

From Fermentation to Fertilizer: Bokashi Composting

bokashi method

bokashi = fermented organic matter

Ferment organic waste

Direct use of microbes (e.g., EM-1)

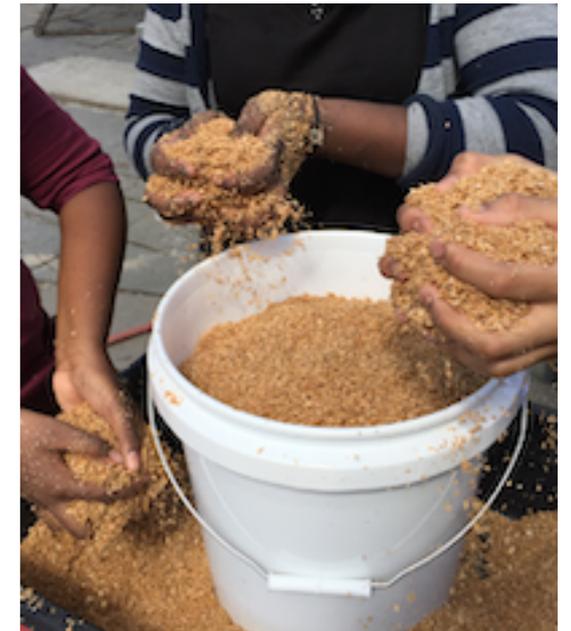
Connection with ancient times? (“fermentation farming”)

⇒

microbe rich

nutrients+metabolites

organic matter content



Making bokashi with students, Apr. 2015

Effective Microorganisms

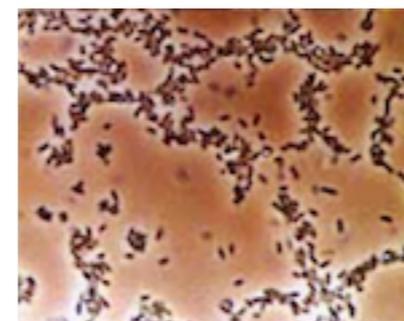
EM, EM-1

Combination of 3 groups of microbes:

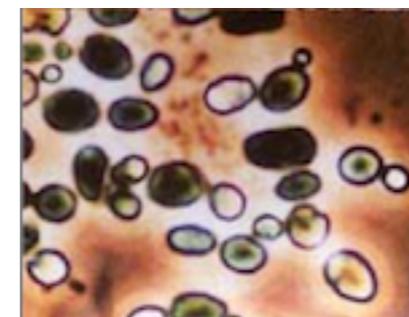
Lactic acid bacteria (various *Lactobacillus* spp.)

Yeast (*Saccharomyces cerevisiae*)

Phototrophic bacteria (*Rhodospseudomonas palustris*)



lactic acid bacteria



yeast



phototrophic bacteria

How to make bokashi



blackstrap molasses
1% to water



EM•1
1% to water



organic material
wheat bran



mix to ~30% moisture
(1 cup water/lb)



pack airtight to ferment



after 2 weeks, ready to use
“wheat bran bokashi”

Make bokashi

Wheat bran — 50 lbs

(on average, 1~2 person household, 12 lb/year)

1st mix these liquids together:

Water — 50 cups (3 gallons 2 cups; 12.5 qt)

(1 cup of water per lb of wheat bran)

Blackstrap molasses — 1/2 cup (4 fl oz)

(1% of volume of water)

EM•1 — 1/2 cup (4 fl oz)

(1% of volume of water)

Add the liquid-mix to the wheat bran and mix thoroughly to ~30% moisture [squeeze test: sticks together, no drip, easily falls apart]

Other Materials

A. As microbial host:

(microbial inoculant, probiotic and/or fermentation starter)

bran (1%*): wheat bran, rice bran, oat bran, barley bran/
barley feed, rye bran/rye feed, millet hulls (*feedipedia.org*)

organic waste (5%*): coffee chaff (husk shed when roasting raw coffee beans), cocoa/cacao husk (chocolate factory waste), coconut coir (shredded), wood shavings (walnut wood, teak, pine, mahogany; *avoid maple, poplar*), leaves (thoroughly dried, then crumbled).

