Rapid Detection of Chloramphenicol Residues in Fermented Foods Based on UPLC-DAD

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Abstract: in the detection of chloramphenicol residues in fermented food, there are often problems of slow detection speed. Using UPLC-DAD method, a rapid detection method of chloramphenicol residues in fermented food based on UPLC-DAD method is designed. According to the characteristics of chloramphenicol, set up the detection reagent, select the detection equipment, and form the detection laboratory. It is usingUPLC-DAD method to design the test paper, using the set test reagent to deal with the sample to be tested, according to the design results of the test process, combining the reagent with the sample, to determine its specificity. Chloramphenicol residue was detected by test paper. So far, the rapid detection method of chloramphenicol residues in fermented food based on UPLC-DAD method has been designed. Compared with the original detection method, the detection speed of the detection method designed in this paper is significantly higher than the original method. In conclusion, the rapid detection method of chloramphenicol residues in fermented food based on UPLC-DAD method is effective.

Keywords: UPLC-DADMethod; Chloramphenicol; Residue Detection; Food Safety;

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1Introduction

Chloramphenicol, also known as L-actinomycin, is a highly effective antimicrobial broad-spectrum antibiotic produced by Streptomyces, which has activities on a variety of aerobic and anaerobic microorganisms and functions by interfering with or inhibiting protein synthesis (Veach Brian T et al. 2018). Chloramphenicol has a strong effect on Gram-negative bacteria. Sensitive bacteria include Enterobacteriaceae (e.g. E.coli, Enterobacteraerogenes, Salmonella, etc.) and anthrax, pneumococcus, Streptococcus, etc. The toxicity of chloramphenicol is that it can block the synthesis of protein in organism. The specific process is: chloramphenicol diffuses into bacterial cells through good liposoluble effect, combines with 50 ribosomes to block the activity of transferrin, and further blocks the synthesis of protein (Alves Georgia

De AssisDiaset al. 2020). However, the binding with another 70 ribosome can inhibit the synthesis of mitochondrial protein, thus causing toxicity to organisms.

With the further understanding of chloramphenicol, it has been found that chloramphenicol has strong toxicity and side effects because it contains nitro group in benzene ring and its half-life is long. Long term consumption of foods containing chloramphenicol residues can lead to anaemia (Reinhard Robert G et al. 2018). In addition, if the human body ingests a small amount of chloramphenicol for a long time, it will not play a role in disease resistance, but will cause resistance of E.coli, Salmonella and other bacterial groups, and eventually lead to the disorder of the normal bacterial group of the body, making the human body more susceptible to various diseases. Moreover, the continuous use of chloramphenicol may lead to an irreversible myelosuppression disease, known as hypoplasia or paraplegia, which in turn can lead to aplastic anemia, although uncommon, but often fatal. Due to these health problems, the joint food additive Expert Committee of FAO and who has announced that chloramphenicol is prohibited from residues in human food supply, and its use in food has been banned in the European Union (EU) and the United States (TozziFrancescaet al. 2019). However, chloramphenicol's wide range of drug effects as well as its availability and low cost have attracted many businesses to use. It is undeniable that whenever chloramphenicol is tested, there may be abuse and illegal use. Recently, chloramphenicol was found in shrimp used for human consumption and imported from China and Vietnam. In daily life, chloramphenicol mainly enters the human body through the food chain and accumulates in the human body, causing great harm to human health. Because of its low price and good bacteriostatic effect, chloramphenicol has been widely used in the treatment and prevention of various infectious diseases in the production process of various poultry, livestock and aquatic products, especially in the aquaculture industry. For example, in the mariculture industry, chloramphenicol is considered to be the most effective drug to inhibit the pathogenic Vibrio of shrimp. Because of the great harm of chloramphenicol, a series of relevant laws and regulations have been formulated in China and abroad to strictly control the use of chloramphenicol. Chloramphenicol is listed in EU Council Directive 96/23/EC as prohibited to add drugs to animal food and to be used in aquaculture. In Announcement No. 235 of the Ministry of agriculture in 2002, the maximum limit of veterinary drug residues in animal food, chloramphenicol and its salts and cools are listed as prohibited drugs, which shall not be detected in all animal food. The definition of "not detected" is that the content of chloramphenicol residues in animal food is less than 1 μg/kg, that is, the content is less than one billionth.

