Frequently asked questions

1. **Question:** Define vermicomposting and add a note on organic wastes employed in the process.

   Answer: The compost is generally called as **Vermicompost or** wormi-compost in which controlled degradation or composting of organic wastes primarily occurs due to earthworms.

   The biologically degradable and decomposable organic wastes commonly used as composting materials in vermiculture and vermicomposting are: animal dung, agricultural waste, forestry wastes, city leaf litter, waste paper, cotton cloth, city refuge, biogas slurry, and industrial wastes. Utilizable wastes for vermicomposting can also be generated from different sources like house hold waste, industrial wastes etc.

   Along with these, earthworms can be fed all forms of food waste, yard and garden waste, paper and cardboard, etc. Yard wastes, such as leaves, grass clippings, straw, and non woody plant trimmings can be composted. Leaves are the dominant organic waste in most backyard compost piles. If grass clippings are used, it is advisable to mix them with other yard waste; otherwise the clippings may compact and restrict airflow. Branches and twigs greater than $1/4^{th}$ inch in diameter should be put through a shredder/chipper. Kitchen wastes such as vegetables scrape, coffee grounds, and eggshells may also be added. Sawdust may be added in moderate amounts if additional nitrogen is applied. Wood ashes act as a lime source and if used should only be added in small amounts (5 Kg per ton of waste).

2. **What are the major requirements for vermicomposting process?**

   Major requirements for the vermiculture are aeration, moisture content and temperature. Earthworms need to breath, just like most other living creatures. The process of osmosis makes a worm rather different than those of us with lungs, but the end results is pretty much the same. Gradually, the available oxygen is used up and replaced with carbon dioxide and other miscellaneous waste gases. Moisture content should be maintained within range, rainfall must not be allowed to enter the bin and also bin must not be dried out during summer. Temperature requirement for optimal results is 20-30°C, earthworms can survive at the range of low temperatures to 48°C maximum.

Earthworm will need little help for feeding bigger sized waste materials. If it is chopped into small pieces it will be easier to the earthworms to feed. Usually 2Kg of earthworms will recycle 1Kg of organic waste in 24hours. In absolutely ideal conditions of comfort and ground up, moist food, the heard will recycle their own weight in wastes every 24hours.

Ideal conditions for earthworms are like temperature between 55 to 70°F, humidity should be maintained at 55% and keep the earthworms out of rain. p^H of the bed should be maintained at 6.0 to 7.0. Ingredient mixture or bedding material will play a major role in vermicomposting; these ingredients are broadly grouped into two classes that are browns and greens. Browns are dry and dead plant materials such as straw, dry brown weeds, autumn leaves, and wood chips or sawdust. These are mostly made of chemicals that are just long chains of sugar molecules linked together. These browns must need to be wetted before they are put into compost system. Greens are fresh plant materials such as green weeds from the garden, kitchen fruit and vegetable scraps, green leaves, horse manure, etc. compared to browns; greens have more nitrogen in them. Good mix of browns and greens is the best nutritional balance for the gut microflora of earthworms in 1:1 ratios of greens and browns, or two parts of brown to one part of greens will be a good nutritional balance for composting.

Particle size of the waste material should be smaller in nature, because smaller the size of organic wastes, the faster the compost will be ready for use. Smaller particles have much more surface area that can be attacked by the gut microflora. Larger wastes are chopped off to smaller size and then it can be used for composting systems as mentioned earlier.

3. Write a note on earthworms employed in vermicomposting.

Earthworms affect ecosystem structure and function directly by ingesting, altering and mixing organic residues and mineral soil. Through these actions, they change the structure, chemistry and biology of soil. Earthworms are classified into three ecological groups based on their distinct feeding and burrowing habits. Stable isotope analysis has confirmed and refined conventional ecological classification systems. Epigeic earthworms live above mineral soil, rarely form burrows and feed preferentially on plant litter. Endogeic earthworms forage below the surface soil, ingest large quantities of

mineral soils and humified material, and they build ramified, predominantly horizontal, burrows. Anecic earthworms build permanent, vertical burrows deep into the mineral soil layer, and they come to the surface to feed on partially decomposed plant litter, manure and other organic residues. The ecological groups of some common, but not all earthworm species are clearly established. For example, *Aporrectodea caliginosa* is an endogeic and both *Lumbricus terrestris* and *L. friendi* are anecic species.

The various species of earthworms have different environmental requirements which are necessary for their propagation and continued health. These requirements will inevitably dictate whether one particular "family" of worms will be suitable for culture in any given circumstance. For instance, though many people may be interested in the possibility of raising *Lumbricus terrestris* (The nightcrawler, or Dew worm) in the house as a source of fishing bait, this is simply not very plausible when we consider that this particular worm prefers temperatures in the area of 5-10°C.

