Detection Method of Acrylamide in Coffee

Acrylamide is limited in coffee roasting, coffee powder and instant coffee in the United States because of its neurotoxicity and potential carcinogenicity. At present, there are many methods for the determination of acrylamide in coffee, each of which has its own advantages and disadvantages. This white paper mainly introduces four methods for the determination of acrylamide in coffee: GC, HPLC, GC-MS and LC-MS, and summarizes the latest progress in the determination of acrylamide in various kinds of coffee.

Methods for detecting acrylamide in coffee

At present, the determination of acrylamide in coffee is mainly based on instrumental analysis, and the general chemical analysis can not meet the requirements of food analysis. After some extraction and purification, GC, HPLC, MS and their combination for qualitative and quantitative detection are the current common detection methods.

- Gas chromatography (GC)

  GC can be divided into two types of gas-solid chromatography and gas-liquid chromatography due to the different stationary phases used. The former uses a solid

adsorbent as a stationary phase, and the latter uses a monomer coated with a fixing solution as a stationary phase. There are many types of detectors that can be used in GC. The most commonly used are flame ionization detector (nD) and thermal conductivity detector (TCD). Both detectors are sensitive to many analytical components and can be used to determine concentrations in a wide range. TCD is universal in nature and can be used to detect any substance except carrier gas, while FID is mainly sensitive to hydrocarbons. FID is more sensitive to hydrocarbon detection than TCD, but it cannot be used to detect water. Both detectors are powerful. Because the detection of TCD is non-destructive, it can be used in series with the destructive FID (connected before the FID), thus giving two complementary analytical information to the same analyte.

- Gas chromatography-mass spectrometry (GC-MS)

  GC-MS has an effective ability to separate and distinguish organic compounds, while MS is an effective means to accurately identify compounds. The GC-MS technology, which is composed of the combination of the two, can be used to directly separate complex mixture samples by gas chromatography under the control of a computer, so that the compounds in the mixture can be entered into the ion source of the mass spectrometer one by one, and all the compounds in each sample can be ionized by means of electron bombardment or chemical ionization, and each compound regularly forms a series of fragment ions and molecular ions. Then, under the action of magnetic field (or electric field), scan and record according to the mass-charge ratio of these ions, and finally use the computer to process the data, according to the chromatographic retention time of each compound, as well as the fracture pattern of molecular ions and key fragment ions in mass spectrometry, combined with standard samples or standard spectra, the compounds are qualitatively identified and quantitatively analyzed one by one.

- High performance liquid chromatography (HPLC)

  HPLC is an important branch of chromatography. Using liquid as mobile phase, using high-pressure infusion system, the mobile phase, such as single solvent with different

polarity or mixed solvent with different proportion and buffer solution, is pumped into a chromatographic column with fixed phase. After the components in the column are separated, they enter the detector for detection, so as to realize the analysis of samples. This method has become an important separation and analysis technology in the fields of chemistry, medicine, industry, agriculture, commodity inspection and legal inspection.

- Liquid chromatography-mass spectrometry (LC-MS)

LC-Ms is a combination of liquid chromatography and mass spectrometry. It combines the effective separation of liquid chromatograph and strong component identification of mass spectrometer. It is an effective means to separate and analyze complex organic mixtures. The key to online is the development of a suitable interface, and the solvent must be removed before the sample components enter the ion source.

Acrylamide content in coffee

Because green coffee beans are an unfinished food, the acrylamide content in green coffee beans has little to do with human health. At present, few scholars have determined the acrylamide content in green coffee beans. Nowadays scholars also use some methods to determine the acrylamide content in roasted coffee, coffee filter and instant coffee, namely GC, GC-MS, HPLC and LC-MS / MS. The results of detection of acrylamide in various kinds of roasted coffee and instant coffee are shown in Table 1.

