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Editorial: Natural products in animal feed and production systems

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Editorial on the Research Topic

Natural products in animal feed and production systems

Natural products are a broad and diverse group of compounds with an even more diverse range of biological activities and can originate from bacterial, fungal, plant, animal, or marine sources (Katz and Baltz, 2016). Use of various products such as antibiotics in animal feed for their growth-promoting effect has been commonplace in modern animal production (Butaye et al., 2003). Although there were and continue to be tangible benefits to the use of antibiotics as feed additives, issues with public perception and increasing implementation of regulations have begun to limit chronic subclinical use of these compounds. This has stimulated a surge in the study of various natural products with the goal of finding a suitable replacement. In addition to improving livestock productivity, there is also an interest in identifying natural products that improve animal health, alter the nutritive qualities of animal products, and improve the sustainability of livestock production by reducing the impact on the environment.

Hops (*Humulus lupulus*) have long been used for their preservative qualities in the beverage industry. The hop cones contain humulones and lupulones that were also found to work great as a growth promoting feed additive in ruminants (Flythe and Aiken, 2010; Flythe et al., 2015). However, a labor-intensive harvest and competition for the product from other established industries such as the brewing industry make hops prohibitively expensive for widespread use in livestock production. Previous work (Bryant and Cohen, 2018) has demonstrated that these compounds are also found in spent brewer's yeast, a product produced as a consequence of the brewing process that is largely viewed as a waste product. Bryant et al. evaluated the potential of using spent brewer's yeast as a feed additive to ruminant diets to reduce methane and ammonia production by conducting *in vitro* incubations with rumen microbes and spent yeast from various origins. The findings from this study demonstrated significant reductions in methane and ammonia associated with the inclusion of spent brewer's yeast. These results offer the prospect of improving ruminant growth efficiency while decreasing contributions of methane production attributed to climate disruption and using another industry's waste product.

Sultana et al. looked at supplementing cattle diets with various components of the moringa (*Moringa oleifera*) tree. The leaves, twigs, and seed pods (waste from a human supplement industry) are high in numerous bioactive compounds that function as

probiotics and ionophores and is also high in carotenoids and vitamin E (Su and Chen, 2020). The authors hypothesized that these constituents would result in improved feed efficiency and reproductive parameters when moringa mash was included in the diet of bulls. The authors found that while moringa mash inclusion did not improve the liveweight gain of the bulls, there was a lower level of urinary nitrogen loss and a decreased methane emission. Additionally, the motility of sperm from bulls supplemented with moringa increased significantly. Thus, the authors concluded that moringa mash may be considered as a feed supplement with use in improving bull reproductive capability as well as reducing the impact of cattle on the environment.

In addition to spent brewer's yeast and moringa mash, the byproducts of pomegranate juice production results in unwanted seeds, peels, and membranes. Pomegranates are a fruit rich in polyphenols and flavonoids that have anti-inflammatory, antimicrobial, and immunomodulatory characteristics (Adams et al., 2006). Using a bovine aortic endothelial cell model, Ciampi et al. evaluated a pomegranate extract for antioxidant effects. The results indicated that the extract of pomegranate by-product can potentially mitigate inflammatory responses and should be studied for beneficial effects as a supplement in dairy cattle diets.

In addition to providing natural products through dietary or value-added supplements, there are numerous phytochemicals that can be ingested based on what is grazed on pasture. Ford et al. looked at the effects of botanical composition of pasture type and the corresponding phytochemicals on milk yield and quality. Cattle that grazed pastures high in forbs (e.g. – chicory and plantain) or legumes (e.g. – birds foot trefoil and red clover) had improved aspects of liver and kidney function and overall antioxidant status when compared to cows that grazed a traditional grass pasture. The authors attributed the positive effects to a greater diversity of plants high in bioactive plant secondary metabolites as blood levels have been previously shown to increase in cows consuming them (Andersen et al., 2009).

The use of natural products in livestock production systems has a limitless number of opportunities that can range from replacement of a synthetic product to creating a value-added product by finding a use for something previously viewed as an

unwanted or waste product. However, as with other additives, care must be taken to thoroughly research the impact that inclusion of even natural products has on the livestock consuming or receiving them and the impact on their production. This Research Topic and the articles that comprise it are examples of the ingenuity and research needed to further the productive incorporation of natural products in to feeds and livestock production systems.

Author contributions

JK conceptualized the Research Topic and writing of the original draft. JK, JM, and MF edited, contributed to the article, and approved the version submitted.

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