With the increasing awareness of public health, food safety has become the focus of social attention, in which veterinary drug residues of animal derived food is an important aspect. In the modernization, intensive and large-scale production of animal husbandry, it can play a very significant role in reducing animal incidence rate and mortality rate, improving feed utilization rate, promoting growth and improving product quality. It is widely used and has become an important factor of production (RyuJi-Yeon et al. 2019). However, due to the lack of scientific knowledge and driven by economic interests, the phenomenon of drug abuse is also widespread in the breeding industry, which leads to the serious phenomenon of veterinary drug residues in animal products, which has become a major hidden danger to the health of consumers, and seriously affects the export of

animal products, causing huge economic losses.

Chloramphenicol residue refers to the compound or its metabolite contained in any edible part of food and the residue of impurities related to chloramphenicol (Dai S Het al. 2019). It refers to the residue of drug prototype or its metabolites in animal cells, tissues, organs or other edible parts (such as meat, viscera, eggs, milk, etc.) after the use of drugs to prevent or treat diseases. This kind of residue will have an irrecoverable effect on human body, so it is urgent to detect chloramphenicol residue in fermented food rapidly.

2Design of rapid detection method for chloramphenicol residue in fermented food based on UPLC-DAD

Chloramphenicol is a white needle like or yellowish green needle like, long flake like crystal or crystalline powder, which is stable in nature, bitter in taste, easily soluble in methanol, ethanol, acetone, slightly soluble in water, only 25 mg in 100 mL water at 25℃. It can be preserved for more than 2 years in a dry state. The pH value of its 2.5% aqueous solution is 4.5-7.5, which is relatively stable in weak acid and neutral solutions. It does not decompose when boiling. It is easy to decompose and fail when encountering alkali substances. Its melting point is 149-1530℃. Its finished product has left-handed phototropism, also known as left mould (Leong Sheldon C et al. 2018). The specific structural formula is as follows.

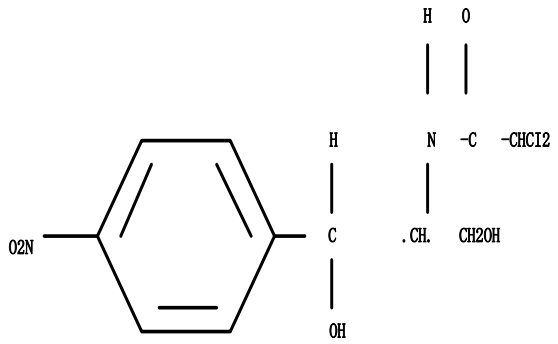

Figure 1 chemical structural formula of chloramphenicol

In recent years, research institutions in China and abroad have found that chloramphenicol drugs are inappropriately used in edible animals, which are easy to cause chloramphenicol residues in animal derived food exceeding the standard, and cause serious harm to human body, mainly manifested in: it can cause hematopoietic dysfunction of bone marrow, because chloramphenicol has inhibitory effect on hematopoietic function of bone marrow vendor (Wiesen Martin H J et al. 2018), which can lead to It can cause thrombocytopenic purpura, agranulocytosis, aplastic anemia, hemolysis, etc.; some enzyme systems in the liver of premature infants and newborns are not fully developed, and the ability of glucuronic acid binding is poor, so it affects the detoxification process of chloramphenicol in the liver; in addition, the ability of renal excretion is weak, which can lead to drug accumulation poisoning; it can also cause optic neuritis, visual impairment Multiple neuritis and other adverse reactions. Therefore, it is necessary to set up corresponding detection methods to detect chloramphenicol residues in food.

2.1Set test reagent

In this design of detection method, a large number of detection reagents are involved. In view of the problem that the detection speed of the original method is too slow, in this method design, the test reagent part will be optimized, and the specific optimization results are as follows.

