"Why Michigan Koi All-In-One Bacteria And Enzymes Work so well"

Understanding The Role Of Bacteria And Enzymes And How We Use Them!

What is Bacterial-Enzyme Digestion?

Bacterial-enzyme digestion is the process of bacteria consuming organic matter. Enzymes act to break the organic matter into water soluble nutrients. The bacteria feeds on organic matter i.e., (fish waste / uneaten food / decaying organisms), obtaining nutrition for growth and reproduction. Using complex chemical reactions, the organic waste is metabolized down to water and carbon dioxide (the final metabolic waste products), providing the bacteria with energy for growth and reproduction. It may be shown by this simple equation:

Bacteria + Enzyme + Organic Matter + Oxygen = Water + Carbon Dioxide

Beneficial bacterial products must contain three necessary components:

- Bacteria
- Enzymes
- Nutrients

These three components work in harmony, to consume the food of unwanted bacteria. They speedily and efficiently digest organic waste without odor or noxious gases and are a non-pathogen.

Bacteria Types

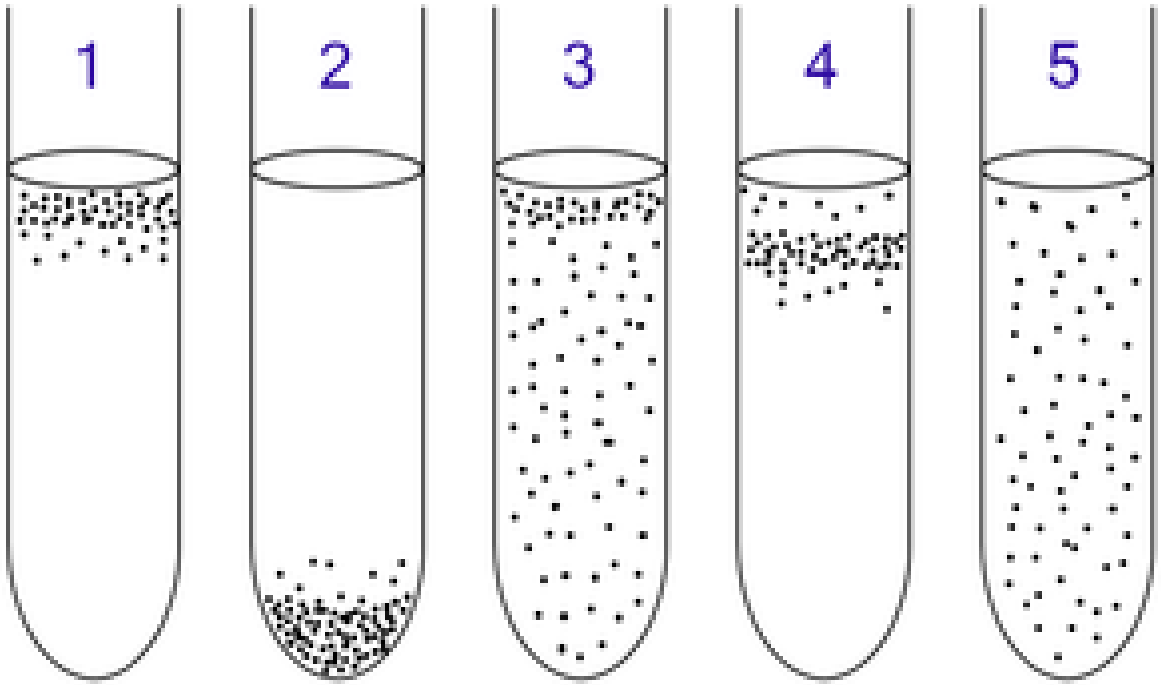
Thousands of different types of bacteria exist everywhere in our world, and most of them carry on bacterial digestion in some way. However, some of them are found only in a particular environment and require specialized types of food, and/or have very unique biological roles.

A bacterium is a single cell life form – each individual cell is a separate, unique organism. Bacteria often grow into colonies or masses, but each cell remains an independent, individual life. Bacteria reproduce by a process called cell division. A mature bacterium reproduces by dividing into two daughter cells, each identical to each other and the parent bacteria. Under ideal conditions, bacteria can reproduce very rapidly, producing a new generation every 20 – 30 minutes.

