



## Nonconventional and New Approaches of Animal Waste Management

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### Introduction

With rapid growth in livestock production is also resulting in the increase in animal mortalities as well. Mortalities occur due to diseases, accidents and natural calamities. Immediate removal and disposal of animal waste is important for an effective bio-security of livestock and humans [1]. Conventional methods of carcass disposal like incineration, burial and burning although seem economical and easy but are associated with environmental and social issues on their long term basis use [2]. Contamination of ground water, air pollution, odour and fly menace problem do exist with these methods. Economical, social and biosecurity issues are also associated with some of these methods as well. Non-conventional methods like composting, lactic acid fermentation, rendering, alkaline hydrolysis and nontraditional rendering are more bio-secure and environment friendly besides require less time and have end product utility as well [3]. Novel approaches of animal waste management like plasma arch processing, novel pyrolysis technology, yeast fermentation, bioreduction, extrusion, integrated waste management system, thermal depolarization, napalm, ocean disposal and re-feeding [1]. Each of these methods is innovative, economical, easy and effective during natural calamities and catastrophes as well. Thus the use of novel and non traditional methods of carcass management is more secure, environment friendly and socially accepted and with their end product utility as well [4].

### Composting

Composting is a method widely used around the world as an alternative to dumping different types of wastes [5]. It is an eco-friendly and less expensive method of generating a valuable end product in the form of bio-manure [6]. In composting a natural biodegradation process is involved in the presence of oxygen. The end

product of this process is a dark-brown or black soil like material or humus with a musty odour rich in plant nutrients. Poultry waste can be effectively composted if the moisture content (50-60%) and temperature (40-45°C) is properly maintained in the compost. During the composting process a significant reduction in both volume and weight occurs with destruction of almost all the pathogens [7]. Decomposition occurs best when there is an adequate supply of the essential nutrients carbon, nitrogen, oxygen [8].

### Lactic acid fermentation

Lactic acid fermentation of farm waste is another environmentally sustained and secure method of disposal and utilization of dead animals and other waste [9]. Lactic acid fermentation is an anaerobic process with the transformation of simple sugars to lactic acid at a low pH (good for preservative). Fermentation of dead birds and poultry litter with lactic acid bacteria is very effective in inactivating pathogenic viruses and bacteria. The lactic fermentation decontaminates the waste material and helps in its further utilization as fermented feed to be utilized by other animals [10]. During fermentation due to absence of oxygen and the presence of glucoses which are rapidly multiplied in the waste material, there occurs ensiling process which further helps in preservation of end product. Thus the use of lactic acid fermentation processes for developing a valuable final product from waste is a good option for ensuring the security and safety of the product and its further utilization in future [11].

### Rendering

Rendering is the process of derivation of different valuable products like: fat, proteinaceous material, bone meals and tallow after proper treatments of crushing, heating and separation of wa-

ter contents. Dead carcass is a rich source of organic matter and a fresh carcass contains around 32% dry matter wherein 52% is protein, 41% is fat, and 6% is ash. When properly done rendering involves production of safe and valuable end products. Due to involvement of heating treatment in rendering storage capacity of final products is significantly increased by killing pathogenic microbes present in the raw material, and consistent removal of excessive moisture for microbial activity. Tallow of rendering is a useful product for in soaps, washing powders, chemical industry and cosmetics. It can also be used for energy production because of its high fat amount and thus there is reduction in the environmental footprint of the process. The main issue associated with rendering is production of gas and odour emissions. In rendering 90% of odours can be removed using cold water washing and using of afterburners, scrubbers or bio-filters [12].

### Alkaline hydrolysis

Alkaline hydrolysis represents a relatively new carcass disposal technology. This method has been applied for disposal of biological tissues (e.g., in medical research institutions) as well as carcass disposals [13]. This process involves the use of sodium hydroxide or potassium hydroxide to perform the catalytic hydrolysis of organic matter like; protein, nucleic acids, carbohydrates, lipids, etc. into a sterile aqueous solution of small peptides, amino acids, sugars, and soaps. Heat approximately of 150°C, (300°F) is used to accelerate the process significantly. Bones and teeth of vertebrates are the only byproducts of alkaline hydrolysis. This undigested residue is only two percent of the initial weight and volume of carcass and is sterile. It is also easy to be crushed into a powder form which can be used as a soil additive.

