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# Grading Manual for Apple Butter

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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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Address inquires to:

Chief, Processed Products Branch  
Fruit and Vegetable Division, AMS  
U.S. Department of Agriculture  
P.O. Box 96456, Rm. 0709, South Building  
Washington, DC 20090-6456

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**I. General.****A. Purpose and Scope.**

These instructions are designed to assist in the interpretation and uniform application of the U.S. Standards for Grades of Apple Butter. They do not attempt to cover all phases of manufacture.

**II. Production.**

Apple butter is manufactured by many canners who also pack other apple products in the principal apple producing areas. It is also packed by many who market large retail lines of preserves and jellies.

**III. Identity -- FDA Requirements.**

Fruit butters are standardized by FDA. Identity, label declaration, and optional ingredients are covered. An outline of these requirements is as follows:

**A. Ingredients.**

1. Fresh, frozen, canned, and/or dried (evaporated) mature fruit, with or without added water, and screening out skins, seeds, and cores.
2. The following safe and suitable optional ingredients:
  - a. Nutritive carbohydrate sweeteners;
  - b. Spices;
  - c. Flavoring (other than artificial flavorings);
  - d. Salt;
  - e. Acidifying agents;
  - f. Fruit juice or diluted fruit juice or concentrated fruit juice, in a quantity not less than one-half the weight of the optional fruit ingredient;
  - g. Preservatives;
  - h. Antifoaming agents except those derived from animal fats; and
  - i. Pectin, in a quantity which reasonably compensates for deficiency, if any, of the natural pectin content of the fruit ingredient.

**B. Ratio of Fruit to Nutritive Carbohydrate Sweeteners.**

Fruit ingredient is not less than 5 parts to each 2 parts, by weight, of nutritive carbohydrate sweeteners.

**C. Soluble Solids Content of the Finished Butter.**

The soluble solids content is not less than 43 percent.

**D. Label Declaration.**

1. Name of product - **Apple Butter**
2. Each optional ingredient, except that:
  - a. Other than in the case of dried (evaporated) apple fruit the name of the fruit used may be declared without specifying the particular form of the fruit used;
  - b. When the optional fruit ingredient is prepared in whole or in part from dried fruit, the label shall bear the words **prepared from** or **prepared in part from**, as the case may be, followed by the word **evaporated** or **dried**, shall appear in the order of predominance, if any, of the weight of such ingredients in the combination; and
  - c. If sugar or invert sugar is the sweetener used, the term **sugar** may be used, and if the sweetener used is derived from corn the term **corn sweetener** may be used.

**E. Processing.**

May be concentrated with or without heat.

**F. Essence.**

The volatile flavoring materials or essence from fruit material may be captured during concentration, separately concentrated, and added back to any such mixture, together with any concentrated essence accompanying any optional fruit ingredient.

**IV. Raw Materials.****A. Ingredients.**

Large packs of apple butter produced near the source of supply are usually made primarily from fresh apples. Some packers use dried apples almost entirely. Other packers use either fresh or dried or mixed depending on the season, and for purposes of adjusting quality. This situation permits packing this product in large cities as

well as in the agricultural areas.

Any of the leading apple varieties may be used. Often varieties are mixed. Because of the spices and cider which may be used, packers are not always as critical about superior varieties as they are in connection with apple sauce. Varieties are blended, however, to enhance the flavor of the apple butter.

#### 1. **Fresh Apples.**

Raw apples for apple butter are not peeled and cored; however, they should be carefully sorted and inspected to remove any visible insect damage, rot, and leaves, stems, and other materials. Fresh apples stored outdoors on the ground may develop a musty flavor or may spoil due to alternate freezing and thawing. The use of frozen apples may seriously affect the consistency of the product if not carefully watched. Sometimes a dilute acid or lye bath is used as an aid in removing spray residue and filth.

#### 2. **Dried Apples.**

Dried apples for apple butter are usually chopped up without removing cores or peeling. These apples are referred to as **chops**. Occasionally peeled and cored dried apples may be used. Often these apples are of good quality except that they may be affected by oxidation.

