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A BRIEF OVERVIEW ON E-TONGUE

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ABSTRACT

The electronic tongue is an instrument that compares tastes. It was invented by Professor Fredrik Winquist of Linkoping University, Sweden. In the biological mechanism, taste signals are Trans ducted by nerves in the brain into electric signals. E-tongue sensors process is similar, they generate electric signals as potentiometric variations. Potentiometric sensors are attractive tools for the fabrication of various electronic tongues that can be used in wide area of applications, ranging from food stuff recognition to environmental monitoring and medical diagnostic. Applications of voltammetric electronic tongue are described, such as in the food industry, environmental analysis, paper and pulp industry, house hold appliances and agriculture. Taste quality perception and recognition is based on building or recognition of activated sensory nerve patterns by the brain and on the taste fingerprint of the product. This step is achieved by the e-tongue's statistical software which interprets the sensor data into tastes patterns.

Keywords: Electronic tongue, potentiometric, sensors nerves.

I. INTRODUCTİON

The sense of tastes consist of five basic tastes, i.e., sourness, saltiness, umami, bitterness and sweetness. When testing food or beverage, humans perceive each type of taste on sensory organs called taste buds on the tongue. Taste buds are composed of approximately 50-100 cells. Reaches on the mechanism behind the reception of taste substance [1],[2] The increasing interest of e-tongue application in the food area can be partially attributed to the lower calibration costs, satisfactory accuracy for compared with other analytical methodologies [3].

The sensation of taste has two meanings. One denotes the five basic tastes of the tongue: sour, salt, bitter, sweet and umami originating from different regions on the tongue containing specific receptors on the taste buds. The other meaning is the sensation obtained when the food and drink enters the mouth. The basic taste will then be merged with information from the olfactory receptor cells generated from aroma passing through the inner passage to the nasal cavity. This later taste sensation is referred to what is commonly known as the descriptive taste by sensory panels [4].

To mimics the nonspecific recognition, traditional electronic tongue that are composed to solid-state sensors array were developed. The sense of taste are linked to a variety of different transduction schemes. Herein, we review the research effort that has been carried out over the past years or so to create an electronic tongue and then discuss some of the technologies that has been explored in what is essentially an intelligent chemical array sensor system [5].

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II. BIOLOGICAL TONGUE

The tongue is a muscular organ on the floor of the mouth. It is involved in tasting through the taste buds, which are sensory end organs covering the surface of the tongue. Apart from this, the tongue also assists in mastication, formation of the bolus, swallowing and capturing food. In humans, the tongue is also used in phonetic articulation.

III. ELECTRONIC TONGUE (E-TONGUE)

Taste has an important role in the development of oral pharmaceuticals with respect to patient acceptability and compliance and is one of the prime factors determining the market penetration and commercial success of oral formulation, especially in pediatric medicine. Hence, pharmaceuticals industry invest time, money and resources into developing palatable and pleasant-tasting products and industries adopts various tastes masking technique to develop an appropriate formations. The multichannel tastes sensor also known as the electronic tongue is claimed to determine taste in a similar manner to biological tastes to perception in humans. Furthermore, such taste sensors have a global selectivity that has the potential to classify an enormous range of chemical into several groups on the basis of properties such as taste intensities and qualities [6].

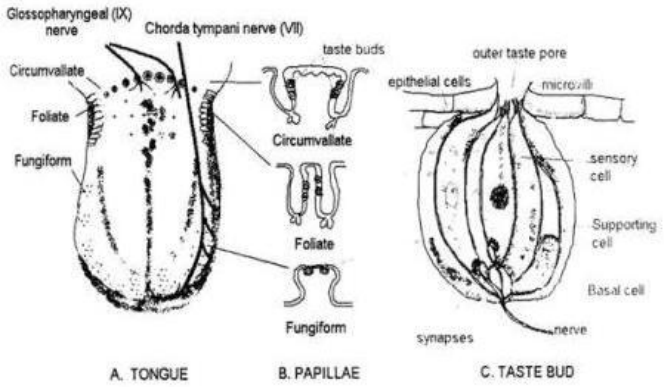

Figure 1: Structure of tongue[6]

