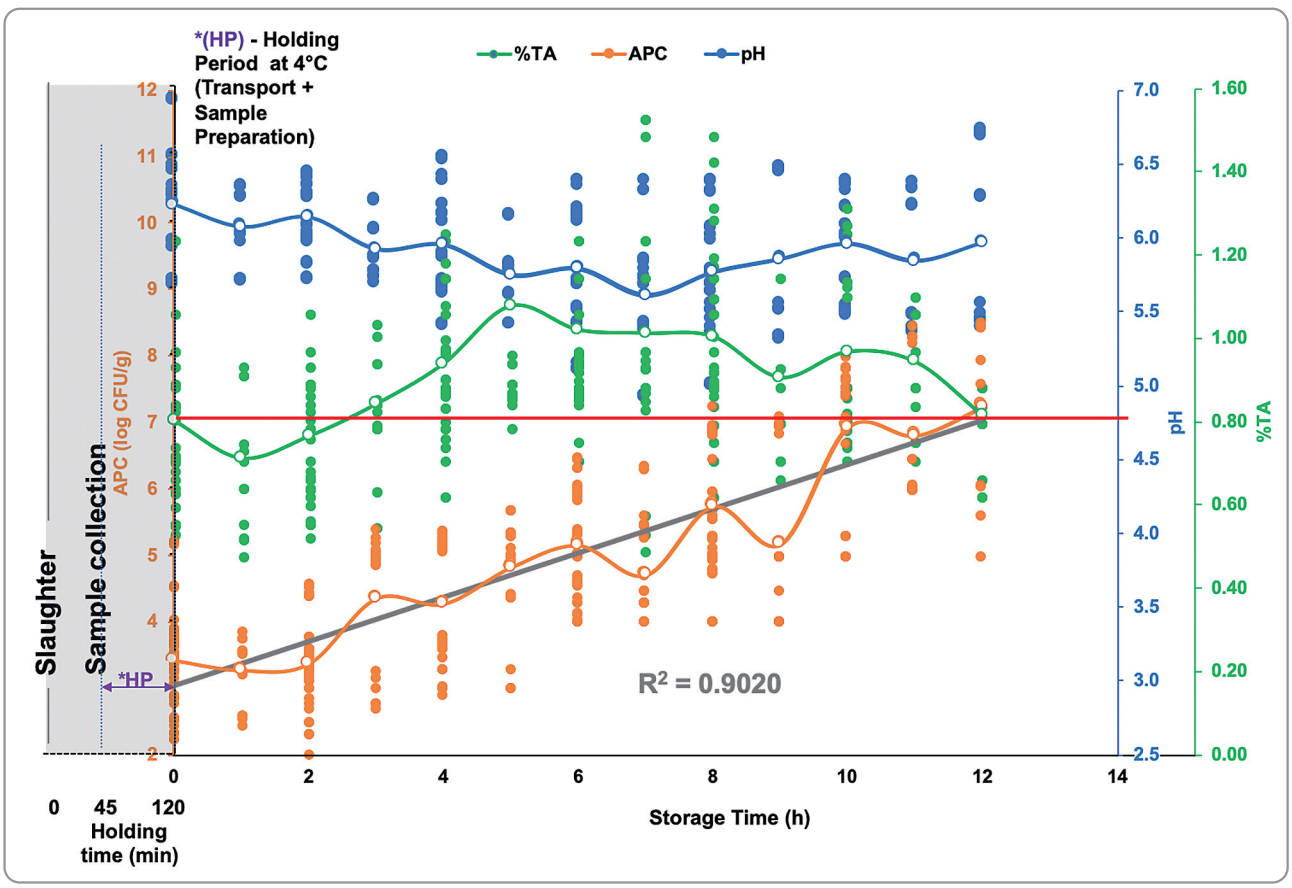

Figure 1. Aerobic plate count (APC), pH and titratable acidity (%TA) of pork meat stored at ambient temperature from 0 to 12 h obtained from eleven (11) sampling runs with three internal replicates per each run. Average values of each parameter are represented by unfilled markers within the curves with similar colour obtained per storage time. The grey curve represents the APC population fit in the *Baranyi and Roberts* (1994) model.

