Macroanalytical Procedures Manual (MPM)

MPM: V-8. Spices, Condiments, Flavors, and Crude Drugs

A. General Method for Spices, Herbs, and Botanicals

Version 2 - January 2025

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Contents

A. General Method for Spices, Herbs, and Botanicals (V-32)

(1) Scope

This method covers several procedures applicable to spices, herbs, botanicals, and medicinals, that consist of dried plant parts which have been processed and marketed in various sizes and forms. Included in this group are parts of plants such as dried rhizomes, corms, roots, bark, leaves, fruits, seeds, stems, buds, flowers, and flower parts. Examples of plant part(s) products include but are not limited to the following (note- A portion of the following plant list is derived from the American Spice Trade Association spice list (Spice List 2016)):

- Rhizomes

Calamus	*Acorus calamus* L.
Ginger	*Zingiber officinale* Roscoe
Turmeric	*Curcuma longa* L.

- Corms

Taro	*Colocasia esculenta* (L.) Schott
Water Chestnut	*Eleocharis dulcis* (Burman) Trinius ex Henschel

- Roots

Chicory	*Cichorium intybus* L.
Comfrey	*Symphytum officinale* L.
Fennel	*Foeniculum vulgare* Miller
Ginseng	*Panax* sp, L.
Licorice	*Glycyrrhiza glabra* L.

- Bark

Cassia	*Cinnamomum* spp. Schäffer
Cinnamon	*Cinnamomum* spp. Schäffer
Sassafras	*Sassafras albidum* (Nuttall) Ness
Soapbark	*Quillaja saponaria* Molina

- Leaves

Basil	*Ocimum basilicum* L.
Cilantro	*Coriandrum sativum* L.
Dill	*Anethum graveolens* L
Marjoram	*Origanum majorana* L.
Oregano	*Origanum vulgare* L
Rosemary	*Salvia rosmarinus* Spenner
Sage	*Salvia officinalis* L.
Sweet Bay	*Lauris nobilis* L.
Tarragon	*Artemisia dracunculus* L.
Thyme	*Thymus vulgaris* L.

- Fruits

Allspice	*Pimenta dioica*-(L.) Merrill
Anise	*Pimpinella anisum* L.
Black Cardamom	Amomum subulatum Roxburgh
Black Pepper	*Piper nigrum* L.
Capsicums	*Capsicum* sp. L.
Caraway	*Carum carvi* L.
Cardamom	*Elettaria cardamomum* (L.) Maton
Cassia Buds	*Cinnamomum* spp.Schäffer
Celery	*Apium graveolens* L
Coriander	*Coriandrum sativum* L.
Cumin	*Cuminum cyminum* L.
Dill	*Anethum graveolens* L.
Fennel	*Foeniculum vulgare* Miller
Paprika	*Capsicum annuum* L.
Star Anise	*Illicium verum* Hooker f.

- Cone

Juniper Berry	*Juniperus* sp. L.

- Seeds

Annatto	*Bixa orellana* L.
Chia	*Salvia hispanica* L.
Fenugreek	*Trigonella foenum-graecum* L.
Lotus Seed	*Nelumbo* sp. Adanson
Mustard	*Brassica* spp. L.
Nutmeg	*Myristica fragrans* Houttuijn
Poppy	*Papaver somniferum* L.
Sesame	*Sesamum indicum* L.

- Aril

Mace	*Myristica fragrans* Houttuijn

- Flowers and flower parts

Calendula	*Calendula* sp. L.
Clove	*Myristica fragrans* Houttuijn
German Chamomile	*Matricaria chamomilla* L.
Lavender	*Lavandula* sp. L.
Roman Chamomile	*Chamaemelum nobile* (L.) Allioni
Saffron	*Crocus sativus* L.

a. General Method -- Procedures applicable to macroscopic examination of most of these products fall into two categories:

(i) A procedure for separating, identifying, and recording amounts of contaminants such as arthropods, animal excrement, and extraneous matter which have been removed by pick-out or mechanical means from the product material itself.

(ii) A procedure for separating and classifying defective product materials (such as insect/arthropod-damaged or moldy material); these are recorded as percentages of reject material by weight or count of each type of reject.

b. Specific methods -- Procedures for certain types of products (e.g., black pepper, nutmegs, saffron, etc.) are specialized for dealing with specific problems. Special techniques related to these products are covered by supplemental methods.

