

Supplementary Materials

Table S1. 197 high-risk projects identified based on characteristics of each food, pollution status of food pollutants, and other factors.

Number	High-risk projects	Number	High-risk projects
1	6-benzylaminopurine	100	Melophos
2	Abamectin	101	Mercury
3	Acephate	102	Metabolites of furotadone
4	Acesulfame Potassium	103	Metalaxyl and fine metalaxyl
5	Acetamiprid	104	Methamidophos
6	Acid Orange II	105	Methanol
7	Acid value	106	Methomyl
8	Acid value (KOH)	107	Methyl parathion
9	Acidity	108	Methylmercury
10	Aflatoxin B1	109	Methylthiocyclophosphorus
11	Aflatoxin M ₁	110	Metophos
12	Aldicarb	111	Metronidazole
13	Aluminium	112	Morphine
14	Amantadine	113	Mould
15	Amaranth red	114	Nacodine
16	Amino acid nitrogen	115	Natamycin
17	Ammonium salt	116	Nicarbazine
18	Anionic synthetic detergent	117	Nitrile benzozole
19	Arsenic	118	Nitrite
20	Aspartame	119	N-nitrosod imethylamine
21	Aureomycin	120	Non-fat milk solids
22	Barium	121	Norfloxacin
23	Benzoapyrene,	122	Number of lactic acid bacteria
24	Benzoic acid	123	Ofloxacin
25	Benzoyl peroxide	124	Olaquinox
26	Bifenthrin	125	Omethoate
27	Borax	126	Oxytetracycline
28	Bright blue	127	Papaverine
29	Bromate	128	Parathion
30	Butyl hydroxyanisole (BHA)	129	Pefloxacin
31	Cadmium	130	Pentachlorophenol sodium
32	Carbendazim	131	Peroxide value
33	Carbofuran	132	Phorate
34	Carmine	133	Phoxim
35	Chloramphenicol	134	P-hydroxy benzoates and its salts
36	Chlorothalonil	135	Polychlorinated biphenyls
37	Chlorpromazine	136	Potassium acetylsulfonate
38	Chlorpyrifos	137	Potassium ferrocyanide
39	Chromium	138	Prochloraz and prochloraz

Number	High-risk projects	Number	High-risk projects
			manganese salt
40	Clenbuterol	139	Profenofos
41	Codeine	140	Propanediol
42	Coliform group	141	Propionic acid
43	Commercial sterility	142	Protein
44	Cyanide	143	Pseudomonas aeruginosa
45	Cyclamate	144	Pyraclostrobin
46	Cyfluthrin and cyfluthrincyhalothrin	145	Pythium
47	Cyfluthrin and cypermethrin	146	Ractopamine
48	Cypermethrin and beta- cypermethrin	147	Residual chlorine
49	Cyromazine	148	Rhodamine B
50	Dafloxacin	149	Ribavirin
51	DDT	150	Saccharin sodium
52	Dehydroacetic acid and its sodium salt	151	Salbutamol
53	Deltamethrin	152	Salmonella
54	Deoxynivalenol	153	Selenium
55	Dexamethasone	154	HCH
56	Diazepam	155	Sodium
57	Dibutyl hydroxytoluene (BHT)	156	Sodium 4-chlorophenoxyacetate
58	DicofolTrichlorfon	157	Sodium chloride
59	Dietary fiber	158	Sodium formaldehyde bisulfite
60	Difenoconazole	159	Sorbic acid and its potassium salt
61	Diiflubenzuron	160	Staphylococcus aureus
62	Dimethoate	161	Starch
63	Dimethyl fumarate	162	Sucralose
64	Dimethylpentyl	163	Sucrose
65	Disodium ethylenediamine tetraacetic acid	164	Sudan I
66	Doxycycline	165	Sudan II
67	Endosulfan	166	Sudan III
68	Enoylmorpholine	167	Sudan IV
69	Enrofloxacin	168	Sulfite
70	Escherichia coli	169	Sulfonamides
71	Ethyl maltol	170	Sulfur dioxide residue
72	Fat	171	Sunset yellow
73	Fenitrothion	172	Talc
74	Fenthion	173	TBHQ
75	Fenvalerate and S-fenvalerate	174	Tebuconazole
76	Fipronil	175	Terbutaline
77	Florfenicol	176	Tetracycline

