Summer Training at

S. Zhaveri Pharmakem Pvt. Ltd.

Evaluation of the potential of the Taste Sensing System with reference to the Food, Beverage & Pharma Industry including Animal Health & Food

By
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Under the guidance of
Dr. Suresh Joshi

Post Graduate Diploma in Pharmaceutical Management
2011-2013

Institute of Health Management Research,
Jaipur
2012

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Certificate

This is to certify that Bipin Kumar Singh has undergone summer training in S.Zhaveri Pharmakem Pvt. Ltd., Mumbai from 30th April to 10th June, 2012

The candidate carried out all the studies related to summer training himself. His approach to the studies has been sincere, scientific, and analytical. This summer training in partial fulfillment of the course requirement is recommended for the award of Post Graduate Diploma in Pharmaceutical Management.

I wish his success in all future endeavors.

Dr .P. R.Sodani

(Dean Academics and student affairs)

Dr.Suresh Joshi

(Professor)

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25th June 2012

This is to certify that ***Mr. Bipin Kumar Singh****, summer trainee from IHMR College has completed the project* ***"Evaluation of the Potential of the taste sensing system with reference to the Food, Beverage & Pharma Industry including animal health & food".***

Being a vast project and a one of its kind system, Mr. Kumar has been very sincere and has provided good insight on the same.

Acknowledgement

The process of learning and questioning had never been as fruitful for as it was for the forty days that I had spent at S. Zhaveri Pharmakem Pvt. Ltd. This opportunity gave an unmatchable insight of the food and beverages, animal food and health, pharma market and the importance of Taste Sensing Machine.

I thank Mrs. Uma Javeri (Managing Director) who showed the right direction while starting this project and was the main motivating factor till the completion of the report. Her guidance and mentoring is surely out of the scope of words.

This acknowledgement would have been incomplete if I did not mention the names of Mrs. Suhagi Parikh (Executive Director) and Mr. Sourabh Dhopade (Executive Marketing), who had been constantly correcting and giving valuable ideas and inputs.

The experience was made more enjoyable by the employees of S. Zhaveri Pharmakem Pvt. Ltd. who supported throughout and the treatment given by them was indeed appreciable.

I gratefully acknowledge my sincere gratitude to my guide Dr. Suresh Joshi, IHMR for his kind guidance and helpful suggestions.

I tried my level best in making this project useful and hope that I came up to the expectations of everyone mentioned.

Table of Content

Acronyms

SZPPL	S.Zhaveri Pharmakem Pvt. Ltd.
TSM	Taste Sensing Machine
RFCL	Ranbaxy Fine Chemical Limited
OTC	Over The Counter Drug
CAGR	Compound Annual Growth Rate
HRI	Hotel Restaurant Institution

Executive Summary

Taste sensor is an intelligent electronic cum biophysical device that could be explored to artificially reproduce the sense of taste, which is otherwise a complex, comprehensive sense of man. Several kinds of foodstuffs, mineral waters and pharmaceutical formulations could be discriminated /differentiated easily using the taste sensor. Different electric potentials generated by chemical substances after interaction with the lipid/polymer membrane of the taste sensor is the basis of taste discrimination by the sensor

The Food and Beverage market is growing rapidly in the Asia Pacific countries like India, Hongkong, Malaysia, Indonesia, Taiwan etc. So it should be a great opportunity for the Taste Sensing Machine to explore this growing market and expand their business because taste play an important role in the buying behaviour decision of consumer.

Taste masking play a very important role in the drugs and OTC medicines to increase the palatability of the drug. So TSM can play a very important role in the quantification of taste.

TSM also provide advantage over the Human Sensory Panel because the chances of error happening are minimised.

This project is an attempt to identify the market potential of TSM in the growing market of Food and Beverages, Pharma and Health industry

Company Profile

S.ZHAVERI PHARMAKEM PVT. LTD.

S. ZHAVERI PHARMAKEM PVT LTD had been established in the city of Mumbai. Mrs. Uma Javeri is the CEO of well-known organization, who possesses profound experience in this field. Below listed is the business in which the company is engaged.

- **Indenting Business in Import:** Organization represent international companies in India on exclusive basis.
- **Contract Research Organization (R & D in Pharma formulation):** Organization develops pharmaceutical dossier for international and domestic market.

Contract Research Centre (CRO - Pharmaceutical Formulation Development) S. Zhaveri Pharmakem Pvt. Ltd. SZPPL is an integrated pharmaceutical RESEARCH and DEVELOPMENT company delivering wide range of products for the generic industry. It aims to be a leading provider of fully integrated and cost effective pharmaceutical out-sourcing services to the international healthcare industry. The R&D is not only equipped with sophisticated instruments but also manned by highly skilled and experienced professionals. The company has a close co-ordination with International companies for providing prompt and quality services. SZPPL provide flexible pharmaceutical solutions enabling customers to accelerate their route to market quickly, safely and cost efficiently.

Infrastructure

- State of the art facility designed to meet the requirement of USFDA and EU specifications
- 26000 Sq. ft. of area for Research & Development for finished formulations
- Low Humidity Areas to handle specific products
- Wide range of GMP machines to handle different technologies
- Qualified team of doctorates, Masters in Pharmaceuticals and Bachelors Pharmaceuticals

SZPPL offer the following broad spectrum of services

- Formulation Development
- Analytical Development
- Stability Studies
- Dossier Compilation
- Therapy Areas

1. Introduction

Taste evaluation is gathering attention worldwide in many fields, such as foods, beverages, and pharmaceuticals. Sensory evaluation and chemical analysis are commonly used to evaluate taste qualities of the products. However, sensory evaluation using a panel of tasters is susceptible to human physical and psychological conditions as well as individual preference, making panel scores highly subjective. In contrast, chemical analysis by high-performance liquid chromatography (HPLC) offers quantitative data that cannot be explained in terms of overall taste because the data cover each taste substance in the food. Finally, chemical analysis cannot detect taste-substance interactions, such as synergistic and suppression effects. Clearly taste evaluation needs a new quantitative and objective method. The so-called "electronic tongue" is one solution researched since the mid-1990s.

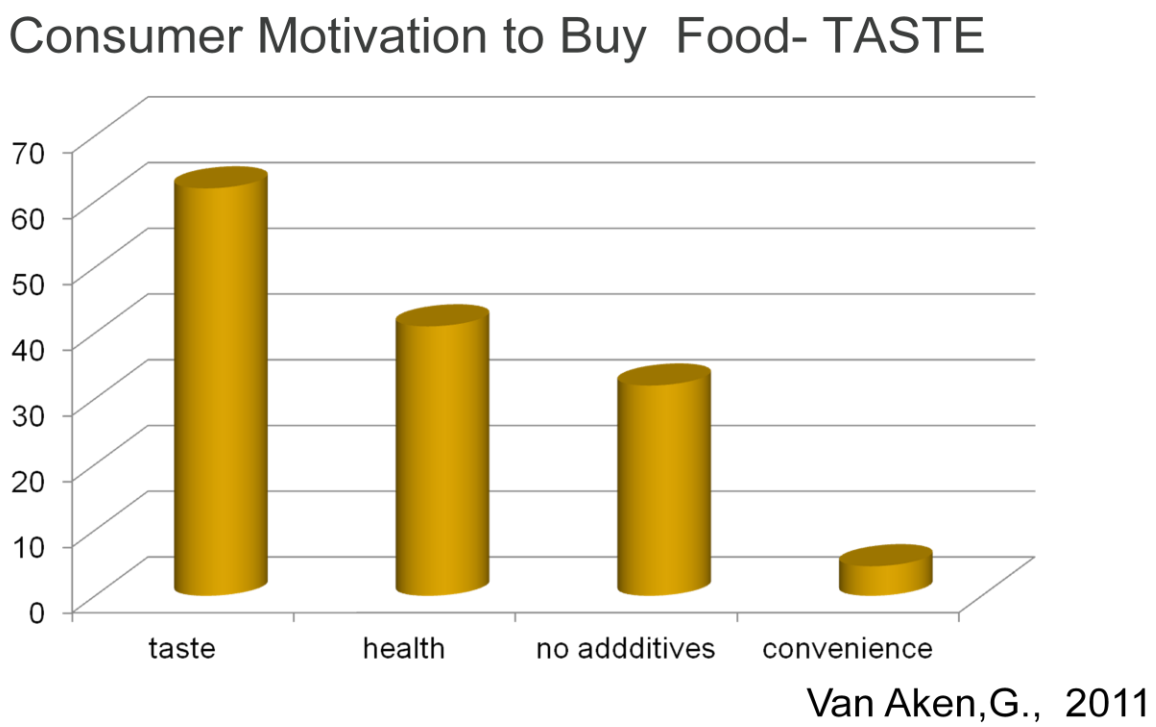
Taste is an important organoleptic property governing acceptance of products for administration through mouth. But majority of drugs available are bitter in taste. For patient acceptability and compliance, bitter taste drugs are masked by adding several flavouring agents. Thus, taste assessment is one important quality control parameter for evaluating taste-masked formulations. The primary method for the taste measurement of drug substances and formulations is by human panellists. The use of sensory panellists is very difficult and problematic in industry and this is due to the potential toxicity of drugs and subjectivity of taste panellists, problems in recruiting taste panellists, motivation and panel maintenance are significantly difficult when working with unpleasant products. Thus, e-tongue includes benefits like reducing reliance on human panel. The present review focus on performance qualification of E-tongue.

The Indian food and drinks market has witnessed strong growth over the past few years. Liberalisation of the economy and growing income of middle class population have had a positive impact on consumer spending and consumption in both rural and urban areas. Indian consumers now spend a significant proportion of their income on food and other essential commodities. Numerous other factors like demographic and macro-economic conditions have also given boost to expenditure on food and beverages in the country. The total food production in India is expected to double in the next ten years and there is ample opportunity for huge investments in food and food processing technologies, skills and equipments.

The food processing industry in India stands at US$ 135 billion and is projected to grow with (CAGR) of 10 per cent to reach US$ 200 billion by 2015.

