JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 10, ISSUE 07, 2023

The use of Nano-Zinc in meat preservation

Heba Tallah Mahfoodh Khaleel [1], Mohamed Norulden Abdulsatar [2],

Anwaar muayad Ismael [3]

[1.2.3]University of samarra, Collage of Sciences Applied , Department of chemistry Applied

hibatallah.m@uosamarra.edu.com, teto.love966@gmail.com, samarrabaghdad171969@gmail.com

Abstract

The process of preserving meat is done by adding some substances that prevent damage to the meat components, in addition to stopping enzymatic activity and microbial growth during the storage period and controlling storage conditions. Nano technology is one of the modern technologies that have been used in preserving food, especially meat. What the research discussed in terms of using nano-zinc to preserve meat and other foods, prolonging its shelf life, and preserving its characteristics of color, smell, texture, and general acceptability.

Key words :- Nano-Zinc, Food preservation, Types of nanoparticles

Introduction

Man used meat for nutrition when he was able to hunt animals, and after he practiced hunting, the meat became surplus to what he needed, which led him to think about ways to preserve the excess of it for longer periods, especially when he did not find hunting or food to satisfy his hunger. The first preservation methods used were drying the meat and It was made by adding salt, and preservation methods developed as other, more effective methods emerged in the field of preserving meat using refrigeration, freezing, and adding preservatives (1).

Meat is the animal tissue that is used for nutrition. This definition includes all manufactured products that can be prepared from animal tissue. It can be said that most of the meat that we consume comes from domesticated animals, and the meat consists mainly of muscle in addition to varying amounts of connective tissue. Skeletal muscle is the main source of muscle tissue in meat. There may be small amounts of smooth muscle in meat. Meat also contains fatty tissue, bones and cartilage. The parts that most affect the nutritional value of meat in terms of quantity and quality are the composition of the meat and the muscle and fatty tissue it contains. (2).

Meat and its products are an important source of human nutrition due to their high nutritional value because they contain essential amino acids that contribute to the cellular structure of the body, in addition to containing fats, carbohydrates, mineral salts and vitamins, which thus constitute a suitable medium for the growth of microbial organisms that lead to spoilage. Meat From here began human attempts to find appropriate means to preserve meat from spoilage while retaining its full nutritional value for long periods of time (3).

Researchers were interested in finding various food additives to preserve the high nutritional value of meat, reduce the risks of eating it, and increase the storability of their products. Poor conditions to which meat and its products are exposed after slaughter and storage may lead to a significant growth of microorganisms, which leads to their spoilage (4). The interest of producers and consumers in preserving the quality of meat by reducing chemical and physical changes in order to preserve the nutritional value of meat and prolong its storage life (5) The process of preserving meat is done by adding some substances that prevent damage to the components. Meat, in addition to stopping enzymatic activity and microbial growth during the storage period and controlling storage conditions (6).

The use of traditional preservative materials whose preservation effectiveness has been discovered is no longer healthy due to knowledge of their dangerous role in causing cancer, including nitrates, nitrites, and benzoic acid. Therefore, the Food and Agriculture Organization of the United Nations has enacted laws limiting the use of these materials and restricting producers to specific percentages of use in order to reduce The harmful effects of these dangerous materials.

Nanotechnology has emerged as a new technology used in several fields, especially the fields of food preservation. Interest in nanotechnology has increased because of its special properties that enable it to enter many fields and applications. It has been used in the chemical, mechanical and technological industries, and has also entered the medical field and the pharmaceutical industry (8) . The field of nanotechnology is one of the most popular areas of research and development in essentially all disciplines (9). This is due to its characteristics such as high strength, light weight, excellent chemical reactivity, very small size, high surface area, and high stability (10). Among the most widely used nanomaterials,

Zinc oxide has gained great interest in the scientific and medical communities, due to its important use in many biomedical and antibacterial applications, due to its chemical and physical properties (11), such as high electrochemical correlation coefficient and high optical and chemical stability (12).

There is an increasing need to search for alternative methods to formulate new types of safe and cost-effective antibiotics to eliminate and control pathogens. Since most biological processes take place at the nanoscale, the combined efforts of nanotechnology and biology can solve medical problems. Importantly, among many semiconductors, metal oxides, especially zinc oxide, are biologically safe, cost-effective, non-toxic, and very useful against pathogenic bacteria.

Historical overview of meat and methods of preserving it :

Man used meat for nutrition when he was able to hunt animals, and after he practiced hunting, the meat became surplus to what he needed, which led him to think about ways to preserve the excess of it for longer periods, especially when he did not find hunting or food to satisfy his hunger. The first preservation methods used were drying the meat and It was made by adding salt, and preservation methods developed as other, more effective methods emerged in the field of preserving meat using refrigeration, freezing, and adding preservatives (13).

Meat is the animal tissue that is used for nutrition. This definition includes all manufactured products that can be prepared from animal tissue. It can be said that most of the meat that we consume comes from domesticated animals. The meat consists mainly of muscle in addition to varying amounts of connective tissue. Skeletal muscle is the main source of muscle tissue in meat, and there may be small amounts of smooth muscle in meat. Meat also contains fatty tissue, bones, and cartilage. These are the parts that most affect the nutritional value of meat in terms of Quantity and quality is the composition of meat and the muscle and fatty tissue it contains (14). Meat and its products are an important source of human nutrition because of their high nutritional value because they contain essential amino acids, which contribute to the cellular structure of the body, in addition to containing Fats, carbohydrates, mineral salts, and vitamins thus constitute a suitable medium for the growth of microbial organisms that lead to spoilage of meat. From here began human attempts to find appropriate means to preserve meat from spoilage while retaining its full nutritional value for long periods of time (15).

Researchers were interested in finding various food additives to preserve the high nutritional value of meat, reduce the risks of eating it, and increase the storability of their products. Poor conditions to which meat and its products are exposed after slaughter and storage may lead to a significant growth of microorganisms, which leads to their spoilage (16), and the interest of producers and consumers lies in preserving the quality of meat by reducing chemical and physical changes in order to preserve the nutritional value of meat and prolong its storage life (17).

The process of preserving meat is done by adding some substances that prevent damage to the meat components, in addition to stopping enzymatic activity and microbial growth during the storage period and controlling storage conditions (18).

The use of traditional preservative materials whose preservation effectiveness has been discovered is no longer healthy due to knowledge of their dangerous role in causing cancer, including nitrates, nitrites, and benzoic acid. Therefore, the Food and Agriculture Organization of the United Nations has enacted laws limiting the use of these materials and restricting producers to specific percentages of use in order to reduce Because of the harmful effects of these dangerous materials, studies have turned to finding natural preservatives of plant origin to avoid dangerous preservatives. For example, many materials began to be used, including rosemary, green tea, and many other materials (19).