#### 3. **Apple Peelings and Cores.**

Peeling and cores are used either entirely or in part by some manufacturers. This is not an approved practice in the industry because of the possibility of increased defects, including insect damage, and spray materials from the peeling excess. Excess peeling may increase the pectin beyond normal needs. The Food and Drug Administration does not approve of this practice and may well take action against it as a violation of the Standard of Identity.

#### 4. **Juice or Cider.**

Boiled cider may be used in the product to improve flavor and acid content and to produce **Old Fashioned** apple butter.

#### 5. **Acid.**

Vinegar is often added in small amounts. Some manufacturers think that vinegar adds flavor. Acid also acts as a preservative and decreases darkening of the top layer of the product,

## 6. Sweeteners.

Most apple butter is sweetened. **Old Fashioned** apple butter may have cider added and little or no sweetener. The sweeteners used are a matter of price. The cheapest sweetener will usually be the predominant sweetener.

## 7. Spice.

Most apple butter is spiced, some is not. Cinnamon is the basic spice; clove, all-spice, and nutmeg are secondary. Spice oils may be used by some manufacturers almost entirely because of the availability and price of the spice oil. Ground spice usually adds dark speck material and is a possible source of insect contamination. Spice houses sell specific spice formulas in air-tight bags in the exact amounts needed for certain size batches.

# V. Preparation and Processing.

## A. Preparing the Mash.

Fresh apples are washed, inspected and chopped in some type of mill. These apples or dried apple chops are stewed in a very small amount of water, often with some agitation to further disintegrate the flesh. This stewing process varies from plant to plant; however, the main purpose is to soften the flesh. The color of apple butter is due to oxidation, the less oxidation the lighter the color and the more oxidation the darker. Color control therefore may be exercised at this time by stirring the apples with steam, air, or mechanical stirrers. After a period of cooking the apple material may be examined for color and compared with a previously determined standard for color and consistency at this point in the operation. Concentration is usually not more than 19 degrees Brix at this time.

The product is then passed through a pulper of some type which removes the peeling, seed, seed cells, stems, and other hard particles by forcing the pulp through a screen. A screen with .027 inch perforations is commonly used. Some operators pass this pulp through a fine finisher to further macerate the pulp and remove more speck material. The equipment used may be identical with that used in the preparation of tomato pulp. The product at this point is spoken of as **mash** or **pulp**. Mash is one of the ingredients in the formula.

## B. Formula.

There is no single acceptable formula for apple butter. Within the limits of the Food and Drug Standard of Identity, the ratio of fruit to sugar varies considerably. It has been said that the higher



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percentages of fruit are preferred in the North, whereas the Southern trade prefers a sweeter, less tart apple butter which is more highly spiced. There are also local preferences, and certain packers have built their trade on a certain type of apple butter. Some packers pack several types.

The following established formula (which could be varied considerably) will yield approximately as follows when concentrated as indicated:

Apple Mash (% solids same as apples)	1600 lbs
Cane sugar	200 lbs
Brown sugar	200 lbs
Cinnamon	8 lbs
Cloves	6 lbs
Citric Acid	2 lbs
Vinegar	1 lb
43% Soluble solids (Food & Drug minimum)	1341 lbs
45% soluble solids	1281 lbs
47% soluble solids	1227 lbs
50% soluble solids	1153 lbs

**C. Calculating Food & Drug Requirements for Fruit-Sweetener Ratio for Sweetened Product.**

A current Food & Drug requirement is that there be not less than 5 parts, by weight, of fruit to each 2 parts, by weight, of the sweetening ingredient (ratio of 2-1/2 to 1).

**1. Fruit.**

For the purposes of calculation, the equivalent weight of the fruit ingredient is determined as specified in the Food and Drug Standard, that is, it is based on the weight of the fruit solids used divided by the solids of a **standard fruit**. This is accomplished by multiplying the fruit solids by a factor which is the reciprocal of the solids of a standard fruit.

The factor of 7.5 given for apples in the standard of identity is derived by considering the soluble solids of apples to be 13.3 degrees Brix. Therefore,

$$\frac{1}{13.3} (100) = 7.5 \text{ or the factor for standard apples.}$$

## 2. Fruit Juice.

The equivalent weight of fruit juice, whether single strength, diluted, or concentrated, is determined in the same manner as is the weight of fruit, i.e., the weight of the fruit solids in the juice multiplied by the factor for standard apples (7.5). In both fruit and juice, the weight of any added sugar is subtracted before multiplying.

