Smart Automation of Food Safety & Quality Assurance

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Smart Automation of Food Safety & Quality Assurance

COVERAGE:

- **Food Chain- Dynamics and food safety challenges**
- **Increasing role of Automation in Food Safety & Quality Assurance**
- **Automation: Strategic Way forward for Safe Food-Chain**

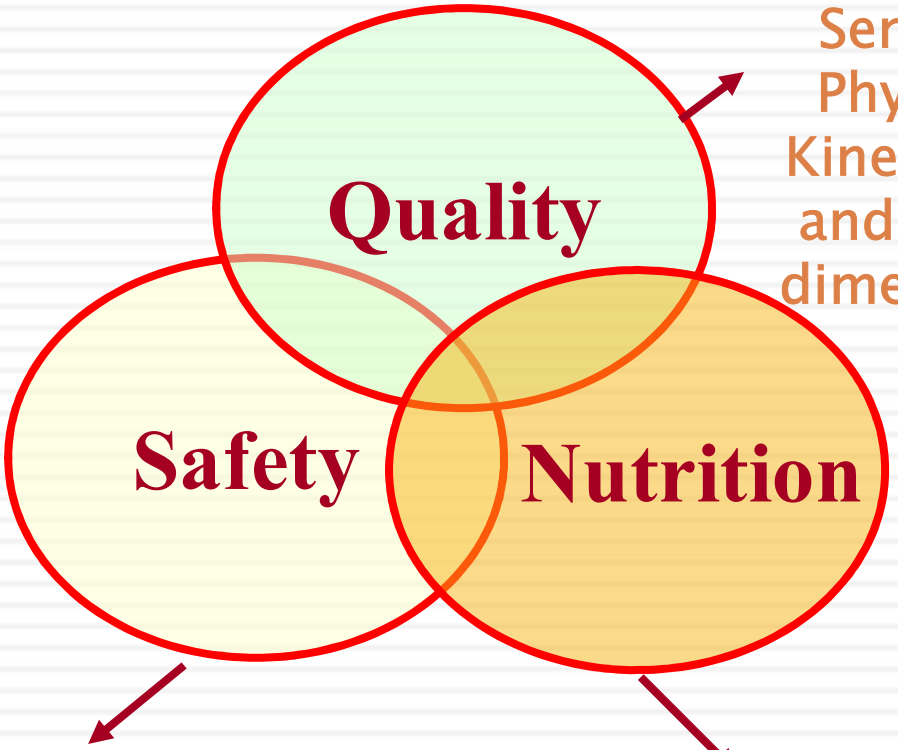
CSIR-CFTRI: Glimpse of Strength & Credentials

- CFTRI, constituent lab of CSIR, since 1950 with staff strength around 350 including about 100 Scientists and 130 Technical Staff with expertise in Food Science & Technology, Food Safety & Analysis, Biotechnology, Microbiology, Food Engineering, Product Development
- Function as Referral Food Laboratory (RFL) for DGHS/ FSSAI (1978 -)
- CFTRI accorded status of National Reference Laboratory by FSSAI
- Centre for GMO testing under authorisation from GEAC, MoEFCC.
- ISO 9001, 14001 certified & ISO-17025 accredited by NABL since 2001
- Toxicological study facilities with animal house, cell lines and in-vitro.
- International Training centre: skill development & entrepreneurship in Food Technology, Food Analysis, Instrumentation

Changing Dynamics of Food

- Food Industry – one of the most powerful industry, worldwide
- Foods transported thousands miles away from production center
- No more barriers of traditional and ethnic food habits
- Food Industry has important role in Indian economy
- Indian Food industry–Greater stake potential in world market
- Unique features of food industry :
  - Variation in raw material – seasonal and geographical
  - Biological / dynamic / perishable nature of food
  - Storage and environment effect
  - Microbial and toxin development
  - Use of additives etc
- Complex diverse food supply– Convenience food, Organic, Functional foods / nutraceuticals, GM foods

Food – Consumer Choices



Sensory, Physical, Kinesthetic and Other dimensions

Microbiology, Additives, Contaminants, Toxins, Environmental pollutants, Adulterants

