



U.S. Department of Health & Human Services



U.S. Food and Drug Administration

Elemental Analysis Manual

for Food and Related Products

The following is a section of the Elemental Analysis Manual for Food and Related Products.

For additional information and to view other sections of the manual, visit the Elemental Analysis Manual for Food and Related Products web page at

<https://www.fda.gov/food/laboratory-methods-food/elemental-analysis-manual-eam-food-and-related-products>

Elemental Analysis Manual

for Food and Related Products

2.1 Food Edible Portion

Version 3.0 (September, 2021)

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[GLOSSARY and ACRONYMS](#)

Information on element mass fractions in food is readily available via internet searches and other on-line resources such as FDA’s [Total Diet Study](#). The differences, however, between food crops (that may undergo considerable changes during processing), raw foods (which may or may not be consumed in raw form), and various food products are not always obvious. From the perspective of the EAM, methods are generally intended for determining the mass fractions of elements or element species in the edible portions of food. With appropriate method development and validation efforts, though, they would likely also be useful for other applications (directly as given or with adaptation) and for other matrices - such as vitamins/supplements, leachate from food contact surfaces, ingredients, packaging materials, soil, contaminants, tampering materials, etc.

A focus on the edible portion of food is simple in concept but this manual gives it particular attention because food encompasses an extremely wide range of matrices and past experiences are quite useful. In addition to the guidelines suggested in this section, detailed records should be maintained, such that the procedures used to prepare the analytical portion(s) are clear. This will be critical for interpretation and

application of the analytical results to food safety and nutrition decisions.

2.1.1. GENERAL PROCEDURES

The edible portion of most foods is generally well-understood. For FDA’s Total Diet Study, a number of specific food preparation instructions have been developed (2.1 Table 1) and these can serve as general guidelines for many of the types of samples that may be received. Analyst discretion will, however, always be necessary because alternative procedures will be needed. For example:

- Fresh produce should be rinsed, drained and dried to remove surface residues.
- Bone-in meat, poultry and seafood should be de-boned.
- Frozen seafood may have to be thawed to remove condensation ice.
- Etc.

The following terminology is used in 2.1 Table 1:

- Water - Water that meets specifications for ASTM Type I water [1]. Sometimes referred to deionized water (DI H₂O).
- Rinse - Wash with water to remove all dirt and debris.
- Drain - Remove excess liquid using a strainer, sieve, colander or other means appropriate for the product.
- Tablespoon - U.S. federal law (21 CFR 101.9(b) (5) (viii)) defines 1 U.S. tablespoon = 15 mL. Although technically a measure of liquid volume, when used for solids (*e.g.*, sugar), it should be measured to the flattened level of the spoon (*vs.* a 'heaping' or 'heaped tablespoon', which is as much as can be held in the spoon).
- Cup - Assume packed and flattened level and use common baking procedures. For example, “packed” would mean pressing brown sugar to completely fill the cup but should not be taken to mean crushing popped popcorn, which would significantly alter its characteristics.

2.1 Table 1 Food preparation procedures for selected foods

Product	<u>Procedure^a</u>
Apple, red, raw (with peel)	Rinse. Do not peel. Remove and discard stem and core.
Apricot, raw	Rinse. Do not peel. Remove and discard pit.
Apricots, canned in heavy/light syrup	Do not drain; use entire contents of can.
Asparagus, fresh/frozen	Rinse fresh asparagus. Drain.
Avocado, raw	Peel. Remove and discard pit.
Banana, raw	Peel.
Beans, green, canned	Drain.
Beans, green, fresh/frozen	Rinse fresh green beans. Remove / discard ends & fiber thread. Drain.

