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Study on the Harm of Chemical Additives to Food Safety and Their Detection Methods

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Abstract: More and more people pay much attention to the food safety. The reason is that food additives play an important role. Improper use of chemical additives has led to increasingly serious food safety problems. People should hold a dialectical view on food additives and a correct view of their role in the preservation and use of food, do not "give up eating for fear of choking". Food additives are not the same as poisons, and only the violation of regulations and excessive use of additives will cause harm to people's lives and bodies. So, this paper puts forward the study of the harm of chemical additives to food safety and their detection methods. This paper describes the types of chemical additives and their respective harm, enumerating several additives that have come to the attention of the people today, such as Sudan Red, Clenbuterol, Melamine and so on; and this paper discusses their detection methods, analyze the pros and cons of various detection technologies, such as biosensing technology, gas phase detection method, spectroscopy detection method and ion chromatography detection method.

Keywords: Chemical additives; Food safety; Harm; Detection methods

1. Introduction

Up to now, the types of food additives in China have been divided into 23 categories, with a total of 25 varieties[1], including bleaching agents, swelling agents, pigments, preservatives and so on. However, China has strict regulations on the use of preservatives and bleach in food production. Because both of these agents contain sulphur, which reacts with the food to produce sulphur dioxide. Sulfur dioxide is a kind of sulfur that can make people carcinogenic. Since sulfur dioxide can increase the brightness and smoothness of the surface of articles, many unscrupulous traders will add sulfur dioxide to food production to promote early maturation and premature delivery. After drinking, the residents will be harmed seriously.

2. The Harm of Chemical Additives to Food Safety

"Food is the paramount necessity of the people." China has always attached great importance to food safety testing and worked on escorting food safety. Therefore, China has published food safety and health laws to make strict regulations for the use of food additives [2]. To some extent, the use of food additives is to increase the color, smell and taste of foods, increase the appetite of the people, and at the same time prolong the storage time of food to achieve the purpose of preservation and preservation. Antioxidants can increase the storage time of food [3], which is beneficial to the preservation of foods. It can also avoid fats and oils in food that have been exposed to air to oxidize into other harmful substances. Food additives cannot be used alone in food, and there are natural and artificial additives.

2.1. Accelerating organ failure

The chemical structure of clenbuterol is similar to that of beta-agonist compounds and is generally used to treat asthma. However, many unscrupulous traders have illegally added it to the feed of livestock such as pig, cattle, horse and sheep to speed up the growth , increase the synthesis of animal muscle protein, accelerate the growth of lean meat, and suppress the production of fat, so that the proportion[4]of muscle and fat content of livestock can be changed. However, once the meat is eaten by the people, it will cause the body to have an increased heart rate, high blood pressure, and irregular heartbeats, in severe cases, it may even endanger lives. Melamine is a common and important chemical industrial raw material which is often used in the manufacture of industrial resins. It is widely used in wood, paper, leather manufacturing, electrical welding, pharmaceutical biology, textile industry and other industries. It is an important raw material used in the manufacture of chemical industry resins. Once melamine is eaten by mistake, it will turn into cyanic acid in the human body, and further chemical reactions will occur, producing cyanuric acid melamine crystals that are insoluble in water [5]. It deposits in the kid-

neys of the human body and can block the renal tubules, causing organ failure and human death. The chemical name of diazepam is "benzodiazepine" which has hypnotic, sedative, anxiolytic, anticonvulsant, antiepileptic and central neuromuscular relaxant therapeutic effects in medicine ,and it is a hypnotic agent that is often used in clinical medicine.

2.2. Causing gene mutation

Sudan Red is a synthetic chemical dye that is widely used in biology, chemistry and other fields. In everyday life, it is often used in the intense dyeing of fireworks and brightening of leather utensils. However, studies have shown that excessive use of Sudan Red and absorption by the human body can lead to human gene mutations, liver cell changes, and it has carcinogenicity. It has been included in the third category of carcinogenic substances by the United Nations. Therefore, the use of Sudan Red in food has been banned internationally and in China.

2.3. Causing cancer and malformation

Industrial copper sulphate contains excessive amounts of toxic metal elements such as lead, boron, antimony, and cadmium. Once used by the human body, it will lead to excessive levels of heavy metals in food and cause heavy metal poisoning in human body. In summer, food is extremely prone to bacterial growth due to decay at high temperature. Some unscrupulous traders use industrial formaldehyde in food in order to obtain profits regardless of human health and safety standards. Formaldehyde has high toxicity and misuse of it can cause respiratory tract infections and trigger genetic mutations such as brain tumors. It can even cause dysplasia and fetal death. It has already been listed by the United Nations as a primary carcinogen and secondary malformation substance, and it has been identified by the World Health Organization as a Class I toxic and harmful illicit food additive and is strictly prohibited.

