Food Waste – Occurrence along the Food Chain, Composition and Anaerobic Digestion

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The acronym FLW (Food Loss and Waste) best describes our target.

There is no universally accepted definition of ‘food waste’ which is why it is difficult to obtain reliable data on how much is actually generated.

**EU parliament definition:**

*Food intended for human consumption, either in edible or inedible status, removed from the production or supply chain to be discarded, including at primary production, processing, manufacturing, transportation, storage, retail and consumer levels, with the exception of primary production losses’*

→ Post-farm FLW make up for 90% of total FLW.
→ FAO estimates global losses of 1.3 billion t/a = 1/3 of food produced.
→ Data interpretation & estimates in Europe: 173 kg/capita*year.
FLW Assessment shall take into account all relevant disposal and recycling options.
When assessing FLW, it is worth considering single stages of the food value chain.

- Switzerland is losing 37% of its food (fresh mass) as avoidable losses.
- With 55-65%, the largest fraction of FLW originates from consumption.
- Avoidable losses can mostly be allocated at the end of the value chain.

Beretta, C.R., 2018, Environmental Assessment of Food Losses and Reduction Potential in Food Value Chains, PhD Thesis ETHZ, Zurich
Anaerobic Digestion of Food Waste represents the most valuable option for valorization combining energy recovery with nutrient cycling and soil improvement.

**Prevention**
- Waste of raw materials, ingredients and product arising is reduced – measured in overall reduction in waste
- Redistribution to people
- Sent to animal feed

**Recycling**
- Waste sent to anaerobic digestion
- Waste composted

**Recovery**
- Incineration of waste with energy recovery

**Disposal**
- Incineration without energy recovery
- Waste sent to landfill
- Waste ingredient / product going to sewer

Most preferable Option
Least preferable Option
Challenges of anaerobic digestion of FLW: Inhibition – Hygienisation – Undesirables

Intended for human consumption ➔ safe with respect to chemicals / pharmaceuticals.

Compositional analysis (sorting & itemizing) ➔ identifying tool: unavoidable / avoidable

Chemical and biochemical analysis

- High moisture content: TS 20-24%
- High in volatile solids: 90-94% of TS
- High in readily degradable components: sugars 48% / lipids 15% / proteins 21% of VS
- Low in fibre and lignin: hemi-cellulose 7% / cellulose 6% / lignin 3% of VS
- High in N (3%), P (4%) & K (1% of TS)
- High methane potential: 450 m³ CH₄/kg VS

Ludlow, 3-week average / % weight

- Fruit & Veg waste 49.8%
- Other food materials 0.3%
- Contamination 0.4%
- Fruit & Veg whole 12.2%
- Sample size: 15 days collection 100 bags per day

Snacks / sweets / desserts 0.3%
Tea bags / coffee granules 9.0%
Eggs (inc shells) 1.4%
Dairy 0.6%
Bones 3.9%
Meat & fish 4.7%
Bread & bakery 12.3%
Cereal 0.3%
Pasta / rice 1.1%
Challenges of anaerobic digestion of FLW: Inhibition – Hygienisation – Undesirables

Pasteurisation and anaerobic digestion provide a double barrier to the transmission of disease vectors: human and animal pathogens.

Sterilisation @ 133 °C / 20 min required for Category 2 material.

Pre-Pasteurisation @ 70 °C / 60 min / 12 mm ➔ homogenisation & digester heat

Post-Pasteurisation @ 70 °C / 60 min ➔ risk of reinfection.

Thermophilic digestion @ 55 °C ➔ sufficient for Category 3 material
Challenges of anaerobic digestion of FLW: Inhibition – Hygienisation – Undesirables

Source separation is a prerequisite for acceptable FLW quality. Nevertheless manual separation on-site might be required.

Curb side collection in small containers ➔ lower degree of plastics compared to central collection schemes with large containers

FLW from retailers bears the highest plastic load

Hammer mills / high shear force crushers on hard plastic packaging ➔ micro plastics < 2 mm

Low shear force shredders and depackaging combined with densitometric separation ➔ high quality end product (digestate, compost).
The concept of nutrient HUBs and decentralized points of digestion PoD offers benefits:

### Economic Benefits
- Additional gate-fees for farm digestion
- Added farm income through energy sales
- No centralized AD can result in lower capital cost
- High flexibility for both waste management companies as well as farmers

### Environmental Benefits
- Full nutrient recycling to agricultural land
- Decentralized production of renewable energy
- High hygienic safety and minimized risk of contamination
IEA Task 37 Report
Food Waste Digestion

Anaerobic Digestion of Food Waste for a Circular Economy

2018

Charles Banks, Sonia Heaven, Yue Zhang, Urs Baier

1. Food Waste as a Global Challenge
2. Source Separated Municipal Food Waste
3. Anaerobic Digestion Systems
4. Case Studies
5. Conclusions
6. References

Ready to download at
http://task37.ieabioenergy.com/technical-brochures.html
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