bokashi

recyclefoodwaste.org

4/16/2020

bokashi method

bokashi = fermented organic matter

Making bokashi with students, Apr. 2015

Ferment organic waste

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

bokashi — use of microbes through fermentation

Connection with ancient times? (“fermentation farming”)

⇒ **microbe rich** | **nutrients+metabolites** | **organic matter content**

uses of bokashi

bokashi (wheat bran)
applied directly to soil
to treat for heavy metals
St. Mary's Urban Farm
521 W 126th St Harlem NY

soil amendment

bioremediate soil, water

animal feed additive

fermentation starter

Mudball event
One Million Apologies to Mother Earth Event
Penang, Malaysia 2009

bokashi methods

*ways to use **microbes** in **different areas***

bokashi **composting** (method of recycling food waste)

bokashi **gardening** (microbial inoculation/application methods in gardening)

bokashi **farming** (microbial inoculation/application methods in farm applications)

bokashi **bioremediation** (method of remediating soil, water with microbes)

bokashi **probiotics** (method of feeding microbes to animals)

bokashi types

by ingredients

fermentation starter

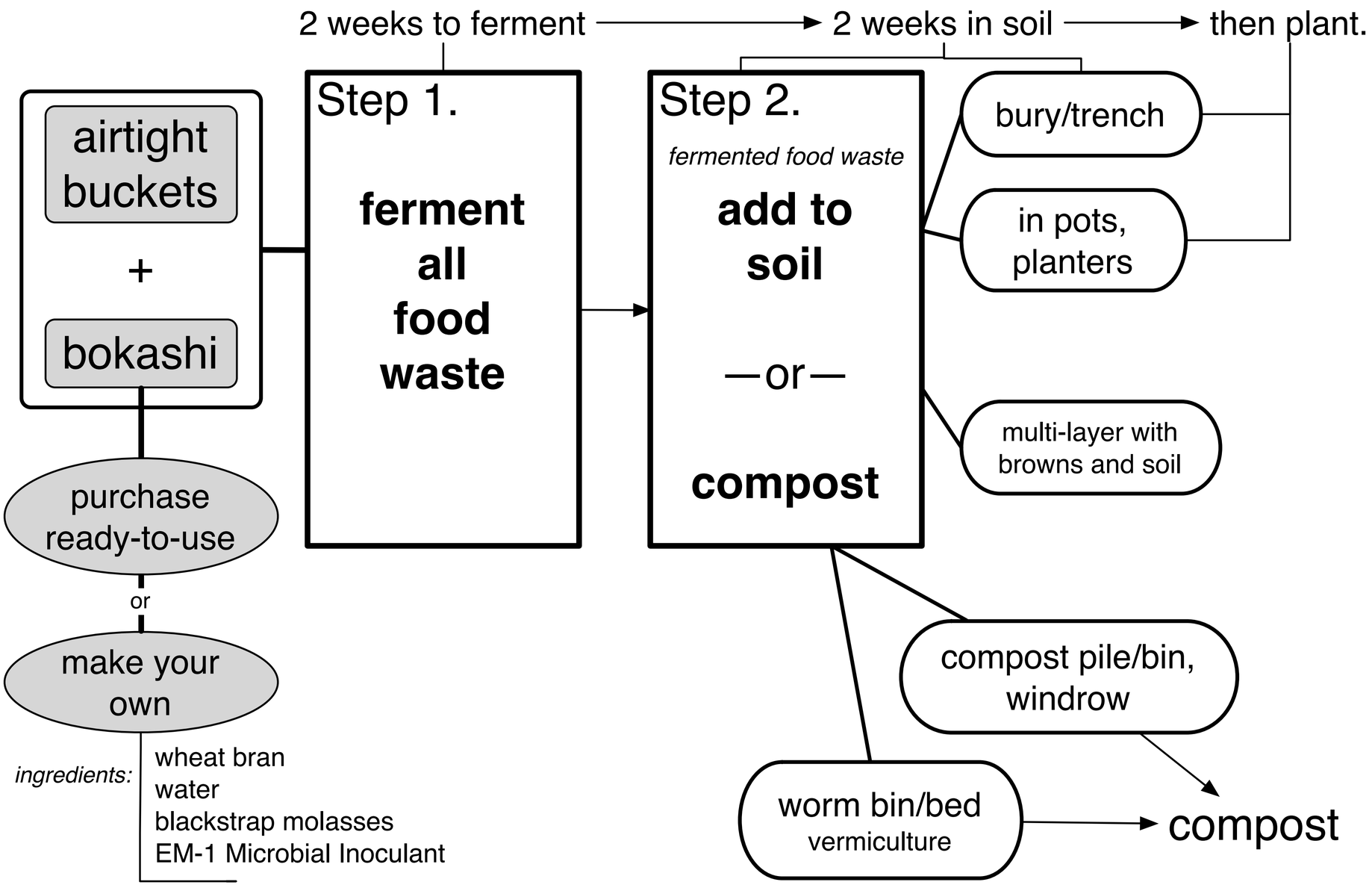
microbial inoculant [+ nutrients + organic matter]

