

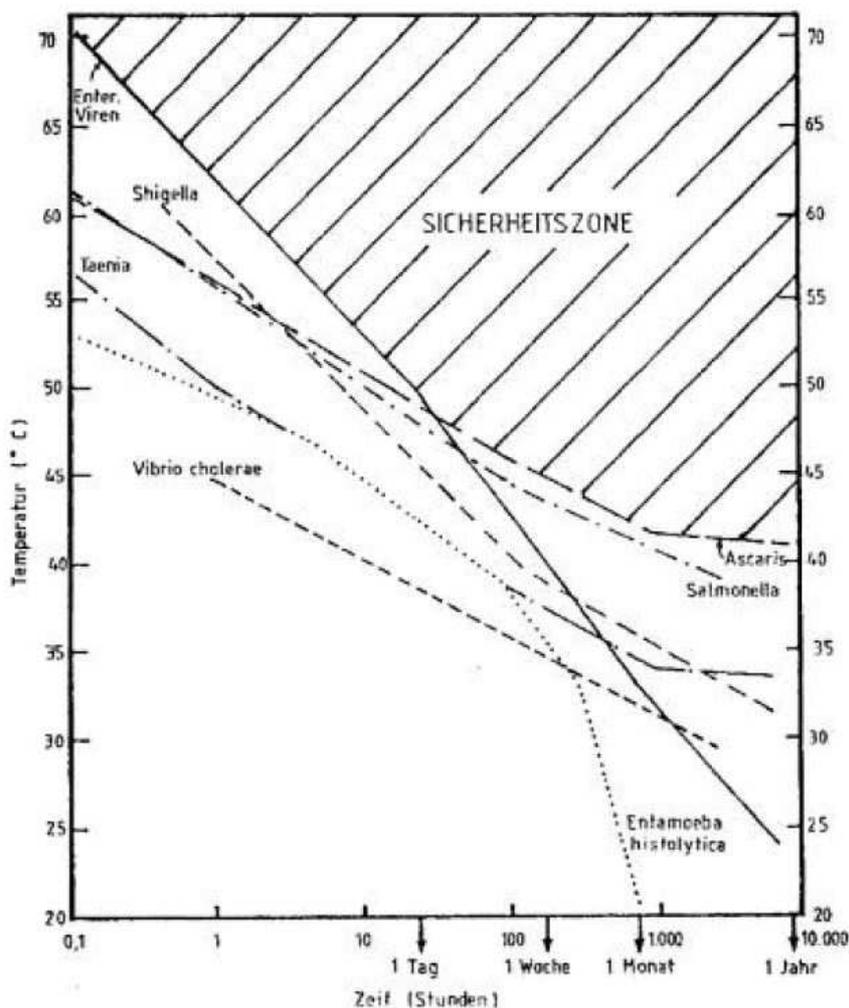
The minimization of health risks depends on the safe handling of the faeces in regard of both technical and behavioral factors.

### Technical:

#### Hygienisation by pasteurization:

Pasteurization of faeces in a low-tech furnace leads to hygienisation, which enables a physiologically harmless use for horticulture.

The material is heated for one hour to a temperature of at least 70° C, thereby destroying most pathogens. [1]



