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Effects of Nitrate on Human Health – A Review

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***Abstract*: Nitrogen metabolism in nature is a requirement for earthly life. In nitrogen cycle, nitrate and nitrite are necessary intermediates, and these anions have been interested throughout nutritional scientists for more than half a century, mostly in relation to cancer due to their ability to form nitrosamines. Nitrate poisoning symptoms can differ depending on the amount and length of exposure. The existing systems measure the toxic nitrate only in water samples. Henceforth, we discuss the nutritional aspects of this mechanism and what the consequences for human health are currently known. The paper presents the surveys and experiments conducted on water samples and vegetables for detection of nitrate and also outlines the health hazards related to nitrates.**

***Keywords*: De-Nitrification, Electric Field, Interdigital sensors, Nitrate, Sensing system.**

1. Introduction

The global nitrogen cycle has seen a huge impact due to the vicious acts of human beings and has been crucially altered over the past century. Nitrate Pollution is one of the leading cause towards this impact.

Agricultural and industrial nitrogen emitted into the environment currently exceeds the natural content of nitrogen in the atmosphere and hence affects the natural N fixation. The nitrogen compounds in the soil are converted by bacteria into nitrates.

An average daily dose of man-made nitrates is 75-100mg, 80-90% of which come from vegetables and 5-10% from food [1]. Studies show that on an average an adult consumes approximately 400 grams of various vegetables, from which the intake of nitrate is about 157 mg/day. Nitrates are found in large amounts in healthy foods like vegetables. Excess of nitrogen in the environment produces pollutants such as ammonia and ozone, which might cause uneasiness to breath, limit visibility and also alter the growth of the plant. If the excess of nitrogen comes back to the earth from the environment, it might also cause harm to health of forest, waterways and also soils. Nitrogen is one of the most important nutrients for plants but if it is excess then it might causes a serious damage to plants. The excess content of nitrate present in vegetables may lead to harmful effect on human health. There is a rare condition known in which the haemoglobin iron is in the oxidized or ferric state and cannot reversibly bind oxygen commonly called as Methaemoglobinaemia. This condition leads to hypoxaemia and death. Through agricultural practices the atmosphere is subjected to the highest contamination of nitrate making air quality that is harmful for human survival. In terms of nutritional needs, the main source to which human beings are actually subjected is primarily the intake of various vegetables and fruits [2].

Nitrate in drinking water is usually the result of groundwater contamination due to manure, animal or human waste [3]. The WHO recommends a maximum daily intake of 3 to 7 milligrams of nitrate per 1 kg of body weight, but we now ingest 10 times more nitrate than that. According to many health studies, an excess of nitrates can lead to medical issues including diabetes, Alzheimer's and Parkinson's disease. Fruits and vegetables after nitrogen absorption, often convert to nitrate and are temporarily stored in the body causing adverse effects in the future.

Generally fresh edible has no effect. However, if the vegetables are not fresh, nitrate will be converted to nitrite, resulting in a significant increase in the content of nitrite which is hazardous to our health.

2. Existing System

Determination of nitrate in liquid samples is a significant aim for environmental monitoring and assessment purposes. The existing system has so far used planar type interdigital sensors for determining Nitrate-N in water samples. The previous research conducted on planar interdigital sensors have been observed to behave like parallel plate capacitors and detection is based on change in electric field generated between two types of electrode. The sensor inputs are fed with low amplitude alternating electrical voltage. The electric field produced is given as input to the material under test (MUT) affecting the electric field. A thin film layer parylene coated interdigital sensor is used for calculating nitrate concentration in water. The challenge faced here is the exposure of the sensor to air and water causes oxidation [4].

Another study shows that if necessary, the designed system can calculate the concentration of nitrate using derived formula with some calibration. It is necessary to apply the appropriate selectivity for the sensor that can capture the nitrate ions. The device can theoretically be used in real-time applications to check water samples [5]. Other designed systems include Self-assembled grapheme electrode arrays used to selectively detect nitrate solutions. In order to make the detector selectively immune to NO_3 ions, an ion selective ionosphere film was

deposited on the grapheme layer [6].

According to an experiment conducted, an asymmetric ion selective membrane technique is used to detect nitrate ions in vegetables with different microstructure geometrizes. The main drawback is that ion sensor is only capable of detecting concentration NH3 solutions ranging from 10 -5 M to 1-0 M which is lower than appropriate residual nitrate in vegetables [7].