Macro- & micro- nutrients

Nutrition Facts

Serving Size 1 package
Servings Per Container 1

Amount Per Serving	
Calories 270	Calories from Fat 100
	% Daily Value*
Total Fat 11g	**17%**
Saturated Fat 2.5g	**13%**
Cholesterol 0mg	**0%**
Sodium 170mg	**7%**
Total Carbohydrate 42g	**14%**
Dietary Fiber less than 1g	**3%**
Sugars 21g	
Protein 3g	

Vitamin A	0%	• Vitamin C	0%
Calcium	0%	• Iron	6%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

		Calories: 2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

PROOF OF PURCHASE

Quality Characteristics of Food

- Quantified characteristics essential for Quality Assurance
- Consumer Perception: Wholesome, Nutritious, Safe
- Sensory and physical attributes:
  - Appearance, colour, shape, flavour, taste, etc
- Kinesthetic attributes:
  - Texture, mouthfeel, viscosity, consistency
- Hidden attributes:
  - Nutritional value, microbial safety, shelf life
  - Other dimensions of Quality:
  - Performance, reliability, conformance and durability
  - Causes for variation: Raw material, process, working conditions

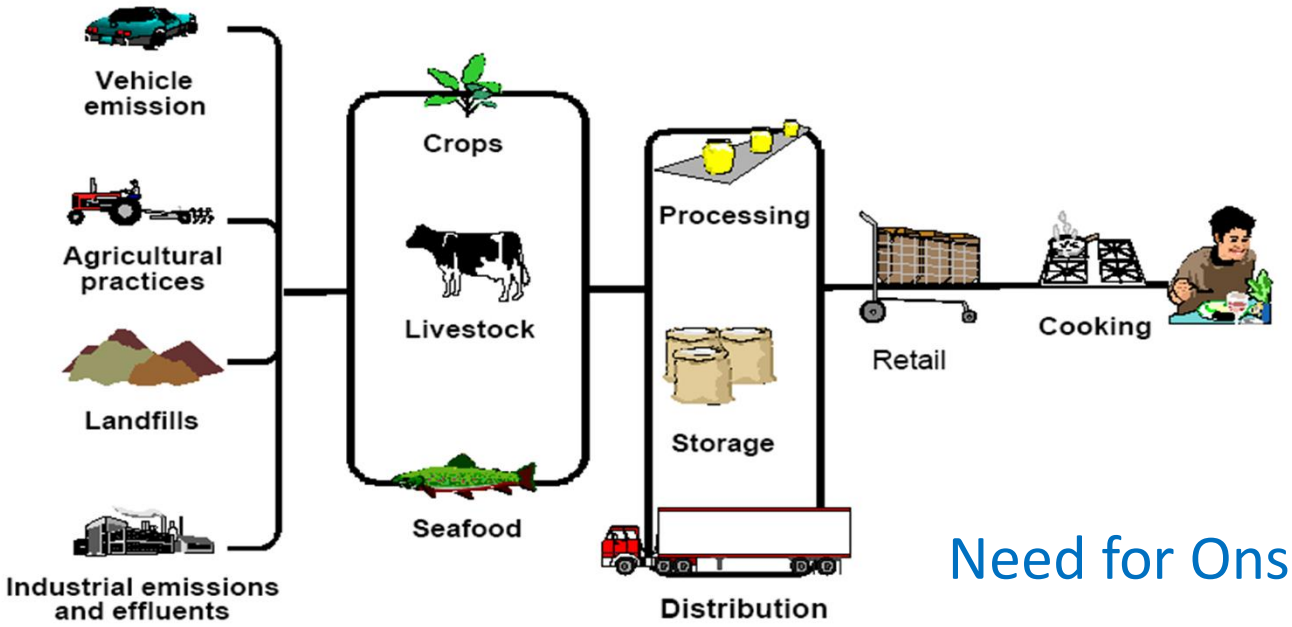
Food Safety: Recent Major Scares in India

Surveillance and Reporting: Needs strengthening

- ICMR, NCDC, INFOSAN

- Adulteration: Still the major concern
- Mid-day meal: Hygiene & Sanitation
- Artificial ripening of fruits: Unpermitted chemicals
- Pesticide Residues: Beverages, Fruits & Vegetables
  - IARI lead All India Monitoring project
- Use of unpermitted and Excess Food Colours
- Spurious liquor
- Hygiene & Sanitation: Food infection & food poisoning
- Heavy metal toxicity
- Scares of Melamine, Sudan dye, Synthetic milk

