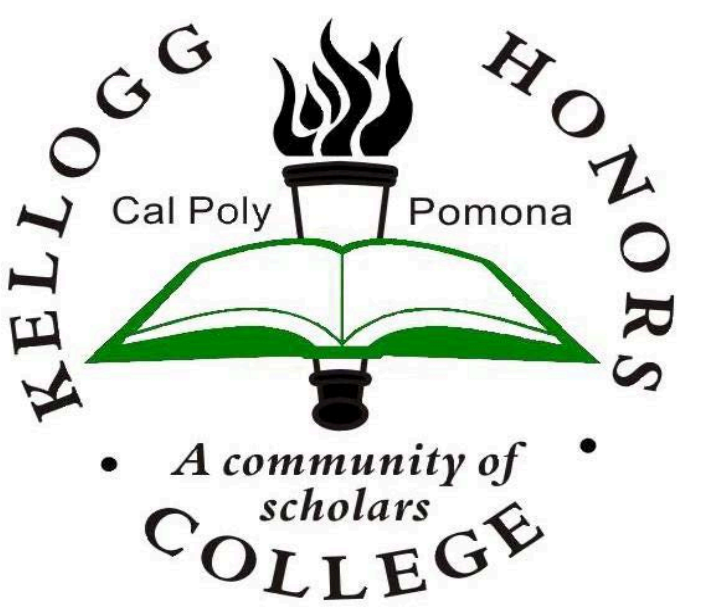




# Inflammation and Wound Healing Following Hypochlorous Acid Treatment in Post-Surgical Canine Patients

Taylor M. Youngquist, Animal Science  
Mentor: Cord M. Brundage, PhD, DVM  
Kellogg Honors College Capstone Project

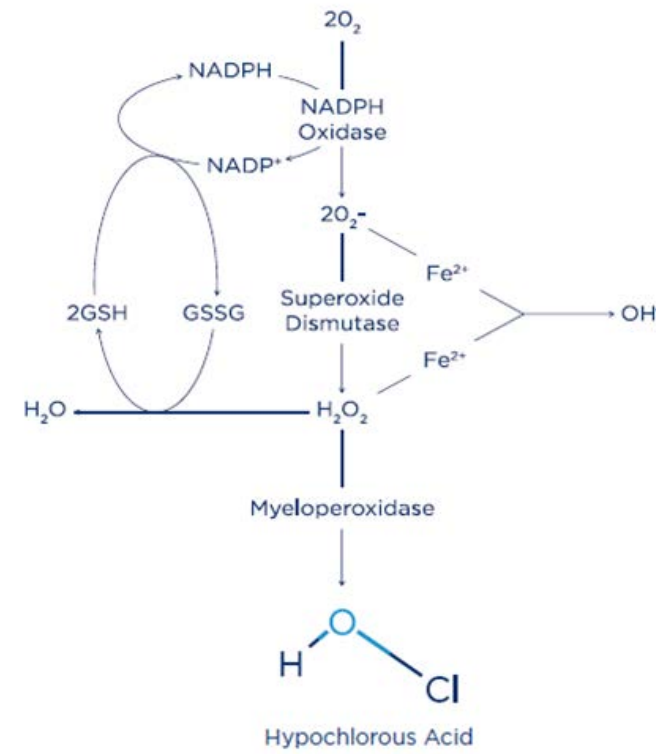
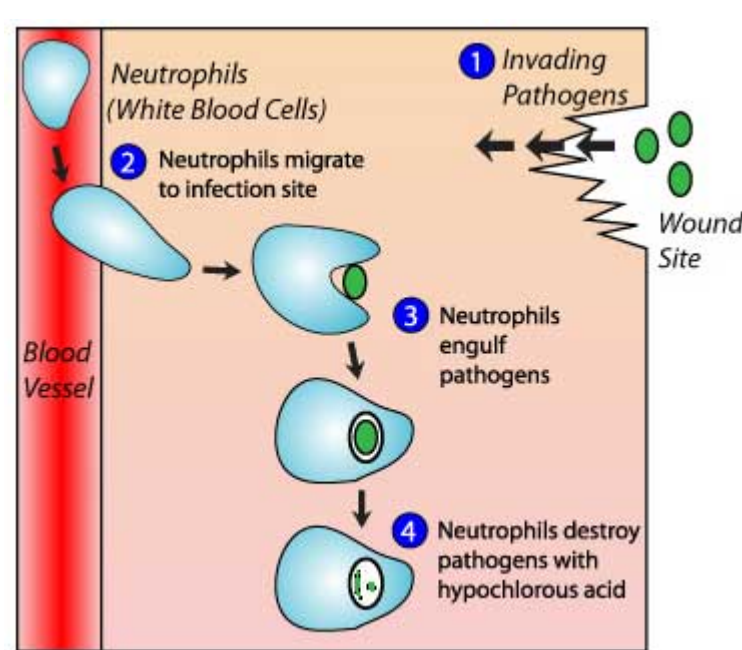