Following this reproduction process, the number of individual bacteria doubles with each generation. The population explodes as the number of organisms increases logarithmically (exponentially). This population boom begins soon after the bacteria are introduced into a favorable environment.

This population cannot increase forever. At some point, the food source will be depleted, waste products will accumulate, or some other change in the environment will cause the population to level off or decrease (i.e. a change in pH, temperature, or oxygen level of the environment). Also, introduction of any toxins into the environment may have negative effects on the population, as well as competition from other types of bacteria.

Bacteria can be classified into different types:



Aerobic and anaerobic bacteria can be identified by growing them in test tubes of thioglycollate broth:

1: **Obligate aerobes** need oxygen because they cannot ferment or respire anaerobically. They gather at the top of the tube where the oxygen concentration is highest.
2: **Obligate anaerobes** are poisoned by oxygen, so they gather at the bottom of the tube where the oxygen concentration is lowest.
3: **Facultative anaerobes** can grow with or without oxygen because, they can metabolise energy aerobically or anaerobically. They gather mostly at the top because, aerobic respiration generates more ATP than either fermentation or anaerobic respiration.
4: **Microaerophiles** need oxygen because, they cannot ferment or respire anaerobically. However, they are poisoned by high concentrations of oxygen. They gather in the upper part of the test tube but, not the very top.
5: **Aerotolerant** organisms do not require oxygen as they metabolise energy anaerobically. Unlike obligate anaerobes, however they are not poisoned by oxygen. They can be found evenly spread throughout the test tube.

There are several crucial beneficial bacteria characteristics ideal for Agriculture and Aquaculture. The good bacteria used must:

a. Not cause any disease in man or animals – they must be non-pathogenic.
b. Digest waste quickly and completely, without producing significant odors or noxious gas.
c. Consume (digest) a wide variety of organic material that are present in wastes.
d. Grow and reproduce quickly and readily in the environmental conditions found in wastes.

Our All-In-One bacteria blend have these desirable characteristics:

- **X1:** [3]Produces copious quantities of extracellular enzymes that degrade starches and carbohydrates, produces cyclic lipopeptides which possess potent surfactant activity.
- **X2:** Can degrade polymers such as protein, starch, and pectin. Therefore, they are thought to be an important contributor to the carbon and nitrogen cycles.
- **X3:** Converts nitrate to nitrogen gas, it demonstrates antifungal activity by producing an antibiotic that acts against fungi.
- **X4:** Possesses some very unusual enzymes, and a high capacity for the production of exoenzymes.[2]
- **X5:** Has antibacterial and antifungal activity.
- **X6:** Enzymatic conversion of cellulose to metabolizable sugars, digests cellulose.
- **X7:** A strain that play an important role in agriculture, detoxing metals from soil.

Each of these bacteria is recognized as safe, non-toxic, non-pathogenic bacteria. Each of these bacteria will regularly be found in any fish pond or soil. However, they will not normally be present in numbers sufficient to improve the clarity in your pond. These bacteria work together to consume nutrients that are the source of undesirable growth that contributes to the water clarity problem

- They consume thousands of times faster than naturally present bacteria.
- They grow and reproduce easily
- They are non-pathogenic, and do not produce foul odors or gas as they digest.

These good bacteria are grown by artificial means on a liquid or dry nutrient medium. These cultured bacteria are then freeze-dried to put them in a state of suspension. They remain alive, ready to swim, eat and reproduce as soon as they are activated and put into the proper environment.

The proper environment needed for a speedy growth and reproduction of these good bacteria must have the following characteristics:

- Dissolved oxygen (for the aerobic types that require it) in sufficient quantities.
- A water (with organic waste) or soil medium containing food for them to eat.
- Moderate temperatures, between 4.44°C and 40°C. (40F-104F)
- Proper pH – not too acid, nor too alkaline – between 6 and 9 on the pH scale.

Organics are consumed by the bacteria, used as nutrients by the bacteria and is no longer present to produce food for algae, sludge, odors, pollution or toxins.