### a. Equivalent Weight Formula.

The equivalent weight of apples and the equivalent weight of apple juice (cider) in any apple butter formula may be determined by substituting in the following formula:

Equivalent weight of fruit (or juice) =

$$\left( \left[ \frac{(\text{Wt. of fruit or juice} \times \text{refract solids } \%) }{100} \right] - \text{added sugar} \right) 7.5$$

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Example - 500 pounds of mash (consisting only of apples and water) and testing 11.5 degrees Brix is used for the batch.

$$= \left( \frac{500 \times 11.5}{100} \right) 7.5 = 431 \text{ pounds equivalent apple.}$$

Example - Find the equivalent weight of 1000 pounds of frozen apples packed 4 + 1. A blend of the fruit and sugar tests 30 degrees Brix. (4 + 1 means 4 parts fruit to each 1 part sugar. Therefore in 1000 pounds 1/5 or 200 pounds of the frozen apples is added sugar).

$$\left[ \frac{(1000 \times 30)}{100} - 200 \right] 7.5 = 750 \text{ pounds equivalent apple}$$

Example - 40 gallons of boiled cider are used weighing 9.00 pounds per gallon and testing 19.8 degrees Brix.

Weight of cider = 40 X 9 or 360 pounds.

Substituting:

$$\left( \frac{360 \times 19.8}{100} \right) 7.5 = 535 \text{ pounds equivalent juice}$$

(For practical purposes the weight of a gallon of any juice may be obtained from the tables contained in any sugar product handbook. These show the weight for each degree Brix.)

### 3. Sweeteners.

For the purposes of this calculation, the equivalent weight of sugar is the weight of the solids in the sweetener.

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Example - Analysis of a production formula to determine compliance with the fruit-sugar ratio.

### Formula.

1600 pounds apple mash @ 16 degrees Brix

400 pounds sugar @ 100 degrees Brix

200 pounds brown sugar @ 95 degrees Brix

100 pounds corn sirup @ 40 percent solids

6 pounds spice

3 pounds vinegar

Calculate equivalent fruit:

$$\frac{(1600 \times 16)}{(100)} 7.5 = 1920 \text{ pounds}$$

Calculate equivalent sugar:

400 pounds sucrose @ 100 degrees brix	- 400 lbs.
200 pounds brown sugar @ 95 degrees brix	- 190 lbs.
100 pounds corn sirup @ 40 percent solids	- <u>40 lbs.</u>
Total sugar	630 lbs.

Calculate the ratio of fruit to sweetener:

$$\frac{1920 \text{ (fruit)}}{630 \text{ (sweetener)}} \text{ or } 3.05 \text{ to } 1$$

The requirement is not less than 5 parts fruit to 2 parts sweetener (or 2.5 to 1). Therefore, the ratio meets this requirement.

This formula then could produce apple butter which would meet the Food and Drug Standard of Identity. This standard, as well as our grade standard, requires that the product be concentrated to not less than 43 degrees Brix.

### D. Fabrication.

Production of the **mash** has been discussed. The principal purpose of the cooking operation is to remove excess water and to blend the various ingredients. This may be accomplished in several

manners. In the original farm operation, apple butter was boiled down in open iron kettles and stirred with wooden paddles. This type of cook tended to darken the product by oxidation and to caramelize some of the sugar solids both of which imparted a traditional color and flavor to the apple butter. Often this darkening and caramelization were carried to the extent of being objectionable.

Usually cooking is done in steam jacketed copper kettles with mechanical agitators or stainless steel cookers with steam coils in the bottom. Kettles designed for this purpose have dome coverings with a small opening to minimize splashing of the hot material. These domes also trap off a large part of the steam from the cookroom.

Some preservers evaporate with vacuum equipment. This tends to prevent caramelization and, therefore, produces apple butter with a slightly different flavor. It is claimed that this apple butter has more apple flavor and a brighter color than that produced by more traditional methods.

The apple mash and sweeteners may all be added at the beginning of the cook, or some packers prefer to cook the sugars with a small amount of **mash** in order to provide the desired amount of caramelization. More mash may then be added and boiled to about the required concentration.