Meat constitutes a distinct place in human meals, especially animal ones, because the properties of proteins are greatly affected by the type of amino acids present in them. The importance of proteins or amino acids is mainly due to them being an essential factor in building body tissues during growth and cellular replacement and building essential proteins to sustain activities. Vital parts of the body, including hemoglobin, enzymes, hormones, antibodies, and the formation of proteins necessary for fat transfer. And other nutrients for the body, as well as the formation of protective proteins that maintain the balance between fluids in Blood and tissues and act as regulators against any changes in the composition and acidity of tissues (20)

Due to the high nutritional value of meat proteins, they play an important role in human nutrition and maintaining their general health, which has led to an increase in meat consumption in many countries of the world, where it now represents 12% of the total calories of a European person and 31% of the total calories of a person American (21).

It is worth noting that the best types of proteins are animal proteins, represented by all kinds of meat, because they contain essential amino acids that are similar in structure to their counterparts found in human body protein, as the absorption rate of amino acids exceeds 90%, which is higher than proteins. Vegetarianism in absorbability. Because of this great importance of animal meat, researchers sought to preserve meat so that it reaches the consumer with its full nutritional value (22).

Red meat contains the most important compounds necessary for building the body and performing its vital functions, as it contains proteins, fats, vitamins, and salts. The proportions of these substances are affected by many factors, including the type of animal, its breed, sex, age, degree of fattening, and the anatomical location of the piece of meat. Beef meat has a high water content of about 71.5%, protein 21.5%, fat 5.5%, and ash 0.9%. The high percentage of protein in beef is considered to be of great importance in the field of meat processing, as it is used in the manufacture of many products, including pastrami, burgers, and sauce. The breeding of beef cattle has been developed by improving the genetics of cows to produce types with high weights, which has allowed for an increase in meat production and a focus on methods of preserving and delivering meat. To distant areas (23).

Food preservation

It is a process taken to slow down the natural spoilage of food. There are several methods for this, ranging from simple cooling of food to preserving food by radiation. It means exposing the food to a source of radiation energy, either from radioactive isotopes or from devices that produce controlled amounts of electron rays or X-rays. Which works to absorb the food in a specific and effective dose with the aim of preserving the food and prolonging its shelf life by eliminating the causes of spoilage and spoilage. This method is characterized by being fast. It is quick, low-cost, and does not cause any harmful effects to humans, all without raising the temperature of the food. For this reason, it is called cold sterilization. Some methods of preserving food are very old, dating back to the prehistoric era, but new methods of preserving food have been developed as a result of modern scientific progress (20).

Food preservation has helped make modern life possible. Without food preservation, most individuals would have to grow their own food, and food could not be transported from the countryside to the cities without it being spoiled or damaged by pests. As a result, it was not possible to establish new cities, and famines would occur. Mostly, it is more common and widespread, because without food preservation it is not possible to preserve surplus amounts of food for use in emergency situations (21).

Spoilage of meat

Meat spoilage is defined as any undesirable change that alters the characteristics of meat, making it unacceptable to the consumer for various reasons, including health or related to other characteristics of meat such as shape, colour, taste and smell. Meat spoilage occurs due to the action of endogenous enzymes present in the meat in addition to... The growth of various microorganisms on meat because it is a nutritional medium suitable for their growth, and these two factors damage the meat and cause it to spoil (23).

ISSN- 2394-5125 VOL 10, ISSUE 07, 2023

Factors of meat spoilage

Meat spoilage occurs due to the influence of various microorganisms found in nature (water, air, soil), as these organisms lead to significant changes in the characteristics of the meat, which makes it unacceptable to the consumer. Among these organisms are (24):

Bacteria

Bacteria cause several unacceptable changes in the characteristics of meat in terms of appearance, as the bacteria change the color of the surface of the meat, and this type of spoilage is considered a major reason for the consumer's rejection of this meat and its products. As for the chemical characteristics of the meat, the bacteria break down several substances, especially carbohydrates, because they decompose quickly and are considered a suitable food for this. Biology: Bacteria also decompose proteins into numerous peptides, amino acids, and ammonia. As for fat, they decompose it into glycerol and fatty acids. The oxidation and reduction process produces aldehydes and various unwanted gases with an unpleasant odor, including hydrogen sulphate, H2S, carbon dioxide, CO2, hydrogen, H, and ammonia, NH3. In this case, from a health perspective, bacteria cause diseases in humans, either directly or through their secretion of toxic compounds that cause human poisoning (25).

Fungi

Fungi spread widely in soil and water and cause health damage to humans and animals and cause some infectious diseases when ingested. Fungi are characterized by being less in need of water than yeasts and bacteria. They are obligate aerobic organisms and grow in acidic media (3.5 - 4.5) and resist this. Fungi, high osmotic pressure and high-sugar media (24).

Yeasts are spread in various places in nature, but they are less widespread than bacteria. Yeasts need a high water environment to grow, more than fungi need and less than bacteria need. It tolerates acidic media (4-4.5) and is divided according to its need for oxygen (aerobic or anaerobic) (24).

Microbial contamination of meat and meat products

Meat is a suitable environment for the growth of microorganisms because of the high moisture, proteins, fats and carbohydrates it contains. Among the microorganisms that grow in meat are Escherichia coli, Stphylococcus aureus, Bacillus Subtilis and Salmonella typhimurium. Microbiological contamination in fresh meat occurs due to many factors, including the polluted external environment. From the animal itself, the tools used and the workers, and from the processes of preparing, storing and cutting meat (26).

ISSN- 2394-5125 VOL 10, ISSUE 07, 2023

A previous study showed that E. coli bacteria can grow in the intestines of animals in the form of colonies, causing contamination of muscle meat during slaughter, as E. coli bacteria resist low temperature conditions in refrigeration and freezing and can reproduce very slowly at a temperature of 36°C for a period of time. Relatively long unless heat is raised to eliminate it (27).

A study conducted by a number of researchers on ten samples of ground beef showed that the number of Staphylococcus aureus bacteria was 310 cfu/g. This bacteria rarely multiplies in fresh meat due to its inability to compete with microbes. It begins to multiply and become active after other species are inhibited by cooking. The bacteria perform two types of activity. Enzymatic activity on fats includes hydrolysis by the enzyme (Lipase) and oxidation of fatty acids by the enzyme oxidase, as releases of the products of these reactions cause the odors and flavor characteristic of the state of rancidity. Some bacteria, such as Pseudomonas, can secrete enzymes that cause hydrolysis of fats (Lipolyticmicrobs), as well as enzymes that cause Lipid oxidation (28).

A group of researchers noticed that when they studied strains of B. subtilis and B. pumilus bacteria in industrial and artisan sausages and investigated their dangers based on immunological studies and DNA tests, they found that many of these strains are present in meat and cured sausages in Italy, and it was found that The bacteria that grow in meat have physiological and genetic characteristics to resist extreme environmental conditions or factors and compounds that inhibit growth. Therefore, studies focused on By preserving food from spoilage and then inhibiting the growth of bacteria that cause food spoilage during storage and marketing, taking into account the preservation of the sensory and appearance characteristics of the meat through the use of natural materials to preserve meat and its products (29,30).

Nanotechnology

It is the science that is concerned with studying the innovation of new technologies and means whose dimensions are measured in nanometers, which is a thousandth of a micrometer, that is, a millionth of a millimeter. Nanotechnology usually deals with measurements between (0.1nm - 100 nm) (31).