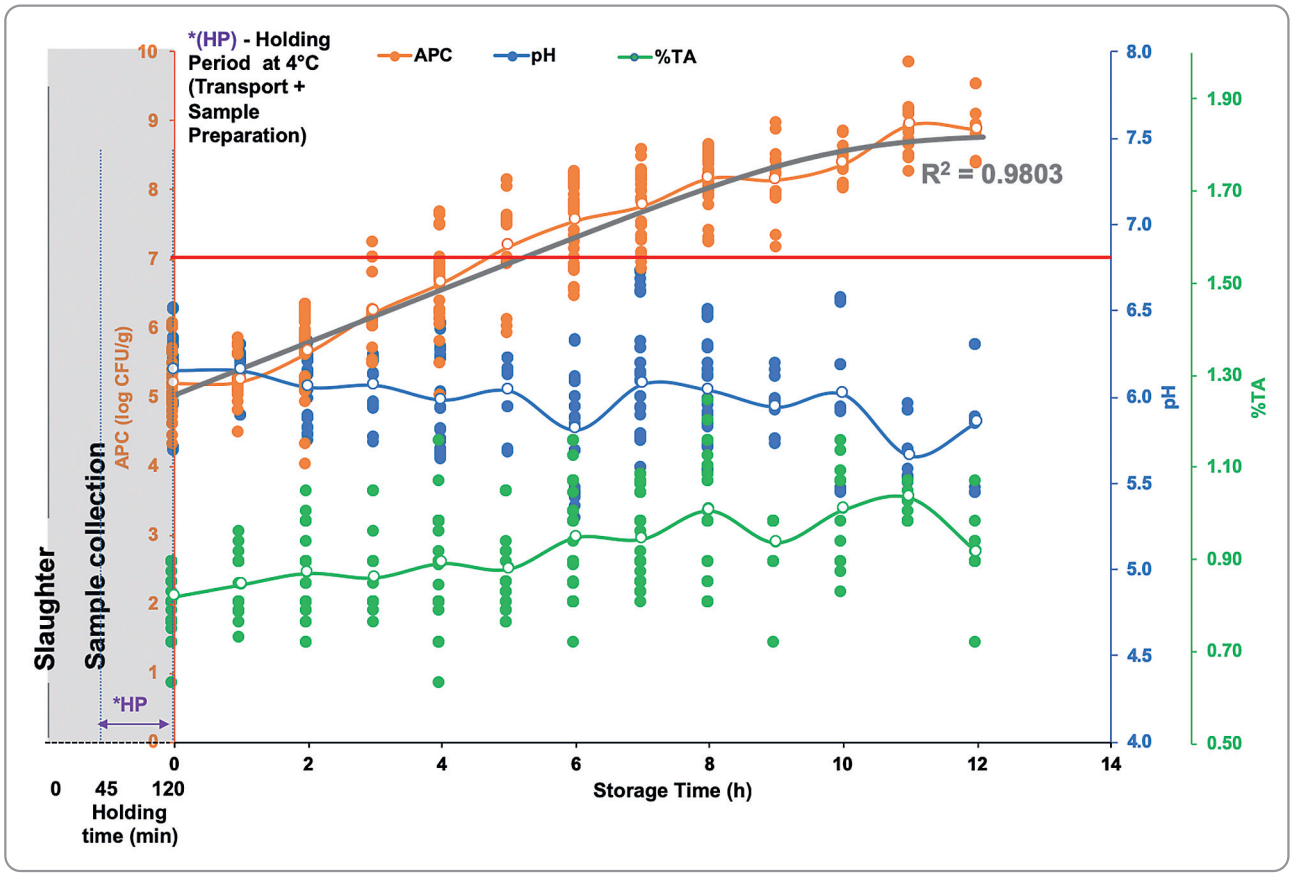

Figure 2. Aerobic plate count (APC), pH, and titratable acidity (%TA) of chicken meat stored at ambient temperature from 0 to 12 h obtained from ten (10) sampling runs with three internal replicates per each run. Average values of each parameter are represented by unfilled markers within the curves with similar colour obtained per storage time. The grey curve represents the APC population fit in the *Baranyi and Roberts* (1994) model.

of both meats were comparable to the acceptable meat quality of newly slaughtered pork (*Boler et al.*, 2010) and chicken (*Ristic & Dame*, 2010) meats. On the other hand, %TA is not commonly measured in newly slaughtered meat, but based on the studies of *van Laack* (2000) and *Terefe* (2017), fresh meat with pH of 5.56±0.12 and 5.71±0.05 had %TA of 1.4±0.2% and 0.96±0.17%, respectively.