The food industry is divided into various segments namely, milk and allied products (dairy), meat and poultry, seafood, bakery and confectionery, fruit and vegetables, grain, pulses and oilseeds (staple) products, alcoholic and non-alcoholic products (beverages), and packaged food. The food processing industry in India is witnessing quick growth. In addition to the demand side, there are changes happening on the supply side as well with the growth in organised retail, increasing foreign direct investment (FDI) in food processing and introduction of new products.This TSM provides the opportunity for food and beverages industry to analyze their product and may provide test according to the needs of consumer because taste play an important role in the buying behaviour of customer

Chart 1



(Source UCD Institute Of Food And Health)

1.1 Objective:-

- To evaluate the potential of the taste sensing System with reference to the Food, Beverage & Pharma Industry including Animal Health & Food.
- Indian Food & Beverage Industry (including animal health & foods)
- Asian Food & Beverage Industry (including animal health & foods)

Research Methodology:- The scope of the study will be as follows

- Overview of the TSM
- To analyze the Food and Beverages and Pharma industries outside India.
- To find key market share holders of different segments bear, wine, biscuits, pharma, animal health, animal food industry.
- To find advantages of the TSM based on sensory evaluation (human).
- Competitor analysis with Alpha moss.
- Current trends of taste evaluation.
- Evaluation of sweeteners used in the food, beverage & pharma industry.
- To find the market potential of TSM.

Sample: - Convenient Sampling

Data Collection: - Both primary and secondary data were collected.

Tools: - Closed ended questionnaire is prepared for collecting primary data.

2. Overview Of TSM

The technologically advanced taste sensors equipped with Taste Sensing System TS-5000Z exhibit specialized ability - global selectivity -, and offer satisfactory results with high correlation to sensory scores. This system offers comprehensive and objective taste evaluation of foods, beverages and pharmaceuticals with accuracy and reliability, and is applicable to a wide range of fields, including R&D, marketing, quality control and quality assurance.

There are many taste substances but the sense of taste has five qualities:

1) Sweet: - Sugar, Saccharin, Alcohols, Some Amino Acids

2) Sour: - Acids (HCl, Acetic acid, Citric acid)

3) Salt: - Metal ions, NaCl

4) Umami: -Mono sodium glutamate (Sea Weeds) Disodium inosinate (Meat, Fish) Disodium guanylate (Mushrooms)

5) Bitter: - Alkaloids (quinine, nicotine, caffeine, morphine) Aspirin, $MgCl_2$

2.1Taste Receptor:-

Current research shows that the taste-receptor proteins play a key role in sensing taste but it may be difficult to create artificial protein-based taste sensors because proteins have low chemical and thermodynamic stability. However, research in the mid-1970s showed that the membrane potential of filter paper impregnated with all the lipids extracted from bovine tongue epithelium changed like that of a living taste receptor cell in response to salts and acids.

Figure 1. Taste receptors for five basic taste qualities and signal transduction pathways. G, GTP-binding protein; PLC, phospholipase C-type β 2; IP3, inositol 1,4,5-trisphosphate; IP3R3, 1,4,5-trisphosphate receptor type 3; TRPM5, transient receptor potential cation channel, subfamily M, member 5.

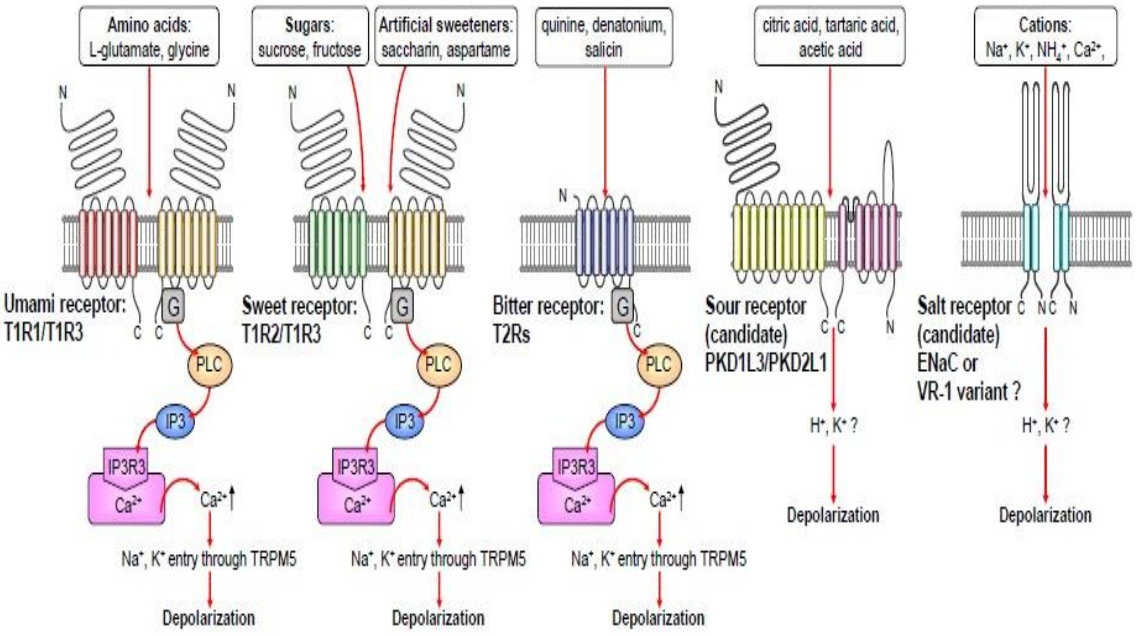
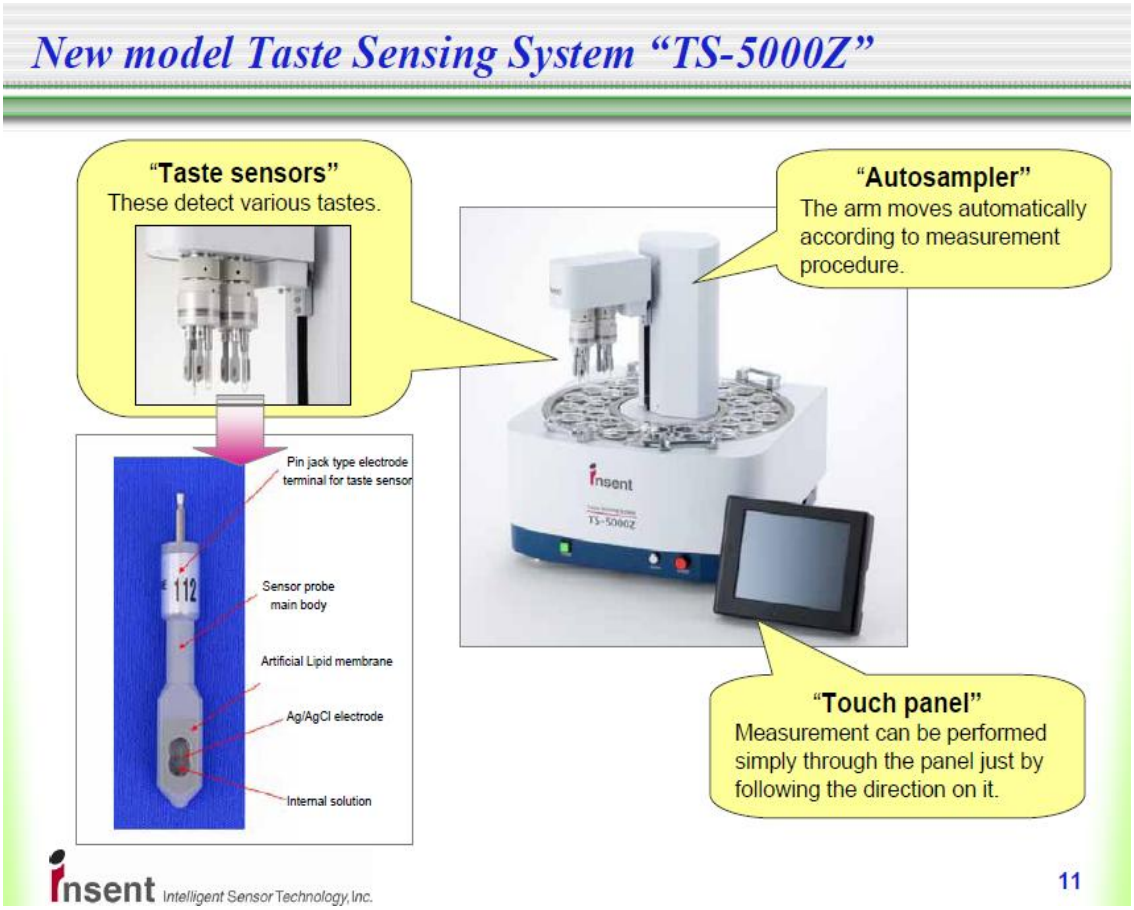


