Chapter-2

Literature Review

2.1 Current Scenario of Floral Waste

R et al., n.d. have developed a microbial consortium for the effective degradation of flower waste generated from temples. They collected soil samples from the areas near and around the temples and isolated bacterial cultures from them.

Makhania & Upadhyay, 2015 conducted research on the aspects of flower waste degradation. The study tracked changes in physico-chemical parameters as temperature, moisture, EC, volatile solids, etc. for up to 50 days after floral waste composting.

Waghmode et al., 2018 found that flowers are used in a variety of businesses, including the perfume, cosmetics, culinary, alcoholic beverage, and textile industries. The disposal of flowers in waterways such as rivers, oceans, etc. causes water pollution and has an impact on the aquatic life there. This review discusses the management of floral wastes through solid state fermentation for the conversion into various value-added products, such as compost, biofuels, biogas, bioethanol, organic acids, pigments, and dyes, as well as the production of polyhydroxybutyrate-co-hydroxyvalerate, food products, biosurfactants, sugar syrup, incense sticks, and more.

The trash from the flower industry is also used to make handmade paper. Compost can be utilised for a variety of plant growths, biogas can be used to generate electricity, and food products can be used as nutrients and additives. While biofuels and bioethanol can help with the energy issue, the dyes and pigments made from floral wastes will find use in a variety of textile sectors. Thus, it is possible to turn trash into wealth. The evaluation emphasises the commercial uses for the value-added goods made from flower wastes. A significant usage of floral wastes in biosorption is also highlighted in the review, which will aid in the treatment of waste waters and other industrial effluents. As a result, there will be less water pollution and environmental pollution overall. This will solve the problems with disposing of flower debris.

The goal of the study by Nair, n.d. was to extract natural dye from waste Aster chinensis flowers and assess its use as a pH indicator in acid-base titrations. Waste aster flowers were utilised, with petals that were both dark and pale pink. Their usefulness in different acid-base titrations, including strong base-strong acid, strong base-weak acid, weak acid-strong base, weak base-strong acid, and strong acid-weak base, was investigated. Additionally, same titrations were carried out independently utilising common synthetic indicators as phenolphthalein and methyl red.

Comparisons were made between the end points reached using organic and synthetic markers. At the end points of the investigated titrations, natural dyes taken from aster flowers with dark and light pink colours caused a visually discernible colour change. These end point values agreed with the readings for the corresponding titrations that were made using conventional pH indicators. The current study demonstrated a useful method for generating an appropriate extract from aster waste flowers, which may then be employed as a precise, affordable, and environmentally friendly alternative to synthetic pH indicators in titrimetric analysis.

The readings for the matching titrations that were conducted with conventional pH indicators and these end point values were in agreement. Aster waste flowers can be used to make an adequate extract that can be used as a precise, reasonably priced, and ecologically acceptable substitute for synthetic pH indicators in titrimetric analysis, as was shown in the current work. By using the reflectance approach, the dye samples' depth of colour was assessed; several colour shades were found. L, a, and b values were also determined in addition to the K/S values. Additionally, the samples' fastness characteristics were investigated. According to studies, some hues have been seen to alter after being washed with soap. Due to their capacity to create coordination complexes with the dye molecules, the majority of the metal salts displayed the highest K/S values. These results show that the extract of the marigold flower obtained by using temple floral waste can be used for dyeing cotton and silk materials in the textile industry.

According to Masure & Patil, n.d., Flowers are frequently seen as temple trash in India since they are used as sacrifices to Deities in temples. Rose and marigold flowers are constantly in season and less expensive than other types of flowers because they are primarily used as gifts to God and for decoration. The natural dye was removed with water and coloured differently using a mordant.

Jain, 2016, a significant amount of solid trash is produced at the majority of religious sites in India, primarily during events, worship, ceremonies, and festivals. The amount of floral trash produced by a few significant temples in the city of Jaipur was measured. In the current investigation, varied ratios of a mixture of floral waste and cow dung were used to perform the vermicomposting process utilising the earth worm species *Eisenia foetida*. The 50:50 and 60:40

ratio of garbage to vermicompost was shown to have a good bioconversion ratio. Throughout the investigation, soil served as the control.

Following the vermicomposting process, numerous physical and chemical characteristics were analysed. It was discovered that the ideal parameters were 25°C temperature, 8.0 pH, 1-2 mm particle size, 60% moisture content, black colour, odourless, and 0.88 bulk density. As a result of vermicomposting, EC, C: N ratio, and C: P ratio decreased, while nitrogen, phosphorus, potassium, calcium, magnesium, and sulphur increased. Using prepared floral waste vermicompost as fertiliser, tomato (*Solanum lycopersicum L.*) plants were grown in pots, and many growth parameters, including mean stem diameter, mean plant height, mean leaf number, mean length of roots, and yield/plant, showed good growth increase. The findings show that the combined effect of all the nutrients in floral waste vermicompost increases tomato plant growth and yield and significantly enhances soil characteristics when compared to control. As a result, vermicomposting leftover temple flower debris is a great and environmentally responsible way to obtain worthwhile items that will contribute to a cleaner and waste-free world.

