An Evaluation of Miscanthus Grass as a Potential Dietary Fiber Source in Human and Animal Nutrition

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Miscanthus grass may be a useful source of dietary fiber in both human and animal nutrition. Processing of Miscanthus grass results in M-Fiber, a commercially available dietary fiber ingredient.

M-Fiber has not been widely tested from the nutritional perspective. The research of Dr. Greg Aldrich and colleagues at Kansas State University using M-Fiber fed to dogs and cats is of importance in positioning M-Fiber into the pet food industry. Pet food companies will value this information as they make decisions about type and concentration of dietary fibers to include in their various brands of foods.

M-Fiber has been studied in our laboratory at the University of Illinois. Analytical information is available as well as a published study on fermentation properties of xylooligosaccharides (XOS) obtained from Miscanthus x giganteus.

M-Fiber is a more complicated mixture of chemical components than powdered cellulose. This is borne out by analyzing Miscanthus grass in comparison to the competitor products, PetFibe and Ridgeland Fiber Powdered Cellulose. PetFibe is a low protein, low fat, and low ash product, and the product specification sheet (trangely enough) does not report the total dietary fiber content of said material. One would assume it would be high. Ridgeland Fiber Powdered Cellulose has a total dietary fiber content of 95% with no to low concentrations of protein, fat, and ash. Clearly, these are very different from the analyses that we have done at Illinois on M-Fiber composition and on the analyses conducted by Dr. Aldrich's lab at Kansas State University. To summarize, and unlike the case for the powdered celluloses, M-Fiber has a lower concentration of total dietary fiber with 8% of the fiber existing in the soluble form. Much higher concentrations of lignin and ash are found in M-Fiber than in powdered celluloses. M-Fiber also contains ~8% of unidentified extractives that may have bioactivity. In short, M-Fiber is a more complicated fiber matrix than is powdered cellulose, and this is a potential positive from the animal and human nutrition perspectives.

Is M-Fiber "intrinsic and intact" as defined in the Institute of Medicine-Food and Nutrition Board (IOM-FNB) definition published in 2002 and that is now part of the FDA (2016) official definition? M-Fiber is "intrinsic and intact" given the procedures used from plant harvest to bagging of finished product. Key steps include: (1) mechanical harvest; (2) roller conditioning; (3) initial grind; (4) fine grind; (5) air classification; and (6) exposure to magnets.

None of these steps affect the fiber composition in a significant manner, so the resulting material is in its "natural" form and unaffected by processing technologies.

Novel co-products may result from processing Miscanthus, so another important issue involves the potential bioactivity of Miscanthus grass components. In our research at the University of Illinois, we examined the potential prebiotic activity of the XOS present in Miscanthus. Previously, our group in Agricultural and Biological Engineering produced XOS from Miscanthus x giganteus using autohydrolysis and purification via activated carbon adsorption coupled with ion-exchange resin treatments. Miscanthus XOS contained 75% xylose oligomers, 3% arabinose oligomers, 4.5% glucose oligomers, and 6.7% bound acetyl groups. The total purity was 89.1% with an additional 1.7% of sugar monomers. Oligomer analysis showed that the XOS contained 8.9% xylobiose, 11.3% xylotriose, 8.8% xylotetraose, 9% xylopentose, and 5% xylohexaose.

The fermentation experiment using human fecal inocula showed that Miscanthus XOS resulted in a 2.02 unit pH drop after 12 h, demonstrating that this substrate was readily utilized by the human fecal microbiota. Short-chain fatty acid production was higher for Miscanthus XOS than for a purified commercial XOS or pectin. Bifidobacteria and lactobacilli both flourished when Miscanthus XOS was fermented, indicating its ability to increase beneficial gut microbial populations. Production of XOS as a result of autohydrolysis of Miscanthus affords an opportunity to realize a valuable co-product from this lignocellulosic substrate.

How does M-Fiber compare to tomato pomace, a fiber source used by some pet food companies? First and foremost, tomato pomace is an ingredient that is much more variable in chemical composition than M-Fiber, which is highly stable in chemical composition considering it is a natural ingredient. Second, tomato pomace has ~60% Total Dietary Fiber (TDF), 52 percentage units of which is Insoluble Dietary Fiber (IDF) and 8 percentage units of which is Soluble Dietary Fiber (SDF). Miscanthus fiber, in comparison, contains ~86% TDF, 74 percentage units of which is IDF and 7 percentage units of which is SDF. Fermentability of tomato pomace by human gut microbiota at 12 h fermentation time is 27% and at 24 h of fermentation, 35%. No similar data have been collected with M-Fiber, although expectations are that fermentability values would be similar. M-Fiber should be a good substitute for tomato pomace in dog and cat diets, with a lesser inclusion level needed because of its higher fiber content. The inclusion level will depend on the dietary matrix ingredients and the nature of the diet to be fed to the dog or cat (i.e., life stage, physiological state, health modulation).

In conclusion, M-Fiber is a value-added product that could play a role in fiber nutrition of humans and pet animals. It is very different than powdered cellulose made from wood. It deserves its own specific definition as regards its classification on the nutrition facts panel of human and animal foods.