Table 1 Test reagent setting result

Reagent number	Name of reagent	Reagent purity	Factory
1	chloramphenicol	Analytical	China
2	Sulfomycin	Analytical	China
3	Amoxicillin	Analytical	China
4	Fusamycin	Analytical	China
5	Chloramphenicol sodium succinate	Chromatographic	China
6	Sulfamethazine	Analytical	China
7	Labelling of enzyme two	Analytical	China
8	BNHS	Analytical	Switzerland
9	SA-HRP	Analytical	Switzerland
10	B-Ab_2	Analytical	Switzerland
11	FG	Chromatographic	Switzerland
12	OVA	Chromatographic	Switzerland
13	KLH	Analytical	Switzerland
14	BSA	Analytical	Switzerland
15	HRP	Analytical	Switzerland
16	Cyclodextrin	Analytical	Switzerland
17	Urea hydrogen peroxide	Chromatographic	Switzerland
18	DMSO	Analytical	Switzerland
19	Protein A-Sepharose 4B	Analytical	China
20	TMB	Analytical	China
21	NHS	Chromatographic	China
22	DSS	Analytical	China
23	methanol	Analytical	U.S.A
24	methanol	Chromatographic	U.S.A
25	Ethyl acetonitrile	Analytical	U.S.A
26	Ethyl acetonitrile	Chromatographic	U.S.A
27	sodium chloride	Analytical	U.S.A
28	Disodium hydrogen phosphate	Analytical	China
29	Sodium dihydrogen phosphate	Analytical	China
30	sulphuric acid	Analytical	China
31	sodium carbonate	Analytical	China
32	Sodium bicarbonate	Analytical	China
33	ethyl acetate	Analytical	China
34	Tetrahydrofuran	Analytical	China
35	Anhydrous sodium sulfate	Analytical	China

The above design is the reagent content set in the rapid detection method. The above selected reagent is stored in the form shown in the figure below, and the corresponding reagent solution is prepared.

Take 1mL of the above-mentioned 25

solution, adjust the pH value of the solution to 9.0 with sodium carbonate buffer (Dario Giuglianoet al. 2018), and then add 100 μg/mL HRP to react at 4 ℃ overnight. After centrifugation at 10000 r/min for 10 minutes, the precipitate was repeatedly washed with PBS buffer for three times. Then, 1mL of Au-HRP solution was added to it and 50μL of Envision^{TM} reagent was slowly vibrated at 4 ℃ for 6 hours. Envision^{TM} was bound to the surface of the reagent particles by Au-S and Au-N bonds. Wash 6 times with PBS buffer (pH 7.4). Then add 24, 18 and 15 reagents to the material and incubate it at 37 ℃ for 60 minutes, and centrifugate the unwanted elements. The reaction was carried out through the specific recognition and binding of the second antibody contained in Envision^{TM} reagent and the first antibody of double stranded DNA antibody. The signal probe is dispersed in buffer (pH 7.4) and is used at 4 ℃. The above parts are the experimental reagents to be used in this design. The experimental reagents are stored in the following storage mode, and the specific status is as follows.

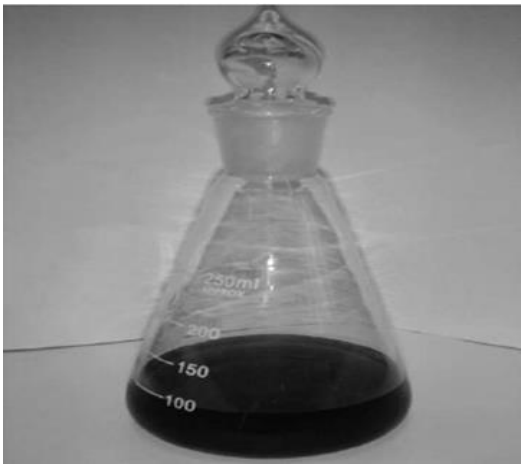

Figure 2 storage mode of experimental reagent

According to the above method, the storage of detection reagent is completed, and the detection reagent set in this part is used in the detection of chloramphenicol in fermented food.

2.2Selecting test equipment

In addition to the above-mentioned detection reagent settings, in order to improve the detection efficiency of the design method, the detection equipment used in this method is set as follows.

