International Journal of Zoology and Applied Biosciences
Volume 5, Issue 1, pp: 12-21, 2020
https://doi.org/10.5281/zenodo.3668840

ISSN: 2455-9571

http://www.ijzab.com

Research Article

BIOTECHNOLOGY PRODUCTS AND TECHNIQUES FOR COMBATTING THE MENACE OF FLIES AND ODOUR IN ANIMAL PRODUCTION: A REVIEW

***Arogbodo, J.O. and Adekolurejo, O.O.**

Department of Animal Production and Health, School of Agriculture and Agricultural Technology,
Federal University of Technology, P.M.B. 704, Akure, Nigeria

Article History: Received 1st January 2020; Accepted 10th February 2020; Published 13th February 2020

ABSTRACT

The geometrical increase in the population of poultry (broilers, breeders, cockerels, turkeys, layers etc) and other livestock produced annually has led to the increased tonnage of animals' droppings/dung which eventually metamorphosised into breeding ground for flies and ammonia-build up. Flies are real nuisance, causing economic loss to poultry and other livestock farmers worldwide. The fact that one adult fly couple can produce about 76 million flies in six weeks indicates the essentiality of flies control in livestock farms. Many pathogens are equally associated with fly, causing diseases like; *Salmonellosis, Colibacillosis, Chronic respiratory disease* (CRD) etc. Ammonia is a corrosive chemical substance that its toxic effects can be serious enough to cause permanent blindness, lung disease, or death both in man and animals. Various methods were used in time past to combat farm odour and flies (Insecticides and pesticides), but these methods presented their own limitations and disadvantages. The advent of biotechnology ushered in products (e.g. cyromazine and ammoblast) and techniques (impermeable covers, permeable covers, acidification, diet manipulation etc.) that can make animal husband man heave a sigh of relief because they are safe and eco-friendly. The untold negative effects of flies and odour on animal's health (poultry, large animals, micro-livestock etc), farm attendants and the environment at large call for urgent attention and effective lasting solution.

Keywords: Flies, Odour, Biotechnology, Ammoblast, Cyromazine.

INTRODUCTION

Over the past century, livestock production has shifted from extensive, independent farms to concentrated and integrated operations. According to (Ducray *et al*., 2007 and Novartis, 2010), poultry provides presently a substantial part of the global demand for proteins of animal origin and that around 34 billion broilers, 4 billion layers, 800 million broiler breeders, 600 million turkeys and 800 million ducks are reared annually. This huge population of poultry being produced annually definitely has led to more poultry droppings generation that will eventually result into breeding ground for flies and ammonia-build up. There is a saying that, 'if you have livestock you are going to have flies' (Zobaai, 2018 and Biozyme, 2018). Flies in livestock production according to (Al Maqtari *et al*., 2011; Beland & Kadlubar, 1985), are real nuisance causing annoyance and great economic loss to farmers worldwide. One adult fly couple producing 76 million flies in six weeks indicates the essentiality of flies control in livestock farms. Many pathogens are associated with flies thereby causing diseases in poultry (e.g. *Salmonellosis, Colibacillosis, chronic respiratory disease*) that can even be transmitted to human. The warm, wet and fresh litter produced by birds is an ideal eco-system for fly development. Adult flies lay their eggs where they quickly hatch into rapidly growing maggots with their pupae and produce new generation of flies (Al Maqtari *et al*., 2011). Ammonia production and build up in livestock facilities such as; poultry houses, piggeries, stables, barns, dairy and feedlot facilities is also a subject of great concern. Ammonia is a chemical substance that is made by humans and by nature. It is made up of one part nitrogen (N) and three parts hydrogen (H_3). It is a colourless gas with a very sharp odour. Ammonia in this

*Corresponding Author: Mr. Arogbodo, J. O., Department of Animal Production and Health, School of Agriculture and Agricultural Technology, Federal University of Technology, P.M.B. 704, Akure, Nigeria. Email: arogbodojos@yahoo.com

form is also known as ammonia gas or anhydrous ammonia (Encyclopedia of earth, 2013). Ammonia is a corrosive substance and the main toxic effects are restricted to the sites of direct contact with it (i.e., skin, eyes, respiratory tract, mouth, and digestive tract). Ammonia burns can be so serious enough to cause permanent blindness, lung disease, or death in man and livestock (Encyclopedia of earth, 2013).

MATERIALS AND METHODS

Relevant text books, articles, and on-line resources were consulted to make this review work worthwhile.

Ancient methods of controlling flies and odour

Insecticides and pesticides

Several methods have been used overtime on farms to control flies ranging from insecticides to flies bait, but it is an indisputable fact, that the flies survive the contact with undiluted concentrates (Al Maqtari *et al*., 2011). There are reports of resistance against insecticides such as Dichloro-Diphenyl-Trichloroethane (DDT), organophosphates, carbamates, synthetic pyrethroids, neonicotinoids, phenylpyrazoles, macrocyclic lactones, etc. Apart from the problem of resistance to insects, these insecticides have lots of adverse environmental effects on its use such as; those to wild life (egg shell thinning), non-targeted species e.g. birds, pollinators decline e.g. honey bees (colony collapse disorder) as well as human health risks (e.g. cancer of the liver and breast). DDT is known to be persistent in the environment, thus resulting into bio-accumulation in tissues (EPA, 2013). The use of insecticides and pesticides were very common in the past as the method of controlling flies in-doors and out-doors. Manure was also treated with an insecticides but this method has now been discouraged as it interferes with biological control of flies, often resulting in a rebound of the fly population (Koomen *et al*., 2008).