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Product	<u>Procedure^a</u>
Beans, pinto, dry	Rinse and soak overnight according to package directions. Drain.
Beans, refried, canned	Do not drain; use entire contents of can.
Beans, white, dry	Rinse and soak overnight according to package directions. Drain.
Beef stew with potatoes, carrots, and onion, canned	Do not drain; use entire contents of can.
Beets, canned	Drain.
Broccoli, fresh/frozen	Rinse fresh broccoli. Drain.
Brussels sprouts, fresh/frozen	Rinse fresh Brussels sprouts. Drain.
Cabbage, fresh	Remove / discard outer leaves and core.
Cantaloupe, raw/frozen	Remove / discard rind and seeds.
Carrot, fresh, peeled	Rinse fresh carrots. Peel. Cut off and discard end pieces. Drain.
Cauliflower, fresh/frozen	Rinse fresh cauliflower. Remove and discard stem. Drain.
Celery, raw	Remove / discard damaged or discolored outer pieces. Remove / discard thickened stem portion and leaves. Rinse each piece.
Cherries, sweet, raw	Rinse. Remove / discard stems and pits.
Chili con carne with beans, canned	Do not drain; use entire contents of can.
Clam chowder, New England, condensed, prepared with whole milk	Add one soup can of whole milk.
Coffee, decaffeinated, from ground	Measure 1 tablespoon coffee for each cup of water in drip-type coffee filter. Boil the required amount of water and pour over coffee.
Coffee, from ground	Measure 1 tablespoon coffee for each cup of water in drip type coffee filter. Boil the required amount of water and pour over coffee.
Collards, fresh/frozen	Rinse fresh collards. Remove and discard stems. Drain.
Corn, canned	Drain.
Corn, cream style, canned	Do not drain; use entire contents of can.
Corn, fresh/frozen	Remove corn from cob.
Cucumber, peeled, raw	Peel. Cut off and discard end pieces.
Cumber, Dill, pickles	Drain.
Eggplant, fresh, peeled	Rinse. Drain. Peel.
Eggs, boiled	Place eggs into hot boiling water and cook approximately 5 minutes until white and yolk are set. Remove shells.
Fruit cocktail, canned, in heavy/light syrup	Do not drain; use entire contents of can.
Fruit drink, from powder	Mix with water according to package instructions.
Gelatin dessert	Prepare according to package directions. Refrigerate and allow to gel.
Grapefruit, raw	Peel. Remove / discard excess white membrane, and seeds.

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Product	<u>Procedure^a</u>
Grapes, (red/green) seedless, raw	Rinse. Remove / discard stems.
Juice, [orange, pineapple, grape, grapefruit], from frozen concentrate	Add water according to label. Usually 3 containers water to 1 container of thawed juice concentrate. [<i>Alternative: Thaw. Do not add water.</i>]
Lemonade, from frozen concentrate	Add water according to label. Usually 3 containers water to 1 container of thawed juice concentrate. [<i>Alternative: Thaw. Do not add water.</i>]
Lettuce, iceberg, raw	Remove outer leaves and core. Wash individual leaves and drain on towels.
Lettuce, leaf, raw	Remove / discard outer damaged leaves and core. Wash individual leaves and drain on towels.
Mushrooms, raw	Rinse. Trim off end pieces and discard.
Okra, fresh/frozen	Rinse fresh okra. Drain. Trim off and discard stem attachment.
Onion, mature, raw	Remove / discard brown outer layer and first white layer and other inedible portions.
Orange, raw	Peel. Remove / discard excess white membrane and seeds.
Peach, raw/frozen	Rinse. Do not peel. Remove and discard pit.
Peaches, canned in light/medium syrup	Do not drain; use entire contents of can.
Pear, raw (with peel)	Rinse. Do not peel. Remove and discard stem and core.
Pears, canned in light syrup	Do not drain; use entire contents of can.
Peas, green, fresh/frozen	Rinse fresh peas. Drain.
Pepper, sweet, green, raw	Rinse. Remove / discard seeds, core, and stem attachment.
Pineapple, canned in juice	Do not drain; use entire contents of can.
Plums, raw	Rinse. Do not peel. Remove and discard seeds.
Popcorn, microwave, butter-flavored	Prepare according to package directions.
Pork and beans, canned	Do not drain; use entire contents of can.
Potato, white	Rinse. Peel. Drain.
Potato, white, with skin	Rinse and scrub. Drain.
Prunes, dried	Remove seeds.
Radish, raw	Rinse. Remove / discard stem attachment.
Sauerkraut, canned	Drain.
Shrimp, boiled	Boil in water until done (about 10 minutes). Shell and de-vein.
Soup, [chicken noodle; tomato, vegetable beef, bean with bacon/pork], canned, condensed	Add one soup can of water.
Spaghetti with tomato	Use entire contents of can.

