RESEARCH PROGRESS OF GOLD NANOPARTICLES IN DETECTION OF FOOD CONTAMINANTS

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Abstract: Food safety and consumer health interest breathing phase has attracted widespread attention from all walks of life. Main factors affecting food safety One of the reasons It is a food contamination problem. There are many types of food contaminants that have been discovered, but the harm is different. Rapid, sensitive and accurate detection of food contaminants is the guarantee important means of food safety. The detection method using nanogold technology has the characteristics of simple preparation, convenient operation, high sensitivity and specificity. Meet the testing requirements for contaminants in food. This article reviews the research progress of nanogold in this area, and discusses the broader research and development of nanogold. Prospects for application prospects.

Keywords: Gold nanoparticles; Food contaminants; Detection methods; Progress; Overview

1 PROPERTIES OF GOLD NANOPARTICLES

Improvement of living standards has put forward higher requirements for the type and quality of food. However, both in developed and developing countries, food safety problems have emerged that seriously endanger consumer health. One of the main reasons is food contamination. Food safety issues not only affect the development of the food industry, but also cause consumers to lose confidence in the food industry, and also bring heavy losses to the country and people. Preventing potential food safety incidents and actively supervising and evaluating food safety require fast, accurate, sensitive, efficient, stable and economical food contaminant detection technology. For food contaminants, commonly used detection methods include atomic absorption, gas chromatography, high-performance liquid chromatography, etc. Among them, chromatography has high sensitivity and accuracy, but the detection instrument is large and difficult to move, and the sample requires preliminary processing, which is time-consuming. However, other detection methods have low sensitivity, are easily affected by environmental matrix and

false positive wait lack points, cannot meet the rapid measurement requirements on site. Find [1]. Gold nanoparticles have unique physical and chemical properties and are simple to prepare It has high sensitivity and is widely used in many fields. This article is about nanometer Research on the detection and optimal detection effect of gold particles on food contaminants A summary of the situation.

Gold nanoparticles have particle sizes in 1 ~100 In addition to the general properties of nanomaterials, ultrafine gold particles between 1 nm and 10 nm are also one of the few metals with surface plasmon resonance absorption properties in the visible light wavelength range. It has high electron density, dielectric properties, catalysis, fluorescence quenching effect, photothermal conversion, surface enhanced Raman scattering effect and surface plasmon resonance effect (SPR) Characteristics such as these, the above advantages make gold nanoparticles widely used in optical sensing, biological imaging, Biological detection, disease diagnosis and cancer treatment and other fields [2].

2 RESEARCH STATUS OF GOLD NANOPARTICLES IN DETECTION OF FOOD CONTAMINANTS

2.1 Detection of Antibiotic Residues in Food

SONG et al. [3] combined gold nanoparticles with penicillin aptamers. Combined, use colorimetric method to detect penicillin in milk, the lowest detection out Limited to 10 ng/ml; ZHOU et al [4] Use this principle to detect actual sample bees Streptomycin in honey, when the streptomycin content is between $0.2 \sim 1.2$ μ mol/L Within the range, its color change is linearly related to its aptamer. Also The researchers chose thioglycolic acid as an aptamer and used gold nanoparticles for colorimetry Method to detect streptomycin [5]. So far, the method has also been applied to cards Ramycin, oxytetracycline, sulfadimethoxine, chloramphenicol, etc. Detection [3, 6-8]. Li Jianlong et al [9] Leveraging GCE/Au/Ab * Penicillium Penicillin sensor determines penicillin in milk G, research shows that the sensor With good immune response to penicillin antigen, the detection method of this method The limit of detection is 2.49 ng/ml, lower than the EU of 4 ng/ml. Luo Yanfang et al. [10] utilized nano-gold nanoparticles that can both aggregate and DNA fragment knot Synthetic polyallylamine hydrochloride (PAH) As an aggregating agent for gold nanoparticles, The content of tetracycline was detected by colorimetric method. The best test for this method The output concentration is 100 nmol/L ~ 1 μ mol/L, within this range there is good A good linear relationship, the lowest detection limit is 95 nmol/L.

