

# *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**

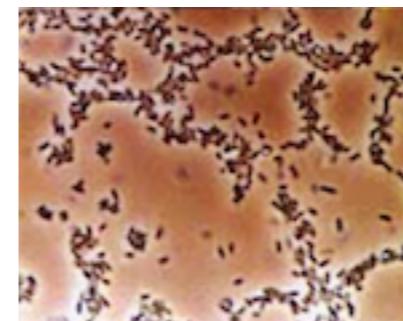
EM, EM-1

Combination of 3 groups of microbes:

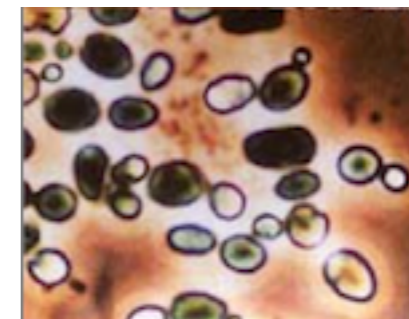
Lactic acid bacteria (various *Lactobacillus* spp.)

Yeast (*Saccharomyces cerevisiae*)

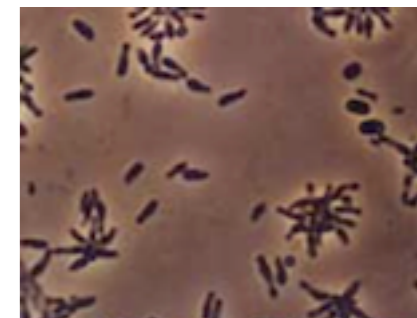
Phototrophic bacteria (*Rhodospseudomonas palustris*)



**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.



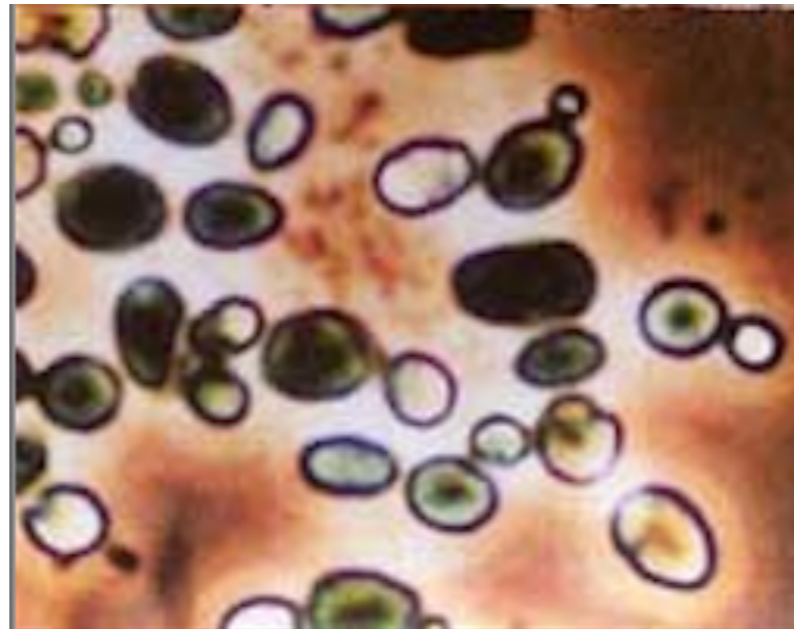
# Effective Microorganisms

## EM, EM-1

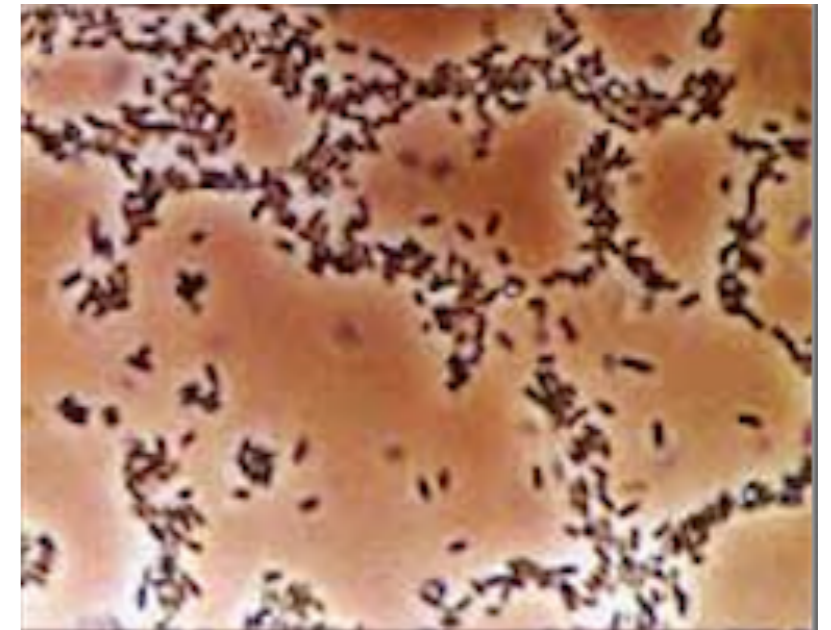
Combination of 3 groups of microbes  
with the dominant species of each group