Definition of insecticide and pesticide

An insecticide according to Wikipedia (2013) is a pesticide used against insects. They include; ovicides used in agriculture, medicine, industry, and general home use. Pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest. Pest can be insect-like organisms, mice and other vertebrate animals, unwanted plants (weeds), or fungi, bacteria and viruses that cause plant diseases. Though often misunderstood to refer only to insecticides but the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests (EPA, 2013). From the above it is very clear that pesticide and insecticide are inseparably inter-woven, they are been used interchangeably in literatures. Examples of insecticides (also pesticides) commonly used are Boric acid and DDT. Powdered Boric acid is placed in places where insects congregate, the powder sticks to the hairs on the insect's body. When they preen themselves, they ingest the boric acid and die. DDT is an organochloride insecticides, it is a colourless, crystalline solid, tasteless and almost odourless chemical compound (WHO, 1989). DDT was first synthesized in 1874 but its insecticidal properties were not discovered until 1939 (Nobel Prize.org., 1948). DDT was introduced into the market in 1944 following its discovery as a contact poison against several arthropods by the Swiss Scientist Paul Muller. For this discovery, he was awarded the Nobel Prize for Physiology and Medicine in 1948. DDT functions by opening the sodium channels in the nerve cells of the insect (Wikipedia, 2013).

Biotechnology advancement on controlling flies and odour

Livestock and cattle operations can produce very high levels of ammonia and hydrogen sulphide. Nitrogen in food produces ammonia and hydrogen sulphide gases during digestion that is released into the air by livestock as the food passes through excretion. These gases cause an obvious unpleasant odour leading to health problems and physical damage to animals, adversely affecting overall livestock production (Vijayalakshmi & Mahalakshmi, 2013). The advent of biotechnology has given us high level of hope in handling the negative effects of the twin problem of flies and ammonia odour in order to at least reduce them to the barest minimum if not completely eradicated.

Definition of biotechnology

Biotechnology is broadly defined as the development and utilization of biological processes, forms and systems for obtaining maximum benefits to man and other forms of life (Dubey, 2014). As a result of the advancements in biotechnology, several useful products have come to limelight and are now available for use in livestock production. Some of such products are; ammoblast (for ammonia odour control), cyromazine (for insect growth regulation), mistral (a litter conditioner) etc. Ammoblast and cyromazine are biotechnology products of great efficacy in the control of farm odour and flies growth respectively in livestock production. Ammoblast is an ammonia degrading powder that is specially developed to knock down the ammonia generated in poultry litters while cyromazine is an insecticide that is specifically targeted against the larval stage of an insect. Cyromazine may be contact poisons, stomach poisons, growth regulators or (increasingly) biological control agents.

Technologies for controlling flies: Biological control

This entails the control of houseflies with their natural enemies. This method is most effective when the environmental and ecological conditions required by such natural enemies are ensured. The most effective enemies of house flies are; a. *Hymenopteran* wasp (e.g. *Splangia spp)*: They deposit their eggs on housefly pupae. The release of parasitoid wasp has grown popular on large farms where enormous piles of manure provide ideal breeding grounds for fly populations. The wasp finds a fly while it is in pupa state and kills the pupa by stinging it. Then she lays a single egg into the shell. Once hatched the wasp larvae feed on the dead fly pupa and grows. A few weeks later an adult wasp emerges. Adult wasps are effective at decreasing fly populations because they kill any fly pupa they come across, even if they don't lay an egg inside (Junquera *et al*., 2019).

b. *Beetles* e.g. *Carcinops spp*. They feed on housefly eggs and larvae.

c. *Mites* e.g. *Machrocheles spp.*, feed on housefly eggs and larvae. Adult female mites attach to houseflies that bring them to new hunting ground (Junquera *et al*., 2019).

d. Hydrotae e.g. Ophyra aenescens; this is the larva of the black dump fly. It is also gaining popularity as a biological control agent for controlling house flies on poultry farms without the use of pesticides. The adult black dump fly is similar in appearance to the adult house fly (Hogsette & Jacobs, 2003).

e. Pathogens: Some natural pathogens can also be effective in controlling housefly populations e.g. *Enthomophtora muscae*, a microscopic fungus.

As a general rule, biological control of houseflies can be quite successful in confined poultry, pig and dairy operations. However, it is technically demanding and requires appropriate training of workers. The maximum benefit from predators and parasites is achieved with dry manure. In very wet manure, predators cannot move about effectively to find and consume fly eggs and larvae.

Technologies for controlling odour

a. Impermeable covers

Impermeable covers include concrete or wood lids placed on top of liquid storage units and lightweight roofs made of fibre glass, etc. rigid covers are usually more expensive than other type of covers, but often last longer, 10 to 15 years depending on the material. Impermeable covers are capable of reducing 80 to 95 per cent ammonia emission from manure storage facilities (Bicudo *et al*., 2004).

b. Permeable covers

Permeable covers, or bio-covers, act as bio-filters on the top of manure storage areas. They physically limit the emission of ammonia and other gases from the surface of storage lagoons and create a biologically active zone where the emitted ammonia and other gases will be aerobically decomposed by microorganisms (Watanabe & Olsen, 1965). Permeable covers and bio-covers include chopped barley, wheat or oats (8-12 inches thick). The effectiveness of ammonia emissions control is lower than with impermeable cover. Permeable covers are cost effective, but they require replacement over time, and they are vulnerable to extreme weather conditions.

c. Acidification

Research in Europe has proven that acidification (using acidifying agents to suppress ammonia emission) of manure just before application reduced ammonia volatilization depending on the degree of acidification and the application technique.