2.2 Detection of Microorganisms and Microbial Toxins in Food

Regarding microorganisms in food, Hasan et al. [11] were the first to apply nanogold labeling to detect Vibrio cholerae. Song Liangjing et al. [12] constructed a " sandwich " structure DNA hybrid biosensor can detect Salmonella with high sensitivity. This method has a minimum detection limit of 35 cfu/ml, and the results are consistent with traditional plate counting. Determination E. coli O157: H7 When the content is 100 %, mercaptoethylamine can be used to combine with gold nanoparticles and E. coli O157: H7 The nature of the binding was determined using a colorimetric method. Yang Yang et al. [13] used the principle of surface plasmon resonance and applied the sandwich method to E. coli O157 : H7 is used for detection, and its minimum detection limit is 10 cfu/ml, linear range is 10 ~ 1 010 cfu/ml. Li Anran et al. [14] constructed a electrochemistry DNA Sensors can be highly sensitive The sensor has good reproducibility and detects Staphylococcus aureus accurately. out limited to $5 \times 10\text{-}13\text{mol/L}$. DENG etc [15] First use the asymmetric PCR Amplification of single- and double- stranded genomes of Bacillus anthracis DNA, using nanogold colorimetric method to detect Bacillus anthracis, Provide reference for clinical rapid determination. FU etc [16] Utilize etc. warm PCR To amplify Listeria monocytogenes, a rapid detection method for Listeria monocytogenes was established using nanogold colorimetric method. It has high sensitivity and the lowest detection limit is 75 bacterial copies. He Shengnan et al. [17] prepared a single-walled carbon tube - gold nanocomposite network sensitive film and applied Based on interdigitated microelectrodes and prepared into immunosensors, the rapid, sensitive and specific detection of listeria hemolysin can be achieved by amplifying the sensitivity of the antigen - antibody reaction.

2.3 Detection of Heavy Metals in Food

With the acceleration of the industrialization process, more and more industries are involved in heavy metal emissions. The problem of illegal and excessive heavy metal emissions is becoming more and more prominent. Not only It pollutes the environment and causes serious health damage. Mercury is harmful to the environment and The harm to the human body is extremely serious, so there are many studies on it. There is research Researchers used thymine combined with gold nanoparticles to Hg2 + occur Reaction to detect Hg 2+ based on color change of Head of. LIU et al. [18] used quaternary ammonium salt modifications to determine Hg2 +, overcoming the system's inability to Stable shortcomings, its detection limit is 30 nmol/L. CHAO etc [19] Using protein to modify gold nanoparticles and Hg2 + Reaction occurs, this method is smart High sensitivity, detection limit is 1 μ mol/L. Boopathi et al [20] used polyethylene Enpyrrolidone and tetraphenylboric acid participate in the synthesis of gold nanoparticles, which can be detected in alkaline medium Hg 2 +. Chansuvarn et al. [21] utilized nano Gold colorimetric detection Hg2 +, this method has good selectivity and the detection limit is as low as 35 nmol/L. CHAI etc [22] Gold nanoparticles modified with glutathione Add lead ions (Pb2 +), inferred from the color change of the solution The content of Pb 2+, the detection limit of this method is 100 nmol/L; in principle phase Under the same circumstances, benzenetriazole can also be used to modify gold nanoparticles and use colorimetric For lead testing, the detection limit is 7 μ mol/L. CHE N et al. [23] used thio Sodium sulfate modified gold nanoparticles, so that the detection limit of lead is 0.5 nmol/L, relatively Other ions are high 1 000 times. Tripathy et al. [24] used nano- gold ratio Color method detects copper ions, the detection limit reaches 10 mg/L, good selectivity.