Number	High-risk projects	Number	High-risk projects
78	Fluorescent substance	177	Thiabendazole
79	Fluoromethylquine	178	Tibain
80	Forchlorfenuron	179	Titania
81	Free mineral acid	180	Total acid
82	Free residual chlorine	181	Total bacterial count
83	Fructose and glucose	182	Triazophos
84	Furacilin metabolite	183	Trichlorfon
85	Furantoin metabolite	184	Trichloromethane
86	Furazolidone metabolite	185	Trimethoprim
87	Herceptin A	186	Turbidity
88	Imidacloprid	187	Volatile basic nitrogen
89	Iodine	188	Water content
90	Isazofos	189	Zearalenone
91	Isocarbophos	190	Zinc
92	Isophos methyl	191	Metasilicic acid
93	Lead	192	Chlordimeform
94	Lemon yellow	193	Dichlorvos
95	Listeria monocytogenes	194	Yeast
96	Strontium	195	Carbamectin benzoate
97	Lomefloxacin	196	Ochratoxin A
98	Malachite green	197	Lactobacillus
99	Melamine		

The 197 high-risk projects encompass various types, including heavy metals, mycotoxins, pesticide residues, food additives and veterinary drug residues.

Table S2. 16 sales channels represented in food sampling data.

Number	Sampled area	Sales channels
1	Raw and auxiliary material warehouse	Large
2	Finished product warehouse (inspected area)	Large
3	Wholesale market	Large
4	Oversized restaurant	Large
5	Group meal delivery unit	Large
6	Farm product market	Medium
7	Market	Medium
8	School/kindergarten canteen	Medium
9	Food market	Medium
10	Supermarket	Medium
11	Midsized restaurant	Medium
12	Other	Small
13	Snack bar	Small
14	Small restaurant	Small
15	Snack grocery store	Small
16	Fast food restaurant	Small

Table S3. Selection of 25 valid items based on food sampling data.

Number	Items	Number	Items
1	Sampled city	14	Sub-food category
2	Region type	15	Food species
3	Region of labeled production enterprise	16	Specific food category
4	Sample name	17	Sample type
5	Update time	18	Package classification
6	Sample number	19	Test item
7	Sample quantity	20	Test result
8	Sampling process	21	Result judgment
9	Whether to import	22	Method test limit
10	Sample specification	23	Minimum permissible limit
11	Sampling site	24	Maximum permissible limit
12	Shelf life	25	Test conclusion
13	Food category		

Table S4. 8 categories with 14 subcategories of commonly used foods.

Number	Food category	Number	Sub-food subcategory
1	Grain processing products	1	Wheatflour
		2	Rice
2	Edible oil products	3	Edible vegetable oil
3	Catering food	4	Catering food
4	Soy products	5	Soy products
		6	Vegetable
		7	Livestock and poultry meat and by-products
5	Edible agricultural products	8	Aquatic products
		9	Eggs
		10	Fruits
		11	Raw and dried nuts and seeds
6	Dairy products	12	Dairy products
7	Starch products	13	Starch products
8	Meat products	14	Cooked meat products

Table S5. The matching principle for food categories.

Number	Statistical Yearbook	Food Safety Sampling And Inspection	
		Sub-food category	Food category
1	Wheat	Wheatflourl	Grain processing products
	Flour		
	Rice	Rice	
2	Edible vegetable oil	Edible vegetable oil	Edible oil products
3	Pastry food	Catering food	Catering food
4	Beans	Soy products	Soy products
	Vegetable	Vegetable	
5	Pork	Livestock and poultry meat and by-products	
	Beef		
	Mutton		
	Chicken		
	Duck		
	Fish	Aquatic products	Edible agricultural products
	Shrimps		
	Eggs		
	Fruits	Fruits	
	Raw and dried nuts and seeds	Raw and dried nuts and seeds	
6	Milk	Dairy products	Dairy products
	Yogurt		
	Milk powder		
7	Potato	Starch products	Starch products
	Pork		
	Beef		
8	Mutton	Cooked meat products	Meat products
	Chicken		
	Duck		

Table S6. Evaluation of hazard value α_j of test projects using acute and long-term toxicity of hazardous substances.