Hazards in Food Chain



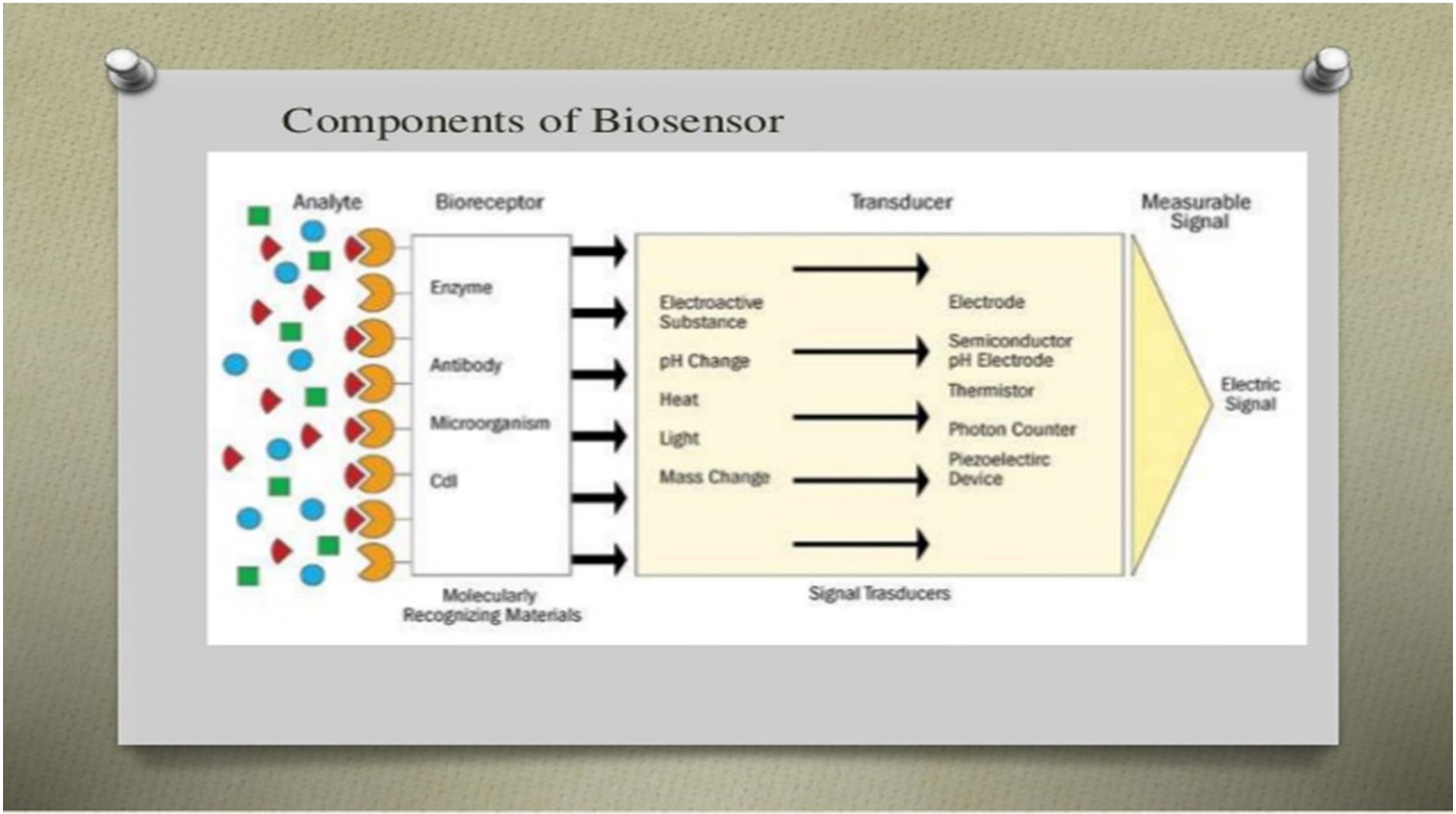
Need for Onsite rapid detection kits

- Pesticide residues
- Heavy metals
- Mycotoxins
- Antibiotics
- Microbial Pathogens
- GMOs

Growing Need for Development of Automation & Food Safety Sensors

- **Early warning in Ensuring Food Quality and Safety**
- **Smart Packaging Solutions**
- **Traceability**