(2) Applicable Documents

- 21 CFR Standards of Identity and Quality
- CPG Sec. 525.100 Whole & Ground Allspice - Adulteration by Mold; Insect & Rodent Filth
- CPG Sec. 525.250 Cloves - Adulteration with Stems
- CPG Sec. 525.300 Condimental Seeds Other than Fennel Seeds and Sesame Seeds - Adulteration by Mammalian Excreta
- CPG Sec. 525.325 Cumin Seed - Adulteration with Sand and Grit
- CPG Sec. 525.375 Whole Ginger - Adulteration with Insect Filth; Mold; Mammalian Excreta
- CPG Sec. 525.500 Leafy Spices, Other than Bay Leaves - Whole Oregano Leaves, Whole Marjoram, Whole Sage Leaves and Whole Thyme Leaves - Adulteration with Insect Filth; Mold; Mammalian Excreta

- CPG Sec. 525.550 Mace - Adulteration with Insect Filth; Mold; Foreign Matter; Mammalian Excreta
- CPG Sec. 525.700 Sesame Seeds - Adulteration with Insect Filth; Decomposition; Mammalian Excreta; Foreign Matter
- CPG Sec. 525.750 Spices - Definitions
- CPG Sec. 525.850 Whole Plant (Unprocessed) Oregano, Crushed Oregano & Ground Oregano - Adulteration by Insect & Rodent Filth; Mold; Mammalian Excreta
- CPG Sec. 525.900 Whole Plant (Unprocessed) Marjoram, Unground (Processed) Marjoram & Ground Marjoram - Adulteration by Insect & Rodent Filth; Mold; Mammalian Excreta
- CPG Sec. 525.925 Whole Plant (Unprocessed) Thyme, Unground (Processed) Thyme & Ground Thyme - Adulteration by Insect & Rodent Filth; Mold; Mammalian Excreta
- CPG Sec. 525.950 Whole Plant (Unprocessed) Sage, and Ground Sage - Adulteration by Insect and Rodent Filth; Mold; Mammalian Excreta
- I0M Chapter 5-Establishment Inspection, and Chapter 4-Sample Collection
- Service and Regulatory Announcements, Food and Drug, No. 2, Nov. 1936, pp. 11-14 -- "Advisory Standards for Spices"

(3) Defects

Defects in these products may be categorized as due to insect infestation, contamination by animals, mold development, or contamination by extraneous material.

a. Arthropod Infestation and Damage -- Numerous arthropods are attracted to spices and botanicals in the growing stage of production and into harvest. In post-harvest, storage and transportation product can become contaminated from storage pest arthropods. Typical field arthropod pests include Lepidoptera, Coleoptera, Hymenoptera, Hemiptera, Thysanoptera and Acari. When there are large numbers of these pests, they may attract predators such as lacewings, lady bird beetles, Syrphid flies, spiders and parasitoids such as parasitic wasps. Ants may also be attracted by the honey dew excreted by aphids and by the other insects that may be present as many ants are voracious predators and scavengers. When the plant is harvested, these may also be collected along with others that may be present. A wide variety of stored-product arthropods, principally Acari, Lepidoptera and Coleoptera, also attack these products. When insects feed upon these plants, they leave behind evidence of this activity including gnaw marks, tunneling, bore holes, webbing, frass, cast skins, body parts, and even their bodies. When predators, parasitoids, and others are present, they may also leave behind cast skins, body parts, and even their bodies. Although numerous arthropod species are associated with these products, serious damage to

products is usually due to a few species, and it may be helpful, in some cases, to define such damage as part of a specific method.

b. Animal Contamination -- Contamination of these products by animals usually results from either gnawing or defilement by excreta. Whole rodent pellets, bird droppings, and other pieces of animal dung are typically found.

Rodent (rat or mouse) excreta - Rodent excreta pellets are normally black or dark colored, cylindrical, blunt at one end and pointed at the other. They roughly range in length from 1.5 to 25 mm. They usually contain rat or mouse hairs, partially digested plant material, and sometimes insect parts. When wetted with water, rodent pellets form a characteristic gray mucous coating. Report as such only if rat or mouse hairs are present. Confirm identification by removing a hair from the pellet, mounting it on a glass microscope slide using an appropriate mounting media, and identifying it microscopically at 100 – 400x magnification using a compound microscope. It may be necessary to mount more than 1 hair as they may be damaged while passing through the rodent's digestive tract. When none are present, proceed with AOAC Official Methods 981.22, Mammalian Feces Alkaline Phosphatase Test. If the product has been heat treated, such as in a sterilization process, proceed with AOAC Official Methods 988.17, Mammalian Feces Thin-Layer Chromatographic Method for Coprostanol.

