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ijirset@gmail.com



www.ijirset.com

# Chemical Analysis of Food by Inspectors in Industry

<sup>1</sup>Smt Disha & <sup>2</sup>Prof. Dr. Manisha Rao

<sup>1</sup>Research Scholar, Dept. of Home Science, GGPG College, Bareilly, India

<sup>2</sup>Dept. of Home Science, GGPG College, Bareilly, India

**ABSTRACT:** Food analysis is the discipline dealing with the development, application and study of analytical procedures for characterizing the properties of foods and their constituents. These analytical procedures are used to provide information about a wide variety of different characteristics of foods, including their composition, structure, physicochemical properties and sensory attributes. This information is critical to our rational understanding of the factors that determine the properties of foods, as well as to our ability to economically produce foods that are consistently safe, nutritious and desirable and for consumers to make informed choices about their diet. The government has a Food Inspection and Grading Service that routinely analyses the properties of food products to ensure that they meet the appropriate laws and regulations. Hence, both government agencies and food manufacturers need analytical techniques to provide the appropriate information about food properties. The most important criteria for this type of test are often the accuracy of the measurements and the use of an official method. The government has recently carried out a survey of many of the official analytical techniques developed to analyze foods, and has specified which techniques must be used to analyze certain food components for labeling purposes. Techniques have been chosen which provide accurate and reliable results, but which are relatively simple and inexpensive to perform. The food industry is highly competitive and food manufacturers are continually trying to increase their market-share and profits. To do this they must ensure that their products are of higher quality, less expensive, and more desirable than their competitors, whilst ensuring that they are safe and nutritious. To meet these rigorous standards food manufacturers need analytical techniques to analyze food materials before, during and after the manufacturing process to ensure that the final product meets the desired standards. In a food factory one starts with a number of different raw materials, processes them in a certain manner (e.g. heat, cool, mix, dry), packages them for consumption and then stores them. The food is then transported to a warehouse or retailer where it is sold for consumption.

**KEYWORDS:** food analysis, grading service, higher quality, standards, consumption, food factory, accuracy

## INTRODUCTION

The physical and chemical testing of food is based on the basic principles of physics and chemistry.<sup>1</sup> The technique of using instruments to test the physical and chemical properties of foods involves a large number of physical experiments and chemical experiments in the physical and chemical testing of foods, so that people can accurately understand Whether there are elements harmful to the human body and their contents in the food and the nutrient content of the food. The routine operation of physical and chemical testing of foods involves the following steps: first, the sample is collected, and the sample is pretreated to prepare for subsequent physical and chemical testing; thereafter, the concentrating method, the extraction method, the extraction method, the distillation method and the like are used. The chemical method separates and purifies the sample to obtain a state that can be directly used for detection; then, the instrument and the chemical analysis means are used to detect and analyze the extracted components, and the composition and content thereof are determined, and finally, the test results are data. Record, check the rationality of the test results, and analyze the test results to produce a physical and chemical test report. The main work is the inspection of the raw and auxiliary materials into the factory, the inspection of the production process, and the inspection of the finished products.<sup>2</sup> The specific work requirements still depend on the requirements of your company or factory. The basic conditions for food inspectors are: **"Implementation Opinions on Strengthening Food Quality and Safety Supervision and Management Work"** stipulates: "Inspectors must master the basic knowledge of the law and the basic knowledge and skills of food inspection." Generally, the following conditions should be met, and only after passing the training and examination, can bear the food quality inspection work, the practitioners must have a secondary education or above or have qualifications for junior professional and technical positions; have engaged in food inspection or related professional inspection; The above qualifications include secondary school, but do not

include high school education. The inspection work of related majors mainly refers to the inspection work similar to the food inspection profession. The food inspectors include the inspectors engaged in food quality inspection by the quality inspection organization and the auditors who audit the inspection results, and the inspectors and inspection department heads of the food production enterprises engaged in factory inspection. The standard food physicochemical testing process should involve three aspects - the collection of food samples, the pretreatment of samples and the inspection and determination of extracted samples.<sup>3</sup> Among them, the collection of food samples is the basis of all subsequent work, and should be highly valued. In the process of collecting food samples, attention should be paid to the representativeness of the collected samples to ensure that the samples are not contaminated, and the samples are strictly in accordance with the sample collection process. Collect work to ensure the accuracy and reliability of the test results. In the pretreatment of food samples, attention should be paid to the selection of appropriate pretreatment methods, the recovery rate of the components to be tested, and also to ensure that the components to be tested are not contaminated, and the components to be tested are often enriched during pretreatment. At this time, it should be ensured that the concentration of the component to be tested is within the available range, which provides guarantee for the accuracy of subsequent measurements. If there is interference group, it will cause interference to the instrument test. A shielding agent should be added to shield the interference of the component to be tested from the interference component, and less measurement error<sup>4</sup>. **Food Hygiene means ensuring food is hygienically prepared and maintained with the help of Food Safety Management Procedures (FSMS Program).** Under FSS Act, it is mandatory for all FBOs to have a Food Safety and Management System program. Any FBO that applies for License or Renewal of License has to submit FSMS program related documents along with the application for license.

