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Composting: A Unique Solution to Animal Waste Management

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ABSTRACT

With increased the animal population, the problem of waste management is rising. The aim of this review is to analyze the process of composting, along with its advantage and disadvantage. Also the factors affecting the composting and its utilization are discussed. Animal waste does not only pollute the environment but is also equally harmful for mankind on one hand and loss of important fertilizer components on the other. It is therefore imperative to develop a suitable strategy to face this challenge. Composting is therefore an appropriate and less expensive solution to the problem of animal waste.

Key Words: Composting; Animal waste management; Legislation

INTRODUCTION

Animal waste management is now a rising global issue as it has hazardous impacts on human health and environment (Ritter, 1989). Human life remains at risk during animal handling and care, especially animal wastes like urine, feces/dung and dead bodies, which are the carriers of pathogens. Upon exposure to these excretes, the pathogens are transmitted to humans through touch, inhalation or drinking water, thereby showing serious impacts on the health of both animal farm worker in particular and common man in general. From these excretes sometimes very complicated diseases like Listeriosis, Leptospirosis, Salmonellosis, Brucellosis and Vibriosis are transmitted to humans (Korner *et al*., 2003). It is reported that most important animal allergens are found in the urine of rats and guinea pig (Clemson, 2003). Animal related allergy is very hazardous and about 30% of animal workers undergo allergic conditions such as nasal drainage whereas, another 10% have symptoms of animal induced asthma. The diseases like influenza are transmitted to human beings and cause an epidemic condition (González, 1982). These diseases are sometimes intricate or even fatal.

The other hazard of animal excrete is environmental pollution and its degradation. Only in the Karachi city waste amounts to 6600 tons per day; approximately 33% of this is not managed and end up in drains, water ways or are indiscriminately dumped in open spaces in air and water causing environmental pollution (Hasan, 2002). According to the United Nations' Food and Agriculture Organization (FAO, 2004), Asia has the fastest-developing livestock sector, followed by Latin America and the Caribbean. Consequently the animal waste production also increases day by day in these regions. Government of Pakistan has adopted the policy to increase the livestock production by increasing number of heads (Paktribune, 2005).

To give an idea of scale, the planet's population of some 2.5 billion pigs and cattle excrete more than 80 million metric tons (mmt) of waste nitrogen annually. The entire human population, in comparison, produces just over 30 mmt (Koopmans, 2004). Due to continuous incorporation of nitrogen from urine and faces in air depress the oxygen concentration and causing respiratory diseases. Whereas waste disposal in water not only pollutes it but also cause water borne diseases resulting in shortage of clean drinking water (Hansen & Meres, 2002).

Other than environmental pollution there is the loss of 1.5 mt of nutrients, which are available in farm yard manure and 101 mt of nitrogen from poultry manure (FAO, 2000). If we utilize this animal waste we can not only clean our environment but money spend on fertilizer could be saved. Awareness should be created among masses through trainings, workshops and seminars about the effectiveness of composting especially for managing animal waste.

In order to make sustained solution of animal waste an appropriate strategy should be adopted. There are many animal waste management (AWM) techniques and tools to design the exact amount of diet of a particular animal according to its weight and then the right amount of wastes disposed by it is calculated and managed through this machine designed by Clint (2004). But AWM demand high precision in operation process. Moreover, it is an expansive tool and developing countries can hardly afford it. Therefore, relatively cheaper strategies affordable by an ordinary farmer should be adopted. As the animal population like the human being is expanding and disposing wastes at the same time, composting remains the most appropriate process to cope with the problem of waste. Long before people inhabited the planet, composting was just something that happened. In every swamp, forest and meadow wherever there was vegetation, there was composting. In the distant past it was noticed that crops grew better near piles of rotting manure and vegetation. The discovery was passed down to succeeding generations being

the best animal waste management strategy.

Composting is a naturally occurring phenomenon that works under controlled conditions in which air, temp, moisture content are regulated for the growth of microorganisms and multiplication through, which organic material is converted into more usable form of organic matter (Chapman, 2005). In advanced countries like USA there is proper legislation with respect to composting: Any person, who owns or operates an agricultural operation, or owns the animals raised by the owner or operator of an agricultural operation and who wishes to conduct composting of dead animals resulting from the agricultural operation should do the following:

1. Participate in an educational course on composting conducted by the Ohio cooperative extension service and obtain a certificate of completion for the course and
2. Use the appropriate method, technique, or practice of composting established in rules.