Mahindrakar, 2018, Flowers are a representation of adoration and respect. Tons of trash flowers are tossed into rivers every year, strangling them to death, killing fish, wreaking havoc on the delicate ecosystem of the water body, and causing a great deal of pollution. This floral waste can be used in a variety of ways to create valuable products, protecting the environment from contamination brought on by incorrect flower trash disposal. You can employ methods like vermicomposting, composting, extracting dyes and essential oils, creating holi colours, and producing biogas. Beyond using them for some art and craft applications, this flower debris can also be utilised to make incense sticks. These flowers must be used to make a variety of environmentally beneficial items.

Singh et al., 2017, this study shows how to extract natural dyes from various biodegradable home and temple trash. The leftover flowers and garlands from various temples, along with onion and vegetable peels from vegetable markets, university residences, and homes, were used as the raw material for colour extraction. These materials were cleaned, dried, crushed, and sieved. After being removed by ultrasonication, the natural colours were dried in a spray dryer and examined using FTIR and UV-Vis Spectrophotometers. They were used to colour a variety of materials, including cotton, wool, silk, and mordants. It was discovered that the leftover residue from dye extraction was nutrient-rich and could therefore be used as the resource material itself. As a result, we investigated the manufacture of biochar and vermicompost from these leftover wastes, both of which can be used as organic fertilisers for farming. Overall, by reducing waste and reusing it, the current waste management strategy will result in closed-loop environmental management.

Fig 1: Floral Waste Dumped in River; taken This from BBC News Website.

2.2 Biocomposting

(Debertoldi et al., 1983) One of the most proven methods of recycling solid urban garbage is composting the biodegradable organic part of it. Is a low-energy method that allows the disposal of the organic element of solid urban trash and sludge, which together form the largest portion of garbage in terms of quantity. If composting is done properly, it produces a product that is safe for use in agriculture and is hygienic. Industrial techniques have been developed to quickly produce compost suitable for agricultural use. It allowed for the optimization of all variables that directly affect the process.

Sánchez et al., 2017, reviewing current research on adding nutrients to compost and the part played by the microorganisms involved (or introduced) in their transformation during the composting process were the main goals of this investigation. The stages of composting are briefly gathered, and several supplementing techniques are examined. The use of nitrogenous materials and the inclusion of microorganisms that fix nitrogen from the atmosphere or oxidise ammonia into nitrogenous forms that are more threatening to plants are examined. There are also several methods for conserving nitrogen while composting. Also discussed are the use of microorganisms that solubilize potassium and phosphorus and the supplementation of phosphorus. The most crucial methods for identifying them are given together with the main categories of bacteria pertinent to the composting process. The creation of these nutrient-enriched bio-inputs generally necessitates research and development not only in the supplementation of compost but also in the isolation and identification of microorganisms and genes allowing the degradation and conversion of nitrogenous substances and materials containing potassium and phosphorus present in the feedstock's undergoing the composting process. This work offers the most significant research trends and techniques for boosting the nutrient content of compost.

Sarkar et al., 2016, in most metropolitan areas, proper waste management is a big concern. One of the earliest and most basic techniques for stabilising organic waste is composting. It is a biological conversion that produces acceptable byproducts such as biogas, fertilisers, and substrates for growing mushrooms (methane). In the highly active thermophilic phase, where microbial activity is intense, organic matter breakdown is expedited, in this stage, the compost is also sanitised. The current study's objective is to maximise a composting system that uses market waste. A significant thermophilic phase (maximum temperature 65.9^0C) was obtained by heaping or piling compost, which was determined to be the most effective way of composting when the moisture level was maintained at roughly 60%.

Farming management Global human population growth has led to intensive farming practises and improper cropland management, which ultimately deplete soil fertility. It is advised to use chemical fertilisers frequently to make up for nutritional deficiencies and boost crop output. Increased soil acidity, mineral imbalance, and soil degradation are just a few drawbacks of chemical fertilisers' extensive use. Nowadays, even farmers do not choose chemical fertilisers (Bedada et al., 2014). In composting, microorganisms break down organic substrate into carbon dioxide, water, minerals, and stabilised organic matter while breaking it down aerobically (Bernal et al., 2009; Kala et al., n.d.; Vakili et al., 2014).

