DRAFT TANZANIA STANDARD

General Standard for food safety

TANZANIA BUREAU OF STANDARDS

0 Foreword

Supply of safe food contributes to protection and promotion of health of consumer. It also supports national economies, trade and tourism, and contributes to food and nutrition security for sustainable development.

Unsafe food poses consumer health threats and may create a vicious cycle of diarrhoea and malnutrition. It also may adversely affect nutritional status of the most vulnerable groups such as infants, young children, pregnant women, elderly and the immuno-compromised consumers. In view of this, control and monitoring of physical, chemical and microbiological food safety hazards across the food value chain is of the utmost importance.

This Tanzania Standard has been prepared as a generic standard to address requirements of food additives, chemical and microbiological contaminants in food products to help stakeholders (food industry, Government and consumers) along the food supply chain to make proper decision for the purpose of ensuring consumers' health and fair trade. It is therefore expected that this generic standard among other things will help food law enforcers to make decisions on the safety of all food products.

In the preparation of this Tanzania Standard, profound assistance was drawn from Tanzania National Standards, East African Community Standards, Codex General Standards for Contaminants and Toxins in food and feed (Codex Stan 193-1995), China's National Food Safety Standard for Maximum Levels of Mycotoxin in Foods (GB 2761-2012), China's National Food Safety Standard for Maximum Levels of Contaminants (Metal contaminants) in Foods, (GB 2762-2012), China's National Food safety Standard of Pathogen Limits for Food (2014), and Indian food Safety Standards (Contaminants, Toxins and Residues) Regulations, EC No 1441/2007- amending Regulation (EC) No 2073/2005 on microbiological criteria for foodstuffs and The Prevention of Food Adulteration Rules, 1955, India.

In reporting the results of a test or analysis made in accordance with this Tanzania Standard, if the final value observed or calculated is to be rounded off, it shall be done in accordance with TZS 4: (See clause 2).

1 Scope

This Tanzania Standard specifies permissible limits for food additives, toxins, and contaminants including heavy metals, pathogenic microorganisms, pesticide residues, and veterinary drug residues in foods. This general standard applies to all foods intended for direct human consumption and further processing in particular where there is no a specific product standard or the specific product standard doesn't specify the limits.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

TZS 4, *Rounding off of Numerical Values*

Codex Pesticides Residues in Food Online Database

CXM 2, *Maximum Residue Limits (MRLs) and Risk Management Recommendations (RMRs) for Residues of Veterinary Drugs in Foods*

CXS 192 -1995*, General Standard for Food additives*

TZS 538- *Packaging and labelling of foods*

TZS 109, *Code of hygiene for food processing unit — General*

TZS 472, *Cassava and cassava products — Determination of total cyanogen's — Enzymatic assay method*

ISO 2590 - *General method for the determination of arsenic - Silver diethyldithiocarbamate photometric method*

TZS 1335/ISO 8294, *Animal and vegetable fats and oils- Determination of copper, iron and nickel contents- Graphite furnace atomic absorption method*

TZS 799/ISO 16050, *Foodstuffs - Determination of aflatoxin B_1 and the total content of aflatoxins B_1, B_2, G_1 and G_2 in cereals, nuts and derived products- High-performance liquid chromatographic method*

ISO 14501- *Milk and milk powder- Determination of aflatoxin M_1 content, Clean-up by immunoaffinity chromatography and determination by high-performance liquid chromatography*

TBS/AFDC 27 (6732) *Foodstuffs - Determination of fumonisin B_1 and B_2 in maize based foods - HPLC method with immunoaffinity column clean-up and fluorescence detection*

TBS/AFDC 27 (6733) *Foodstuffs - Determination of fumonisin B_1 and fumonisin B_2 in processed maize-containing foods for infants and young children - HPLC method with immunoaffinity column clean-up and fluorescence detection after pre-column derivatisation*

TZS 2648 /ISO 8128-1- *Apple juice, apple juice concentrates and drinks containing apple juice. Determination of Patulin content, Part 1: Method using high-performance liquid chromatography*

TBS/AFDC 27 (6738) *Foodstuffs - Determination of patulin in fruit juice and fruit-based puree for infants and young children - HPLC method with liquid/liquid partition clean up and solid phase extraction and UV detection*

TZS 2615 *Foodstuffs - Determination of ochratoxin A - HPLC method with immunoaffinity column clean up and fluorescence detection*

TZS 118/ ISO 4833-1*, Microbiology of the food chain- Horizontal method for the enumeration of microorganisms- Part 1: Colony count at 30 degrees C by the pour plate technique*

TZS119/ISO 4831, *Microbiology of food and animal feeding stuffs - Horizontal method for the detection and enumeration of coliforms - Most probable number technique*

TZS 2426-1: 2019/ISO 21527-1, *Microbiology of food and animal feeding stuffs - Horizontal method for the enumeration of yeasts and moulds - Part 1: Colony count technique in products with water activity greater than 0.95*

TZS 2426-2: 2019/ISO 21527-2, *Microbiology of food and animal feeding stuffs - Horizontal method for the enumeration of yeasts and moulds - Part 2: Colony count technique in products with water activity less than or equal to 0.95*

TZS 122/ ISO 6579 -1, *Microbiology of the food chain - Horizontal method for the detection, enumeration and serotyping of Salmonella - Part 1: Detection of Salmonella* spp.

TZS 852- 1/ISO 11290-1, *Microbiology of the food chain - Horizontal method for the detection and enumeration of Listeria monocytogenes and of Listeria* spp*. - Part 1: Detection method*

TZS 125/6888-1, *Microbiology of food and animal feeding stuffs - Horizontal method for the enumeration of coagulase-positive staphylococci (Staphylococcus aureus and other species) - Part 1: Technique using Baird-Parker agar medium*

TZS 730/ ISO 16649-1, *Microbiology of the food chain - Horizontal method for the enumeration of beta-glucuronidase-positive Escherichia coli -- Part 1: Colony-count technique at 44 degrees C using membranes and 5-bromo-4-chloro-3-indolyl beta-D-glucuronide*

TZS 2279/ISO 10272-1, *Microbiology of the food chain - Horizontal method for detection and enumeration of Campylobacter* spp*.- Part 1: Detection method*

TZS 127/ISO 21872-1, *Microbiology of the food chain - Horizontal method for the determination of Vibrio* spp*. - Part 1: Detection of potentially enteropathogenic Vibrio parahaemolyticus, Vibrio cholerae and Vibrio vulnificus*

TZS 403: 2019/ISO 21567, *Microbiology of food and animal feeding stuffs - Horizontal method for the detection of Shigella* spp.

TZS 2427: 2019/ISO 21871*, Microbiology of food and animal feeding stuffs - Horizontal method for the determination of low numbers of presumptive Bacillus cereus - Most probable number technique and detection method*

TZS 2422: 2019/ISO 22964, *Microbiology of the food chain - Horizontal method for the detection of Cronobacter* spp.

3. Terms and definitions

For the purposes of this document, the following terms and definitions shall apply.