This limitation in measurement is matched by an expansion in the nature of the materials used. Nanotechnology deals with any phenomena or structures at the nanoscale. Such phenomena can include quantum confinement change that leads to new electromagnetic and optical phenomena for the matter that lies in the middle between molecules and solid matter. (32).

ISSN- 2394-5125 VOL 10, ISSUE 07, 2023

The term nanotechnology is used in another sense, meaning it is the technology of extremely small materials, microscopic technology, or miniature technology. The word nano is from the Latin word (naos), which in Greek means dwarf, which is equal to (1*10-9) a billionth of a thing. Nanotechnology is a scientific application that produces things by assembling them on a small level from their basic components, such as the atom and the molecule, as long as all materials are composed of atoms arranged according to a specific structure. We can take any atom and arrange it to another side in a way different from what it was originally. Thus, we can make something new out of anything, and sometimes these materials surprise us with new properties that we did not know before, which opens up areas for their use and harnessing them for the benefit of humans, as happened before the discovery of the transistor (33).

Nano technology boils down to rearranging the atoms that make up materials in their correct position. Whenever the atomic arrangement of a material changes, the resulting product changes to a great extent. In other words, products manufactured from atoms are manufactured that depend on how these atoms are arranged. If we rearrange

By arranging the atoms in coal, we can get diamonds, but if we rearrange the atoms in sand and add a few elements, we can make computer chips (34).

One of the things that science is currently working on is to change the method of arrangement based on the nanoscale of another substance, and by solving this puzzle, what scientists dreamed of centuries ago - converting cheap metals into gold - will be possible, but the reality is that gold will lose its value in this case (35).

Norio Taniguchi coined the term nanotechnology in 1974 and defined it as the creation of technologies capable of achieving high degrees of accuracy in the functions, shapes and sizes of goods, devices and their components, that is, controlling the functions of devices used in the fields of medicine, pharmaceuticals, industry, agriculture, engineering, etc., through Reducing its components into small chips leads to achieving high performance, as well as flexibility of use, transportation, and storage (36).

The actual beginning of the era of nanotechnology was in 1991, when researchers Warren Robinette and Stan Williams from the University of North Carolina were able to invent a device called the Nanomanipulator, through which scientists were able to enlarge...

Sizing images of chips, particles, and ultra-small organisms such as bacteria and viruses to different sizes

It reached the size of a football field, and discoveries in nanotechnology continued until it became representative

An integrated science based on the intersection of various physical, chemical, biological, mechanical and electronic sciences, and aims to deal with atoms individually and place them in a specific form. To produce any new structure bearing special characteristics (38 ,37)

The importance of this technology lies in the fact that it is inexpensive compared to other traditional technologies. Therefore, this technology has been widely applied in the field of medicine and for various purposes, including diagnosing diseases, discovering therapeutic drugs, manufacturing and preserving food (39), and manufacturing cosmetics, dyes, detergents, and water purification systems because these The materials and molecules used in this technology have antimicrobial properties (40)

Types of nanoparticles

Inorganic nanoparticles

Many types of nanoparticles used in foods are composed primarily of inorganic materials, such as silver, iron oxide, titanium dioxide, silicon dioxide, or zinc oxide. 13 These particles are either crystalline or amorphous solids at ambient temperature, which may be spherical or non-spherical, have different surface properties, and come in different sizes depending on the starting materials and preparation conditions used in their manufacture. Inorganic nanoparticles also differ in their tendency to dissolve under different solution conditions (e.g., pH, ionic strength and in their chemical interactions), which has a significant impact on their fate and toxicity (41,42).

Organic nanoparticles

Organic nanoparticles (ONPs) have the potential of other inorganic and mineral nanoparticles because the variation in composition and detail of the organic compound is infinite (43-45). Small molecule organic nanostructures have attracted intense interest because they can provide tunable electronic and optical properties through molecular design (45). Organic nanoparticles are important organic compounds that have played an important role in medicinal and agricultural chemistry and due to their biological and pharmaceutical activity, have been used in drug synthesis (46).

Use of nanotechnology in food

Nanotechnology integrates several disciplines, including physics, chemistry, biotechnology, and engineering and refers to the use of nanomaterials with nanostructures ranging from 1 to 100 nm (47). Nanotechnology has many

ISSN- 2394-5125 VOL 10, ISSUE 07, 2023

growing applications in various sectors, including agriculture, medicine, apparel, cosmetics, food, and public health due to its unique ability to increase solubility, bioavailability, and protect bioactive ingredients during processing and storage (48).

Due to the excellent physicochemical nature and antimicrobial potential of nanomaterials, they are widely used against various pathogenic and unhealthy microbes, crop protection, water treatment, food safety, and food preservation (49). In addition, nanostructured materials (NSMs) are applied in the food industry as a nanosensor, novel packaging material, and encapsulated food ingredient. In general, this review concerns the use of nanotechnology, especially nanoparticles and nanostructures in the food sector. It has nanotechnology Wide range of food related applications. In these applications, a specific type of nanomaterial is incorporated into a particular food product in order for that food produced to develop some desired properties (50). In the field nanotechnology has also been an integral part of the research and development of large-scale agro-industrial products and food and beverage manufacturers as well as for food packaging around the world (51). Several reports confirm that these nanomaterials can successfully improve food safety by enhancing food packaging effectiveness, shelf life, and nutritional value as additives without changing the taste and physical properties of food products (52). Although they have a lot of potential for product framing and innovative production processes in the food industry, The main challenge of nanotechnology is to use cost-effective processing processes to create edible and non-toxic nanodelivery systems and to develop effective formulations that are safe for human consumption (53).

Effectiveness of nanocarriers against microbial organisms

Many scientific researches were conducted during the first years of the beginning of this century on nano-grains of silver metal to determine the extent to which they can be used in the field of infection resistance and killing different types of harmful bacteria and viruses. The results indicated that the crystalline granules of silver metal have a high ability to kill multiple types of germs. This is due to the fact that reducing the size of these granules to diameters of less than 5 nanometers greatly increases their surface area, so the atoms of the silver element present in the core of the granules have a tendency to migrate to the outer surface of the granules, which leads to a significant increase in their chemical activity and interaction with oxygen in the air. Aerial, the result is composed Therefore, toxic silver ions are responsible for killing germs and viruses. On this basis, companies specialized in the manufacture of electronic and electrical devices have manufactured home refrigerators covered from the inside with a thin layer of silver metal to protect preserved foods from bacterial contamination (54).

ISSN- 2394-5125 VOL 10, ISSUE 07, 2023

nano zinc oxide

Zinc oxide nanoparticles (ZnO) are nanoparticles less than 100 nanometers in diameter. It has a large surface area for its size and high catalytic activity. The exact physical and chemical properties of ZnO nanoparticles depend on their different manufacturing methods (55).

Zinc oxide nanoparticles are thought to be one of the three most commonly produced nanomaterials, along with titanium dioxide nanoparticles and silicon dioxide nanoparticles. The most common use for ZnO nanoparticles is in sunscreen. They are used because they effectively absorb ultraviolet light, but possess a band gap large enough to be completely transparent to visible light (56). They are also screened to kill harmful microorganisms in packaging, and in UV-protective materials such as textiles (57).