Figure 2 Insent Taste Sensing Machine

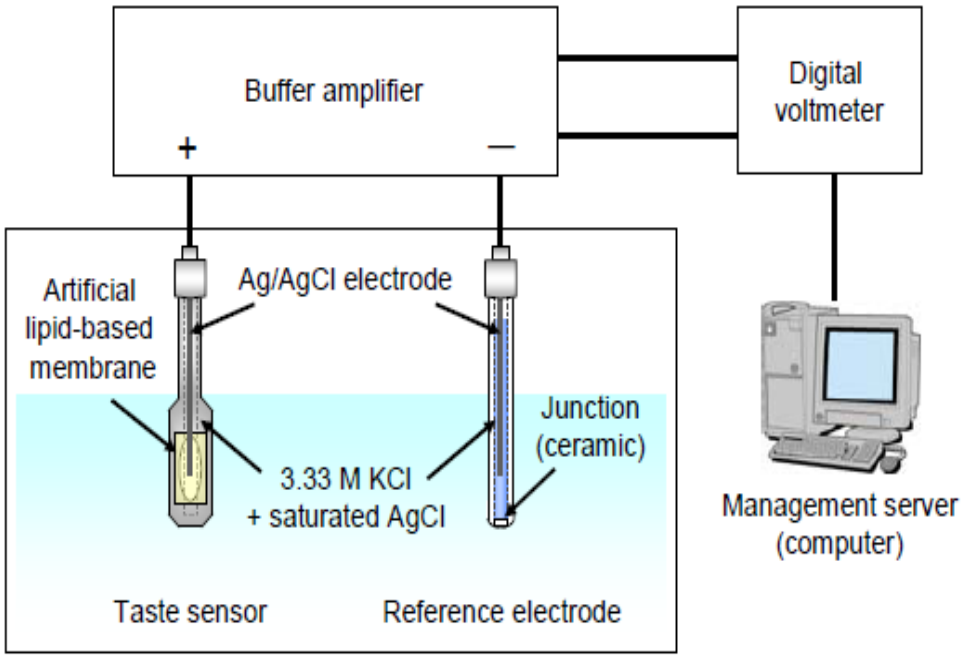


2.2 Reagents

The artificial-lipid sensors were made using tetradodecyl ammonium bromide (TDAB), trioctyl methylammonium chloride (TOMA), oleic acid, 1-hexadecanol,gallicacid, phosphoric acid di-*n*-decyl ester (PADE), and phosphoric acid di (2-ethylhexyl) ester (PAEE). Dioctyl phenyl-phosphonate (DOPP), 2-nitrophenyl octyl ether (NPOE), bis (1-butylpentyl) adipate (BBPA),bis(2-ethylhexyl) sebacate (BEHS), phosphoric acid tris (2-ethylhexyl) ester (PTEH), tributyl*O*-acetylcitrate (TBAC), 3-(trimethoxysilyl) propyl methacrylate (TMSPM),diethylene glycol dibutylether (DGDE), and trioctyl tri mellitate (TOTM) were used as the plasticizer. The polymer support was polyvinyl chloride (PVC). Tetrahydrofuran (THF) was used as the preparation solvent.

2.3 Measurement system

Figure 3 shows a diagram of the taste sensing system with the taste sensor acting as the working electrode. The Ag/AgCl electrode with a single ceramic junction is the reference electrode. A solution containing 3.33 M KCl and saturated AgCl was used as the inner solution for the sensors and reference electrode. These electrodes were conditioned for 2 days in a solution of 30 mM KCl and 0.3 mM tartaric acid before measurement.



2.4 Measurement procedure

First, the sensor is immersed in the reference solution of 30 mM KCl and 0.3 mM tartaric acid to obtain the membrane potential, V_r. The reference solution in this system has almost no taste and mimics human saliva. **Second**, the sensor is immersed in the sample solution to obtain the potential, V_s. **Third**; the sensor is rinsed lightly with the reference solution. After rinsing, it is immersed in the reference solution again to obtain the potential, V_r'. As shown in Figure 6, the difference in potential ($V_s - V_r$), called the relative value, should approximate the initial taste at sensory evaluation, including sourness, saltiness, and umami. The difference in potential ($V_r' - V_r$) called CPA (Change of membrane Potential caused by Adsorption) provides data on the adsorption of bitter and astringent substances by the artificial lipid-based membrane. This value is significant for evaluating bitterness and astringency, because the corresponding taste substances are thought to be adsorbed strongly on the human tongue. Finally, the sensor is rinsed well in alcohol solution to remove adsorbed substances before measuring the next sample.

Figure.4 Measurement procedure. *Note: The reference solution should be tasteless compared to the measured sample. Therefore, the reference solution should have a lower concentration for samples with extremely low concentrations.

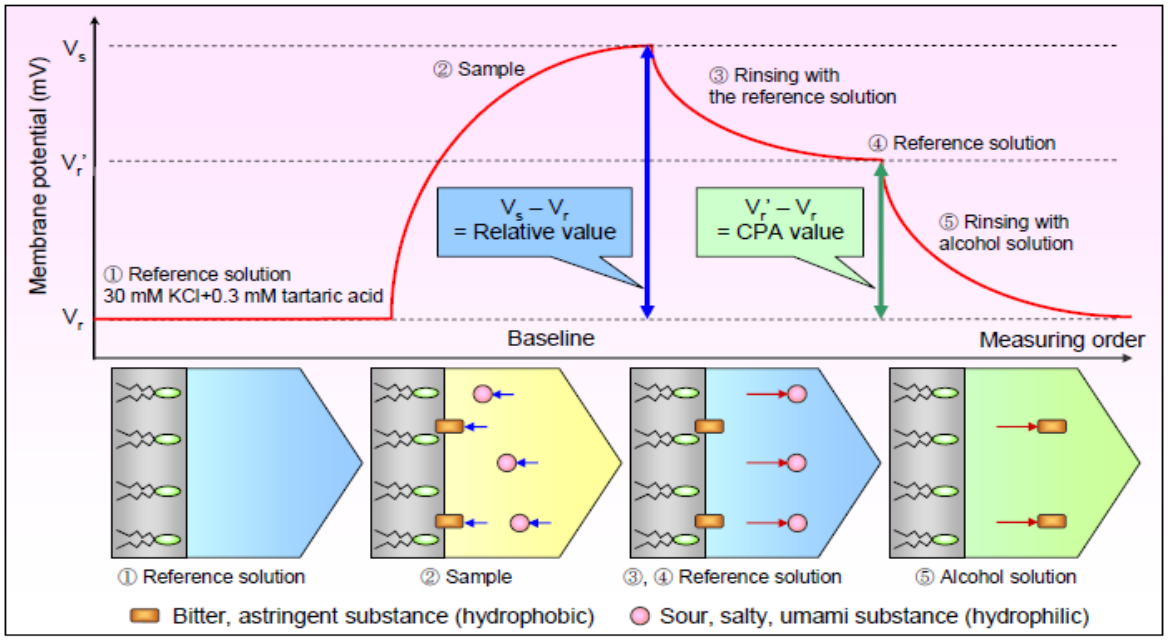
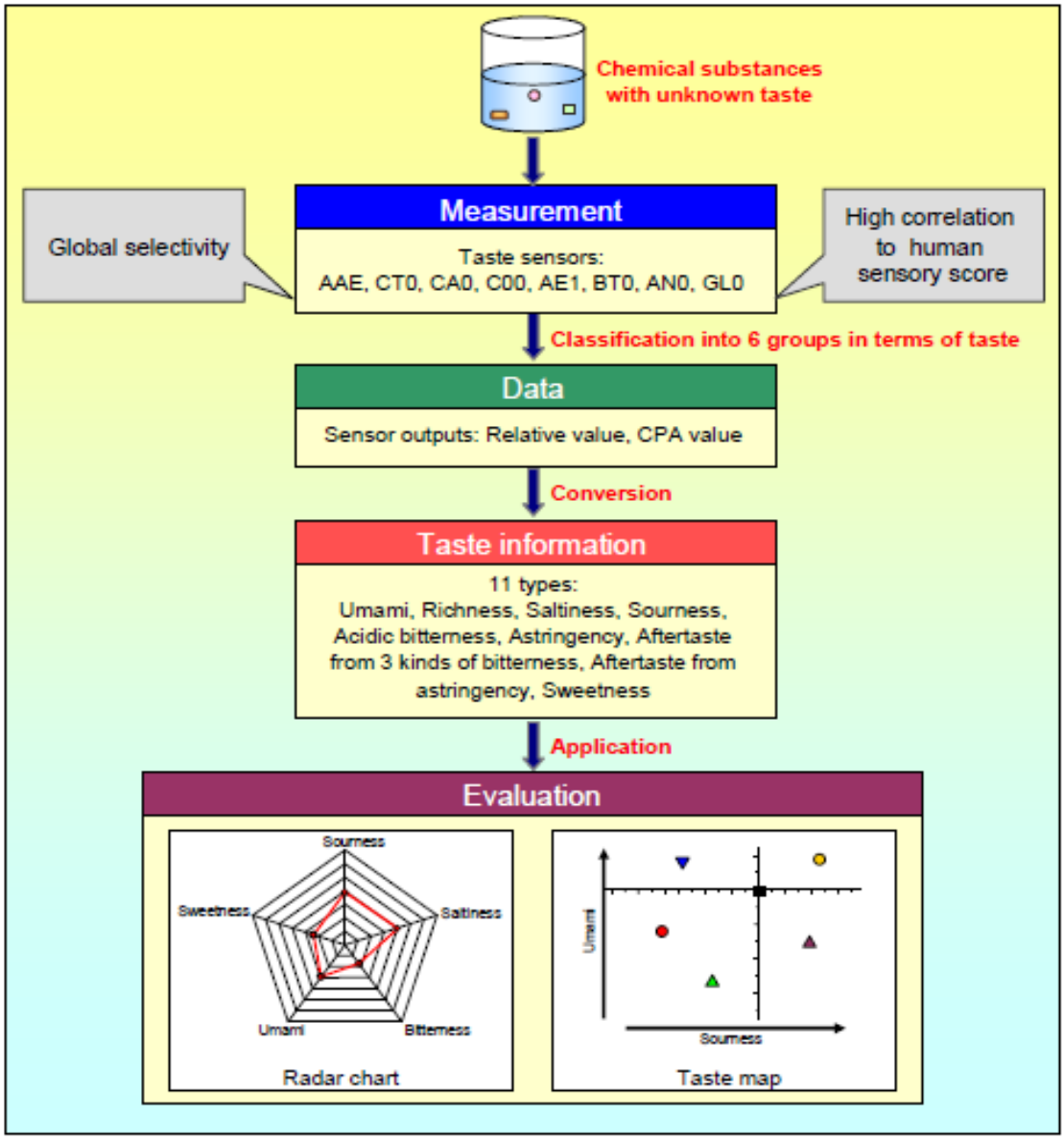


Table 1 lists the components of eight taste sensors, including a prototype sweetness sensor for further improvement

