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Antimicrobial Resistance in Retail Ground Beef with and Without a "Raised Without Antibiotics" Claim

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Objectives

The occurrences of human bacterial infections complicated by antimicrobial resistance (AMR) have increased in recent decades. Concerns have been raised that food-animal production practices that incorporate antimicrobials contribute significantly to human AMR exposures since food-animal production accounts for approximately 81% of U.S. antimicrobial consumption by mass. Although empirical studies comparing AMR levels in meat products, including ground beef, are scant ground beef products with Raised without Antibiotics (RWA) label claims are perceived to harbor less AMR than "conventional" (CONV) products with no label claims regarding antimicrobial use. The objective of this research was to determine AMR levels in retail ground beef with and without an RWA label claims.

Materials and Methods

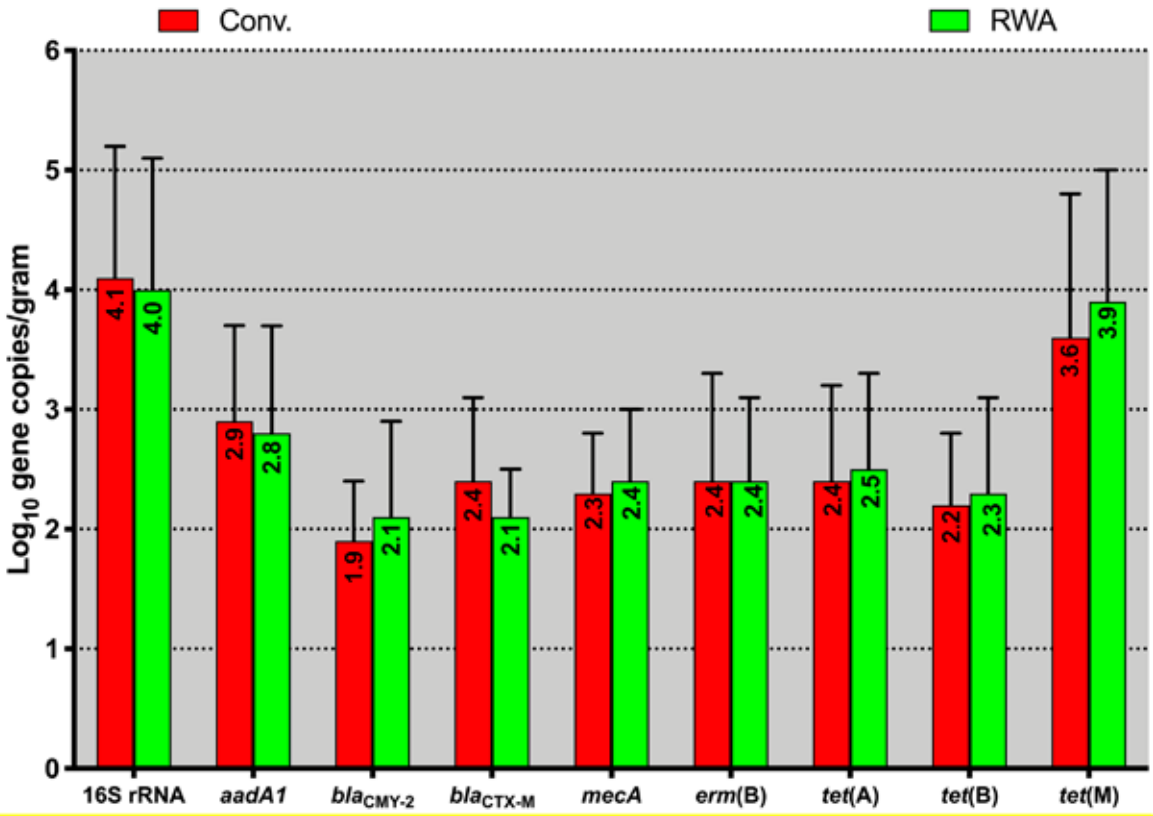
Retail ground beef samples were obtained from 6 U.S. cities. Samples were obtained on the following dates: 9/18/2017, 10/30/2017, 11/27/2017. 1/29/2018. 3/5/2018, and 6/11/2018. A total of 599 samples were obtained. Samples with a "Raised without Antibiotics" or USDA Organic claim ($N = 299$) were assigned to the RWA production system. Samples lacking a "Raised without Antibiotics" claim ($N = 300$) were assigned to the CONV production system. Each sample was cultured for the detection of five antimicrobial resistant bacteria (ARB). Genomic DNA was isolated from each sample and qPCR was used to determine the abundance of ten antimicrobial resistance genes (ARGs). The impacts of production system and city on ARB detection were assessed by the Likelihood-ratio chi-squared test. The impacts of production system and city on ARG abundance was assessed by two-way ANOVA.

Results

Tetracycline-resistant *Escherichia coli* (CONV = 46.3%; RWA = 34.4%) and erythromycin-resistant *Enterococcus* (CONV = 48.0%; RWA = 37.5%) were more frequently ($P < 0.01$) detected in CONV. Detection of third generation cephalosporin-resistant *E. coli* (CONV = 5.7%; RWA = 1.0%), vancomycin-resistant *Enterococcus* (CONV = 0.0%; RWA = 0.0%) and methicillin-resistant *Staphylococcus aureus* (CONV = 1.3%; RWA = 0.7%) did not differ ($P = 1.00$). The $bla_{\text{CTX-M}}$ ARG was more abundant in CONV (2.4 vs. 2.1 log copies/gram, $P = 0.01$) but the *tet*(A) (2.4 vs. 2.5 log copies/gram, $P = 0.02$) and *tet*(M) (3.6 vs. 3.9 log copies/gram, $P < 0.01$) ARGs were more abundant in RWA. *aadA1*, $bla_{\text{CMY-2}}$, *mecA*, *erm*(B), and *tet*(B) abundances did not differ significantly (Fig. 5) ($P > 0.05$). Abundances of *aac (6')-Ie-aph (2")-Ia* and $bla_{\text{KPC-2}}$ were not analyzed since they were quantified in less than 5% of the samples.

Conclusion

U.S. retail CONV and RWA ground beef harbor generally similar levels of AMR since only 5 of 15 AMR measurements were statistically different between production systems. Three AMR measurements were higher in CONV, while 2 AMR measurements were higher in RWA. These results are in general agree-



P (Prod. sys.)	0.31	0.09	0.16	0.01	0.54	0.02	0.33	< 0.01
P (City)	< 0.01	< 0.01	0.01	< 0.01	0.03	< 0.01	< 0.01	< 0.01
P (P.s. x City)	< 0.01	< 0.01	0.58	< 0.01	< 0.01	0.20	0.12	0.01

Figure 5.

ment with a recently published study authored by our group that examined antimicrobial resistance in CONV and RWA ground beef obtained from U.S. foodservice suppliers (Vikram et al., *J. Food Prot.* 81:2007–2018. 2018.). Together these studies suggest that antimicrobial use during U.S. cattle production has minimal to no impact on human exposure to AMR via ground beef