Table 2Test equipment design results

Device serial number	Device name	Place of Origin
1	Ultra pure water system	U.S.A
2	Spin evaporator	U.S.A
3	Plate washer	U.S.A
4	Single channel micro adjustable pipette	Switzerland
5	8 micro adjustable pipettes	U.S.A
6	Microplate Reader	U.S.A
7	Protein purifier	U.S.A
8	High performance liquid chromatography	U.S.A
9	Analytical balance-bl610	U.S.A
10	Solid phase extraction vacuum filtration device	China
11	Heating magnetic stirrer one rh-kt	Switzerland
12	Turnover vibrator - MS2	Switzerland
13	Qualitative filter paper	Switzerland

14	Pipette	China
15	homogenizer	China
16	Volumetric flask	China
17	C18 solid phase extraction column	China
18	96 well enzyme plate	China
19	Beaker	China
20	Suction bag	China
21	Suction head	China

According to the equipment connection mode set in the original method, the above tests are used to form the special test laboratory used in the method design. The specific laboratory is shown in the figure below.

Figure 3 test lab setup

Use the above environment to complete the operation of the design method in this paper, pay attention to the cleanliness of the experimental environment in the process of the experiment, and ensure that the experimental utensils are not polluted by the external environment.

2.3Using UPLC-DAD method to complete the test paper design

The traditional method of chloramphenicol detection rarely uses the method of test strip. In this method design, UPLC-DAD method (NaushadVarish,&Arup Kumar Pal 2018) is used to detect oxymycin residue. In addition, the traditional test strip often uses the specific binding reaction of antigen and antibody. In this design method, nucleic acid aptamer is used instead of antibody, which can ensure the uniformity of batches, reduce the cost and save more easily. ZORBAX SB-C18(2.1 mm x 100 mm) was used as the analytical column. The design of the method in this paper was completed by means of chromatographic detection. In order to better fix the probe on the nitrocellulose membrane, one end of the test paper is filled with the test substance, and then the test reagent on the other end of the test paper is incubated and combined to fix it on lineT. Fix the probe to ethanol and other substances at the position of line C. After the detection reagents such as ethanol are combined, they are fixed on the binding pad. If there is a target substance (Perandrés-López Rubén et al. 2018) in the solution to be tested, the solution to be tested flows through the binding pad, and the target substance will bind to the aptamer, so that it cannot bind to the probe 1 at the back, then the color will not appear at lineT, but because the suffix of the aptamer sequence has an end connecting the arm base, it will still bind to the probe 2 at line C position, so the color will appear at line C. If there is no target substance in the liquid to be tested, the aptamer and the probe at line T position combine, and the detection reagent is intercepted at line T position, so line T will develop color. Therefore, the amount of target substance in the solution can be determined according to the color depth atline T. The more amount, the lighter the color. Qualitative detection can be realized by naked eyes, but in order to carry out more accurate quantitative detection, it is necessary to carry out digital qualitative analysis of the color of

the test strip with the help of a reading instrument. The test paper design results are as follows.

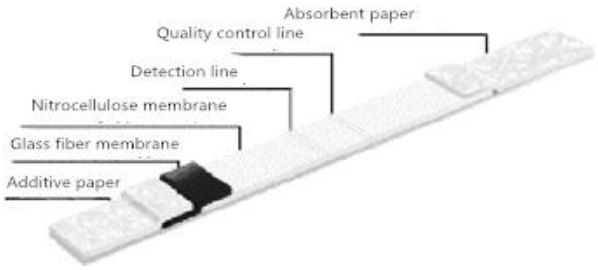

Figure 4 test paper design results

The strip of test paper consists of several parts: sample pad, binding pad, nitrocellulose film, absorption pad and support pad. The specific design contents are as follows:

Sample pad: the first pad in the strip, whose function is to transfer the sample to the next component of the test strip. It is made of cellulose or glass fiber, and a liquid sample is applied to the pad to start the determination. Sample pads are sometimes designed to pre treat samples prior to shipment. The pretreatment can include separation of sample components, removal of interference, adjustment of pH, etc. Therefore, the sample pad should be pretreated before use, which is usually soaked in a buffer (pH 8.0). Another aptamer based strip biosensor for ATP detection has a sample pad saturated with TBS buffer. The sample pad is soaked in PBS saturated solution containing 1% OVA and dried at 37 ℃, and then stored in cool and ventilated condition, which is conducive to sample flow and reduce non-specific adsorption.