d. Diet manipulation

Monitoring and reducing the dietary crude protein for swine, poultry, and cattle have been shown to reduce ammonia emissions. Although, the excretion of nitrogen supplied in the feed cannot be avoided, careful control of dietary protein and amino acids can be used to minimize the amount of nitrogen that ends up in manure and serve as a source of ammonia (Powers, 2002). Excess Nitrogen fed to livestock animals is not retained by the animal's body but is simply passed out in the urine and faeces. It has been observed that ammonia emission could be reduced in dairy cows by up to 20 to 30 per cent by manipulating dietary crude protein types and levels. Feeding a reduced crude protein amino acid-supplemented diet is an effective tool for reducing ammonia emissions from growing- finishing swine. Phase feeding is a commonly used practice for meeting livestock nutrient needs without exceeding them (Watanabe & Olsen, 1965).

Capture-and-Control Methods

a. Filtration and bio-filtration

Bio-filters are usually comprised of ventilation fans that exhaust air from buildings through ducts and into a plenum below the bio-filter-media. The air passes through the bio-filter media where it is being acted on by microorganisms before it is emitted into the atmosphere. Bio-filters have the potential to effectively reduce substances in the air, such as ammonia. Several factors determine the effectiveness of bio-filters and their practicality. The filters can be costly to install, operate and maintain. In addition, bio-filters require close, frequent monitoring and intensive management to ensure optimum operational conditions are achieved continuously (EPA, 2000).

b. Bio-scrubbing and ammonia stripping

Bio-scrubbing and bio-filters rely on the microbial degradation of ammonia. The difference between them is that the bio-scrubber is housed in a closed tower containing water. When ammonia passes through the tower, it will be captured and absorbed by the water and then oxidized by the microorganisms. Ammonia stripping is a process of removing ammonia from manure. Air stripping in combination with absorption can be used to remove and recover ammonia from manure. Ammonia is transferred from the manure stream into the air and then absorb from the air into a strong acid solution (typically sulphuric acid), thereby generating an ammonium-salt, which can be crystallized and used as fertilizer. Values of pH from 10.5 to 11.8 are generally considered to be required for ammonia stripping processes (EPA, 2000).

Landscaping

Trees, shrubs and other vegetative barriers planted around livestock building have the potential to reduce ammonia emissions. Trees and shrubs act as a type of bio-filter for odorous compounds attached to fine dust particles. Planting just three rows of trees of various species and sizes around poultry farms can reduce total dust by 56%, ammonia 53%, and odour 18% (Nnadi & George, 2010).

Odour and ammonia control using herbal product

Bio-powder is a natural feed additive for livestock and poultry to control odours, ammonia and other gas emission which can be detrimental to livestock performance. It is made with 100% *Yucca schidigera* extract (Customers' link, 2001). BioSol-YS-30S is made with 100% *Yucca schidigera* by Ultra Bio-Logics Inc., USA. The product is light free flowing soluble powder having *saponin* as active ingredient. For many years research has shown that natural *saponins* can effectively reduce and control ammonia and odour (Wikipedia, 2012). BioSol-YS-30S is manufactured with the highest quality standards and has all the *saponins* and *glycol* components of the *Yucca schidigera* plant. It is non-toxic, heat stable and Flies have affected humans and with excellent pH stability (Customers' Link, 2001).

Environmental and public health impact of flies their welfare for thousands of years. In the Bible, the Hebrew term for the devil, Beelzebub, is translated as "Lord of the Flies". They are not only a nuisance, they transmit diseases and can cause an allergic reaction in many people (Do it yourself, 2011). The house fly *(Musca domestica*) has been buzzing around the world, pestering animals for 65 million years. House fly are not biting flies; instead, they puke digestive juices on us and drink it up (Agro china, 2012). Flies commonly develop in large numbers in poultry manure under caged hens, and this is a serious problem requiring control (Biozyme, 2018). The control of *Musca domestica* is vital to human health and comfort in many areas of the world. The most important damage related with this insect is the annoyance (abbood *et al*., 2018) and the indirect damage produced by the potential transmission of pathogens (viruses, bacteria, fungi, protozoa, and nematodes) associated with this fly. Pathogenic organisms are picked up by the flies from garbage and other sources of filth, and then transferred on their mouthparts, through their vomitus, faeces and contaminated external body parts to human and animal food (Rajkumar *et al*., 2008). The major diseases transmitted by flies to humans and domestic animals can be grouped under: Enteric Diseases, Eye infections, Mastitis, Parasitic Diseases and Other Diseases.

a. Enteric Diseases

Flies are important vectors of several enteric infections affecting human and domestic animals (abbood suhaim Alkhalifa, 2018; Gill *et al*., 2010). They have been confirmed as disseminator of; Cholera: caused by *Vibrio cholerae* (Boulaire, Fotedar, & Fotedar, 2000), Salmonellosis: caused by *Salmonella enteritidis* (Olsen *et al*., 2000), Shigellosis: caused by bacterium, *Shigella spp.* (Cohen & Levesque, 1991), Colienteritis: (Olsen *et al*., 2000), Campylobacter: (Nnadi & George, 2010).There are also reports on the transmission of porcine transmissible gastroenteritis virus (TGE) through the housefly (Olsen *et al*., 2000).

b. Eyes infections

The house fly *Musca domestica* has demonstrated its ability to carry *Chlamydia trachomatis*, the causative agent of the disease, trachoma and to transmit it from one animal to another under laboratory conditions. Also in cattle, the principal ophthalmic infection is infectious keratoconjunctivitis or pink eye, caused by *Moraxella bovis* (Olsen *et al*., 2000).