bokashi mudballs / EM mudballs

probiotic feed

prebiotic starter

The bokashi method
of recycling food waste



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

microbes

microorganisms = microbes = microscopic organisms

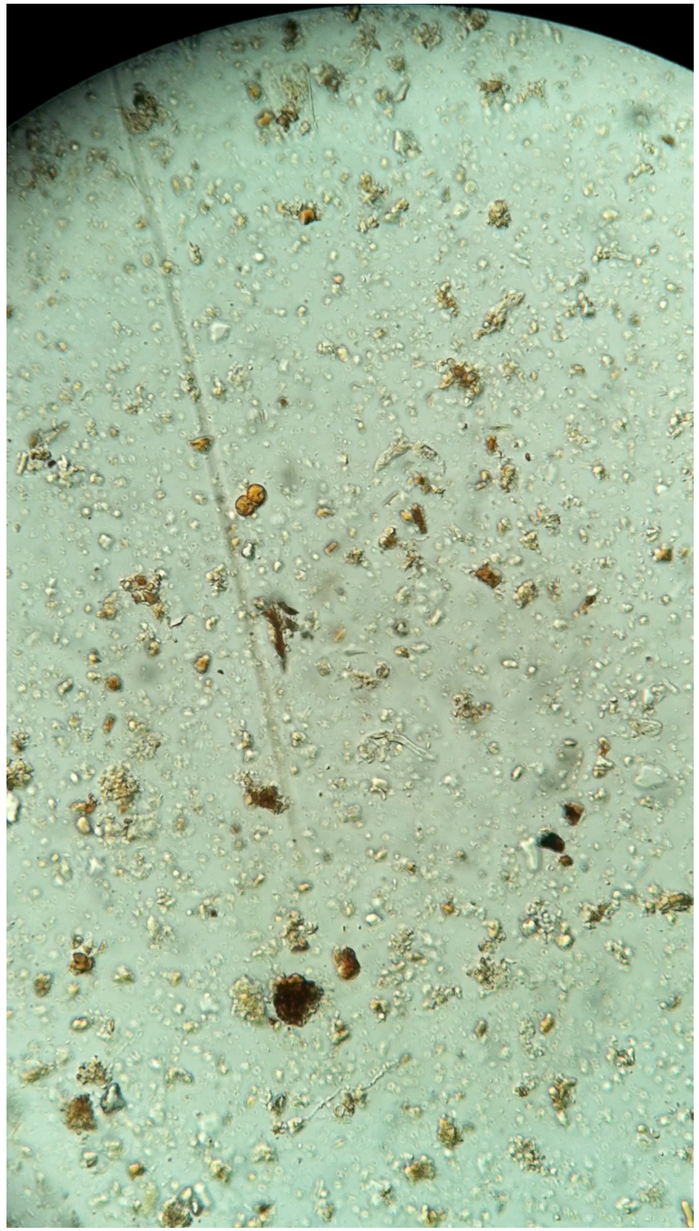
archaea, bacteria, fungi, algae, protozoa, microscopic plants, microscopic animals

