

Is dietary exposure to Bisphenol A (BPA) associated with phenotypic changes in dogs?

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BACKGROUND

- Bisphenol A (BPA) is an industrial chemical that is ubiquitously present in our environment. It is found in common household products such as baby bottles and canned foods, including pet foods.¹
- Humans and animals are exposed to it through many routes, including the diet. To date, there has been little investigation into dietary exposure in companion animals.⁴
- BPA is structurally very similar to estradiol (Fig. 1) and is classified as an endocrine disrupting chemical (EDC). It BPA has the potential to cause a multitude of molecular and phenotypic abnormalities. A few of these include DNA methylation, reproductive dysfunction, fetal developmental anomalies, behavioral deficits and inflammatory response.²

HYPOTHESIS: Dogs fed dog food that contains high amounts of BPA will have an increase in the circulating concentrations of this chemical and exhibit alterations in liver enzymes, DNA methylation changes in lymphocytes, and gut dysbiosis.

MATERIALS & METHODS

- Subject recruitment and feeding trial
 - 14 dogs were recruited, screened by physical examination and randomly assigned to Diet A or Diet B
 - Dogs were kept on the diet for 14 days.
 - Blood and fecal samples were collected on day 0 and day 14.
- Parameters measured
 - CBC and general chemistry
 - Serum BPA levels¹
 - Global DNA methylation²
 - Fecal microbiome
- Diets
 - Canned diets were selected because BPA is commonly found in the linings.
 - The can linings³ and food⁴ are both being analyzed for BPA content.
- Statistical analysis
 - Samples are being analyzed for differences between day 0 and day 14 as well as for differences between diet groups.
 - SAS software and ANOVA methodology is being used.