2.4 Detection of Restricted and Prohibited Substances in Food

Melamine is a substance with limited use in food. In infants and young children, The safe limit in formula milk is 1 mg/kg, the specified limit value in feed raw materials and feed products is 2.5 mg/kg. Using nano There are many ways to detect melamine using gold technology. According to the modification of nanogold, Ornaments can be divided into two categories, one is directly induced by melamine, GUAN et al. [25] used hydrogen bonding between melamine molecules to make nanometer Gold particles aggregate to detect; The other type uses non-melamine Modifications combined with gold nanoparticles, XING et al [26] in nanogold solution Add a single strand of thymine to DNA, in polydiene Propyl dimethyl ammonium chloride (PDDA) In the existing system, add three After polycyanamide was added, the color of the solution changed, and this method greatly improved the three-dimensional The sensitivity of polycyanamine detection, the detection limit is as low as 34 nmol/L. Satine Amino alcohol is beta - agonist A kind of although many countries have banned its use However, there are still criminals who are motivated by profit and apply it to animal feeding. In the material. Wu Jun et al. [27] prepared a composite nano-immunosensor for detecting sand Butamol was tested. Graphene is used to modify gold nanoparticles. Study on the electrochemistry of salbutamol on modified electrode surface by cyclovoltammetry behavior, its detection limit is $2 \times 10\text{-}7\text{g}$ /L, and the stability of the sensor Good performance and repeatability. Vanillin is an infant formula food Commonly used additives in Chinese medicine, but excessive amounts can cause liver and kidney damage. Currently, the country The country lacks relevant testing standards. Wang Shi et al [28] Using gold nanoparticles Surface-enhanced Raman spectroscopy effect, from sample pretreatment, enhancement The preparation of the substrate and the selection of machine parameters were studied in three aspects. A rapid determination method for vanillin was established. The analysis time of this method Short and reliable results.

2.5 Detection of Pesticide Residues in Food

LIU et al. [29] used rhodamine B (RB) Tagged gold nanoparticles, via Fluorescence and colorimetric analysis for detection of organophosphorus and carbamate pesticides drug residue.

3 OPTIMAL RESEARCH ON GOLD NANOPARTICLES IN DETECTION

Size and other characteristics of gold nanoparticles are due to their surface plasmon resonance effect (SPR), surface enhanced Raman scattering effect and other determinants of physical and chemical properties [2]. Yang Yang et al. [13] 3 gold nanoparticles of different sizes (AuNPs) marked SPR Compare the sensor detection effects to obtain enhanced SPR signal best The particle size of AuNPs is 17.79, 34.05 and 28.22nm. explain Explain the method High accuracy and good repeatability. Although the best AuNPs Particle size and The results of the study by ZENG et al [30] are not completely consistent, which may be due to the larger size of the first and second antibodies. In the detection of melamine, although the detection principles are similar, the sensitivity of the detection methods is different. 3 orders of magnitude, this is mainly due to the different synthesis methods of gold nanoparticles, It is caused by the different coating particles on the surface of gold nanoparticles.

4 PERSPECTIVES

Due to the wide variety of contaminants in food, a large number of The occurrence of security incidents has aroused widespread concern from the whole society. use Although gold nanosensors can detect a variety of pollutants, they cannot detect all pollutants. Detection of contaminants, such as quinolone antibiotics in food, Campylobacter jejuni, Bacillus mutans and Clostridium perfringens in food There are few studies on micro-detection. In addition, most of the existing detection methods are The measurement of a single substance and the simultaneous measurement of multiple substances are less common. To a certain extent, it will affect the efficiency of food testing, resulting in certain The detection of some contaminants has been ignored. Therefore, for the currently discovered pollutants, utilizing the high sensitivity and specificity of gold nanotechnology, Synthesize more complex nano -immunosensors to detect pollution Materials are an important development direction to ensure food safety, and diversification of materials Simultaneous measurement of quality is also an important way to improve the efficiency of pollutant detection. path. With the continuous improvement and development of nanogold technology, it will be used in food play a greater role in the detection of product contaminants.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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