Animal Dung - Animal dung consists of an amorphous, usually dark-colored material pressed into a matrix. Incorporated plant material usually consists of ligneous, fibrous material which is either pale-yellow or green. Parts of insects and small amounts of inorganic, earthy material may also be present. Report as animal dung or excreta, only when matricized plant material predominates. Confirm as excreta, using AOAC Official Method 981.22, Mammalian Feces Alkaline Phosphatase Test. If the product has been heat treated, such as in a sterilization process, proceed with AOAC Official Method 988.17, Mammalian Feces Thin-Layer Chromatographic Method for Coprostanol.

Bird Excreta – The color of bird excreta may vary but almost always contains chalky white material. It may appear as a splatter to a rounded or coiled dropping. There is no mucous coating, and the matrix is a mixture of a chalky white discharge containing chiefly urine mixed with darker food residue. Feather fragments are routinely encountered. Undigested insect fragments may be seen as well. Confirm using AOAC Official Method, 962.20, Food and Containers Microchemical Test for Uric Acid.

c. Moldiness Deterioration -- Pathological effects of fungi, molds and yeast on plant tissues vary widely, ranging from slight physiological disturbances to those which cause a substantial degree of cellular changes, including hypertrophy, hyperplasia, hypoplasia, cell separation and necrosis. Products may be attacked by fungi in the field or while in storage. Field fungi capable of attacking and infecting the growing product may cause varying degrees of decomposition and damage. The damage from invading fungi and yeast may be manifested as leaf spot diseases, dry rot, decomposed and discolored tissue of stems and roots, or decay in seeds and fruits. Fungi which produce necrosis of plant tissue usually affect the tissue before the mycelium or mold hyphae are evident. Secretions of some of these fungi kill the cells before the mycelium contacts them, while

other fungi may invade the intercellular spaces before their products kill the cells. Many symptoms of mold attack that are clearly apparent in fresh food are masked when the food is processed by canning, freezing, or drying. Storage fungi (which can grow under limited moisture conditions) may cause moldiness in some products stored under conditions of temperature and relative humidity favorable to their growth. Pockets of moist product can arise in a dried and otherwise normal product through roof leaks, insect activity, and moisture translocation when temperature gradients develop within the product mass. These pockets can promote the rapid growth of molds in the stored product. Moldiness can range in appearance from mycelium-matted leafy spices and surface mold on cassia bark, to internal molds in nutmegs and capsicum pods. Improperly dried material can also develop the growth of yeast which is another form of fungal deterioration. The yeast can form at times a whitish encrusted type of material on various products.

d. Contamination by Extraneous Material -- Objectionable matter such as sticks, stones, burlap bagging, or cigarette butts may enter the product at various points during its production, transit, and storage because of improper preparation or handling. Also, valueless parts of the raw plant material and other foreign plant material may contaminate the product and require special attention for removal. This general category is intended to include all other miscellaneous objectionable matter not reported in the other specific categories. Several leafy spices have issues with pithy plant material or stems. These include, but are not limited to, sage, laurel leaves, rosemary, savory, basil, oregano, and thyme. Foreign seeds present a particular problem in some seeds and leaves. These foreign seeds may be invasive weed species, and some may be toxic. Many of these are quarantined and are not allowed to enter the United States. They should also be counted as extraneous matter if found. Whole cloves can become contaminated with stem material from the plant (CPG 525.250). It is important not to confuse the clove calyx with clove stems. The calyx is long and terminates with four spreading sepals with the round clove bud in the center (Figure V-8-A-1).

Note: although adulteration/substitution is not covered by this manual, it is an issue with spices, herbs, botanicals and Medicinals. This problem can be found in reference books dating back to the 1800s. This adulteration includes, but is not limited to, species substitution, a valuable constituent has been wholly or partially removed, or a valueless component has been added or substituted. The detection of this adulteration includes simple physical testing, microchemical spot tests, microscopy, and the use of advanced instrumentation.