Binding pad: the second pad in the strip. It's a pad for loading biometric molecules. When moving the liquid sample, the material of the binding pad shall immediately release the labeled binding biometric molecules. It is made of glass fiber, cellulose, polycarbonate and other materials. Therefore, the combination pad should be pretreated before use. Sometimes, the treatment of the labeled conjugates can affect the sensitivity of the strip assay, which can be used as an aptamer biosensor for field detection.

Cellulose nitrate membrane (CláudiaPeixotoet al.2019): the largest pad in the strip, which is very important in determining sensitivity. Draw test lines and control lines on the film. The function of the membrane is to fix specific molecules on the detection line and control line, and guide the samples and detection compounds to the reaction zone. In order to achieve this goal, the membrane must have a uniform high adsorption capacity, and also need to have a certain degree of porosity and wettability to ensure the capillary flow of water-based samples. Nitrocellulose is such a polymer that NC membrane is suitable for most cases. In order to load the probe in the detection area, streptavidin (SA) was used as a connector to connect the probe and the membrane. The conjugates will be used for the side flow immunoassay biosensor for the rapid detection of chloramphenicol. The conjugates will be dispersed on the NC membrane as the test line and the control line respectively to form the test line and the control line.

Adsorption pad: it is the last pad in the strip. Its function is like paper suction. It also helps to maintain the flow rate of the liquid on the membrane and prevent the reflux of the sample, so the adsorption pad should not be damped during use and storage, so as not to affect its water absorption. Support pad: also called back pad, all these components are fixed in the back pad. It is used to support and provide a properly assembled platform. All of these pads are laminated 2 mm in sequence with each other to ensure that the liquid solution migrates through the flow immunochromatographic strip.

In order to ensure the reliability of the detection process, the specificity of the strip was tested, that is, four chemicals, including TAP and FFC (Philippe Vaskouet al. 2019), and another toxin aflatoxin, were detected under blank condition to study the specific selectivity

of the aptamer sensor to chloramphenicol. Because the mode of the test strip sensor is the competition mode, the amount of target substance is inversely proportional to the signal value at lineT, the more target substance is, the lower the signal value at lineT position is, the concentration of the four substances we selected for detection is 100μg/L, and it is observed that the interaction between the test strip and 100 μg/L chloramphenicol results in significant color reduction, but the color response of the other three chemicals (100 μg/L) The current of blank background has the same signal value. Only when the side material is chloramphenicol, the test strip will produce a decrease of signal value, which indicates that only chloramphenicol can bind to specific aptamer, and when there is no chloramphenicol and other substances can not bind to chloramphenicol aptamer, which also proves that the test strip has a very high specificity, so the experimental results can be concluded that the strip can be used for the detection of other samples, and also for the detection of different small molecular substances, with high sensitivity, strong specificity and strong anti matrix interference ability.

Through the above part, the design of the test paper in the detection is completed, and it is applied to the rapid detection here. In order to improve the detection speed of the detection method designed in this paper, the test paper is stored in the form of a test paper box to expand the contact area between the test paper and the liquid to be tested and improve the detection speed.