3.1 contaminant

any substance not intentionally added to food, which is present in such food as a result of the production (including operations carried out in crop and animal husbandry and veterinary drugs), manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food or as a result of environmental contamination. The term does not include insect fragments, rodent hairs and other extraneous matter

3.2 extraneous matter

any foreign substances in foods that are associated with objectionable conditions or practices in production, storage, or distribution of foods

3.3 edible part

part of food material fit for human consumption, which remains after manual or mechanical process to remove the non-edible parts such as grain husk, fruit peeling, nut shell, bones in meat/fish, shell of shellfish

3.4 limit

maximum amount of a contaminant or additive in food and/or the edible part of the finished food products

3.5 heavy metal

any metallic chemical element that has a relatively high density and is toxic at low concentrations, e.g., mercury, lead, arsenic, and cadmium

3.6 toxins

naturally occurring toxicants including toxic metabolites of toxigenic fungi that are not intentionally added to food

3.7 mycotoxin

toxic secondary metabolite produced by toxigenic fungi

3.8 pesticide residues

refer to the pesticides or their metabolites that remain on or in food after they are applied to crops before and/ or after harvest or get into the food due to environmental sources

3.9 veterinary drug residues

refer to the remains of veterinary drugs or their metabolites in animal food products

3.10 food additive

food additive means any substance not normally consumed as a food by itself and not normally used as a typical ingredient of the food, whether or not it has nutritive value, the intentional addition of which to food for a technological (including organoleptic) purpose in the manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food results, or may be reasonably expected to result

(directly or indirectly), in it or its by-products becoming a component of or otherwise affecting the characteristics of such foods. The term does not include contaminants or substances added to food for maintaining or improving nutritional qualities

3.11 foodborne pathogens

mainly bacteria, viruses, fungi or even parasites that are present in the food and are the cause of major diseases such as food poisoning

3.12 packaging material
substance used to hold a product securely to prevent leakage and breakage and protect it from different hazards such as germs, heat, moisture loss or moisture pick up

4. Requirements

4.1 General requirements

4.1.1 Food product intended for human consumption shall not exceed the set permissible limits of additives, toxins, and contaminants as per this standard.

4.1.2 Levels of toxins and contaminants in food product shall be determined based on the edible part of the food unless otherwise specified.

4.1.3 When a permissible limit is applied to a certain food category all types of food product in that category are subject to the limit unless otherwise specified.

4.1.4 When codex maximum levels are referred, the current version shall apply.

4.2 Specific requirements

4.2.1 Contaminants

Contaminants in this standard include heavy metals and residues of pesticide and veterinary drugs

4.2.1.1 Heavy metal contaminants

Food product intended for human consumption shall not contain heavy metals (i.e. lead, mercury, cadmium, arsenic, nickel, and tin) in amounts that pose risks to human health and shall comply with the limits as specified in the following tables:

4.2.1.1.1 Lead (Pb)

Limits of Lead in food product shall be as specified in Table 1.

Table 1: Limits of Lead in food products in mg/kg unless specified

Food Category (name)	Maximum Limit Lead (Pb) mg/kg
1. Cereals and cereal products excluding starches and baked products	0.2
2. Roots, tubers and their products (excluding starches and baked products)	0.1
3. Banana and its products (including ripe banana)	0.1
4. Vegetable and vegetable products (excluding beverages)	
Fresh vegetables, and canned vegetables (excluding, leafy vegetables, leguminous vegetables, tuberous vegetables, fruiting vegetables)	0.1
Leafy vegetables	0.3
Leguminous vegetables, tuberous vegetables	0.2
Vegetable products (excluding canned vegetables)	1.0
Fruiting vegetables	0.05
5. Fruits and Fruits products (excluding beverages)	
Fresh fruits (excluding berries and other small fruits)	0.1
Berries and other small fruits	0.2
Fruit products (excluding juice and concentrates), canned strawberries and raspberries	1.0
Canned fruits	0.1
6. Edible fungi and their products	0.3
7. Pulses and their products	
Pulses	0.2
Pulses products (excluding soy milk)	0.5
8. Nuts, oil seeds and their products	0.1
9. Meat and meat products (including game meat)	
Meats (excluding viscera of livestock)	0.1
Viscera of livestock	0.2
Meat products	0.1
10. Edible insects	0.2
11. Aquatic animals and their products	
Fresh, frozen and smoked aquatic animals (excluding, crustaceans, bivalves, and Cephalopods)	0.3
Crustacean	0.5
Bivalves	1.5
Cephalopods	1.0
Aquatic products (excluding jellyfish products)	1.0
Jellyfish products	2.0
12. Dairy and dairy products	0.02
13. Food intended for special dietary uses	
Infants formula, formula for special medical purpose intended for infants	0.01
Follow-up formula	0.01
Complementary foods for infants and young children	0.2
Sports nutritional foods	0.5
Formulas for special medical purposes (excluding varieties related to formulas for special medical purposes intended for infants)	0.5 (in solid product basis)
14. Egg and egg products	0.1
15. Edible fats and oils	
Vegetable fats and oils (excluding animal fats)	0.08
Spreads	0.04
Animals' fats	0.1

16. Condiments, spices and herbs	0.3
17. Starch and its products	0.2
18. Baked products and confectioneries	0.5
19. Non-alcoholic beverages	0.03 mg/L
20. Alcoholic beverages	0.2 mg/L
21. Tea, coffee, cocoa, and their substitutes (e.g. Ice tea, ice coffee, etc. Tea Cocoa Coffee	 1.0 1.0 0.1
22. Bee products	0.1
23. Edible ices	0.01
24 Sugar and its products	0.5

Testing method: See Annex A

4.2.1.1.2 Cadmium (Cd)

Limits of cadmium in food products shall be as specified in Table 2.

Table 2: Cadmium limits in foods in mg/kg unless specified

Food category (name)	Maximum Limit (in Cd basis) mg/kg
1. Cereals and cereal products Cereals and cereal products (excluding rice) Rice	 0.1 0.4
2. Roots, tubers and their products (excluding starches and baked products	0.1
3. Banana and its products excluding ripe banana	NA
4. Vegetable and vegetable products (excluding beverages) Fresh vegetables (excluding leafy vegetables, leguminous vegetables, root and tuberous vegetables, stem vegetables, fruiting vegetable) Leafy vegetables and celery Leguminous vegetables, root, stem vegetables (excluding celery) Fruiting vegetable and tuberous vegetables	0.05 0.2 0.1 0.2 0.05
5. Fruit and fruit products excluding beverages	0.05
6. Edible fungi and its products Fresh edible fungi Edible fungi products	 0.2 0.5
7. Pulses and their products Pulses excluding soybeans Soybeans	 0.1 0.2
8. Nuts, oil seeds, and their products excluding peanut Peanut	0.1 0.5
9. Meat and meat products including game meat Meats (excluding viscera of livestock and poultry) Liver of the livestock and poultry Kidney of the livestock and poultry Meat products (excluding liver, kidney , and dried products) Liver products Kidney products Dried meat products	 0.1 0.5 1.0 0.1 0.5 1.0 0.05

10. Edible insects	0.03
11. Aquatic animals and their products Fresh, frozen and smoked aquatic animals (excluding, crustacean, bivalves, molluscs, and cephalopods) Crustaceans Bivalves, molluscs, and cephalopods	 0.3 0.5 2
12. Dairy and dairy products	NA
13. Food intended for special dietary uses Powdered formula manufactured from cow's milk proteins or protein hydrolyses Liquid formula manufactured from cow's milk proteins or protein hydrolyses Powdered formula manufactured from soya protein isolates alone or in mixture with cow's protein Liquid formula manufactured from soya protein isolates alone or in mixture with cow's protein Processed cereal-based foods for infants and young children	 0.01 0.005 0.02 0.01 0.04
14. Egg and egg products	0.05
15. Edible fats and oils	0.1
16. Spices, condiments, and herbs	NA
17. Starch and its products	0.1
18. Baked products and confectioneries	0.1
19. Non-alcoholic beverages	NA
20. Alcoholic beverages	NA
21. Tea, coffee, cocoa and their substitute e.g. ice tea, ice coffee, etc. Tea Products with more than 70% cocoa Products with 50%-70% cocoa	 0.1 0.9 0.8
22. Bee products	0.01
23. Edible ice	0.03
24. Sugar and its products	NA

Testing method: See Annex B

4.2.1.1.3 Mercury (Hg)

Limits of mercury in food products shall be as specified in Table 3.