## Abstract

Hypochlorous acid (HOCl) is an oxyacid of chlorine containing a monovalent chlorine that acts as an oxidizing or reducing agent. Hypochlorous solution has been used in wound care because of its disinfectant properties. Anecdotally, claims have been reported of increased wound closure rates and a reduction in wound inflammation following HOCl use. In a double-blind study, we investigated the effects of HOCl in post-surgical incision healing. Canine patients (n=16) receiving either castration or mass removal surgical procedures were treated topically with either 0.015% HOCl spray or a placebo every 12 hours for 7 days. Incisions were evaluated every 48 hours for 7 days post-op. Inflammation, including erythema (redness), swelling, drainage, and wound contracture rate, were scored individually and collectively in a composite qualitative scale. In all cases, the greatest reduction in inflammation and degree of wound contracture rate were noted on the incisions between post-surgical days 3 and 7. These results show that HOCl has the potential to expedite healing and affect the incidence on inflammation in canine post-surgical incisions; however, overall data was not statistically significant.

## Introduction

- Vetericyn® is a line of veterinary wound care products, containing HOCl.
- HOCl is a weak acid formed by the dissolution of chlorine in water<sup>1</sup>.
- Antimicrobial that inhibits the growth of microorganisms<sup>2</sup>.



- Other topical antimicrobial agents, such as H<sub>2</sub>O<sub>2</sub>, can be damaging to surrounding cells, prolonging the healing process.
- HOCl is non-cytotoxic; it does not negatively affect the healing process while acting as an antimicrobial<sup>3</sup>
- In this study, we examined the effects of using HOCl on canine surgical incision sites, with sterile saline as a control/placebo.



Figure 1. Vetericyn VF® Plus

Figure 2. Study Preparation: Bottles of HOCl and sterile saline.



Score	Evaluation Parameters
1	Tissue undifferentiable from normal tissue
2	Minor tissues changes, no sign of inflammation
3	Small areas of erythema
4	Generalized mild erythema, minimal swelling, no drainage
5	Moderately erythematous, some swelling, no drainage
6	Erythematous, swollen beyond expectations, some discharge
7	Injected and inflamed to the point of needing intervention

## Contact Information

Taylor M. Youngquist  
California State Polytechnic University, Pomona  
Huntley College of Agriculture  
Kellogg Honors College  
Email: tmyoungquist@cpp.edu

## Methods and Materials

In a blinded study, owners were sent home bottles containing either HOCl or sterile saline following spay, neuter, or mass removal surgery. Owners were instructed to spray the surgical incision sites twice daily with the solution provided. The owners took pictures of the incision sites and sent them to us on days 1, 3, 5, and 7 post-op. Once all of the pictures were obtained, the incision sites were scored by a single blinded evaluator using a 7-point inflammation scale (shown to right). The data was analyzed using repeated-measures two-way ANOVA, one-way ANOVA, and T-tests to determine if any results or trends were statistically significant. The average score for each day based on the surgery type and which treatment was used (HOCl or placebo) was graphed to compare how the inflammation changed from day to day. The percent change in inflammation for each day from day one (percent of inflammation *left* from day one), based on surgery type and treatment was also graphed.



Figure 3. Finley, 1 year old Labradoodle who was spayed during the study



Figure 4. Example of one of the pictures of an incision site from an owner: Woody, 8 year old Golden Retriever Had 5 masses removed for this study. Used bottle T on 3 of the masses and N On 2 of the masses.

Chart 1. Average inflammation score per day for spays.