Enzymes:
What is an enzyme? How does it aid digestion?

1. An enzyme is a catalyst that breaks up long, complex waste molecules into smaller pieces, which can then be digested directly by the bacteria.
2. Enzymes are simply chemicals – they are not living things, and they cannot grow or reproduce themselves.
3. Enzymes are manufactured by bacteria, and used by the bacteria in order to digest waste. The extra enzymes that are mixed with bacterial products are actually produced by special bacteria, extracted from them and blended into the bacterial-enzyme mixture.

Enzymes are added with bacteria to enhance the efficiency of the digestive process. When added to the organic waste, the enzymes immediately go to work breaking down the waste. The large complex molecules of proteins, starches, carbohydrates and cellulose are broken into smaller, simpler pieces. These enzymes act like chemical blades decreasing in size the large molecules of waste into smaller pieces for the bacteria. The growing bacteria produce more enzymes on their own, creating a continuing cycle of enzyme production.

Some examples of digestive enzymes produced by our beneficial bacteria:

am·yl·ase [am-**uh-leys, -leyz]**
any of a widely distributed class of enzymes that catalyze the hydrolysis of starch, glycogen, and related polysaccharides to oligosaccharides, maltose, or glucose, any of several digestive enzymes that break down starches.

cel·lu·lase [sel-yuh-leys, -leyz]
any of several enzymes, produced primarily by fungi and bacteria, that catalyze the hydrolysis of cellulose.

es·ter·ase [es-**tuh-reys, -reyz]**
any enzyme that hydrolyzes an ester into an alcohol and an acid.

li·pase [lahy-peys, lip-eys]
any of a class of enzymes that break down fats, similar to the one's produced by the liver, pancreas, and other digestive organs or by certain plants.

lig-nin-ase [Lig-nin-eyz]
Ligninase is the original term encompassing many different types of oxidative, extracellular fungal enzymes which catalyze the breakdown of lignin which is commonly found in the cell walls of plants.

pro·te·ase [proh-tee-eys, -eyz]
any of a group of enzymes that catalyze the hydrolytic degradation of proteins or polypeptides to smaller amino acid polymers.

u·re·ase [yoo r-ee-eys, -eyz]
an enzyme that changes urea into ammonium carbonate, occurring in bacteria, fungi, etc

The five types of enzymes that should be present in water/soil treatment products are:

Protease – breaks down proteins
Amylase – breaks down carbohydrates and starches
Lipase – breaks down fats and greases
Cellulase – breaks down cellulose
Xzlaninase – breaks down hemicellulose, one of the major components of plant cell walls.

Enzyme production of each culture (shown below) is based on a 1 - 5 scale, with 5 being the greatest production. The effective pH range of the overall formulation is 4.0 - 10.0 and the effective temperature range of the overall formulation is 35 F - 120 F.

X1: working temp. 59°F to 122°F
Nitrogen 1 Phosphorous 4 Protease 3 Amylase 2 Lipase 2 Cellulase 2 Ligninase 3 Xzlaninase 2 Esterase 2 Urease 3
X2: working temp. 59°F to 122°F
Nitrogen 1 Phosphorous 2 Protease 5 Amylase 2 Lipase 5 Cellulase 1 Ligninase 3 Xzlaninase 2 Esterase 3 Urease 1
X3: working temp. 41°F to 122°F
Nitrogen 3 Phosphorous 2 Protease 5 Amylase 4 Lipase 4 Cellulase 4 Ligninase 5 Xzlaninase 4 Esterase 4 Urease 2
X4: working temp. 41°F to 122°F
Nitrogen 3 Phosphorous 2 Protease 5 Amylase 3 Lipase 4 Cellulase 5 Ligninase 4 Xzlaninase 1 Esterase 4 Urease 2
X5: working temp. 59°F to 131°F
Nitrogen 2 Phosphorous 4 Protease 2 Amylase 2 Lipase 2 Cellulase 1 Ligninase 2 Xzlaninase 1 Esterase 2 Urease 2
X6: working temp. 37.4°F to 113°F
Nitrogen 2 Phosphorous 5 Protease 3 Amylase 1 Lipase 3 Cellulase 3 Ligninase 2 Xzlaninase 3 Esterase 3 Urease 4
X7: working temp. 41°F to 122°F
Nitrogen 2 Phosphorous 2 Protease 4 Amylase 2 Lipase 3 Cellulase 3 Ligninase 4 Xzlaninase 4 Esterase 4 Urease 2

