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Vegetable
Division

Processed
Products Branch

Grading Manual for Canned Apple Juice

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This manual is designed for Processed Products Branch Personnel of the U.S. Department of Agriculture. Its purpose is to give background information and guidelines to assist in the uniform application and interpretation of U.S. grade standards, other similar specifications and special procedures.

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Sampling Procedures

Follow



1. Regulations (109-A-1)
2. Sampling Procedures (120-A-1)
3. Time Sampling (120-A-4)
4. Condition of Container (125-A-1)
5. In-Plant Inspection (160-A-1, 162-A-1)
6. Foreign Material (172-A-1)

Non-Quality Procedures

Follow



1. Time Sampling (120-A-5)
2. Net Contents (128-A-10)
3. Vacuum (128-A-20)
4. Fill of Container (128-A-40)
5. Brix Measurement (128-A-50, 135-A-3)
6. Acid Conversion Chart (135-A-25)
7. General Inspection Instructions (130-A-1)

Headspace and Fill of Container

Generally, the headspace of containers of canned apple juice need not be checked as long as the declared net contents for the particular container size are met. The quality control department of some plants may prefer to have the headspace recorded for all containers opened for grading. Under lot grading, the headspace should be recorded for all containers with low net contents.

There are no Federal Food and Drug standards of fill for canned apple juice. The FDA "general requirements" for fill of container which are applicable to all products for which there are no specific standards of fill are applicable. Essentially, this means that the container should be filled as full as practicable without impairment of quality and the size and configuration of the container must not be deceptive. The 90% minimum fill applies. The net contents may be determined either by direct measurement in volumetric cylinder graduated in fluid ounces or by net weight and conversion to fluid ounces. Refer to File Code 130-A-1 for this latter procedure.

The net content statement for canned apple juice must be declared in liquid measure in the largest whole units (quarts, quarts and pints, or pints, as appropriate) with any remainder in terms of fluid ounces or common or decimal fractions of the pint or quart.

Volume Measurement

Measuring Flask Method

Glass flasks are available that are accurately calibrated for measuring volume of liquids. There are two important things to remember when using this method. The flask is calibrated for volume of a liquid at a standard temperature, usually 20°C. The legend is etched on each flask. The juice must be at this temperature for accuracy. Also, it is important not to incorporate air into the liquid when filling the flask. Heavier products such as cloudy apple juice must stand after filling the flask to permit any occluded air to escape.

Net Weight to Fluid Ounces Conversion Method

Take the net weight of the juice. Convert this weight to volume measurement by the following formula:

$$\text{Net contents} = \frac{\text{Net weight (avoir. oz.)} \times 0.9614}{\text{Specific gravity at } 20^{\circ}\text{C}}$$

Example:

Apple juice No. 3 cylinder
Net weight - 49.2 ounces
Refractive Index (20°C) - 1.3414 (See File Code 135-A-50 for Sp. Gr.)
Specific gravity - 1.02289

$$\text{Net contents} = \frac{(49.2) (0.9614)}{1.02289} = \frac{47.3}{1.02289} = 46.24 \text{ fl oz.}$$

Example:

- (1) A declaration of 1 quart shall be expressed as "Net 32 fl oz (1 qt)".
- (2) A declaration of 1-3/4 quarts liquid measure shall be expressed as "Net contents 56 fluid ounces (1 quart 1-1/2 pints)" or as "Net 56 fluid oz (1 qt 1 pt 8 oz)", but not in terms of quart and ounce such as "Net 56 fluid oz (1 quart 24 ounces)".
- (3) A declaration of 2-1/2 gallons liquid measure shall be expressed as "Net contents 2-1/2 gallons," "Net contents 2.5 gallons," or "Net contents 2 gallons 2 quarts" and not as "2 gallons 4 pints".

When the contents are less than one pint only the fluid ounces must be declared.

Styles

- (a) Style I, Clear -- Juice that has been properly clarified and filtered should be bright clear, and practically free from any turbidity or sedimentation.
- (b) Style II, Cloudy -- Cloudy style juice is unclarified and generally not filtered. The cloudiness comes from natural apple materials. The amount of sedimentation may vary substantially depending on the process used and natural variations in the apples.

Preparation of Clear Juice

The juice is usually strained before clarification to remove the larger apple particles. Straining may be accomplished by the use of clean press cloths, by passing the juice through a rotating screen, or with a vibrating type shaker screen. The screens should be stainless steel.