B. As direct bokashi application:

nutrient-rich (1%*): rice bran + fish meal + oil cake

* 1% blackstrap molasses and EM•1 each to the volume of water used.
5% blackstrap molasses and EM•1 each to the volume of water used.

Make Activated EM

Fermentation container: **2-Liter** PETE bottle (soda bottle)

Add 2 cups **water**

Add heaping tablespoon of **sea salt**; swirl bottle

Add 5% **blackstrap molasses** 100 ml; swirl bottle

Add 5% **EM-1**, 100 ml; swirl bottle

Add water to 1 inch below neck of the bottle

Squeeze out air when closing cap.

2 weeks to ferment. Room temperature. When pressure (carbonation), release gas.

EM-5 recipe

Same as Activated EM (no sea salt) plus the following:

Apple cider **vinegar** 5%, 100 ml

Vodka (**40% alcohol**) 5%, 100 ml

Garlic clove, 1 or 2 skinned and crushed

Hot/spicy chili peppers, 2 to 5 whole fruits cut open

—preferably Scoville rating/pungency(heat/spiciness) **above 25K**—25,000 SHU.

Can be same or mix of peppers, examples: cayenne [30K-50K], Satan's Kiss peppers [40K-50K], Thai orange peppers [50K-100K], Bird's Eye (Thai chili, Piri Piri) [50K-350K], Scotch bonnet [80K-400K], habanero [100K-350K], ghost pepper [850K-1M+], etc.