Enzymes are specific; one type of enzyme can work on only one type of molecule. i.e., lipase will attack animal fats and grease, but will not work on paper or wood fibers (cellulose). Likewise, protease enzyme will break down complex proteins into simple pieces, but will have no effect on fats and greases.

Essential Nutrients:

Special nutrients are added to create the vitamins and minerals required for the fastest growth and the greatest activity of the bacteria. These vitamins and minerals may not be present in the waste, and a lack of any one of them may seriously inhibit the growth, reproduction and waste digestion performance. They must be added to the bacteria and enzyme product to assure the fastest, most efficient action.

The biological process of bacterial-enzyme digestion is responsible for the digestion of organic waste, no matter where it occurs. With minor variations, this process benefits soils and waters: i.e.

- Koi Ponds
- Fish Farms
- Lakes
- Municipal Sewer Treatment Operations
- Septic Tanks
- Agriculture
- Compost-Making
- Organic Waste Disposal Systems

Continuous Digestion: The Open System

Most Agriculture and Aquaculture systems are open systems. With an open system, things can be added and removed to maintain the environment in a condition that is most favorable to the growth of beneficial bacteria.

- The pH of the water or soil may be adjusted to maintain conditions that promote the growth of the desirable bacteria. As the carbon dioxide builds up, a small amount of caustic soda or another alkaline chemical can be added to adjust the pH within the best range.

- The water can be aerated to replenish the dissolved oxygen supply and soil can be tilled. The added oxygen will encourage continued bacterial growth and rapid digestion, because the most favorable growing conditions for the beneficial bacteria are maintained.

- Additional doses of bacteria and enzymes can be added to keep the population at the desirable bacteria count. This is done to insure that the good bacteria will remain dominate in the face of tough competition from all the naturally occurring bacteria.

These techniques are used in both Agriculture and Aquaculture. By actively working to maintain a healthy environment, the growth of the desirable bacteria can be maximized. The conditions may be monitored, and adjusted, to keep the process of bacteria digestion going at full speed. The results will be an absolute minimum of gas or odors, and the fastest most complete water or soil treatment .

This was put together to help you understand some of the principles involved with bacteria in water and soil management. While the process is the same for almost all systems indicated, the actual conditions may vary from system to system. Each type of system is unique, but by understanding the way bacteria and enzymes work, and what makes them work best, you can fine tune the treatment program to produce the best results – while maximizing soil or water quality in Agriculture and Aquaculture.

We should be thanking these microscopic creatures for everything from the medicines we take to the foods we eat, from the waste we generate to the gold we wear.

2014 - William Risher

2) Ref:
An **exoenzyme**, or **extracellular enzyme**, is an enzyme that is secreted by a cell and functions outside of that cell. Exoenzymes are produced by both prokaryotic and eukaryotic cells and have been shown to be a crucial component of many biological processes. Most often these enzymes are involved in the breakdown of larger macromolecules. The breakdown of these larger macromolecules is critical for allowing their constituents to pass through the cell membrane and enter into the cell. For humans and other complex organisms, this process is best characterized by the digestive system which breaks down solid food via exoenzymes. The small molecules, generated by the exoenzyme activity, enter into cells and are utilized for various cellular functions. Bacteria and fungi also produce exoenzymes to digest nutrients in their environment, and these organisms can be used to conduct laboratory assays to identify the presence and function of such exoenzymes. Some pathogenic species also use exoenzymes as virulence factors to assist in the spread of these disease causing microorganisms. In addition to the integral roles in biological systems, different classes of microbial exoenzymes have been used by humans since pre-historic times for such diverse purposes as food production, biofuels, textile production and in the paper industry. Another important role that microbial exoenzymes serve is in the natural ecology and bioremediation of terrestrial and marine environments.