Eroa, 2015, *Jatropha curcas* (tubang-bakod) is processed to make biodiesel, and this process generates wastes in the form of seedcake, which can be turned into valuable products that can help maintain and enhance soil qualities. An experimental investigation that involves composting the mixture of chicken manure and jatropha seed cake, creating ratios of the two, and characterising the resulting organic fertiliser. In general, this study attempted to prove the viability of using the fertiliser as the primary source of nutrients for plants by creating an organic fertiliser from the waste of biodiesel manufacturing, which employs the Jatropha plant. In particular, the nutrients Nitrogen (N), Phosphorus (P), Potassium (K), and the Carbon:

Nitrogen (C:N) ratio were taken into account. Three formulations—30(CM):70(JSC), 50(CM):50(JSC), and 70(CM):30—were composted for six weeks (JSC). The outcome suggests that the organic fertilisers created could be a good replacement for the commercial fertilisers.

Hassoon Ali et al., 2018, The goal of the current study was to examine the characteristics of compost made from a combination of algal biomass and municipal solid waste's organic portion. To determine the optimal circumstances affecting the breakdown of organic solid waste and algae, a lab scale anaerobic digester was used. In terms of the ratio of algae to solid waste to be mixed, pH, total solid T.S., and temperature, the optimal conditions were discovered to be 1:2, 7.5, 8%, and 32°C, respectively. In pilot scale, the ideal circumstances were applied. The resultant compost was tested in a pilot-scale digester for its electric conductivity (EC), moisture content (MC), nitrogen, phosphorus, potassium nutrients (NPK), and heavy metals (Pb^{2+}, Zn^{2+}, Cu^{2+}, Ni^{2+}, and Cd^{2+}). All of the results fell within the range of the US and UK compost quality standards for composts. The determined germination index (GI) value of 83.88% demonstrated that the compost produced in this study is suitable for use in agriculture.

Mahyudin et al., 2018, The goal of this study is to compare the quality of compost produced by aerated static piles (ASP) and the open windrow method, as well as to investigate the composting conditions of leaf organic waste (temperature and pH variation). Ingredients for a single compost pile are as follows: 20 kg of leaf debris, 0.8 kilogramme of lime, 0.6 kg of chicken manure, 20 ml of EM-4, 20 grams of sugar, and 200 ml of water. In this ASP approach, the aeration rate varies by 0.4 L/min.kg, 0.5 L/min.kg, and 0.6 L/min.kg, with the open windrow method serving as the control. Temperature, pH, and other variables were measured before and after each aeration. The study's findings revealed that compost has a brown to black colour, is odourless and smells like soil, has a similar texture to soil, has particles between 0.55 and 25 mm in size, and reaches a mature compost temperature of 30°C according to SNI: 19-7030 2004. The best aeration rate, according to temperature fluctuation, is 0.5 L/min.kg because it produces the maximum temperature fluctuation compared to other aeration rates. The pH parameter for all aeration rates did not demonstrate any appreciable variations and has the same range of 8,17 to 8,27. Based on carbon-to-nitrogen ratio, the ideal aeration rate is 0.6 L/min.kg; this rate has the lowest carbon-to-nitrogen ratio (11.50). According to the findings of statistical studies, there are no appreciable variations between the carbon-to-nitrogen ratio of compost at aeration rates of 0.4, 0.5, and 0.6 L/min.kg.

Waqas et al., 2019, the purpose of this study is to investigate how zeolites can improve the composting of food waste. In-vessel compost bioreactors can now use a revolutionary sequential hydrothermal technique to change natural zeolite. In comparison to an unaltered control trial, raw and modified natural zeolites were treated at 10% and 15% (w/w) of the total trash. Both raw and modified zeolites had an impact on the composting procedure, however modified natural zeolite produced the most noteworthy outcomes. At a concentration of 15% modified natural zeolite, the results for measures relating to compost stability were noticeable. For modified natural zeolite, the temperature and moisture content quickly and persistently decreased to the ideal range. Additionally, modified natural zeolite had higher concentrations of total ammonium ($NH4+$) and nitrate ($NO3$) than raw zeolite by 11.1 and 21.5%, respectively. After 60 days of composting, the compost met the requirements for international compost quality standards for stability against moisture contents (MC), electrical conductivity (EC), organic materials (OM), total carbon (TC), mineral nitrogen, nitrification index (NI), and germination index (GI). According to the study's findings, the ideal ratio for composting food waste in order to produce stable, nutrient-rich compost is 15% modified natural zeolite addition to the overall trash.

Saranraj P, 2012, the massive rise in agricultural productivity, urbanisation, industrialization, and population causes large amounts of solid waste to accumulate. This has caused grave environmental issues. This trash needs to be transformed successfully in order to be disposed of safely. By composting agricultural, urban, and industrial waste, this is accomplished. More people are becoming aware of the fact that composting is an environmentally benign procedure that turns a wide range of wastes into beneficial agricultural inputs. Compost is a great source of humus and plant nutrients, and its application enhances the soil's biophysical characteristics and level of organic matter. Vermicomposting and its significance in enhancing soil nutrition and agricultural crops were the main topics of this review. The following issues are evaluated in this review: vermicomposting, its raw materials, its microbiology, its impact on agriculture, the physico-chemical characteristics of soil, and its significance. Vermicomposting is being evaluated as a financially sound method of recycling organic wastes. Earthworms are regarded as natural bioreactors because they multiply alongside other microbes and create the ideal environment for trash to biodegrade.