Table 3: Limits of mercury in food products in mg/kg unless otherwise specified

Food Category (name)	Maximum Limit (in Hg basis) mg/kg	
	Total mercury	Methyl mercury
1. Cereals and cereal products excluding starches and baked products	NA	
2. Roots, tubers and their products (excluding starches and baked products	NA	
3. Banana and its products	NA	
5. Fruit and fruit products (excluding beverages)	NA	
6. Edible fungi and its products	0.01	—
7. Pulses and their products	NA	
8. Nuts, oil seeds, and their products	NA	
9. Meat and meat products (including game meat)	0.01	
10. Edible insects	NA	
11. Aquatic animals and their products Fish and their products (excluding carnivorous fishes and their products) Carnivorous fishes and their products	— —	0.5 1.5
12. Dairy and dairy products	NA	
13. Food intended for infants, young children and special dietary uses	NA	
14. Egg and egg products	NA	
15. Edible fats and oils	NA	
16. Spices, condiments and herbs	0.1	
17. Starch and its products	NA	
18. Baked products and confectioneries	NA	
19. Non-alcoholic beverages	NA	
20. Alcoholic beverages	NA	
21. Tea, coffee, cocoa and their substitutes e.g. ice tea, ice coffee,	NA	
22. Bee products	0.03	
23. Edible ices	0.001	
24. Sugar and its products	NA	
NOTE For aquatic animal and its products, total mercury could be tested first; if the total mercury level is lower than the limit of methyl mercury, it is not necessary to test the methyl mercury; otherwise, the methyl mercury shall be tested.		

Testing method: see Annex C

4.2.1.1.4 Arsenic (As)

Limits of arsenic limits in food products shall be as specified in Table 4

Table 4: Limits of arsenic in food products in mg/kg unless specified

Food Category (name)	Maximum Limit (in As basis) mg/kg	
	Total arsenic	Inorganic arsenic
1. Cereals and cereal products (particularly rice) Paddy Rice	 0.35 0.2	 — —
1. Roots, tubers and their products (excluding baked products)	NA	
2. Banana and its products	0.2	
4. Vegetables and their products (excluding beverages) Fresh vegetable and vegetable products	0.5	—
5. Fruits and fruit products (excluding beverages) Fresh fruit pulp Fruit juices Dried fruits	 0.1 0.2 0.2	
6. Edible fungi and their products	0.2	
7. Pulses and their products	NA	
8. Nuts, oil seeds , and their products	0.1	
9. Meat and meat products (including game meat)	0.1	—
10. Edible insects	NA	
11. Aquatic animals and their products	0.1	
12. Dairy and dairy products Raw milk, heat treated milk, fermented milk Whole and skimmed milk powder	 0.1 0.5	— —
13. Food intended for special dietary uses Processed cereal-based foods for infants and young children	0.1	
14. Eggs and eggs products	NA	
15. Edible fats and oils	0.1	—
16. Spices, condiments and herbs	0.2	
17. Baked products and confectioneries	1	
18. Non-alcoholic beverages	NA	
19. Alcoholic beverages	NA	
20. Tea, coffee, cocoa and their products and substitutes Tea Cocoa Coffee	 0.15 1.0 0.5	 —
21. Bee products	0.1	
22. Edible ices	0.01	
23. Sugar and its products	1	

Testing method: ISO 2590

4.2.1.1.5 Tin (Sn)

Limits of tin in food products shall be as specified in Table 5.

Table 5: Limits of tin in food products in mg/kg unless specified

Food Category (name)	Maximum Limit (in Sn basis) mg/kg
Foods in tin-plated containers (excluding beverages, formula for infants and young children, complementary foods for infants and young children)	250
Canned beverages, including fruit juices and vegetable juices	150
Canned infants and follow-up formula, and complementary foods for infants and young children	5
Canned dietary foods for special medical purposes	5
Food products including canned foods in non-tin-plated containers	50
Bee products	5

Test method: see Annex D

4.2.1.1.6 Nickel (Ni)

Limits of nickel in food products shall be as specified in Table 6.

Table 6: Limits of nickel in food products in mg/kg unless specified

Food Category (name)	Maximum Limit (in Ni basis) mg/kg	Test method
Fats and their products Products mainly produced of hydrogenated vegetable oil	0.1	TZS 1335/ISO 8294

4.2.2 Toxins

The toxins, which are covered by this standard, include cyanogenic glycosides and natural toxins produced by living organisms such as mycotoxins.

4.2.2.1

Mycotoxins

The mycotoxins covered by this standard include aflatoxins (aflatoxin B_1, aflatoxin total (B_1+ B_2+ G_1+G_2) and aflatoxin M_1), fumonisins (B_1, B_2 alone or in combination), patulin, and ochratoxin A

4.2.2.1.1 Aflatoxin

Limits of aflatoxin in food product shall be as specified in Table 7.

Table 7: Limits of Aflatoxins B_1, Total Aflatoxins and Aflatoxin M_1 in foods

Food Category (name)	Maximum Limit (µg /kg)		
	Aflatoxin B_1	Total Aflatoxin (B_1+B_2+G_1+G_2)	Aflatoxin M_1
Cereals and cereal products including starch and baked products Cereals and all products derived from cereals, including processed cereal products, with the exception of processed cereal-based foods and baby foods for infants and young children, dietary foods for special medical purposes intended specifically for infants Cereal-based breakfast and cereal-based snacks	5	10	-
Dietary foods intended for infants and young children			
Processed cereal-based foods and baby foods for infants and young children	0.5	-	-
Infant formulae and follow-on formulae, including infant milk and follow-on milk	-	-	0.25
Dietary foods for special medical purposes intended specifically for infants	0.5	-	
Nuts, oil seeds, and their products	5	10	
Roots, tubers, and their products Dried roots and tubers (e.g. cassava, potatoes, and yams) and processed products thereof, intended for human consumption or use as an ingredient in foodstuffs	5	10	-
Fruits and their products (excluding beverages) Dried fruit/seed and processed products thereof, intended for human consumption or use as an ingredient in foodstuffs	5	10	
Vegetables and their products (including dried vegetable seeds and excluding beverages) Dried vegetables and processed products thereof, intended for human consumption or use as an ingredient in foodstuffs	5	10	-
Spices Spices including *Capsicum spp.* (dried fruits thereof, whole or ground, chillies, chilli powder, cayenne and paprika); *Piper spp.* (fruits thereof, including white and black pepper); *Myristica fragrans* (nutmeg); *Zingiber officinale* (ginger); *Curcuma longa* (turmeric), cinnamon, cardamom, clove, and their mixtures	5	10	-
Dairy and dairy products Raw milk, powdered milk, heat-treated milk and milk for the manufacture of milk-based products	-	-	0.5
Starch and its products	5	10	
Alcoholic and non- alcoholic beverages (only for cereal-based)	5	10	

Test method: For aflatoxin B_1 and aflatoxin total, TZS 799/ISO 16050**;** for aflatoxin M_1, ISO 14501

4.2.2.1.2 Fumonisins (B_1 and B_2)

Limits of fumonisins in food products shall be as specified in Table 9.