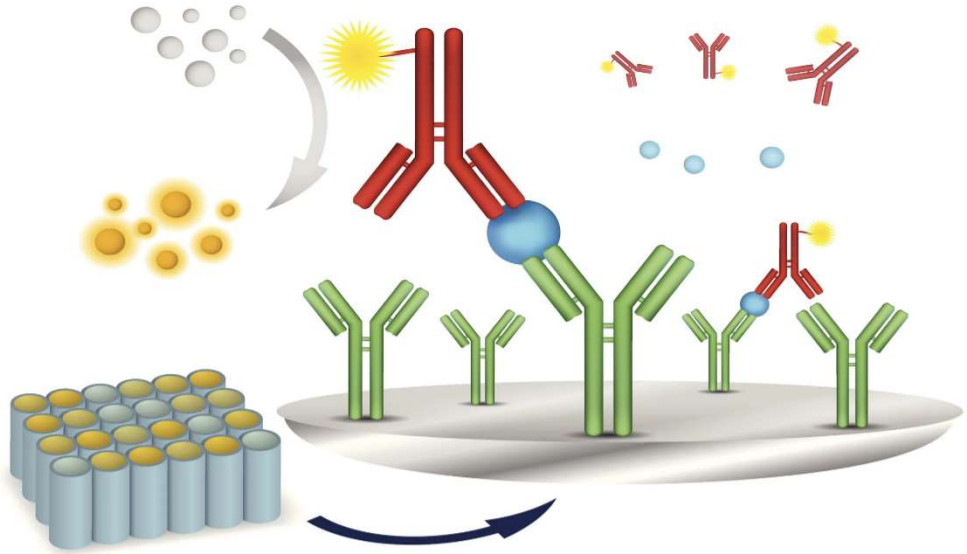
Basic Sensing Principles



Basic Sensing Principles

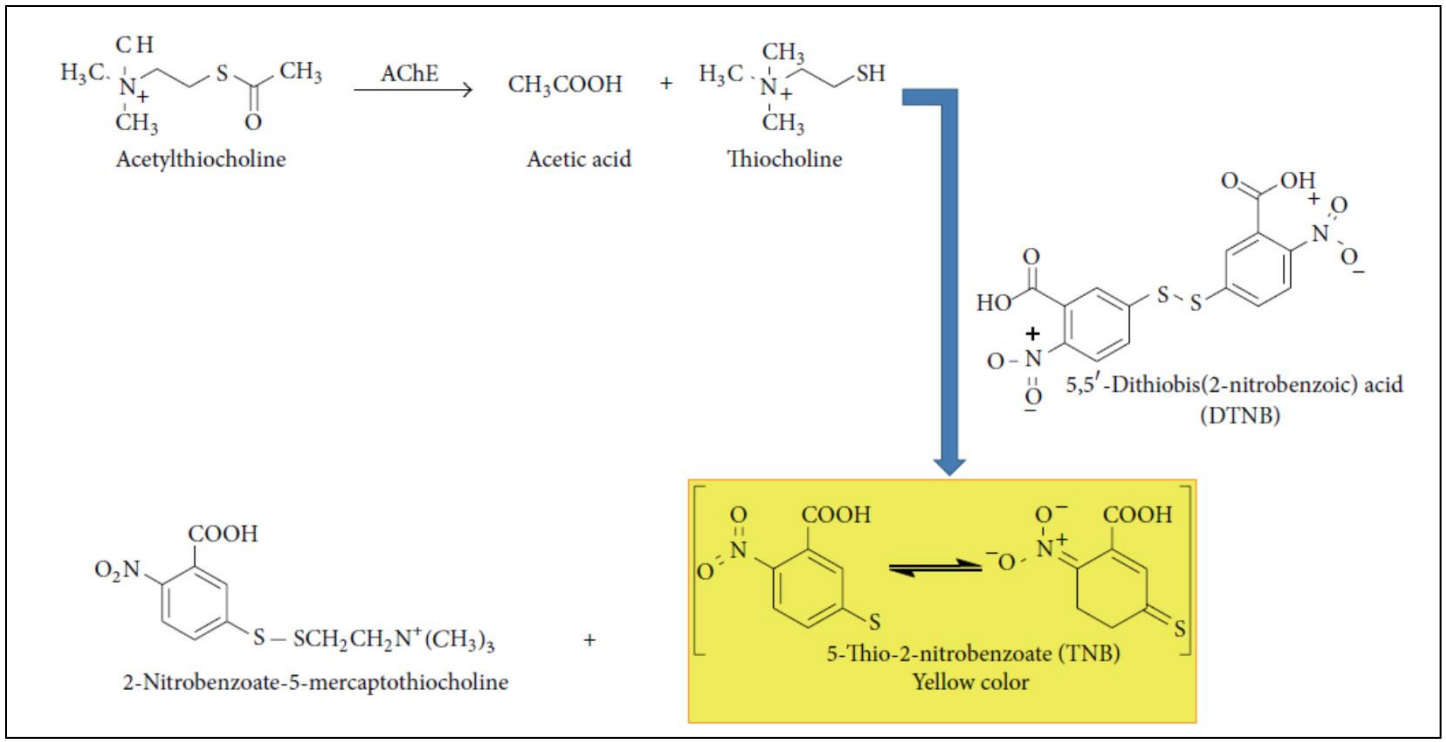
- **ELISA (E**nzyme-Linked Immuno-sorbent Assay) **based**