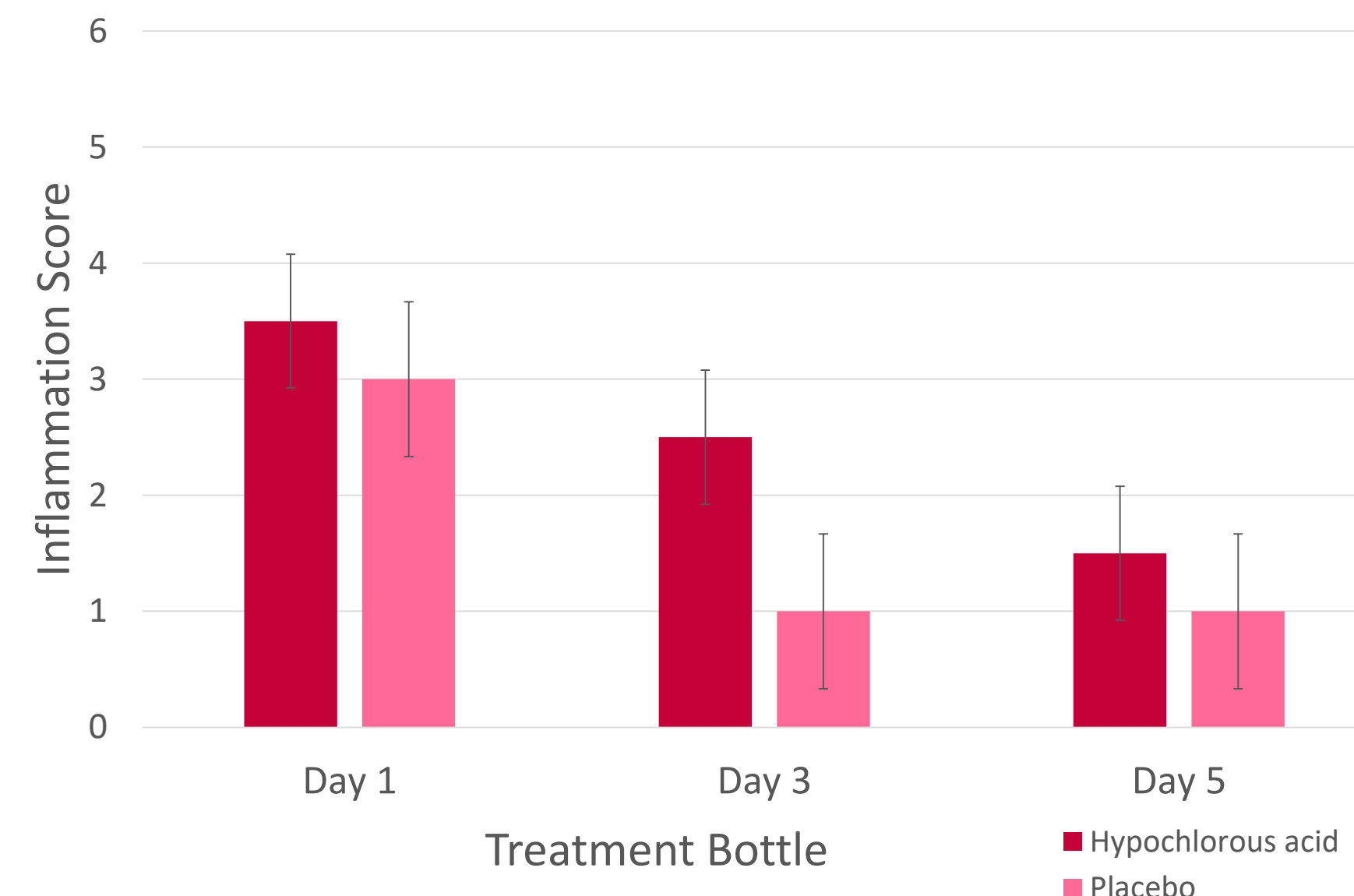


Chart 2. Average inflammation score per day for neuters.