c. Mastitis

Flies are implicated as vectors of various organisms causing both chronic and acute mastitis in cattle. They are involved in the spreading and transmission of *Corynebacterium pyrogenes*, and other forms of mastitis, due to other species of *Corynebacterium, staphylococcal* and possibly *streptococcal* infections (Grange *et al*., 2000). Heifers from herds using fly control usually have a lower prevalence of mastitis than herds without fly control (Nickerson *et al*., 1995).

d. Parasitic Diseases

Flies are frequent carriers of helminthes. Several nematodes like *Parafilaria bovicola*, *Thelazia spp*., and *Heterotylenchus automalis* are found in various fly species. The house fly is a vector of *Cestodosis* in poultry and *Coccidiosis* can be transmitted by flies as well, although this is not the major way of spreading of the disease (Nnadi & George, 2010).

e. Other diseases

Other diseases can be caused by infections from housefly commonly caused by bacterium *Escherichia coli.* The type of disease will depend on the type of this bacterium involved. The strain known as *Escherichia coli 0157:H7* can lead to acute diarrhoea containing blood in the stools. It can lead to failure of the kidneys in younger children via a condition known as *Haemolytic Uremic Syndrome* (Word Press, 2011). House fly is also implicated in transmission of food poisoning, typhoid fever, dysentery, tuberculosis and anthrax (Rajkumar *et a*l., 2008). According to Peter (2008), poultry birds eating contaminated flies seem to be the primary mechanism of transmission of *Salmonella* bacteria from flies to birds. This shows that flies in poultry houses are not only a nuisance, but also a threat to the safety of poultry products. The life cycle of a housefly is as shown in figure 1.

Effects and environmental impacts of ammonia

General effect of ammonia

According to Lancaster *et al*. (2013), decreased birth and weaning rates, reduced gain rates and reduced feed efficiency were observed in Pigs exposed to 100-150 ppm of ammonia concentration. Ammonia gas has a characteristic pungent odour. At high concentrations has a negative impact on overall livability, weight gain, feed conversion, condemnation rate at processing and the immune system of birds. Experimentally, broiler chickens kept in an environment with ammonia concentrations of 50 ppm and 75 ppm were shown to have reductions in body weight of 17% and 20%, respectively, at 7 weeks of age compared to broiler chickens kept in an environment with near zero ammonia concentration (Tahseen & Griffiths, 2010). In the US, the maximum levels of ammonia in poultry houses have been set at 25 ppm by the National Institute of Occupational Safety and Health (NIOSH), and 50 ppm by the Occupational Safety and Health Administration (OSHA). These levels have been established based on human safety and represent the limits for 8 hours of exposure. OSHA considers 50 ppm to be the lowest level to cause irritation to the eyes, nose and throat of the most sensitive individuals. People can generally smell ammonia at concentrations between 20 and 30 ppm. Ammonia has great negative effects on livestock, environment and human health.

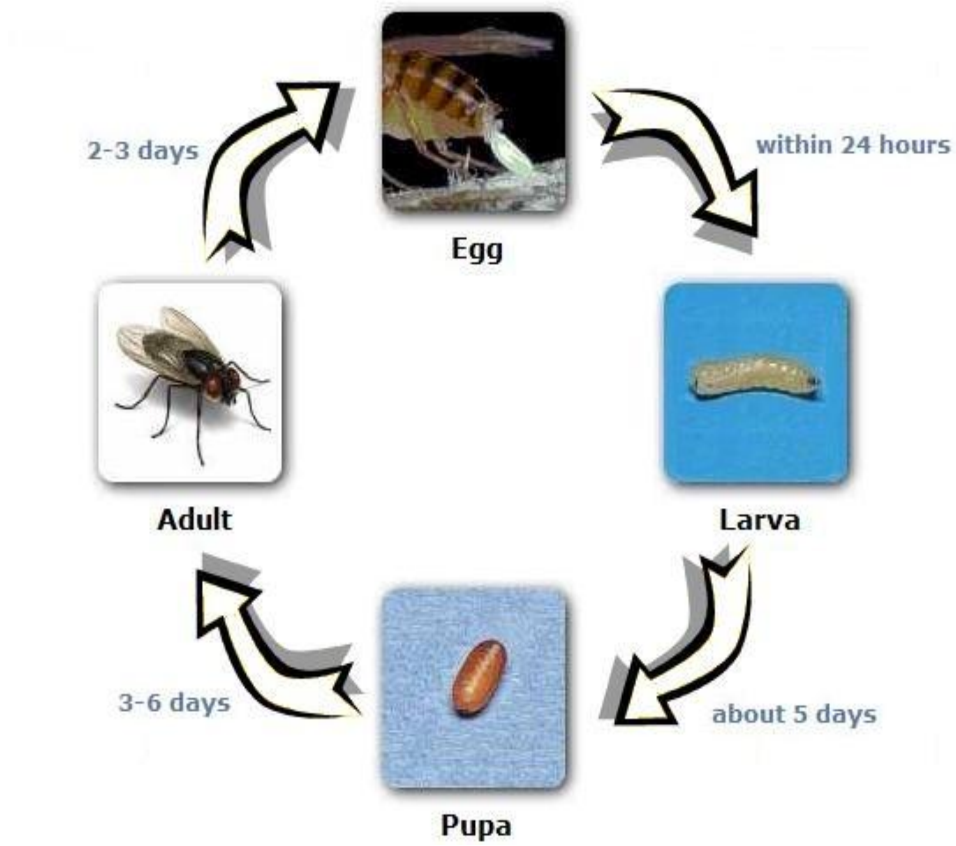

Figure 1: The life cycle of a housefly, Source: Alan and Hui (2013).

