



Fermentation of Manure Yields Ingredient for Fish Feed - An Overview

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Rearing of livestock is an age-old practice in India. More than 62% of marginal and small farmers directly associated with livestock sector [7]. In pursuant with 20th Livestock Census, the total Livestock population is found to be 535.78 million showing an increase of 4.6% over Livestock Census of 2012, in which the total population of cattle is given as 192.49 million accounting the highest portion accounting for 35.94% of total livestock. It is worth mentioning that India remained as the largest producer of milk in the globe for the past few decades.

It has been estimated that one adult cow excretes 10 + 2 kg of dung and 5 + 1 L of urine per day. In this perception, 192.49 million of cattle @10kg of dung production, the total annual production of cattle dung is estimated to be 702.588 million tons, which is a huge organic waste for the country every day. Notwithstanding that this huge quantity is effectively used as manure, biofertilizer, biopesticides, pest repellent and as a source of energy [2]. In some villages, the utility of cow dung is beyond imagination that it is also used for plastering walls and floor and as a burning block in the stoves. Smoke generated from the dried cow dung act as mosquito repellent and subsequent ash as cleaning agent for kitchen utensils. Therefore, the disposal of cow dung is not taken as an important one considering its multiple uses.

Despite to all these usages, a significant amount of cattle dung is still remaining as waste and causing serious health hazards to

human being as it contains many pathogenic bacteria and parasites like *Escherichia coli*, *Cryptosporidium* spp. and *Entamoeba histolytica* [5]. There have been instances where the cow dung gets mixed with drinking water pool or tank and causing health issues. This necessitates careful and appropriate disposal of the cow dung like any other excreta.

Cow dung as a useful raw material

Cow dung contains 24 different minerals like nitrogen and potassium, along with trace amount of sulphur, iron, magnesium, copper, cobalt and manganese [11]. Indigenous cows'excreta contain higher amount of calcium, phosphorus, zinc and copper than the cross-breed cow [10]. Considering the availability of such a basic minerals and elements, this waste can be treated so as to make them useful in the field.

Cattle dung is presently used in the aquaculture ponds as a manure to supply nitrogen and carbon for the microbes in the aquatic ecosystem. Besides the above, there are some fishes like common carp which takes the raw cow dung as their principal feed. This helps in minimising the feed cost in carp culture. The decomposition of the manure helps in the release of nitrogen which is taken by the phytoplankton for their growth and multiplication. These phytoplankton besides helping the zooplankton to grow, also support some of the planktivore fishes like silver carp. The zooplankton which is an essential feed for the fishes like Catla invariably depend

on phytoplankton for their multiplication [3]. Such an important basic role is played by the cow dung in the aquaculture pond.

Although fish can directly use the cattle dung presence or development of many harmful bacteria in non-composted manure, high C:N ratio and production of phytotoxic substances such as phenolic and volatile fatty acids during organic matter decomposition may cause different health hazards as put forth by [12]. Using this organic manure as such may increase BOD in the pond and may lead to mass mortality. Spreading of parasitic disease [4] can also not be ignored. Hence, cow dung manure requires pre-treatment before its application in fishponds.

In addition to serving as the manure, the cow dung can also serve as a basic raw material for the production of ingredient for the feed making through fermentation. Fermentation of cattle dung is practiced worldwide for enriching the waste with valuable nutrient such as nitrogen. Different technologies are there to treat the raw cattle manure.

Fermentation of manure

Fermentation is a technique which is used for the production of various useful matters through the bacterial interactions and enrichment. While the simple domestic fermentation technique that is more common to the world remains in bread making, wide scale industrial fermentation technique is adopted for the wine making. The end product of the fermentation is always simply separated or processed matter which can be used depending on its nature and composition. For instance, the fermentation of grapes leads to the production of alcohol enriched wine and similar fermentation technique of organic matter also leads to production of natural gas. While there are methods of production of liquid or gaseous products, Solid State Fermentation helps in fermenting the solid matter to yield product without any moisture.

Solid state fermentation (SSF) is an effective method to process the manure in either presence or absence of moisture and water. It has been described as the process that takes place in a solid matrix (inert support or support/substrate) in the absence or near absence of free water [16], but the substrate requires moisture to support the growth and metabolic activity of microorganisms [17]. Although many microbial fermentations are accomplished in liquid phase, SSF has few advantages over it. It is an economic process with low wastewater output than liquid phase processing. SSF has

also emerged as an appropriate technology for the management of agro-industrial residues for their value addition [13].

Manure fermentation is a technique by which the dried cow dung can be converted into microbial free, nitrogen rich powdered ingredient that can be used for making fish feed.

Fermented manure as an ingredient in fish feed

Fish culture is a remunerative venture in a developing country like India. Several marginal and small farmers are doing fish farming, particularly carp farming. Presently, India is in the second place in the world fish production in 2018 [9] next to China. Indian freshwater resources could support the freshwater fish production and it has been practised for more than 100 years. Yet Indian fish farmers are not adopting advanced technologies in fish farming due to high cost of inputs, particularly feed. In carp farming too, farmers prefer to go with low-cost farm-made feed.

In feed-based fish farming, the feed cost accounts for 60-70% of total production costs. Common ingredients such as soybean, corn, fishmeal, fish oil, rice and wheat are equally consumed by people also. Feeding fishes with commercial feed has become burdensome for lay farmers. In order to make the feeds affordable for the marginal farmers, many low-cost alternative ingredients have been continuously researched for the feeds in aquaculture.

[8] showed that chicken manure subjected to fermentation under thermophilic condition (55°C) resulted in a decreased total bacterial count and total coliform count was bacteriologically safe [2]. reported that phytotoxicity of goat manure was reduced after fermentation and further demonstrated the effect of fermentation on nutrient level of manure. They noticed an increase in important nutrient level such as total nitrogen and total sulphur content, whereas, pH of manure, moisture level, total carbon content and C:N ratio showed a decreasing rate after fermenting the manure.

Nitrogen and sulphur are the primary components of protein. Feeding fishes with nitrogen enriched organic fertilizer subsequently improved the growth and development of fishes in many experiments where fermented manure was used as feed.

As [1] incorporated camel and cow manures in the diets of tilapia at 10, 20 and 30% and concluded that camel and cow manures could be included in pellet feeds of tilapia at levels of up to 20% and

higher inclusion of two manures significantly suppressed growth, the possibility of treated manure to be used as feed ingredient is clear and proved [14]. incorporated fermented poultry manure as an ingredient in aqua feed for freshwater prawn *Macrobrachium rosenbergii* and showed positive results.

All the above foregoing vouches the possibility of using the fermented manure as an ingredient for the feed making in aquaculture. However, extensive research is required for demonstrating the positive results for all the species. There is a great potential for this fermented product as the cost of aquafeed is of great concern.

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