pH and % TA of both meats in the present study were variable during storage. Generally, a decreasing trend was observed for pH but an increasing trend for %TA; however, the changes in both parameters were not significant throughout the storage period of pork (Table 1) and chicken (Table 2) meats. These results did not show similar trends to several studies conducted previously. In the study of *Choi et al.* (2017), the pH of pork meat stored aerobically at room temperature for 48 h and monitored every 4 h increased during storage. In other studies that used different storage conditions, the trends in pH increased whereas the trends in titratable acidity decreased during storage, regardless of whether the meats were pork or chicken (*Golasz et al.,* 2013; *Kuswandi et al.,* 2014; *Singh, Sahoo, Chatli & Biswas*, 2014; *Terefe*, 2017). The difference of the present results from the previous studies could be due to differences in setting the time for the initial readings of pH and %TA in meat and the monitoring duration and intervals.

The generally decreasing trends in pH and increasing trends in %TA of pork and chicken meats in the present study could be attributed to the conversion of available glucose into organic acids by lactic acid bacteria (LAB) (*Hernandez-Herrero et al.*, 1999; *Fraqueza et al.*, 2008), a group of spoilage bacteria that is commonly present in meat carcasses (*Chouliara et al.*, 2008; *Patsias et al.*, 2008). There is a possibility that the pH of pork and chicken meats in the present study would also increase if stored for longer durations, as was observed by *Choi et al*. (2017) in their study. This commonly happens when the growth of *Pseudomonas* overtakes that of LAB, causing increased production of ammonia and other products of amino acid decomposition

Table1. Titratable acidity, pH, and aerobic plate count (APC) of pork meat stored under ambient temperature for 12 hours

Storage time (hours)	Titratable acidity (% lactic acid)			pH			APC (log CFU/g)		
	Mean±SD	Min	Max	Mean±SD	Min	Max	Mean±SD	Min	Max
Initial	0.81±0.19^{bcd}	0.55	1.28	6.22±0.37^{a}	5.67	6.93	3.42±0.76^{ef}	2.23	5.23
1	0.70±0.17^{d}	0.49	0.97	6.07±0.26^{ab}	5.69	6.34	3.27±0.50^{g}	2.43	3.85
2	0.77±0.15^{cd}	0.54	1.10	6.14±0.25^{ab}	5.70	6.53	3.37±0.56^{g}	2.00	4.57
3	0.85±0.14^{bcd}	0.56	1.07	5.92±0.20^{abc}	5.68	6.25	4.35±1.04^{cde}	2.70	5.41
4	0.94±0.17^{abcd}	0.64	1.30	5.95±0.34^{abc}	5.39	6.54	4.27±0.96^{def}	2.90	5.39
5	1.08±0.35^{a}	0.81	1.79	5.75±0.25^{bc}	5.40	6.14	4.82±0.84^{bcd}	3.00	5.69
6	1.03±0.26^{ab}	0.73	1.79	5.79±0.37^{bc}	5.09	6.38	5.15±0.84^{bc}	4.00	6.50
7	1.02±0.30^{ab}	0.50	1.59	5.61±0.42^{c}	4.91	6.37	4.70±0.58^{bcd}	4.00	5.60
8	1.01±0.21^{ab}	0.64	1.54	5.77±0.39^{bc}	4.99	6.37	5.74±0.98^{b}	4.00	7.26
9	0.91±0.15^{abcd}	0.68	1.19	5.86±0.51^{abc}	5.30	6.47	5.17±1.20^{b}	4.00	7.11
10	0.97±0.22^{abc}	0.73	1.36	5.96±0.34^{abc}	5.46	6.38	6.93±0.95^{a}	5.00	8.01
11	0.95±0.15^{abc}	0.73	1.14	5.84±0.45^{abc}	5.35	6.36	6.80±1.08^{a}	6.00	8.49
12	0.82±0.11^{bcd}	0.64	0.91	5.97±0.56^{abc}	5.38	6.72	7.23±1.39^{a}	5.00	8.53

Note: Different letters within a column indicate significant differences ($p<0.05$)

Table 2. Titratable acidity, pH, and aerobic plate count (APC) of chicken meat stored under ambient temperature for 12 hours