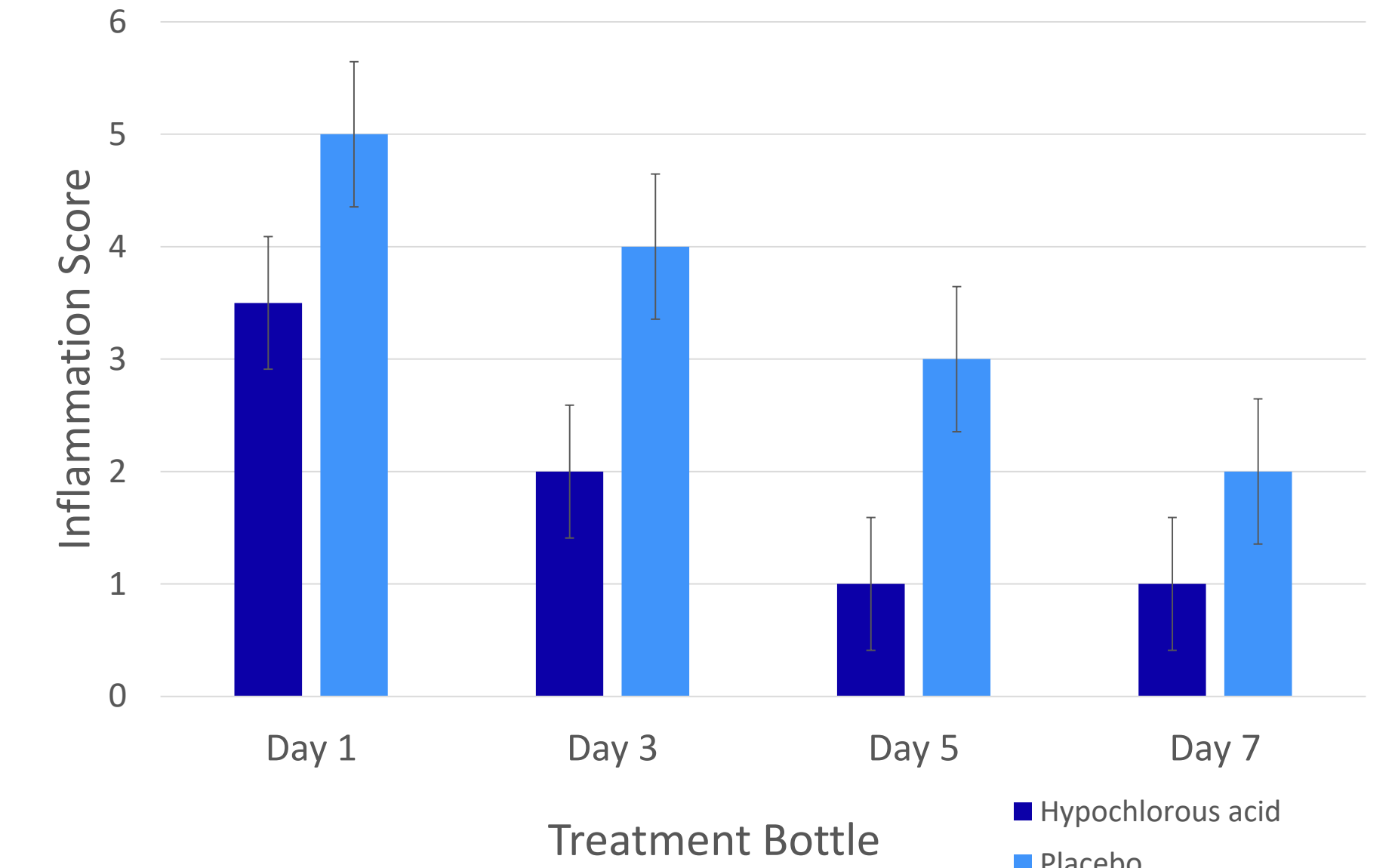


Chart 3. Average inflammation score per day for mass removals.

