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Food Waste Reduction with the Application of non-Destructive Methods for Food and Agricultural Products

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Abstract

Non-destructive studymeans to the surface testing of fruits and vegetables without any interfering technique affecting the food part and quality. Now days the quality and safety of food is agrowing concern for world business because they give thesimultaneous measurement of chemical and physical data from food without damage of thesubstance. This article discusses the necessity for food waste reduction with the help of non-destructive testing and its methods.

Keywords: Food waste, non-destructive methods, quality

Introduction

Food waste reduction is a significant aim for consumers, organizations and government authorities looking to be budget-conscious, reduce global warming, growth food production levels reduce plastic consumption and protect the environment. Agricultural and food products with high quality, food reduction waste and safety are essential parameters for the consumers, and it is essential to introduce strict rule for food safety. Therefore, the current food industry has been focused on developing safe products that meet the quality foods demanded by the market, seeking quick and accurate technologies [Saldana et al., 2013].

Necessity for food waste reduction

Now a day the maximum quantity of food were wasted by homes, shops, cafes and other food premises. This waste is taking place when millions of peoples are suffering from starvation. Food waste minimization has some application for humans and the environment, including improved food supply, cost savings, reduced stresses on ecology and the atmosphere, less emission.

What is non-destructivetesting?

Non destructive methods refers to the qualitative and quantitative measurements in agricultural products and processed food that has been surveyed without any physical, chemical, thermal and mechanical damages to cycle back.Non-destructive testing (NDT) is the detection and characterization of defects on the exterior or inside the objects without breaking the substance apart or physically modifying it. In other words NDT means the process of evaluating and inspecting the food products to detect the faults and deficiencies without changing their original properties being tested. NDT methods provide low cost method of assessing food products. Today, measuring the quantity and quality of agricultural products without any injuries and reduce food waste has a special position in post-harvesting and processing of agricultural products. Non destructive methods attributed quality valuation methods have increased dominant factor and considerable attempts for fresh fruit and vegetable these years.

Advantages of Non-destructive testing in the food industry

NDT is used in the high quality control scheme and other well-established approaches. Non destructive examination refers to the surface examination of fruits and vegetables without the use of any invasive technique that may damage the foods appearance or freshness. Non- destructive analysis techniques provide information on food qualities such as structural, morphological, physiological and thermodynamic composition. The use of non destructive monitoring is the best method for food and meat processing.

Temperature testing techniques for food industry

Traditional techniques require inserting a metallic gauge into the packaged food to ascertain the degree, which is commonly done at the probes base. To measure the degree of warmth of a product, place the sensor such that the end is in the center (or thickest section) of the food and leave it in place until the measurement stabilizes.

Types of Non-destructive quality evaluation of food and agricultural products:

1. **Acoustic Technique: -** The acoustic approach is an intriguing way of assessing the quality of food and farm products. It is rapid, inexpensive and nondestructive. Because of these benefits, mechanical acoustic approaches have become increasingly popular as effective instruments for measuring the quality of meals. The acoustic system consists of noise generator, an absorption system, and procedures for

determining pitch fluctuation, whereby the freshness of meals is determined based on the noise produced by crunching it.

2. **Color measurement and computer image analysis:-** Chemical components of any food material absorb light energy at specific wavelengths; hence some compositional information can be resolute from spectra measured by spectrophotometers. In the visible wavelength range, carotenoids, pigments such as chlorophylls, anthocyanin and other colored compounds are the major light absorbing component of foodstuffs such as vegetables.

3. **Machine Vision technique:-** The machine vision technique has been used to examine and estimate foodstuff quality in the food industry. It is affordable, quick, economical, hygienic, and consistent. Currently, applications of the machine vision technology are commonly used for shape classification, defect detection, and quality assessment.
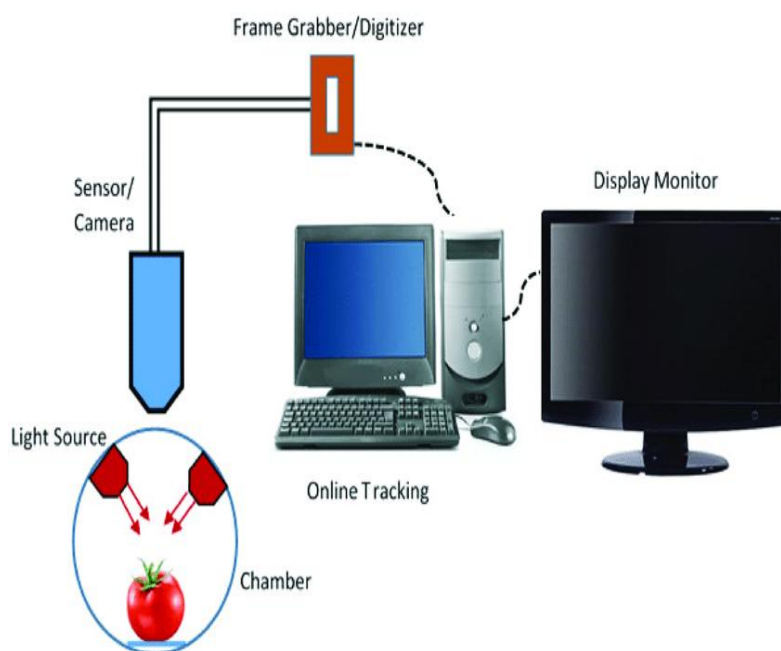

Figure1. The basic concept and components of a typical machine vision system.