However, there are problems in developing countries regarding legislation on the composting process. The AWM is the part of Pakistan environmental policy with the words "promote organic farming along with recycling of livestock waste" (GOP, 2005). If this policy is implemented through proper law and order it will be practically more effective. The most appropriate AWM i.e. composting require animal waste material (Teira-Esmatges & Flotats, 2003) and other than animal waste leaves, yard and garden debris, grass or cereal straw, food waste sewage sludge can also be used as an organic material for composting (Su *et al*., 2003). Composting begins as soon as a pile of waste is made. Microorganism starts decomposing by utilization of oxygen and converting it into CO_2, water vapors and heat (González, 1982). Following should be the objectives:

To determine the appropriate animal waste management strategy

To analyze the importance of composting

To study the steps of composting method

To identify the advantage and disadvantage of composting.

Composting methods. It may be on farm or in a building at commercial level. Composting of dead animals may best be described as above ground burial in a biofilter with pathogen killed by high temperature. It can be accomplished by mixing an energy and structural component (Keener *et al*., 2000). Composting systems can be open or close, the organic matter can either be placed openly in piles or rows or in a close container or reactor (Jones, 2000). The open system is rarely used in low-income countries due to its technical complexity.

Backyard composting at the household level is a simple technique. It requires only suitable organic waste, space to construct the heap and time to carry out the necessary work. The waste can be placed in a pit (e.g. 2 m x 2 m x 1 m deep) and left to decompose for 2–3 months. Alternatively, the waste can be piled up within an enclosure of 4 poles and surrounded by boards or chicken wire and left for a similar period. This produces rich compost, which can be used as a fertilizer on fields or gardens (Evans, 1986). For commercial composting the appropriate size of piles depends on the equipment used for aerating and moisture contents maintenance process. If the pile is too large then the center of pile would not be aerated which results in blocking the process. The exact steps of composting are listed below:

1. Animal manure, urine, bedding, crop residues, clean wood waste and animal dead bodies should be piled up. Animal dead bodies are incorporated within 24 h of death and covered with 3 feet of solid manure. Composting is done in a way that prevents formation or release of runoff and leaches out and control odors, flies, rodents and other vermin (Morrow, 2001).
2. Regular aeration can be controlled with a tractor having a bucket to mix up and down the pile.
3. Dead animals should not be recommended for composting until all fresh, internal organic and soft tissues are fully decomposed (Suet *et al*., 2003).
4. Composting must be done outside of wetlands or 100 - yards flood plain and at least 100 feet from private wells.
5. If composting is done in permanent structure, composting ware shall utilize weather and rot resistant materials capable of supporting composting operations without damage.
6. Maintain moisture contents like silage damp, not wet. Add manure solids or water when needed, its temperature should be 40^{o}C for 3 days to kill the pathogens. It should be turned 5 times for a complete process of 180 days and first turns after one month (Chapman, 2005).
7. It can spread on crop field as well as a bedding material due to its odorless sterile, weed free related and dried (Daniel *et al*., 1987). However, it is a risk to compost dead bodies of animals.

Caution. Animals showing signs of a neurological disease must be reported and disposed off as recommended. For example, it is not clear whether prions, the agent that causes Bovine Spongiform, Encephalitis (Mad Cow Disease) would be destroyed in the composting process. Dead animals with the signs of neurological disease, anthrax or those under quarantine should not be composted (Bonhotal, 2003).

Factors affecting composting. There are five major factors that affect composting process. These factors coordinate with each other, and also with organic materials and begin decaying process by the action of decomposers.

Air control. Composting is an aerobic process (in the presence of oxygen). Air should regularly be provided by exhausts, fans and blower or by continuous stirring or mixing the organic material (Chapman, 2005).

Nutritional traffic. Compost should have a definite ratio of incoming and out-going nutrient traffic in order to maintain the balance. This process is mostly successful when the pile contains 20 - 40 parts of Carbon to oxygen (Eldridge, 1995) i.e C/N ratio as 20/1 and varies to 40/1 (Korner *et al*., 2003).

If Nitrogen is too low, excess nitrogen is converted in to ammonia and escapes into the air cause odor and air pollution. On the other hand if this ratio is too high, the process reduces.

Suitable temperature. Temperature is an integral factor of every decomposing process like composting in order to regulate the breakdown of organic material by microbial activity. The process begins when the outer temperature is up to 45°C for two days (Morrow, 2001). The optimum temperature to maximize composting is between 35-45°C and for global market production 40°C for three days to destroy all weed seeds, parasites and un-necessary microbes (Albama, 2003).