2.3 Microbial Flora of Cow dung

Recent studies have found that compost's physical, chemical, and nutritional qualities are improved when cow dung is added to biomass produced by the palm oil industry. When palm oil biomass and cow dung were combined in a 1:3 ratio, it significantly increased the compost's quality in terms of a number of factors, including pH, electrical conductivity, and the C:N ratio (Vakili et al., 2014). Because it increases organic matter, cow dung may therefore serve as a substitute for chemical fertilisers as well as a soil conditioner (Bélanger et al., 2015; Garg & Kaushik, 2005).

Nutrient-rich source is the slurry from biogas plants, but due to its downsides, such as eutrophication and leaching of the soil's nutrients, it cannot be employed on a wide basis (Garg & Kaushik, 2005; Lu et al., 2014). It's possible that using only organic amendments won't provide enough nutrients to meet demand (Bedada et al., 2014; Gentile et al., 2011; Palm et al., 2015).

ISFM, or Integrated Soil Fertility Management, is a strategy for addressing this soil fertility issue that uses both organic and inorganic resources to increase yield responsiveness and improve nutrient storage (Bedada et al., 2014; Ewusi-Mensah et al., 2014). For instance, the yield of potato tubers increased noticeably by 8.9 t/ha when cow dung and NPK (15:15:15) were combined at concentrations of 3 t/ha and 100 kg/ha, respectively, in comparison to the control, which produced just 1.8 t/ha. Following treatment with this combination, it was discovered that the soil's organic carbon content had dramatically risen, rising from 1.33 to 3.21 percent. In compared to untreated soil, the combination also increased soil organic matter, phosphate availability, exchangeable ions, effective cation exchange capacity, and pH. (*Effectivenessofcowdungandmineralfertilizer*, n.d.). Additionally, it has been claimed that the same combination increases maize output (Ayoola & Makinde, 2008; Bedada et al., 2014).

Utilizing microorganisms to solubilize insoluble phosphorous is one way to make it available to plants (Swain et al., 2012). Cow dung microorganisms are currently being employed in soil fertility promotion to increase crop output. In this investigation by (Swain et al., 2012), thermotolerant *Bacillus subtilis* strains with high potential for phosphate solubilization were obtained from cow manure. These Bacillus strains produce growth regulators and have antagonistic actions against plant diseases. The results of (K. K. Gupta et al., 2016) 3:28 Page 4 of 11 are significant because isolated bacterial strains that are thermotolerant may be employed as bio-inoculants in tropical agriculture where summertime temperatures can reach 42–45 °C (Swain et al., 2012).

Numerous cow dung-derived biodynamic preparations have demonstrated an antagonistic impact against plant pathogens including *Rhizoctonia bataticola* (Radha & Rao, 2014; Rupela et al., 2003). According to a study, cow dung extract is superior to antibiotics like penicillin, paushamycin, and streptomycin for preventing rice bacterial blight.

The most prevalent isolates from the culturable cow dung microflora are *B. subtilis* strains. Several studies have demonstrated that these *B. subtilis* strains are hostile to plant diseases such *Fusarium soalni, Fusarium oxysporum,* and *Sclerotio rum* (Swain et al., 2006, 2012). Nematodes that cause plant disease are a significant crop pathogen. In a recent study by (Lu et al., 2014), 219 bacterial strains from cow dung were examined for nematicidal activity against the model worm *Caenorhabditis elegans*. Of these, 17 strains killed more than 90% of the tested nematode in within one hour. *Alcaligenes faecalis, Bacillus cereus, Proteus penneri, Providencia rettgeri, Pseudomonas aeruginosa, Pseudomonas otitidis, Staphylococcus sciuri, Staphylococcus xylosus, Microbacterium aerolatum,* and *Pseudomonas beteli* were among the strains discovered Out of these 14, one additional *nematode, Meloidogyne incognita*, was inhibited. *Proteus, Providencia,* and *Staphylococcus* bacteria from cow dung showed nematicidal activity for the first time in this study.

In traditional agricultural practises on the Indian subcontinent, cow dung is used to increase soil fertility. In addition to enhancing the various qualities of soil, it also serves as a source of microorganisms that produce biological nematocidal agents that have no adverse effects on the environment. Therefore, it is important to encourage the use of cow manure in agriculture. Pollutants in the environment are bioremediated. Through absorption, toxic chemicals enter the bodies of people, plants, and animals (Adams et al., 2014).