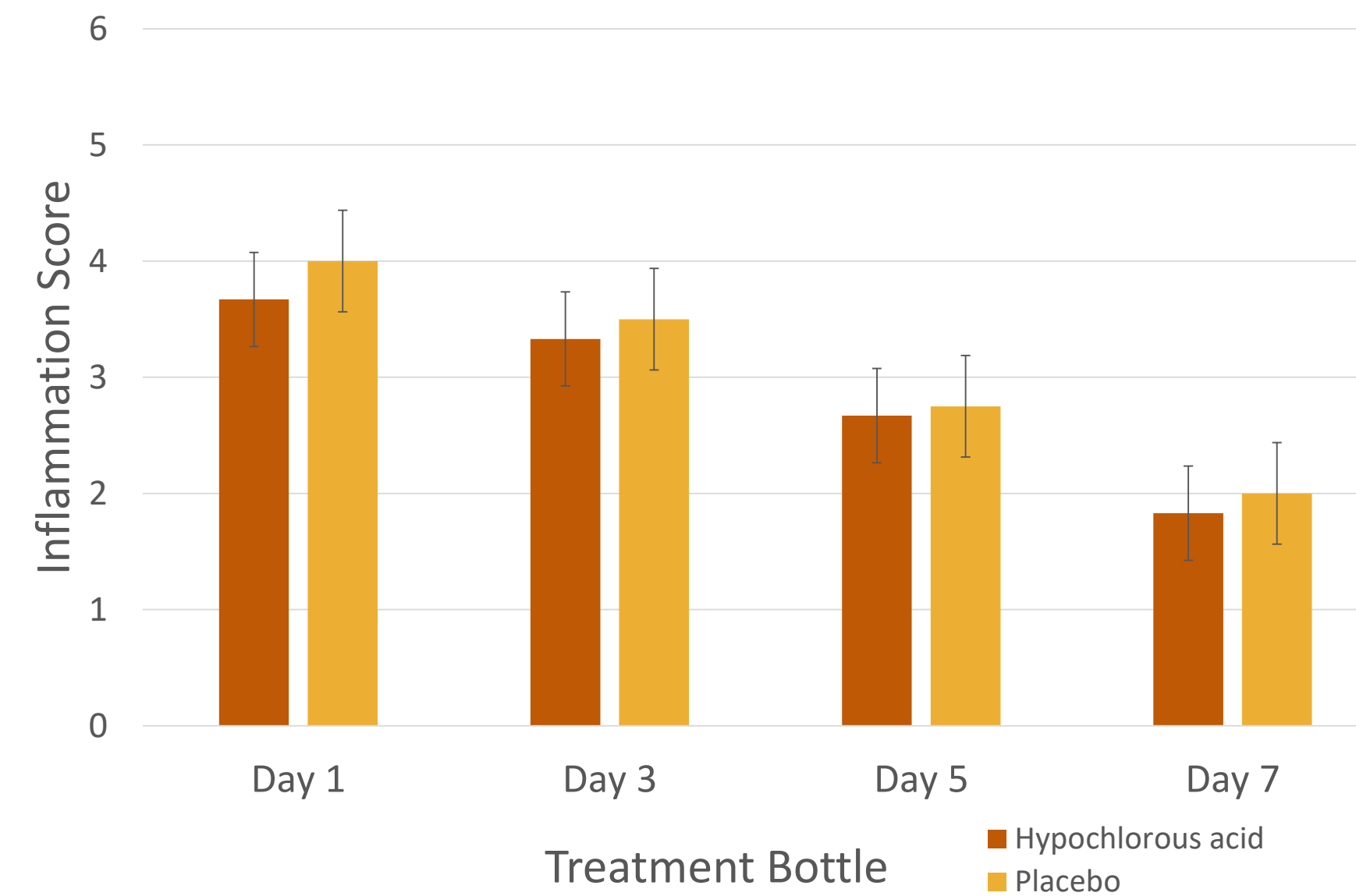
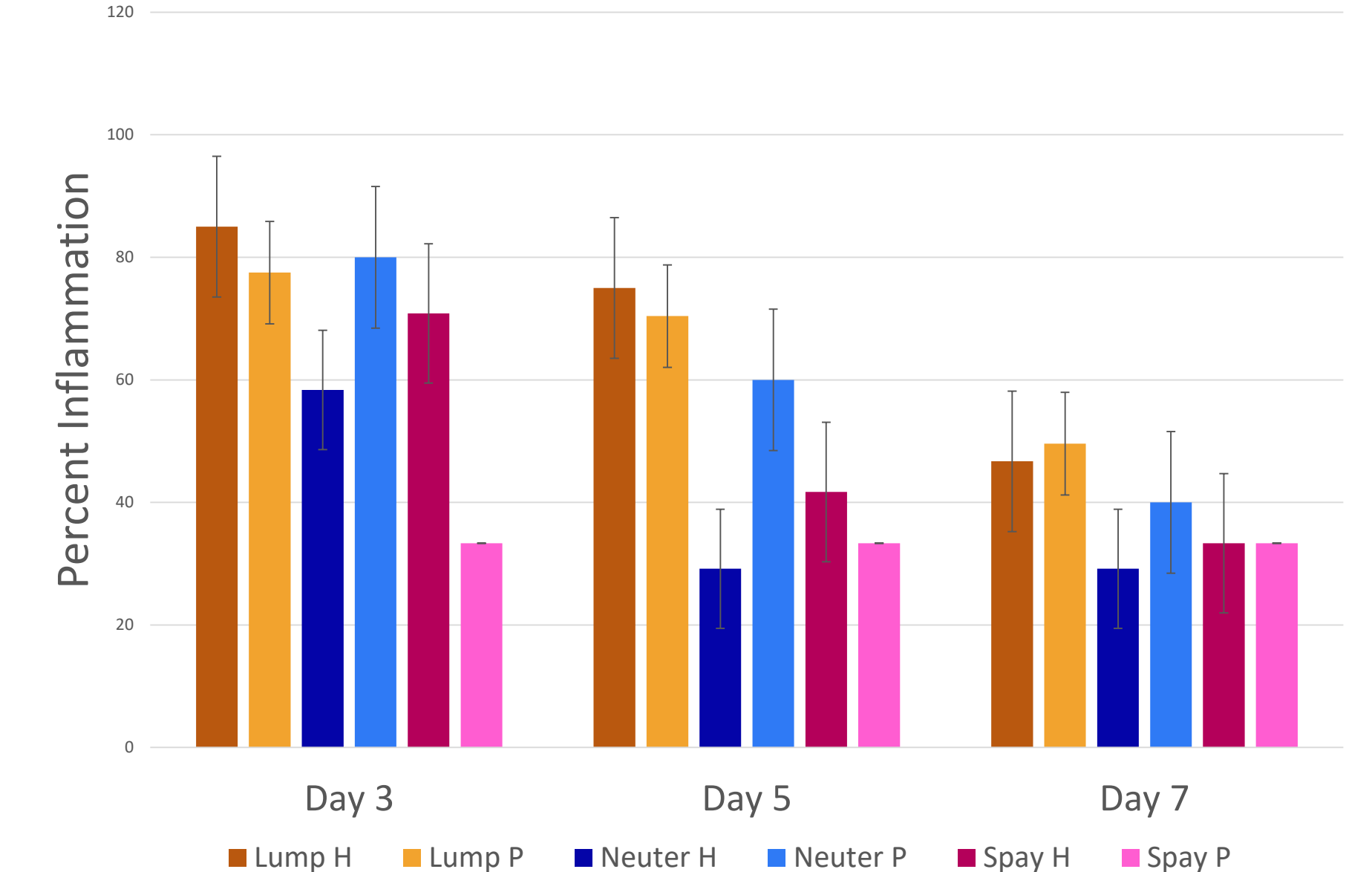