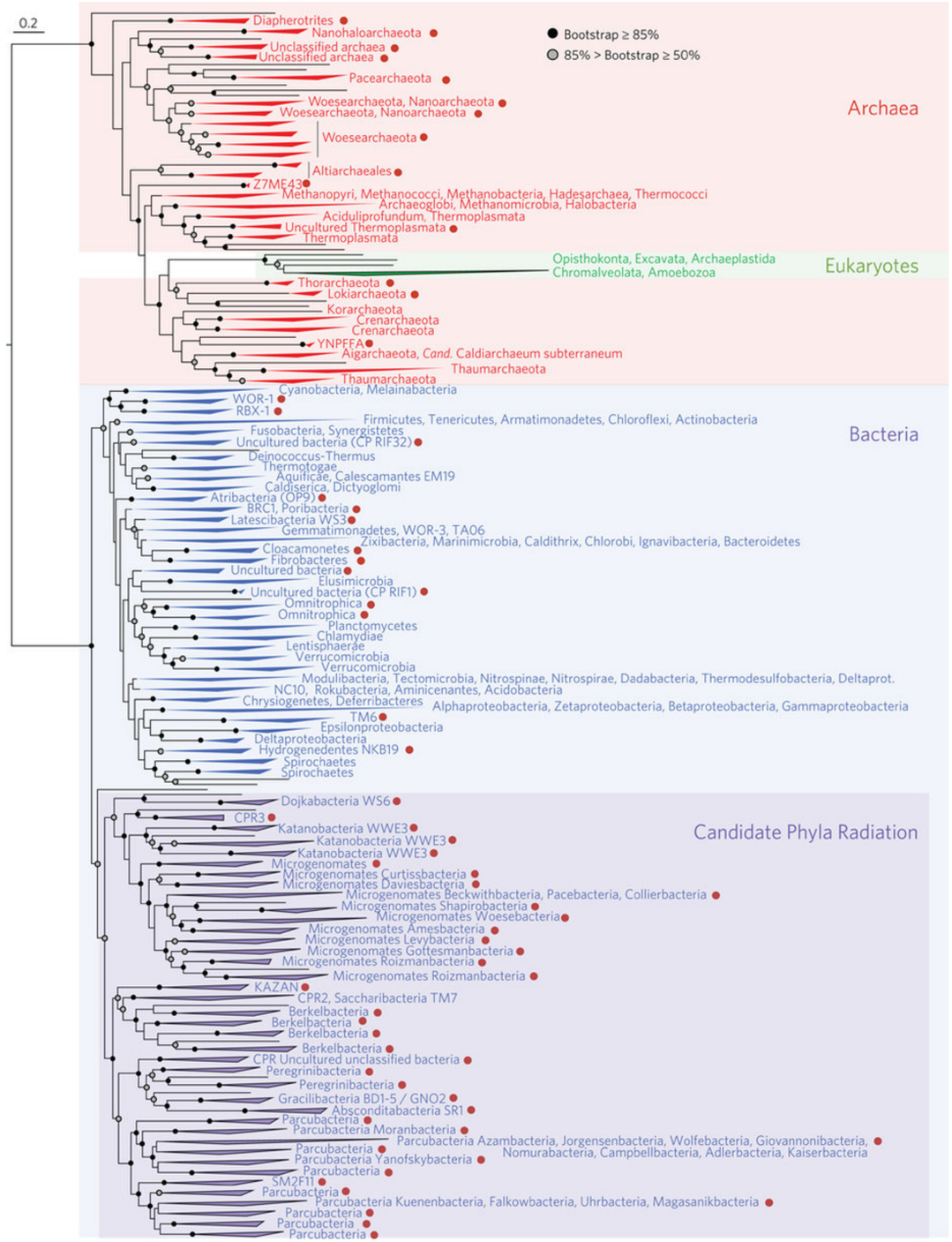
pathogens – disease causing by toxins or cell damage
bacterial, fungal, viral, parasitic, prionic (protein)
— a fraction of 1% of all microbes

Microbes are everywhere

Necessary for all of life

They terraformed our planet.





“A new view of the tree of life” [biology]

from Nature Microbiology

https://www.nature.com/articles/nmicrobiol201648
May 2016

Past tree of life diagrams had animals represent about half of all the species.

Now, all of the visible life (from fungi to plants to animals to humans) are on that one thick line under Eukaryotes.

The bottom third, “Candidate Phyla Radiation” (a temporary name) have all been recently discovered (ca. 2015).

How little we still know about the microbial world.