Table 9: Limits of fumonisins (B_1, B_2, alone or in combination) in food products

Food Category (name)	maximum limit (µg /kg)	Test method
Cereals and all products derived from cereals, including processed cereal products and starches, with the exception of processed cereal-based foods and baby foods for infants and young children, dietary foods for special medical purposes intended specifically for infants	2000	TBS/AFDC27 (6733) P3
Cereal-based breakfast and cereal-based snacks	1000	
Processed cereal-based foods and baby foods for infants and young children	200	TBS/AFDC27 (6733)P3
Dietary foods for special medical purposes intended specifically for infants	200	

4.2.2.1.3 Ochratoxin A

Limits of ochratoxin A in food products shall be as specified in Table 10.

Table 10: Limits of Ochratoxin A in food products

Food Category (name)	Maximum Limit µg /kg	Test method
Fruits and fruit products (excluding beverages) Grape juice, concentrated grape juice, grape nectar Dried vine fruits (currants, raisin and sultanas)	 2.0 10.0	TZS 2615
Coffee and coffee products (excluding soluble coffee) Soluble coffee (instant coffee)	5.0 10.0	

4.2.2.1.4 Patulin

Limits of patulin in food products shall be as specified in Table 11.

Table 11: Limits of patulin in food products

Food Category (name)	Maximum Limit (µg /kg)	Test method
Fruits and their products (excluding beverages) Apple fruit products including liquor (with the exception of solid apple products) Solid apple products	 50 25	TZS 2648 /ISO 8128-1
Foods for infants and young children Apple juices and apple-based products	 10	TZS 2648 /ISO 8128-1

4.2.2.2 Hydrocyanic Acid

Applies only to foods containing cyanogenic glycosides as the main source of cyanide.

The limits of Hydrocyanic acid in food products shall be as specified in Table 12

Table 12: Limits of Hydrocyanic acid in food products

Food Category (name)	Maximum limit mg/kg
Cassava and its products	
Cassava and its products excluding gari	10
Gari	2

Test method: TZS 472

4.2.3 Other chemical contaminants

4.2.3.1 Vinyl Chloride/ Chloride of Vinyl

Limits of Vinyl Chloride in food products shall be as specified in Table 13.

Table 13: Limits of Vinyl Chloride in food products in mg/kg unless specified

Food Category (name)	Maximum Limit mg/kg
Foods in contact with materials with migrant Vinyl Chloride such as Plastic (PVC) containers	0.01

4.2.3.2 Acrylonitrile/ vinyl cyanide (VCN)

Limits of Acrylonitrile in food products shall be as specified in Table 14.

Table 14: Limits of Acrylonitrile/ vinyl cyanide (VCN) in food products in mg/kg unless specified

Food Category (name)	Maximum Limit mg/kg
Foods in contact with materials with migrant Acrylonitrile	0.02

4.2.3.3 Chloropropanols

The limits of Chloropropanols in food products shall be as specified in Table 15

Table 15: Limits of Chloropropanols in food products in mg/kg

Food Category (name)	Maximum Limit mg/kg
Liquid condiments containing acid hydrolyzed vegetable proteins NOTE: The Maximum limit does not apply to naturally fermented soy sauce.	0.4

4.2.3.4 Melamine

The limits of Melamine in food products shall be as specified in Table 16.

Table 16: Limits of Melamine in food products

Food Category (name)	Maximum Limit mg/kg
Food with exception to infant formulae	2.5*
Powdered infant formula	1
Liquid infant formula	0.15
* The Maximum limit applies to levels of melamine resulting from its non-intentional and unavoidable presence in food. The Maximum limit does not apply to food for which it can be proven that the level of melamine higher than 2.5 mg/kg is the consequence of: -Authorised use of cyromazine as insecticide. The melamine level shall not exceed the level of cyromazine. -Migration from food contact materials. The melamine level shall not exceed the acceptable migration limit.	

4.2.4 Pesticide residues

Food of plant and/or animal origin intended for human consumption shall not exceed maximum residues limits of pesticide as established by Codex Alimentarius Commission.

4.2.5 Veterinary drug residues

Food and food products of animal origin intended for human consumption shall not exceed maximum residues limits of veterinary drugs as established by Codex Alimentarius Commission.

4.2.6 Foodborne pathogenic microorganisms

Food products covered by this standard shall be prepared in accordance with TZS 109 and other Codes of Practice recommended by the Codex Alimentarius Commission, which are relevant to those products.

Food and food products intended for human consumption shall comply with the microbiological limits provided in Table 17.

Table 17: Microbiological limits in foods

Food Category	Microorganisms	Limits	Test method
Meat and meat products (including game meat)			
Processed meat products Ready to eat raw meat products	*Salmonella* spp.	Not detected/25g	TZS 122 / ISO 6579 -1
	Clostridium botulinum (for canned meat products)	Not detected/25g	TZS 121
	Clostridium perfringens	Not detected/25g	TZS/ISO 7937
	Listeria monocytogenes (for products that support their growth)	Not detected/25g	TZS 852-1/ISO 11290-1
	Coagulase positive *Staphylococcus aureus*	10^2 cfu/g	TZS 125/6888-1
	Escherichia coli (cfu/g)	Absent	TZS 730/ ISO 16649-1
Poultry and poultry products with exception to egg and their products	*Campylobacter* spp.	Not detected/ 25g	TZS 2279:2018/ ISO 10272-1:2017

and canned poultry meat	*Salmonella* spp.	Not detected/ 25g	TZS 122/ ISO 6579-1
	E. coli (cfu/g)	Absent	TZS 730/ ISO 16649-1
	Coagulase positive *Staphylococcus aureus*	10^2cfu /g	TZS 125/ISO 6888-1
	Clostridium perfringens	Not detected/ 25g	ISO 7937
Canned poultry meat	*Clostridium botulinum*	Not detected/ 25g	TZS 121
	E. coli (cfu/g)	Absent	TZS 730/ ISO 16649-1
	Salmonella spp.	Not detected/25g	TZS 122 / ISO 6579 -1
	Coagulase positive *Staphylococcus aureus*	10^2 cfu/g	TZS 125/ISO 6888-1
Egg and egg products			
	Salmonella spp.	Not detected/25g	TZS 122 / ISO 6579 -1
	E. coli (cfu/g)	Absent	TZS 730/ ISO 16649-1
	Coagulase positive *S. aureus*	10^2 cfu/g	TZS 125/ISO 6888-1
Aquatic animals and their products			
Processed fish products Ready-to-eat raw fish Ready-to-eat algae products	*Salmonella* spp.	Not detected/25g	TZS 122/ISO 6579-1
	Vibrio parahaemolyticus (For marine products)	Not detected/25g	TZS 127: 2018/ ISO/21872 -1:2017
	Vibrio cholerae (For fresh water products)	Not detected/25g	TZS 127: 2018/ ISO/21872 -1:2017
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125 /ISO 6888-1
	E. coli (cfu/g)	Absent	TZS 730/ ISO 16649-1
	Shigella spp.	Not detected/25g	TZS 403:2019/ISO 21567:2004
	C. perfringens	Not detected/25g	TZS/ISO 7937
Dried fish/salted fish/dried salted fish	*Salmonella* spp.	Not detected/25g	TZS 122/ISO 6579-1
	V. parahaemolyticus	Not detected/25g	TZS 127: 2018/ ISO/21872 -1:2017
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125 /ISO 6888-1
	Shigella spp.	Not detected/25g	TZS 403:2019/ISO 21567:2004
	E. coli (cfu/g)	Absent	TZS 730/ ISO 16649-1
	Vibrio cholerae (For fresh water products)	Not detected/25g	TZS 127: 2018/ ISO/21872 -1:2017
Canned fish	*Clostridium botulinum*	Not detected/25g	TZS 121
	C. perfringens	Not detected/25g	TZS/ISO 7937
Cereals and cereal products excluding starches and baked products			
Cereals and cereal products excluding starch and baked products	*Salmonella* spp.	Not detected/25g	TZS122/ISO 6579-1
	E. coli (cfu /g)	Absent	TZS 730/ ISO 16649-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125 /ISO 6888-1
	Bacillus cereus	Not detected/25g	TZS 2427:2020/ISO 21871:2006

