Post-Extrusion In-vitro Fermentability of Fiber in Extruded Dog Foods

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Introduction

In the United States, pet food sales reached $33 billion in 2018, with extruded diets representing about 70% of the market (Lange, 2016). Today, market sales are mostly driven by categories such as novel ingredients and health benefits. Dietary fibers have been widely recognized to benefit gastrointestinal heath due to colonic fermentation (Cummings et al., 2001; Miller and Wolin, 1996). The short chain fatty acids (SCFA) acetate, propionate, and butyrate are the major end-products of this microbial fermentation of fiber in the colon. Although acetate is the most abundantly produced SCFA, butyrate is the most biologically significant regarding gut health (Alexander et al., 2019; Velazquez et al., 1997). Previous work has evaluated the fermentation characteristics of fiber ingredients; however, fermentation characteristics of nutritionally complete, extruded dog diets have rarely been explored. Therefore, the objective of this experiment was to evaluate post-extrusion fermentability in extruded diets, with different fiber sources, using an *in-vitro* model.

Materials and Methods

Dietary treatments containing 10% of apple pomace (AP), blueberry pomace (BP), and miscanthus grass (MM) as well as a control diet (CD) with no added fiber were produced using a pilot-scale X-20 single screw extruder (Wenger Manufacturing Inc., Sabetha, KS) under set processing conditions. Additionally, higher (MH) and lower (ML) mechanical energy was applied to the miscanthus treatment. Samples were collected and stored at -20°C for later analysis.

Treatments were ground to pass a 1 mm screen and predigested using a bulk total dietary fiber (TDF) procedure prior to inoculation. Residual fibers were fermented via an *in-vitro* dog fecal inoculum model with incubation time points of 1, 3, 6, and 12 hours. Results reported are for 12 h only. Buffer media and dilution solution were made according to Sunvold et al. (1995).

At the end of each incubation time point, SCFA, branch chain fatty acids (BCFA), and organic matter (OM) disappearance (OMD) were determined. Organic matter disappearance was computed using the equation below:

$$\text{OMD} = 1 - \frac{(\%\text{OM in residue} - \%\text{OM in blank})}{\text{Initial }\%\text{OM}}$$

Data was analyzed as a completely randomized design. There were 3 replications for each combination of fiber substrate and time point. Blanks were also incubated in triplicate at each time point for data correction. Means were separated using a pairwise comparison and significant F (α=0.05) with statistical analysis software (SAS, v. 9.4).