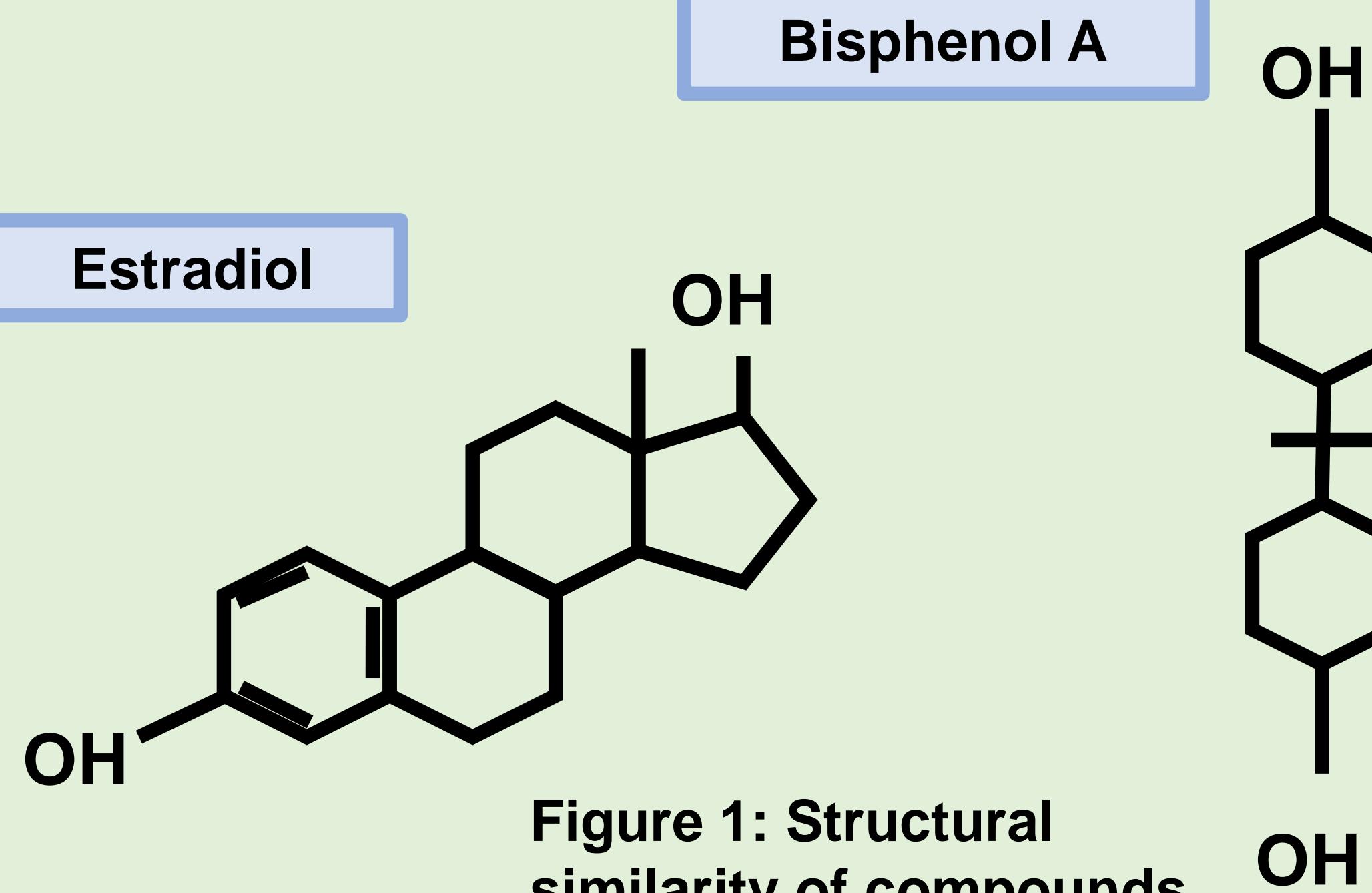


Figure 1: Structural