Biology of composting

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Biology of composting

› What can be composted or treated by anaerobic fermentation?
› Basis of the biology of composting
  › The microorganisms serving the compost producer
  › The parameters of composting process
What can be composted or treated by anaerobic fermentation?
What can be composted or treated by anaerobic fermentation?

› Waste of horticulture

› Composting: OK
› Anaerobic fermentation: depending on the woody fraction
What can be composted or treated by anaerobic fermentation?

› Animal manure

› Composting: OK
› Anaerobic fermentation: OK
What can be composted or treated by anaerobic fermentation?

› Woody organic waste

› Composting: OK
› Anaerobic fermentation: inappropriate
What can be composted or treated by anaerobic fermentation?

› Waste of fruits and vegetables

› Composting: OK (in small quantity)
› Anaerobic fermentation: OK
What can be composted or treated by anaerobic fermentation?

› Waste from vegetables processing

› Composting: OK (in small quantity)
› Anaerobic fermentation: OK
What can be composted or treated by anaerobic fermentation?

- Egg shells
- Composting: inappropriate
- Anaerobic fermentation: OK (thermophilic or after sanitation treatment)
What can be composted or treated by anaerobic fermentation?

- Waste from agro-industry

  - Composting: inappropriate
  - Anaerobic digestion: OK
What can be composted or treated by anaerobic fermentation?

› Waste of fish / meat

› Composting: inappropriate
› Anaerobic fermentation: OK (after sanitation treatment)
What can be composted or treated by anaerobic fermentation?

- Waste of restaurant
  - Composting: inappropriate
  - Anaerobic fermentation: OK (thermophilic or after sanitation treatment)
What can be composted or treated by anaerobic fermentation?

- In theory, all organic residues can be composted or digested.
- However, not all are easy to handle, biodegradable, and free from toxic and pathogenic germs.
- Depending of the system used, some residues are more or less easy to be treated.
- Depending of the system, some input materials have to be treated before processing (e.g. pasteurization of kitchen waste before mesophilic anaerobic digestion).
- The starting mixture is important for the success of the process.
What can be composted or treated by anaerobic fermentation?

Composting or anaerobic fermentation?

**Composting (anaerobic)**
- Cutting from trees or bushes
- Rural green waste
- Urban green waste

**Anaerobic digestion**
- Cooking and food waste
- Restaurant waste
- Slaughterhouse waste

**Humidity of the material**

**Structural (“woodness”)**
What can be composted or treated by anaerobic fermentation?

› Quality of input materials (levels of undesirables)

› Source-separated organic waste
› Each undesirable that does not enter the process does not need to be taken out at the end of it!
What can be composted or treated by anaerobic fermentation?

› Quality of input materials (levels of undesirables)

› Begin of the 1980s: only source-separated organic waste can be composted / treated by anaerobic fermentation. Mechanical biological treatment (MBT) no more allowed.
Basis of the biology of composting
Basis of the biology of composting

The microorganisms of composting

- fungi
- actinomycetes
- bacteria
Basis of the biology of composting

The microorganisms of composting

- Bacteria

  - aerobic / anaerobic
  - very active at the beginning of the process
  - responsible for the hot phase
  - can not degrade wood efficiently
Basis of the biology of composting

› The microorganisms of composting
  › Fungi

- aerobic
- degrade wood
- creation of stabilized crumbs
- important during maturation stage
Basis of the biology of composting

The microorganisms of composting

Actinomycetes (ray fungus)

- can degrade substances, which can not be degraded with bacteria or fungi e.g. chitin
- responsible for decomposition of difficult materials
Basis of the biology of composting

- Composting: rotting process
  - Phase of decomposition
    - Intensive microbiological activity
    - Increasing temperature
    - Extreme loss in volume
    - Natural hygienization
  - Phase of maturation (curing)
    - Creation of stable humus
    - Development of positive characteristics of compost
Basis of the biology of composting

› Evolution of temperature during composting

Illustration: Dr. Ulrich Galli
Basis of the biology of composting

› Evolution of gas composition during composting

Illustration: Dr. Ulrich Galli

Duration of process

CO₂

O₂

[volume-%]
Basis of the biology of composting

› Evolution of organic substance during composting
Basis of the biology of composting

Evolution of $N_{\text{min}}$ forms during composting

- $NH_4^+ - N$
- $NO_2^- - N$
- $NO_3^- - N$

Duration of process

$N_{\text{min}}$ [mg/kg]

Illustration: Dr. Ulrich Galli
Basis of the biology of composting

› Evolution of pH during composting

Illustration: Dr. Ulrich Galli
Basis of the biology of composting

› Evolution of compost extract colour during composting

Illustration: Dr. Ulrich Galli
Basis of the biology of composting

› Evolution of undesirable materials during composting

› metals, earth, plastics, …

### before

- for example 90 kg degradable material
- for example 10 kg non-degradable material

### after

- for example 45 kg degradable material
- for example 10 kg non-degradable material

= 10% = 18%
Basis of the biology of composting

› Evolution of undesirable materials during composting

› metals, earth, plastics, … ➙

› other chemical compounds ???

› pathogenic germs and weed seeds ⇩
Basis of the biology of composting

› Final product: compost
› Organic fertilization
› Amelioration of soil structure
› Biological plant protection product

› Compost is not waste!
Questions ? Discussion ?