Results

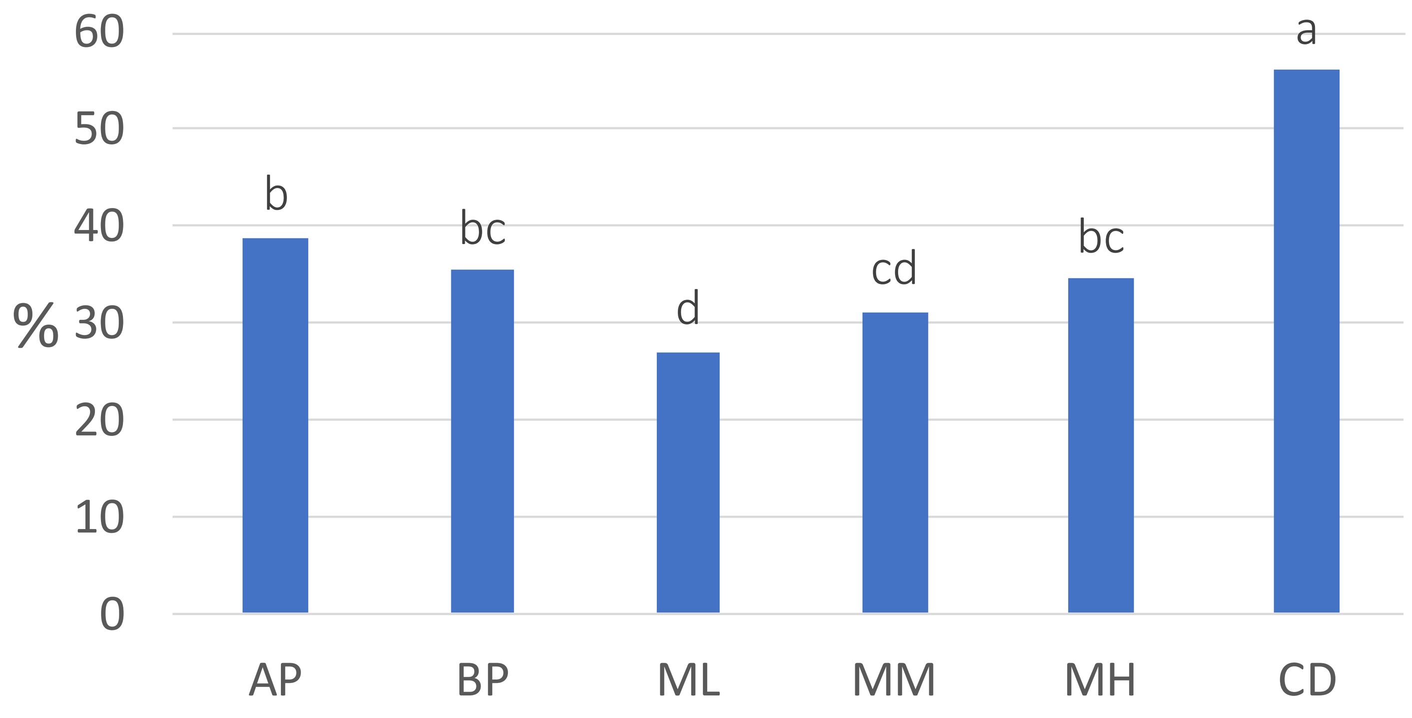

Figure 1: Organic matter disappearance (OMD) as percent of substrate for each treatment after 12 h