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

fermentation

fermentation – where microbes break down complex molecules into simpler ones.

Different kinds of fermentation

lactic-yeast fermentation (*incl. bokashi*)
methane fermentation (*anaerobic digesters*)

bokashi ≠ methane fermentation

We've been **fermenting foods** and **beverages** since ancient times to **feed our bodies**.

Farmers may have fermented plant/crop waste in the past to feed their soil and plants.

With bokashi, we're **fermenting food waste** to **feed the soil** and **plants**.

sauerkraut

kimchee

yogurt

kefir

cheese

dark chocolate

vanilla extract

bread

hard salami

mead

wine

beer

purpose of bokashi

microbes

microbial inoculant, fermentation starter

nutrients

and metabolites

organic matter

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)

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”

St. Mary’s Urban Farm, 521 W 126th St Harlem NY, Nov. 2013

Sprinkling the microbes

Making Activated EM

Activated EM ingredients

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.

Uses of Activated EM (AEM)

- watering plants*, 1 fl oz / gallon of water*
- foliar feed*, 0.5 fl oz / gallon of water*
- soil inoculant*, 1-2 fl oz / gallon of water*
- cleaning *(general cleaning, tools and equipment), 1-2 fl oz / gallon of water*
- tough stains*, 2-10 fl oz / gallon of water*
- odor problems *(carpet odor, urine odor), 2 fl oz / gallon of water*
- laundry*, either replace 1/2 detergent with AEM or totally replace with AEM*

uses of EM

bioremediation
break down of pollutants, chemicals, toxins—they eat our waste and secrete beneficial substances

St. Mary's Urban Farm, West Harlem, NYC

antioxidants
anti-rusting,
anti-corrosion

Experiment started 9/22/2004
Photo taken 4/25/2011

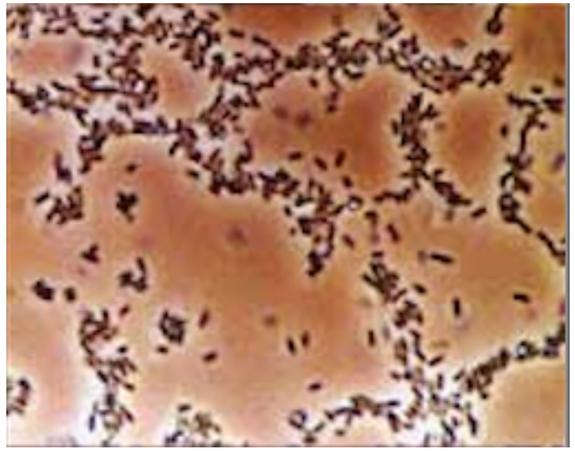
odor control
replace odor-(gases)-producing microbes

Washington Square Park Dog Run, New York NY

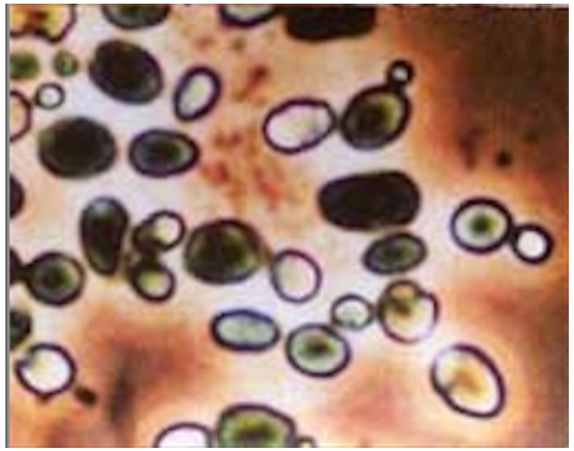
Effective Microorganisms

EM, EM-1

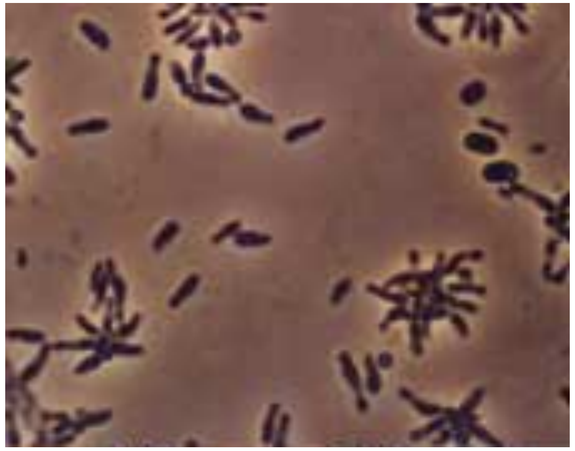
Combination of 3 groups of microbes



lactic acid bacteria
(various *Lactobacillus* spp.)