Spices are usually added at about the time the cooking operation is finished. If added too early, much of the flavoring oils may be lost by evaporation.

Concentrated apple juice (boiled cider) may be added late in the cook. More dilute or single-strength juice should be added earlier to prevent excessive cooking of the mash. Some packers run the product through finishers to holding tanks which are provided with agitators where spices are added and final adjustments made for solids.

#### **E. Filling.**

Apple butter is packed in glass or tin. Usually there is no additional process after filling. Glass containers are often rinsed with hot water and inverted. Packers attempt to reduce the headspace as much as practical in order to prevent oxidation of the top layer. Iron and tannin present in apples cause rapid darkening after exposure to air.

#### **F. Quality Control.**

Quality control operations of particular interest to inspectors are those concerning color, consistency, absence of defects and flavor.

##### **1. Color.**

The color of apple butter is affected not only by the ingredients used but by the cooking, type of equipment (metals) amount of agitation, caramelization, and amount of exposure to air. Often the color of the batch is controlled by the color of the mash. Samples of mash are compared to standard samples. The cook may be increased in time or more fresh apples added in order to adjust this color. Color control of the finished product is not usually perfect, that is, there is often a slight difference in the color of the various batches -- early batches are usually lighter -- late batches darker.

## **2. Consistency.**

For best results apples should be mature. Both immature and over-mature apples affect consistency and flavor. Blending helps adjust the pulp to the desired solids. Consistency may be measured by one or more devices and at one or more points in the operation. These devices and procedures will vary from plant to plant as will the standards which have been set up for the particular measurement and place in the operation.

The Bostwick consistometer is one of the common instruments used in control work on the hot butter or mash. Other devices may be based on the time it takes a plummet to reach the bottom of a tube containing the product, the length of time it takes to empty a container of the product, the distance the product will flow in a given time, the resistance the product presents to being stirred, or on other similar characteristics of consistency. Consistency of the finished apple butter is checked by pouring on a tray and examining the mound and the amount of free liquid.

## **3. Defects.**

Defects which affect the grade of apple butter usually originate in the pulp. They are caused by the use of poor raw stock and failure to remove leaves and stems before chopping. They may also be caused by faulty machinery such as broken screens or improperly set brushes or paddles in the pulpers or finishers. Failure to use a finisher or a fine enough screen on the finisher may also result in many defects. Other defects, usually dark specks, may come from burned material on the coils or improperly cleaned tanks or machinery. Dark specks may also be caused by coarse spices.

The important thing in controlling defects is to discover their presence when they first occur. This may be done by regularly checking the mash before mixing with the other ingredients and samples of the finished product just before filling. If proper control of this type is set up and remedial action is prompt there is seldom any reason for degrading

apple butter because of the presence of defects.

**4. Flavor.**

Flavor may be controlled by one person or by taste panels of experienced people. Flavor, with respect to spices, is a matter of personal preference and experience in the market.

**5. Finishing Point.**

The end point is usually determined by refractometer to a point predetermined by the packer. A minimum of 43 percent soluble solids (by refrax) is required. Higher solids assure better keeping and often a preferred flavor. A check for consistency is often made just before dropping the batch. If too thick at the desired solids some dilution can be made with mash. If too thin additional mash made from dried fruit or other fruit which is kept quite thick may be added. The batch is again brought to the desired solids. It requires good control to adjust the solids and consistency because color and flavor are also affected by adjustments. In making adjustments of fruit and sugar at finishing, the legal requirements of the formula must be kept in mind.

**VI. Inspection of the Product.****A. Sampling.**

Follow applicable sampling instructions meticulously when drawing samples of apple butter. Each container in any one batch is usually very similar to every container in the batch but it may be very different from the product in a successive batch. It is, therefore, very important to select samples from each batch present in a lot if possible. Occasionally apple butter is made in batteries of small kettles each of which is filled and coded separately; or a code may represent a period of time such as a day, an hour, or a season. Some knowledge of the meaning of the codes will be helpful in securing samples that are representative of a lot. At least the prescribed number of containers should be examined for condition of container. Proper records should be kept of all aspects of the sampling procedure.