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Harmful effects of ammonia on birds

Ammonia is a gas present in the atmosphere of every poultry house. It results from the chemical decomposition or uric acid in droppings by certain bacteria in the litter. It is particularly high in houses where the same litter is used for successive flocks. The main factors affecting atmospheric ammonia concentration in poultry houses are litter conditions and air movement (ventilation). Moisture content, pH and the temperature of the litter, influence the degradation of uric acid by bacteria. Poor ventilation, loose droppings and faulty over filled or low positioned drinkers, are common causes of wet litter in poultry houses (Tahseen & Griffiths, 2010).

a. Damages to the respiratory system

The effect of ammonia gas on the mucosal surface of the trachea ranges from paralysis of cilia, to deciliation (loss of cilia) of epithelial cells to injury (necrosis) of the mucosal epithelium itself. When cilia become paralyzed or are lost due to high ammonia levels in the poultry house, mucus on the mucosal surface of the trachea cannot be cleared, and thus entrapped bacteria on the dust particles may reach the lungs and air sacs to cause infection. Prolonged exposure to atmospheric ammonia may also incite proliferation of the epithelial cells that line the arterial spaces in the lung. The proliferative lesion cause thickening of para-bronchial walls. In severe cases, total obliteration of arterial spaces, with subsequent reduction in pulmonary gas exchange can occur (Tahseen & Griffiths, 2010). At higher concentrations (50-70 ppm) ammonia causes respiratory diseases on Pigs and Turkeys as a result of their inability to clear their lungs of bacteria (Olsen *et al*., 2000).

b. **Damages to the eyes**

Atmospheric ammonia at high concentrations causes conjunctivitis and damage the cornea of the eyes. Swelling and reddening of the eyelids, reddening of the conjunctivae and nictating membrane (third eyelid), and partial or complete closure of the eyes are common clinical signs. In severe cases, the eyelids are often shut (Tahseen & Griffiths, 2010).

Environmental impacts of ammonia

When in gaseous form, ammonia has a short atmospheric lifetime of about 24 hours and usually deposits near its source. In particulate form, ammonia can travel much further impacting a larger area. Both gaseous and particulate ammonia contribute to eutrophication of surface water, soil acidification, fertilization of vegetation, changes in gases present in the atmosphere. Ammonia readily reacts with strong acidic gases in the atmosphere such as nitric acid and sulphuric acids, to form ammonium salts, also known as fine particulate matter or PM 2.5 (Colorado State University, 2008). Ammonia + Acidic gases (i.e. nitric acid, sulphuric acid from NO_2 and SO_2) = PM 2.5 Due to their small diameter (less than 2.5 microns) and increased atmospheric lifetime of 15 days, these particulates are able to travel long distance before being dry and deposited to the ground surface. This allows them to travel from rural areas to urban locations where they mix and build up in the atmosphere leading to smog or transportation to other areas.

a. Eutrophication

Eutrophication is a result of nutrient pollution (from deposition or run-off) into natural waters (creeks, rivers, ponds, or lakes). It generally promotes excessive plant growth and decay, favours certain weedy species over others, and is likely to cause severe reductions in water quality. In aquatic environments, enhanced growth of choking aquatic vegetation or algal blooms disrupt normal functioning of the ecosystem, causing problems such as a lack of oxygen in the water needed for fish and other aquatic life to survive. The water then becomes cloudy, coloured a shade of green, or yellow, brown or red (Colorado State University, 2008).

Soil Acidification

Soil acidification occurs when the NH_3 or NH_4^+ is converted to nitrate, because it is an acid-forming reaction (Choi and Moore, 2008). When ammonia reaches the soil surface, it usually reacts with water in the soil and it is converted into its ionic form, ammonium (NH_4^+) and absorbed to the soil. The ammonium in the soil eventually dissociates or is nitrified into nitrite (NO_2^-) or nitrate (NO_3^-) by nitrifying bacteria, releasing H^+ ions into the soil. If not taken up by biomass and converted to methane, the surplus H^+ ions eventually lead to the formation of an acidic soil environment. The nitrogen left over in the soil will either be taken up by plants, stored in the soil, returned to the atmosphere, or will be removed from the soil in run-off or leaching (Colorado State University, 2008).

Fertilization of Vegetation

In this case ammonia gas from the air deposits on the leaf or soil surface at the base of the plants and is taken up by the plant. Changes in plant growth can then occur, similar to those resulting from fertilization. In a grass plain environment, changes may be subtle; however, in natural or mountain areas, changes in plant species may be more obvious, promoting weedy plants while choking out native plants and wild flowers or promoting grasses and sages.

Changes in Ecosystem

An ecosystem is a natural system consisting of plants, animals, and other micro-organism functioning together in a balanced relationship. Changes in ecosystem due to ammonia deposition occur through a combination of all the above mentioned processes. When changes in ecosystems occur, the natural balance of a system is disrupted and fragile plant and animal species can be replaced by non-native species. The disruption of an ecosystem can cause it to adapt by changing (positive or negative outcome), or a disruption may lead to the extinction of the ecosystems (Colorado State University, 2008).

