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Role of Electronic Tongue as an E-sensing tool in Biomedical, pharmaceutical and allied sciences: A Systematic review.

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ABSTRACT

Keeping in view the recent technological advancements in the adulteration; contamination and dilution of natural milk with artificial milk various studies and researches are carried out so far. Electronic tongue alias E-tongue is an e-sensing device built on sensing machinery which analyses and monitors and discriminates the statistical figures obtained by the samples of dairy products, diets, brews and medications drugs that greatly accord the quality management. This paper is a holistic study carried in all aspects to appraise the significance of electronic tongue with respect to its applications in various engineering pharmaceutical and biomedical sectors and fields areas and its progress over the years and future directions of the e-sensing in the fields' medical and paramedical sciences with various attributes.

Keywords: Electronic Tongue, Taste Sensor, Adulteration, food, medicine

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INTRODUCTION

Individuals' identify sense of taste by sensory structures called as taste buds, which contain 50-100 cells. As on date there are five tastes which the human tongue can notice -tartness, saltiness, sullenness, sugariness and an amalgamation of all four types called umami. Each sense of taste receiving element gets numerous biochemical ingredients which form a single sense of taste. Taste receiving elements in human body unveil semi-selectivity in its place of stiff and high choosiness. High discrimination is one to one correspondence to a particular constituent.

The problem such as low purposes and reproducible ability which rises the stress on panellist during food discerning can be flabbergasted by electronic distinguishing know-how that has been technologically advanced for segregating and reckoning the sense of taste of diet, called as Electronic Tongue. It works on the conception of explicit biochemical substance at extraordinary sensitivity which means categorizing and assessing particular constituent according to the necessity.



Fig 1: E-tongue image

Sense of taste of Therapeutic formulation has an effect on the observance of patient to the medicine. Patients suffering from long-lasting maladies are pretentious and concerns may ascend. Teen-agers are most subtle to rancorous taste relating to grownups, as sullenness has lethal attributes. Sensitivity drops during improvement and reworking of such substances.

Many vigorous pharmacological constituents have unpleasant tastes and Bitterness, Saltiness that may root exasperation in the oral cavity. Hence taste masking mediators is a joint excipient being used in medicinal preparations. Development of a pleasurable recognizing preparation comprising Quinine hydrochloride, as a proto typical medicine is a foremost job for the production houses and with the aid of an E-tongue it has been made easier and simpler.

As per the WHO procedures, Quinine hydrochloride is widely used as a medicine for severe malaria, mostly in the case of infants up to year 2006. Due to its bitter taste and life threatening side effects it is no longer used as an antimalarial. But it is still used as a major flavour component in tonic water and bitter lemon drinks.

Latelyvarious majors have been conceded out to diminish the unpleasantness of Quinine hydrochloride in liquid formulation. Attempts are being made to select the accurate quantity of particular taste masking agents using advanced analytical techniques. To quantify; appraise and to choose the optimum

taste screening agent for an unpleasant tasting drug, Electronic tongue has the potential to be utilized in pharmaceutical industry.