On the other hand, the two most commonly-used worms for vermicomposting, *Eisenia foetida* and *Lumbricus rubellus*, are the most popular precisely because of the ease replicating in the environmental conditions they prefer. Perfectly suited to an indoor existence, the culturing of these animals presents next to no problem, requiring only a minimum of effort, and presenting no hardship for those of us who share their place of residence. The fact is, in the absence of the normal hazards these worms usually face in their outdoor habitats, they are found to grow faster, stay healthier, live longer, and reproduce at an increased rate indoors. Thus, indoor culture turns out to be heaven for them, and a great benefit to the "landlord" who will have a great new way to convert his organic waste materials into a wonderful "food" for his plants, lawn, and garden.

4. Discuss the role of microorganisms in vermicomposting.

Differences in earthworm digestion and assimilation processes suggest the possible existence of ecological group-specific gut microbiota. Although the microbial profile of the gut content is of the same kind to that of soil and feed resources, it is not a coincidental combination of the microorganisms present in soil. The evolutionary relationship between earthworm burrowing and feeding habits and the gut microbial community has not been defined. However, based on studies conducted on insects and

faunal gut-associated microbial communities, we can expect the microbial profile of the gut to be an important determinant of earthworm metabolism.

Decomposition and humification of biodegradable organic waste materials is predominantly carried out by microorganisms in the soil but earthworms too have roles in humification. The composition of microflora in the earthworm gut varies depending on the species of earthworm, season and feeding regime of the earthworm. The number of microorganisms present in the gut of earthworm depended on the substrate that the earthworm fed on soil.

Interactions between earthworms and microorganisms seem to be complex. Earthworms are reported to have association with such free living soil bacteria and constitute the drilosphere. In this way, it is known that microbial biomass and activity are usually enhanced in the drilosphere, with greater numbers of microbial colony forming units (CFUs) in the burrow walls and earthworm casts than in the parent soil. The aerobic bacterial counts in midgut of the earthworm, *Libyodrillus violaceous* was higher than that of foregut whereas the hindgut region recorded maximum. This incorporates with the findings of the researchers proving that earthworms include microorganisms in their substrates as a food source and can digest them selectively.

5. Explain the process of vermicomposting?

Process of vermicomposting will starts from the construction of bins, these can be made of wood or plastics, or from recycled materials or concrete tanks may also be used. The length and width of the bin will depend on whether it is to be stationary or portable. The shape and size of the vermicomposting container depend on the requirement that is quantity of the waste to be composted and number of live earthworms required for culturing. On an average, 2000 adult earthworms can be maintained in containers of $1m^2$ dimension. These with appropriate conditioning of composting material would convert approximately 200 Kgs wastes every month. Interestingly, roughly in a container of 2.23 X 2.23 m. about 10 Kgs of earthworms can convert approximately 1 ton per month.

- Vermicomposting will start from the process of preparing the vermicomposting bin.
- Vermibed is cleaned and disinfected properly.

- A layer of broken bricks or pebbles are added to the vermibed.
- A layer of coarse sand was added.
- Loamy soil was filled up to $3/4^{th}$ of the vermicomposting bin.
- Above this a layer of epigeic and anecic earthworms were added.
- A layer of cattle dung and hay was added on the top of the vermicomposting bin.
- Finally on the top of vermicomposting bin a net was covered.

The lower most layer of earthworm feed substrate that is required to be vermicomposted is called as bedding material. The bedding material for startup and future restarts can be any biodegradable matter like banana stem peels, coir pith, coconut and other leaves, sugarcane trash, stems of crops, grasses or husk, etc. Any moistened organic materials can be used for bedding.

6. Discuss the problems involved in vermicomposting?

There are many problems that will directly or indirectly affect the vermicomposting process. Earthworms are the key players in the vermicomposting process, as all the organisms have their own predators in the natural system. The major earthworm predator is the mole. This voracious insect predator loves to dine on white and any earthworms it can find.

Tilling the soil does reduce the earthworm population. Not because it kills or disturbs them, but because tilling aerates the soil, and this oxygen quickly reduces the organic matter that the earthworm use as food. Mulching with green matter will help provide food to earthworms to replenish what is lost in tilling.

Earthworms come out of their burrows during rain to avoid drowning. Worms have no lungs they take their oxygen directly through the skin, either from air or from water. In fact, rather than fear water, they love it. Its drying out they fear and dry soils kill them.

The excess food wastes must be maintained in a proper storing facility otherwise this food wastes will be spoiled by the fruit flies. They lay their eggs on the waste foods and spoil the texture and cannot be used as a composting material. Too much of food wastes are loaded on to the bin then earthworms will get stressed and they will die.

Even too wet condition or too dry conditions have influence on survival of earthworms or they will try to escape. If the bedding material was used up by the earthworms, bin should be harvested and fresh bedding material should be added or then

also these earthworms will try to escape. If the bin started smelling very bad, then the lid has to be taken off for some time and more ventilation must be provided, this is because the bin is too wet, too much of food was loaded or there was not enough air present. If fruit flies were started growing then it is because of food wastes exposed to the air and it must be buried inside the bed.