similarity of compounds

PRELIMINARY RESULTS

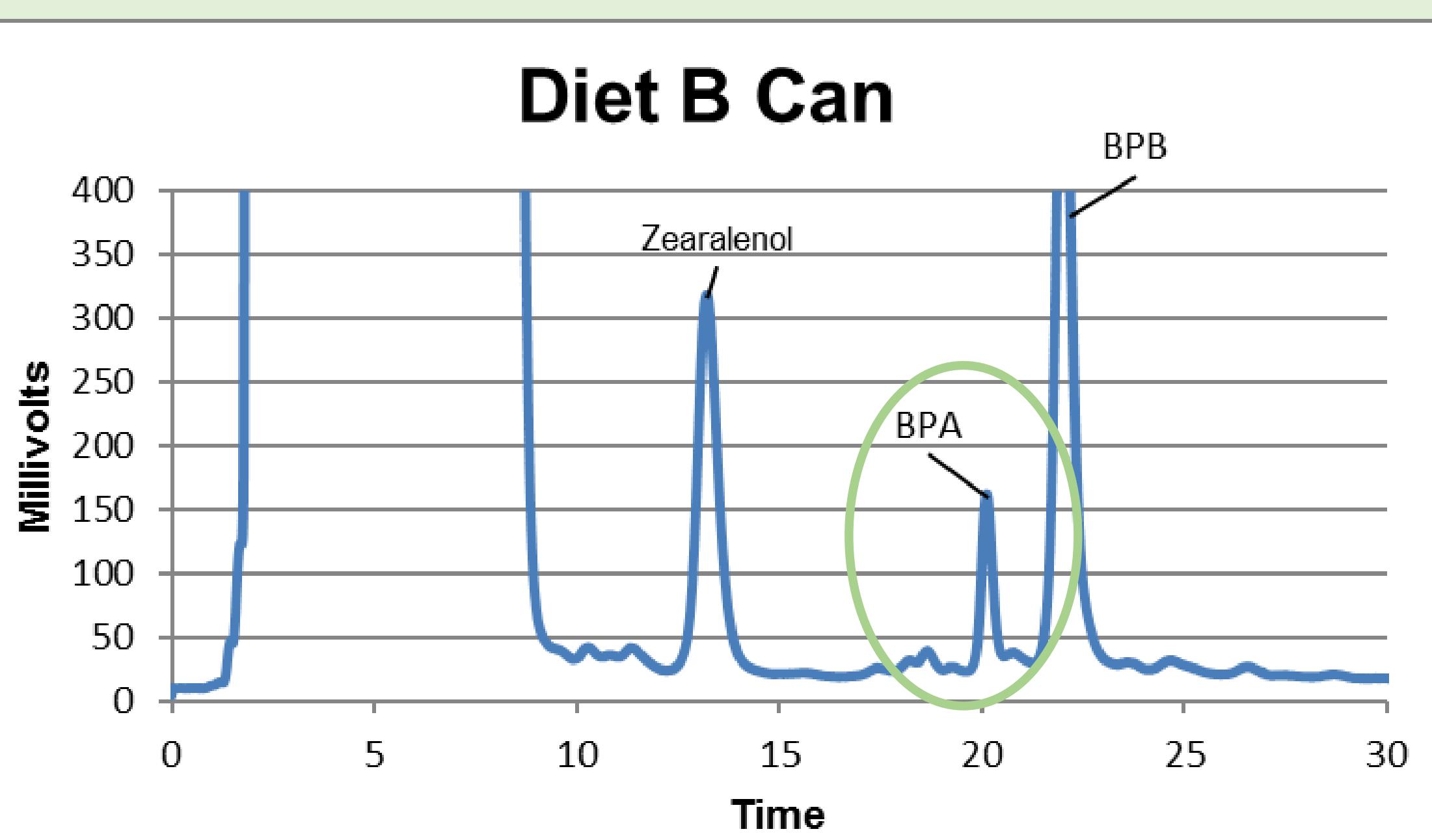
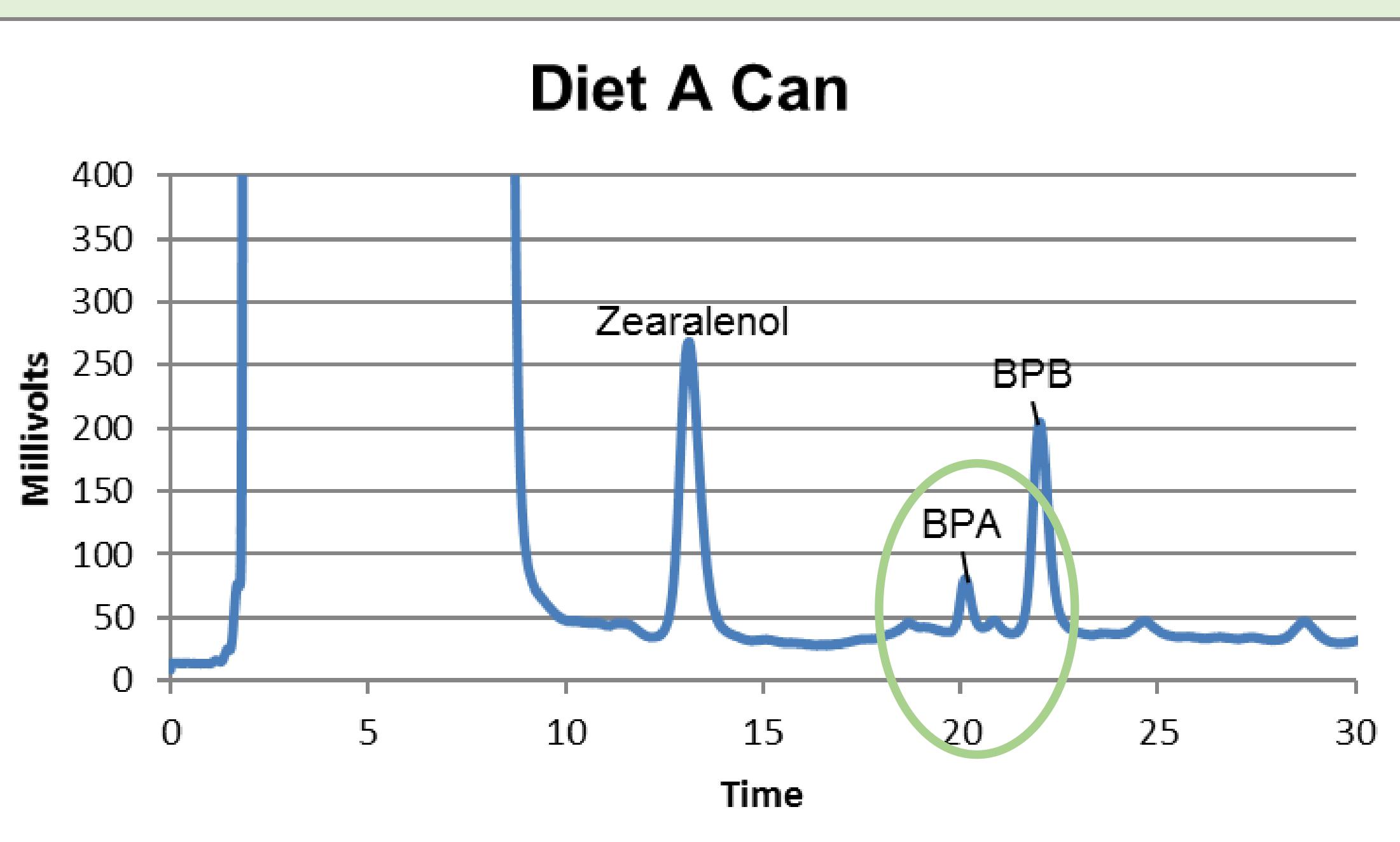