Microbes function  
differently  
when combined

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



yeast



**lactic acid bacteria**



**phototrophic 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.

# 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

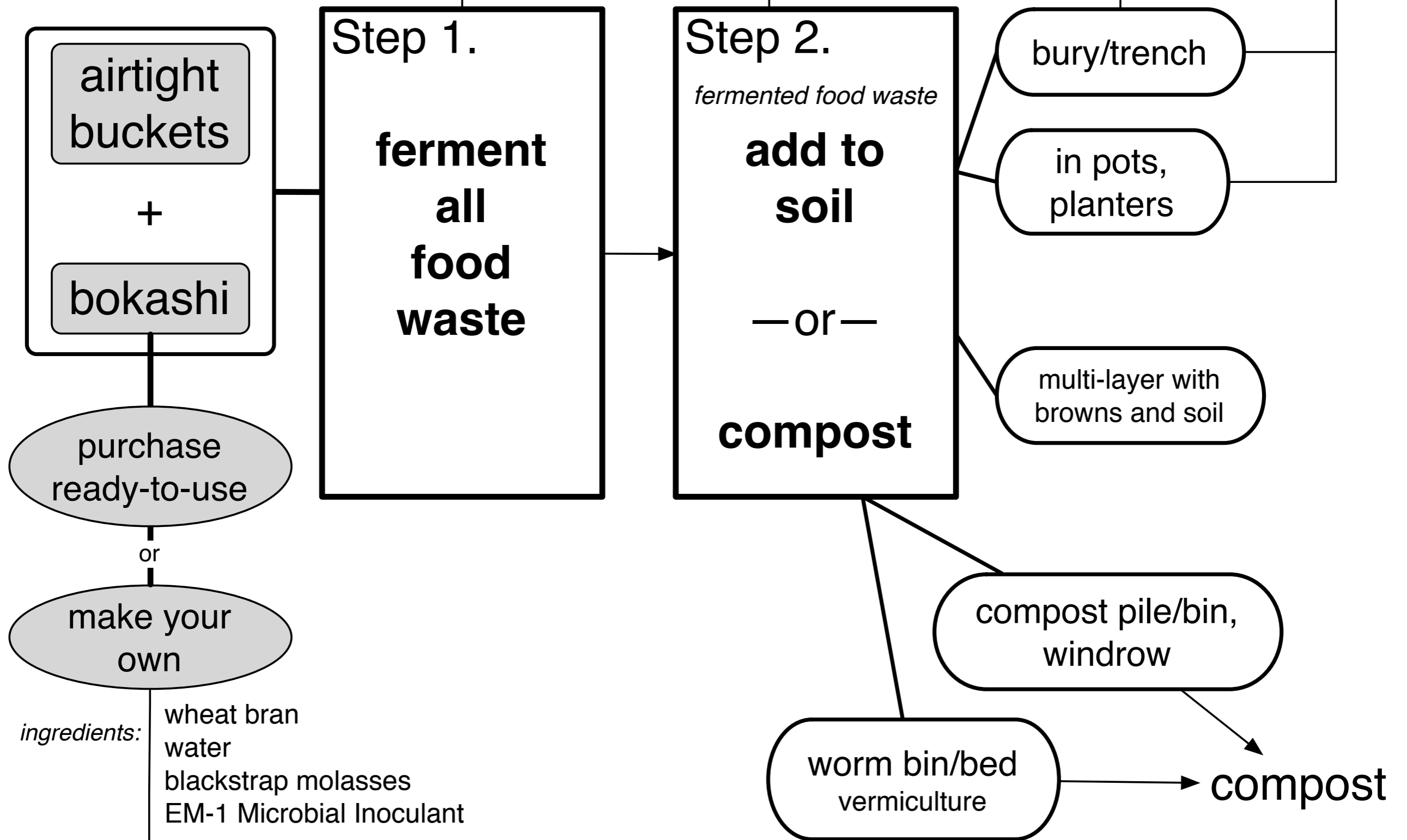
Some will ...

- 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)

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**recyclefoodwaste.org**

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