Taste sensor	Artificial lipid	Plasticizer
Umami sensor AAE	Phosphoric acid di(2-ethylhexyl) ester Trioctylmetylammonium chloride	Dioctyl phenylphosphonate
Saltiness sensor CT0	Tetradodecylammonium bromide 1-Hexadecanol	Dioctyl phenylphosphonate
Sourness sensor CA0	Phosphoric acid di(2-ethylhexyl) ester Oleic acid Trioctylmetylammomium chloride	Dioctyl phenylphosphonate
Bitterness sensor C00 (for acidic bitter materials)	Tetradodecylammonium bromide	2-Nitrophenyl octyl ether
Astringency sensor AE1	Tetradodecylammonium bromide	Dioctyl phenylphosphonate
Bitterness sensor BT0 (for bitter hydrochloride salts)	Phosphoric acid di-*n*-decyl ester	Bis(1-butylpentyl) adipate Tributyl *O*-acetylcitrate
Bitterness sensor AN0 (for basic bitter materials)	Phosphoric acid di-*n*-decyl ester	Dioctyl phenylphosphonate
Sweetness sensor GL0 (prototype)	Tetradodecylammonium bromide Gallic acid	Dioctyl phenylphosphonate

Figure5 Overall process that is carried out for evaluation of the taste by taste sensing machine



3. Food and Beverages Industry

3.1Philippines

Market Overview

The Philippines is New Zealand's 7th largest food and beverage export destination, with exports totalling US$436 million in 2010.Food accounts for nearly half of an average Filipino family's expenses and Filipino consumers generally eat five times a day. The economy in the Philippines has recovered from the 2009 recession due to government stimulus packages and a renewed trust in the government. In the fourth quarter of 2010, personal consumption expenditure (PCE), the primary driver of the Philippines economy, jumped to 7 percent. This was the highest since the 8.4 percent growth recorded in the third quarter of 1988. The country's GDP grew by 4.5 percent in2011, which resulted in a per capita income of US$2,012.

Market by product category

Packaged food

In 2011, packaged food sales totalled US$9.1 billion. Dairy products reported the highest market share of 17 percent, followed by bakery (14 percent), oils and fats (11 percent),sweet and savoury snacks (8 percent) and dried processed food (8 percent).During the period 2006-2011, the highest compound annual growth rate (CAGR) was in frozen processed food (10 percent), followed by meal solutions (7 percent), canned /preserved food (7 percent) and chilled processed food (7 percent).Impulse and indulgence products are to witness 5 percent current value sales growth in2011. During the period 2006-2011, the highest CAGR in impulse and indulgence products was reported in biscuits (over 5 percent), followed by sweet and savoury snacks (5 percent) and confectionary (2 percent). While all impulse and indulgence products showed a positive growth, snack bars fell by a CAGR of 1 percent during the same period .Super markets and hypermarkets dominate the distribution of packaged food, accounting for 48 percent of packaged food sales, followed by other grocery retailers (35 percent), and small grocery retailers (13 percent).

Wine

The wine industry in the Philippines is still in its infancy, in comparison to other alcoholic drinks such as beer and spirits. In 2011, wine sales in the Philippines totalled US$ 107 million, or 9 million litres. In value terms, still light grape wine dominates the market, with a 94 percent

market share, followed by sparkling wine (5 percent). Retail wine sales contributed over 51 percent of total wine sales in 2011.

During the period 2005-2010, wine volume sales grew at a CAGR of 8.3 percent, reaching almost 13 million litres in 2010, and value sales by a CAGR of 11.4 percent. The highest growth was in still light grape wines, with a CAGR of 9 percent in volume terms and over 12 percent CAGR in value terms. Red still wines in particular, saw a boost in consumption as companies took advantage of the perceived health benefits of red wines. Volume sales of fortified wines and vermouth grew by a CAGR of 6 percent, followed by sparkling wines (5 percent). Value sales of sparkling wines grew by a CAGR of over 8 percent, followed by fortified wines and vermouth (8 percent).

3.2 Malaysia:-

Introduction to the Food Sector

Malaysia's current population of 26.64 million is growing steadily at an annual rate of about 1.95%. The country has seen a steady increase in the standard of living and with it, its purchasing power (per capita income exceeds RM 19,739 or US$5681). Lifestyle changes have led to an increase in the demand for convenience food and health food. Malaysia's food industry is rich in terms of tropical and agricultural resources reflecting diverse cultures in Malaysian society — Malay, Chinese and Indian, have resulted in a fascinating range of processed food with an Asian twist.

Increasing consumer awareness in nutrition value and food fortification for healthcare has created the demand for functional/healthy minimally processed fresh food, organic food and natural food flavours from plants and seafood.

Processed Food and Beverage Industry

In line with the government's emphasis on the agriculture sector, the processed food and beverages industry had become an important component of the agro-based industry. In 2008, the food processing industry contributed about 10% of the Malaysian manufacturing output and is predominantly Malaysian-owned. Employment in the processed food and beverages industry increased in 2008 by 1.4% to 45,418 compared with 44,778 in 2007. Labour cost for the industry remained competitive, as its Unit Labour Cost decreased by 8.2%, reflecting an efficient utilization and management of resources. A total of 70 projects with investments of RM1.5 billion were approved in 2008. Small and medium sized enterprises represent more than 80% of

the total number of establishments in the processed food segment. They are mainly involved in sub sectors like fish and fish products, livestock and livestock products, fruits and vegetables, and cocoa-based products. The beverage segment covers the manufacture of soft drinks and mineral water.

In the livestock sub-sector, Malaysia is the third largest producer of poultry meat in the Asia Pacific region. Malaysia is self sufficient in poultry, pork and eggs, but imports about 80% of its beef requirements. Among the dairy products produced are milk powder, sweetened condensed milk, pasteurized or sterilized liquid milk, ice cream, yogurt and other fermented milk. Currently, Malaysia is the largest cocoa processor in Asia and ranks fifth in the world. However, meanwhile output of cocoa is declining due to a significant reduction in cultivation area in Sabah, as well as intensive replanting activities. Consequently, most of the cocoa beans are imported. Malaysia is also one of the world major producers of spices. In the fruits sub-sector, besides mangos, star fruits and papayas, the cultivation of pittaya (dragon fruit) is gaining interest among farmers. Most of these fruits are to cater for the domestic market. In the Ninth Malaysia Plan (9MP), the production of fruits and vegetables is targeted to reach 2.56 million tonnes and 1.13 million tonnes, respectively, by 2010. Vegetables are mainly grown on a small scale for fresh consumption, and are exported mainly to Singapore. The major locations for the cultivation of vegetables are in Johor, Pahang, Kelantan and Perak. Functional/health food produced in Malaysia is mainly in the form of food products that are enriched. Food ingredients such as customized formulations required by food manufacturers, natural food additives and flavours have the potential for further growth.

3.3 Thailand:-

Market Overview

Thailand has a rapidly growing food processing sector and is the only net food exporter in Asia, earning it the nickname “kitchen of the world”. Thanks to its rich agricultural resources and government incentives, which have encouraged diversification into more value-add products, Thailand has become one of the world’s largest producers and exporters of processed foods. Fifty percent of production is sold outside of the country. Its food and beverage processing industry is made up of over 10,000 companies and the Thai Ministry of Industry estimates the

production of processed food to be more than 28 million tons annually. More than 80 percent of the raw materials used are sourced locally.iii Thailand is the leading producer and exporter of rice, canned and frozen seafood, processed chicken, processed shrimp and canned pineapple. Other key food and beverage products include cassava, sugar, maize, fruit and vegetables, sauces and curries.

Thailand's food exports were valued at US$24.38 billion in 2010, and are expected to rise to US$27.65 billion in 2011. Main export markets include the United States, Japan, Association of South East Asian Nations (ASEAN) and the European Union (EU).iii Thailand also has a well developed brewing industry.

Retail

Total retail sales for the food and beverage sector in Thailand were estimated to be US$13 billion in 2009. The average Thai consumer spends US$150 per month on retail products, 49 percent of which is spent on fresh foods. Competition in the food retail market is intense and modern retailers (hypermarkets, supermarkets and convenience stores) account for around 70 percent of total retail sales. In 2010, there were estimated to be:

• 430 supermarkets (Central Food Retail, Leader Price)

• 360 hypermarkets (Casino, Tesco, Makro)

• 8,100 convenience stores (7-Eleven, Family Mart, Tesco Lotus Express)

Hypermarkets account for around half of retail sales and are dominated by a small number of multinational players. Most hypermarkets and supermarkets also offer additional services, such as fast food outlets, kiosks and bookstores rather than being stand-alone stores. Convenience stores account for around 15 percent of retail sales.Wet markets are still popular in rural areas where people prefer more traditional diets and tend to be price sensitive.

3.4 Taiwan:-

Market Overview

Food Retail

The Taiwanese food retail industry has enjoyed steady growth in recent years and this growth trend will continue towards 2014. The Taiwanese food retail industry had total revenues of $55.5 billion in 2009, representing a compound annual growth rate (CAGR) of 2.9 percent for the period spanning 2005-2009.1 Convenience stores and gas stations share the strongest sales in the

Taiwanese food retail industry in 2009, with total revenues of $24.8 billion, equivalent to 44.7 percent of the industry's overall value. In comparison, hypermarkets, supermarkets, and discounters together generated revenues of $21.7 billion in 2009, or 39.2 percent of the industry's total revenue.

The industry growth is forecast to slow slightly, with an anticipated CAGR of 2.5 percent for the five year period 2009-2014. It is estimated that the food retail industry will have a size of around $62.9 billion by the end of 2014.

HRI Sector

The Taiwanese foodservice market had total revenue of $9.8 billion in 2009, representing a compound annual growth rate (CAGR) of 6.3 percent for the period spanning 2005- 2009. Cafés & restaurants sales proved the most lucrative for the Taiwanese foodservice market in 2009, with total revenues of $6.5 billion, equivalent to 66.3 percent of the market's overall value. In comparison, sales of fast food generated revenues of $2.6 billion in 2009, equating to 27 percent of the market's aggregate revenues. The performance of the market is forecast to slow somewhat, with an anticipated CAGR of 5.2 percent for the five year period 2009-2014, which is expected to drive the market to a value of $12.6 billion by the end of 2014.