Figure 2: HPLC images from can analysis
*Zearalanol and BPB serve as internal standards

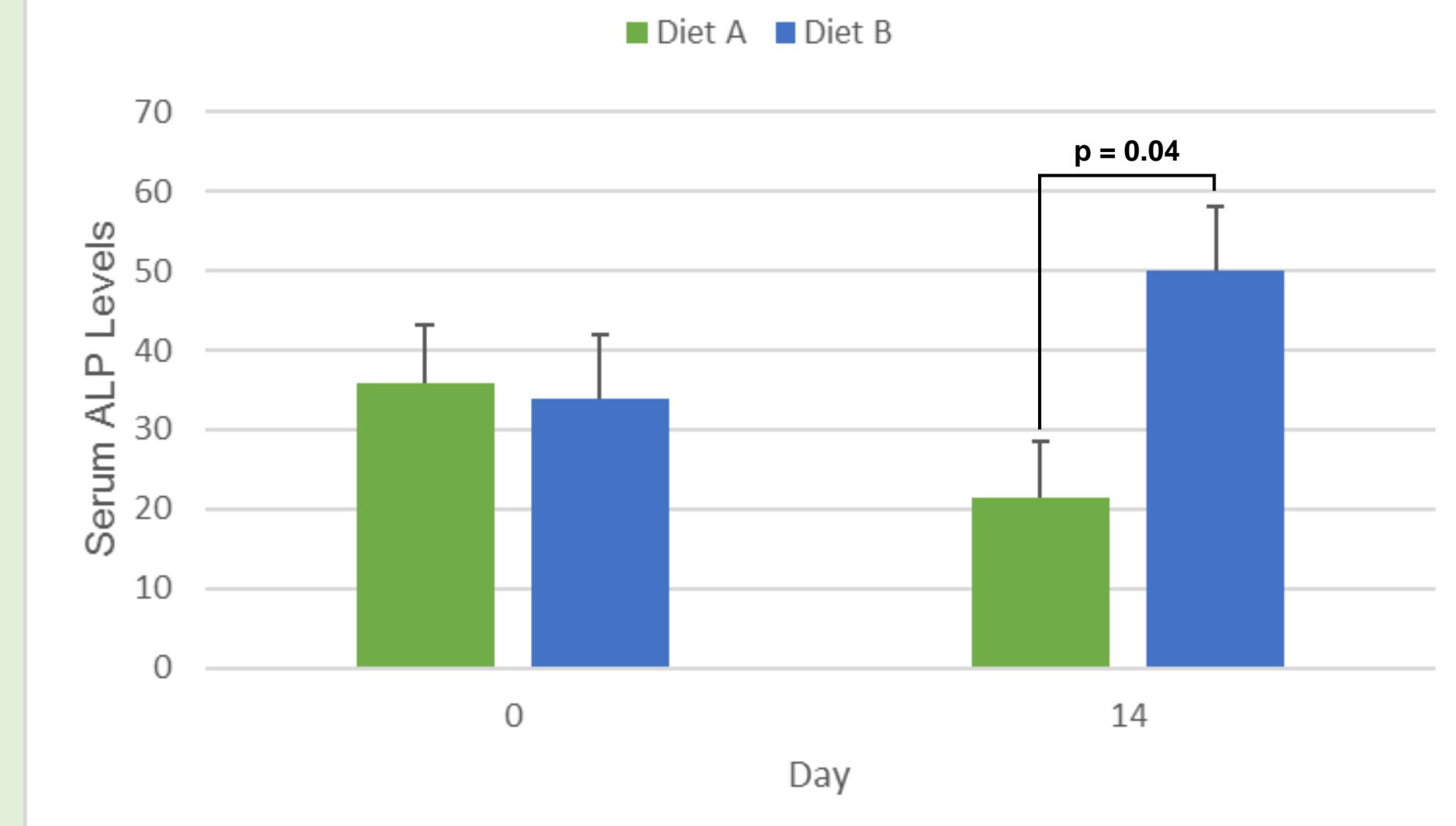


Figure 3: Serum ALP levels

CONCLUSIONS & FUTURE AIMS

- A statistically significant elevation in circulating concentrations of liver alkaline phosphatase (ALP) on day 14 compared to day 1 was found in the diet B group, which may contain higher BPA concentrations. This liver enzyme could serve as a biomarker for BPA exposure in mammals.
- Analysis of BPA in the serum of dogs enrolled in this study is still underway. The expected outcome is that dogs will have elevated serum BPA levels on day 14 compared to day 0 and that will correlate with the presence of BPA in the food itself.
- This is the first study to date looking at dietary exposure to BPA in dogs. However, further investigation is still needed before any firm conclusions can be drawn.

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REFERENCES

- Vandenbergh, L. N., Gerona, R. R., Kannan, K., Taylor, J. A., van Breemen, R. B., Dickenson, C. A., ... Woodruff, T. J. (2014). A round robin approach to the analysis of bisphenol A (BPA) in human blood samples. *Environmental Health : A Global Access Science Source*, 13(1) doi:10.1186/1476-069X-13-25
- Tellez-Plaza M, Tang WY, Shang Y, Umans JG, Francesconi KA, Goessl W, Ledesma M, Leon M, Laclaustra M, Pollak J, Gallar E, Cole SA, Fallin MD, Navas-Acien A. *Association of global DNA methylation and global DNA hydroxymethylation with metals and other exposures in human blood DNA samples*. Environ Health Perspect. 2014 Sep;122(9):946-54. doi: 10.1289/ehp.1306674. Epub 2014 Apr 25. PubMed PMID: 24769358; PubMed Central PMCID: PMC4154206.
- Kang JH, Kondo F. *Determination of bisphenol A in canned pet foods*. Res Vet Sci. 2002 Oct;73(2):177-82. PubMed PMID: 12204638.
- Liao, C., & Kannan, K. (2014). A survey of bisphenol A and other bisphenol analogues in foodstuffs from nine cities in china. *Food Additives and Contaminants - Part A Chemistry, Analysis, Control, Exposure and Risk Assessment*, 31(2), 319-329. doi:10.1080/19440049.2013.868611