Cow dung is suitable for microbial breakdown of contaminants because it contains a variety of microorganisms, including *Acinetobacter, Bacillus, Pseudomonas, Serratia,* and *Alcaligenes species* (Adebusoye et al., 2015; Umanu et al., 2013). The rural, urban, and hospital wastes, including oil spillage, can be broken down to five fundamental parts when cow dung slurry is maintained at a ratio of 1:10 or 1:25. (Randhawa & Singh Kullar, 2011). According to a study by (Orji et al., 2012), cow dung isolates both bacterial and fungal are crucial for bringing the overall amount of petroleum hydrocarbons in contaminated mangrove soil down to zero percent. The microbes isolates included species from *Rhizopus, Aspergillus, Penicillium, Fusarium, Saccharomyces,* and *Mucor,* while the bacterial isolates included *Pseudomonas, Bacillus, Citrobacter, Micrococcus, Vibrio, Flavobacterium*, and *Corynebacterium*. In a study conducted by (Adams et al., 2014), total petroleum hydrocarbon was reduced by up to 81 percent by the metabolic activities of cow dung microorganisms such *Bacillus, Staphylococcus, Pseudomonas, Flaviobacterium, Arthobacter, Enterobacter*, (K. K. Gupta et al., 2016) in soil contaminated with motor oil. Bioprocess. Bioresource (2016). *Trichoderma, Mucor* and *Aspergillus spp*.

According to (Umanu et al., 2013), using cow dung in the right dosage could be quite effective at causing water contaminated with motor oil to biodegrade. A metabolic pathway for the microbial breakdown of polycyclic aromatic hydrocarbons has also been proposed by certain researchers. Several degrading products, including Cis 4, 5-pyrene dihydrodiol, 4-5-phenanthrene dicarboxylic acid, 1-hydroxy-2-naphthoic acid, 2-carboxybenzaldehyde, phthalic acid, and protocatechuic acid, were recognised by a *Mycobacterium sp.* that was isolated from contaminated soil of a gasworks plant (Haritash & Kaushik, 2009).

Cow dung can supply the nutrients and energy needed for microbial development, which leads to the bioremediation of contaminants. The technique of choice for getting rid of biomedical waste is incinerating it, but doing so creates harmful gases that are bad for your health and the environment. Treatment of biomedical and pharmaceutical waste is another advantageous use of cow dung microorganism (Randhawa & Singh Kullar, 2011). Thus, *Cya stercoreus*, isolated from old cow dung, not only has the ability to break down lignocelluloses in vitro (The Coprophilous Fungal Community: An Experimental System, 1992), but it also has the ability to metabolise the antibiotic enrofloxacin (Randhawa & Singh Kullar, 2011). Research by (Pandey & Gundevia, 2008) demonstrated 100% biodegradation of biomedical waste cultivated with the fungus *Periconiella* from cow dung. India produces 90,000 tonnes of pesticides annually, of which 2-3% are used, while the remaining amounts remain in the soil and cause environmental concerns.

India is the second-largest producer of pesticides in Asia (WHO 1990; Randhawa & Singh Kullar, 2011). Few reports have been published describing the importance of cow dung microbiota in effective disposal of pesticides. (Dipty & M.H., 2007) designed a bioreactor for bioremediation of phenol utilising cow dung as a source of biomass. This cow dung microbial consortium that included bacteria, fungi and actinomycetes was found effective in degrading phenol ranging from 100 to 1000 mg/l concentrations.

Two bacteria namely *Pseudomonas plecoglossicida* and *Pseudomonas aeruginosa* present in microbial consortium have also been detected to completely degrade hazardous chemicals like cypermethrin and chlorpyrifos (Boricha & Fulekar, 2009; Fulekar & Geetha, 2008; Randhawa & Singh Kullar, 2011). For the bioremediation of pesticides such as chlorpyrifos, cypermethrin, fenvalerate, and trichlopyr butoxyethyl ester, (Fulekar & Geetha, 2008) used cow dung slurry in a ratio of 1:10 and discovered that all of these pesticides are converted into some intermediate or less hazardous chemicals.

There is a need for cheaper, cleaner, and greener methods because all of these ones are pricy and unfriendly to the environment. Heavy metals including chromium, strontium, and arsenic have lately been remedied using cow dung and its microorganisms. Methylation is a method for detoxifying arsenic. It is already known that bacteria may methylate arsenic into volatile compounds, primarily dimethylarsine, which is an arsine analogue. According to (Mohapatra et al., 2008), cow dung can serve as a significant substrate for bacterial growth during the volatilization process used to remove arsenic from arsenic-rich sludge It was discovered that methanogenic bacteria could efficiently volatilize about 35% of nicotinic at substrate concentrations of 25 mg/l in cow dung.