### Anaerobic digestion

Anaerobic digestion, sometimes referred to as biogasification and biodigestion, is one method for the disposal of carcasses. It can eliminate carcasses and produce energy at the same time, but in some cases it is necessary to reduce the size of the carcasses and sterilize them on-site before proceeding with anaerobic digestion. The early steps taken in anaerobic digestion check the risk of spreading pathogens during transportation to a digester and hence reduce the need for new digesters. If the volume of carcasses is large, there is then the need to distribute carcasses between several digesters and later transport them to different locations. In

anaerobic digestion there is a transformation of organic matter by different mixtures of bacterial cultures in absence of oxygen. Anaerobic digestion is a natural process with the production of a gas with major portion as methane and carbon dioxide [14].

### Thermal depolymerization

Thermal depolymerization is an interesting possibility for disposing large-scale mortality dealings. A relatively new process which involves the use of high pressure and heat to convert organic matter in matter (e.g., preprocessed carcasses) to a type of fuel oil. As it disassembles organic matter at the molecular level and hence it is an effective process to destroy the pathogens. This technology is still being evaluated and examined in the laboratory; a large commercial-scale plant is being installed in Missouri to process organic byproducts from a poultry processing plant [15].

### Plasma arc processing

Plasma arc processing involves the use of extremely hot plasma-arc torches to vitrify and gasify hazardous wastes, contaminated soils, or the contents of landfills. Vitrification of material leads to reduction of cost and also eliminates its further contamination. The final product in the form of rock-like substance is highly resistant to leaching. After treating the landfill contents by this method there is a reduction in volume by around 90 percent. There is also a generation of fuel gases which are collected and help further in reduction of operational costs [16].

### Refeeding

Refeeding of dead animal carcasses is essential in the poultry industry. Currently there are a number of farmers who are practicing this method, particularly at alligator and reptile farms to consume mortalities. Practically a very less processing is involved in the refeeding process, with most of the carcasses fed as such to the animals. Some farmers first grind carcasses to create a liquid type feed which is then consumed by alligators/crocodiles. Refeeding is an attractive method of carcass utilization in areas where alligator farming is permissible and practical, particularly in some southeastern states, many questions remain about the ability of such systems to accommodate the volume of mortalities associated with large-scale die-offs. Initial costs and skill levels workers for an alligator farms can be high. Other issues related to method is its potential for disease transmission through the predators [12].

### Noval pyrolysis technology

Noval pyrolysis technology involves the use of high intensity electromagnetic waves to heat up the organic matter of the waste to decompose it fully in a flash of time. This method is considered a very high bio-secure method to eliminate all types of pathogenic organisms of waste material. Further no gas emission is involved and hence least energy is required for this process [16].

### Napalm

It involves the use of fast-burning napalm to replace burning pyres. It destroys the all expected pathogens [17]. This process of carcass disposal is highly useful in catastrophes and large scale accidental livestock mortalities.

### Extrusion

It is a technique where high intensity friction is used to grind and cook carcasses. It involves moisture removal to a greater level and the addition of a dry ingredient turns waste carcass into a feed [17].

### Non traditional rendering

Non traditional rendering is the fluidized bed drying/flash dehydration. It is generally used for non disease mortalities [18].

### Integrated waste management

It is a coordinated based approach to dispose of and utilize waste material generated in a particular society. It involves segregation of the waste material in to disposal and non disposable categories and thereafter integrated approach to utilize the final end product within a society [17].

### Bio-reduction

In this disposal technology the farm waste and carcasses are stored in a vessel containing water and its contents are then heated and aerated continuously. This technique is used for volume reduction prior to disposal [19].

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