Storage time (hour)	Titratable acidity (% lactic acid)			pH			APC (log CFU/g)		
	Mean±SD	Min	Max	Mean±SD	Min	Max	Mean±SD	Min	Max
Initial	0.82±0.07^{d}	0.63	0.90	6.15±0.22^{a}	5.67	6.49	5.20±0.49^{g}	4.30	6.00
1	0.85±0.07^{cd}	0.73	0.97	6.15±0.14^{a}	5.87	6.28	5.23±0.36^{g}	4.48	5.84
2	0.87±0.09^{cd}	0.72	1.06	6.05±0.18^{ab}	5.73	6.30	5.65±0.53^{g}	4.00	6.33
3	0.86±0.09^{cd}	0.76	1.06	6.07±0.18^{ab}	5.72	6.22	6.23±0.52^{f}	5.48	7.23
4	0.89±0.11^{cd}	0.63	1.17	5.98±0.26^{ab}	5.62	6.40	6.65±0.55^{f}	5.00	7.67
5	0.88±0.10^{cd}	0.77	1.06	6.03±0.19^{ab}	5.66	6.20	7.18±0.68^{e}	5.90	8.13
6	0.95±0.12^{abc}	0.72	1.17	5.81±0.31^{bc}	5.28	6.31	7.55±0.56^{de}	6.45	8.26
7	0.95±0.09^{abc}	0.81	1.10	6.07±0.35^{ab}	5.54	6.70	7.76±0.50^{cd}	6.85	8.57
8	1.01±0.14^{ab}	0.81	1.26	6.04±0.30^{ab}	5.55	6.48	8.16±0.35^{bc}	7.23	8.63
9	0.94±0.08^{abc}	0.72	0.99	5.94±0.15^{abc}	5.71	6.17	8.14±0.50^{bc}	7.14	8.95
10	1.01±0.12^{ab}	0.83	1.17	6.01±0.42^{ab}	5.43	6.55	8.37±0.25^{b}	8.01	8.82
11	1.04±0.04^{a}	0.99	1.08	5.66±0.17^{c}	5.49	5.94	8.93±0.44^{a}	8.25	9.83
12	0.92±0.08^{bcd}	0.72	1.08	5.85±0.31^{bc}	5.43	6.28	8.87±0.40^{a}	8.36	9.51

(*Hernandez-Herrero et al.,* 1999; *Masniyom et al.*, 2002; *Fraqueza et al.,* 2008). This notion can be supported by the locally conducted study of *Pel et al.* (2017), where fresh pork from a wet market was monitored for 30 h every 5 h. The initial pH of pork meat in their study was 6.13 which decreased to 6.06 after 10 h of storage. Reversal in the pH trend began at 15 h, and it continuously increased until 30 h. Similar to the present study, although the pH of pork initially decreased after 10 h of storage in the study of *Pel et al.* (2017), the decrease was not significant.

Aside from microbiological activity, the minimal and insignificant changes of pH and %TA in meat in the present study can also be explained by several biochemical reactions involved in the conversion of muscle to meat. The normal muscle pH of a live animal is close to neutral, and ranges from 6.5 to 6.8 (*Pel et al*., 2017), but can reach up to 7.2 to 7.3 in some cases (*Knox*, 2003). Immediately after slaughter, anaerobic glycolysis begins and the stored glycogen in the muscle is converted into lactic acid, leading the muscle pH to decrease (*Bruckner*, 2010). Muscle pH falls steadily from slaughter until the muscle runs out of energy or the pH is too low for enzymatic activity and the rigor is complete (*Marsh*, 1981). At the post-rigor stage, all reserve glycogen in the muscle has already been used up, and therefore, lactic acid formation would be ceased, maintaining the pH level and %TA of meat for a certain period of time. In addition, *Nielsen and Nielsen* (2012) discussed that the meat pH, after glycolysis has been completed, depends not only on the lactate concentration but also on the pH buffer capacity of the tissue. In pork and chicken meats, the buffer capacity of the muscle tissue originates primarily from carnosine (β-alanyl-l-histidine). Carnosine is a dipeptide that can neutralize the lactic acid formed when the degradation of glycogen exceeds the capacity of the Krebs cycle (*Abe*, 2000). These could be the possible reasons why the pH and %TA of the post rigor meat samples in the present study did not change significantly throughout storage.