Recently, dry cow dung powder was employed as a source of adsorption for the removal of chromium from aqueous solution, and 73.8 % of the chromium was removed. Another dangerous heavy metal is radiotoxic strontium, which mimics calcium in the body and raises the risk of leukaemia and bone cancer. Its half-life is 29 years, making it a particularly dangerous substance (Barot & Bagla, 2011; Peterson et al., 2007).

Dry cow dung powder was found to have biosorption of a radiotoxic strontium (90Sr) by (Barot & Bagla, 2011). 85–90% of the strontium was adsorbed after 350 mg of dried cow dung powder was mixed with specific laboratory conditions, including pH 6, contact duration of 10, and 4000 rpm agitation. Due to their higher cost, longer production time, and higher energy requirements than alternative synthetic adsorbents, dry cow dung powder may be preferred. A cheap and economically feasible material that is widely accessible is cow manure.

The facts mentioned above indicate that cow dung is a great way to bioremediate non-biodegradable and toxic substances, whether used with or without pre- or post-treatment.

Potentially harmful pollutants are described in (K. K. Gupta et al., 2016). Because it doesn't contain any toxic by-products, using cow dung for bioremediation is an easy and environmentally benign process. However, much more extensive research in this area is necessary.

There are numerous microbial enzymes that have been identified and researched for industrial and commercial applications. The diversity of microorganisms in cow dung makes it a viable source for the aforementioned purpose, but there is still a constant hunt for suitable bacteria that are able to synthesise industrially practical enzymes (Dowd et al., 2008).

Cow dung-derived Bacillus species can produce cellulase, carboxymethyl cellulose, and cellulose (Sadhu et al., 2014). Genetically modified strains can be created for increased enzyme output in cases of low enzyme production. For instance, according to (Sadhu et al., 2014), NTG-induced mutations in *Bacillus spp*. from cow dung can boost cellulase production from 9.4 to 16.3 U/mg proteins. Numerous isolates of cow dung that produce enzymes like protease, lipase, and esterase lipase were found by (Teo & Teoh, 2013).

Cow dung-derived *Paenibacillus favisporus sp.*, a member of the *xylanolytic bacteria*, was shown to produce a wide range of hydrolytic enzymes, including xylanases, cellulases, amylases, gelatinases, urease, and -galactosidase. Cow dung can be used as an excellent substrate for the synthesis of enzymes, such as the detergent-stable dehairing protease produced by the alkaliphilic *B. subtilis*, the alkaline protease produced by the *Halomonas spp*., and the fibrinolytic enzyme produced by *Pseudoalteromonas sp* (Vijayaraghavan et al., 2012)

Girija et al., 2013 using a culture-free, 16S rDNA sequencing method, the variety of microorganisms found in cow faeces was determined. The investigation revealed the transcending phyla *Bacteroidetes, Firmicutes*, and *Proteobacteria*. It has been established that members of these phyla are effective degraders of complex organic substances, such as cellulose, lignin, chitin, xylan, and other materials. The results of the current investigation thus validate the use of cow manure in composting. This investigation also identified species previously only accounted for as producers of IAA and *siderophores*, such as *Acinetobacter*, *Bacillus, Stenotrophomona,* and *Pseudomonas*. Farmers have observed numerous Acinetobacter and Pseudomonas species to have nitrogen fixing and phosphate solubilizing activities, which confers plant development and advances cow dung mobility.

(K. K. Gupta et al., 2016) Cow dung contains a diverse range of microorganisms with variable characteristics. Utilizing the microbial flora in cow dung can help with all practical horticulture and vitality requirements. One of the world's bioresources that is widely available and is still largely underutilised is this one. Understanding the mechanisms that allow organisms found in cow dung to break down hydrocarbons can help with bioremediation of naturally occurring contaminations. The characteristics that lend themselves to bioremediation can be identified thanks to recent developments in logical analysis and techniques for full genome successions. The development of microbial catalysts and antibiotics is another stimulating area for future research. From this tiny bioresource, microbes can produce proteins that have broad applications in a variety of industries, including agribusiness, science, and biotechnology.

International Journal of Advances in Pharmacy, Biology and Chemistry Research Article, 2015. According to research, isolated bacterial strains can be used to prevent diseases caused by pathogenic strains. In this way, cow dung serves as a purifier for all environmental losses and is a rich source of microbial flora that may be used to make probiotics, live microbial dietary supplements that change the microbiota in the intestines. Therefore, focused efforts must be made to identify and preserve all indigenous breeds of cows for close-proximity, microbiological, and immunological examination of milk, urine, and compost with particular reference to their use in horticulture, medicine, and food.