2.4 Test sample preparation

Through the above part, the equipment selection part of the design method is completed. In order to ensure the validity of the test results. The samples to be tested also need to be processed accordingly. Accurately measure 10 mL of the sample to be tested and put it into a 50 mL centrifuge tube. Add a small amount of anhydrous sodium sulfate and 30 mL of ethyl acetate, homogenize for 1 min, centrifuge (5000 r/min, 5 min), then pour out the upper ethyl acetate and put it into a 100 mL concentration bottle. Remove the ethyl acetate in a water bath at 50 ℃. Add 4mL of methylalcohol sodium chloride (20% sodium chloride) and 4mL of mixed reagent solution. After fully shaking, transfer it to a 10mL centrifuge tube, Then add 1 mL of methanol sodium chloride solution to clean the concentration bottle, combine the cleaning solution in a 10 mL centrifuge tube, vortex for 0.5 min, and centrifuge for 1 min at 5000 r/min, then use a sharp mouth pipette to absorb n-hexane, add 4 mL of detection reagent to repeat the above operations, then add 4 mL of ethyl acetate in the centrifuge tube, vortex for 1 min, and centrifuge for 1 min at 5000 r/min, and then use a sharp mouth pipette to suck out ethyl acetate to repeat the above operations, Combine ethyl acetate in a 100mLconcentration bottle, and concentrate to near dry state on a 50 ℃ water bath. Add 0.2 mL of methanol and 5 mL of double distilled water into the concentrate and pass through the Cog SPE column. The specific steps are as follows: wash the column with 2 mL of methanol and 3 mL of double distilled water at a flow rate of 5 mL/min, run the sample through the column at a speed of 4 mL/min, and then wash it with 5 ml of 5% methanol at a speed of 5 mL/min, and finally wash it with 5 mL of 45% methanol at a speed of 2 mL/min. The eluate is collected, dried by nitrogen, and dissolved by vortex. The treated sample is stored in a centrifuge tube, and the results of the selection of the centrifuge tube are as follows.

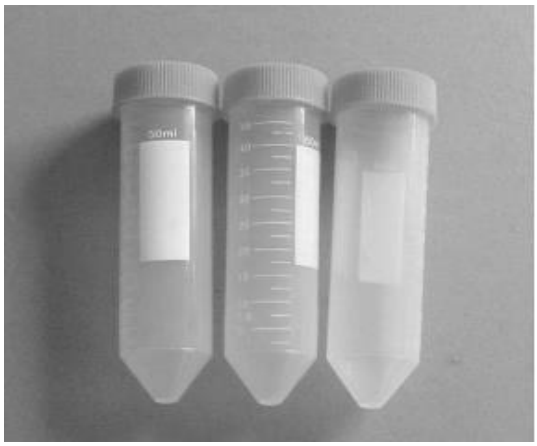

Figure 5 selection results of centrifuge tube

With the above selected equipment, the prepared samples to be tested are sub packed into the centrifuge tube. During the operation, the drying of the centrifuge tube is ensured to avoid contamination of the samples to be tested.

2.5Rapid detection of chloramphenicol residue in fermented food

The basic part of the method is completed through the selection and preparation of the above detection reagents and equipment. Through the link setting of the test method, the rapid detection of chloramphenicol residues in fermented food can be realized.

The test reagent was diluted properly, and 100μL was added into the reaction pore of each polystyrene enzyme plate (M. V. Ioannisian et al. 2019), and coated at 37 ℃ for 3h. Discard the solution in the hole, wash the PBST plate for three times, and add 200μL of closing solution into each reaction hole for one hour at room temperature; discard the closing solution, wash the plate for three times, and add 100μL of sample to be tested (or gradient diluted sample) and purified sample to be tested respectively into the reaction hole. Meanwhile, empty the white hole (no standard sample or sample to be tested, no antibody solution), negative control hole (no standard sample or sample to be tested) , incubate at 37 ℃ for 1 h, wash the plate for 4 times; dilute the test reagent with PBS, add 100μL to each hole, incubate at 37 ℃ for 30 min; wash the plate for 4 times, dilute the CSA-HRP labeled by peroxidase, add 100μL to each reaction hole, incubate at 37 ℃ for 20 min; wash for 5 times, add 150μL of TMB substrate solution temporarily prepared in each reaction hole, develop color for 20 min, and measure the absorption at 450 nm by enzyme marker Optical value. In the process of this detection, part of the calculation process is designed. Analyze and optimize the test results, determine the best working conditions, start with 45 ng/mL of the standard test reagent, dilute with 3 times gradient, conduct indirect BA-ELISA determination, get the absorbance value Z corresponding to different cap concentrations, and calculate the inhibition rate of the test reagent according to formula (1). If the inhibition rate of the detection reagent is set to R, then:

$$R = (1 - \frac{Z_1 - Z_2}{Z_3 - Z_2}) * 100 \quad (1)$$

Using the above formula, the specificity of the detection reagent can be evolved. Expressed by the degree of cross reaction, the calculation method of cross reaction is: the ratio of the concentration IC_{50} (P) of the target analyte required to inhibit 50% of the maximum binding rate of antibody to the concentration IC (other antibiotics are set as O). The formula is as follows: the smaller the cross reaction, the higher the antibody specificity.