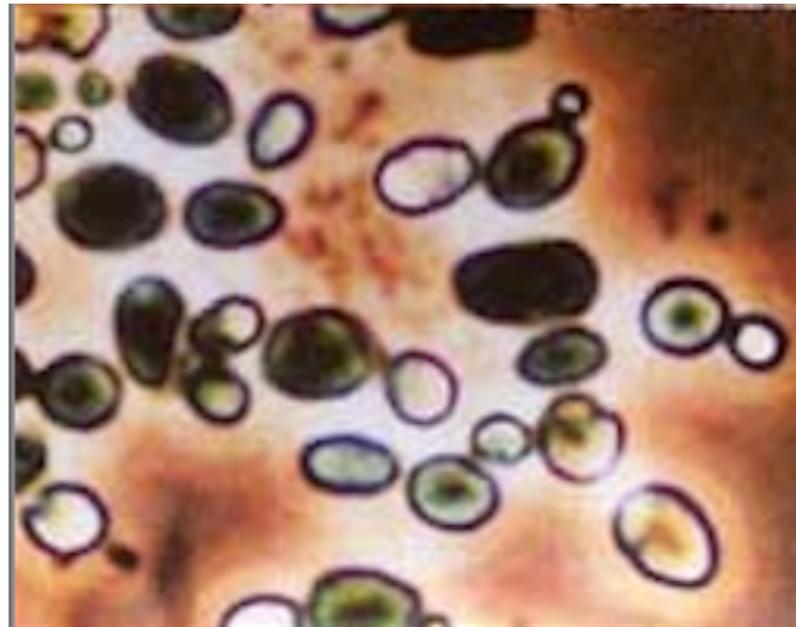
Effective Microorganisms

EM, EM-1

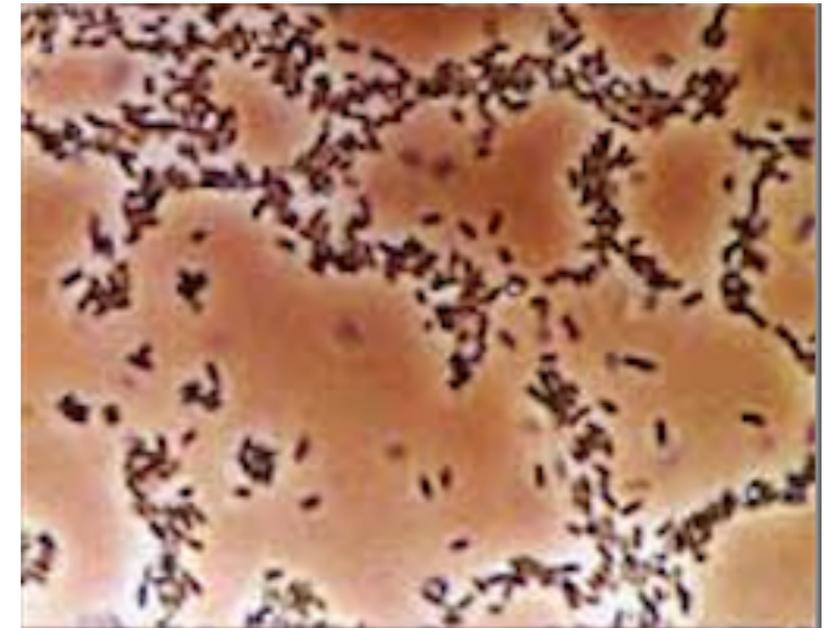
Combination of 3 groups of microbes
with the dominant species of each group

Microbes function
differently
when combined

These microbes exist most
anywhere, but are not
normally found together.



yeast



lactic acid bacteria

When Teruo Higa discovered (1982) how effective
this combination was, he needed to refer to this
grouping by a name, so he called it
Effective Microorganisms or EM.

And EM-1 is the actual liquid containing these 3
groups of microbes.



phototrophic bacteria

Purpose of fermentation

purpose of bokashi

microorganisms

increase population
& diversity

probiotic
(microbial inoculation)

life cycles
(break down dead matter—
composting;
feed living matter—nutrient
availability & transport)

food for other
organisms

nutrients + metabolites

release nutrients

increase bioavailability

macronutrients &
micronutrients

produce metabolites

increase microbial
functions

organic matter content

replenish the organic
component of soil
(humus)

for soil structure (flow)

soil microbiome
(prebiotic)

improve soil functions
(biodiversity, fertility, sequestration, filtration)

Use of Microbes

Direct application → different environments/conditions

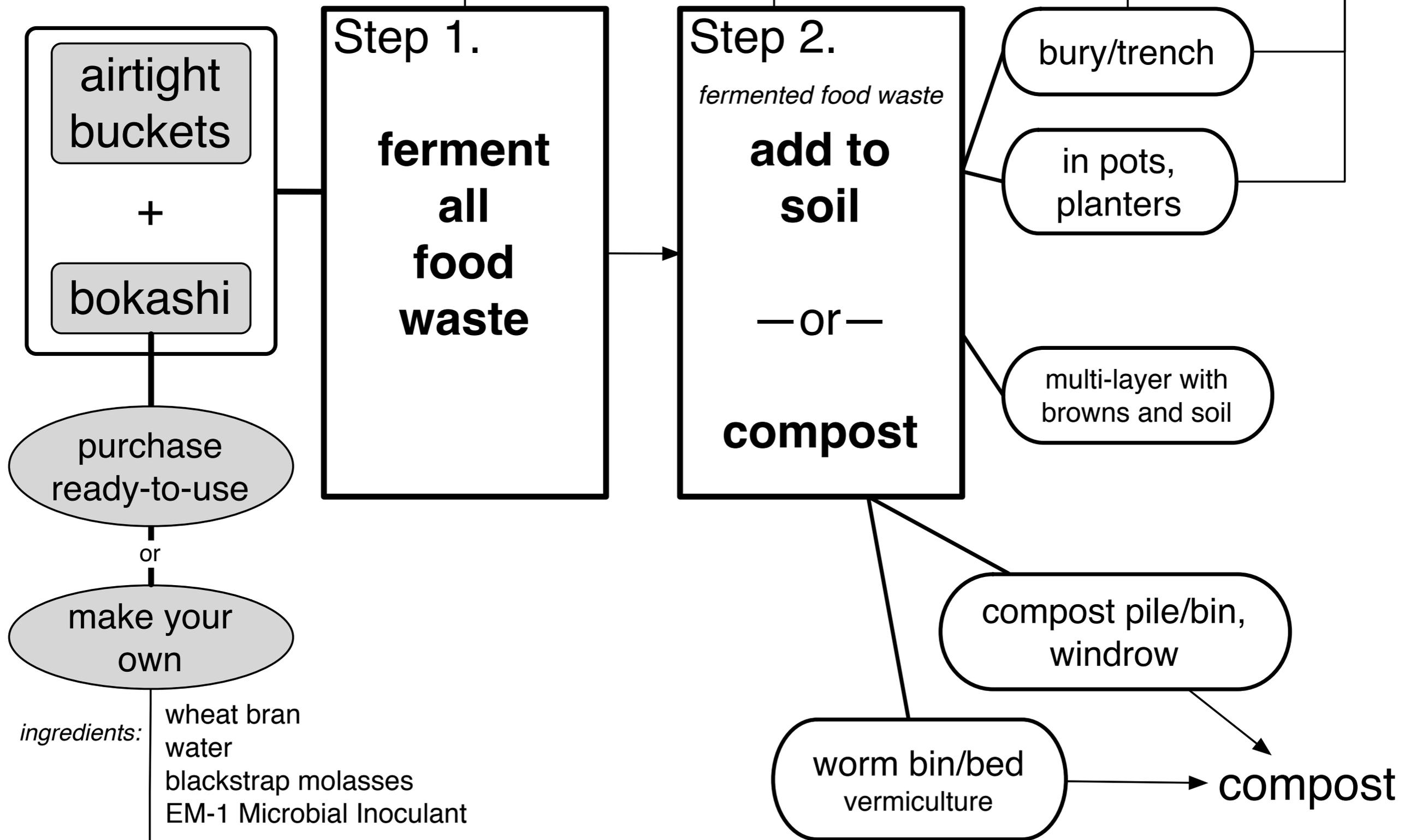
Some will ...