Table V-8-A-1

Method Selection Aid

Product	Amount to Examine: Procedure (4)	Amount to Examine: Procedure (5)	No. of Subsamples	Section for Analysis
High Density Products: Seeds, roots, rhizomes, bark, buds, Fruits-allspice, cardamon, black cardamon, cassia buds	Entire contents of subsample	300 g - 500 g	6	A. (4) & A. (5)
High Density Products: Fruits-pink peppercorns corktree, *Euonymus phellomanus* Loesener; Peruvian pepper tree, *Schinus molle* L., and Brazilian pepper tree, *S. terebinthifolius* Raddi. Other peppercorns *Piper* sp., excluding *P. nigrum* (L.) (see below)	Entire contents of subsample	300 g – 500 g	6	A. (4) & A. (5)
Low Density Products: Leaves, flowers, flower parts,	Entire contents of subsample	200 g – 300 g	6	A. (4) & A. (5)
Peppercorns (black, white, green, or red) *Piper nigrum* (L.)	Composite 4 kg for Siftings/Pickings	Weigh 200 or more berries for insect/mold damage	6	B. Supplemental Method for Black, White, Green and Red Peppercorns, *Piper nigrum* (L.) (V-39)
Whole Nutmeg *Myristica fragrans* Houttuyn	Entire contents of subsample containing 500 g or more of product	100 count	6	C. Supplemental Method for Nutmegs, *Myristica fragrans* Houttuyn
Saffron, *Crocus sativus* L.	3 g - 4 g	3 g – 4 g	2	D. Supplemental Method for Saffron, *Crocus sativus* L.
Small Chili Peppers, *Capsicum* sp. L. (chiltepin, chile de arbol, pequin, serrano, tepin and similar small chilies)	Entire contents of subsample	100 g	6	E. Supplemental Method for Whole Chili Peppers, *Capsicum* sp. L. Pods
Large Chili Peppers, *Capsicum* sp. L. (ancho, cascabel, chipotle, guajillo, habanero, jalapeno, paprika, pasilla, poblano and similar large chilies)	Entire contents of subsample	250 g	6	E. Supplemental Method for Whole Chili Peppers, *Capsicum* sp. L. Pods
Bay Leaf *Laurus nobilis* L.	225 g	50 g	6	F. Supplemental Method for Bay Leaves *Laurus nobilis* L. and Related Leaves
Whole Cinnamon/Cassia Bark, *Cinnamomum* sp. Schäffer	Entire contents of subsample	100 g	6	G. Supplemental Method for Cinnamon/Cassia Bark, *Cinnamomum* sp. Schäffer

(4) Procedure: Determination of Contamination in Spices, Herbs, Botanicals and Medicinals Caused by Arthropods, Animal Excreta, and Extraneous Material

a. Sample Preparation –The representative sample consist of six (6), 454 g subsamples or consumer size packages taken from the lot, unless otherwise stated in (Table V-8-A-1). Examine entire contents of each container.

b. Visual Examination-- Examine the product (high density and low-density materials) in small amounts with good light and against ~~a~~ white paper or other suitable contrasting background. Due to the variability of the product, use an appropriate technique for the examination of the product. These techniques can include and are not limited to:

- Examine a small portion of the product at a time, by placing a portion in a pile on white paper. Using a spatula or similar tool, move a small amount of product in a thin layer across the paper.
- Use a moving belt or other mechanical device if all the material can be seen easily.
- Sifting may facilitate separation and concentration of certain types of objectionable matter. If sifting is performed, size of screens used, and method of use should be stated in the report of results.
- If the subsamples are large and bulky (Figure V-8-A-2), then mix subsample in such a way to incorporate any sediment in the bottom of the container back into the sample. After mixing product remove half of the contents based on weight and record this weight. Alternatively, the large bulky sample, especially if it is in a plastic bag, the bag could be cut in half lengthwise. Then weigh the half that is to be examined and retain the other half. (Table V-8-A-1).

Examine material visible to the naked eye up to 10x. After the initial examination, higher magnification may be used to confirm findings as necessary. If the magnification exceeds 10x in the initial analysis, then it should be stated in the report of the results. Examine for rodent/bird excreta, manure, arthropods, and arthropod debris, mold clumps, miscellaneous objectionable matter, and other evidence of contamination. Note: if sample was received in plastic bags, filth elements may adhere to the bagging through static electricity. Examine the bagging for any adhering filth elements.

c. Classification of Contaminants -- Separate contaminants into suitable groupings relative to defect action levels, regulatory guidelines, or other applicable requirements. Add categories to tabulation of results depending on type(s) of contaminants found. See (Figures V-8-A-3-8(A-C)) for examples of defects. Classify as follows:

(i) *Arthropods and their fragments* -- Count the number of whole arthropods and equivalent visible to the naked eye (corrected as necessary for abnormal vision) with such magnification as may be necessary. If the magnification exceeds 10X, this should be stated in the report of results. After the initial examination, higher magnification can be used to identify arthropods, using appropriate arthropod identification keys. Classify arthropods as "Field" or "Storage", making a special notation when they are found alive. Note the size of any unidentified arthropods and larvae found.