Product	<u>Procedure^a</u>
sauce, canned	
Spinach, fresh/frozen	Rinse fresh spinach. Remove / discard stems. Drain.
Squash, Summer, fresh/frozen	Rinse fresh squash. Drain. Cut off and discard end pieces.
Squash, Winter, fresh/frozen	Rinse fresh squash. Drain. Cut in half and remove stems and seeds. Scoop out tender flesh and mash with a fork.
Strawberries, raw/frozen	Rinse. Remove / discard stems.
Sweet potato, canned	Drain.
Tea, decaffeinated, from tea bag	Pour 1 cup boiling water over 1 tea bag in a cup. Steep for 3 minutes. Remove bag.
Tea, from tea bag	Pour 1 cup boiling water over 1 tea bag in a cup. Steep for 3 minutes. Remove bag.
Tomato, red, raw	Rinse. Remove / discard stem attachment. Leave skin.
Tomatoes, stewed, canned	Do not drain; use entire contents of can.
Tuna, canned in oil	Drain thoroughly. [<i>Using a #10 High Density Polyethylene (HDPE) sieve. Leave product in sieve for at least 2 minutes.</i>]
Tuna, canned in water	Drain thoroughly. [<i>Using a #10 High Density Polyethylene (HDPE) sieve. Leave product in sieve for at least 2 minutes.</i>]
Turnip, fresh/frozen	Rinse fresh turnips. Drain. Trim off and discard stem attachment.
Vegetables, mixed, frozen	{no prep}
Watermelon, raw/frozen	Remove / discard rind and seeds.

^a Based on instructions used in FDA's [Total Diet Study](#).

2.1.2. DEGASIFICATION OF CARBONATED BEVERAGES

Degasify carbonated beverages by ultrasonication at room temperature in a sonicating water bath for at least 30 min or until there is no further effervescence. Other means of degasification may be used.

2.1.3. CONTAMINATION CONTROL MEASURES

The principles outlined in 2.4 should be followed to the extent practical. Particular care should be taken to minimize the risk of cross-contamination of analytical samples, especially those being processed in close proximity or sequence. Common household kitchen utensils and apparatus may be suitable if they can be effectively cleaned between uses.

- Generally, ceramic or plastic utensils (knives, tongs, measuring spoons, etc.) are preferable to glass, stainless steel or other metal utensils.
- A clean-rinsing laboratory detergent, followed by thorough rinsing with water is the preferred cleaning protocol
- Avoid soaking metal items in diluted mineral acid solutions.

2.1.4. HISTORY

EAM 2.1 Table 2. History

Version	Revisions Made	Effective Date
1.0	<i>Laboratory Sample to Analytical Sample</i>	June 2008 (hard copy only)
2.0	Major re-organization. Section 2.1 title changed to <i>Food Edible Portion</i> ; former section 2.1.1 title changed to <i>General Procedures; Candy Preparation</i> (former section 2.1.2) moved to (i.e., becomes) section 2.2.2.2; <i>Carbonated Beverage Degasification</i> (former 2.1.3) renamed (to <i>Degasification of Carbonated Beverages</i>) and moved to (i.e., becomes) section 2.1.2; Converted to pdf for web posting.	September 2014
3.0	Major reorganization and editing; added <i>Contamination Control Measures</i> section; added <i>History</i> section.	September 2021

References

- [1] ASTM Subcommittee D1193, "ASTM D1193-06(2018) Standard Specification for Reagent Water," [Online]. Available: <https://www.astm.org/Standards/D1193.htm>. [Accessed September 2021].