(Adeleke et al., 2015) The capacity to segregate high quantities of certain unrefined petroleum debasing microorganisms from the cow dung is characteristic that those microorganisms are the most dynamic degraders in that condition and can be utilized in the bioremediation of oil defiled destinations. Consequently, these microbial segregates from cow dung can be applied independently or as a consortium; seeding through bio augmentation for the improvement of debasement of raw petroleum when created and gathered in huge number as microbial biomass.

(Godambe & Fulekar, n.d.) The utilization of basic and effectively accessible waste, cow dung harbor a scope of microorganisms that demonstrate an extraordinary potential to degrade benzene. This microorganism in disconnection or as a consortium use and increase in nearness of high benzene focuses. Our research facility level bioremediation system has effectively given a proof of idea that the consortium produced can be additionally utilized at modern scale to decrease the weight of harmful benzene from the earth and check its wellbeing hazard.

(K. K. Gupta et al., 2016) Cow dung has a wide assortment of microorganisms shifting in singular properties. Abuse of cow dung microbial flora can contribute altogether in practical horticulture and vitality prerequisites. It is one of the bio resources of this world which is accessible for huge scope and still not completely used. The comprehension of the systems empowering cow dung organisms to degrade hydrocarbons can advance bioremediation of natural contaminations. With late advances in logical examination and methods for complete genome successions, the qualities liable for bioremediation can be distinguished. Another energizing zone of exploration for future examinations is creating microbial catalysts and antimicrobials. The creation of proteins by microorganisms from this modest bio resource can discover wide applications in different fields, for example, agribusiness, science and biotechnology.

(Alam Khan et al., 2011) Cow dung can be a very good source for the isolation of Cellulase producing bacteria. Cellulases purified here can be used for all its applications.

Radha & Rao, 2014, Biodynamic arrangements based on cow dung demonstrate that *Bacillus spp.* are in charge. This is an additional account of an encounter between *L. xylanilyticus* and *B. licheniformis* in biodynamic settings. The identified bacterial strains boosted the growth of maize plants by exhibiting traits that advance plant development, such as the production of IAA, the solubilization of phosphate, and danger to *R. bataticola*. The results provide a foundation for comprehending the beneficial effects of biodynamic arrangements and for communicating the challenges in contemporary biofertilizer and biocontrol operator creation.

2.4 Importance of Agnihotra Yajna and Ash

Agnihotra Farming: A process of fumigation, which has wide applications in agriculture, is thus started. These days, fumigation of air as well as of soil is done with the help of chemicals. These chemicals kill the pathogenic forms and thereby sterilize the surroundings. They are not only costly but their residual effects are also quite hazardous and harmful to health. Agnihotra, on the other hand, does not involve any major expenses and is within the reach of a common man. The gases released during its process get dissipated easily, over a wide area and the medicinal effect of the minute dose becomes visible. Such gases are of temporal and spiral type. The fumes produced by Agnihotra rise up in the atmosphere in a spiral manner and, therefore, can reach higher levels. For details, regarding concentration and stability of these gases at different levels, further investigations can be undertaken. J. E. Miller and his co-workers have recently shown the positive effect of fumigation on crops. These effects have been mainly, due to the presence of typical gases in the fumes.

Fig.2. Material Required for Agnihotra (https://www.fivefoldpathmission.org/agnihotra-materials-required/)

Agnihotra Ash: Experiments conducted to find out the effect of such ash have shown that it has insecticidal effect. It was observed that when the seed of pulses were stored in polyethylene containers, sample (A) with 1% ash, and another sample (B) without ash, the former did not show insect attack while the latter was heavily attacked by insects. It has been a traditional method, followed by a large number of villagers to store their grains after applying ash. The experiments also revealed that the crops grown with intermittent supply of Agnihotra ash were, apparently, healthier than those grown without supplying such ash. Considering the potential benefits of organic farming and its compatibility with biocompost and agnihotra ash for enhancing the quality of food and environmental sustainability.

Environmental Purification by Agnihotra

The ecological imbalance caused by the industrial wastes, rapid urbanization, deforestation, air and water pollution, ozone layer depletion, radioactive waves etc., acts of ‘civilized men’ have resulted into disastrous threat not only to human survival but to the life as a whole on our planet. It was formerly believed that scientific inquiry could provide solutions to all of humanity's problems. Due to the severity of air pollution today, we are finding an increasing variety of ailments, including organ malfunction. Ozone layer loss has been linked to diseases like sunburn, skin cancer, cataracts, and immune system deterioration. Viruses are growing steadily and developing antibiotic resistance.

Even though the germs that cause diseases in plants and animals may differ, disinfecting the air benefits both plant and animal life. During the Yagna, fragrant compounds are released into the atmosphere and provide vegetation with protection from hazardous creatures. This guarantees strong plant growth. The ash and atmosphere of Agnihotra can be added as adjuvants to the "Natural farming" techniques, also referred to as Agnihotra farming techniques.