**According to food safety regulations**, processed food items and served foods must reach the end user in an environment that is healthy and in a hygienic condition. With Food Safety Management Procedures in place it is expected that cooking areas are free from insects and external influences, the equipment being used is in good shape, the water supply including water for preparation and for other purposes is regular, staff members maintain personal hygiene, hygienic transportation/supply of food items<sup>5</sup>, the packaging and wrapping of food items is as per standards, disposal of waste food is regular, hygienic conditions of premises where food is served and every step is taken so that the food product is served in a good condition. FSSAI has also incorporated Codex Alimentarius (An international organization for ensuring safe and hygienic food) recommended standards based on **Hazard Analysis and Critical Control Point (HACCP)**. This system helps food business operators to manage food handling and to introduce procedures to make sure the food produced is safe to eat.<sup>6</sup>

**HACCP ensures that operational activities are controlled in all key areas and that food remains within microbiological parameters.** There is a requirement for allergen testing, testing for chemical contaminants besides maintaining sanitary and hygienic conditions at every stage of food handling from processing to delivery which is the final product. Top 5 laboratories and is accredited by NABL, FSSAI, BIS, CDSCO, ISM&H, APEDA, EIC/EIA, AGMARK and more. They have a range of testing technology and their food testing laboratory is equipped to analyse food adulteration using techniques like HPLC, HPTLC, GCMC, LCMSMS and they also conduct chemical analysis.<sup>7</sup>

**They offer the following services:**

- Area monitoring –air sampling for viable microbial contaminants
- Swab sampling of staff from hand and finger
- Swab sampling of utensils, chopping boards and table
- Swab sampling of food contact surfaces
- Testing for Chemical and Microbial Parameters Cleaning validation of CIP/SIP equipment
- Testing for Pesticide Residues
- Testing of Adulterants in Food

## DISCUSSION

In this modern era, pesticides are often used, particularly to preserve food, and in the agrarian and floricultural practices, to combat undesirable pests and improve productivity which has undoubtedly reduced food value. The residue of such chemicals on soil, terrestrial, and aquatic ecosystems affects not only human health but also animals' health. **For instance, organochlorine is the most toxic yet widely used pesticide in agriculture, and its exposure**



has caused a dramatic decline in honeybee populations as well as direct pollution of honey. To detect organochlorine pesticides like DDT chemically known as 1,1-(2,2,2-trichloroethane-1,1-diyl) bis (4-chlorobenzene), an immune nanobiosensor based on AuNPs in dipstick format using competitive immunoassay is developed<sup>8</sup>. Furthermore, all honey samples are regularly identified with at least two pesticides, amitraz metabolites and coumaphos, and at most nine more, while lipophilic pesticides are primarily contained in beeswax, and the results suggest that children's well-being can be jeopardized if honey and beeswax are consumed regularly. 24 new pesticide residues are selectively determined by a miniaturized extraction-partition procedure requiring small amounts of nonchlorinated solvents in fruits like apple puree, concentrated lemon juice, and tomato puree<sup>9</sup>. New detection methods like aptasensor, enzyme-based biosensor, origami multiple paper-based electrochemical biosensors, and graphene quantum dots-based photoluminescent sensor are used for the detection of pesticides in food. Along with the advancement of spectrometric methods, liquid and/or gas chromatography-tandem mass spectrometry (LC-MS/MS and/or GC-MS/MS) and biosensors are used for monitoring pesticides, and various enzyme inhibition-based detectors have been used for detecting pesticides in food. To ensure food safety, pollutants must be continuously regulated and monitored using appropriate advanced procedures<sup>10</sup>.

### Public Analyst

The person recruited for this post should not have interest in manufacturing, import, sale or distribution of food. Central Government or State Government may appoint **public analyst** for Local Area.