Pulses and their products			
	Salmonella spp.	Not detected/25g	TZS 122 /ISO 6579-1
	E. coli (cfu/g)	Absent	TZS 730/ISO 16649-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS.125-1 /ISO 6888-1
Tea, cocoa, coffee and their substitutes			
	Salmonella spp.	Not detected/25g	TZS 122/ISO 6579-1
	E. coli (cfu/g)	Absent	TZS 730/ISO 16649-1
Vegetable and vegetable products (excluding beverages)			
Vegetables and their products (including preserved vegetables)	*Salmonella* spp.	Not detected/25g	TZS 122/ISO 6579-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125/ISO 6888-1
	E. coli (cfu/g)	Absent	TZS 730/ISO 16649-1
Fruits and fruits products (excluding beverages)			
	Salmonella spp	Not detected/25g	TZS 122/ISO 6579-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125/ISO 6888-1
	E. coli (cfu/g)	$<10^1$/cfu/g	TZS 730/ISO 16649-1
Edible fungi and their products			
	Salmonella spp	Not detected/25g	TZS 122/ISO 6579-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125/ISO 6888-1
	E. coli (cfu/g)	$<10^1$/cfu/g	TZS 730/ISO 16649-1
Spices, Condiments and herbs			
Soy sauce Sauce and sauce products Aquatic dressing Composite seasonings	*Salmonella* spp.	Not detected/25g	TZS 122/ISO 6579-1
	Coagulase positive S. aureus	10^2cfu/g	TZS 125/ISO 6888-1
	V. parahaemolyticus (only applies to seasonings containing marine ingredients)	Not detected /25g	TZS 127: 2018/ ISO/21872-1:2017
	V. cholerae (applies seasoning containing fresh water ingredients)	Not detected/25g	TZS 127: 2018/ ISO/21872-1:2017
	E. coli (cfu/g)	Absent	TZS 730-2:2007/16649-1
Spices	*B. cereus*	Not detected/25g	TZS 2427:2020/ISO 21871:2006
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125/ISO 6888-1
	E. coli (cfu/g)	$<10^1$	TZS 730-2:2007/16649-1
	Salmonella spp.	Not detected/25g	TZS 122/ISO 6579-1
Nuts, oil seeds, and their products			
Nuts, oil seeds and their products	*Salmonella* spp.	Not detected/25g	TZS 122/ISO 6579-1
	E. coli (cfu/g)	Absent	TZS 730/ISO 16649-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125/ISO 6888-1

Foods for infants and young children and foods for special dietary needs or medical purposes			
Cereal-based formula for infants, young children and foods for special dietary needs or medical purposes	*Salmonella* spp.	Not detected/25g	TZS 122/ISO 6579-1
	E. coli (cfu /g)	Absent	TZS 730-2:2007/16649-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125/ISO 6888-1
	Bacillus cereus	Not detected/25g	TZS 2427:2020/ISO 21871:2006
Dairy-based formula for infants, young children and foods for special dietary needs or medical purposes	*Salmonella* spp.	Not detected/25g	TZS 122/ISO 6579-1
	Cronobacter spp.	Not detected/25g	TZS 2422:2020/ISO 22964
	Total coliforms	Not detected/25g	TZS 119/ISO 4831
	E. coli (*cfu /g)*	Absent	TZS 730/ ISO 16649-1
	L. monocytogenes	Not detected / 25g	TZS 852-1/ISO 11290-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125/ISO 6888-1
	Clostridium perfringens	Not detected/25g	TZS/SO 7937
Formula for infants, young children and foods for special dietary needs or medical purposes containing vegetable, nuts or legumes ingredients	*Salmonella* spp.	Not detected/25g	TZS 122./ISO 6579-1
	E. coli (cfu/g)	Absent	TZS 730/ISO 16649-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125/ISO 6888-1
Fruit-based formula for infants, young children and foods for special dietary needs or medical purposes	*Salmonella* spp.	Not detected/25g	TZS 122/ISO 6579-1
	E. coli (cfu/g)	Absent	TZS 730/ISO 16649-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125/ISO 6888-1
Formula for infants, young children and foods for special dietary needs or medical purposes containing fish ingredients	*Salmonella* spp.	Not detected/25g	TZS 122/ISO 6579-1
	Vibrio parahaemolyticus (applies to product containing fish ingredient from marine water	Not detected/25g	TZS 127: 2018/ ISO/21872-1:2017
	Vibrio cholerae (applies to product containing fish ingredient from fresh water)	Not detected/25g	TZS 127: 2018/ ISO/21872-1:2017
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125 /ISO 6888-1
	Shigella spp.	Not detected/25g	TZS 403:2019/ISO 21567:2004
	E. coli (cfu/g)	Absent	TZS 730-2:2007/16649-1
Roots, tubers and their products (excluding starches and baked products)			
	Salmonella spp.	Not detected/25g	TZS122/ISO 6579-1
	E. coli (cfu/g)	Absent	TZS 730/ ISO 16649-1
	Yeasts/Moulds	10^3cfu/g. max	TZS 2426-2:2020/ISO 21527-2:2008
Dairy and dairy products			
Raw milk, powdered milk, heat-treated milk and other milk products	Total coliforms	Not detected/25g	TZS119/ISO 4831
	E. coli (cfu/g)	$<10^1$cfu/g	TZS 730/ ISO 16649-1
	L. monocytogenes	Not detected /25g	TZS 852-1/ISO 11290-1