(ii) *Rodent (Rat or Mouse) Excreta* -- Rodent excreta pellets are normally black or dark colored, roughly cylindrical, blunt at one end and pointed at the other. They range in length from 1.5 to 15 mm. They usually contain rat or mouse hairs, partially digested plant material, and sometimes insect parts. When wetted with water, rodent pellets form a characteristic gray mucous coating. Weigh suspect pellets and report as such *only* if rat or mouse hairs are present. Confirm identification by removing a hair from the pellet and identifying it microscopically. When none are present, proceed with AOAC Official Method 981.22 Mammalian Feces-Alkaline Phosphatase Test or AOAC Official Method 988.17 Mammalian Feces-Thin-Layer Chromatographic Method for Coprostanol. Record the size and weight of the excreta pellets before wetting with water.

(iii) *Animal Dung* -- Animal dung consists of an amorphous, usually dark colored material pressed into a matrix. Incorporated plant material usually consists of ligneous, fibrous material which is either pale-yellow or green. Parts of insects and small amounts of inorganic, earthy material may also be present. Weigh suspect material and report as animal dung or excreta, *only* when matricized plant material predominates. Confirm as excreta, using AOAC Official Method 981.22 Mammalian Feces-Alkaline Phosphatase Test or AOAC Official Method 988.17 Mammalian Feces-Thin-Layer Chromatographic Method for Coprostanol.

(iv) *Bird Excreta* -- Bird excreta will appear as rounded droppings, sometimes coiled with a white residue. Measure and weigh droppings and test a portion of the white, amorphous particles for uric acid AOAC Official Method 962.20 Excrement (Bird) on Food and Containers-Microchemical Test for Uric Acid or AOAC Official Method 986.29 Excrement (Bird and Insect) on Food and Containers-Thin-Layer Chromatographic Method for Uric.

(v) *Extraneous Material* – Any foreign material in a product associated with objectionable conditions and practices in production, storage, or distribution. In addition to substances (i) to (iv) above, this includes but not limited to sand, glass, rust, plastic, sticks, paint chips etc.

d. Report -- Tabulate results as follows, adding additional categories as necessary (Table V-8-A-2). To determine excreta mg/lb use the following formula: Weigh excreta pellets (mg) x 454 g / Weight of product (g) x 1 lb = Excreta mg/lb

Table V-8-A-2

	Subsample No. 1	Subsample No. 2	Subsample No. 3	etc.
Amount Examined (g)				
Whole and W/E Other Arthropods (count) [a]				
Whole Mites (count) [a]				
Arthropod Fragments (count) [a]				
Rat/Mouse Excreta Pellets (mg)				
Mammalian Excreta Pellets (mg)				
Bird Excreta Pellets (mg)				
Total Excreta (mg/kg) [b]				
Extraneous Material (g)[c]				
Other [d]				
Remarks:				

Notes:

a. Identify and if whole state alive/dead.
b. Excludes insect excreta pellets.
c. Describe ((3)d)
d. Substitute appropriate heading(s)

(5) Procedure: Determination of Arthropod Damaged, Moldy, and Otherwise Reject Product Material in Spices, Herbs, and Botanicals

a. Sample Preparation -- Examine 300 g-500 g subsamples of high-density products (e.g. allspice/pimento, anise seed, caraway seed, cardamon seed, other condimental seeds, cloves, ginger, turmeric) or 200 g-300 g subsamples of light, bulky products (e.g. mace, marjoram leaves, oregano leaves, thyme leaves and other leafy spices). Weigh out representative analytical units from sieved material remaining after completing procedure in Section 8.A(4)a. Alternatively, draw analytical unit directly from sample. State how analytical unit is taken. Due to the variability of spice, herb, and botanical samples the 200 g-300 g and 300 g-500 g may be an excessive amount to analyze for some products. If these amounts are excessive for a particular product, then a lower amount may be analyzed. Explain on worksheet the reason for the change of weight analyzed. AOAC Official Methods are available for light filth in spices, leafy products, and excreta in condimental seeds.