**B. Inspection Equipment.**

1. Minimum equipment needed for the inspection of apple butter:
  - a. Scales.
  - b. Color grading standards, Nos. 1, 2, 3, and 4.
  - c. Large flat white grading trays.
  - d. Scraper with prescribed clearance.
  - e. Refractometer.
  - f. Filter paper.
  - g. Vacuum gauge.
  - h. Spoon.
  - i. Mold and light filth counting equipment.



**C. Setting Up The Score Sheet.**

Line up samples by code and record all important information concerning the inspection on the score sheet as directed in basic instructions on this subject. This includes such information as net weights, kind of containers, vacuum readings and all significant information taken from the labels.

**D. Net Weights.**

Net weights are taken and recorded.

**E. Vacuum Readings.**

Since apple butter is very easily affected by oxidation and because certain types of closures require a good vacuum to keep the closure in place the vacuum readings are often important to buyers of apple butter. Every effort should be made to get as accurate vacuum readings as possible on this product.

**F. Fill of Container.**

Compliance with the fill of container recommendation in the standards (at least 90 percent of the capacity of the container) assures that the headspace in most containers will not be excessive. Excessive headspace is rarely encountered because of possible color loss due to oxidation. If the headspace appears excessive, measure and record your findings.

**G. General Appearance.**

Before proceeding with the inspection, note the general appearance of the product. Consider and record any abnormal condition of the product labels or containers that might affect its quality and merchantable value. In apple butter, particular consideration should be given to any top layer of product which might be darkened by oxidation. Any appreciable oxidized layer would cause the color score to be lowered to Substandard.

**H. Soluble Solids.**

A soluble solids content of not less than 43 percent is required by the standard of identity. Soluble solids content is determined by the refractometer using the sucrose scale or by converting the refractive index to Brix. Correction is made for temperature but not for acids or insoluble solids. Reading is made from a well mixed smear or filtrate through cheese cloth.

**I. Grade Requirements.**

All quality factors in this standard are scoring factors.

## 1. Color.

The actual color of apple butter may be adjusted through a wide range by the procedures used in the manufacturing process. Since there are several hundred visibly discernible shades of brown, many of which could be considered **good color** with respect to apple butter, it is not practical to depend entirely on color names or to reproduce the many color standards which would be necessary to establish cut-off points.

Color Standards 1 and 2 have proper hue and intensity of color for Grade A apple butter. They have been selected to represent the **moderately reddish-brown** and the **moderately dark brown** referred to in the standards. Various colors similar to these may be considered **equal to or better** even though they do not exactly match them in hue, value, or chroma. For example, apple butter which is somewhat lighter in color than the standards but which is bright and has a good red or reddish-brown hue is acceptable for Grade A.

Color Standards 3 and 4 lack the reddish-browns of color Standards 1 and 2. They represent the **dark brown** and the **light brown** referred to in connection with Grade C. These colors usually result from improper processing.

### a. Lighting.

Proper lighting is very important when evaluating such dark colors as those of apple butter. Critical evaluation should be made under approved artificial laboratory lighting.

**b. Grade A Color (17 to 20 points).**

This color is lustrous and characteristic of properly prepared apple butter. It need not match but must be equal to or better than USDA Color Standard 1 or 2. That is, it may be redder, brighter or somewhat more translucent than either 1 or 2 but **not** darker than 2 without red, or **not** more tan (in the direction of Color Standard 4). It must, however, have a proper hue, that is, an attractive reddish-brown rather than having the appearance of apple pulp or apple sauce or the dull blackish hue illustrated by Color Standard 3.

**c. Grade C Color (14 to 16 points).**

If the color of the apple butter fails Grade A for any reason (dullness or improper hue), it may be Grade C, provided it is no worse than USDA Color Standards 3 or 4.

**d. How to use the USDA Apple Butter Standards.**

Compare the apple butter with the color standard in the following manner and assign score points:

- (1) Pour a mound of the apple butter on a flat tray. The mound should be thick enough so that no light is reflected through the butter from the bottom of the tray;
- (2) Place the color standard on the apple butter, shiny side up, and push down so the surface of the butter and the standard are even;
- (3) To eliminate texture, place a clear plastic or glass beside the color standard in a manner so that approximately the same area of standard and apple butter under the plastic may be observed. (Tinted glass should not be used). The plastic scraper furnished to each office may be used for this purpose as long as it is in good condition optically.
- (4) Make the observation under the best conditions of lighting that are available, preferably under approved laboratory lighting or diffused north daylight.