	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125 /ISO 6888-1
	Salmonella spp.	Not detected/25g	TZS 122/ISO 6579-1
	Clostridium perfringens	Not detected/25g	TZS/SO 7937
Edible ices			
	Salmonella spp.	Not detected/25g	TZS 122/ISO 6579-1
	E. coli (cfu/g)	Absent	TZS 730/ISO 16649-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125/ISO 6888-1
Baked products and confectionaries			
	Salmonella spp.	Not detected/25g	TZS122/ISO 6579-1
	E. coli (cfu/g)	$<10^1$cfu /g	TZS 730/ ISO 16649-1
Non-alcoholic beverages			
	Salmonella spp.	Not detected/25g	TZS 122./ISO 6579-1
	E. coli (cfu/g)	Absent	TZS 730/ISO 16649-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125/ISO 6888-1
Alcoholic beverages			
	Total coliforms	Not detected/25g	TZS119/ISO 4831
Bee products			
	Total coliforms	Not detected/25g	TZS119/ISO 4831
	Salmonella spp.	Not detected/25g	TZS 122./ISO 6579-1
	E. coli	Absent	TZS 730/ISO 16649-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125/ISO 6888-1
Sugar and its products			
	Salmonella spp.	Not detected/25g	TZS 122/ISO 6579-1
	E. coli	Absent	TZS 730/ ISO 16649-1
Banana and its products (excluding ripe banana)			
	Salmonella spp.	Not detected/25g	TZS 122/ISO 6579-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125 /ISO 6888-1
	E. coli (cfu/g)	Absent	TZS 730/ ISO 16649-1
	Bacillus cereus	Not detected/25g	TZS 2427:2020/ISO 21871:2006
Edible insects			
	Salmonella spp.	Not detected/25g	TZS 122/ISO 6579-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125 /ISO 6888-1
	E. coli (cfu/g)	Absent	TZS 730/ ISO 16649-1
Starch and its products			
	Salmonella spp.	Not detected/25g	TZS122/ISO 6579-1
	E. coli	Absent	TZS 730/ ISO 16649-1
	Coagulase positive *S. aureus*	10^2cfu/g	TZS 125 /ISO 6888-1
	Bacillus cereus	Not detected/25g	TZS 2427:2020/ISO

			21871:2006

5 Food Additives

The use of food additive(s) in all food products intended for human consumption shall be in conformance with Codex Stan 192. The food additives shall be used singly from each functional class or category of additives in order to serve a similar technological application; unless it is technologically justified to apply as such in combination and proven through risk assessment that such application shall not end up into creating something else chemically that could become a health hazard to the consumer.

6 Packaging and Labelling

Packaging and labelling of foods intended for human consumption shall be in accordance with TZS 538.

ANNEX A (Normative)

DETERMINATION OF LEAD IN FOOD BY ATOMIC ABSORPTION SPECTROPHOTOMETRIC (AAS) METHOD

A. Principle

Organic matter is digested and Lead (Pb) released co-precipitates with Strontium sulphate ($SrSO_4$). Soluble sulphate salts are decanted, and precipitate is converted to carbonate salt, dissolved in acid, and determined by AA at 217.0 or 283.3nm.

B. Apparatus

(a) Atomic absorption spectrophotometer- Operated at 217.0 nm or 283.3nm

(b) *Stirring motor*. - With eccentric coupling for stirring centrifuge tubes.

C. Reagents

(Age all new glassware and all glassware which has contained high Pb concentration in boiling HNO_3 before washing. Never let used glassware dry before washing, and always include final HNO_3, rinse followed by deionized H_2O rinse).

(a) *Strontium solution.* – 2 %. Dissolve 6 g $SrCl_2.6H_2O$ in 100 ml H_2O.

(b) *Ternary acid mixture*. - Add 20 ml H_2O_4 to 100 ml H_2O, mix, add 100 ml HNO_3 and 40 ml 70% $HCLO_3$, and mix.

(c) *Nitric acid* 1M. – Add 128 ml redistilled HNO_3 to 500 - 800 ml distilled or deionized H_2O and dilute to 2L. Redistilled HNO_3 may be diluted and used without re-distllation.

(d) *Lead standard solutions*. - (1) *Stock solution*. – 1000 µg/ml. Dissolve 1.5985 g $Pb(NO_3)_2$, recrystallized, in ca 500 ml 1M HNO_3 in 1L volumetric flask and dilute to volume with 1M HNO_3. (2) *Working solutions.* - Prepare 100 µg Pb/ml by diluting 10 ml stock solution to 100 ml with 1M HNO_3. Dilute 1, 3, 5, 10, 15, and 25 µg Pb/ml, respectively).

D. Separation of Lead

Accurately weigh test portion containing ≤10 g dry matter and ≥3 µg Pb. Place in 500 ml boiling Kjeldahl flask and add 1 ml 2 % Sr solution, **C (a)**, and several glass beads. Prepare a reagent blank and carry through same operations as test portion. Add 15 ml ternary acid mixture, **C (b)**, for each g dry matter and let stand ≥ 2 h. Heat under hood or H_2O vacuum manifold system until flask contains only H_2O_4 and inorganic salts. (*Note:* Take care to avoid material loss from foaming when heat is first applied, and when foaming occurs soon after material chars. Remove heat and swirl flask before continuing digestion. Add HNO_3, if necessary).

Cool digest few min. (Digest should be cool enough to add ca 15 ml H_2O safely, but hot enough to boil when H_2O is added). Wash while still hot 40 – 50 ml tapered-bottom centrifuge tube and swirl. Let cool, centrifuge 10 min at 350 × g, and decant liquid into waste beaker. (Film-like precipitate on surface may be discarded). Dislodge precipitate by vigorously stirring with eccentric-coupled stirring motor. To compare transfer, add 20 ml H_2O and 1ml 0.5M H_2SO_4 to original flask and heat. Do not omit this step even though it appears transfer was complete in first wash. Wash hot contents of original digestion flask into centrifuge tube containing precipitate. Swirl to mix, cool, centrifuge, and decant liquid into waste beaker.

Dislodge precipitate by stirring vigorously, add 25 ml saturated $(NH_4)_2CO_3$ solution (ca 20%), and stir until all precipitate is dispersed. Let stand 1 h, centrifuge, and decant liquid into waste beaker.

After decanting, invert centrifuge tube on paper towel and drain all liquid. Add 5 ml 1M HNO_3 (use large volume 1 M HNO_3 in both test solution and blank if >25 µg Pb is expected), stir vigorously to expel CO_2 or use ultrasonic bath 2-3 min, let stand 30 min, and centrifuge if precipitate remains. (Use same technique for all test solution.)

E. Determination

Set instrument to previously established optimum conditions, using air- C_2H_2 oxidizing flame and 217.0 or 283.3 nm resonant wavelength. Determine *A* of test and blank solutions and ≥ 5 standards within optimum working range (10 – 80 %T) before and after test readings. Flush burner with 1M HNO_3 and check 0 point between readings. Determine Pb from standard curve of *A* against µg Pb/ml:

$$\text{Concentration Pb, mg/kg} = \frac{(\mu\text{g Pb/ mL}) \times (\text{mL 1M HNO}_3)}{\text{g test portion}}$$

ANNEX B (Normative)

DETERMINATION OF CADMIUM IN FOOD BY ATOMIC ABSORPTION SPECTROPHOTOMETRIC METHOD

A. Principle

Material is digested with HNO_3, H_2SO_4, and H_2O_2; all reactive metals are extracted from solution, after adjustment to ca pH 9, with dithizone- $CHCl_3$. Cd is removed by stripping $CHCl_3$ solution with dilute HCl and determined by AA Spectrophotometry at 228.8nm.

B. Reagents and Apparatus

(Thoroughly wash all new glassware and glassware, which contained high Cd concentration with 8M HNO_3, and rinse with H_2O. Cover beakers with watch glasses during all operations.)