Ammonia and Acid Rain

In natural conditions, rainwater is slightly acidic due to carbon dioxide reacting with the atmosphere. When the pH of rainwater drops below 5.6, it is considered as acid precipitation (Hurrell et al., 2013). Acid rain is a rain or any other form of precipitation that is unusually acidic, meaning that it possesses elevated levels of hydrogen ions (low pH). It can have harmful effects on plants, aquatic animals, and infrastructure. Acid rain is caused by emission of sulphur dioxide and nitrogen oxide, which react with the water molecules in the atmosphere to produce acids. However, unpolluted rain can also contain other chemicals which affect its pH. A common example is nitric acid produced by electric discharge in the atmosphere such as lightning. Carbonic acid is formed by the reaction (Wikipedia, 2013).

$$H_2O\ (l) + CO_2 \Longrightarrow H_2CO_3\ (aq)$$

Carbonic acid then can ionize in water forming low concentration of hydromium and carbonate ions;

$$H_2O\ (l) + H_2CO_3\ (aq) \Longrightarrow HCO_3^-\ (aq) + H_3O\ (aq)$$

Acid deposition as an environmental issue would include additional acids to H_2CO_3. While sulphate and nitrate ions in the atmosphere contribute to increased levels of acidity in rainwater, other chemicals (bases) can counteract these acids. The most common base found in the atmosphere is the ammonium ion. Ammonium ions can be introduced into the atmosphere from industrial burning or agriculture. When combined with water, ammonia is converted to ammonium ions. In dry areas ammonium ions can escape to the atmosphere, Nitrate ions (from nitric acid) represent the other significant human contribution to acid rain (Exploring Earth, 1994). Acid rain dissolves forest nutrients much faster than previously believed, posing a threat to future forest productivity. The chemicals in acid rain can cause paint to peel, corrosion of iron, copper, bronze, steel structures such as bridges, damage buildings and historic monuments and statues, especially those made of rocks, such as limestone and marble that contain large amounts of calcium carbonate. Acids in the rain react with the calcium compounds in the stones to form gypsum, which then flakes off. It is important to note that only SO_2 and NO_2 play a significant role in acid rain (Wikipedia, 2013).

Smog and Decreased Visibility

When ammonia combines with NO_2 and SO_2 emissions it forms fine particulates. These fine particulates are a contributor to haze/smog in the cities and decreased visibility (haze). Smog is also a human health issue leading to an increased rate of respiratory and heart diseases. Visibility in the eastern United States is generally worse due to higher average humidity levels and higher levels of particulate matter (Jain *et al*., 2009).

Impacts of ammonia on human health

Human health are affected by both the gas and particulate (particulate matter 2.5) form of ammonia. The particulate form has broader implications for general public, whereas the gaseous form is a localized concern for the health of agricultural workers. The fine particulate with such small diameter are able travel deep into lung tissue down to the alveoli causing a variety of respiratory ailments such as bronchitis, asthma and coughing. Ammonia gas is a highly hydrophilic base that has irritant properties which when inhaled and combined with water, can injure and burn the respiratory tract. The base form of ammonia, ammonium hydroxide, dissolves in the water of mucus membranes hydrolyses, and rapidly irritates tissues due to high pH that results. Ammonia can also alter the uptake of oxygen by haemoglobin due to the increase of pH within the blood, which leads to decreased oxygenation of tissues, and decreased metabolic function (Colorado State University, 2008). Other problems associated with long term exposure to the fine particles (PM 2.5) include; cardiovascular problems, premature death and increased admissions from respiratory causes. Children, the elderly, and individuals with compromised cardiovascular health or lung diseases, such as emphysema and asthma are especially vulnerable to such health problems caused by PM 2.5 (Jain *et al*., 2009). At moderate concentrations (50 to 150 ppm), ammonia exposure can lead to eye, throat and skin irritation as well as cough and mucus build-up. Prolonged exposure at this level can result in the transfusion of ammonia from the alveoli into the bloodstream and a subsequent disruption of oxygen uptake by haemoglobin. At high concentration (> 150 ppm) ammonia can scar lung tissue, cause lower lung inflammation and pulmonary oedema. Exposure to high concentrations of ammonia (500 to 5000 ppm) will cause death in a relative short time period from prevention of oxygen uptake by haemoglobin. These levels are rarely found near livestock operations, but may occur in closed manure storage facilities and poorly ventilated buildings where ammonia concentrations can accumulate (Colorado State University, 2008). Ammonia is part of the EPA's (Environmental Protection Agencies) top ten cleaning ingredients to avoid.

Ammoblast and Cyromazine; biotechnology products for odour and flies control: Ammoblast

Ammoblast is an ammonia degrading powder that is developed to knock down ammonia generated in poultry litters. There are two types of ammoblast which are; ammoblast plain (designed for poultry litters) and ammoblast-Y (designed for use in ponds). Ammoblast (plain) is a dry, free flowing powder prepared from a group of ammonia oxidizing microorganisms that utilize ammonia as their main nutrient for growth. They secrete a mixture of ammonia oxidizing enzymes which sequentially oxidize ammonia to hydroxylamine and then to nitrite. Nitrite is further degraded by other microorganisms present in the litter to nitrates. The active ingredients include ammonia oxidizing biochemical system 34%, stabilizer 2% and catalyst 2 % and inert support q.s. (Polchem, 2013 and Sanchez-Sanchez *et al.*, 2013).

Mode of action of ammoblast

Enzymes oxidize ammonia to hydroxylamine, then to Nitrite and finally to Nitrate. Oxidizing enzymes involved are: Ammonia monooxygenase (AMO) converts ammonia to hydroxylamine, hydroxylamine oxidoreductase (HAO) converts hydroxylamine to nitrite and nitrite oxidoreductase (NO) finally converts nitrite to nitrate (Balch et al., 2009).

