A PRELIMINARY ATTEMPT TO CULTIVATE AWARENESS OF ALPHA-GAL SYNDROME IN RURAL KANSAS AND ASSESS CONCENTRATIONS OF ALPHA-GAL IN VARIOUS MEAT PRODUCTS

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I. INTRODUCTION

Alpha-gal syndrome (AGS), also known as red meat allergy, is caused by lone star tick (*Amblyomma americanum*) bites. The tick introduces galactose-alpha-1,3-galactose (α-Gal) into the bloodstream, triggering a surge in specific IgE antibodies against α-Gal. The allergic reaction typically occurs 2-6 hours after the consumption of food products containing mammalian tissues, and the symptoms can range from hives, swelling and gastrointestinal distress to potentially life-threatening reactions such as respiratory difficulties and anaphylaxis. Historically, AGS was most prevalent in the southeastern US, where the lone star tick population is well established. However, the tick population range has expanded in the US, and an increased number of AGS cases has been reported in Kansas in the recent years. Unfortunately, little is known about the AGS prevalence throughout Kansas. Furthermore, no work has been conducted to quantify the amount of α-Gal present in different meat products to evaluate the potential impact of processing technique on α-Gal concentration. Thus, the two objectives for this study are: 1) to gain a better understanding of the prevalence of AGS in rural Kansas communities; and 2) to quantify the α-Gal concentration in various fresh and processed meat products that are commonly consumed by Midwesterners.

II. MATERIALS AND METHODS

For the first objective, 160 incentivized surveys were sent out to custom-exempt, state and federally inspected meat processors across the state of Kansas. Survey questions were designed to understand AGS prevalence in Kansas and the respondents' prior knowledge of AGS. For the second objective, 10 beef striploins and 10 batches of 8 different processed meat products were purchased. The strip loins were either left raw or cooked to medium rare (MR; 54℃) medium (MED; 60℃), or well done (WD; 70℃). The processed meat samples were fully cooked pork bratwurst, fully cooked bacon, deli ham, beef hot dog, classic hot dog (mostly chicken, but with pork and beef added), beef summer sausage, beef jerky, and fully cooked beef hamburger patty. Whole muscle protein was extracted from each sample and separated by gel electrophoresis and immunoblotted against anti-α-Gal IgG1. Additionally, each gel included a reference sample of α-Gal Conjugated-Human Serum Albumin (HSA) with a known α-Gal content of 59.2 pmol. The concentrations of α-Gal in the samples were determined as the ratio of the lane densities of the sample and the HSA reference.

III. RESULTS AND DISCUSSION

Of the 160 sent surveys, 50 were returned. Survey results showed that 28% of respondents knew at least one person in their area with AGS. The geographical distribution of these cases was concentrated in the south central and southeastern regions of Kansas, which is consistent with the range of the lone star tick (figure 1). Furthermore, only 58% of respondents knew that red meat allergy is related to tick bites and 96% of them expressed there is not enough public information about AGS. On the other hand, it was clear that fresh beef striploin steaks had much higher α-Gal concentration than processed meat products regardless of degree of doneness ($P < 0.01$). It was interesting to note that α-Gal concentration increased as the degree of doneness increased for beef striploins ($P < 0.01$), with the lowest concentration in raw sample (8.24 pmol/μg protein), followed by MR and MED (11.09 and 10.85 pmol/μg protein, respectively), with the highest concentration in WD samples (13.05 pmol/μg protein). Among the processed meat products, it was determined that pork brats and beef hot dogs had the

highest concentration of α-Gal with 3.29 and 3.26 pmol of α-Gal/µg of protein, respectively, followed by cooked beef patty with 2.76 pmol of α-Gal/µg of protein, beef jerky at 2.45 pmol/µg of protein, cooked bacon with 2.11 pmol/µg of protein, beef summer sausage with 1.77 pmol/µg of protein, deli ham with 1.37 pmol/µg of protein, with classic hot dog having the lowest concentration of α-Gal at 0.88 pmol per µg of protein ($P < 0.01$; figure 2).