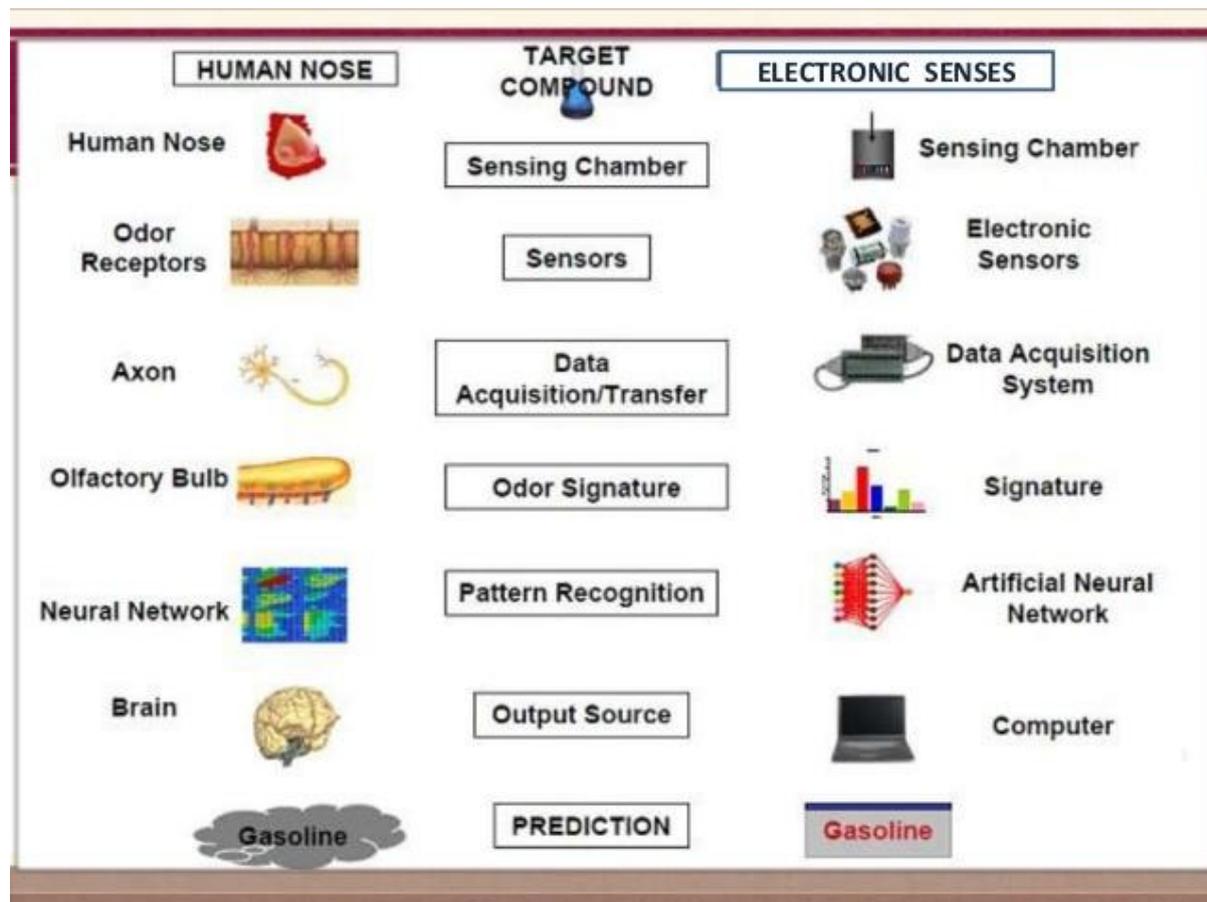


Fig 2: E-Tongue Applications

It helps for balanced evaluation and quantification of numerous sweetener in assortments and in amalgamation with other taste covering ingredients that have not yet been implemented.

Electric Tongue

Electronic Tongue is a e-sensing tool that trials and relates tastes. Like humanoid receiving agents,

E-Tongue has various kind of sensors transducers and sensing monitoring and evaluating devices which are having different spectrum of response from the other.

Way back in the year 1997, Winqvist and Lündstorm established a Volta metric Electronic tongue shadowed by a hybrid Electronic tongue which had the amalgamation of tools used for measurement of potentiometric voltammetry and conductivity. Almost 06dissimilar electrodes were deployed for measuring electrodes in Volta metric measurements, which contributed diverse potential responses and Principle Component Analysis (PCA) which is used to scrutinize the data acquired and distinguish diet and foodstuffs.

Later on in continuation to it Legin & co-workers, in the year 1997 and 2005, further established an Electronic Tongue, by smearing solid-state crystalline ion-selective electrodes built on Chalcogenide Glass. These researchers offered specimens by expending their structure to the investigation and quality supervision of Brews such as wine and Mineral water. The investigation was done by using Artificial Neural Network Techniques based techniques for better results.

Aissy Inc. developed and delivered the truthful investigation of the foodstuff with its measuring devices and is expedient for developing new products in the manufacturing units. The Electronic Tongue have the specifications of low choosiness and high cross discrimination. With the advent of new Sensing technologies followed by subsequent signal condition and manipulation of the same based on above topographies are being premeditated in relative with Electric noses, to generate new technologies for betterment of society and human beings [15].