Benefits of ammoblast

It is Eco-friendly, safe, non-toxic, odourless, creates a cleaner, healthier and safer environment, reduces ammonia smell and enhances fertilizer value of manure (Sanchez-Sanchez *et al*., 2013).

Cyromazine

Cyromazine is a biotechnology product for insect growth regulation that is specifically targeted against the larval stage of an insect. Treated larvae will not moult to the next stage. Cyromazine belongs chemically to the triazines, it is a cyclopropyl derivative of melamine. Cyromazine works by affecting the nervous system of the immature larval stages of certain insects (Summers *et al*., 1998). It is one of the insects development inhibitors (probably interfering with the process of chitin deposition) effective against larvae of most dipterian insects (flies, mosquitoes, etc), fleas and some beetles. It is available for sheep as concentrates for dipping and spraying and as pour-on for blowfly strike prevention, as a feed additive for poultry to control houseflies in the manure (Summers *et al*., 1998), and as a concentrate for manure and environmental treatment against houseflies and other nuisance flies (Zubko et al., 2012).

Properties of cyromazine

Molecular formula = $C_6H_{10}N_6$, Molar mass = 166,19g/mol, Appearance = crystalline, Melting point = 219 – 222^{0}C and IUPAC Name = N-Cyclopropyl-1,3,5-triazine-2,4,6-triamine.

Benefits

It reduces fly and larvae nuisance in poultry pen, ensures firm, dry and odourless poultry manure.

Pharmacokinetics of cyromazine

Topically administered cyromazine is poorly absorbed through the skin. Cyromazine is quite soluble in water, in contrast with many ecto-parasiticides that are lipophilic. After oral administration to poultry 99% of the administered dose is excreted unchanged in the faeces. Only about 0.6% is deposited in eggs and very few in chicken tissues. Both in mammals and poultry, a small portion is metabolized in the liver and the largest portion is excreted through the urine. Excretion is rather fast; about 95% of the ingested dose is excreted within 24hours after administration (Zubko *et al*., 2012). In treated poultry, since cyromazine excreted with the urine is mixed with the faeces in the cloaca the whole manure gets uniformly treated, which allows a rather effective control of fly maggots. In mammals, ingested cyromazine does not end in the faeces but in urine, and consequently it cannot be used as feed-through for manure fly control. Numerous studies conducted (laboratory and field) demonstrate that cyromazine is degraded by biological mechanisms (Higuchi *et al*., 2013 and Guide Chem, 2013).

Occupational risk

The United States Environmental Protection Agency (USEPA) conducted an occupational risk assessment for inhalation exposures to cyromazine during mixing, loading, and application activities vial aerial sprayer or ground-boom to dry beans. Risks from dermal exposures were not determined because there were no effects in two different 21-day dermal toxicity studies in rabbits at doses up to 2,010 mg/kg/day. The USEPA did not estimate Margin of Exposures (MOEs) for post application occupational exposure because dermal toxicity end-points were expected to be negligible (Swedberg *et al*., 2005).

Carcinogenicity

Cyromazine did not cause oncogenic effects in rat or mouse chronic feeding studies. This compound was also negative in a number of genotoxicity studies. The USEPA classified cyromazine as a GROUP E carcinogen (evidence of non-carcinogenicity for humans) (Swedberg *et al*., 2005).

Regulation

The Food Safety and Inspection Services (FSIS) of the United States Department of Agriculture(USDA) provides a test method for analysing cyromazine and melamine in animal tissues in its Chemistry Laboratory Guidebook which "contains test methods used by FSIS Laboratories to support the Agency's inspection programme, ensuring that meat, poultry, and egg products are safe, wholesome and accurately labelled." In 1999, in a proposed rule published in the Federal Register regarding cyromazine residue, the United States Environmental Protection Agency (EPA) proposed removing melamine, a metabolite of cyromazine from tolerance expression since it is no longer considered a residue of concern (EPA, 2013).

CONCLUSION

It can be concluded that cyromazine and ammoblast together with the biotechnology techniques discussed in this paper will go a long way in controlling odour and flies in livestock production due to their so many inherent advantages. The biotechnology products are eco-friendly, they cause no allergic skin reactions, not easily absorbed on animals and almost completely eliminated from the body. In addition to the above, there has not been any record of resistance documented against them. Cyromazine and ammoblast will be an effective replacement for the ancient insecticides and pesticides used in controlling flies and odour in livestock and poultry farms. The mechanism of action of cyromazine has not been completely elucidated. Hence, more research work is highly recommended to be carried out in this area.

ACKNOWLEDGMENT

The authors express sincere thanks to Department of Animal Production and Health, School of Agriculture and Agricultural Technology, Federal University of Technology, Akure, Nigeria for the facilities provided to carry out this research work.

REFERENCES

Abbood suhaim Alkhalifa, A. (2018). The effect of Biozy!rase.*American Journal of Medical Genetics, 90*(4), 328-335.

Biozyme, (2018). How to Effectively Control Flies around Your Livestock. An article by Biozyme® incorporated. 6010 Stockyards Expressway St.Joseph, Missouri 64504. Pp1 -2.

Encyclopedia of Earth (2013). Health effects of Ammon-ia <http://www.eoearth.org/article/> . 1- 2.

Exploring Earth (1994). Ammonium ion Concentration, 1994. National Atmospheric De- position Program/ National Trend Network. http;nadp.sws.uic.edu. 1-8.

Guide chem (2013). Environmental Fate and Exposure Potential of Cyromazine.Guide-chemIcp:09045134-11

Higuchi, A., Ling, Q.D., Chang, Y., Hsu, S.T., & Umezawa, A. (2013). Physical cues of biomaterials guide stem cell differentiation fate. *Chemical Reviews, 113*(5), 3297-3328.