Moisture contents. Moisture contents are essential to integrate the composting process; however, it also depends on continuous mixing. The stabilizing rate for moisture content is between to 40-60%. Below 40%, the process reduces and beyond 60 it becomes more anaerobic. Overall 50% moisture contents can be maintained by adding water in case of dryness (Bonhotal, 2003).

Physical characteristics. The physical characteristics of the ingredients must also be considered when developing a compost mix. Different physical characteristics affect aeration, the amount of decomposition and the ability of a pile to maintain aerobic conditions. Three main physical characteristics of the compost mix of main concern are porosity, texture and structure. Porosity is a measure of the air space within the compost mix and influences the resistance to airflow through the pile. If the pores become filled with water because of high moisture content, then the resistance to airflow increases. Less oxygen reaches the micro-organisms and anaerobic activity begins to dominate. Porosity is improved by a more uniform mix of material that provides continuity of air spaces, proper moisture to allow adequate free air space and larger particles to increase the pore size and reduce the resistance to airflow. Larger particles are desirable to promote the flow of air, but they also diminish the surface area of the particles. Majority of the microbial activity occurs on the surface of the compost particles within a thin liquid layer. Greater the amount of surface area exposed, the greater the amount of decomposition. Texture is the relative proportion of various particle sizes of a material and is descriptive of the amount of surface area that is available to the micro-organisms (Su *et al*., 2003). The finer the texture, the greater the surface area exposed to microbial activity. Minimizing the particle size by such methods as selection and grinding also increases the overall surface area of the material in the pile that is exposed to microbial decomposition. Structure refers to the ability of a particle to resist compaction and settling. It is a key factor in establishing and maintaining porosity during the composting process. Structure is important because even a mix that has all of the necessary components may not be able to sustain rapid composting. If the pile begins to settle and close off air spaces as the material decomposes, the compost process slows down. Highly absorbent material tends to maintain better structure than less absorbent ones. The ideal particle size of the compost material must therefore be a compromise between maximizing porosity, maximizing surface area and increasing structure (Hoare, 1987).

Compost utilization. Compost can be utilized in a variety of ways:

1. Compost reduce odor so it is much preferred than manure to maintain soil fertility (Su *et al*., 2003).
2. It can also be used for livestock bedding (Albama, 2003).
3. The composted nutrients release more slowly to plants than the nutrients in fresh manure. It improves soil water holding capacity, leaves wind and water erosion, improves aeration and reduces runoff or dilution of water.
4. Heavy manure applications can increase soil salinity, which inhibit plant growth and decrease yield. Controlled application of compost also solves this problem and disease causing organisms in the soil, causing soil borne diseases are destroyed (Teira-Esmatges & Flotats, 2003).
5. It conditions soil and improves manure handling (reduced volume), and adds organic matter in the soil.
6. Compost has the greatest potential as a marketable product and quality compost has a value in international market. Especially in the scenario of globalization and WTO, its demand is increasing day by day.
7. For motorway construction erosion is a major factor with subsequent non-point source pollution. Recent years have seen the use of compost as an erosion control material, often in blend with mulch (Korner *et al*., 2003).

Constraints. There are certain constraints with compost processing and its utilization like:

1. It requires time, space, money, produce odor, the need for protection from rain and herbicide carry out (Zurbergg, 2003).
2. Composting needs equipment, labor and management, which can be expensive for commercial production.
3. If a considerable amount of waste is composted, it requires a large area and may be a building to protect from rainfall.
4. It is expensive to purchase (Evans, 1986).
5. It contains less nitrogen than fresh manure.
6. Marketing takes time and many producers do not want to deal with selling compost (Hartung, 1986).
7. Unfortunately, the past has shown many composting efforts, which have failed and were abandoned. The main reasons for failure are as a combination of:
8. lack of support and cooperation from the public and municipal governments
9. poor marketing plans for the end product
10. poor quality feedstock waste
11. maintenance
12. lack of understanding of the composting process and training in operational procedures, often resulting in offensive odor emissions (Hartung, 1986).

CONCLUSION

Animal waste management is not only un-hygienic for both farm workers and common man but also pollutes the environment. Composting has made it easy to decompose animal wastes under controlled conditions. The compost is although expensive and its process takes time but is better solution to restore the soil fertility and to keep the environment clean, healthy and friendly.

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