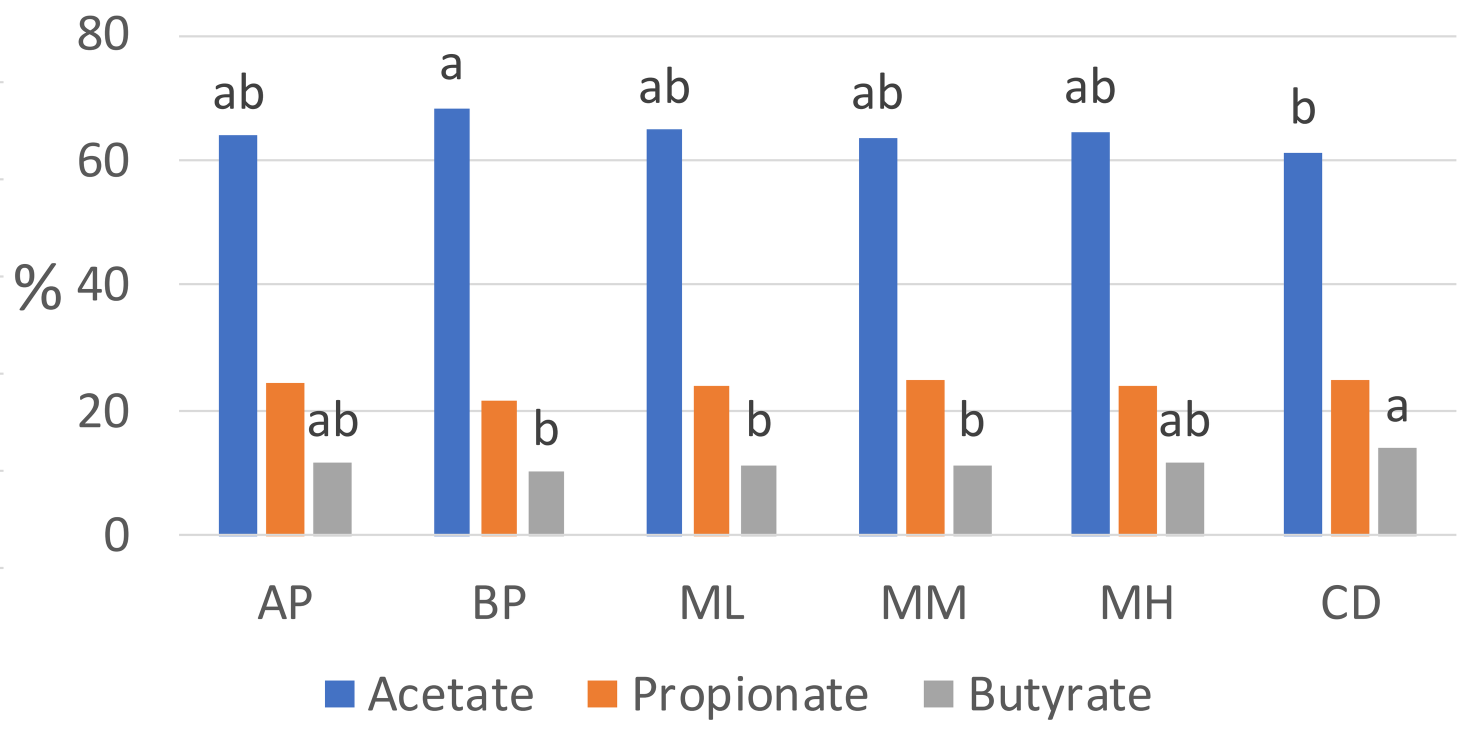

Figure 2: Acetate, propionate, and butyrate as proportions of their sum for each treatment after 12 h

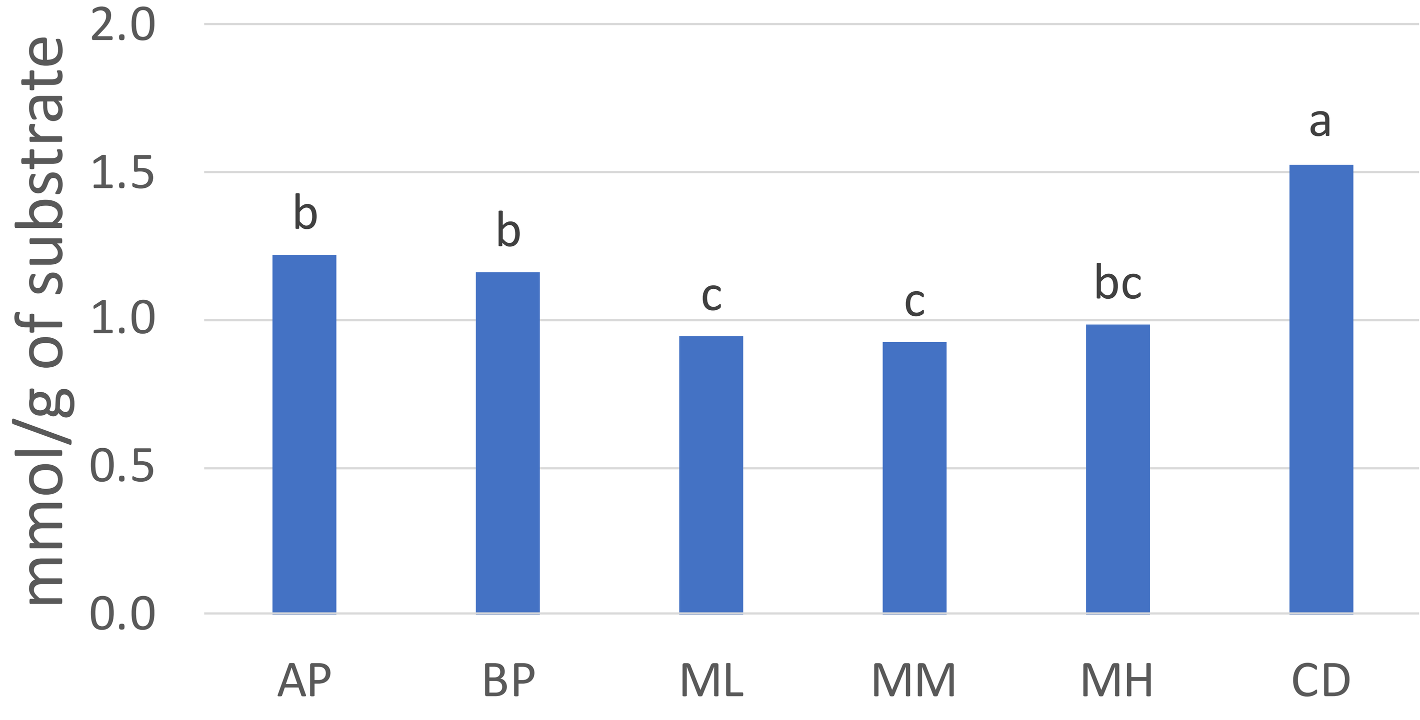

Figure 3: Total short chain fatty acid concentration per gram of fiber (mmol/g of substrate) for each treatment after 12 h