Hogsette, J. A., & Jacobs, R. (2003). The black dump fly: a larval predator of house flies.

Hurrell, J. W., Holland, M. M., Gent, P. R., Ghan, S., Kay, J. E., Kushner, P. J., Lindsay, K. (2013). The community earth system model: a framework for collaborative research. *Bulletin of the American Meteorological Society, 94*(9), 1339-1360.

Jain, S., Kamimoto, L., Bramley, A. M., Schmitz, A. M., Benoit, S. R., Louie, J., Chugh, R. (2009). Hospitalized patients with 2009 H1N1 influenza in the United States, April–June 2009. *New England Journal of Medicine, 361*(20), 1935-1944.

Junquera, P., Hosking, B., Gameiro, M., & Macdonald, A. (2019). Benzoylphenyl ureas as veterinary antiparasitics. An overview and outlook with emphasis on efficacy, usage and resistance. *Parasite, 26*.

Koomen, J.M., Haura, E.B., Bepler, G., Sutphen, R., Remily-Wood, E.R., Benson, K., Hildreth, L.T. (2008). Proteomic contributions to personalized cancer care. *Molecular & Cellular Proteomics, 7*(10), 1780-1794.

Lancaster, M. A., Renner, M., Martin, C.-A., Wenzel, D., Bicknell, L. S., Hurles, M. E., Knoblich, J. A. (2013). Cerebral organoids model human brain development and microcephaly. *Nature, 501*(7467), 373.

Nickerson, E., Greenberg, F., Keating, M. T., McCaskill, C., & Shaffer, L.G. (1995). Deletions of the elastin gene at 7q11. 23 occur in approximately 90% of patients with Williams syndrome. *American Journal of Human Genetics, 56*(5), 1156.

Nnadi, P., & George, S. (2010). A cross-sectional survey on parasites of chickens in selected villages in the subhumid zones of South-Eastern Nigeria. *Journal of Parasitology Research, 2010*.

Novartis (2010). Fly Control in Livestock and Poultry Production. Novartis Animal Inc. 1 – 3.

Olsen, B.R., Reginato, A.M., & Wang, W. (2000). Bone development. *Annual Review of Cell and Developmental Biology, 16*(1), 191-220.

Polchem (2013). Ammonia Controlling Agents. Polchem Hygiene Laboratories PVT. LTD. Pune, India. http://www.polchemgroup.com 1 of 1.

Powers, W. (2002). Emerging air quality issues and the impact on animal agriculture: Management and nutritional strategies. Paper presented at the 49th Annual Maryland Nutrition Conference for Feed Manufacturers. Timonium, Md.

Rajkumar, S.V., Rosiñol, L., Hussein, M., Catalano, J., Jedrzejczak, W., Lucy, L., Zeldis, J.B. (2008). Multicenter, randomized, double-blind, placebo-controlled study of thalidomide plus dexamethasone compared with dexamethasone as initial therapy for newly diagnosed multiple myeloma. *Journal of Clinical Oncology: Official Journal of the American Society of Clinical Oncology, 26*(13), 2171.

Sanchez-Sanchez, A., Pérez-Baena, I., & Pomposo, J. A. (2013). Advances in click chemistry for single-chain nanoparticle construction. *Molecules, 18*(3), 3339-3355.

Summers, R. M., Andrasko-Bourgeois, J., Feuerstein, I. M., Hill, S. C., Jones, E. C., Busse, M. K.,Tucker, E. (1998). Evaluation of the aortic root by MRI: insights from patients with homozygous familial hypercholesterolemia. *Circulation, 98*(6), 509-518.

Swedberg, K., Cleland, J., Dargie, H., Drexler, H., Follath, F., Komajda, M., Haverich, A. (2005). Guidelines for the diagnosis and treatment of chronic heart failure: executive summary (update 2005) The Task Force for the Diagnosis and Treatment of Chronic Heart Failure of the European Society of Cardiology. *European Heart Journal, 26*(11), 1115-1140.

Tahseen, S., & Griffiths, M. (2010). Vaginal birth after two caesarean sections (VBAC-2) a systematic review with meta-analysis of success rate and adverse outcomes of VBAC-2 versus VBAC-1 and repeat (third) caesarean sections. *BJOG: An International Journal of Obstetrics & Gynaecology, 117*(1), 5-19.

Vijayalakshmi, S., & Mahalakshmi, V. (2013). An impact of consumer buying behavior in decision making process in purchase of electronic home appliances in Chennai (India): an empirical study. *Elixir MarketingManagement, 59*, 15267-15273.

Watanabe, F., & Olsen, S. (1965). Test of an ascorbic acid method for determining phosphorus in water and $NaHCO_3$ extracts from soil 1. *Soil Science Society of America Journal, 29*(6), 677-678.

Wikipedia (2013). Acid rain – Wikipedia, the free encyclopedia.1-5.Accessed on 20/03/2013.

Zobaai, H.A.A.A. (2018). Effect of spraying with Biozyme and bacterial fertilizers on the yield and vegetative traits of two potato cultivars. *Euphrates Journal of Agriculture Science*, *10*(2), 137-147.

Zubko, P., Jecklin, N., Torres Pardo, A., Aguado-Puente, P., Gloter, A., Lichtensteiger, C.,Triscone, J.M. (2012). Electrostatic coupling and local structural distortions at interfaces in ferroelectric/paraelectric superlattices. *Nano Letters, 12*(6), 2846-2851.