$$T = \frac{IC_{50}(P)}{IC_w(O)} * 100 \, (2)$$

The above sample reagent was purified and taken out after dialysis with phosphate buffer solution for three days, and the concentration of detection reagent was determined. Concentration method of detection reagent: after diluting the antibody 20 times with PBS, measure the absorbance value at 280 nm, take PBS as the blank control, and calculate the antibody concentration Q according to

formula (3).

$$Q = \frac{B_1 - B_0}{1.35} * 20 \quad (3)$$

Among them, B_0 is the blank control absorbance, B_1 is the test reagent absorbance. Through the above formula, the test design is processed and fused with the sample to be tested to complete the test. In order to ensure the reliability of the detection process, the chloramphenicol residue detection process is set as follows.

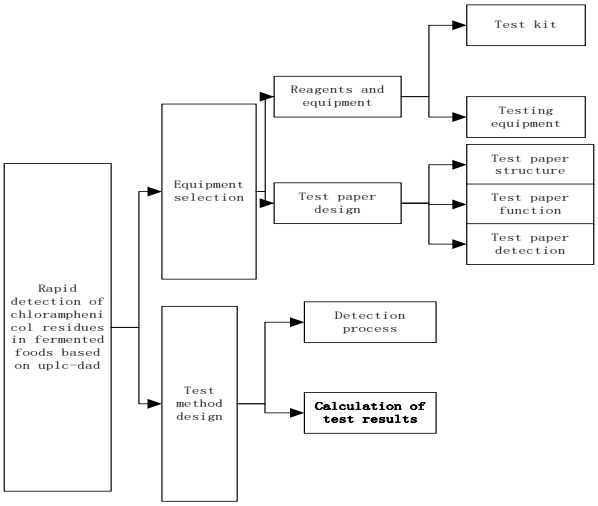

Figure 6 detection process

According to the above process, immerse the test strip in the test reagent and sample solution to be tested (the liquid level of the sample should be lower than the lower line of the test paper) with the end of the sample adding paper facing down. When the sample is siphoned from down to up through capillary action along the test strip, the sample to be tested passes through the test end of the test strip (YehTsung-Jang et al 2019), moving to the other end, successively passing through the glass fiber membrane sprayed with the detection reagent labeled with chloramphenicol antibody and the nitrate fiber membrane sprayed with the control line of the detection line of the sample combination to be tested. If the content of chloramphenicol in the sample exceeds the standard, the chloramphenicol in the sample will compete with the sample combination to be tested on the detection line of the nitrate fiber membrane and compete with the labeled chlorine on the glass fiber membrane. Because the labeled chloramphenicol antibody is inhibited by chloramphenicol in the sample, it can not react with the sample conjugates on the detection line, so it can not make the detection particles agglomerate and color. If the content of chloramphenicol in the sample does not exceed the standard, the labeled chloramphenicol antibody will not be inhibited by competition and react with the sample combination to be tested on the detection line to make the test particles agglomerate and develop color. The control line on the nitrocellulose membrane is set for the purpose of detecting whether the method of labeled immunochromatography is effective. The color of the control line indicates that the test result of the strip is effective, otherwise, it is invalid.

Through the above part, the detection process of chloramphenicol residue was completed. So far, the rapid detection method of chloramphenicol residue in fermented food based on UPLC-DAD method was designed.

3 Experimental analysis

Through the above part, the design process of rapid detection method of chloramphenicol residue in fermented food based on UPLC-DAD method was completed. In order to carry out a detailed study, it was compared with the original rapid detection method of chloramphenicol residue in fermented food to build a comparative experimental link.

3.1Experimental environment

Both the original method and the rapid detection method of chloramphenicol residues in fermented food based on UPLC-DAD method designed in this paper are chemical experiment processes. The experimental environment is set as a chemical laboratory of a university. The specific laboratory environment

is as follows.