(a) *Nitric acid*- Low in Pb and Cd

(b) *Hydrogen peroxide*- 50%

(c) *Citric acid*- Monohydrate, fine crystal.

(d) *Thymol blue indicator*.

(e) *Dithizone solutions.* - (1) *concentrated solution.* - 1 mg/ml. Prepare 200 ml in $CHCl_3$. (2) *Dilute solution*. - 0.2 mg/ml. Dilute concentrated solution 1+ 4 with $CHCl_3$. Prepare fresh daily.

(f) *Cadmium standard solutions*. - (1) stock solution- 10mg/ml. Dissolve 1.00g Cd (Fischer Scientific certified 99.9% pure or equivalent) in 165 ml HCl in 1L volumetric flask. Dilute to volume with H_2O. (2) *Intermediate solution.* - 10µg/ml. Dilute 10 ml stock solution with 2N HCl to 1L. Prepare just before use. (3) *Working solution.* –Dilute 0,1,5,10, and 20 ml intermediate solution to 100 ml with 2N HCl (0, 0.1,0.5,1.0, and 2.0µg Cd/ml).

(g) *Atomic absorption spectrophotometer*- With hollow-cathode Cd lamp and 10 cm burner head for air – C_2H_2 flame; wavelength 228.8 nm, range 0-2.0 µg/ml.

C. Digestion

Weigh 50.0 g test portion into 1.5 L beaker. Add several boiling chips or beads, and cover. Carefully add 25 ml HNO_3, cover, and warm gently with flame to initiate reaction. (Meker- type burners are preferred throughout for their versatility and speed). When reaction subsides, add 25 ml HNO_3, warm again, and continue until 100 ml HNO_3 has been added. (Alternatively, add 100 ml HNO_3 all at once, with caution, and let stand at room temperature overnight). Heat until most NO fumes have evolved; control excessive frothing by cooling or quenching with H_2O from wash bottle. Only some cellulose and fatty materials, if any remain undissolved.

To remove any fat visible in hot solution, proceed as follows: Cool beaker in ice, and decant clear, aqueous solution from coagulated oils and solids through glass wool pad into 1L beaker. Add 100 ml H_2O to 1.5 L beaker with fat, heat, swirl vigorously to rinse fat, chill, and filter as before. Wash funnel and glass wool pad with ca 20 ml H_2O.

Add 20 ml H_2SO_4 to test solution, dilute to ca 300 ml with H_2O, and evaporate over flame until charring begins. When charring becomes extensive, cautiously add 50 % H_2O_2, 1 ml at time. Let reaction subside before adding next portion of oxidant, and never add >1 ml at time. Continue additions of H_2O_2 until solution is colourless. Heat vigorously to SO_3 fumes, adding more H_2O_2 as required to remove char. Heat vigorously to expel excess H_2O_2. Cool colourless digest to room temperature.

Prepare reagent blank of 100 ml HNO_3, 20 ml H_2SO_4, add same amounts of H_2O as added to test portion. Cautiously add same amounts 50 % H_2O_2, as above, and remove all HNO_3 from blank. Carry blank through same operations as test portion.

D. Extraction

Add 2 g citric acid to cooled digest and cautiously dilute to ca 25 ml with H_2O. Add 1 ml thymo blue indicator and adjust to ca pH 8.8 by slowly adding NH_4OH while cooling in ice bath, until solution charges from yellowish green to greenish blue. Transfer quantitatively to 250 ml separator, using H_2O, dilute to ca 150 ml.

Cool solution, and extract with two 5 ml portions concentrated dithizone solution, portion shaking 1- 2 min each time. Continue extraction with 5 ml portions dilute dithizone solution until last 5 ml portion dithizone extract shows no change in colour. Combine dithizone extracts in 125 ml separator. Extract H_2O wash 5 ml $CHCl_3$ and add this to dithizone extracts. Add 50 ml 0.2M HCl to combined dithizone extracts, shake vigorously 1 min, and let layers separate; discard $CHCl_3$. Quantitatively transfer aqueous solution to sides of 400 ml beaker, add boiling chips, and evaporate carefully to dryness. Carefully rinse down of beaker with 10 - 20 ml H_2O and again evaporate to dryness.

E. Determination

Set instrument to previously established optimum conditions, using air- C_2H_2 oxidizing flame and 228.8nm resonant wavelength. Dissolve dry residue in 5.0 ml 2M HCl and determine *A* of test and standard solution against 2M HCl as blank. Flush burner with H_2O between readings. Use scale expansion controls to obtain 4 - 10 × expansion, as convenient. Determine Cd from curve of *A* against µg Cd/ml:

$$\text{Concentration (mg Cd/kg} \frac{\mu\text{g Cd}}{\text{mL}} \times \frac{\text{mL 2M HCl}}{\text{g test portion}}$$

For concentration> 2.0 µg Cd/ml, dilute solution with 2M HCl.

ANNEX C (Normative)

DETERMINATION OF MERCURY IN FOOD BY FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETRIC METHOD

(Rinse all glassware before use with HNO_3 (1+9)

A. Apparatus

(a) Atomic absorption spectrophotometer. Operating conditions: wavelength 253.7 nm, slit width 160 µm, lamp current 3 ma, and sensitivity scale 2.5.

(*b) Diaphragm pump.* Coat diaphragm and internal parts of pump with acrylic-type plastic spray.

(*c) Water condenser*. - 12- 18 (id) × 400 mm borosilicate, 24/40 standard taper joint, modified to hold 6 mm Rasching rings. Fill condenser with Rasching rings to height of 100 ml; then place 20 mm layer of 4 mm diameter glass beads on top of rings.

(d) Gas inlet adapter. - 24/40 standard taper,

(e) Digestion flask. – 250 ml boiling flask with 24/40 standard taper joint.

B. Reagents

(*a) Reducing solution*. –Mix 50 ml H_2SO_4 with ca 300 ml H_2O. Cool to room temperature and dissolve 15 g hydroxylamine sulphate, and add 25 g $SnCl_2$ in solution. Dilute to 500 ml.

(b) Diluting solution. To 1 L volumetric flask containing 300 - 500 ml H_2O, add 58 ml HNO_3 and 67 ml H_2SO_4. Dilute to volume with H_2O.

(c) Magnesium perchlorate. - Drying agent placed in filter flask. Replace as needed. (*Caution*: Mg $(ClO_4)_2$ is explosive when in contact with organic substance).

(*d) Mercury standard solutions.* - (1) *Stock solution.* – 1000 µg/ml. Dissolve 0.1354 g $HgCl_2$ in 100.0 ml H_2O. (2) *Working solution*. -1 µg/ml. Dilute 1 ml stock solution to 1 L with 0.5M H_2SO_4. Prepare fresh daily.

C. Determination

Weigh 5.0g test portion into digestion flask; add 25 ml 9M H_2SO_4, 20 ml 7M HNO_3, 1 ml 2% sodium molybdate solution, and 5 - 6 boiling chips. Connect condenser (with H_2O circulating through it) and apply gentle heat ca 1h. Remove heat and let stand 15 min. Add 20 ml HNO_3-$HClO_4$ (1+1) through condenser. Turn off H_2O circulating through condenser and boil vigorously until white fumes appear in flask. Continue heating 10 min. Cool cautiously and add 10 ml H_2O through condenser while swirling liquid in flask. Again boil solution 10 min. Remove heat and wash condenser with three 15 portions H_2O.