Buyer trends

Taiwan has recently seen strong growth in demand for types of food that are thought to contribute to good health. Demand for organic food, including grains, beans, lentils, tree nuts and dried fruits, has risen.

Demand has shifted from traditional consumption patterns, which emphasise freshly prepared foods, to new food products from overseas. The rise in demand for convenience foods and eating out has been particularly marked in recent years, and this trend is expected to continue.

3.5 Srilanka :-

The food and beverage industry in Sri Lanka has become a thriving sector in the economy propelled by the post war optimism and reaping maximum benefits from peace dividends since May 2009. Contribution to the Gross Domestic Product (GDP) by the food and beverages industry was recorded at 7.9 % of GDP by end of 3rd quarter 2011.

The food and beverage sector industries listed in the Colombo Stock Exchange (CSE) witnessed a staggering growth of 42 % subsequent to the cessation of the 3-decades-long internal conflict.

The private sector took full advantage of the end of the prolonged war by entering into untapped markets in the North and East provinces. Private sector firms in the food and beverage industry penetrated the North and East provinces in a massive wave increasing firm level earnings by two to three fold.Among the many industries, the food and beverage industry, was among the fastest growing sectors in the economy and has the potential to grow even further in the short to medium term. During 2010, this industry grew by 6.8 % with the growth in the first half 2011 being 7.2%. Therefore, the growth rate in 2011 could be projected at a comfortable 8.0 to 8.5%.

The strategic plan of the Export Development Board (EDB) for 2011 -2015 has identified the F&B industry as one of the seven key priority sectors and has set a target of US$1 billion in export earnings by 2015. All these factors reflect the growth potential of the F&B sector of the economy.

Fastest growing FMCG market in the Asia- Pacific Region According to market research findings published by AC Nielsen based on their retail audit, for the period January - September 2011, Sri Lanka recorded the highest nominal growth of 21 % and a volum growth of 11.7 % in the FMCG category within the Asia - Pacific region. The research findings further elaborate that the major contribution for this growth is from the F&B sector.

3.6 Hongkong :-

Food safety has become a prime concern of consumers over the globe. Increasing number of countries, including the Chinese mainland and Japan, have implemented more stringent controls on food safety, whether locally produced or imported.

In the first three quarters of 2011, Hong Kong's total exports of processed food and beverages enjoyed 17% growth to reach $29 billion. The Chinese mainland was the largest export market for Hong Kong's processed food and beverages (accounting for 35% of the total), followed by ASEAN (31%) and Vietnam (28%).

The food and beverages industry in Hong Kong is largely related to re-export activities. During Jan – Sep 2011, Hong Kong's re-exports of food and beverages accounted for more than 90% of Hong Kong's total exports of food and beverages. In terms of market, the Chinese mainland

accounted for one-third of Hong Kong's total re-exports. Hong Kong is a major gateway through which the Chinese mainland's growing demand for western food is met.

The processed food and beverages industry in Hong Kong is characterised by its active trading activities. Major food importers/traders in Hong Kong include Dah Chong Hong, Four Seas Food Investment, EDO Trading Co, Kwan Hong Yuen Trading Co Ltd, Yu Kee Trading Co Ltd, Sun Shun Fuk etc.

There is a considerable scale of food and beverages production in Hong Kong. Most of this production is for local consumption. Major products include instant noodles, macaroni, spaghetti, biscuits, pastries and cakes. Others include canning, preserving and processing of seafood (fish, shrimps, prawns, and crustaceans); manufacture of dairy products (fresh milk, yoghurt and ice cream); seasoning and spirits.

3.7 Singapore:-

Singapore is relatively wealthy nation since it is estimated that over 68% of its households have an annual income of over USD 50,000. On a per capita basis, Singapore has the highest food consumption levels in the Southeast Asia region.

The country's food consumption was estimated to reach USD 7.4 bn in 2011, accounting for 3% of GDP, according to "Singapore Food and Beverage Industry 2011″ on www.cri-report.com. Due to its limited land for agriculture and rapid urbanization, Singapore imports more than 90% of its food products, particularly from other Asian countries. Like other countries, Singapore's F&B industry is competitive, hence calling for continuous innovation to cater to consumer demands which is growing more complex over time.

Varying pricing strategies to make their products more accessible, most F&B outlets are engaging in low cost pricing, making gourmet cuisines like Italian, French and American dishes and selling them in an affordable price available even in food courts, coffee shops and hawker centres. Some F&B establishments still opt to maintain their niche, while some try to cater to all classes for a larger market share.

3.8 Pakistan:-

According to the Census of Manufacturing Industries there were 924 units engaged in the manufacture of Food and Beverages. According to the UNIDO it is the largest manufacturing industry of the country. Value of production stood at Rs.74.094 billion and manufacturing value added (MVA) stood at Rs.24.287 billion. Food processing is a relatively capital intensive industry. The share of food in the manufacturing industry has declined from 22.66 per cent in 1981-82 to 19.76 per cent in 1990-91.

The growth rate in the food industry has been estimated at 10.00 per cent per annum. The most rapidly growing items are dairy products fish processed, bakery items, sugar, biscuits and confectioneries, fruit juices and other soft beverages. Rapid export growth has characterized fish preparation, fruit preserves, dry fruits, some beverages and sugar, and honey preparation.

3.9 Indonesia:-

The new addition in the RNCOS' catalogue of market research reports on Food & Beverages sector provides extensive research and rational analysis on the Food, Beverage & Tobacco Industry in Indonesia. This report has been made to help clients in analyzing the opportunities, challenges and the drivers critical to the growth of food and beverage industry in Indonesia.

The extensive report provides detailed overview of the consumption patterns of Indonesians in various food segments like milk, fruits, vegetables, meat etc; the beverage segment talks about the type of beverages, their sales and consumption patterns among Indonesians; and the tobacco segment gives a brief description of the industry. Indonesia consumer expenditure on food, beverages and tobacco had grown at a CAG of approx 12% from 2003 to 2006 and for the period spanning from 2007 to 2011, the CAGR is forecasted at 7.7%. With the growing demand for health and energy drinks (that are included in soft drinks segment), sales of soft drinks in Indonesia is forecasted to grow at a CAGR of over 7% during 2007 to 2011.

The sale of bottled water in Indonesia had grown at a CAGR of 17% during 2001 to 2006. Enhanced consumer awareness of fortified or healthy foods, rising affluence and uptake of western lifestyle has been fuelling growth in demand for organic, processed and packaged foods and beverages.

The health food supplements market in Indonesia has grown considerably and will continue to grow between 13% and 18% per year in near future as well.

4. Key Market Share Holders

The food-processing industry has been identified as a focus area for development and has been included in the priority-lending sector. Most of the food-processing industries with the exception of beer & alcoholic drinks and items reserved for small scale sector, like vinegar, bread, and bakery have been exempted from the provisions of industrial licensing under

Chart 2 Biscuit Industry

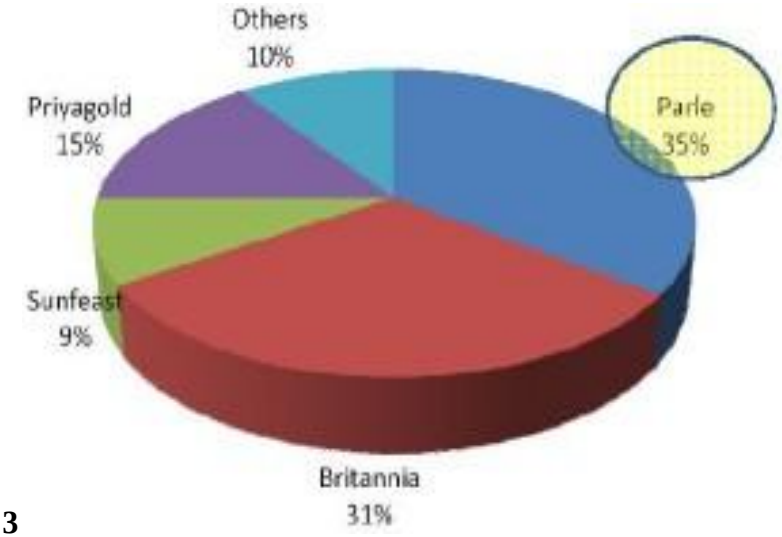


Chart 3

Wine Industry

India's wine consumption is rapidly increasing and is forecasted to grow at a compounded annual growth rate of 27 per cent from 2010-12. India has emerged as one of the fastest growing markets for wine consumption on the global map.

The wine market in India today is still in its nascent stage. The industry is just over one million cases of wines manufactured in India and 0.15 to 0.2 million cases of imported wines. The value of the Indian wine market is around 2 per cent of the total alcohol beverage industry. A lot needs to be done in terms of education, awareness and demystifying wine as a product.

Presently most of the imported wine come from France, Italy, Australia, Chile, USA, South Africa and New Zealand. France has the biggest market share of approximately 40 per cent followed by Italy (15%) and Australia (12%)

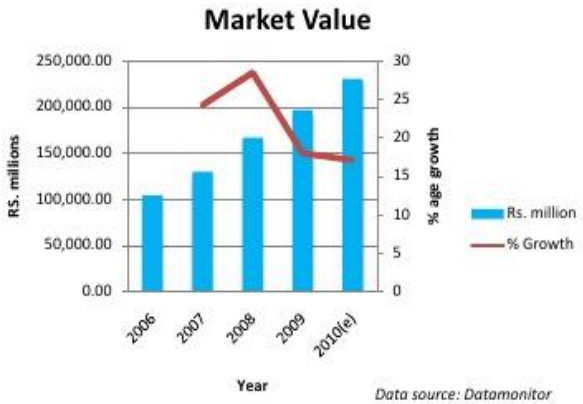
Up to 80 per cent of wine is consumed in the major Indian cities: Mumbai (39%), Delhi (23%), Bengaluru (9%) and the foreign tourist dominated state of Goa (9%), the remaining 20 per cent are sold in the rest of India. The Red wine consumption is pegged at 45 per cent followed by white wine with 40per cent sparkling wine 13 per cent and Rosé wine by two per cent.