(3) Ref. *Code Names:* X1, X2, X3, X4, X5, X6 and X7 are to protect the proprietary blend in Michigan Koi All-In-One Dry

Putting Good Bacteria to Work

X1: this bacterium is known for its ability to break down proteins. It has some mild antibacterial properties as well, but they are less pronounced. **X1** produces and secretes amylase, an enzyme that breaks down starch into sugars the plant can use. It also secretes an antibiotic protein called barnase; it tells the host plant to begin manufacturing a barnase inhibitor called barstar. It also provides protection against various soil born diseases and strengthens plants' vitality and yield.

X2: produces protease (binds amino acids into proteins) and amylase (breaks down starch into sugars). By breaking down the plants food ahead of time, your plants gets to use its energy on more important things like making better buds. Colonies of **X2** near the root zone stimulate root production, as well as secondary stem growth. **X2** is recognized to produce antibiotic like Bacitracin, which suppress the growth of undesirable microbes & is very useful in degrading excess organic matter in the pond & also waste materials like sediments & chitinous exoskeletons of the shrimps, because of its ability to produce the enzyme Keratinase.

X3: like other bacteria, it produces many enzymes. It acts as a fungicide by preventing the development of fungal spores on plants. It forms a physical barrier between the plant leaf and the fungal spores, and then colonizes the spores. **X3** also stimulates the plants own resistance system by inducing systemic acquired resistance (SAR). It fights fungal pests such as molds, mildews, blights, rusts. Also degrades waste organic matter & sediments in the pond which enables to keep the water clean

X4: A strain that play an important role in agriculture.
Findings suggest that the strain might play a vital role in the improvement of crop production in metal-contaminated soil, as well as in acidic soil. When poultry diet contained 10^{10} spores/g, mortality of flies reared on feces exceeded 80%. The use of **X4** spores as a feed additive in poultry production systems fostering a more integrated approach to farming is discussed.

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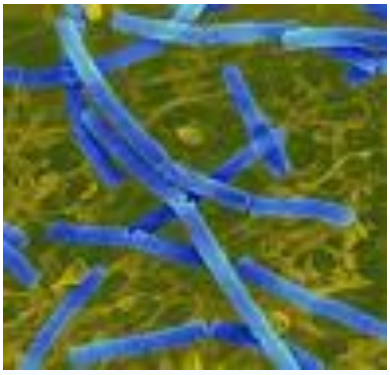


X5: during their growth process produce many enzymes like Amylases, Proteases and Lipases etc. and forms a symbiotic relationship with the hosts in the slime layers of fish/prawns and on the host besides having an activity inside the gut. **X5** is so strong that it practically cannibalizes all harmful microorganisms. It is one of the most potent and beneficial of all health-promoting and immune-stimulating bacteria. **X5** are able to activate nearly all systems of a plants immune defense. Helps in the process of denitrification & converting Nitrates into Oxygen and Nitrogen. It is a fast growing bacteria & produce many digestive exo-enzymes into the environment. Decomposes the waste & excess organic matter in the pond thereby helps to keep the water clean. Known to produce substances inhibiting the growth of undesirable bacteria, especially Vibrio spp., & for its ability to solubilise phosphates.