**2. Consistency.**

Apple butter is used principally as a spread for bread. The consistency should be such that it spreads easily and mounds well but does not soak up the bread to any appreciable extent.

It is believed that if the criteria for **Good consistency** and **fairly good consistency** provided in the standards are carefully applied there will be little difficulty in assigning appropriate scores for this factor.

### 3. **Finish.**

Most apple butter as it is made today has a good finish and merits a Grade A score for this factor. Occasionally, particularly when the pectin is excessive, as when apple peelings are a source of apple pulp, the product may consist of gummy granules. Such apple butter would be scored in the Grade C or Substandard range depending on the seriousness of the condition. Any deviation from a smooth, fine grained butter would be cause for lowering the score for this factor.

### 4. **Defects.**

The defects that appear in apple butter are pieces of apple material such as stems, carpel, skin, twigs, leaves, and calyx which because of their texture take a much darker color than the apple pulp. These defects can be minimized by sorting and proper screening. However, a certain amount of this material is not objectionable. Because of the wide variety in size, number, kind, type, and color of the defects which might be present in any apple butter and the differing effect of various combinations of these defects on the appearance or eating quality of the product, it has not yet proved feasible to assign score points on a strictly objective basis; that is, on the number of the various kinds which are present. The method of preparing the sample for this observation described in the standard does assure that all observers will look at about the same amount of the product in approximately the same manner. The decision as to the degree the defects present and observable in the prepared sample affects the appearance and eating quality of the product must necessarily be based on experience with the product and on good judgment. Experience can be gained and judgment be improved by checking samples with your supervisor at every opportunity. This is the responsibility of both inspectors and supervisors and if conscientiously borne will result in a high degree of uniformity of interpretation throughout the inspection service.

### 5. **Flavor.**

Apple butter is a formula product and, as such, the flavor can be adjusted considerably by the amount and kind of spices, adjustments of the sugar-acid ratio, the types of sweeteners, the cooking process and the apple stock itself. It follows that all good quality apple butters do not taste alike and that one

individual will prefer one apple butter while another equally competent person will prefer another. However, flavor is an important characteristic of apple butter and every effort should be made to accurately evaluate this factor in a manner to minimize personal preferences. The following may be helpful:

**a. Expected Variations in Flavor.**

Keep in mind certain expected variations in flavor, that is, do not use any particular brand or style as a guide to good flavor. For example a good medium spiced butter having a good apple flavor would not be a suitable guide for evaluating an **old fashioned** dark apple butter that may be highly flavored with spices, brown and caramelized sugars, and apple cider, or one containing only sugar or cider without spices.

**b. Factors Which Affect Flavor.**

Apple butter that has good bright color and pungent, pleasing odor will usually have a good acceptable flavor. Therefore, in line with the wording of the standards, if the apple butter has a flavor that indicates that good quality ingredients were used and that the process was proper a score of 17 to 20 points may be given. The proportions of the various ingredients must be considered because these affect the acceptability of the flavor; that is, if the apple butter is extremely acid or very bland and sweet it would probably not meet Grade A flavor. Lack of a clean, distinct, pleasing apple flavor or any abnormal bitterness would tend to lower the score.

**c. When To Evaluate Flavor.**

The flavor of fruit butters, particularly those that are highly spiced such as apple butter, must be evaluated quickly. The first impression is the best impression because the taste sensation is quickly satiated and successive tastes do not give the impression one would get from eating bread and butter with a thin spread of apple butter in the usual manner. The language of the standard indicates that the flavor of the apple butter may be in the Grade C range, 14 to 16 points, if it fails Grade A but is not seriously objectionable.

**6. Examination for Natural or Unavoidable Defects.**

Apple butter should be examined for foreign material. Mold, rodent hairs, and insects may originate from fresh apples, storage apples, dried apples, or from spices. Red Delicious apples may contain mold in the core cavity. Apples can be examined for moldy cores by periodically cutting several apples from the raw fruit preparation line and checking the cores.