Potentiometric electronic tongue and methods

All the polymeric membrane components were of analytical grade (fluka) and used as purchased. The multisensor system together with a double junction Ag/AgCL reference electrode was connected to a multiplexer Agilent data acquisition unit model 34970A. Agilent Bench Link performed in a double wall glass cell thermostat zed at 25oC. Figure-2 shows the two sensor arrays and the Ag/AgCL reference electrode. It is also shows the device immersed in a sample contained in a double wall glass cell [3]

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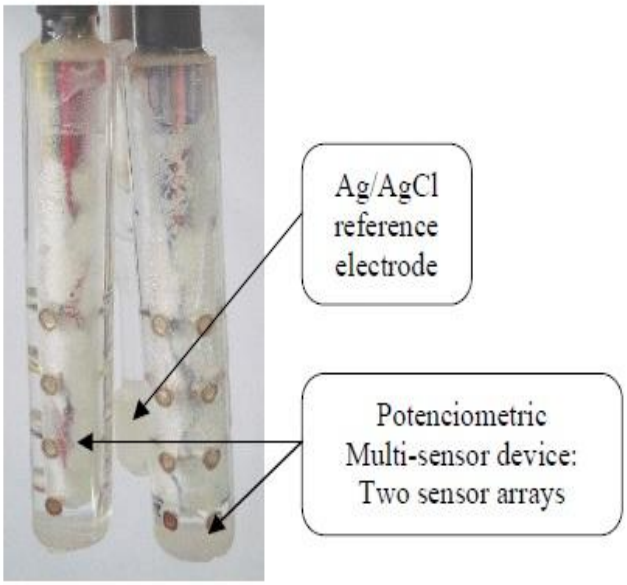

Fig. 2. E-tongue device.[3]

IV. SENSORS

Teste Sensor

The fundamental concept of the taste sensor and electronics tongue are very different except for the electrical detection of sample information. Electronic tongues aim to discriminate and analyze foods and beverage using sensors array such as ion-selective electrodes with different specificity property and statistical analysis such as PCA and neural network techniques.

Fig. 3. TS-5000Z taste sensing system (Intelligent Sensor Technology, Inc.).[7]

Figure-3 shows the commercially available TS-5000Z taste sensing system. This system has following four concept: (1) The taste sensing system must respond consistently to the same taste like human tongue(global selectivity). (2) The taste sensor threshold must be the same as the human taste threshold. (3) There must be a clearly defined unit of information from the taste sensing system. (4) The taste sensing system must detect interaction between taste substances.

Sweetness Sensor

The development of sweetness sensor, i.e., sensor electrode for sweetness was behind that of other taste sensor electrode. This is mainly because sweet substance are nonelectrolytes. i.e. , substance without charges, and the potential of liquid/polymer membranes is hardly changed by sweet substance. Although Brix meters may be used as an alternative method of measuring sweetness, they perform indirect measurements in which the reflection index of solutions is measured. Therefore measurements results greatly depends on the composition of solution. [7]

Portable Taste Senseor

The commercialized taste sensing system is large and can be used only by the particular users at limited places. We are developing a portable sensor with the aim of downsizing the conventional taste sensing system[8],[9].

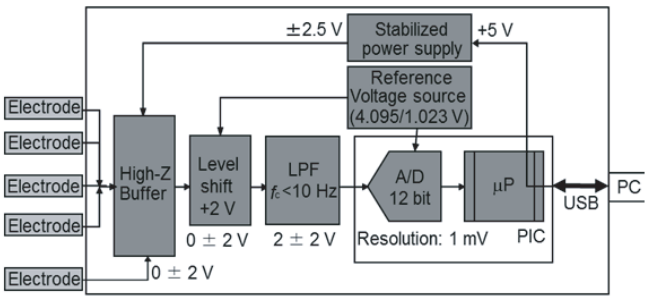

Fig. 4. Block diagram of portable taste sensor device [9].