Key market players

1) Sula Wines
2) ND Wines
3) Vintage Wines
4) Grover Vineyards
5) Indage Wines
6) Sankalp Wines
7) Renaissance Wines
8) Brindco International
9) Sonarys Co-Op Brands
10) Moet Hennessy India
11) Sovereign Impex

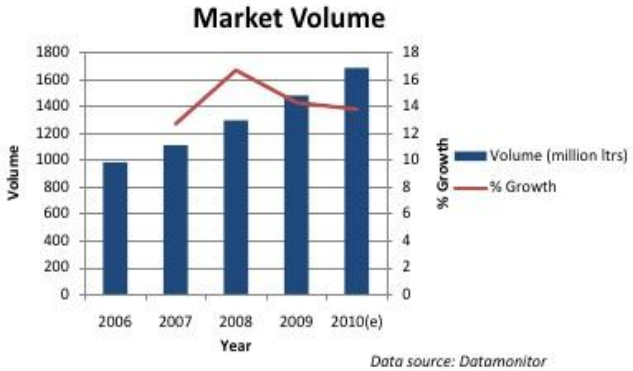
Beer industry

Indian Beer market grew by 17.1% in 2010.Volume grew by 13.8% in 2010 to reach 1687.4 million litre.United breweries limited is the leading player having 42.4% share oh market volume.In 2015 forecasted to have a value of 9369 million.



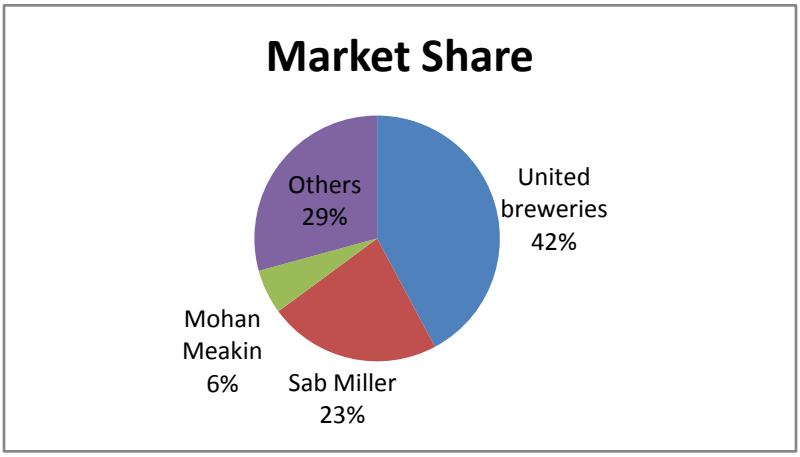
In 2010, Indian beer market grew by 17.1% to reach a value of $5,022.8 million. CAGR for period 2006-2010 was 21.9%.

Data source: Datamonitor



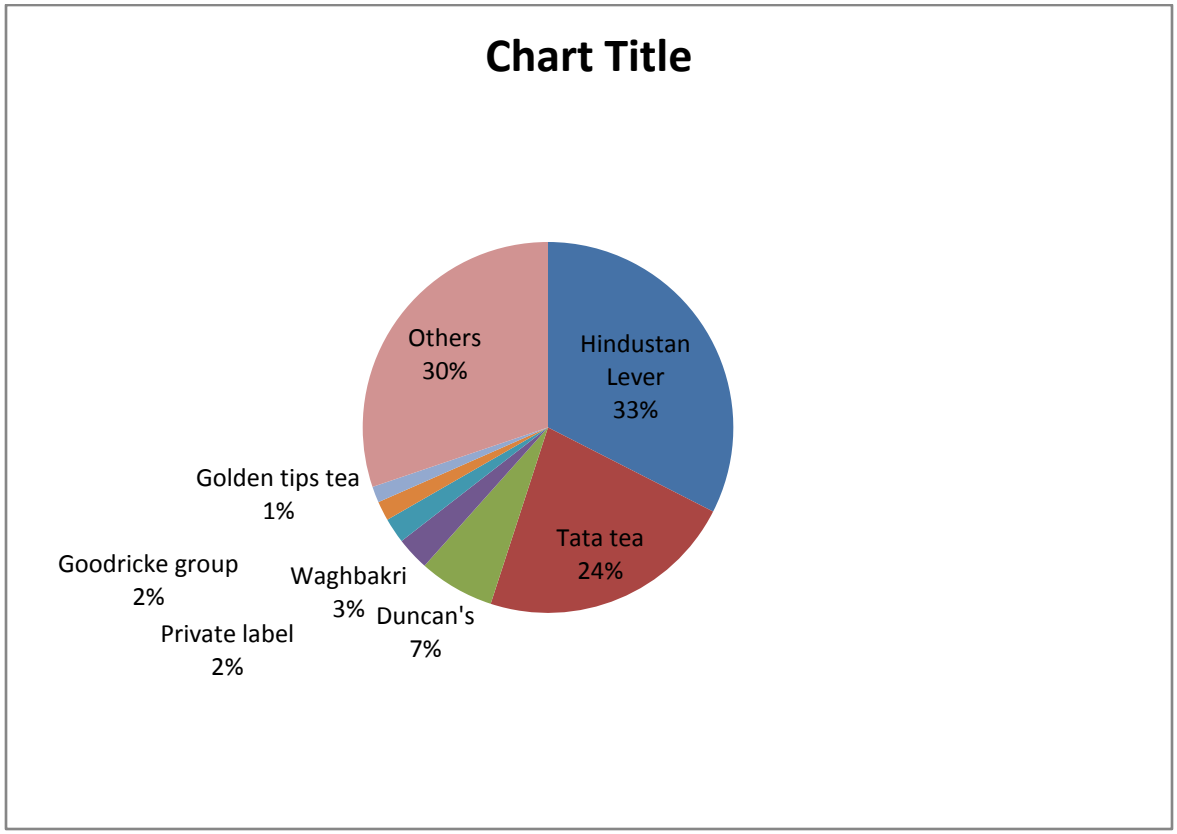
Volumes grew by 13.8% in 2010 to reach a volume of 1,687.4 million liters. CAGR for period 2006-2010 was 14.4%

Data source: Datamonitor



Tea industry

The total turnover of the tea industry in India is likely to touch Rs 33,000 crore by 2015 from the current level of about Rs 19,500 crore, as per a study titled 'Indian Tea Industry', released by industry body ASSOCHAM. With nearly six lakh hectares area under tea cultivation, the domestic tea industry is growing at a compound annual growth rate (CAGR) of about 15 per cent, stated the study.



Pharma Industry:-

Indian pharmaceutical market grew at 15.7% during December 2011.Globally India ranks third in terms of manufacturing pharma products by volume. The Indian pharmaceutical industry is expected to grow at rate of 9.9% till 2010 and after that 9.5% till 2015.The Indian pharmaceutical market is expected to touch US$ 74 billion sales by 2020 from US$ 11 billion.

More ever increasing population of higher income group in the country will open potential US$ 8 billion market for MNC selling costly drugs by 2015.Besides domestic pharma market is

expected to touch US$ 20 billion by 2015,making India a lucrative destination for clinical trials for global giants.

Key market player

1) Abott

2) GSK

3) Cipla

4) Alembic

3) Sun Pharma

6) Zydus

7) Ranabaxy

8) Lupin

9) Dr Reddy

10) Pfizer

Animal Health Care Industry:-

The $16 billion animal healthcare market may not be a traditional diversification strategy for Indian pharmaceutical players. But with a steady CAGR of five to six percent, some savvy Indian players have ambitious plans.

One of the silent contributors to the balance sheets of some Indian pharmaceutical companies is the animal healthcare market. Off late, for a variety of reasons, there has been a paradigm shift from being a silent player to a more aggressive positioning. Zydus Cadila, Alembic, Vetnex, Virbac Animal Health India, Intas Pharmaceuticals, Intervet India, Concept Pharmaceuticals and Wockhardt ar some of the major players in India who have stakes in the animal healthcare market. Their global counterparts include Pfizer, Merial, Schering Plough, DSM Nutritional Products, BASF Animal Nutrition, Bayer Animal Health, Elanco, Novartis and Ceva Sante.

Market

Quoting a livestock industry survey report published by Compound Livestock Feed Manufacturers Association (CLFMA) of India, Animal health industry is poised to grow at a CAGR of six to seven percent in the next five years. In rupee terms, the projected valuations are considerably attractive. The market estimation values are based on Animal Pharma Scrip reports (2006-07) which project that the total Indian animal health market is approximately Rs 1157 crore, which includes verticals like livestock cattle, poultry companion animals, equine and small ruminants.

Key Market Player:-

Concept Pharmaceuticals

Ranbaxy Fine Chemicals Limited

Intas Pharmaceutical

Interlink Consultancy

Bayer

5. Advantages of the TSM based on sensory evaluation (human).

Human sensory panel are the experts of taste which are included in the panel for the evaluation of taste. Thereare lot of errors which can be happen by the human sensory evaluation panel. These are as follows

Time consuming nature.

Requirement of capital investment.

Extensive training of personnel.

Difficulties in data analysis.

Interpretations are major limitation of taste assessment trial.

Methodology is not amenable to screening very large no of sample rapidly and economically.

Health concern.

Poor memory.

Fatigue of tasters.

Personal preference.

Maintaining the motivation for tasting unpleasant compound.

Lack of analytical standardisation.

Salivary mixing.

Mixture suppression.

Toxicity of drug.

Genetic variation in test.

New drug molecule before phase 1 of clinical trials cannot be tasted by human being.

6. Evaluation of sweeteners used in the food, beverage & pharma industry:-

Nutritive Sweeteners

Sugars. Sugars (saccharides) are widespread in nature and are the building blocks of carbohydrates - monosaccharides, disaccharides and polysaccharides. The monosaccharides, glucose, fructose, and galactose are composed of just one sugar molecule, and are known as the "simple sugars."