source: "Anaerobic" by Wolfgang Bischofberger, p.163

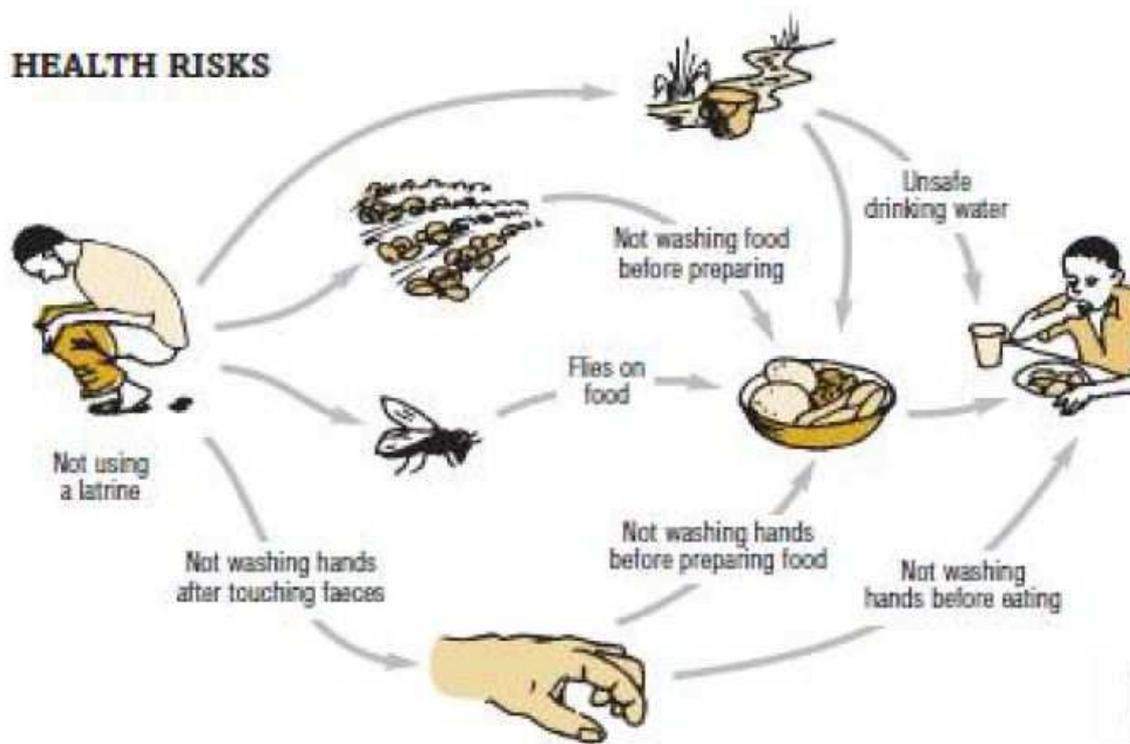
\* However, a contamination with worm eggs may persist after pasteurization / composting.

→ Option: long-term [2 years] or worm-composting [2,5]

\* Due to successful pasteurization any subsequent use / composting has to meet lower standards (with respect to human pathogenic aspects).

## Behavior:

- \* Key element of the transfer of diseases in human excrements is human behavior. [3]
- \* It is essential for both the users, as well as for those responsible, to impart knowledge and to deal with the given cultural background.
- \* Multi-barrier system
  - Washing hands (!), protective clothing, avoiding contact, tools (before & after) ... [4]



source: [infonet-biovision.org/default/ct/716/hygiene](http://infonet-biovision.org/default/ct/716/hygiene)

## Steps of hygienisation:

0. Acquiring knowledge
1. Separation of faeces in the dry-separation toilet
2. Pre-drying (faeces) / storage (urine)
3. Thermal hygienisation in the clay oven
4. Composting similar to Terra Preta (temperature, time, pH, carbon, earthworms ...)

## Notes / Sources:

### Overview: hygienisation procedures

Verfahren	Zeit	Temperatur	Weitere wichtige Parameter	Mögliche verbleibende Pathogene
Trocknung	1-2 Jahre		Wassergehalt	Wurmeier
Basische Behandlung	Stunden bzw. Monate	70 °C bzw. Umgebungstemperatur	pH>9 bis 12,5	
Aerobe Kompostierung	Mehrere Tage	50-55 °C		Wurmeier, Bakteriensporen
Pasteurisierung	10-30 min.	65-95 °C		Bakteriensporen, Viren
Auskochen	15 min.	100 °C		Bakteriensporen
Thermische Konditionierung	45-60 min	Hochtherm. 180-210 °C; Niedertherm. 80-90 °C, Autoklavieren 120-130 °C	2-20 bar	keine

*source: aspects of hygienisation, Ariane Krause, Sirkka Jacobsen, 2011*

- [1] S. Klages, Dr. U. Schultheiß, T. Frei et al. "Anforderungen an die Novellierung der Klärschlammverordnung unter besonderer Berücksichtigung von Hygieneparametern." Technical report, BMU, 2009.
- [2] Fatura, H., T. Bettendorf, C. Buzie, H. Pieplow, J. Reckin and R. Otterpohl. 2010. Terra Preta sanitation: re-discovered from an ancient Amazonian civilisation – integrating sanitation, bio-waste management and agriculture.
- [3] World Health Organisation, "Guidelines for the safe use of wastewater, excreta and greywater", Vol. 4 – Excreta and greywater use in agriculture, Switzerland, 2006.
- [4] Caroline Schönning, Thor Axel Stenström, "Guideline for the safe use of Urine and Faeces in Ecological Sanitation Systems", 2004, Swedish Institute for Infectious Disease Control, EcoSanRes Programme.
- [5] GS Itchon, AU Miso, R Gensch , "A field trial of terra preta sanitation in Mindanao, Philippines" Conference, Hamburg, 2013.