Cool solution to room temperature. Completely transfer digest with H_2O to 100 ml volumetric flask and dilute to volume with H_2O. Transfer 25.0 ml aliquot from each test solution to another digestion flask. Adjust volume to ca 100 ml with diluting solution, **B (b)**.

Adjust output of pump to ca 2 L air/min by regulating speed of pump with variable transformer. Connect apparatus, except for gas inlet adapter. With pump working and spectrophotometer zeroed, add 20 ml reducing solution to diluted aliquot. Immediately connect gas inlet adapter and aerate ca 3 min. (Adjust aeration time to obtain maximum A.) Record *A*, disconnect pressure on “out” side of pump, and open vent on filter flask to flush screen. Prepare reagent blank and standard curve by adding 0, 0.2, 0.4, 0.6, 0.8, and 1.0 µg Hg to series of digestion flasks. To each flask, add 100 ml diluting solution. Finally, add reducing and aerate standards as for test solution.

Plot standard curve from least squares linear regression of *A* against µg Hg, use calculator which performs linear regression. Determine µg Hg in aliquot from curve. If µg Hg determined falls outside range of calibration, repeat determination with smaller aliquot of test solution to bring µg Hg into region of standard curve. From size of aliquot used, determine total µg Hg in original test portion.

$$\text{Concentration Hg, µg/kg} \frac{\text{µg Hg}}{\text{g test portion}}$$

ANNEX D (Normative)

DETERMINATION OF TIN IN FOODS BY ATOMIC ABSORPTION SPECTROPHOTOMETRIC METHOD

A. Principle

Materials are digested with HNO_3 and then HCl are diluted. Aqueous KCl is added to test solutions and standards to reduce positive instrument interference. Sn is determined by AAS at 235.5nm with oxidizing N_2O-C_2H_2 flame.

B. Reagents and Apparatus

(a) *Atomic absorption spectrophotometer*. – With simultaneous background correction and N_2O-C_2H_2 burner.

(*b) Tin standard solutions.* (1) *Stock solution*.- 1 mg Sn/ml. Dissolve 1.000 g Sn (reagent grade) in ca 200 ml concentrated HCl, add ca 200 ml H_2O, cool to ambient temperature, and dilute to 1 L with H_2O. (2) *Working solutions*.- 0, 50, 100, 150, and 200 µg Sn/ml. Into each of five 100ml volumetric flasks, pipet 10 concentrated HCl, 1.0ml KCl solution, (C), and 0, 5, 10, 15, or 20 ml Sn stock solution. Dilute to volume with H_2O.

(c) Potassium chloride solution. – 10 mg K/ml. Dissolve 1.91 g KCl and dilute to 100ml with H_2O.

(*d) Nitric acid*. - Concentrated. Test purity of lot by diluting portion 1:4 (v/v) with H_2O and aspirating into AA spectrophotometer. Absence of Sn signal indicates suitability for analysis.

C. Preparation of Test solutions

Accurately (±0.01 g) weigh test portion into 250 ml Erlenmeyer: 30 - 40 g juices or drinks, 20 g foods containing 50 - 75% H_2O, and 5 -10 g solids or semisolids. Limit fat or oil content to 2- 4 g and total organics to ca 5 g. Dry in oven at 120°C.

Do not add HNO_3 to test portions unless there is time to complete this stage of digestion in the same day. Add 30 ml concentrated HNO_3 to flask and, within 15 min, heat gently in hood to initiate digestion, avoiding excessive frothing. Gently boil until 3 – 6 ml digest remains or until residue just begin to dry on bottom. Do not let material char. Remove flask from heat. Without delay, continue as follows, including 2 empty flasks for reagent blanks: Add 25 ml concentration HCl, and heat gently ca 15 min until bumping from evolution of Cl_2 stops. Increase heat, and boil until 10-15 ml volume remains, using similar flask with 15 ml H_2O to estimate volume. Add ca 40 ml H_2O, swirl, and pour into 100 ml volumetric flask, rinsing once with ca 10 ml H_2O. When HCl is present in digest, test portions may stand overnight or longer.

Pipet 1.0 ml KCl solution into each volumetric flask. Cool to ambient temperature and dilute to volume with H_2O, adding additional H_2O to approximately compensate for volume of fat in flask. Mix well and filter ca 30-50 ml through dry, medium porosity paper into dry, polypropylene or polyethylene screw-cap bottle. Do not filter blanks. Cap bottles until analysis. Solutions are stable several months.

D. Determination

(*Caution:* Due to explosive nature of gases, take care when igniting and using flame. Heating tape on N_2O regulator may be needed to maintain steady gas flow).

Using 200 µg/ ml standard and 235.5 nm Sn line, optimize spectrophotometer, burner, and flame according to manufacturer's instructions. Then increase N_2O flow or decrease C_2H_2 flow to give oxidizing flame; red part should be ca 4 mm above burner slot. This reduces sensitivity but improves precision to 0 ± 0.0004 *A* for blank and gives 0.201 ± 0.001 *A* for 100 µg/ ml standard. Periodically monitor sensitivity of a standard; if sensitivity decreases > 20 %, turn off flame and carefully clean burner slot.

Zero spectrophotometer while aspirating H_2O but do not adjust zero until after determinations; autozero reduce precision. Aspirate H_2O before and after each test, standard, and blank solution. Take three 5 s reading for each solution, average, and reference all *A* measurements to *A* of H_2O.

Record *A* for standard, draw calibration curve, and visually check for inaccurate standards. Two times blank-corrected *A* for 50 µg/ ml standard should not differ by more than 3% from blank-corrected *A* for 100 µg/ ml standard.

Block standard blank solution with 50 µg/ ml standard, and using ratio of *A*, calculate concertation of standard blank:

$$\text{Standard blank, µg/ ml} = (A_O / (A' - A_O)) \times 50$$

Where A_O and A' refer to blank and mean of readings for 50 µg/ ml. Blocking standard, respectively.

Add standard blank concertation to nominal standard concentrations to obtain standard concentrations.

Measure *A* of material blanks for standard blank and calculate:

$$\text{Material blank, µg/ ml} = A_O / A' \times \text{true concentration of 50 µg/ ml standard}$$

Where A_O and A' refer to blank and 50 µg/ ml standard, respectively. Calculate mean concentration of material blanks, B. Determine test solution concentration by one of 2 ways:

(1) Measure *A* of test solution (maximum 3 solutions) and 50 µg/ ml standard (100 µg/ ml standard, depending on test solution concentration level), blocking test solution with standards. Calculate blank-corrected test solution concentrations:

Test solution concentration, µg/ ml = (A/ A' x true concentration) – B

Where *A* and *A'* refer to test and standard solution, respectively. When high accuracy is not required or when calibration curvature is sensitive, use procedure (2) after confirmation that sensitivity changes and baseline drift are absent during analytical run.

(2) Calibrate using blank and 50, 100, and 150 µg/ ml standards. Run material blanks and test solutions, and calculate solution concentrations using either instrument microprocessor or calibration curve. Calculate mean of sample blank concentrations, *B*. Calculate blank-corrected solution concentrations (µg/ ml) by subtracting *B* from solution concentrations.

For both (1) and (2), calculate concentrations in test portions:

$$\text{Concentration Sn, mg/ kg} = \frac{\text{blank} - \text{corrected solution}}{\text{test portion weight (g)}} \times 100$$