Sucrose comes from sugar beets or sugar cane, and is more commonly known as table sugar. Sucrose is composed of the two simple sugars, glucose and fructose. It is the most abundant sugar in nature, important for its palatability, availability, low cost, and simplicity of production.

Lactose also is referred to as milk sugar. Lactose is made of the two simple sugars glucose and galactose. Maltose, two glucose units, is the result of the fermentation of the starch in grains by yeast or enzymes, as in bread-making or brewing.

Corn Syrup. Corn syrup is a glucose derivative of corn starch, popular in the brewing, canning, and baking industries because it lends texture and body to these types of products.

Sugar Alcohols. Sugar alcohols are sometimes used as a substitute for sucrose. Mannitol, sorbitol, and maltitol occur naturally in fruits.

Alternative Sweeteners

Alternative sweeteners are essentially calorie-free and at least 30 times sweeter than sucrose. There currently are five alternative sweeteners approved for use in the United States:

Saccharin. Saccharin actually is a petroleum derivative that is 200 to 700 times sweeter than sucrose. It is sold as a white powder for use as a table-top sweetener, and used in a variety of foods such as beverages, jams, and baked goods. It has a bitter aftertaste at high concentrations. Despite controversy over its safety, it remains on the generally-recognized-as-safe (GRAS) list.

Table 2

Low-Calorie Sweeteners At-A-Glance			
Sweetener	**Date Approved**	**Sweeter Than Sugar**	**Brand Name(s)**
Ace-K	1988	200x	Sunett®, Sweet One®
Aspartame	1981	180x	NutraSweet®, Equal®, others
Neotame	2002	7,000x	n/a
Saccharin	Years prior to 1958	300x	Sweet 'N Low®, Sweet Twin, Sugar Twin®, others
Stevia Sweeteners	2008	200x	Truvia™, PureVia™, Sun Crystals®
Sucralose	1998	600x	Splenda®
Sources: *Comprehensive Reviews in Food Science and Food Safety*, IFT, 2006 *Food and Chemical Toxicology*, 2008			

Pharma industry:-

Taste is an important parameter in administering drugs orally and is a critical factor to be considered while formulating orodispersible, melt in mouth, buccal tablet and other formulations which comes in contact with taste buds. Good flavour and texture are found to significantly affect sell of the product. Undesirable taste is one of the important formulation problems encountered with most of the drugs. Taste masking technologies offer a great scope for invention and patents. Several approaches like adding flavors and sweeteners, use of lipoproteins for inhibiting bitterness, numbing of taste buds, coating of drug with inert agents, microencapsulation, multiple emulsion, viscosity modifiers, vesicles and liposomes, prodrug formation, salt formation, formation of inclusion and molecular complexes, solid dispersion system and application of ion exchange resins have been tried by the formulators to mask the unpleasant taste of the bitter drugs.

7. Competitor Analysis:-

Insent taste sensing machine have a direct competition with Alpha Mos which is available in the market.

Table 3

	Competitor 1	Competitor 2
Company name	Intelligent Sensor Technology,Inc	Alpha Mos
Company Description	Japan based company	France based company
Product name	TS -5000Z	Astree E-Tounge
Competing Price	-	N.A
Distinctive weakness	Relatively new	Established product in the market
Strengths	1)Availability in India 2)8 taste sensors 3)Diagnosis of products are possible at the centre.	1)Not available in India 2)7 taste sensors 3)Not available for diagnosis of product.

8. Current Trends In Taste Evaluation:-

In today's environment taste sensing machines are used for different application and in different industries. Some of them are as follows

1) Rational development of taste masked oral liquids guided by an electronic tongue

Human taste testing is often associated with ethical concerns, organizational and validation issues. Electrochemical sensor array systems, so called electronic tongues, offer an alternative to assess the taste of multi-component liquid formulations. Therefore, it should be investigated how an electronic tongue can be implemented in the rational development of taste masked formulations. Taste masking of bitter tasting quinine hydrochloride (QH) in a liquid formulation was carried out by screening sweetening agents.

2) Taste sensing systems (electronic tongues) for pharmaceutical applications

To date, the most widely used method for measuring the taste characteristics of pharmaceutical preparations is psychophysical evaluation by a taste panel. However, conventional chemical analyses, on the basis of release studies, have been shown to be useful subsidiary methods. More recently, novel in vitro taste assessment apparatus and methodologies have been developed for high-throughput taste screening and quality control. Bio mimetic taste sensing systems (BMTSSs), such as multichannel taste sensors or electronic tongues with global selectivity, have been welcomed by both pharmaceutical scientists and the industry as a whole. As discuss here, the emerging in vitro approaches for assessing taste characteristics of taste masked drug and drug products will result in a decreased reliance on human panel tests.

3) Sweetener Recognition and Taste Prediction of Coke Drinks by Electronic Tongue

Natural and artificial sweetener monitoring methods are getting more important since soft drinks with low energy plays a considerable role on the market. The objective was to describe the relevant sensory attributes and to determine the applicability of the electronic tongue to discriminate the coke drink samples with different sweeteners. Furthermore, the aim was to find relationship between the taste attributes and measurement results received by electronic tongue. The samples were definitely distinguished by the electronic tongue. The main difference was found according to the sweetener content of the samples. The electronic tongue was able to

distinguish samples containing different kind of artificial and different kind of natural sweeteners, as well.

4) Evaluation of bottled nutritive drinks using a taste sensor

The purpose of this study was to evaluate the taste of 20 bottled nutritive drinks, all commercially available on the Japanese market, both in human gustatory sensation tests and using a multi-channel taste sensor. In the gustatory sensation tests, seven trained healthy volunteers were asked to score the drinks in terms of the intensities of four basic tastes (sweetness, saltiness, sourness, and bitterness).

5) Bitterness evaluation of orally disintegrating famotidine tablets using a taste sensor

The purpose of this study was to evaluate the ability of a quantitative prediction method using a taste sensor to determine the bitterness of orally disintegrating famotidine tablets for use in hospital as a commercial generic medicine from an ethical viewpoint. The relationship between the bitterness intensity scores of famotidine in human gustatory sensation tests and the predicted bitterness scores derived from the taste sensor output was evaluated.

6) Prescribing for children – taste and palatability affect adherence to antibiotics

The taste of an antibiotic is often not taken into account by practitioners, although there is significant evidence to show palatability correlates strongly with adherence. Many parents will be familiar with the difficulties of convincing young children to take bitter, unfamiliar medicine. Certain drugs, for example flucloxacillin, are so unpalatable that they should not be prescribed as syrups without prior 'taste testing' in an individual child, while others, such as oral cephalosporins, are accepted very well although they are more expensive with a broader antimicrobial spectrum than may be strictly necessary.

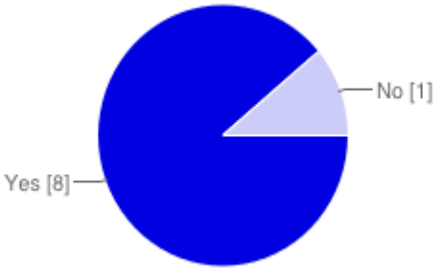
7) Different kinds of commercial mineral water were classified by using the taste sensor. Mineral water was classified on the basis of the hardness of water. The tastes of 20 bottled nutritive drinks, all commercially available on the Japanese market were evaluated both in human sensory test and by using electronic tongue. The electronic tongue was able to differentiate between low price group products, middle price group products, high price group products and played important role in evaluating the palatability of bottled nutritive drinks.

8) Different varieties of tomato were recognized using taste sensor by measuring the crushed tomatoes. The taste sensor were first calibrated in canned tomato juice to which four basic taste substances, NaCl, citric acid, monosodium glutamate, and glucose were added.

9. Market Potential Of TSM

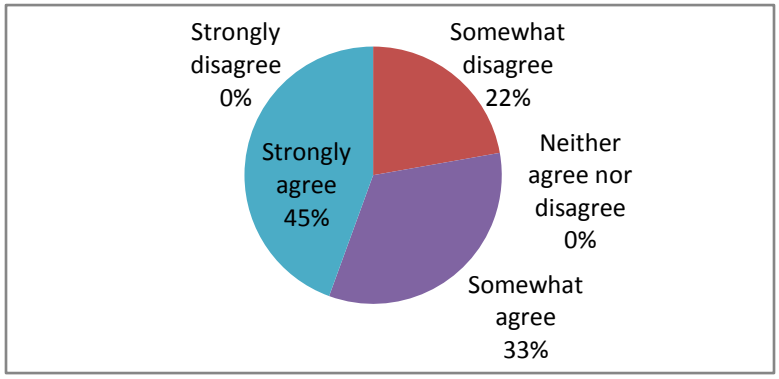
Closed ended questionnaire was prepared and send via email to get the response.

Q-1 Have you heard about the taste sensing machine?

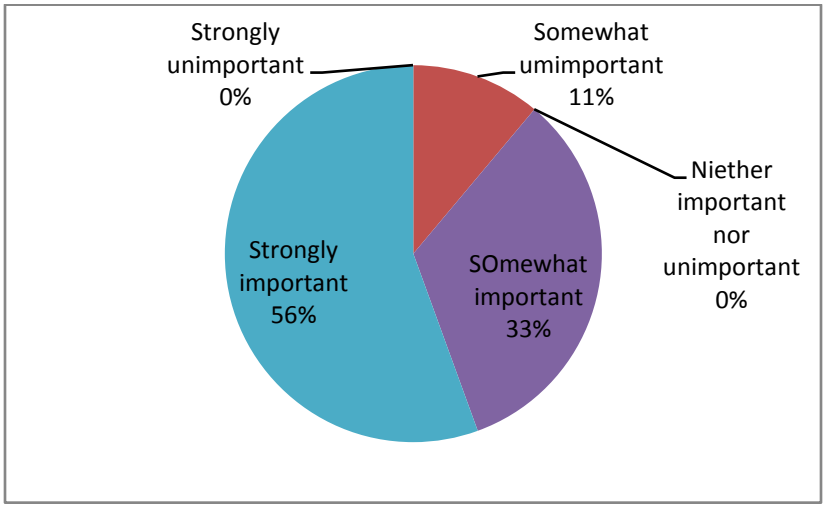


(Yes 89% No 11%).this shows that their is awareness about TSM.