**Different analysts for different articles can also be appointed.**

**The person with following qualification is eligible for the post of public analyst.**

(a) A person who holds degree in science with chemistry/food technology/food and drugs/biochemistry or equivalent examination and not less than 5 years practical experience after graduation in analysis of food articles or holds masters degree in chemistry/food technology/biochemistry/food and drugs/ microbiology or Associateship of Institution of Chemists (analysis of food) or any other equivalent qualification with a minimum of 3 years practical experience after post graduation in analysis of food.<sup>11</sup>

(b) The person should have been declared qualified for appointment by the Board appointed by Government.

### Food Inspector

Food Inspectors can be appointed by the Central Government or State Government for Local Areas identified. A person to be appointed as food inspector should have no interest in manufacturing, sale or distribution of food articles.

The person with following qualification is eligible for the post of food inspector.

(a) A medical officer in charge of Health Administration of Local Area or

(b) A graduate in medicine with a minimum of one month training in inspection of food sampling work in an institution approved by Central Government or State Government or

(c) A graduate in science with chemistry/agriculture/pharmacy/ veterinary science/food technology/dairy technology/public health/diploma holder in food or dairy technology or equivalent qualification and a minimum of 3 months satisfactory practical training in inspection of food and training approved by Central Government or State Government.<sup>12</sup>

### Duties of Public Analysts

On receipt of sample from food inspector, the public analyst confirms the authenticity of the sample sent by him comparing the seal on it. He keeps the sample in safe custody before, during and after analysis and preserves it for submission into court, as and when required. He carries out the analysis of food samples sent by inspectors using approved methods, records the findings of analysis in specified manner and inform the food Inspector about the

analysis. The public analyst should also be in touch with the Central Food Laboratories for the purpose of consultation and dissemination of knowledge.<sup>14</sup>

### **Duties and Powers of Food Inspectors**

- To inspect establishment for licence for manufacture, storage or sale of food article and satisfy that the conditions and provisions of the Act are complied with
- To make enquiries on receipt of complaints about the quality of food and conduct inspection accordingly
- To investigate into matters of specific complaints given in writing.
- To maintain the records of inspection properly and keep inform higher authorities about inspection.<sup>15</sup>

The food inspector can prohibit sale of food article in public interest for a specific period, can also stop the vehicles carrying adulterated or misbranded food, seize the samples of food articles prepared in contravention with the provisions of the Act, enter the premises within the reasonable time of business and seize the sample or break open any package containing adulterated or misbranded food. For seizing the sample, a notice in writing has to be given to the owner. Three parts of the seized material are prepared in presence of witnesses, sealed, one part is sent to public analyst and two parts to local authorities.<sup>16</sup>

### **Permitted Colours in Food**

Chlorophyll, caramel, beta-carotene, annatto, coal-tar dyes, saffron and curcumin. The colour content should not be more than 0.2 mg per kg of food material.

### **Antioxidants Permitted in Food**

Tocopherol, ascorbic acid, lecithin

### **Preservatives Permitted in Food**

Class I: Common salt, sugar, dextrose, glucose, syrup, vinegar, honey and edible vegetable oil.

Class II: Benzoic acid and salts, sulphurous acids and salts, nitrates and nitrites of sodium and potassium. Sorbic acid and salts, methyl diacetate, sodium, potassium and calcium salts of lactic acid. Not more than one class II preservative is permitted.<sup>17</sup>

No nitrate or nitrite preservative to be added to infant food.

The Food Inspector functioning beyond the scope of this Act is liable to the penalty of Rs. Five hundred.

## **III.RESULTS**

COVID-19 cases have occurred before hence although food might not be a direct transmitter of the virus, but food surface, its quality, and processing techniques, etc can possibly be the reason for transmission. This can also damage to the brand as well as to the reputation of the Indian Food Industry, which is why food testing by Accredited and Certified laboratories is a must to ensure safety and hygiene of food products.<sup>18</sup>

Food product testing is considered as the most important step despite being the last process of the food manufacturing chain. Food product testing is vitally necessary, to assure that the food is free of physical, chemical, and biological hazards and also determines the safety of the food for use. Examples of potentially hazardous food contaminants

include metals, pathogens, cleaning agents, additives, preservatives, pesticides, adulterants, and more. Food product testing also refers to the scientific analysis of food and its contents to provide information about characteristics of food like its structure, composition, and Physico chemical properties.