Assignment	Harm	
	Acute toxicity	Long-term toxicity
	Rat oral LD_{50} (mg/kg bw)	ADI/ TDI/PTWI/PTMI
		Hazardous substances with ADI or TDI>10 µg/kg bw day; For substances with no ADI or TDI value, the hazards include: Carcinogens (category 4); neurotoxicity (category 4); uncertain health hazard effects and unclassified toxic or harmful substances; substances not classified as toxic or harmful.
1	> 5000	
		Hazardous substances with ADI or TDI =0.1-10 µg/kg bw day; For substances with no ADI or TDI value, the hazards include: Carcinogens (category 3); neurotoxicity (category 3).
2	501 – 5000	
		Hazardous substances with ADI or TDI =0.001-0.1 µg/kg bw day; For substances with no ADI or TDI value, the hazards include: Carcinogens (category 2B); neurotoxicity (category 2); mutagens (category 3); reproductive / developmental toxicity (category 3); chronic toxicity (category 2).
3	51 – 500	
		Hazardous substances with ADI or TDI <0.001 µg/kg bw day; For substances with no ADI or TDI value, the hazards include: Carcinogens (category 2A); neurotoxicity (category 1); mutagens (category 2); reproductive / developmental toxicity (category 2); chronic toxicity (category 1).
4	1 – 50	
		Hazardous substances with ADI or TDI <0.001 µg/kg bw day; For substances with no ADI or TDI value, the hazards include: Carcinogens (category 1); mutagens (category 1); reproductive / developmental toxicity (category 1).
5	< 1	

LD_{50} refers to the half lethal dose of oral exposure; ADI: Acceptable Daily Intake, it refers to the dose of certain chemical substances (food additives, pesticides, etc.) consumed by the end person or animal every day without any known adverse effects on health; TDI: Tolerable Daily Intake, it refers to the allowable amount of lifetime intake of a substance without an estimated risk of harmful health, and it is the safety limit for the intake of a substance.

Table S7. Weighting of sales channels determined by expert elicitation.

Number	Sales channels		
	Large	Medium	Small
Expert 1	1.0	0.5	0.5
Expert 2	1.0	3.0	1.0
Expert 3	1.0	1.0	0.5
Expert 4	1.0	1.0	1.0
Expert 5	1.0	1.0	0.8
Expert 6	1.0	0.9	0.8
Expert 7	1.0	2.0	1.0
Expert 8	1.0	0.8	0.6
Expert 9	1.0	1.0	1.0
Expert 10	1.0	0.5	0.3
Expert 11	1.0	0.8	0.5
Expert 12	1.0	2.0	4.0
Expert 13	1.0	0.8	0.6
Expert 14	1.0	2.0	2.0
Expert 15	1.0	3.0	2.0
mean value	1.0	1.4	1.1
median	1.0	1.0	0.8
standard deviation	0.0	0.8	0.9
range	0.0	2.5	3.8

Table S8. Weighting of food production regions determined by expert elicitation.

Number	Food production regions		
	Local city	Region X	Other regions
Expert 1	1.0	0.6	0.3
Expert 2	1.0	0.5	0.5
Expert 3	1.0	1.0	1.0
Expert 4	1.0	0.6	0.6
Expert 5	1.0	0.5	0.5
Expert 6	1.0	0.7	0.6
Expert 7	1.0	1.0	0.5
Expert 8	1.0	0.8	0.6
Expert 9	1.0	0.8	0.6
Expert 10	1.0	0.8	0.4
Expert 11	1.0	1.0	1.0
Expert 12	1.0	0.8	0.8
Expert 13	1.0	1.0	1.0
Expert 14	1.0	1.0	1.0
Expert 15	1.0	0.3	1.0
mean value	1.0	0.8	0.7
median	1.0	0.8	0.6
standard deviation	0.0	0.2	0.2
range	0.0	0.7	0.7

Data Normalization Processing:

For the convenience of subsequent data calculation, the numerical data before screening are uniformly normalized. The shelf life time is processed in months. If the shelf life is two years, it is recoded as 24 months; if the shelf life is 15 days, it is recorded as 0.5 months. The units of the test results, the detection limit, the minimum permissible limit, and the maximum permissible limit are unified to provide scientific and reasonable data for subsequent evaluation. The qualitative data are normalized, and the formula is as follows:

$$x = \frac{X_{max} - X}{X_{max} - X_{min}}$$

Where, x is the normalized data, X is the original data, X_{max} is the maximum value in the original data, and X_{min} is the minimum value in the original data.

