



A Guideline for Co-Digestion of Food Wastes in Farm-based Anaerobic Digesters

Introduction

Anaerobic digestion (AD) is a biochemical degradation process that converts complex organic materials into biogas in the absence of oxygen. Biogas is composed of methane, carbon dioxide and trace amounts of hydrogen sulfide. Animal wastes, especially dairy manure, have proven to be ideal feedstocks for anaerobic digesters. Food wastes, mostly generated from food processing, food service and retail establishments, also can be excellent feedstocks for AD. Food wastes typically have high ratios of volatile solids/total solids (VS/TS), which indicate high energy content.

Currently, most farm-based anaerobic digesters in the U.S. have been designed to treat animal wastes that may have different characteristics (moisture content, VS/TS, chemical oxygen demand (COD), etc.) compared to food wastes. The addition of food wastes may disrupt AD operation unless careful consideration is given to the characteristics of the food waste. Therefore, there is a significant need to develop guidelines to determine the types and percentage of food wastes to be mixed with animal manure. This fact sheet seeks to provide information and recommendations for farmers and their advisors who are considering addition of food wastes to existing or proposed anaerobic digesters.

What types of food wastes can be added?

For farm-based anaerobic digesters, food wastes that have components similar to dairy manure should be suitable AD feedstock. Key parameters of raw dairy manure and typical concentrations include: moisture content (88-91%); total solids (9-12%); volatile solids (7-9%); and COD (7.5-15%). Food processing

wastes tend to have similar characteristics to dairy manure, and are also available in large quantity and relatively good quality (i.e. less contaminated and a fairly uniform composition).

A few dairy farms with anaerobic digesters in the U.S. have tried mixing food wastes with dairy manure for biogas production. Successful results have been reported with increased biogas production and better gas quality. Based on practical experiences and results from comparative studies of co-digestion, the following food wastes would seem to be good candidates as feedstocks:

- Cheese whey
- Dairy processing waste (spoiled yogurt, cheese, butter, ice cream, etc.)
- Vegetable residues from food processing
- Fruit residues from food processing
- Spoiled grape juice

What is the best percentage of food waste to mix with animal manure?

Anaerobic digesters have been built in New York State to process 100% food waste. There is little experience in New York with various manure/food ratios but there is a perception that it is possible to go as high as 75% food waste. A few New York farms have experimented with lower percentages. Food waste and animal manure can be mixed in many different ratios, and there is a need for data on the effect of mixing on biogas production. The recently revised net metering law in New York State requires that at least 75% of the feedstock be livestock manure on an annual basis to qualify for net metering benefits. Thus, if a farmer wants to take advantage of net metering, food waste cannot compose more than 25% of the co-digestion mix.

What is the estimated energy potential of food waste?

Some food wastes, such as cheese whey, have a high percentage of organic matter and are much more pu-

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rified compared to animal manure. Studies estimate that a methane yield of 0.17 -0.34 m³/kg (2.7 ft³/lb-5.5 ft³/lb) of total volatile solids in the feedstock can be achieved through anaerobic digestion of food wastes. The methane potential varies by the composition of wastewater or sludge and its degradability. The methane content of biogas with food waste may be higher (70% compared to 55-65%).

The table below shows the estimated potential of biogas production from manure co-digested with three different percentages of feedstocks.

Manure (%)	Food Waste (%)	Biogas Potential (ft ³ /cow/day)
100	0	90
75	25	158
50	50	225

Potential tipping fee revenues from accepting food wastes

The average landfill-tipping fee is \$55/ton in upstate New York, and can be as high as \$125/ton in New York City. For a dairy farm of 500 cows, manure production is estimated at 11,000 tons/year. A farm of this size with a suitable digester design could treat

up to 3,000 tons of food waste per year and could realize a tipping fee of \$165,000, a very significant source of income for farmers.

Who should consider adding food wastes in anaerobic digesters?

Anaerobic digesters that are designed for processing dairy manure can accept food wastes which are similar to dairy manure in terms of these parameters: total solids, volatile solids, chemical oxygen demand, and moisture. Generally, farms should consider using food waste if:

- Foods processing plants or other major food waste generators are located within a reasonable distance from the digester.
- They have adequate technical skills and resources to monitor food waste influent.
- They have resources or contracts to collect and transport food wastes.
- The food waste source is compatible with dairy manure and the source is stable.

You should check with the state's environmental agency for solid waste regulations governing the land application of food waste, as these may also apply to food waste co-digested with manure.

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