Many companies do not label products containing nanoparticles, making it difficult to make statements about production and prevalence of consumer products (58).

One of the most important biological applications of nano-zinc oxide is as an antimicrobial (59), anti-bacterial and anti-fungal. As for its most important industrial applications, it has been used in the manufacture of solar cells, as well as in water treatment, and pesticides. Nano-zinc oxide has also been used in food preservation and medical applications, including the bone industry. , anti-cancer, and drug delivery (60).

The use of nano-zinc oxide in food preservation

Nanotechnology has been applied in the field of food, and the term nanofood has been widely used, which means any food produced or treated at any stage of its production related to its cultivation, processing, or rehabilitation using various nanotechnology techniques. Under this term, those foods that contain ingredient additives fall under this term. Of nanomaterials such as nanograins of free metallic elements of iron and zinc and enzyme materials that operate these enzymes efficiently, as thin layers composed of some metallic oxides such as zinc oxide ZnO were used To preserve fresh food products such as: meat, fruits and vegetables, dairy products, sweets and bread, and these layers with a diameter of less than 5 nanometers work to extend the shelf life of preserved foods even after opening the package by preventing the leakage of gases to the surface of the foods and not being affected by moisture and radiation factors that lead to spoilage. Food and its contamination, and these layers are antioxidants, safe, non-toxic, and biocompatible with the human body (61).

ZnO NPs are a highly toxic metal oxide, as they have a selective toxicity property towards bacteria without affecting human cells (62). Studies have

ISSN- 2394-5125 VOL 10, ISSUE 07, 2023

shown the high antibacterial activity of ZnO NPs, as a study (63) demonstrated that the high antibacterial activity of ZnO NPs Against multiple types of bacteria, including E. coli, Pseudomonas flourecenes, and Bacillus subtilis. A study also indicated that ZnO NPs has a high toxicological activity against Staph. aureus, Salmonella typhimurium, It can decompose these bacteria (64), and nano-zinc is used as an antibacterial to control the spread of antibiotic-resistant pathogens (65). Therefore, it has been considered a very important material in recent years, not because it is stable in extreme conditions, but because it is a safe material for humans and animals. In addition to its inhibitory activity (66), moreover, zinc represents a mineral element necessary for human health, and ZnO represents the prepared form of zinc. Thus, ZnO NPs possess high biocompatibility (high biocompatibility) for human cells (67).

Studies have also shown that low concentrations of ZnO NPs are not toxic to eukaryotic cells (68). The different properties possessed by ZnO NPs such as particle size and shape made them possess different degrees of antibacterial activities (69). Atmaca and others (70) also suggested that the binding of Zn+2 ions to the microbe wall leads to a prolongation of the lag phase of the microbial growth cycle, which leads to the discontinuation of the other growth phases and thus the cessation of the life cycle.

In order for ZnO NPs to be widely used without any side effects, it is necessary to understand the mechanism of its action as an antibacterial, as this mechanism includes stimulating the formation of Reactive Oxygen Species (ROS), such as (H2O2), which is a powerful oxidizing agent that causes damage to bacterial cells, as the size The small size of ZnO NPs, which is about 250 times smaller than the size of bacteria, leads to an increase in its surface area. Thus, the number of atoms will increase on the surface of the molecules, which, in contact with the surface of the bacterial cell, generate a very large amount of (H2O2), causing the generation of electrical forces that are fatal to the bacterial cells. (65) In addition, ZnO NPs have the ability to destroy the bacterial cell membrane and then collect it inside the bacterial cell, achieving cellular colonization by releasing Zn+2 ions that have the ability to interact with its internal components (71). Some studies have also indicated that ZnO NPs act as an antioxidant. Bacterial by increasing cell membrane permeability (72)

There have been contradictory opinions of researchers about the effect of the particle size of ZnO NPs on its antibacterial effectiveness, as a study (73) found that smaller molecules are more toxic than larger molecules, while, in a previous study conducted by (74), they found that there is no effect of particle size on Its antibacterial effectiveness. Mixing it with other nanomaterials affects its inhibitory effectiveness. In a study conducted on the effect of ZnO NPs on Gram-positive and Gram-negative bacteria, it was

ISSN- 2394-5125 VOL 10, ISSUE 07, 2023

found that it has an effect on Lactobacillus, Citrobacter, and Pseudo. aeruginosa, Staph. aureus, E. coli (75).

It increases when mixed with other metal oxides or other metals such as silver to form a nano-composite consisting of ZnO/Ag composite, as this compound is more inhibitory to bacteria than if it were

ZnO NPs were used alone. It also exhibits strong protein adsorption properties that can be used to modulate its toxicological properties and cellular responses (76).

One of the important chemical properties of ZnO NPs is its ability to continuously change its surface and electrical properties and its ability to stimulate the formation of active oxygen species that lead to cell death after it overcomes the antioxidant activity shown by the cells (77). It differs from other metals in that it has a wide range of Electronic properties, as these electrons interact with oxygen to form hydroxyl radicals and monovalent superoxide ($O2^{\cdot}$) This, in turn, reacts with hydrogen ions H+ to form the HO2 radical, and with the transfer of electrons, it produces monovalent hydrogen peroxide, which, by interacting with hydrogen ions, produces hydrogen peroxide H2O2 (77). ZnONPs also take the lead in reductive reactions and generate ROS in cellular environments because of the bonding sites they possess and their high reductive voltage (78).

In a study, nano-zinc oxide was used in packaging food products and its effect in prolonging the shelf life of food was studied. The study showed that new biodegradable gelatin covers supported by nano-zinc oxide (ZnONPs) were prepared. The results of the sensory evaluation showed the superiority of fish meat encased in gelatin cover supported with zinc oxide particles. Nanocoated has its characteristics in terms of (color, smell, texture, and general acceptability) compared to uncoated fish meat (79).

Risks of nanotechnology

The risks of nanotechnology may be related to both environmental and health issues, safety issues and negative effects of the fine particles being studied; Transition effects such as displacement of traditional industries and nanotechnology products become dominant; Military applications such as biological weapons and surveillance through nano-sensors, which are of concern to privacy rights advocates.

There is debate about whether nanotechnology is subject to government regulation, and regulatory bodies, such as the US Environmental Protection Agency and the European Commission's Health and Consumer Protection Directorate, have begun to address the potential risks of this controversial technology. It is worth noting that the Arab world lacks these institutions.

ISSN- 2394-5125 VOL 10, ISSUE 07, 2023

The organic food sector has also been at the forefront of addressing the regulated exclusion of nanoparticles from the certified organic production process in both Australia and the United Kingdom (80).

Potential risks of nanotechnology

The risks of nanotechnology applications can be broadly summarized into the following four areas:

● Health issues – effects of nanomaterials on the vitality of the human body.

● Environmental issues – effects of nanomaterials on the environment.

● Social issues – the impacts of the potential use of nanodevices on politics and human interaction.