Another important quality indicator in meat is APC. It represents the largest group of microorganisms enumerated in food and serves as an indicator of the overall level of contamination in fresh pork (*Knox*, 2003). The initial APC levels of our pork meat ranged from 2.23 to 5.23 log CFU g^{-1}, while the initial APC levels of chicken were 4.30 to 6.0 log CFU g^{-1} (Tables 1 and 2). The APC levels were in agreement with the ranges reported by other works for animal carcasses slaughtered under appropriate hygienic conditions (*West et al.*, 1972; *Göksoy et al.*, 2004; *Zhang et al.,* 2012). The microbial population increased over storage time, reaching 5.0 to 8.53 log CFU g^{-1} for pork (Figure 1) and 8.36 to 9.51 log CFU g^{-1} for chicken (Figure 2) at the end of 12 h storage. Pork and chicken meat samples reached the end of shelf-life between 8 to 12 h and between 3 to 6 h of storage, respectively, after attaining the average APC value of 7.0 log CFU g^{-1}, which was previously considered as the upper acceptability limit for fresh meat *(Senter et al.*, 2000). The APC of pork obtained in this study agrees with that reported in the study of *Tejada et al*. (2013). Based on their study, newly slaughtered meat with initial APC of 3.81 reached 7.0 log CFU g^{-1} at 10 h. On the other hand, chicken meat reached the average APC value of 7.0 log CFU g^{-1} after 5 h of storage but there were a few samples that already reached the end of shelf-life after as little as 3 h of storage.

Local regulations allow the holding of newly slaughtered meat in the wet market for 8 h (*NMIS*, 2012). In the current study, the microbial shelf-life of the newly slaughtered pork was still acceptable after 8 h storage, but that of chicken was unacceptable. Although the present study in our laboratory setting found newly slaughtered pork meat can maintain an acceptable microbial level until 8 to 12 h post slaughter, another local study reported the microbial count of meat obtained from a wet market was already unacceptable after 5 h of storage at ambient temperature (*Pel et al.*, 2017).

Relationship of pH, APC and %TA in pork and chicken meats

Relationships between pH, APC and %TA in pork and chicken meats were determined using Pearson correlation coefficient as shown in Tables 3 and 4, respectively. %TA had a direct opposite trend to that of meat pH, as was observed in some other studies (*Singh et al.,* 2014; *Terefe*, 2017). Several studies show that pH can be used for monitoring of meat shelf-life due to its relationship with microbial spoilage (*Mano et al.*, 2002; *Muela et al.*, 2010; *Kanatt et al.*, 2010; *Golasz et al.*, 2013). There was a significant negative relationship between pH and %TA of pork ($r = -0.593$, $n = 288$, $p < 0.005$) and between pH and %TA of chicken ($r = -0.338$, $n = 281$, $p < 0.005$). Although these results somewhat support the previous studies of *Singh et al.* (2014) and *Terefe* (2017), they also negate the result of *van Laack* (2000). According to the Department of Food, Bioprocessing and Nutrition Sciences (FBNS, n.d), there is no fixed relationship between pH and titratable acidity

Table 3. Pearson correlation of %TA, pH and aerobic place count (APC) of pork meat

		%TA	pH	APC (log CFU/g)
%TA	Pearson Correlation	1	−.593**	.053
	Sig. (2-tailed)		.000	.376
	N	288	288	278
pH	Pearson Correlation	−.593**	1	–.010
	Sig. (2-tailed)	.000		.865
	N	288	288	278
APC (log CFU/g)	Pearson Correlation	.053	−.010	1
	Sig. (2-tailed)	.376	.865	
	N	278	278	342

Legend: **Correlation is significant at the 0.01 level (2-tailed).

Table 4. Pearson correlation of pH, titratable acidity (%TA) and aerobic plate count (APC) of chicken meat

		pH	%TA	APC (log CFU/g)
pH	Pearson Correlation	1	−.338**	−.165**
	Sig. (2-tailed)		.000	.007
	N	282	281	267
%TA	Pearson Correlation	−.338**	1	.419**
	Sig. (2-tailed)	.000		.000
	N	281	281	266
APC (log CFU/g)	Pearson Correlation	−.165**	.419**	1
	Sig. (2-tailed)	.007	.000	
	N	267	266	342

Legend: **Correlation is significant at the 0.01 level (2-tailed).

in a food; instead, the pH is influenced by the ability of the acids present to dissociate (*Neta et al.*, 2007).