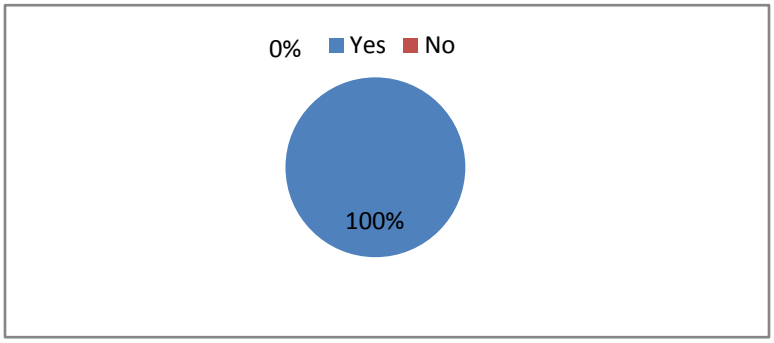
Q-2 Does taste play an important role in the success of your product?



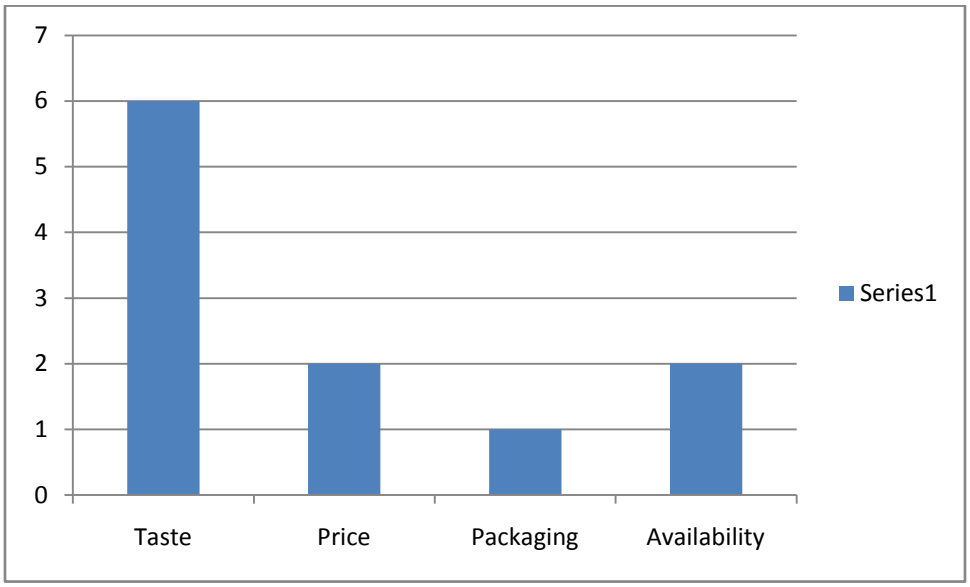
Q-3 How do you rate importance of test in comparison to competitor product



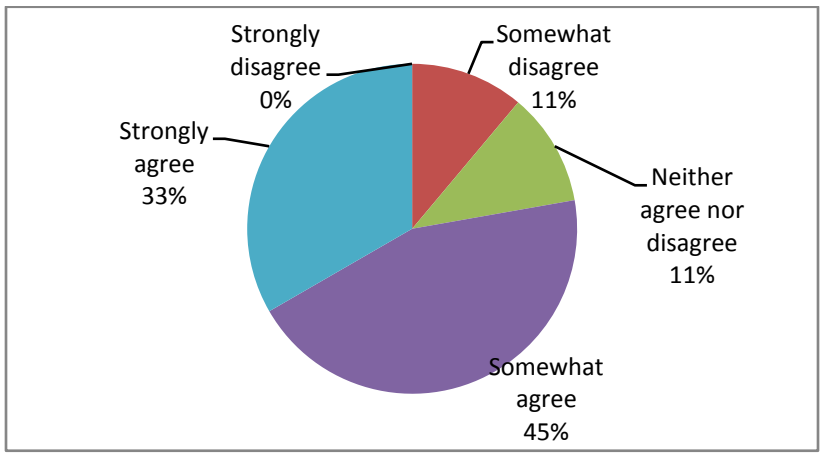
Q-4 Do you think improvement of taste in your product would improve your product image?



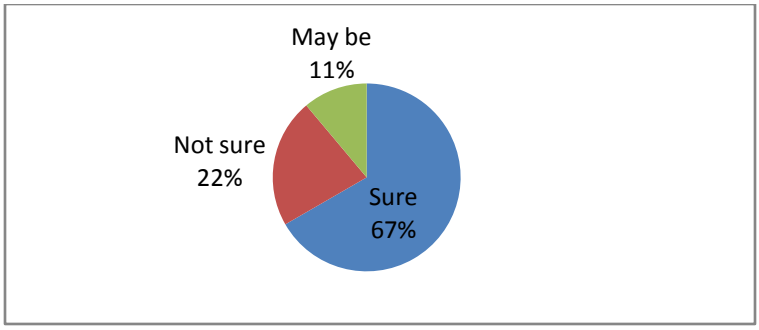
Q-5 Which factor you think should be the most important for improvement of your product?



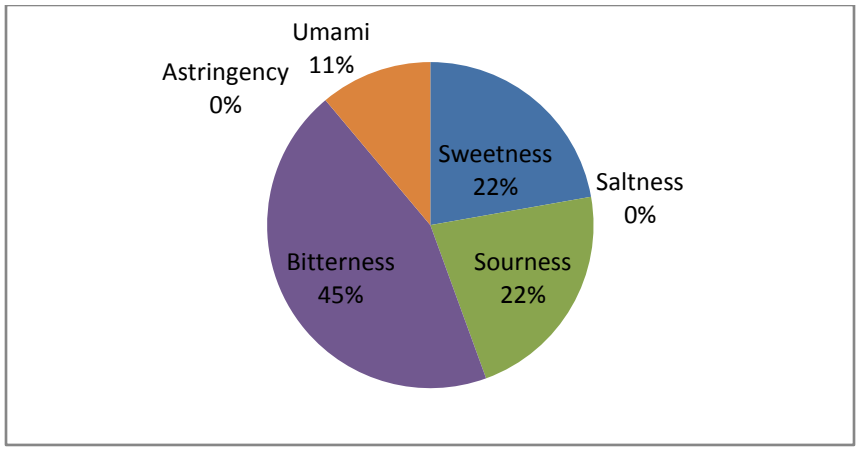
Q-6 Do you think analysis of taste of your product with competitors would be beneficial for



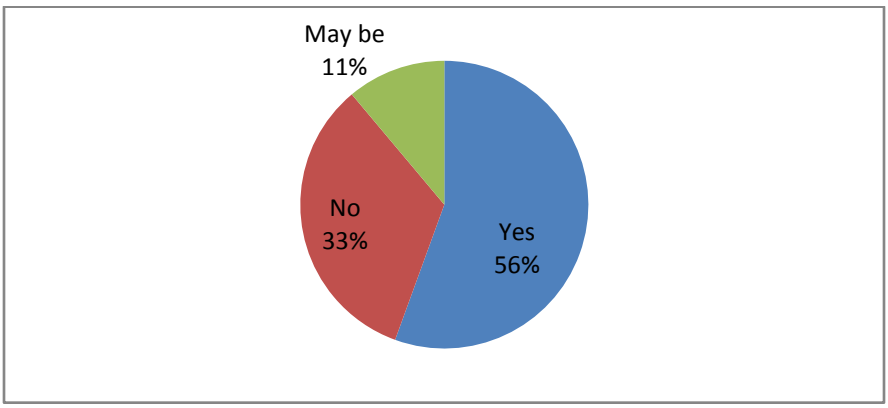
Q-7 Do you think quantification of taste of your product would be beneficial for you?



Q-8 Analysis of which of the following taste factor you think should be the most important for your product?



Q-9 Does the availability of taste sensing machine in India influence you for the taste sensing analysis?



These results shows that their is awareness about TSM in pharma industry and good response had been shown by the company towards the TSM.

Conclusion

Taste sensors can provide a technically suitable and cost effective method for screening and analyzing taste in the early stages of the development of API/formulations, thereby eliminating both safety concerns and subject bias effects. In conclusion, taste sensors may be useful in evaluating taste masking efficiency for a formulation. It can also provide standard and quantified result to the food and beverages company which would be helpful for them to make their product superior. The availability of the TSM in India also made it easier for the companies to analyze their product. All these factors may play an important role for the growth of market of taste sensing machine.

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Annexure

Q-1 Have you heard about the e-tounge?(Taste Sensing Machine)

Yes

No

Q-2 Does taste play an important role in the success of your product?

Strongly disagree

Somewhat agree

Neither agree nor disagree

Somewhat agree

Strongly agree

Q-3 How do you rate importance of taste in comparison to competitor product?

Strongly unimportant

Somewhat unimportant

Neither important nor unimportant

Somewhat important

Strongly unimportant

Q-4 Do you think improvement of your product would improve your product image?

Yes

No

Q-5 Which factor do you think most important for improvement of your product?

Taste

Price

Packaging

Availability

Q-6 Do you think analysis of taste of your product with competitor's would be beneficial for you?

Strongly disagree

Somewhat disagree

Neither agree nor disagree

Somewhat agree

Strongly agree

Q-7 Do you think quantification of taste of your product would be beneficial for you?

Yes

No

May be

Q-8 Analysis of which of the following taste factor would you think most important for your product?

Saltness

Sweetness

Bitterness

Sourness

Umami

Astringent

Q-9 Does the availability of taste sensing machine in India would influence you for taste sensing analysis?

Yes

No

May be