IoT based analysis of PFSC using spectrophotometer

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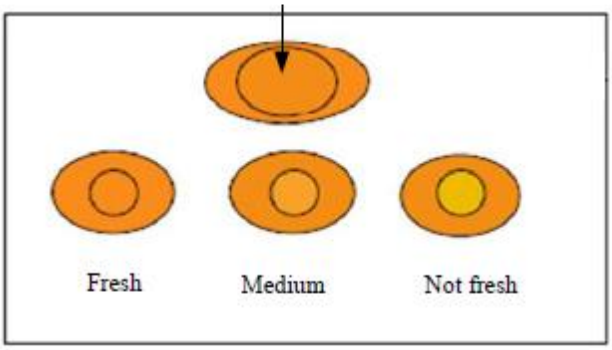
Abstract: Designing a spectrometer requires knowledge of the problem to be solved, the molecules whose properties will contribute to a solution of that problem and skill in many subfields of science and engineering. Internet of things (IoT) is a technology with a vision to connect anything at anytime and anywhere. Utilizing IoT in the Preservative food supply chain (PFSC) is believed to enhance the quality of life by tracing and tracking the food conditions and live-sharing the obtained data with the consumers or the PFSC supervisors. Currently, full application of IOT in the PFSC is still in the developing stage and there is a big gap for improvements. The purpose of this paper is to explore the possibility of applying IoT for agriculture to trace and track food quality and safety. Mobile application for food freshness investigation was successfully developed and the results showed that consumer mobile camera could be used to test the Preservative of food. By applying the IOT technology this information could be shared with all the consumers and also the supervisors. Food is the main energy source for the living beings; as such food quality and safety have been in the highest demand throughout the human history. A seemingly simple problem, design of an ultraviolet, visible, and near-infrared spectrometer, is used to show the reasoning behind the trade-offs in instrument design.

I. Introduction:

Spectrophotometers work by exposing a sample material to a polychromatic light source. The reflected light from the sample is then split to its various components, within the visible spectrum. The result will be what is known as a reflectance or spectral curve. The resulting data can now easily be analyzed to give a quantifiable measure of the sample's color[1]. As an analytical scientist your main concern would have been to report your findings in terms of what is present in your sample using IoT send the data to Cloud. Most instruments convert input in other units to concentration or other required units. Food packaging plays an important role to preserve the quality and safety along the line of the supply chain. Traditional packaging is only meant to protect the food from the environmental changes such as, temperature, humidity, light, gaseous emissions or microbial attacks[2]. On the other hand, active packaging systems are those which have interactive communication between the packed food and the packaging environment to provide protection to extend the shelf life of the food. Smart packaging devices can be divided into two types.

The first type is called data carriers such as barcode labels and radio frequency identification (RFID) tags, while the second type is called package indicators, which are used to monitor environmental changes such as time-temperature indicators and gas indicators. Fadable ink for time-temperature control of food freshness has been widely used in printing labels on food packages for the freshness indication.



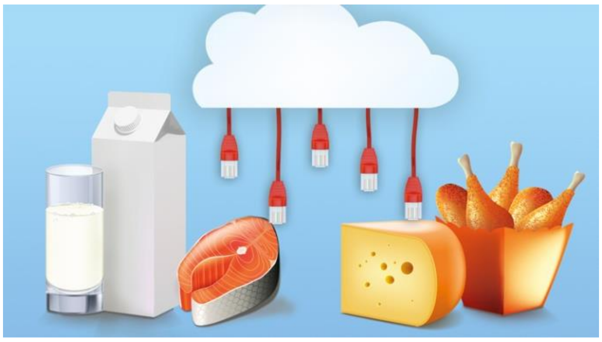


Fig.1: Preservative efficacy test

As shown in fig.1 The Preservative efficacy test is a laboratory test that determines the level of antimicrobial activity of a product and to evaluate how well a product withstands microbial contamination during use. Preservative efficacy test is an important parameter for both pharmaceutical and food products where there is higher risk of microbial contamination[3].