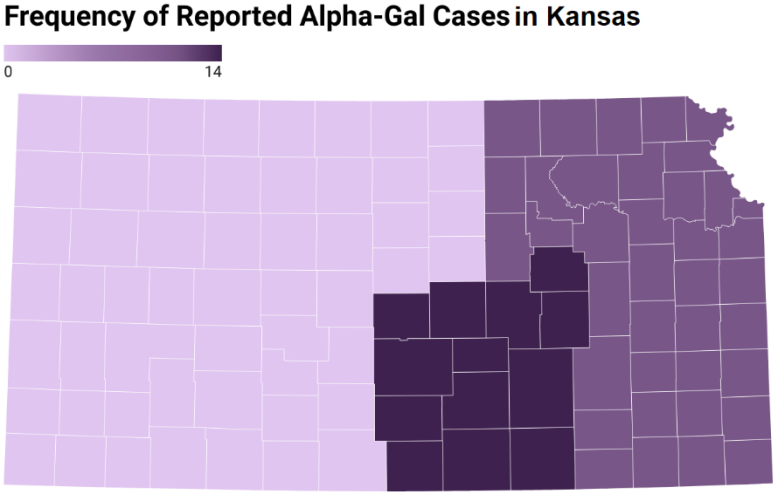

Figure 1. Prevalence of AGS in Kansas, USA based on the 160 surveys sent to small meat processors in Kansas.

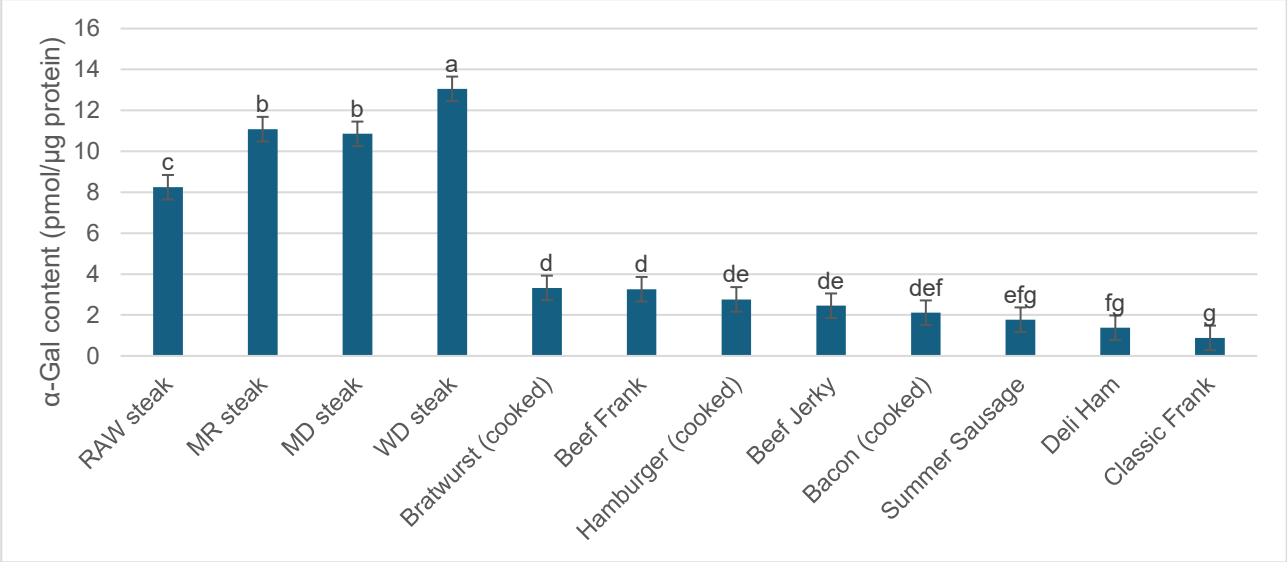

Figure 2. The α-Gal concentration of beef striploin steaks cooked to various degree of doneness [raw, medium rare (MR), medium (MD) and well done (WD)] and various processed meat items.
[a-g] Least sqaure means without a common superscript differ from each other.

IV. CONCLUSION

The AGS is a growing clinical and public health concern for people in the US and the world, which AGS has been reported to occur in at least seventeen nations worldwide. Our preliminary survey results indicated a need for AGS education in Kansas, especially amongst rural communities and those located in geographically high-risk areas. On the other hand, our α-Gal content data suggested that α-Gal content could be influenced by freshness, cooking methods, species, use of collagen casing and other processing techniques, while heat itself does not reduce α-Gal concentration. Future research should focus on determining the relationship between α-Gal content/consumption level and blood α-Gal IgE antibody production in AGS patients for better management of the condition.

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