Table 1 Content of Acrylamide in coffee roasting and instant coffee

Serial number	Acrylamide content in coffee/(μg/kg)		Determination method	Detector	Sample preparation	Re
	Coffee roasting	Instant Coffee				
1	1000~17500		GC-FID	Shimadzu GC, RTX-5	Hot water dissolution	1

Serial number	Acrylamide content in coffee/(μg/kg)		Determination method	Detector	Sample preparation	Re
	Coffee roasting	Instant Coffee				
2	131.8~191.2		GC-MS	Agilent GC-6890N, MSD-5975N	Water dissolution, brominated with sodium thiosulfate	2
3	210~330	23.8~42.2	GC-MS	Agilent GC-6890N, MSD-5975N	Hot water dissolution	3
4	40~600		GC-MS	Agilent GC-6890N, MSD-5975N	Water dissolution, brominated with sodium thiosulfate	4
5	57~181	237~476	GC-MS	HP GC-6890, Agilent MSD-5973N	Ethanol dissolution	5
6	52~191		HPTLC	HPTLC System	Derivatization to dansulfinic acid	6
7	374~3800		HPLC-LFD	Agilent HP1100-MSD	Derivatization to dansyl chloride	7
8	43.4~464.8	42~338	LC-MS/MS	TSQ Quantum System	Water dissolution, adding dichloromethane	8
9	115~237.5	180~225	LC-MS/MS	HP1100 HPLC, Quantum Ultima	Water dissolution	9

Serial number	Acrylamide content in coffee/(μg/kg)		Determination method	Detector	Sample preparation	Re
	Coffee roasting	Instant Coffee				
10	64~374	172~471	LC-MS/MS	LC-MS System, Agilent 1100 HPLC	Water dissolution	10
11	206~356	715~865	LC-MS/MS	LC-MS/MS System Alliance 2695	Water dissolution	11
12		109~250	HPLC-MS	HP-1100 series LC-MSD system	Distilled water dissolution	12
13	163~313	349~499	LC-MS/MS	LC-MS System Shodex RSpak DE-413L	Distilled water dissolution	13
14		1020	LC-MS/MS	Agilent LC-MS/MS, Acquity UPLC HSS T3	Distilled water dissolution	14
15	140~159	81~101	LC-MS/MS	HP-1100 series LC-MSD system	Distilled water dissolution	15
16	150~327		LC-MS/MS	HP-ESI-MS/MS System, Finnigan LXQ	Distilled water dissolution	16

Serial number	Acrylamide content in coffee/(μg/kg)		Determination method	Detector	Sample preparation	Re
	Coffee roasting	Instant Coffee				
17	130~1250		LC-MS/MS	Dionex UltiMate 3000, Hypercarb	Water dissolution	17
18	61~379	152~830	LC-MS/MS	Dionex UltiMate 3000, Hypercarb	Water dissolution	18
19	62~261		LC-MS/MS	HP GC-6890, MSD-5973N	Ethanol dissolution	19
20	13~468		LC-MS/MS	UPLC System, TQ detector	Formic acid dissolution	20
21	267.7	806.9~1492.4	LC-MS/MS	Agilent LC-MS/MS	Derivatization to 2-mercaptobenzoic acid	21
22	12~29	42~338	LC-MS/MS	Agilent 1100 HPLC, Agilent 1100 MS	Methanol dissolution	22
23	17~320		LC-MS/MS	Agilent 1100 HPLC, Agilent 1100 MS	Methanol dissolution	23

Summary

Acrylamide in coffee was determined by GC, HPLC, GC-MS and LC-MS/MS. GC-MS and LC-MS / MS are the most widely used methods. The method for the determination of acrylamide includes three steps: extraction, purification and chromatographic separation. The difference lies in the use of different extractants, derivates and chromatographic separation methods. There are some differences in precision and sensitivity of all kinds of detection methods. Different coffee varieties, roasting degree and detection methods also have great influence on the content of acrylamide in coffee, and the highest content of acrylamide in coffee is 17500 (μg/kg). There are many levels of coffee roasting, and each level of roasting has a unique smell and taste, but only a few levels of acrylamide content have been determined. For the sake of people's healthy diet, it is necessary to determine the content of acrylamide for all kinds of coffee and the degree of roasting of all kinds of coffee to evaluate the quality of coffee.

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