By performing Agnihotra (Yagna) in the midst of the farm and using the Yagna's ash as fertiliser, it is a comprehensive concept for cultivating plants in a healthy environment and keeping ecological equilibrium. It is not only secure and effective, but it also takes an all-encompassing stance on the environment.

In homes where Agnihotra is routinely conducted, experimental investigations show that the prevalence of physical problems, sickness, and disease is decreased because this practise fosters a pure, nourishing, and therapeutic environment. It regenerates brain cells, rejuvenates the skin, cleans the blood, and inhibits the development of pathogenic organisms.

Essentially, agnahotra is a healing procedure. The modus operandi is "Heal the atmosphere and the atmosphere will heal you." One well-established impact of this technique is the purification of the atmosphere through the constituent electrons of the compounds fumigated in the Yagya.

Dr. Hafkine mentioned "Mixing ghee and sugar and burning them produces smoke that kills the germs of some ailments and secretion occurs from some glands related to the windpipe, which fill our heart and mind with pleasure."

"The sugars in Havishya have a powerful ability to filter the air. It eradicates the measles, mumps, smallpox, and cowpox virus germs." Prof. Tilward.

According to **Dr. Shirowich,**

(i) Cow's milk has strong atomic radiation protective properties;

(ii) Homes with floors covered in cow dung are completely shielded from atomic radiation.

(iii) When cow's ghee is added to a Yagya fire, its fumes significantly lessen the impact of atomic radiation.

Researchers in the field of microbiology have noted that the gases coming from Agnihotra are unmistakably bacteriolethal in nature. These eliminate microorganisms like bacteria, which are the main culprits of sickness and disease. The incidence of physical problems, sickness, and diseases must decrease for this reason in homes where Agnihotra is frequently practised. Without getting into specific chemical bacteriology, it is clear that Yagya performance results in air cleaning. As a result, the following four things happen.

Foul Odor Removal:

The different volatile oils are diffused in the surrounding atmosphere along with steam and smoke during steam volatilization, as was already mentioned. The bad odours are automatically replaced because these oils have a very nice smell. Due to the diffusion of compounds like thymol, eugenol, pine, terpinol, and oils of sandalwood, camphor, and clove, this aroma can be easily detected in the surroundings when Yagna is done.

Bacterial Removal:

As mentioned under products of combustion, formaldehyde, a potent antiseptic, is produced by the partial oxidation of hydrocarbons and the degradation of complex organic compounds. It's also noteworthy to note that water vapour, which is also created in great numbers during the Yagna, is required for formaldehyde's germicidal activity to take place.

Formaldehyde spray is frequently used to disinfect walls, ceilings, and other surfaces. This spray is created automatically when Yagna is conducted. Formic acid and acetic acid, two further products of the oxidation of hydrocarbons, are both effective disinfectants. It's usual practise to use formic acid to preserve fruits and acetic acid to preserve vinegar. By carrying out the necessary tests on rabbits and mice, the antiseptic and antibiotic properties of yagna fumes were also investigated, and it was found that yagna fumes are potent antibiotics. Agnihotra ash cleans and purifies the water, making it suitable for consumption.

Insects Removal:

There are parasites that are not caused by bacteria, such as flies, ringworm, fleas, and others. These parasites are resistant to bactericides, which are also detrimental to other living things. These insects are typically resistant to common chemicals. However, when they come into touch with the fumes of volatile oils like camphor distributed in the atmosphere, they either die or are driven away.

Problem Statement based on the Review

- Floral waste generation occur largely during **functions, worships, ceremonies, festivals,** etc.
- The flower wastes are released in the water bodies or dumped at the available places of land which creates **severe environmental pollution** and **health hazards.**
- **Degradation of floral waste** is a **very slow process** as compared to kitchen waste degradation.
- Hence aim of present study is to **develop efficient microbial consortium** for the bioconversion of **floral waste into compost.**
- Alternate source of chemical fertilizer

Contribution of the research work towards problem domain

- Floral waste can be utilized in different ways to produce valuable product biocompost and can thus help to save environment from pollution caused due to improper disposal of flower waste.
- Effective microbial consortium can serve as a biological tool for the removal of organic solid waste from the environment and compost generated from the degradation can be used to increase the soil fertility.

- Combination of agnihotra ash and floral waste biocompost is most effective alternate of chemical fertilizer

2.5 Objectives

- Collection and Segregation of floral Waste.
- Collection of Indigenous Gir Cow's dung, urine, saliva and Gaushala soil sample
- Isolation and screening of floral waste degrading bacteria from the indigenous Gir cow and Gaushala soil
- Microscopic Analysis of the isolated Microorganisms
- Development of enriched microbial consortium
- Production of Effective Biocompost
- Study of physical and chemical parameters of the Biocompost
- Check the Combined Effect of Agnihotra Ash and Floral waste biocompost on plant growth