A. Clarification

After straining, the juice is further clarified by one of the following methods:

Enzymatic Method

The enzymatic method is probably the most common and most reliable method used to clarify apple juice. This method is a batch operation, which requires several large holding tanks for commercial production. Some processors may

heat the juice to about 125°F and let it settle overnight. Others may hold the juice at 60 to 70°F for settling overnight. Pectolytic enzymes are added to the juice for clarifying action.

The juice can also be flash heated to about 185 to 190°F, cooled to 120 to 130°F, and then treated with enzymes for about 30 minutes.

The pectic enzymes break down the natural pectins in the juice, precipitating part of it, and making the rest soluble.

Bentonite Method

In this method the juice is heated to approximately 190°F, held for a few seconds and then cooled rapidly. The juice is then pumped from the cooling unit to a tank where 7 to 8 ounces of mixture of equal parts of bentonite and filter aid are added to 100 gallons of the juice. The heat treatment coagulates the colloidal material in the juice and the bentonite mixture causes the coagulation material to flocculate, making it easier to filter the juice.

Gelatin-tannin Method

The gelatin-tannin method works on the principle that when gelatin is dissolved in water and added to the apple juice, it combines with the tannins of the juice forming a bulky precipitate. When this precipitate settles out it pulls any suspended material down with it, clarifying the juice. Exact amounts of gelatin should be used since an excess of gelatin will have a tendency to stabilize the colloidal material. The precipitate should be allowed to stand for approximately 24 hours before the juice is drawn off. The juice is generally drawn off from near the bottom of the vat.

Since the gelatin combines with tannins which is precipitated and settled out, tannins should be added back to the juice to restore the natural flavor quality for which they are responsible.

Juice clarified by this method is generally lighter in color than when clarified by the other methods mentioned.

Flash Heat Method

The flash heat method is generally used in conjunction with one of the other three methods previously explained since it does not do a thorough job of clarification. Filtration of the juice is also slowed down below a satisfactory speed for production.

In this method the juice is heated to approximately 190°F, held for a few seconds, then rapidly cooled. The suspended material is coagulated, setting it up for further clarification by one of the other methods.

Electrokinetic Adsorption Method

This method employs a cartridge filter that provides electrokinetic adsorption as well as small-pore mechanical straining. The filter medium is composed of cellulose and polymers which impart a positive charge to the fibers.

B. Filtration

After the juice has been clarified it is pumped into mixing tanks where it is prepared for filtering. The juice is mixed with a filter aid, generally diatomaceous earth or siliceous powder, in the mixing tank. It is then pumped to the filter units where it is filtered through a filter cloth or filter paper. The clear juice is caught in the filter units and the filter aid along with the flocculated apple material from the clarification process is caught on the filter cloth or filter paper. The filter units should be made of stainless steel to prevent the juice from coming in contact with iron. Another type of filter unit is now being used to some extent in which a cake of filter aids up to 2-3/4 inches thick is first built up on the outside of a cylindrical screen. The screen is covered by a filter cloth. Approximately one half of the screen is immersed into a tank containing the apple juice. A vacuum of about 17 inches is drawn on the interior of the screen as it revolves through the unfiltered juice. The vacuum forces the juice through the immersed portion of the filter cylinder.

At the same time the upper portion is dried so that the solids and filter cake can be continuously scraped off, presenting a fresh surface of filter aid to the unfiltered juice. This system provides a fast and continuous filtration for approximately eight or more hours before cleaning and rebuilding a new filter cake is required.

Preparation of Cloudy Juice

The juice is held in deep holding tanks to permit the suspended solids to settle out. This reduces the amount of sediment which would form in the bottom of the containers after canning. The juice is siphoned off the sediment and is either put through a centrifuge to remove the excess solids or given a preliminary heat treatment and then cooled to aid in removal of solids that may be coagulated by subsequent heat treatment to sterilize the juice.

Pasteurization

The juice, in the case of both the cloudy and clear juice, is pumped to a heat exchanger or pasteurizer where it is brought up to a temperature of 190°F just prior to filling.

Mixed Lot of Clear & Cloudy Juice

Under normal packing practice clear style juice would not be mixed with cloudy style. However, if a lot is inadvertently mixed style, the packer may wish to segregate the lot before offering for grading. In the event the packer declines the segregation grade the lot according to the style that it is offered for -- either clear style or cloudy style.