yeast
(*Saccharomyces cerevisiae*)



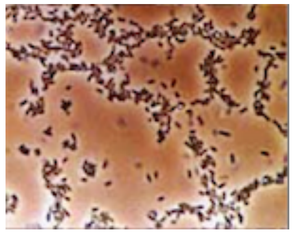
phototrophic bacteria
(*Rhodopseudomonas palustris*)

Images: EM Research Organization

Effective Microorganisms

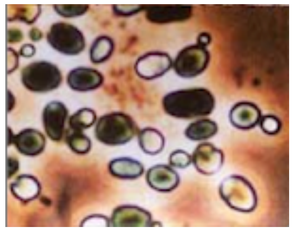
EM, EM-1

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

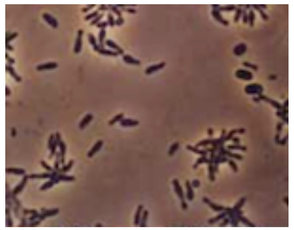

lactic acid bacteria

Microbes function differently
when combined

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


yeast

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.


phototrophic bacteria

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

Images: EM Research Organization

The microbes in EM•1

http://recyclefoodwaste.org/files/Microbes%20in%20EM1.pdf

EM-1 ingredients (U.S. version as of May 2010). EM-1 Microbial Inoculant (full name) is OMRI Listed (Organic Materials Review Institute), omri.org, and can be used by certified organic operations.

ACTIVE INGREDIENTS:
Microorganisms: 1 million colony forming units/cc (units/ml), 1%:
Lactobacillus plantarum, *Lactobacillus casei*, *Lactobacillus fermentum*, *Lactobacillus delbrueckii*, *Bacillus subtilis*, *Saccharomyces cerevisiae*, *Rhodopseudomonas palustris*
INACTIVE INGREDIENTS:
96% Water and 3% Molasses

Lactic Acid Bacteria

L. plantarum - in saliva (first isolated); liquefies gelatin
[foods found in: sauerkraut, pickles, brined olives, kimchi, Nigerian ogi, sourdough, cheeses, fermented sausages, stockfish]

L. casei - in human intestine and mouth; known to improve digestion and reduce lactose deficiency and constipation ; complements growth of *L. acidophilus*
[foods found in: cheddar cheese, green olives]

L. fermentum
[foods found in: sourdough]

L. delbrueckii
[foods found in: yogurt, mozzarella cheese, pizza cheese, Hartkäse, Berg-Alpkäse, Bleu de Bresse, Bleu de Gex, Fourme d'Ambert]

Bacillus subtilis - commonly found in soil; can survive extreme heat; natural fungicidal activity; used in alternative medicine; can convert explosives into harmless compounds; used in safe radionuclide waste; produces amylase enzyme (present in saliva; breaks down starch into sugar)
[foods found in: Japanese natto (fermented soy beans), Korean cheonggukjang (fermented soybean paste)]

Yeast

Saccharomyces cerevisiae - brewing and baking, top-fermenting yeast (ale)
[foods found in: baked breads, coffeecakes, pastries, croissants]
[beverages found in: beer, wine, mead, cider, vinegar]

Phototrophic Bacteria

Rhodopseudomonas palustris - naturally found in soil and water, a food source for small organisms (zooplanktons, small crustacea); a natural detoxifier; degrades odors in agricultural and industrial waste; stimulates growth of actinomycetes (white 'mold') which suppresses the growth of pathogenic fungi, improves soil structure, humus formation, helps soil retain water, and breaks down tough plant materials; benefits growth of certain crops and fruits; also found in earthworm droppings, swine waste lagoons, marine coastal sediments, pond water. [foods found in: Swiss cheese]

Making the bokashi spray