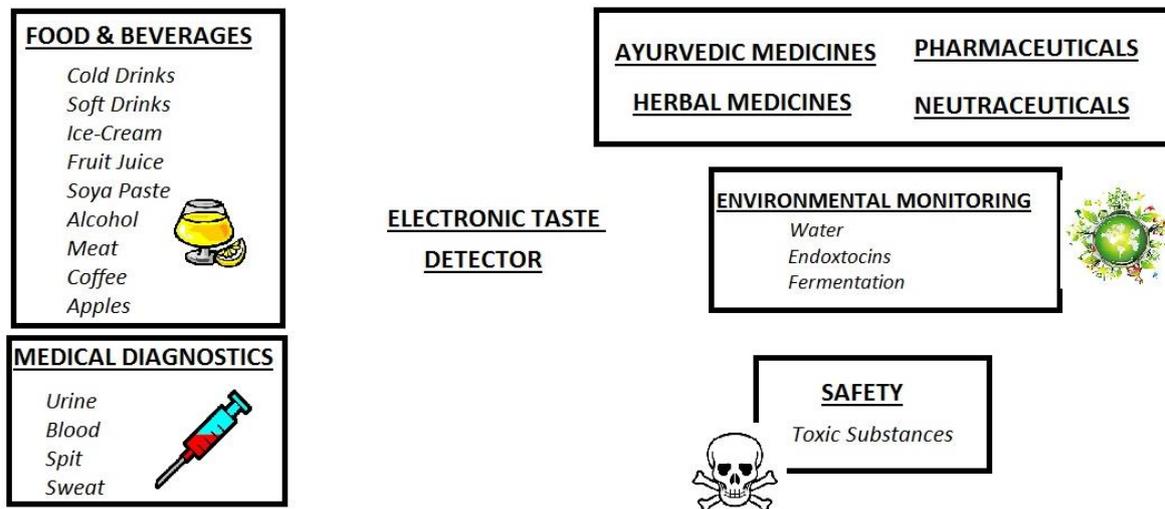


Fig 3: Fields of application for electronic taste sensing system

Applications

E-tongue has several applications in various industrial areas. We have covered some of the applications in this paper. Electronic Tongue discriminates and analyses foods and beverages, and contribute towards Quality Management. It works as a taste sensing system to measure the precise taste and substance quality. In pharmaceutical area it can be used for taste masking and for quantifying the bitterness of a medicine. Milk adulteration is also one of the major problems experienced in the food industry nowadays which can be determined by e-tongue.

Food and Beverage

These e-sensing devices and techniques called E-tongue is actuality used in the quality control sections of foodstuffs and beverages manufacturing units and also for customers and promotion in the agro products business. These sensing techniques are widely used in finding the cessation date of produce by means of taste sensing schemes and platforms. Taste of various nutrients and brews like soft drinks beverages black tea, grains rice, green tea, milk, dairy products, beer, wine and ginseng, have been enumerated by means of this taste sensing technology.

These new sophisticated tools has also been scrutinised in the assortment of nutriment appropriate for the progression of chickens or poultry products which targets in sinking the upbringing cost. The electronically technology based taste sensing mechanism or Electronic Tongue can be used not only for value administration, but also to add the quality control taste info and various aspects attributes to the yields. It empowers us to precisely craft a preferred taste in a petite period of time.

Pharmaceuticals

Majority of pharmaceutical drugs have strong bitterness. This can lead to low medication compliance especially by paediatric patients. Hence masking the bitter taste of formulation will help in increasing the patient compliance. E tongue has been successfully applied for quantifying the bitterness value and for selecting the right masking agent.

Orally disintegrating Tablets (OTD's) usage has been rapidly promoted over the last three decades as an alternative to conventional oral dosage methods such as tablets or capsules. *Harada et al.* designed the unpleasantness of carrageenan-containing pectin, whose sullenness concentration at wide spread fragmentation was restrained by means of sense of taste sensory mechanisms and was equated with the outcomes of sensory assessment by outside experts and examiners in the field giving a extraordinary relationship coefficient of $R=0.907$. A collection also testified the clampdown of unpleasantness for dissimilar medicines by the usage of β -cyclodextrin.

A study was steered to progress a bitterness-free cetirizine hydrochloride ODT. It was pains taking challenging since of its extraordinary unpleasantness level and the perception of the raw ingredients. The unpleasantness value of cetirizine was gauged by means of sense of taste sensory measurement and evaluation mechanism which showed that the perception of cetirizine hydrochloride is correlated to tartness. The sour sense of taste can be supplementary diminished by means of Sodium Citrate. The unpleasantness can also be kerbed meritoriously by using β -cyclodextrin [14]. Likewise, as in the above case, the taste sensory scheme is projected to be supplementary exploited in the therapeutic businesses.

Determination of Adulteration

Various latest researches and investigations have revealed that contaminated stuffs have carcinogenic belongings on individuals after ingestion over a long period of time. The electrical properties and specifications of nutrients and food products rest on their biochemical arrangement, which can be found out by trial state of affairs.

Contamination of regular milk with artificial milk is a sombre alarm. Artificial Milk is an exceptional imitation of regular milk. It is prepared by blending vegetal oils with apposite quantity of soap in urea.

The explicit significance of artificial milk is identical as regular cow milk. Due to such brilliant impersonating, it becomes very challenging to estimate the contamination in milk. The existing scheme used to check tarnishing in milk includes approximation of residues by coercing milk through filter patch, determination of bacterial amount, determination of freezing point etc. Nevertheless altogether these approaches are affluent tedious time consuming and cumbersome. And again, the tasters need to be sent to research laboratory for testing which may not be practicable. Henceforth, speedy, vigorous and commercial techniques are essential to evaluate the same.

Electronic tongue has been a rapid and dependable procedure to find the contamination in milk and allied sustenance contents. This is a super numerary procedure over conservative processes to plentiful indication outlines were predictable by the e-tongue manoeuvre composed with linear discriminant analysis allowed the enactment of a prototypical that possibly will discriminate between fresh skim milk groups (goat, cow and goat/cow) with an inclusive susceptibility and specificity of close too cent percent [18].