● Special risks associated with the expected visibility of molecular nanotechnology

Health and safety effects of nanoparticles

The mere presence of nanomaterials (materials that contain a nanoparticle) does not pose any threat in itself. However, there are certain characteristics that make them risky, most notably their mobility and increased reactivity. It is only if certain properties of some nanoparticles are harmful To living organisms or the environment, this will result in us facing a clear danger, and in this case we can call the result nano-pollution.

We also need to distinguish between two types of nanostructures when confronting the environmental and health impact of nanomaterials, which are:

(1) Nano-composites, nano-surfaces, and nano-components (whether electronic, optical, sensitive, etc.), where molecules are integrated at the nano-level within the essence of the material, the material itself, or even devices ("fixed" nano-particles).

(2) "Free" nanoparticles, where individual nanoparticles of a substance are present at some stage of the production and use process. These nanoparticles may fall into one of the classes of the nanoscale for simple elements or compounds as well as complex compounds where the nanoparticle is coated with another material ("coated" nanoparticle or "core-shell" nanoparticle).

Hence, there is a consensus of opinion that: although one should be aware of materials containing fixed nanoparticles, the current concern is with free nanoparticles.

In addition, nanoparticles are very different from their current counterparts, so their diverse and multiple effects cannot be derived from the known toxicity of fine-sized materials. This point raises important issues to address the health and environmental impacts of free nanoparticles.

To complicate matters further, when talking about nanoparticles it is essential that the powder or liquid containing nanoparticles is never monodisperse (81), but instead contains a diverse range of particle sizes. This complicates experimental analysis as larger nanoparticles may have different properties from smaller ones. In addition, nanoparticles have a tendency toward aggregation, and such aggregates often perform differently than individual particles (82).

The dose of ethyl containing different types of nanoparticles, which was given to laboratory mice over a period of six months, was characterized by the Skovkjaer index, after the scientist Kasper Skovkjaer (83).

The National Institute for Occupational Safety and Health is conducting research into how nanoparticles interact with body systems and how workers in factories or during industrial use of nanomaterials may be exposed to nano-sized particles. The National Institute for Occupational Safety and Health issues guidelines that are consistent with the best scientific knowledge and are intended for handling nanomaterials (84).

Imarla Fletcher of the Consumer Product Safety and Nanotechnology Commission suggested that: The Consumer Product Safety Commission, which is responsible for protecting the public from any undue risks of injury or death associated with consumer products, is not well-equipped to oversee the safety of complex, high-tech, industrially produced products. By nanotechnology.

Longer-term concerns also focus on the effects of new technologies on broad sectors of society, as well as on whether these effects may lead to the emergence of a post-scarcity economy, or may lead to an exacerbation of the wealth gap between developed and developing nations. In addition, the effects of nanotechnology on society as a whole and on human health and the environment as well, in addition to its effects on trade, security, food systems, and even on the definition of the term “human” have not yet been defined or politicized as well (85).

Health issues

The health impacts of nanotechnology are the potential effects of nanomaterials and devices on human health. Since nanotechnology is a new field, this has resulted in a wide debate about the extent to which the benefits or risks of nanotechnology to human health can be exposed. The health

ISSN- 2394-5125 VOL 10, ISSUE 07, 2023

effects of nanotechnology can be divided into: the ability or possibility of nano-inventions to have medical effects in treating diseases, as well as potential health risks when exposed to nanomaterials.

Nanotoxicology is defined as the field that studies the potential health risks of nanomaterials. The extremely fine and small size of nanomaterials means that they have the ability to penetrate the human body more than other large particles. Also how they move and interact

Nanoparticles within living organisms are a big issue that needs to be solved and addressed. The behavior of nanoparticles is a function of their function, size, and surface interaction with the surrounding tissue. Nanoparticles accumulate within organs partly because they do not decompose or decompose slowly. Another cause for concern is their expected interaction with vital processes within the body: because of their large surface area, once nanoparticles are exposed to tissue and fluids, some of the microparticles they contain are absorbed. on the surfaces of those tissues.

The large number of variables influencing toxicity also means that it is difficult to generalize about the health risks associated with exposure to nanomaterials – each nanomaterial must be evaluated individually and the properties of all materials must be taken into account. Both health and environmental issues are integrated into the work environment of companies related to the production and use of nanomaterials, as well as the work environment of laboratories related to nanoscience and research in the field of nanotechnology. It is safe to say that current workplace dust exposure standards cannot be directly applied to nanoparticle dust (84).

The term nanomedicine refers to the medical applications of nanotechnology. (86) Nanomedicine approaches range from the medical use of nanomaterials to biosensors associated with nanoelectronics as well as future applications of molecular nanotechnology. Nanomedicine aims to provide a valuable set of research tools as well as devices useful in treatment clinics in the near future (87-88). The National Nanotechnology Initiative expects new commercial applications in drug delivery, which may include advanced drug delivery systems. Neural interfaces and other sensors associated with nanoelectronics represent another active target for research in this field. The predictive field of molecular nanotechnology believes that cell repair machines may have the potential to revolutionize medicine and pharmaceuticals as well (88).

Environmental issues

Nanotechnology pollution is a general and comprehensive term for all waste resulting from the use of nanotechnology devices or during the manufacturing process of nanotechnology materials. This waste may be considered highly hazardous, due to its size. It can float in the air and may easily penetrate animal and plant cells, causing unknown effects for each. Most human-made microparticles are not visible in nature, so organisms may not have adequate means of dealing with these microscopic wastes (86).

To assess the health risks of manufactured small molecules, the full life cycle of these molecules must be evaluated, including their manufacturing, storage, and distribution as well as their application, misuse, and disposal (89). The effects on humans and the environment may vary and change during many stages of their life cycle. Skrinis raises concerns about pollution resulting from nanotechnology, and explains that it is not currently possible to “accurately predict or even control the environmental effects of the emission of waste from this technology into the environment” (90).

On the other hand, some available nano applications may be used in the future to serve environmental purposes. One class of filtration methods is based on the use of membranes with appropriate hole sizes, allowing the liquid to be trapped behind the membrane. Hence, nanoporous membranes are suitable for mechanical filtration, which are characterized by having pores smaller than 10 nanometers that may consist of nanotubes. Nanofiltration is mainly used to remove ions or separate different liquids. Magnetic nanoparticles provide an effective and reliable way to remove metal contaminants heavy waste water by utilizing magnetic separation methods. The use of nanoparticles increases the effectiveness of the ability to absorb pollutants, in addition to being an inexpensive process compared to traditional sedimentation and filtration methods. In addition, nanotechnology may have a great impact on the clean energy production process (89).

Social impacts

Beyond the risks associated with first-generation nanotechnology that affect both human health and the surrounding environment, there is a broader set of social impacts that pose more broad-ranging societal challenges. Sociologists have suggested that the social issues associated with microtechnology must be understood and evaluated in a way that is not simple. Where it is not seen as a group From current impacts or risks only. Instead, such challenges should be taken into account as research and decision-making “against the grain” with the aim of ensuring that the development of such technology is consistent with social goals (91).