Techniques for active central treatment include physical, chemical and biological nitrate elimination, including ion exchange, reverse osmosis, biological denitrification and electro-dialysis, these that are mentioned are chemical and biological nitrate removal procedures and include ion exchange, reverse osmosis method, biological denitrification and electro dialysis process, which are capable of extracting more than 80% of nitrate from aqueous samples to achieve effluent nitrate contents of up to 13 mg /l; standard treatment methods (coagulation, sedimentation, filtration and chlorination) are not successful [8].

The analysis conducted to this point has targeted chiefly on measurement of toxic nitrate in water. Similarly, a solution to check nitrate in fruits and vegetables has been proposed. The existing system that are accustomed to measure nitrate in vegetables and fruits chiefly uses laboratory methods primarily based on calculation through the usage of chemicals. The answer planned is predicted to perform testing directly from farmlands avoiding tedious laboratory strategies. A high yield needs observation of soil fertility by maintaining a balance between nutrient demand and chemical (nitrogen and phosphorus) application. Fast access to the nutrient level, like nitrate content, directly in soil or recirculating water within the greenhouse, is essential for the potency of chemical usage. This has the potential to cut back production prices and make it attainable. Nowadays, soil nutrient level analysis is finished by first removing nitrate-nitrogen, phosphorus, potassium from the soil and further scrutinizing the samples. Spectrophotometric devices, physical phenomenon sensors or standard ion-selective electrodes (ISEs) can be accustomed to confirm the concentration (or total concentration) of those compounds within the extract solution [8, 9].

Among these devices, because of their ion-selective membrane, the ISEs are easy and supply comparatively smart sensitivity and decisive property. It contains an enclosed solution that hinders the shrinking and integration of the detector. Ammonia is made by human action and happens naturally. It's a vital gas supply that plants and animals require. Ammonia is made by microorganisms within the intestines. Most of the people are acquainted with the odor of ammonia, as a result it is employed to smell salts, several unit and industrial cleaners, and products for window cleanup. Ammonia gas dissolved in water is called liquid ammonia or aqueous ammonia.

Once being exposed to environment, liquid ammonia quickly becomes a gas. Ammonia is applied on to soil on farms and is employed for the assembly of fertilizers for farm crops, lawns and plants. It's found throughout the atmosphere in air, water, soil, animals, and plants. Everyone is exposed to low levels of ammonia present within the air, food, water and soil. Some people are also exposed to higher levels throughout the utilization of ammonia-containing clean up product.

Exposure to high levels of ammonia within the air might cause irritation to the skin, eyes, throat, and lungs and cause coughing and burning. After exposure to terribly high levels of ammonia, some individuals with respiratory illness is also additionally inclined than others to respiratory ammonia. Swallowing targeted ammonia solutions will cause mouth, throat, and abdomen burns. Burning your eyes with ammonia will cause burns and even visual impairment [10].

For the cultivation of fruits and vegetables, fertilizers containing the mandatory components for plant growth are used. However, misuse of producing technology, the utilization of prohibited fertilizers, pesticides and chemicals, similarly as the next level of soil chemical concentrations will all cause serious health harm. Of all the substances that are transferred to the soil from fertilizers, nitrates are one amongst the foremost harmful if consumed in excess. Continuous intake of food with a high nitrate content might cause elevated risk of critical diseases. This may lead to unsafe levels of fruit nitrate and vegetable nitrate content. Most health aware individuals understand the risks of pesticides in the fresh produce of fruits and vegetables. But only few are aware that fresh fruit and vegetables expose them to dangerous nitrates. Because of lack of laws and client awareness, nitrates in recent fruit and vegetables cause a larger threat than pesticides. Due to the risks, most jurisdictions tightly manage the nitrate content of meat product.

Food producers who add nitrates to meat should accommodate strict laws and labelling necessities. Sadly nitrate levels in fruit and vegetables are unregulated and unbridled in most places. There are not many standards for producers or labelling necessities for sellers. Improper farming and storage strategies may result in excessive nitrate content in fruit and vegetables. As a result, there's no testing for nitrate levels at any point within the offer chain. Consumers of fruit and vegetables are exposed to surplus danger. It has long been established that excessive nitrates are harmful to health. Excessive nitrate consumption causes infant syndrome and adult Methemoglobinemia. Nitrates considerably increase the danger of polygenic disease, Alzheimer's disease and brain disease and are bound to varieties of cancer. Some researchers believe that the dramatic rise in cancer of the gullet recorded over recent decades may be attributed to excessive nitrates in fruit and vegetables. Even fruit and vegetables will create individuals sick from contamination from microorganism, pesticides and alternative residues. Consumers are mostly shielded from these risks by testing and regulative oversight. But they're not shielded from excessive nitrate content in fruit and vegetables. Due to this negligence, health aware individuals that eat healthy

amounts of raw and gently grilled fruit and vegetables have a larger risk of exposure to intense harmful nitrates. Individuals seeking healthier food usually opt for turn out that is full-grown organically while not the produce contaminated with pesticides and herbicides. However, that organic label will give a false sense of security. Fruit and vegetables certified organic should still contain high levels of nitrates, absorbed from over application of natural fertilizers like manure.