No statistically significant relationships were found between APC and pH (r=−0.10, n=278, $p>0.05$) and between APC and %TA (r=0.053, n=278, $p>0.05$) of pork. These findings agree with *Bruckner* (2010) and *Pel et al.* (2017). Contrariwise, there was a weak negative relationship between APC and pH (r=−0.165, n=267, $p<0.005$) in chicken and a positive relationship between APC and %TA (r=0.419, n=266, $p<0.005$). This indicates that pH cannot be used as a good indicator of meat spoilage. Moreover, the differences between fresh and obviously spoiled meat in the present study, for both pH and %TA, were not great enough for practical use. These impressions were demonstrated by the statistically treated average values of pH, APC, and %TA, as shown in Table 1 for pork and Table 2 for chicken. Results of ANOVA showed that the pH and %TA of pork meat stored for 8 to12 h (spoiled meat) were not significantly different ($p>0.05$) to the same parameters of some of our pork meat stored for 0 to 7 h (acceptable meat). Similarly, pH and %TA of chicken meat stored for 3 to 12 h (spoiled meat) showed no significant difference ($p>0.05$) to these parameters in some of the chicken meat stored for 0 to 2 h (acceptable meat). However, APC levels in spoiled pork and chicken meats were significantly different ($p<0.05$) from those in meats that were still acceptable for consumption.

Conclusion

As a general evaluation, the microbial populations of pork and chicken meats both increase during storage for 12 hours at ambient temperature, while pH and %TA of the meats are not significantly affected by this storage. Relationships between APC and physicochemical characteristics of both meats are weak. Therefore, developing microbial spoilage indicators based on either pH or %TA for meat may not be feasible, and based on this study, the only way to determine the shelf-life of meat is to conduct microbiological analysis. In terms of microbiological shelf-life (APC <7 log CFU g^{-1}), a suitable pork shelf-life is attained when the local regulation of maximum holding time of 8 h at ambient temperature is conformed with, while some chicken meat can reach the end of its shelf-life in as little as 3 h storage at ambient temperature, showing non-conformity. Research related to shelf-life determination of newly slaughtered meat, particularly chicken, at ambient temperature is very scanty and rare. This may be due to the fact that holding fresh meat at ambient temperature is not widely accepted in other countries. With that, conduct of related study is encouraged to gather more information on meat spoilage occurrence in local scenarios. Moreover, development of affordable methods as alternatives to chilling to extend the shelf-life and overall safety of raw meat are necessary, especially for developing countries that practice the same method of meat handling as described in this study.

Promene u fizičko-hemijskim i mikrobiološkim svojstvima svinjskog i pilećeg mesa u uslovima ambijentalnog skladištenja

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A p s t r a k t : Uzorci svinjskog i pilećeg mesa su uzeti iz prethodno odabranih klanica kako bi se odredila pH vrednost, % TA i broj aerobnih bakterija (Aerobic Plate Count — APC) od vremena klanja do isteka roka trajanja na sobnoj temperaturi (30±2°C). Rezultati su pokazali da se populacija mikroorganizama u uzorcima mesa povećavala tokom vremena skladištenja. Sa druge strane, pH vrednost i% TA su varirali i nisu pokazali statistički značajne promene tokom perioda skladištenja. Na osnovu mikrobiološke analize, rok trajanja svinjskog i pilećeg mesa kretao se u rasponu od 8 do 12 h, odnosno 3 do 6 h. Pearsonova korelacija otkrila je da ne postoji značajna veza između broja aerobnih bakterija i pH vrednosti svinjetine ($r = -0,10$; $n = 278$, $p > 0,05$) i između broja aerobnih bakterija i % TA svinjetine ($r = 0,053$; $n = 78$, $p > 0,05$). S druge strane, postojala je slaba negativna korelacija između broja aerobnih bakterija i pH vrednosti kod piletine ($r = -0,165$; $n = 267$, $p < 0,005$) i pozitivna između broja aerobnih bakterija i % TA ($r = 0,401$; $n = 66$, $p < 0,005$). To je pokazalo da se pH vrednost ne može koristiti kao dobar pokazatelj kvarenja mesa. Pored toga, razlike između uzoraka svežeg i očigledno pokvarenog mesa, za pH vrednost, kao i za % TA, nisu bile dovoljno velike za praktičnu upotrebu.

Ključne reči: *svinjetina, piletina, pH, broj aerobnih bakterija, titrabilna kiselost.*

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