The Problems of TiO_2 Nanoparticle Additives in Food Additives

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Abstract. With the improvement of people's living standards and the development of the food industry, TiO_2, as a food additive, has been increasingly applied in the food processing industry, such as a preservative, colorant, antioxidant, thickening agent, etc. It can play an antibacterial role in food processing, but can cause allergic reactions if used for a long time or in large quantities. For example, when TiO_2 comes into contact with food, it will make the taste of some food deteriorate and even lead to severe food poisoning. In addition, if TiO_2 cannot be completely decomposed during processing, some harmful substances will remain. Research shows that in most areas of our country there are some people with food allergies. It can be seen that TiO_2, as a food additive, may have an impact on human body during food processing. Therefore, mixing with other substances should be avoided as far as possible. TiO_2 nanoparticles have excellent nanoscale effect and dispersion, as well as high mechanical strength and chemical stability, so they have a broad application prospect in food additives. TiO_2 nanoparticles can be used as food additives, mainly by the covalent bonding of iron and non-iron ions in polymer organic materials to form nano-scale TiO_2 gel. The gel has a high specific surface area and porosity, and can be added to food as an anti-coagulant. Due to the size effect and dispersion of nanoparticles, nano-TiO_2 gel has advantages such as better, faster synthesis speed and lower cost compared with traditional dispersants.

Keywords: TiO_2, Food additives, Health, Environment.

1. Introduction

TiO_2, as a food additive, is widely used in the coloring, solubilization, sterilization and other processes of candy, beverage, bread, pastry, jelly, milk, biscuits and other food, with good antioxidant, antibacterial, anti-corrosion and antioxidant effects. In addition, there are still many problems to be studied in the application of TiO_2 as food additives. The research of TiO_2 started late and the techniques of TiO_2 were not mature, and the insufficient understanding of TiO_2 performance was in many people. At present, the most widely used and deeply studied TiO_2 in China is Division Dictionary TiO_2 (DDT) developed by Guangdong Sanhua Group. DDT is one of the most widely used food additives. DDT is mainly used in the food industry as an additive for sweeteners (such as lactose and jam) and food flavors and sodium in their products. It can also be used as a decolorizing agent in meat products. However, compared with other food additives, TiO2 and its modifiers have better physical and chemical properties, such as temperature and pressure, water solubility and viscosity.

TiO_2 nanoparticles as a new food additive have been widely used in food field. In the process of production and consumption, TiO_2 nanoparticles have the advantages of higher thermal stability, better safety, lower toxicity and so on. After being absorbed by digestive tract, TiO_2 nanoparticles enter the body and become a functional food additive, but a large number of by-products will be produced in the processing process, such as residual acid (acid), aluminum-containing substances (alkaline), heavy metals, etc. Therefore, scientific and reasonable management of its application is of great significance to the protection of food health. TiO_2 as a functional food additive has been widely used in food processing for many years. However, there are few researches on the issues of TiO_2 nanoparticle additives.

2. Research status

2.1. Influence of nano polyolefin (PO) on TiO_2 gel properties

Nano PO can be combined with polyethylene, polyacrylate, acrylonitrile and other polymers. Because different chemicals have different functions in covalent bonds, it is possible to improve the anti-emulsification ability and thickening effect of polymer materials by modifying them. Nishin et al. chemically modified TiO_2 to form a unique process, whose molecular chain is shorter and longer than polyethylene, thus having excellent flexibility and high viscosity [1]. TiO_2 molecular chain is longer than polyethylene, so it has high viscosity, large specific surface area and excellent viscosity stability. TiO_2 molecular chain is longer than polyethylene, so when added to meat and fish products, it has good emulsifying resistance to fat and certain oil [2]. At present, polyethylene monomer, polyacrylate, polycaprolactone and so on are widely used in the world to make gel. Gel has high anti-emulsification ability, which can inhibit the interaction between protein and polymer and reduce the emulsification effect. It has good anti-emulsification effect on meat and fish products. PO can also form a good gel by synergistic action with a variety of polymers, so it is widely used in a variety of polymer-based gels. Therefore, nano PO can get better effect and performance when added to TiO2 complex gel in different acting modes. At the same time, the viscosity, stability and physical stability of the composite gel can be significantly improved when the nano PO content is high.

2.2. The influence of PO content in food

Organic foods contain a variety of organic compounds, some of which form cations in aqueous solutions, such as organic acids. In general, acidic substances are used in food processing to regulate acidity and pH, thus controlling the concentration of contaminants in food. TiO_2 polymer with iron base (FeO) as stabilizer is an ideal choice [3]. Nanoparticles can be well dispersed in PO compounds in food and can be used to improve food quality because they can be dispersed through the formation of large molecular compounds into nanoparticles or colloids, resulting in a stable and easily dispersed gel structure. Therefore, it is feasible for TiO_2 to be added to food, but the nano gel will also produce PO in the process of use. These PO include inorganic PO (NaOH), organic PO (OH), water (H_2SO4) and metal (ZnO), etc., and some PO can enter the food and cause product defects and product safety problems [4].