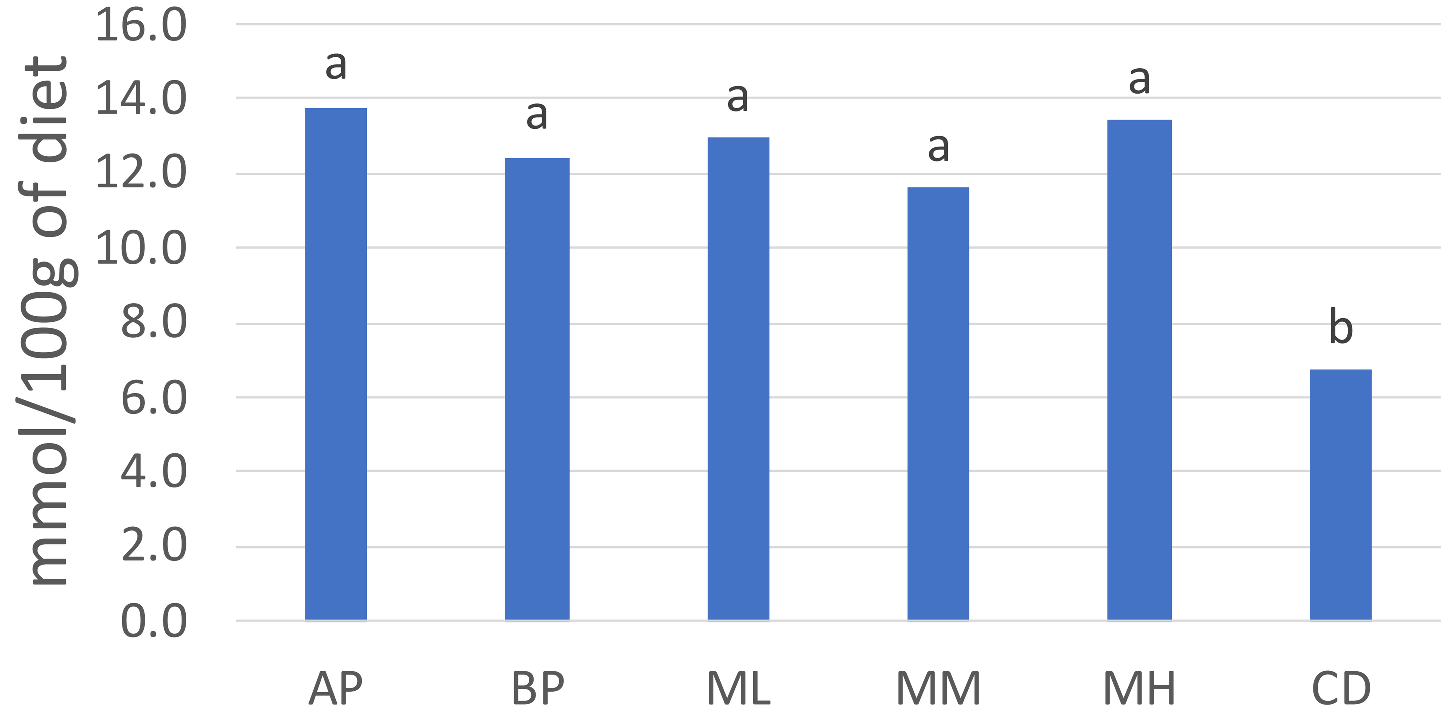

Figure 4: Total short chain fatty acid concentration per 100g of diet (mmol/100g of diet) for each treatment after 12 h

Conclusions

Greater mechanical energy input during processing may have led to greater substrate disappearance in the miscanthus treatments. Total SCFA concentration and proportions were similar among the different mechanical energy inputs to the miscanthus grass treatments. Small differences were observed in SCFA proportions between different fiber treatments. When compared on a gram of fiber basis, CD had the greatest OMD and total SCFA concentration and had greater proportions of butyrate than BP, ML, and MM. When corrected for total fiber content, all fiber treatments had similar SCFA concentrations and were greater than CD.