3. Detection Methods for Chemical Additives

3.1. Biosensing technology

As the advanced technology in the field of biomedicine, biosensing technology can be applied to the quality tests of food ingredients, such as sugar, cholesterol, and fat in food. With the birth of nanotechnology, biosensing technology can be further innovated and developed. Nanomaterials can combine with a variety of molecules of materials without affecting the activity of biomolecules due to their simple and controllable operation process, stable material performance and good biocompatibility. On the other hand, graphite as a lightweight chemical material, one can imagine that carbon nanotechnology can be widely used in real life. Carbon materials are light and stable, and can be used as catalysts to adjust the chemical reactions between molecular materials. Although the application of biosensing technology is relatively large and the actual effect is good, due to the limitations of technical conditions and the relatively large amount of capital investment, there are still some restrictions in the application of real life.

3.2. Gas phase detection method

The gas phase detection method use the inert gas represented by helium as the transporter to transport the detection objects into the chromatogram, and separates the small molecules of the material according to the intensity of the light column and the time of action between different detection objects and the chromatographic column, then check through the detection system. Gas phase detection has a series of advantages, such as mature technology, high separation strength, high suspension degree, and high accuracy.

3.3. Spectroscopy detection method

Spectroscopy is a highly penetrating technology, among this, Raman spectrum is caused by the reaction of substances and spectrum, which leads to the mutation of the change rate and the evolution rate in small molecules, and thus the unique vibration and rotation frequency can occur. Raman spectroscopy was discovered by an Indian physicist, who shined a beam of color light on liquids such as carbon trichloride and hydrogen trichloride. After the emission, scattering, and projection of light rays and substances, Raman scattering was finally collected and distributed. After the substances in food pass through the Raman spectrum are shown in Table 1.

Table 1. Analysis information of compound spectrogram

Compounds	Linearity range (ug/ml)	Detection limit (ug/m)	Relative standard deviation	Linear equation
Benzoic acid	1-234	0.75	4.43	y=41.35x-49.71
Butylated hydroxytoluene	0.3-356	0.65	5.42	y=71.16x+131.80
Tert-butylhydroquinone	0.25-134	1.23	5.49	y=0.40x-14.07
Ethyl cinnamate	2.31-254	2.31	7.89	y=3.18x-2.87
Acetic acid	0.78-278	1.12	4.32	y=9.28x-2.87
Ethyl vanillin	3.43-251	3.21	5.56	y=3.28x-2.07
Benzyl cinnamate	0.79-357	0.78	7.32	y=54.16x+11.580

Butyl hydroxy anisd	4.32-234	0.97	5.55	y=74.16x+1.80
Propyl gluconate	7.11-311	1.87	7.32	y=7.40x-10.07
Sodium cyclamate	2.45-651	2.34	3.57	y=9.40x-14.07
Vanilla bean extract	1.23-346	3.67	9.42	y=70.16x+1.080
Vanillin	5.32-454	1.43	0.32	y=14.16x+12.080
Vanilla	2.34-673	0.35	5.32	y=94.16x+201.80
Acetic acid	1.09-598	2.13	6.33	y=14.16x+211.80

According to the map analysis information table, it is possible to determine the specific data and the range of rays between the various compounds in the food and understand the nature of the substances.

3.4. Ion chromatography detection method

Ion chromatography is an analytical method with advantages of high speed, high sensitivity, high accuracy, and simultaneous detection of multiple components in high performance liquid representation chromatography. Ion chromatography can be used to analyze common anions and cations in chemistry, as well as analysis of multi-effect complex organic ions in composites such as proteins and amino acids. Ion chromatography detector can be divided into electrochemical detector and optical detector. Electric detector is divided into electric conductor detector and ampere detector, while electrical conductor detector is the most widely used materials with higher sensitivity requirements. Amperometric detectors are often used to analyze less sensitive substances. The analysis of substances in ion chromatography is shown in Table 2.

Table 2. Analysis of compound ion chromatography

Compounds	Linearity range（ug/ml）	Detection limit （ug/m）	Detection limit	Recovery rate（%）
Benzoic acid	1-223	0.85	3.43	109.21
Butylated hydroxytoluene	4.34-390	0.55	1.42	89.12
Tert-butylhydroquinone	0.15-139	4.23	5.00	123.12
Ethyl cinnamate	9.31-204	9.31	7266	218.21
Acetic acid	1.78-278	0.12	3.32	219.08
Ethyl vanillin	3.03-201	1.21	2.06	109.11
Benzyl cinnamate	0.79-307	2.78	7.32	129.10
Butyl hydroxy anisd	032-234	9.97	1.55	211.01
Propyl gluconate	1.41-111	4.87	2.32	99.09
Sodium cyclamate	4.45-151	9.34	3.07	99.12
Vanilla bean extract	7.23-746	0.67	1.42	90.98
Vanillin	3.32-254	0.43	0.72	98.91
Vanilla	2.34-773	0.05	2.32	108.79

According to the detection of various components of the compound by ion chromatography and the calculation of the recovery rate, We can understand the improvement and effective utilization of ion chromatography detection method in the recovery rate of objects.

4. Conclusion

Based on the understanding of the meaning of chemical additives, this paper analyzes the types and harmful ingredients of food additives. Relying on the development and maturation of current technology, the detection methods for chemical additives are further examined according to the analysis of the compounds in the spectrum and ion detection methods. It is hoped that the study in this paper will provide a theoretical basis for food safety detection technology.

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