2.3. Dosage in food salts, preservatives and thickeners

The results show that nano TiO_2 has good safety in salted food and will not affect the salting process. Therefore, TiO_2 has a broad application prospect as a preservative in preserved food, but there is no appropriate preservative technology at present. However, this method does not need to go through the drying process, and only needs to hydrolyze TiO_2 nanoparticles to obtain food additives with good anti-corrosion effect. Moreover, TiO_2 applied in pickled food can also improve the appearance quality of products. Studies have shown that nano TiO_2 can quickly dissolve and precipitate in salt, preservative and thickening agent, preservative and thickening agent, so as to promote food dehydration and shorten drying time. As a preservative, TiO_2 not only has a good anti-corrosion effect, but also can improve the color and color of products and improve its stability. However, due to the hygability and solubility of TiO_2 itself, it is not easy to dissolve in water to maintain viscosity and other reasons, so it is not suitable for use as a preservative. The application of nano-level TiO_2 can improve the antioxidant capacity of products, but it will have some negative effects at the same time. In addition, the size effect and high dispersion (less than 50 nm) of TiO_2 nanoparticles will also affect the quality of food and produce adverse consequences [5]. Therefore, the safety and processing characteristics of food additives should be considered in the selection.

2.4. Factors affecting the quality of food additives

For food additives, there are many differences between TiO_2 nanoparticles and additives themselves. First of all, in food, additives in their own will not react with food. Secondly, when TiO_2

is added, the additive itself does not need to be decomposed by emulsification. However, it does not dissolve itself in water and therefore does not react with food. Therefore, the addition of TiO_2 in many foods will cause changes in food quality, such as rancidity, oxidation and rotten odor, and even affect consumers' judgment of food quality and appetite. Studies have shown that when TiO_2 is added to food, liquid or solid beverages, the food may break down into smaller units during heating. As a result, these changes may adversely affect food quality. However, with the increase of the supplemental amount, the food quality will change due to the increased consumption of nutrients in the food, the change of food flavor, oxidative rancidity, spoilage odor, enzyme activity and other factors. Especially due to the increase of molecular weight, the change of food structure, food perishable, food flavor changes and the enhancement of enzyme activity and other factors, food safety risk increases. Therefore, many food additive manufacturers begin to pay attention to the impact of food additives on food quality [6]. There are significant differences between the addition of TiO_2 as a food additive to beverages, foods, meat products, and dairy products. Therefore, it is possible to predict the change amplitude of food quality by the effect of the amount of food additives on its quality.

2.5. Some important issues of the interaction between nanoparticles and other TiO_2 gels

As a gel with strong anti-binding force, nano TiO_2 can promote the release of food additives, but there will be adverse effects caused by interaction between nanoparticles. Nano TiO_2 can be combined with polymetallic oxides or organic iron oxides [7]. In the synthesis, cation exchangers can be used, thus avoiding the influence of other components. These methods are also well researched. Nano surface growth factors are composed of polymer systems with size effect and dispersion. Nano-surface growth factors are widely used in food additives for their applications in the food industry. With the increasing demand for food processing, nano-surface growth factors need to be more widely used in research and production.

3. The impact of TiO_2 on environment (land, sea)

Recently, a paper detailing new findings about nanoparticles' impact on the environment (land). The study reports for the first time a new method for identifying surfactant and biological surface adsorbed TiO_2 nanoparticles entering the atmosphere, ocean and causing changes. The researchers evaluated the environmental impact of TiO_2. TiO_2 is a material that can be used as an electron probe, material electrode and interface device. It can become be applied in renewable energy, medical devices and sensors (for example, in robots), batteries and other electronics.; It can also be used as a supplementary component of a smart chip. This kind of metal film with ultra-high surface energy has a wide range of applications, but it is difficult to prepare because of its amorphous characteristics.

3.1. They way nanoparticles enter the environment

Interactions between particles lead to interactions between surfactants and biological surfaces. Although these interactions do not affect each other individually or simply, they interact with each other through mechanisms that ultimately interact with each other [8]. Thus, in this interaction, the biological system can recognize the surfactant interaction and produce molecules. The researchers describe how to discover the interactions between particles found in biological environments.

Researches show that in microbes and plants, particles interact with each other in relation to their interactions with biological surfaces. This helps understand how particles pass through plants and microorganisms to have a direct impact on how particles affect the environment. There are many microorganisms in the ocean such as actinomycetes (bacteria) and algae, whose impact on the environment helps to turn their nanoparticles into beneficial particles. Studies have shown that these organisms typically use TiO_2 as adsorbents and bacteria [9]. After the particles take nutrients from the microbes, the microbes can change the chemical composition of their surfaces through adsorption; They can also use external chemicals or enzymes produced by bacteria to break down substances already in the environment. This is why microbes are involved in the chemical reactions involved in

getting TiO_2 nanoparticles into the environment. These chemical reactions occur in two ways: bacterial decomposition and microbial action.