3. Proposed system

The proposed system is a simple and sustainable device for nitrate and ammonia for consistent measuring in fruits and vegetables. A user-friendly interface and measuring process that is expected to take less time.

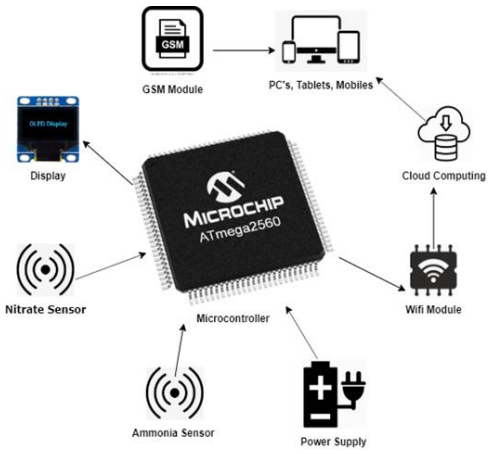

Fig. 1. Block Diagram of Proposed System

The technology that is intended to implement for operating the proposed system is Internet of Things (IoT). In this system, the sensor collects the data in the form of analog input from the environment. Further, the collected information will be sent to the cloud which will be accessible to the intended users in the form of notifications. The device is expected to be versatile in terms of measuring the nitrate content in green groceries in agricultural land and atmosphere.

4. Conclusion

In this paper, we have explained the existing systems for measuring nitrate contents based on the research carried out previously. Most of the methods employ techniques to detect nitrate by use of complex instruments that are not implemented commercially for the benefit of the people. Also, the studies carried out earlier mainly focuses on detection of nitrate in water samples and very few for vegetables, fruits or processed meat. Hence, by taking reference from these papers we have proposed an IoT based system for smart measurement of nitrate and ammonia concentration levels in green groceries and atmosphere.

References

[1] S. Tannenbaum and P. Walstra, Handbook of Water Analysis, edited by L. M. Nollet, Marcel Dekker, New York, NY, U.S.A, 2000.
[2] A. Hmelak Gorenjak and A. Cencic, (2013) “Nitrate in Vegetables and Their Impact on Human Health”.
[3] M.H Ward, T.M deKok, P Levallois etal. “Workgroup Report-Drinking water nitrate and health-recent findings and research needs”, Environmental Health Perspectives, 2005.
[4] S. Vigneshwaran, T. Sandhya, K. Sanjay, T. Santhya and S. Saranya (2018), “IoT Based Nitrate Measurement and Environment Monitoring System”, International Journal of Advance Research in Science and Engineering.
[5] Li Xie, Asif I. Zia, Subhas Mukhopadhyay, Lucy Burkitt, “Electrochemical Impedimetric sensing of nitrate contamination in water”, Ninth International Conference on Sensing Technology, 2015.
[6] Li Wang, Jungyoon Kim, and Tianhong Cui, “A Low-Cost Ion Selective Nitrate Sensor Based On Self assembled Graphene Microelectrode Arrays”, IEEE Euro sensors, vol. 33, Berlin, Germany, 23-27 June 2019.
[7] Vananh, T. Dam and Maecel A. G Zevenbergen, “A Low Cost Nitrate Sensor for Agricultural Applications”, IEEE, Transducers 2019 – Eurosensors Xxxiii, Berlin, Germany, 23-27 June 2019.
[8] V. I. Adamchuk, J.W. Hummel, M.T. Morgan, S. K. Upadhyay, “On-the-go soil sensors for precision agriculture”, Computers and Electronics in 1287 Agriculture, vol. 44, pp. 71–91, 2004.
[9] S.J. Birrell a, J.W. Hummel, Real-time multi ISFET/FIA soil analysis system with automatic sample extraction, Computers and Electronics in Agriculture, vol. 32, 1, pp 45-67, 2001.
[10] Agency for Toxic Substances and Disease Registry (ATSDR). 2004. Toxicological Profile for Ammonia. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.