Chart 4. Percent of inflammation left from day one for each surgery type.



## Results

- For both mass removals and neuters, the average inflammation score for each day for those treated with the HOCl was lower than those treated with the sterile saline.
- When analyzed with a repeated measures two-way ANOVA, the results were not statistically significant.
- For spays, those using HOCl had on average higher inflammation each day than those using saline.
- Neuters using HOCl experienced greater percent reduction in inflammation each day from day 1 than those using saline. The same was seen for mass removals after day 3.
- Spays using HOCl experienced less percent reduction in inflammation from day 1 than those using saline.
- When percent reductions were analyzed in a statistics program, these results were still not statistically significant.

## Discussion and Conclusions

- The results seen in neuters and mass removals could indicate HOCl does in fact decrease inflammation and aid in wound healing.
- However, all data analyses showed no statistically significant trends; therefore, it cannot be definitively concluded that HOCl has any effect on surgical incision site healing.
- There was a statistically significant reduction in inflammation from days 1 to 7 for every incision, regardless of procedure and treatment, indicating that both HOCl and sterile saline allowed the wounds to heal properly and efficiently.

## Future Directions

- Increase sample size
- Further analyze inflammation by breaking into parts: swelling, redness, and drainage
- Expand study to include other surgery types

## References

- What is Vetericyn Plus. (n.d.). Retrieved from <http://www.vetericynvf.com/what-is-vetericyn-plus/>
- Sampson CM, Sampson MN. Hypochlorous acid: a safe and efficacious new wound therapy. Poster presented at: World Union of Wound Healing Societies; 2008; Toronto, Ontario, Canada.
- Wolcott R, Fletcher J. The role of wound cleansing in the management of wounds. *Wounds International*. 2014; 1(1): 25-31.

## Acknowledgements

Cord M Brundage, PhD, DVM  
Vetericyn® (Innovacyn, Inc)  
Kellogg Honors College at Cal Poly Pomona