3.2. New methods to identify particle pollution

This study is the first to report a new method that can be used to identify particle pollution. Using this method, the researchers were able to extract biological surface signals from TiO_2 particles adsorbed on the surface of the object as well as chemical signals generated by capturing the particles using biological surfaces, providing a new method for identifying particles. This method has shown a challenging ability to identify particles better than other methods in the atmosphere and ocean because they cannot adsorb near (rather than on) the particle surface. It only allows interactions between particles to occur on the surface of the particles. This could explain what happens when the particles reach the ocean [10].

3.3. Using nanoparticles to simulate the effects of TiO_2 on climate change

Over the past decade, nanoparticles have had a significant impact on the climate systems of the atmosphere, oceans and land. This is mainly due to low CO_2 concentrations and the effects of human activities: deforestation, for example, leads to higher global temperatures, more methane emissions led to more air pollution, and ultimately more fossil fuel burning that leads to heat exchange between the ocean and the atmosphere, leading to more greenhouse gas emissions. Scientists have found that these pollutants are produced in our lives and are usually released into the atmosphere in the form of water and carbon dioxide [11]. TiO_2 can also affect seawater plants. Due to the wide distribution of solar radiation in the Earth's atmosphere, the emission of TiO_2 in the atmosphere is very large. It is therefore crucial to reduce greenhouse gas production by changing the way nanoparticles reach the Earth's surface and are released into the atmosphere. Such emissions are needed to reduce greenhouse gas emissions by reducing carbon emissions to protect the land and sea life around us from climate change pollutants.

4. Future trend of TiO_2 particles' impact on the environment

A study shows that the chemical reactions before the particles enter the environment are critical to the biological properties of TiO_2. The effect was particularly strong in Marine bacteria. The study also suggests that TiO_2 particles can be absorbed by the Earth, but may accumulate more in the atmosphere. As a result, this could lead to more TiO_2 entering more Marine or atmospheric environments. Fundamentally speaking, TiO_2 nanoparticles have great potential for natural impact.

TiO_2 is a stoichiometric mixture that may undergo chemical reactions when adsorbed on a surface. For example, when adsorbated to a living surface, biomolecules are released into the atmosphere. This is important in biological processes, but it is also possible to damage the environment and cause damage, which makes the method potentially useful. However, researchers can use biomolecules to monitor how particles enter the atmosphere and how microbes and other living things interact with each other. This helps better understand these processes and study how organisms affect conditions on Earth and in the oceans. The study is the first to report new findings on the environmental (land) impacts of TiO_2 nanoparticles [12]. Relevant technologies will be further developed to improve understanding of environmental factors and promote sustainable development strategies. It will help better understand how life and its environment interact.

Researchers understand the chemical and biological role of nanoparticles by modeling biological responses in the atmosphere, oceans and Earth systems. This model analyzes the effects of the interactions between nanoparticles and bioactive substances and the interactions between particles and cells. It showed that this is a dynamic process. Although particles have entered the atmosphere through ocean dispersal, water dissolution and atmospheric deposition, it also can be found that particles eventually accumulate in Marine organisms. This is a big find. It shows that TiO_2 nanoparticles and their interactions with microorganisms are the basis of biology. When particles

enter the air, they are adsorbed by microbes to their surfaces and interact with their cells. This is the basis for changes in biological activity and behavior. As a result, researchers can better understand the processes by which TiO_2 nanoparticles affect the production of biological systems in Earth systems.

First, this study provides scientists with tools to better understand how particles affect the environment and have a profound impact on future development. Second, there are many opportunities to examine how nanoparticles enter the atmosphere and interact with the ocean, which is critical to our understanding of how particles affect the environment. Nanoparticles can affect the environment (land) by altering the water environment, making them one of the key factors for more sustainable development. It is necessary to understand this fact not only to understand how particles affect our ecosystems and protect our most vulnerable and sensitive biological species. Now is the time to start taking action to make climate change more effective. The research can be applied to more and wider applications in the future [13]. For example, nanoparticles could also adapt to climate change by changing microbial communities leading to higher impacts on the global ocean. Therefore, there is still a long way to go in thinking about how to protect the planet's ecosystems and protect human health.

5. Conclusions

TiO_2, as a functional food additive, can provide health protection for people in a certain sense. Its application in food field needs further research and experimental confirmation. At present, there are few relevant reports, and the research is still in the primary stage. Many research results need to be further improved and applied, such as how to more effectively inhibit the pollution of by-products such as heavy metals; How nanoparticles can be added to various products; How to better play its performance in the application. These need to be studied in depth. At the same time, relevant national departments are required to formulate relevant management methods and standards to guide the use and supervision of TiO_2 raw materials and nanoscale particle additives.

Based on the wide application in the food industry, the application of nanoparticles in food additives is increasing. The application of nanoparticles is still in its infancy. Future research should focus on the synthesis and characterization of novel nanoparticles combined with the food industry. In addition, attention should be paid to the biosafety of food additives used in nanoparticles. There is a close relationship between food additives and human health, so it is very important to study the safety of food additives. This will greatly improve food safety.

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