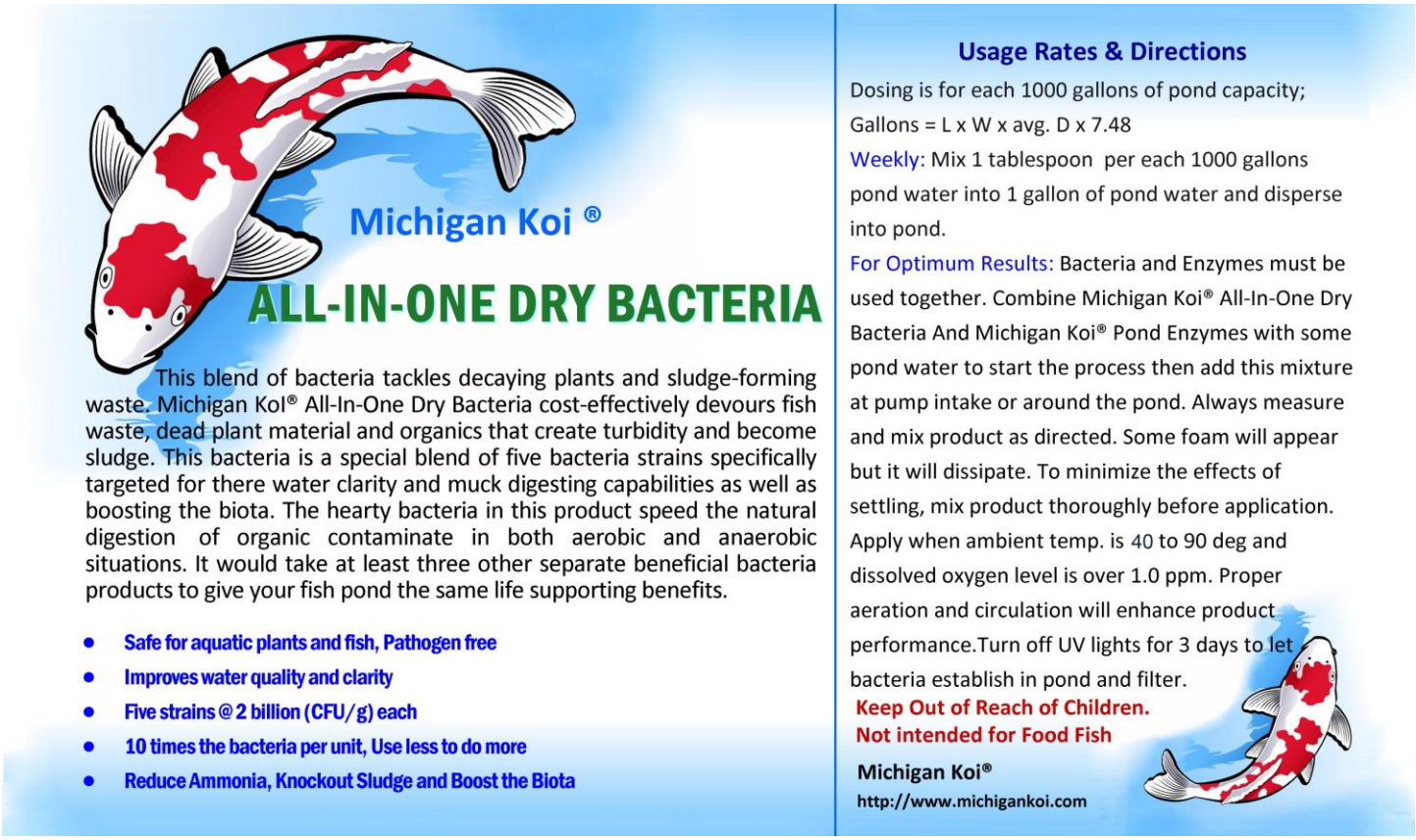
Biosurfactants: are surface-active substances synthesized by living cells. Interest in microbial surfactants has been steadily increasing in recent years due to their diversity, environmentally friendly nature, possibility of large-scale production, selectivity, performance under extreme conditions, and potential applications in environmental protection. Few of the popular examples of microbial biosurfactants includes Emulsan produced by Acinetobacter calcoaceticus, Sophorolipids produced by several yeasts belonging to candida and starmerella clade, and Rhamnolipid produced by Pseudomonas aeruginosa etc.
Biosurfactants enhance the emulsification of hydrocarbons, have the potential to solubilise hydrocarbon contaminants and increase their availability for microbial degradation. The use of chemicals for the treatment of a hydrocarbon polluted site may contaminate the environment with their by-products, whereas biological treatment may efficiently destroy pollutants, while being biodegradable themselves. Hence, biosurfactant-producing microorganisms may play an important role in the accelerated bioremediation of hydrocarbon-contaminated sites. These compounds can also be used in recovery and may be considered for other potential applications in environmental protection. Other applications include herbicides and pesticides formulations, detergents, healthcare