II. Measurement Units Commonly Used in Analytical Work:

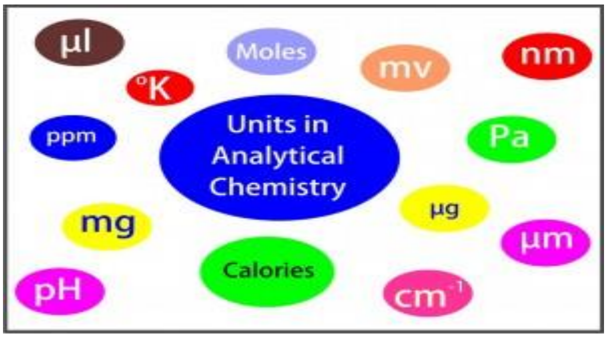


Fig.2: Measurement Units

Food safety is a scientific field which includes a number of routines and inspections at every stage of the food chain that should be adopted to avoid potentially dangerous health risks[4,5]. Novel and efficient solutions across the supply chain are the consequence of constant upgrades of information and communication technologies. With the help of internet of things (IoT) connected testing equipment, food quality can be monitored at any point from farm to table, connecting at the same time food producers, transportation and hospitality/retail companies.

The purpose of this paper is to explore the possibility of applying IOT for agriculture to trace and track food quality and safety. Mobile application for food freshness investigation was successfully developed and the results showed that consumer mobile camera could be used to test the freshness of food. By applying the IOT technology this information could be shared with all the consumers and also the supervisors. This can be especially important in the food industry because foods have specific dyes that they are allowed to have in them, and any deviation can be the cause of a discarded batch of products, could turn consumers off to the product, or could induce fines from governmental agencies, under certain circumstances. The manufacturer is required to strictly adhere to the product label with regards to the ingredients, including food dyes, that make up the recipe for each food product[6]. Thus, food producers tend to be very careful when analyzing food colors, and there are three primary methods for doing so:

Before production, food producers tend to collect resources and ingredients from many places before they produce the actual end product. These ingredients, raw materials, can be analyzed using spectrophotometers to ensure that no nonstandard ingredients reach the production line, and this cuts down on waste and saves time by making sure that only approved ingredients even make it to Production.

III. Food Testing:

Determination of additives and impurities in foodstuffs and food supplements. Substances tested include Preservatives, Vitamins, Sugars, Trace elements, Metals, Mycotoxins. The methodology used implies an extended range of analytical equipment like chromatography (HPLC, GC, GC/MS), atomic absorption spectroscopy (AAS, GFA, FIAS)[7]. Matrixes tested include a variety of foodstuffs like meat products, dairy, pastry, ready to eat foods, sauces, refreshments, beverages and food supplements During production, the food manufacturing process can sometimes involve many steps and it's possible that food colorings could become mixed or diluted at any stage of this process. Because of this, food producers often scan small test batches of products during the production process. This is done to ensure the quality of the end product and can identify any production-line level problems before they cause major issues down the line[8].

The manufacturer can also look into checking as shown in fig.3 the color of the product as it is being produced. Color information can also be obtained, in real time, and can report to process control indicating whether the product color is within prescribed tolerances. If the color of the product does drift out of spec, the in-line system can send a signal to process control to affect a change in the color of the product.