- **Enzymatic reaction product signals – Color, Fluorescence, Electro-chemical (change in redox – potentiometric current)**



- **Data Algorithm Analytics based on NIR / IR signature spectra**

Bioactive Paper Sensor Based on the Acetylcholinesterase for the Rapid Detection of Organophosphate and Carbamate Pesticides



Acetylcholinesterase (AChE) hydrolyses acetylthiocholine and forms thiocholine base, which then reacts with dithiobisnitrobenzoate (DTNB) to generate 5-thio-2nitrobenzoate (TNB, an anion), which is yellow in color

Emerging stronger Role for sensor based automation in food safety surveillance

- Sensor based devices on spoilage, based on VOCs
- Smart packaging sensors with chemically modified carbon nano-tubes- ability to carry electric current.
- Carbon nano-tubes modified by coating metal containing metalloporphyrins with cobalt at core, which binds with nitrogenous compounds - amines.
- Post binding, increase in electrical resistance measured
- Surface Plasmon Resonance (SPR) biosensors with array of DNA probes, micro-spotted for rapid detection of bacterial pathogen specific nucleic acid
- Polymer based nano-photomic sensor chips
- Active Packaging with additives, capable of scavenging gases

CSIR-CEERI Intervention in Milk Quality

System capable of measuring milk contents like fat (%), solid nonfat (%), proteins (%), lactose (%), density and added water (%) in milk.

System Specifications:

- **Portable and user friendly**
- **Environmental friendly technology (chemical free)**
- **Auto calibration at field**
- **Measurement time: 30-35Sec.**
- **Accuracy: Butterfat ±0.1%; Solid nonfat ±0.2%; Protein ±0.2%; Lactose ±0.2% and water ±5%.**

NDDB & DFRL Milk Adulteration Kit

CFTRI- Development of Spoilage Indicator for Milk

Milk Spoilage Indicator

Green color (FRESH)

Orange color (About to spoil)

Red color (Spoiled)

- **Milk indicator is a time and temperature dependent.**
- **Validation of indicator at large scale is under progress.**

Mobile Food Safety Lab

Automation in Food Safety & Quality Assurance: Way Forward & Follow-ups

- Validation of sensor based rapid methods important.
- Regulation support- detection methods, toxicity study, labeling needs
- Use of Smart packaging spoilage sensors with chemically modified cobalt coated carbon nano-tubes, which reacts with amines
- Enhance Surveillance & Early warning system
- Capacity building of state health departments
- Establishment of National Electronic Network for rapid finger print control of inter-state food borne outbreak

Concluding…

Automation in Food - Shared Responsibility ?

Government	Industry / Trade	Consumer
Food Legislation & Enforcement	Good Practices by Primary Producers and Distributors	Educated and Knowledgeable Public
Guidelines for Industry/ Trade	Quality Assurance and Control of Processed Foods	Discriminating and selective consumers
Consumer Education	Appropriate Process and Technology	Safe Food Practices in Home
Information Gathering and Research	Trained Managers and Food Handlers	Community Participation
Provision for Health related services	Informative labelling	Active Consumer Groups.

Appreciate your Connect & Attention

THANK YOU