Many social scientists as well as civil society organizations have assumed that the process of technology assessment and management must include public participation of citizens (92-93). Hence, the issue of social risks of using the microtechnology appeared. At the most basic level, these risks include the potential for military applications of nanotechnology, for example, the use of implants and other means to enhance recruits, as in the case of the Nanotechnology Recruit Institute at MIT (94), as well as the increased capabilities of enhanced surveillance from Through the use of nanosensors (95-96).

1- Oueslati, K., Promeyrat, A., Daudin, J. D. and Gatellier, P. (2015). Analysis of free radical production in meat in the physicochemical conditions of storage and cooking. In 61th. International Congress of Meat Science and Technology (ICoMST). 2015; 61. International Congress of Meat Science and Technology (ICoMST), Clermont-Ferrand, FRA, 2015-08-23-2015-08-28: 194-194.

2- Zhou, G. (2008). Meat science and technology. Meat products processing theory," ed. By Xu XL, L X. and L XB, 157-163.

3- Visessanguan, W . (2016) . 62nd International Congress of Meat Science and Technology. Meat science, 120, 1.

4- Kristensen, L., Støier, S., Würtz, J. and Hinrichsen, L. (2014). Trends in meat science and technology: The future looks bright, but the journey will be long. Meat science, 98(3), 322-329.

5- Hygreeva, D. and Pandey, M. C. (2016). Novel approaches in improving the quality and safety aspects of processed meat products through high pressure processing technology-A review. Trends in Food Science & Technology, 54: 175-185.

6- Shah, M. A., Bosco, S. J. D. and Mir, S. A. (2014). Plant extracts as natural antioxidants in meat and meat products. Meat science, 98(1): 21-33.

7- Negi, P. S. (2012). Plant extracts for the control of bacterial growth: Efficacy, stability and safety issues for food application. International journal of food microbiology, 156(1): 7-17.

8- Hamida E. S., Hanaa A. A., & Mayes A. K. (2019). Adsorption Study Of The Interaction Between Zinc Oxide Nanoparticles With Albumin And Creatinine. College of Education for Pure Science, University of Kerbala.

9- Paul, D. R., & Robeson, L. M. (2008). Polymer nanotechnology: nanocomposites. Polymer, 49(15), 3187-3204.

10- Mayes A. K., Hamida E. S., & Hanaa A. A. (2019). Adsorption of Albumin and Creatinine on ZnO Nanoparticles. International Journal of Pharmaceutical Quality Assurance, 10(04), 689-695.

11- Noor, H. A., Mohamed, H., & Nehad, A. A. (2017). Preparation and Surface Modification of Zinc Oxide Nanoparticles. Journal of Babylon University, 25, 497503.

12- Kołodziejczak-Radzimska, A., & Jesionowski, T. (2014). Zinc oxide—from synthesis to application: a review. Materials, 7(4), 2833-2881.

13- Oueslati, K., Promeyrat, A., Daudin, J. D. and Gatellier, P. (2015). Analysis of free radical production in meat in the physicochemical conditions of storage and cooking. In 61th. International Congress of Meat Science and Technology (ICoMST). 2015; 61. International Congress of Meat Science and Technology (ICoMST), Clermont-Ferrand, FRA, 2015-08-23-2015-08-28: 194-194.

14- Zhou, G. (2008). Meat science and technology. Meat products processing theory," ed. By Xu XL, L X. and L XB, 157-163.

15- Visessanguan, W . (2016) . 62nd International Congress of Meat Science and Technology. Meat science, 120, 1.

16- Kristensen, L., Støier, S., Würtz, J. and Hinrichsen, L. (2014). Trends in meat science and technology: The future looks bright, but the journey will be long. Meat science, 98(3), 322-329.

17- Pan, T., J. Jankovic and W. Le. (2003). Potential therapeutic properties of green tea polyphenols in Parkinson`s disease. Drugs Aging, 20(10): 711-721.

18- Shah, M. A., Bosco, S. J. D. and Mir, S. A. (2014). Plant extracts as natural antioxidants in meat and meat products. Meat science, 98(1): 21-33.

19- Negi, P. S. (2012). Plant extracts for the control of bacterial growth: Efficacy, stability and safety issues for food application. International journal of food microbiology, 156(1): 7-17.

20- Pateiro, M., Barba, F. J., Domínguez, R., Sant'Ana, A. S., Khaneghah, A. M., Gavahian, M. and Lorenzo, J. M. (2018). Essential oils as natural additives to prevent oxidation reactions in meat and meat products: A review. Food Research International, 113: 156-166.

21- Misra, N. N. and Jo, C. (2017). Applications of cold plasma technology for microbiological safety in meat industry. Trends in Food Science & Technology, 64: 74-86.

22- Pateiro, M., Barba, F. J., Domínguez, R., Sant'Ana, A. S., Khaneghah, A. M., Gavahian, M. and Lorenzo, J. M. (2018). Essential oils as natural additives to prevent oxidation reactions in meat and meat products: A review. Food Research International, 113: 156-166.

23- Lyu, F., Zhao, Y., Shen, K., Zhou, X., Zhang, J. and Ding, Y. (2018). Using Pretreatment of Carbon Monoxide Combined with Chlorine Dioxide and Lactic Acid to Maintain Quality of Vacuum-Packaged Fresh Beef. Journal of Food Quality, 2018.

24- Eltilib, H. H., Elgasim, E. A. and Ahmed, I. A. M. (2016). Effect of incorporation of Cyperusrotundus L. rhizome powder on quality attributes of minced beef meat. Journal of food science and technology, 53(9): 3446-3454

25- Shale, K., F. Lues., P. Venter and E. M. Buys. (2005). The distribution of staphylococcus sp. On bovine meaty from abattoir deboning rooms. Food. Microbial., 22 , 5: 433-438.

26- Borch, E. and Arinder P. (2002). Bacteriological safety issues in red ,meat and ready-to-eat meat products, as well as control measures. Meat Sci., 62(3): 381–390.

27- Matarante, A., Baruzzi, F., Cocconcelli, P. S. and Morea, M. (2004). Genotyping and toxigenic potential of Bacillus subtilis and Bacillus pumilus strains occurring in industrial and artisanal cured sausages. Applied and environmental microbiology, 70(9): 5168-5176.

28- Roselli, M., Finamore, A., Garaguso, I., Britti, M. S. and Mengheri, E. (2003). Zinc oxide protects cultured enterocytes from the damage induced by Escherichia coli. The Journal of nutrition, 133(12):4077-4082.

29- Beales, N. (2003). A depletion of Microorganisms to cold temperatures, weak acid preservatives, Low pH and osmotic stress. Comprehensive Reviews in food Science and food safety. Institute of Food Technologists, 3: 1-25.

30- M. Al Hoshan, (2007) «Novel nanoarray structures formed by template Based approach: characterization and electrochemistry» PhD Thesis, Minnesota University .

31- Nano science and nanotechnology , July , 2004, the royal society and The royal Academy of engineering.

32- What is nanotechnology , henry good band , sustain pact News letter .

33- " Societal and ethical implications of nanotechnology " Meanings Interest groups and , social dynamics , Joachim Schummer , thchne : Journal of the society for philosophy and Technology , 2005 .