Methods of Analyses

Brix Measurement

The official method for determining degrees Brix as specified in the canned apple juice grade standards is by use of the refractometer. A Brix hydrometer may be used only as an alternate when a refractometer is not available. When Brix measurements are taken at temperatures other than 20°C (68°F), a temperature correction should be made. Separate tables for this correction for the hydrometer and refractometer are contained in File Code 135-A-3. Procedures for taking Brix measurements are outlined in File Code 135-A-3 (Technical Inspection Procedures -- Brix Measurement).

Acid Determination

Transfer 10 mL of well mixed juice to a 250 mL Erlenmeyer flask. Rinse inside of flask down with approximately 100 mL distilled water. Add 3 or 4 drops of phenolphthalein indicator or other suitable indicator. Titrate this solution with approximately 0.1N sodium hydroxide (NaOH) to the first signs of a permanent end point according to the indicator used (pink in the case of phenolphthalein).

The acid content is expressed in grams malic acid per 100 grams of juice according to the following formula:

$$\text{mL NaOH} \times \text{N of NaOH} \times 0.67 = \text{gms malic acid/100 mL juice.}$$

Refer to Inspection Aid No. 87 -- Acid Conversion Chart (File Code 135-A-25) for conversion from wt/vol to wt/wt. For acid content in the range of 0.50 to 2.00 grams per 100 mL juice use the conversion table in File Code 135-A-25 (Inspection Aid No. 87). Outside this range use the formula:

$$\frac{\text{Acid wt/vol}}{\text{Sp. Gr. of juice}} = \text{Acid wt/wt}$$

NOTE: Degrees Brix must be converted to specific gravity per Table A of File Code 135-A-3 or File Code 135-A-50 (Sucrose Conversion Table).

Flavor

A proper combination of various apple characteristics is essential to a high quality apple juice flavor. Specifically, these are:

- (1) A good sugar-acid balance; and
- (2) Apple essences which provides the "fruity flavor", bouquet and aroma.

Minimum requirements are provided for sugar, expressed as "Degrees Brix", in grades A and B. Minimum and maximum requirements are provided in these grades. Although a sample unit of apple juice may meet the requirements for a particular grade for both sugar and acid, a subjective evaluation must be made with respect to sugar-acid balance. For example, if the acidity of the juice approaches the maximum for Grade A, the sugar content should be such that the juice is not too tart to the taste.

On the other hand, if the acidity of the juice approaches the minimum for Grade A, the sugar content should not be such as to cause the flavor to be too sweet, although it must meet the specified minimum for the grade.

Apple essences must be present such as to provide a pronounced fruity flavor characteristic of fresh, aromatic apples in addition to meeting sugar and acid requirements in order for the juice to qualify for Grade A. If the juice does not have a pronounced fruity flavor, the sample unit must not be classified above Grade B even though sugar and acid requirements for Grade A are met.

Suggested Order of Grading a Sample Unit

Clear Style

1. Draw 500 mL (250 mL for containers 12 fl. oz. or less) of well mixed canned apple juice. This could be a portion of the contents of a container, the entire contents of a container, or a composite of more than 1 container from a particular code.
2. Evaluate the color by pouring the suggested amount (250 mL or 500 mL) into a clean glass cylinder approximately two inches in diameter and twelve inches tall and viewing the juice through the cylinder under good lighting conditions.

Grade A - the color should be good, bright and sparkling. Canned apple juice that falls into this classification may be assigned a score of 18 to 20 points.

Grade B - the color should be reasonably good and may be slightly translucent. Canned apple juice that falls into this classification may be assigned a score of 16 or 17 points and should not be graded above U.S. Grade B regardless of the total score for the product.

3. Evaluate the juice for absence of defects.

Grade A - may contain slight amounts of amorphous sediment or residue, trace of nonamorphous sediment or residue and dark specks, and contains no particles of seeds, pulp or other defects. Canned apple juice that falls into this classification may be assigned a score of 18 to 20 points.

Grade B - may contain moderate amounts of amorphous sediment or residue, moderate amounts of nonamorphous sediment or residue and dark specks, and a slight amount of particles of seed, pulp or other defects. Canned apple juice that falls into this classification may be assigned a score of 16 or 17 points and should not be graded above U.S. Grade B regardless of the total score for the product.

Noticeable sedimentation may be determined by allowing the juice to stand in the glass cylinder used to determine color for approximately ten minutes. Examine for any sediment that may accumulate in the bottom of the cylinder. Sedimentation check for the 250 mL sample should be done with 1-1/2 inch diameter cylinder; 2 inch diameter cylinder for the 500 mL sample. Nonamorphous sediment is heavy; amorphous sediment is lighter and stays partially in suspension.