and cosmetics, pulp and paper, coal, textiles, ceramic processing and food industries, uranium ore-processing, and mechanical dewatering of peat.
Several microorganisms are known to synthesize surface-active agents; most of them are bacteria and yeasts. When grown on hydrocarbon substrate as the carbon source, these microorganisms synthesize a wide range of chemicals with surface activity, such as glycolipid, phospholipid, and others. These chemicals are synthesized to emulsify the hydrocarbon substrate and facilitate its transport into the cells. In some bacterial species such as Pseudomonas, biosurfactants are also involved in a group motility behavior called swarming motility.

"With these facts you know why these products work so well"

For best results: Bacteria and Enzymes must be used together. Combine Michigan Koi® All-In-One Dry Bacteria And Michigan Koi® Pond Enzymes with some pond water to start the process then add this mixture at pump intake or around the pond.

NOTE: Turn off UV lights for 3 days to let bacteria establish in pond and filter. (UV kills good bacteria also)



Michigan Koi ®

CONCENTRATED LIQUID POND ENZYMES

A blend of specialized Enzymes that decompose organic substances and sludge plus restores clarity to water. These enzymes penetrate and emulsifie all types of organic contaminants. Liquid Pond Enzymes promote effective biological remediation in three ways: jump starting indigenous bacteria; produce surfactants that quickly emulsify organics; restore water quality and improve the pond's balance. Maintaining optimum water quality is important for consistently growing large fish, controlling nuisance vegetation, and keeping your pond or lake young and healthy forever!

- **Speeds up the natural breakdown of organics**
- **Fortified blend goes twice as far**
- **Biodegradable formula, stimulates pond biota**
- **Improves water quality and clarity**
- **Safe for fish, aquatic plants**
- **Eliminate odor**

Usage Rates & Directions

Dosing is for each 1000 gallons of pond capacity;
Gallons = L x W x avg. D x 7.48

Weekly: Mix 1 oz. for each 1000 gallons into 1 gallon of pond water and disperse into pond.

For Optimum Results: Bacteria and Enzymes must be used together. Combine Michigan Koi® All-In-One Dry Bacteria And Michigan Koi® Pond Enzymes with some pond water to start the process then add this mixture at pump intake or around the pond.

Always measure and mix product as directed. Some foam will appear but it will dissipate.

To minimize the effects of settling, shake or mix product thoroughly before application.

Apply when ambient temp. is 40 to 90 deg and dissolved oxygen level is over 1.0 ppm

Proper aeration or circulation will enhance product performance.

Turn off UV lights for 3 days to let bacteria establish in pond and filter.
(UV kills good bacteria also)

Keep Out of Reach of Children.
Not intended for Food Fish

Michigan Koi®
http://www.michigankoi.com

Almighty Plant Cleaner

Cleans away parasites:
Spider Mites, Whitefly, Thrip, Aphids

No Lingering Odor or Taste, and Non-Toxic

Almighty Plant Cleaner is not a chemical or an insecticide; just an all natural product that is non-toxic and environmentally safe.

16 FL. OZ.

Safety Notices:
Completely safe when used as directed. Contents are highly concentrated, never use more than the recommended ratio and follow all directions closely.

Keep Out of Reach of Children!
Contents are highly concentrated. In case of skin or eye contact, rinse with water. Should irritation occur seek medical attention. Do not take internally. Buyer assumes all responsibility when not used as directed.

Active Ingredients:
Potassium Sorbate .1% by weight
Inert Ingredients:
Water, Yeast, Citric Acid 99.9%

Note:
Michigan Koi represents that this product qualifies for exemption from registration under the 25 (b) FIFRA.

Usage Rates & Directions:
Add 2 teaspoons of Almighty Plant Cleaner to 128 ounces of water; mix and fill sprayer.

Turn off all plant lights prior to applying cleaner; bright lights magnified through water droplets can cause leaf burns.

Spray both top and bottom of leaves to fully wet plant foliage. Full wetting will clean away all stages of parasites.

Apply when needed, can also be used as a plant wash.

Made in USA
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