Figure 7 experimental environment

In order to ensure the accuracy of the experimental data, set the experimental data to be counted by computer. The model parameters of the computer equipment selected in the experiment are as follows.

Table 3 parameter setting of experimental computer equipment

Direction of use	parameter	Model
Computing equipment1	Host	5537
	CPU	Intel
	Hard disk	64G
	Host	Z357
Computing equipment2	CPU	I7-6700
	Hard disk	6G
	Control system	WIN10
Application software	data base	SQL2016

Using the above equipment to analyze the experimental data, and as an important basis for the effectiveness of the design method in this paper.

3.2Experimental samples

In this experiment, the fermented food of a food factory will be tested, and 20 kinds of food will be selected as the test samples. The specific sample selection results are as follows.

Table 4 experimental samples

Experiment sample No	Name of experimental sample	Types of experimental samples	Production time of experimental samples
1	Yogurt1	Yogurt	10/25/2019
2	Yogurt2		10/25/2019
3	Yogurt3		10/25/2019
4	Yogurt4		10/25/2019
5	Yogurt5		10/25/2019
6	Yogurt6		10/25/2019
7	Yogurt7		10/25/2019
8	Fermented glutinous rice 1	Fermented glutinous rice	6/15/2009
9	Fermented glutinous rice 2		6/15/2009
10	Fermented glutinous rice 3		6/15/2009
11	Fermented glutinous rice 4		6/15/2009
12	Beer 1	Beer	8/24/2019
13	Beer 2		8/24/2019
14	Beer 3		8/24/2019
15	Beer 4		8/24/2019
16	Wine1	Wine	7/18/2016

17	Wine2	7/18/2016
18	Wine3	7/18/2016
19	Wine4	7/18/2016
20	Wine5	7/18/2016

Using the above experimental samples as the basis of the comparison between the original method and the designed detection method in this paper, the original method and the designed detection method are used to detect the above-mentioned fermented food, and the detection reaction time is obtained and compared.

3.3 Experimental results

Using the above settings, the experimental process is completed, and the specific experimental results are as follows.

Table 5 experimental results

Experiment No	sample	Detection time of the original method/s	The detection time of design method in this paper/s
1		45.9	44.1
2		45	44
3		49.1	43.4
4		41.4	37.6
5		45.3	39.4
6		49.6	37.5
7		45.5	44.1
8		51	41.4
9		54.2	44
10		51.8	40.3
11		52.7	42.9
12		51	42.6
13		52	41.3
14		50.8	44.2
15		50.7	42.4
16		72.7	54
17		60.6	52.2
18		69.4	54.3
19		67.9	53.3
20		70.1	52

Through the comparison between the original method and the design method in this paper, it is concluded that the detection speed of the design method in this paper is higher than that of the original detection method. Using the design method in this paper to detect the experimental samples, we can get high precision detection results.

In order to better reflect the difference between the design method and the original method, the experimental results are presented in the form of tables. It can be seen from the above table that the original detection method and the detection method designed in this paper have high detection accuracy for chloramphenicol residues in fermentation products. Therefore, the two methods have high detection capacity. The experimental results show that the detection speed of the design method is faster than the original method, the detection time of the original method is basically distributed between 45-70s, and the

detection time of the design method is significantly lower than the original method. In conclusion, the design method in this paper is better than the original method.

4Conclusions

Chloramphenicol, as an antibiotic widely used and familiar to the public, can play a role of resistance and bacteriostasis to a certain extent, but in many cases, the abuse of chloramphenicol has gradually highlighted its side effects, so it is urgent to develop a new detection method with strong specificity, high sensitivity, easy operation and high efficiency for the initial rapid screening of chloramphenicol residues, visible Chemical detection side and strip sensor are two common low-cost and easy to operate detection methods. To some extent, the method developed in this paper has achieved rapid qualitative and quantitative detection of chloramphenicol. However, compared with the relatively mature detection method based on antigen and antibody, its sensitivity and sensitivity still need to be improved, and the instability of strip itself also needs to be overcome.It is greatly affected by the external environment, temperature and humidity may affect the detection sensitivity, and in a simple sensor such as test strip, many factors are in an uncontrollable state, so in the later development of test strip, we should focus on how to improve its stability.

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