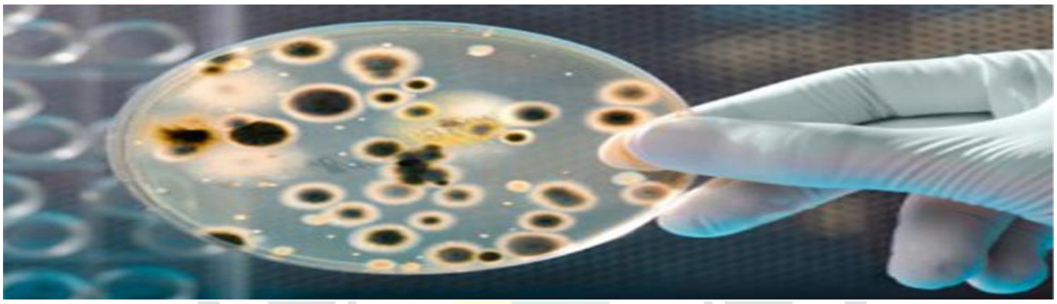


Fig.3. Preservative Efficacy Test

3.1. After production is completed. We can test

Vitamins

Vitamin B1, Vitamin B12, Vitamin B2, B6, Vitamin C, Vitamin D3, Vitamin E, A.

Preservatives

Sorbic, Benzoic, Propionic, Natamycine

Sugars

Fructose, Glucose, Sacharose, Maltose

Mycotoxins

Aflatoxin B1+B2+ G1+G2, Aflatoxin M1, Ochratoxin A.

Metals

Pb, Cd, Hg, As, and all metals

There are many factors that can cause food dyes to change color. If they are exposed to oxygen or light for too long, or if they are accidentally mixed with other dyes, even small deviations in dye color can cause big changes in the color of end products. Because of this, food manufactures generally test a number of product samples before the finished product is shipped to retailers or distributors[9,10].

IV. Food type authenticity

Another application example of developing sensors for IOT sensing layer is using Fourier transform infrared spectroscopy (FTIR) to differentiate non-halal meat from halal meat which is necessary for the Muslims consumption[11]. The data collected by FTIR sensor could be communicated directly through the communication layer to the application layer, where consumers and also supervisors can directly access the type of the meat source[12].

V. Results:

The preservative properties of the product are considered adequate if there is either a fall or no increase in the number of microorganisms inoculated in to the preparation[13]. The organisms specified for use in the tests are intended to be representative of those that might be expected to be found in the environment in which the preparation is manufactured, stored and used. Environmental isolate from manufacturing side also considered for this test as shown in below fig.4.

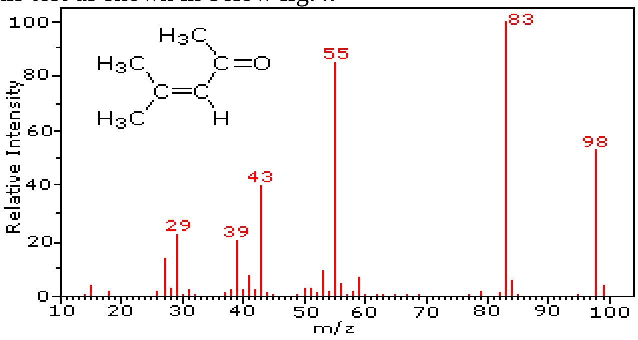


Fig.4. Food test result

VI. Conclusion:

This paper presented an idea of utilizing internet of things (IOT) for agriculture, food quality and safety. A mobile application (app) for the sensing layer of the IOT technology was developed and the

app shows that the freshness of food could be investigated by studying the picture of the food and comparing it to the reference picture. The QACS laboratory is equipped to offer a variety of controlled temperature and humidity climatic storage conditions. **Food Shelf Life Testing** is supported by appropriate analytical, microbiological and sensory testing facilities, operated under an ISO 17025 accredited quality system. The objective of the **Food Shelf Life Testing** study is to evaluate and document the time period where the food product maintains its intended physical, chemical and microbiological quality and properties[14]. The condition of the food whether it is fresh, good or spoiled could be shared with all consumers and food supervisors through the network and application layers of the IOT technology. The QACS team of experienced food technologists is at your disposal to propose **Food Shelf Life Testing** protocols to evaluate product shelf life. Specialized in accelerated ageing technology for **Food Shelf Life Testing** studies. Food deterioration can be accelerated by subjecting the food to controlled environments, followed by then quality evaluation and shelf life estimation. Short and long term protocols apply, depending on the expected Shelf Life.

VII. References:

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