Missing values and Outliers Processing:

Because the sampling data is collected and entered manually, data missing is inevitable. For the data missing value, we apply the mean supplement method to fill the data. Because of the existence of ‘dirty data’ in the sampling data, which can also be called ‘outliers’, these data will cause the deviation of the overall characteristics of the data. In order to find out the outliers, we directly delete them.

Data Equilibrium:

When calculating the simple qualification degree, the differences between the data cannot be clearly distinguished because the calculation results are too concentrated in the range of (0.8, 1.0). Therefore, it is not conducive to accurate calculation and clear results display. This paper uses the

frequency histogram method to make the data balanced, so that the data distribution in the interval is more even, and the results are shown in Figure S1:

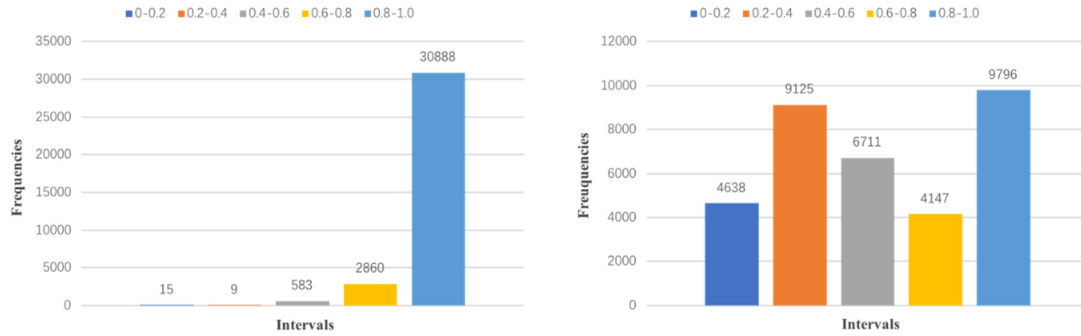


Figure S1. Data Equilibrium Distribution

Table S9. Algorithm Flow of Food Safety Evaluation System

Algorithm: Food Safety Evaluation System Based on FADM

Input: Food sampling data set $F = \{(x^{(1)}, y^{(1)} \dots), (x^{(2)}, y^{(2)} \dots), \dots (x^{(m)}, y^{(m)} \dots)\}$

Output: Comprehensive food safety qualification $\bar{Q}$

1: Normalization: F

2: Calculate simple qualification Q

3: **if** $0 = \text{Min}_{jk} = \text{Max}_{jk}$ **then**

4: **if** $T_{jk} = 0$ **then** $Q = 1$ **else** $Q = 0$

5: **else if** $0 = \text{Min}_{jk} < \text{Max}_{jk}$ **then**

6: **if** $0 \leq T_{jk} < \text{Max}_{jk}$ **then** $Q = 1 - \frac{T_{jk}}{\text{Max}_{jk}}$ **else** $Q = 0$

7: **else if** $0 < \text{Min}_{jk} = \text{Max}_{jk}$ **then**

8: **if** $T_{jk} \geq \text{Min}_{jk}$ **then** $Q = 1 - \left(\frac{T_{jk}}{\text{Min}_{jk}}\right)^{-1}$ **else** $Q = 0$

9: **else** $0 < \text{Min}_{jk} = \text{Max}_{jk}$ **then**

10: **if** $\text{Min}_{jk} \leq T_{jk} < \text{Max}_{jk}$ **then** $Q = 1 - \left| \frac{T_{jk} - \text{Min}_{jk}}{\text{Max}_{jk} - \text{Min}_{jk}} - 0.5 \right|$ **else** $Q = 0$

11: **end**

12: Calculate expert elicitation weight $\omega_c, \omega_h, \omega_s, \omega_r$

13: Calculate FADM weight $\omega_{FADM} = \frac{\sum_{i=1}^n f(F_i) \times \omega_i}{\sum_{i=1}^n \omega_i}$

14: Food safety evaluation index system $\bar{Q} = \omega_c \cdot \omega_h \cdot \omega_s \cdot \omega_r \cdot \omega_{FADM} \cdot Q$