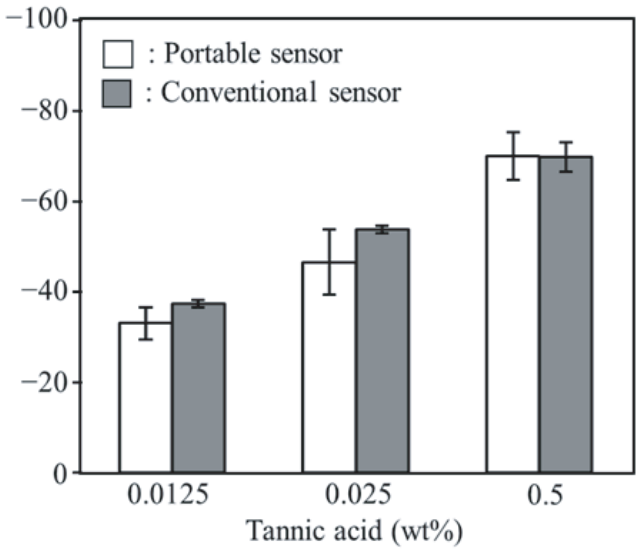

Fig. 5. CPA value of the portable taste sensor to tannic acid [9].

V. PRINCIPLES OF OPREATIONS

A vast number of electronic tongue and taste sensors have been described in the literature based on different measurements techniques, the main part being electrochemistry such as potentiometry or voltammetry. Electrochemistry techniques are very well established in analytical chemistry and have found a vast range of applications, there are also a number of textbooks covering the subjects. In potentiometery, a potential across a

working electrode is measured when an equilibrium state is reached, corresponding to a state where the net current is zero.

In voltammetry, a potential is applied to a working electrode, and the resulting current obtained when redox active species are reduced or oxidized on the electrode surface is measured. There are thus a number of possibilities available for obtaining information using voltammetry[4].

VI. APPLICATIONS OF E-TOUNGUE

Electronic tongues have several applications in various industrial area: the pharmaceutical industry, food and beverage sector, etc. it can be used to:

- Analyze flavor ageing in beverages (for instance fruit juice, alcoholic or non-alcoholic drinks, flavored milks…)
- Quantify bitterness or "spicy level" of drinks or dissolved compounds (e.g. bitterness measurement prediction of teas)
- Quantify taste masking efficiency of formulations (tablets, syrup, powders, capsules….)
- Analyze medicine stability in terms of taste.
- Benchmark target products.
- Monitor environmental parameters.
- Monitor biological and biochemical process. [10]

The main application area of electronic tongue is the analysis of food stuff and beverages in particular. The analysis of food stuff included different tasks: discrimination between different sorts, brands and products of different quality, their classification and quantitative determination of the content of various compounds. The most application area of electronic tongues is taste quantification [11]. Many expensive applications of electronic tongue have been explored including food evaluation, drink discrimination and even hazards detection, etc.[5]

VII. CONCLUSION

The development of artificial sense technologies is occurring rapidly with demonstrated ability to differentiate among food and edible products for aroma, bitterness and other basic tastes. The systems are becoming faster more reproducible and smaller. What is needed is speed, reproducibility, consistency and robustness for commercial applications [12]

The electronic tongue has a new concept of global selectivity. What is important in recognition of taste is not discrimination of minute difference in molecular, structure, but to transfer molecular information contained in interaction with biological membrane into several kinds of group.[6]

VIII. FUTURE SCOPE

An electronic tongue can now sample food testing for bacteria and other combination during production or transport as well as direct new procedure in medicine. This is not the first e-tongue but it designed to be more versatile than earlier versions. An electronic tongue that could distinguish between different brands.

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