- thrive, but **function** differently –*adaptation*
- die –*no adaptation or survival mechanism*
- go passive (slow metabolic activity or activity provide no significant source of bioactive/catalytic substances) –*survival*
- go **dormant** (zero or near-zero metabolic activity) –*survival*
- become **food** for other organisms –*food chain*

⇒ biodiversity & ecological function

The bokashi method of recycling food waste

2 weeks to ferment → 2 weeks in soil → then plant.



Step 1. 'pickling'

fermenting food waste

pretreats (safer =>)

microbial pop. increase

release nutrients

metabolites:

organic acids (pH≈3.9)

amino acids (protein building block)

enzymes (breaks down materials)

coenzymes, bacteriocins (anti-pathogens)

antioxidants (naturally preserve)

Generally, anti-pathogenic and anti-rotting (preservation)

2 weeks - room temp.

4 weeks - <50°F (if enough mass)

all food waste

(microbial and nutrient diversity)

Step 2. 'break down'

adding to soil or compost

as a soil amendment

microbial inoculant

organic matter content

bioavailability of more nutrients:

diversity (fat, proteins, carbohydrates, vitamins, minerals)

macronutrients (i.e., NPK, Mg, Ca, S)

micronutrients (e.g., I, Fe, B, Mn, Zn)

2 weeks - warmer seasons

4 weeks - winter (successive)

90%~99% broken down

bokashi composting

Step 1

ferment food waste

Step 2

as soil amendment



*El Sol Brillante Community Garden
and the Children's Garden
East 12th St, Ave A & B
East Village/Lower East Side
New York, NY*



bokashi sites, information, and contacts

volunteer/non-profit

- El Sol Brillante community garden
526 East 12th St, New York NY
elsolbrillante.org
- Children's Garden
544 East 12th St, New York NY
childrensgarden12b.org
- LUNGS — lungsnyc.org
Loisaida United Neighborhood Gardens
Represents 50 community gardens in
the Lower East Side and East Village,
Manhattan, NYC
- Sustainable Jersey City
sustainablejc.org

businesses

- EM Research Organization
emrojapan.com
(case studies, global contacts)
- TeraGanix
teraganix.com
(U.S. distributor, technical information)
- Vokasi
vokashi.com
(bokashi-treated food waste in 5-gal
bucket pickup service based in
Brooklyn NY)

recyclefoodwaste.org

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