Suggested Order of Grading a Sample Unit

Clear Style (Continued)

Dark specks, seed particles, pulp or other defects are evaluated by pouring 250 mL portions of the sample onto a flat white grading tray (approx. 17" x 12") and observing the defects present.

**NOTE: DONOT DISCARD THIS JUICE (PLUS SEDIMENT, IF ANY) SINCE
 IT WILL BE USED LATER FOR THE FLAVOR TEST.**

4. Evaluate flavor.

Grade A - the juice has **good** flavor typical of apple juice that has been properly processed. Canned apple juice that falls into this classification may be assigned a score of 54 to 60 points.

Grade B - the juice has **reasonably good** flavor typical of apple juice that has been properly processed. Canned apple juice that falls into this classification may be assigned a score of 48 to 53 points and should not be graded above U.S. Grade B regardless of the total score for the product.

Refer to Table I in the grade standards for tolerances on acid and Brix measurements for the respective grades. Follow the AOAC method (or other acceptable method such as is contained in File Code 137-0-210) for malic acid determination. Brix measurement procedures are outlined in File Code 135-A-3.

Refer back to page 7 for a full discussion on **flavor**.

Suggested Order of Grading a Sample Unit

Cloudy Style

1. Shake container well before opening; draw 500 mL (250 mL for containers 12 fl. oz. or less) of well mixed canned apple juice. This could be a portion of the contents of a container, the entire contents of a container, or a composite of more than one container from a particular code.
2. Evaluate the color by pouring the suggested amount (500 mL or 250 mL) into a clean glass cylinder approximately two inches in diameter and twelve inches tall and view the juice under good lighting conditions.

Grade A - the color should be good, may be slightly translucent to definitely cloudy. Canned apple juice that falls into this classification may be assigned a score of 18 to 20 points.

Grade B - the color should be reasonably good, typical of the cloudy style but not off-color. Canned apple juice that falls into this classification may be assigned a score of 16 or 17 points and should not be graded above U.S. Grade B regardless of the total score for the product.

3. Evaluate the juice for absence of defects.

Grade A - may contain normal amounts of amorphous and nonamorphous sediment or residue, trace of dark specks, and contains no particles of seeds, coarse particles of pulp or other defects. Canned apple juice that falls into this classification may be assigned a score of 18 to 20 points.

Grade B - may contain normal amounts of amorphous and nonamorphous sediment or residue, moderate amounts of dark specks, and a slight amount of particles of seeds, coarse particles of pulp or other defects. Canned apple juice that falls into this classification may be assigned a score of 16 or 17 points and should not be graded above U.S. Grade B regardless of the total score for the product.

Noticeable sedimentation may be determined by allowing the juice to stand in the glass cylinder used to determine color for approximately ten minutes. Examine for any sediment that may accumulate in the bottom of the cylinder.

Suggested Order of Grading a Sample Unit

Cloudy Style (Continued)

Sedimentation check for the 250 mL sample should be done with 1-1/2 inch diameter cylinder; 2 inch diameter cylinder for the 500 mL sample.

Nonamorphous sediment is heavy; amorphous sediment is lighter and stays partially in suspension. More sedimentation is allowed in the cloudy style than in the clear style. Dark specks, particles of seeds, coarse particles of pulp or other defects are evaluated by pouring 250 mL portions of the sample onto a flat white grading tray approx. 17" x 12") and observing the defects present.

NOTE: DO NOT DISCARD THIS JUICE (PLUS SEDIMENT, IF ANY) SINCE IT WILL BE USED FOR THE FLAVOR TEST.

4. Evaluate flavor.

Grade A - the juice has **good** flavor typical of apple juice that has been properly processed. Canned apple juice that falls into this classification may be assigned a score of 54 to 60 points.

Grade B - the juice has **reasonably good** flavor typical of apple juice that has been properly processed. Canned apple juice that falls into this classification may be assigned a score of 48 to 53 points and should not be graded above U.S. Grade B regardless of the total score for the product.

Refer to Table II in the grade standards for tolerances on acid and Brix measurements for the respective grades. Follow the AOAC method (or other acceptable method such as is contained in File Code 137-0-210) for malic acid determination. Brix measurement procedures are outlined in File Code 135-A-3.

Refer back to page 7 for a full discussion on **flavor**.