In India, regulations set up by FSSAI are most vital and should be followed and monitored regularly.<sup>19</sup>

**Food testing is crucial for food industries for many reasons as it covers wide range of requirements like**

- Testing the quality of a product
- Quality control
- Food inspection and grading
- Food authenticity check
- Testing for adulterants
- Nutritional labelling
- Food nutrient content analysis
- Shelf-life analysis
- Sensory evaluation

**How Food Testing can benefit food production business**

1. **Customers:** Protects and guaranteed prevention to customers from food-borne diseases.
2. **Manufacturers:** Assures product safety, approval to enter the market, and aids in brand reputation which in turn, leads to an increase in business ventures.<sup>20</sup>

**Techniques that take place in a food testing laboratory:**

3. **Analytical chemistry testing:** This helps to identify, separate and even find the quantity of the chemical components of natural and artificial materials in the food product such as pH, additives, nutrients, preservatives, contaminants, minerals and much more.
4. **Microbiology testing:** This food testing helps food manufacturers identify the microorganisms that inhabit the food and understand the safety of the raw materials used in food production, ingredients as well as the final product. This is also used to test and examine spoiled pathogens to prevent food poisoning outbreaks that are generally caused by the products and the ingredients used in the products. This is also a necessity otherwise the whole supply chain can be contaminated and disrupted in the process of food production, leading to not only a danger to the general public but also a hefty loss of money<sup>21</sup>.
5. **Food allergen test:** Food allergens are proteins that appear in huge quantities. It helps to find the main target allergen in the ingredients and finished food product. Normally allergens are tested in food products such as peanuts, gluten in grains, eggs, nuts and milk, etc.
  6. **Nutritional analysis:** This area in food testing provides accurate information on the nutritional content of food products. This gives manufacturers the required details to include it on food packaging and ensure that they are following all compliances and labelling regulations.<sup>30</sup>

**Quality assurance (QA)** is a set of activities for ensuring quality in the processes by which products are developed. It's a proactive process and aims to prevent defects by concentrating on the process used to make the product. The goal of QA is to improve development and test processes so that defects don't arise when the product's being developed.<sup>29</sup>

QA can be achieved by establishing a good quality management system and assessing its adequacy. What's more, everyone on the team involved in developing a product is responsible for quality assurance.<sup>22</sup>

**Quality control (QC)** is a set of activities for ensuring quality in products by identifying defects in the actual products produced. It's a reactive process and aims to identify (and correct) defects in finished products.<sup>28</sup>

QC can be achieved by identifying and eliminating sources of quality problems to ensure customer's requirements are continually met. It involves the inspection aspect of quality management and is typically the responsibility of a specific team tasked with testing products for defects.

### 1) Food X-ray Inspection Equipment Provides Quality Assurance and Quality Control in the Food Industry

The ability of x-ray inspection systems to provide unsurpassed detection of a wide range of physical contaminants including metal, glass, mineral stone, calcified bone, high-density plastics, means they can be used to keep contaminants out of the production process, as well as catch contaminants before products leave the factory. It simply depends on where they're located in the production process – the critical control points (CCPs).<sup>23</sup>

The chemical testing scope includes:

- Heavy Metals (Pb, Cu, Zn, Sn, Hg, As, Cd, ...)
- Food Additives (Preservatives, Sweeteners, Synthetic colors, antioxidants, etc.)
- Fatty Acid (SAFA, MUFA, PUFA, TFA, Omega 3, Omega 6, etc.)
- Special content (EGCG, Tanin, Teina, Caffein, etc.)
- Alcohol (Methanol, Ethanol, etc.)
- Mycotoxin (Aflatoxin Total, B1, B2, G1, G2, etc.)
- 3-MCPD
- Pesticide Residue
- Brix
- Peroxide Value
- and other routine chemical test<sup>24</sup>

## IV.CONCLUSIONS

Food testing is integral to the efficient production of safe, quality products. With the food industry increasingly subject to scrutiny, testing to ensure compliance with food safety regulations and to protect public health, is a must.<sup>27</sup>

The comprehensive range of food testing services includes microbiology to test for pathogens like *Salmonella*, *E.coli*, *Campylobacter* and *Listeria*, as well as spoilage organisms such as Yeasts and Moulds, underpinned by our expert shelf life testing service. We can provide all of your chemical and nutritional requirements with nutritional analysis, meat species identification and more. **Inspectors can also provide expert testing services to detect allergens, residues and contaminants, as well as specialist services for all your food packaging, genetically modified organisms (GMOs) and honey analysis needs.** If you would like to understand how consumers perceive your food products, the sensory analysis services can help you with your requirements.<sup>26</sup>

Inspectors use the latest methods and technology to identify risk factors, improve quality, efficiency and to add value to the market. As your testing partner, you can be sure of fast turnaround times and accurate test results, demonstrating compliance with statutory requirements.<sup>25</sup>

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