# EFFECT OF PLASMA-ACTIVATED GALLIC-LACTIC ACID ON THE BIOLOGICAL AND PHYSICOCHEMICAL TRAITS OF CHICKEN DURING STORAGE

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## I. INTRODUCTION

Poultry meat is highly perishable and prone to microbial growth due to its biological composition and favorable environment. The use of organic acids such as gallic, lactic, acetic, and citric in the meat industry for decontamination is well established due to their antimicrobial properties and cost-effectiveness [1]. Gallic acid is known for its antioxidant and antimicrobial activity, but its milky and yellow crystalline appearance from gallotannic acid, may negatively affect the appearance of meat [2]. Low concentrations of gallic acid mixed with other organic acids may help to overcome their effects. The integration of plasma activation with organic acids has a synergistic effect in an acidic environment, leading to changes in redox potential, conductivity, and the formation of reactive oxygen nitrogen species (ROS) [3]. The study aims to evaluate the potential of plasma-activated gallic-lactic acid (PLGA) as a decontamination method for chicken meat (breasts and drumsticks) also assessing its effect on the biological and physicochemical of chicken meat during storage.

## II. MATERIALS AND METHODS

At 0.3 % concentration of organic acids was selected for the study based on preliminary studies. To prepare the LGA solution, 0.3% gallic acid and 0.3% lactic acid were mixed (1:1 v/v) and exposed by the plasma discharge for one hour using zirconium based on the preliminary experiment. Atmospheric air was used as the operating gas, and plasma was generated at 10 kHz and 2.0 kVpp. Chicken breasts and drumsticks were purchased from a local store and the skin was removed using a sterile knife. The samples were then cut into pieces weighing 50± 0.1 g. Total 108 samples of each chicken type were randomly allocated into four treatments: deionized water (DDW), mixed lactic and gallic acids (LGA), plasma-treated deionized water (PAW), and plasma-treated LGA (PLGA). Each solution (200 mL) was treated with every 9 samples for 5 mins of the reaction time at room temperature (20 ± 1°C). The samples were stored in separate containers under aerobic conditions at 4 ± 0.5°C, and were analyzed at 0, 4, and 8 days of storage. Several parameters including thiobarbituric acid reactive substance (TBARS), total bacterial count (TBC), pH, and color. TBC, pH, and color were measured immediately after sampling while the remaining samples were stored at -80°C prior to TBARS analysis.

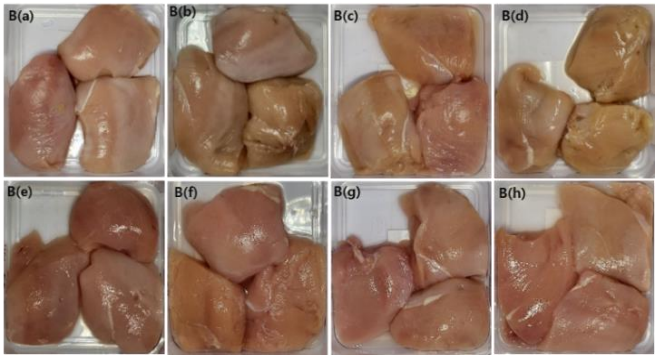


**Figure 1.** Representative pictures of chicken breasts (B)**.** CON at 0d (a), LGA at 0d (b), PAW at 0d (c), PLGA at 0d (d), CON at 8d (e), LGA at 8d (f), PAW at 8d (g) and PLGA at 8d (h).

## III. RESULTS AND DISCUSSION

The PLGA treatment in chicken breasts resulted the lowest TBC and TBARS values at day 8 of storage compared to the other treatments ($p<0.05$) (Figure 2A and 2C). However, the PLGA

treatment in chicken drumsticks showed the lowest TBC during the entire storage days ($p<0.05$) (Figure 2B). The PLGA in chicken drumsticks also had the lowest TBARS values, although the difference was not statistically significant (Figure 2D). The gallic acid is known for its antioxidant properties, while lactic acid is commonly used as a food preservative due to its ability to inhibit bacterial growth [1,2]. Additionally, synergistic effect of plasma activation and organic acids results in a significant increase in antimicrobial effect [3].

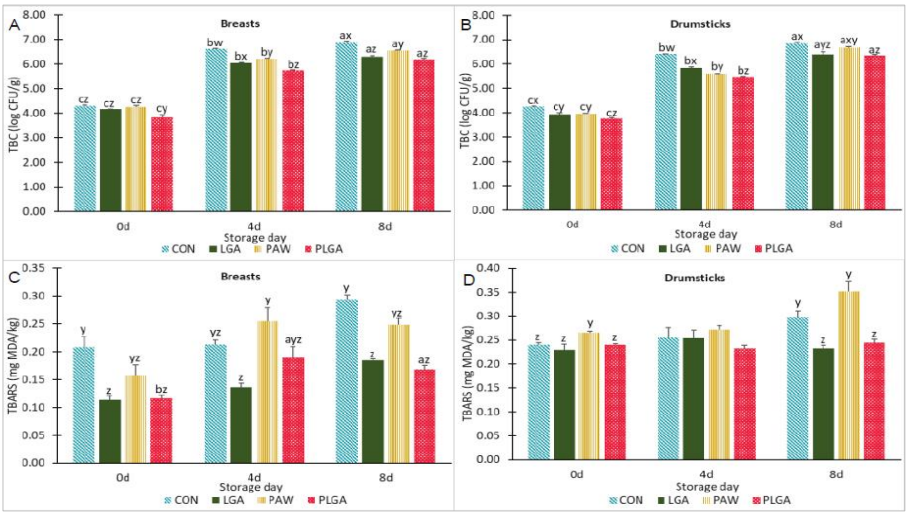


**Figure 2.** Total bacterial count and lipid oxidation of chicken meat. A and C, chicken breasts; B and D, chicken drumsticks. All values represent the mean ± standard error (n=3). $^{a-c}$Different letters within the day differ significantly ($P < 0.05$). $^{w-z}$Different letters within the treatment differ significantly ($P < 0.05$).

The PLGA treatment proved the lowest pH in both cuts at day 0 (5.89-6.73) differing from other treatments (5.91-6.76) (data not shown). This is likely due to the generation of ROS during plasma treatment under acidic conditions from the organic acids [3]. Interestingly, LGA and PLGA treatments had no significant effect on the yellowness of chicken breasts during storage, but instead, the yellowness of LGA and PLGA was improved from day 0 (16.69-16.32) to day 8 (15.87-15.44) (Figure 1). In contrast, the PLGA treatment in chicken drumsticks had significantly higher yellowness at day 0 than the other treatments, which then plateaued during storage. The co-effect of LGA and plasma in meat products may help to preserve their quality by reducing microbial growth, lipid oxidation and improving color stability, particularly in chicken breasts.

## IV. CONCLUSION

Overall, the combination of LGA along with plasma treatment (PLGA), have shown promise as natural solutions for preserving chicken meat during storage. This method has the potential to maintain the quality and appearance of the meat, while also reducing the need for conventional sanitizers and potentially harmful chemical additives in the meat processing industry. Further research may be needed to optimize the PLGA treatment parameters for different types of meat and to evaluate its effectiveness under different storage conditions.

## REFERENCES


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