34- Bilal, Hassan Ezzedine, 2010, Nanotechnology and its Applications, Syrian Ministry of Culture.

35- Buzea, C., Pacheco, I. and Robbie, K. (2007).Nanomaterials and nanoparticles:sources and toxicity,Biointerphases.2(4):17-71.

36- Kovalenko, M. V., Manna, L., Cabot, A., Hens, Z., Talapin, D. V., Kagan, C. R. and Guyot-Sionnnest, P. (2015). Prospects of nanoscience with nanocrystals, 22(4): 130-148.

37- Moghimi, S. M. (2005). Nanomedicine : prospective diagnostic and therapeutic potential. Asia Pacific Biotech News. 9:1072-1077.

38- Baker, C., Pradhan, A., Paktis,L., Pochan, D. J. and Shah, S.I. (2005). Synthesis and antibacterial properties of silver nanoparticles .J. Nanosci. Nanotechnol 5:244-249.

39- .Frohlich, E. E. & Frohlich, 1–22 (2016(, E. Cytotoxicity of nanoparticles contained in food on intestinal cells and the gut microbiota. Int. J. Mol. Sci. 17.

40- Pietroiusti, A., Magrini, A. & Campagnolo, (2016(, L. New frontiers in nanotoxicology: Gut microbiota/microbiome-mediated effects of engineered nanomaterials. Toxicol. Appl. Pharma. 299, 90–95.

41- Kwon A B, Jung S, Park S S. (2002) Enhanced emission and its switching in fluorescent organic nanoparticles. J Am Chem Soc 124 (48). pp14410-5.

42- Atia A and Al-Mufrgeiy S 2012 Synthesis and Antibacterial Activities of New 3-Amino-2-Methyl- Quinazolin-4 (3h)-One Derivatives. American Journal of Chemistry 2 (3). pp150-156.

43- Cunha S, Oliveira S, Rodrigues Jr, Bastos R, Ferrari J, de Oliveira C, Kato L, Napolitano H, Vencato I, Lariucci C 2005 Structural Studies of 4-Aminoantipyrine Derivatives. J. Mol. Struct 752 pp 32-39.

44- Dighe N, Saudagar R and Jain D 2012 Synthesis, antimicrobial and anti-inflammatory activities of some substituted 5-(pyridin-4-yl)-1, 3, 4-oxadiazole-2-thiols. Medicinal chemistry and drug discovery 2 (1) pp 1-9

45- Chandra P. Nanobiosensors for personalized and onsite biomedical diagnosis. The Institution of Engineering and Technology; 2016. https://doi.org/10.1049/PBHE001E.

46- Pathkoti K, Manubolu M, Hwang HM. Nanostructures : current uses and future applications in food science. J Food Drug Anal 2017;25(2):245e53.

47- Gupta A, Eral HB, Hatton TA, Doyle PS. Nanoemulsions: formation, properties and applications. Soft Matter 2016;12:2826e41.

48- Fu PP. 2014;22:1e2, Introduction to the special issue: nanomaterials e toxicology and medical applications. J Food Drug Anal.

49- Singh T, Shukla S, Kumar P, Wahla V, Bajpai VK, Rather IA. 2017;8:e1501, Application of nanotechnology in food Science: perception and overview. Front Microbiol.

50- Hu B, Liu X, Zhang C, Zeng X. 2017;25:3e15, Food macromolecule based nanodelivery systems for enhancing the bioavailability of polyphenols. J Food Drug Anal.

51- Baranwal A, Srivastava A, Kumar P, Bajpai VK, Maurya PK, Chandra P. 2018;9:e422, Prospects of nanostructure materials and their composites as antimicrobial agents. Front Microbiol.

52- Sekhon, B. S. (2014). Nanotechnology in agri-food production: an overview. Nanotechnology, science and applications, 7: 31.

53- Xiaojuan Zhang ,Yuanyuan Li ,Yani Hu . 20 November 2020, 125288 ,

Green synthesis of silver nanoparticles and their preventive effect in deficits in recognition and spatial memory in sporadic Alzheimer's rat model Colloids and Surfaces A: Physicochemical and Engineering Aspects Volume 605,

54- Keller, Arturo A.; McFerran, Suzanne; Lazareva, Anastasiya; Suh, Sangwon (2013-06-01). "Global life cycle releases of engineered nanomaterials". Journal of Nanoparticle Research. 15 (6): 1692.

55- Iosub, Cristina Ș.; Olăreț, Elena; Grumezescu, Alexandru Mihai; Holban, Alina M.; Andronescu, Ecaterina (2017), "Toxicity of nanostructures—a general approach", Nanostructures for Novel Therapy, Elsevier, pp. 793–809.

56- Isadora Martini Garcia , Abdul Rahman A.Balhaddad , Maria S.Ibrahim,Michael D.Weir,Hockin H.K.Xu,Fabrício MezzomoCollares, Mary Anne S.Melo , Dental Materials Available online 17 December 2020. Antibacterial response of oral microcosm biofilm to nano-zinc oxide in adhesive resin.

57- Karima GaberHelmy,Abir M.Partila, M.Salah. October 2020, 101728, Gamma radiation and Polyvinyl pyrrolidone mediated synthesis of Zinc oxide /Zinc sulfide nanoparticles and evaluation of their antifungal effect on pre and post harvested orange and pomegranate fruits . Biocatalysis and Agricultural Biotechnology . Volume 29.

58PalanivelSathishkumara1ZhaofaLia1RajiGovindanaRajarajeswaranJayakumarbChaoyangWangaFengLong, 15 January 2021, 147741, GuaZinc oxide-

ISSN- 2394-5125 VOL 10, ISSUE 07, 2023

quercetin nanocomposite as a smart nano-drug delivery system: Molecular-level interaction studies . Applied Surface Science Volume 536, 15 January 2021, 147741

59- Jennifer, K. and Peter,V. (2006). Nanotechnology in agriculture and foodproduction:Anticipated applications. Washingto, DC Woodrow Wilson Internalional Center for Scolars,poject on emerging nanotechnologies9 (3) : 58-105.

60- Zhang, X., Kong, B. and Xiong, Y. L . (2007). Production of cured meat color in nitrite-free Harbin red sausage by Lactobacillus fermentum fermentation . Meat Sci. 77: 593-598.

61- Chen, Y. L., Jiang, Y. M., Duan, J., Shi, J., Xue, S. and Kakuda, Y. (2010) . Variation in catechin contents in relation to quality of ' Huang Zhi Xiang' Oolong tea (Camellia sinensis) at various growing altitudes and season . Food Chemistry, 119: 648-652.

62- He, L., Liu, Y., Mustapha, A. and Lin, M. (2011). Antifungal activity of zinc oxide nanoparticls against Botrytis cinerea and Penicillium expansum.Microbiological Research.166: 207-215.

63- Stoimenov, P. K., Klinger, R. L., Marchin, G. L. and Klabunde, K. J. (2002). Metal oxide nanoparticles as bactercidal agent .Langmuir.18:6679-6686.