4. **NIR Spectroscopy:-** Near infrared spectroscopy is one of the most widely studied quality assessment tools for the last twenty years. It is a rapid, powerful, reliable and non-destructive technique for the measuring qualitative and quantitative properties of biological materials. This technique is now increasingly used for non-destructive measurement of the quality of fruits and

vegetables such as soluble solids (Brix), acidity, titrable acidity, water content, dry matter, firmness.

5. **Biosensors: -** A biosensor is an analytical device, used for the detection of a chemical substance that combines a biological component with a physicochemical detector.
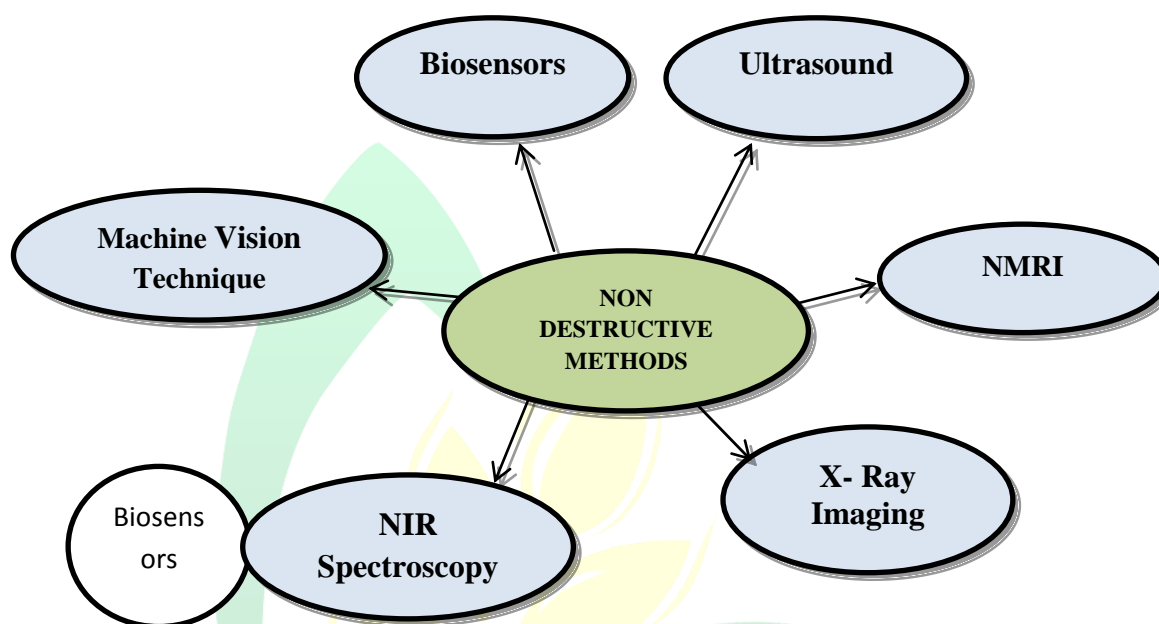

Figure 2. Types of Non Destructive Methods for quality evaluation of food products

6. **X-Ray imaging and computing technology:-** An imaging system technique is a common to obtain spatial information of the samples in monochromatic forms or color images. Imaging system is therefore used for color, shape, size, surface texture evaluation of food products and to detect surface defect in food samples.

7. **Nuclear magnetic resonance imaging:-** Magnetic resonance imaging (MRI) has become a well-established technique for non destructive analysis of the internal structure of food. It is used to evaluate the property of interest for food processing (as drying), physical tissue damage assessment (as bruising) and others for online sorting process or detection of internal defects (as internal browning.

8. **Ultrasound:-** Ultrasound technology has been known and used in many areas, including medical diagnostics, industrial processes, and metal fabrication. It has

also gained attention and increasing popularity in assessment and testing the biological and food-stuffs.

Table1. Non-destructive methods to evaluate the quality characteristics of agricultural and food products (El-Mesery*et al*., 2019)

Scientific basis	The techniques used	Measurable types
Optical	Image processing	Size, shape, color, outward defects
	Spectroscopic reflectance, transmission and absorption, laser spectroscopy	Sugar, acidity, soluble solid content, color, internal and external defects, stiffness
	Laser spectroscopy	Firmness, viscoelasticity, defects, shape
X-Ray	imaging X-Ray And CT	The inner cavity structure, the degree of maturity
Mechanical	Vibrational excitation	Stiffness, viscoelasticity, the degree of maturity
	Sound and ultrasound	Stiffness, viscoelasticity, internal cavity, density, sugar and
Electromagnetic	MRI, NMR and NIR	Sugar, moisture content, the inner cavity
Chemical	E-tongue, E-nose	Acidity, sugar

Conclusion:

This summary shows that various non destructive testing methods were used for food waste reduction during processing. The non-destructive detection methods for food quality have an advantage compared to other instrumental analysis methods. The future of using non-destructive technologies for assessing the quality of food and agricultural products will improve the measurement of internal quality characteristics of fruits. The utilization of non-destructive techniques provides better advantages for the food industry and also reduces the food waste.

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