A voltameric electronic tongue was invented for scrutinization of contamination of milk. It comprises of 03 probes poised of gold, silver and copper. The monitoring and evaluation is done by taking multiple voltametric appraisals and by associating and plotting them. Electrochemical quartz crystal microbalance investigation was cast-off to examine the probe reaction to comprehend the device by which the tongue could discriminate amongst the trials [19].

Rational Development of Taste masked oral liquids by E-Tongue

Along with taste; drug development, design and therapeutic preparation has an effect on the observance of a patient to the medicine. Patients suffering from prolonged sicknesses are pretentious and concerns may ascend. Kids are utmost subtle to acrimonious taste compared to grownups as unpleasantness bear a resemblance to lethal features. Toddlers prefer sweet constituents seemingly grown to fascinate them in the direction of get-up-and-go sources [1].

A lot of medicinal constituents have spiteful taste which may origin exasperating mouth feeling that's why taste concealing or taste testing have turn out to be significant for enlargement of therapeutic mechanisms.

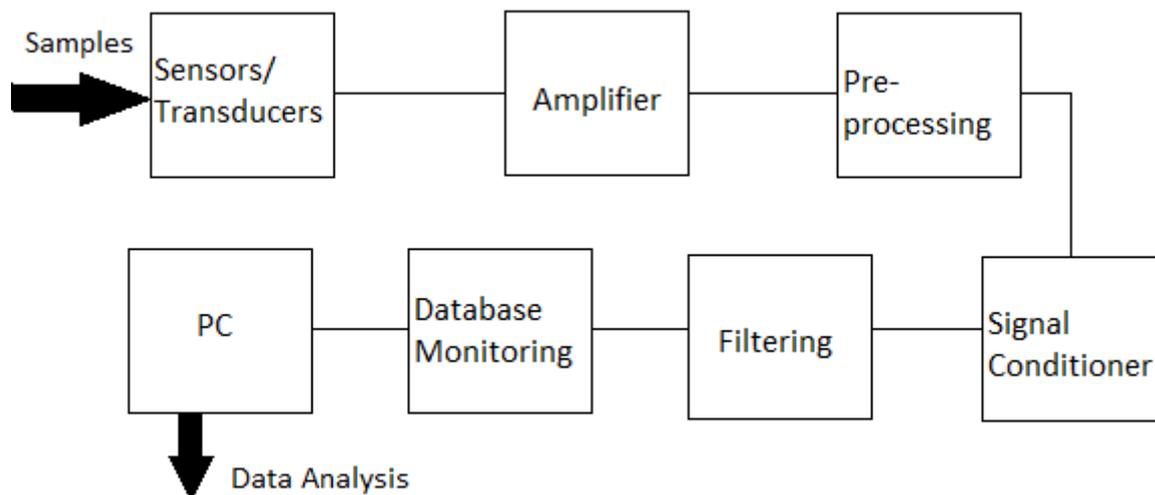


Fig 4: Basic Principle of an electronic taste sensing system [1]

A foremost set of taste concealing approaches emphasizes on the inhibition of the constituent receptor interface, like for sample covering of a rock-hard dosage formulae or complexation of the medicine constituent by solid or soluble complexing proxies. Few researches and findings are also focuses on the growth of detailed obstruction of taste receptors or to cover the perception by ambiguous the sensory system.

A pleasurable discerning preparation for Quinine Hydrochloride is being established, as a archetypal medicine. According to WHO Quinine Hydrochloride is used to treat malaria mainly in the case of children. The unpleasantness assessment of Quinine hydrochloride is very extraordinary. Exertions have been made out to diminish its sullenness in fluid preparation. To appraise the finest taste camouflaging practice for bitter discerning medicines by the use of Electronic Tongue, a balanced screening of variety of sweetening proxies in fusions and in mixture with other taste masking constituent has not yet been performed.

CONCLUSION

This paper addresses various e-sensing techniques along with main focus on E-Tongue to taste numerous tenders of microelectronic tongue in diverse business sectors and food Industry as well as Agro Products. It is an electronically sensing mechanism that processes and associates tastes. This mechanism has been demonstrated as a prodigious benefit in Quality administration where human tongue cannot be used and with advent of latest analytical tools like AI ML and Deep Learning along with IoT devices there is huge scope for this scheme in the pharmaceutical and paramedical sciences. Some of the significant claims of electronic tongue are also discussed and reviewed in this study which are extremely useful and applicable in the field of foodstuff and brews, drugs and manufacturing of dairy products agro products as well. The Smart and Intelligent sensors used in E-Tongue can be used further to control regulate and evaluate bitterness of any specific medicine, determination of contamination of regular milk with artificial milk can be more precisely done by a setup used as an electronic tongue which fundamentally catches the variance between the conductance of different ingredients and many more, which are of abundant practise in our day to day life.

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