64- Fu, G., Vary, P. S. and Lin, C. T. (2005). Anatase TiO2 nanocomposites for antimicrobial coatings.J Phys Chem .109:8889-8898.

65- Holt, J. G., Krieg, N. R., Sneath, P. H. A., Staley, J. J. and Williams, S. T. (1994). Group 17 gram- positive cocci. In: Bergey's Manual of Determinative Bacteriology. 9th edition eds. W. R. and Forlifer, L. E. PP: 527-543.

66- Roselli, M., Finamore, A., Garaguso, I., Britti, M. S. and Mengheri, E. (2003). Zinc oxide protects cultured enterocytes from the damage induced by Escherichia coli. The Journal of nutrition, 133(12):4077-4082.

67- Yamamoto, O. (2001). Influence of particle size on the antibacterial activity of zinc oxide.Int. J. Inorg. Mater.3:643-646.

68- Atmaca, S., Gul, K. and Clech R. (1998). The effect of zinc on microbial growth .Turkish J Med Sci.28:595-597.

69- Brayner, R., Ferrarilliou, R., Brivois, N., Djediat, S., Benedetti, M.F. and Fievet, F. (2006).Toxicological impact studies based on Escherichia coli bacteria in ultrafine ZnO nanoparticle colloid medium .Nano Lett 6:866-870.

70- Jin, T., Sun, D., Su, Y., Zhang, H. and Sue, H. J. (2009). Antimicrobial efficacy of zinc oxide quantum dots against Listeriamonocytogenes,Salmonella enteritidis and Escherichia coli O157:H7.J Food Sci.74:46-52.

71- Jones, N., Ray, B., Ranjit, K. T. and Manna, A. C. (2008). Antibacterial activity of ZnO nanoparticle suspensions on abroad spectrum of microorganisms .FEMS microbial.lett.279(1):71-76.

72- Franklin, N. M., Rogers, N. J., Apte, S. C., Batley, G. F. and Caesey, P. S. (2007). Comparative toxicity of nanoparticulate Zno,bulk ZnO,and ZnCl2 to a fresh water microalgae(Pseudokirohneriella subcapitata):the importance of particle solubility.Environ.Sci. Technol.41,(24): 8484-8490.

73- Ismail, M. M., Ibraheem, L. Q., Marzoog, T. R., Ahmed, D. S. and Humadi, M. D. (2015). Role enhancement of ZnO nanoparticles and ZnO\Ag composite for medical applications.Chemistry and Materials Research.7(11): 55-82.

74- Horie, M., Nishio, K., Fujita, K., Endoh, S., Miyauchi, A., Saito, Y., Iwahashi, H., Yamamoto, K., Murayama, H., Nakano, H., Nanashima, N., Niki, E. and Yoshida, Y. (2009). Protein adsorption of ultrafine metal oxide and its influence on cytotoxicity toward cultured cells. Chem Res Toxicol.22: 543–53.

75- Ryter, S. W., Kim, H. P., Hoetzel, A., Park, J. W., Nakahira, K., Wang, X. and Choi, A. M. (2007). Mechanisms of cell death in oxidative stress.Antioxid Redox Signal.9:49-89.

76- Salman, A. A. (2012). Antibacterial activity of ZnO nanoparticles on some gram-positive and gram-negative bacteria.Iraqi Journal of Physics.10(18):5-10.

77- Schilling, K. (2010). Human safety review of "nano" titanium dioxide and zinc oxide.photochem photobiol Sci.9:495-509.

78- Abdul Reda, Amir Salem, 2021, Master's thesis, College of Agriculture, University of Kufa, using nano-zinc oxide in packaging food products and studying its effect in prolonging the storage life of food

79- M. Al Hoshan, «Novel nanoarray structures formed by template Based approach: characterization and electrochemistry» PhD Thesis, Minnesota University, (2007) .

80- Nano science and nanotechnology , July , 2004, the royal society and The royal Academy of engineering .

81- Rich Working Molecules : progress toward molecular nanotechnology , and P . , October , 2004, Terra , analog science fiction , fact Magazine.

82- Paull, John (2010) ‹Nanotechnology: No Free Lunch, Platter, 1(1) 8-17

83- http://www.nanowerk.com/spotlight/spotid=1360.phpNanotechnology food coming to a fridge near you

84- kasper%20skov%20kjaer"&hl=zhCN&pg=PP1#v=onepage&q="kasper%20skov%20kjaer"&f=true Dr. Jon Schiller (2010)

85- "Approaches to Safe Nanotechnology: An Information Exchange with NIOSH".2008-04-13, United States National Institute for Occupational Safety and Health.

86- Felcher, EM. (2008). The Consumer Product Safety Commission and Nanotechnology.

87- Al-Hilali, B. M. I., Theyab, M. A., Hasan, N. A. H., AL-Samarraie, M. Q., Sahi, S. H., & Abdullah, H. S. A. (2021). Crude oil affecting growth of plants (castor: Ricinus communis, and bean: Vicia faba) and some soil properties. Materials Today: Proceedings, 42, 3068-3071.

88- Wagner V, Dullaart A, Bock AK, Zweck A. (2006). "The emerging nanomedicine landscape". Nat Biotechnol. 24 (10): 1211–1217. doi:10.1038/nbt1006-1211. PMID 17033654.

89- Freitas RA Jr. (2005). "What is Nanomedicine?". Nanomedicine: Nanotech. Biol. Med. 1 (1): 2–9. doi:10.1016/j.nano.2004.11.003. PMID 17292052.

90- Nanotechnology in Medicine and the Biosciences, 1996, by Coombs RRH, Robinson DW. ISBN 2-88449-080-9

91- Al-Sammarraie, H. W. M., AL-Samarraie, M. Q., & Al-Obaedi, A. I. (2023). Detection of Hepatitis B virus (HBV) by using the RT-PCR and Serological Assay for Detecting Surface Antigen HBsAg. Journal of Advanced Zoology, 44(S-1), 389-394.

92- - Al-Obaedi, A. I., Ahmed, N. M., AL-Samarraie, M. Q., & AL-Azzawie, A. F. (2022). Genetic Diversity of Pathogenic Fungi Aspergillus flavus Isolates Using Random Amplified Polymorphic DNA-Polymerase Chain Reaction. Journal of Drug Delivery Technology, 12(3), 1261-1265.

ISSN- 2394-5125 VOL 10, ISSUE 07, 2023

93- - Monahan, Torin and Tyler Wall. (2007). Somatic Surveillance: Corporeal Control through Information Networks. Surveillance & Society 4 (3): 154-173.[1]

94- Invernizzi N, Foladori G and Maclurcan D (2008). "Nanotechnology's Controversial Role for the South". Science Technology and Society. 13 (1): 123–148. doi:10.1177/097172180701300105.

95- -Nanotech's "Second Nature" Patents: Implications for the Global South, Communiques No. 87 and 88, March/April and May June". ETC

96- Group.Invernizzi N, Foladori G and Maclurcan D (2008). "Nanotechnology's Controversial Role for the South". Science Technology and Society. 13 (1): 123–148. doi:10.1177/097172180701300105.