b. Visual Examination -- Examine each analytical unit for reject material visible to the naked eye up to 10x assisted magnification. If the magnification exceeds 10x for the initial examination, this should be stated in the report of the results. Higher magnification

may be used for confirmation of findings after the initial examination.
Classify, weigh, or count each category according to (5)c. below.

c. Classification of Reject Product Material -- Report findings by weight and % in (Table V-8-A-2). Classify reject product material (leaf, seed, fruit, root, bark, etc.) as follows:

(i) *Arthropod-Damaged* -- Any product material exhibiting definite evidence of arthropod feeding or containing one or more whole arthropods or equivalent, webbing, or excreta. Determine, if possible, whether infestation is "Field" or "Storage," making special notation for live arthropods. Determine average length and note range of lengths for any larvae and/or unidentified arthropods present. Additionally, arthropod excreta pellets can be confirmed by AOAC Official Method 986.29 Excrement (Bird and Insect) on Food and Containers-Thin-Layer Chromatographic Method for Uric Acid or AOAC Official Method 969.46 Excrement (Insect) in Flour-Spectrophotometric Method for Uric Acid.

(ii) *Moldy* -- Any product material bearing mold on more than 1/4 of its surface area or any material where the aggregate moldy area is greater than 1 cm^2. Confirm presence of mold with magnification as necessary, but determine the area affected without magnification. Describe general appearance of the moldy areas. Mold and yeast can be confirmed on a microscope slide with the use of lactophenol cotton blue. Alternatively, one could also do the following to confirm mold. Prepare a slide of tissues from the affected portion of the food material and examine microscopically using a compound microscope. The tissue should be sufficiently thin so that the elements of the host tissue and any invading fungal hyphae can be clearly seen under the microscope. Dry foods such as spices usually require softening of the tissues by rehydration. Prepare a suitable mount of these materials for microscopic examination by thin sectioning with a razor blade or other expedient cutting device. Other tissues may be teased apart to prepare a suitable mount. Specimens should be mounted in a suitable clearing agent such as Hertwig's solution (see Chapter III, Reagents for Macroanalytical Methods). Select tissues for examination from different parts of the affected area. Knowledge of the various species responsible for decomposition in a product and their growth characteristics in the host food will also aid in detecting their presence. Knowledge of the normal cell structure of the host tissues will aid in interpreting the microscopic observations. To facilitate interpretation, the analyst may find it useful to prepare slides of normal tissues of the food material for comparison. It is important not to confuse plant trichomes (hairs) with mold (Figure V-8-A-8). The difference between plant trichomes and mold hyphae can be recognized microscopically. Plant trichomes can have parallel side walls but they narrow typically to a sharp point, compared to mold which will narrow to a rounded point. Mold can also be recognized by the presence of septation, branching patterns of the hyphae and presence of fruiting bodies. Plant trichomes will remain clear in lactophenol cotton blue, while mold hyphae will pick up the blue coloration (Figure V-8-A-9).

(iii) *Animal-Contaminated* -- Any product material showing animal excreta, animal chewing, or gnawing. AOAC Official Method 945.88 Urine Stains on Foods and Containers has a flow chart on testing urine stains on product and containers.

(iv) *Otherwise Reject Material* -- Any product material that is not classified as above, but is otherwise decomposed, discolored, abnormal in appearance or otherwise unfit for food. This also includes product with adhering hair and or feather material but is not limited to these adhering materials. Describe rejects in remarks and document with photos**.**

d. Report - Tabulate results as follows (Table V-8-A-3):

Table V-8-A-3

	Subsample No. 1	**Subsample No. 2**	**Subsample No. 3**	**etc.**
Amount Examined (weight (g) or count)				
Arthropod Damaged (weight (g) or count) [a]				
Moldy (weight (g) or count) [b]				
Animal Contamination [c]				
Otherwise Rejected Material (weight (g) or count) [d]				
Total weight (g) or count of rejects				
% by weight (g) or count of rejects				
Remarks:				

Notes:

a. Describe ((5)c.(i)); report under Remarks
b. Describe ((5)c.(ii)); report under Remarks
c. Describe ((5)c.(iii)); report under Remarks
d. Describe ((5)c.(iv)); report under Remarks

Figures

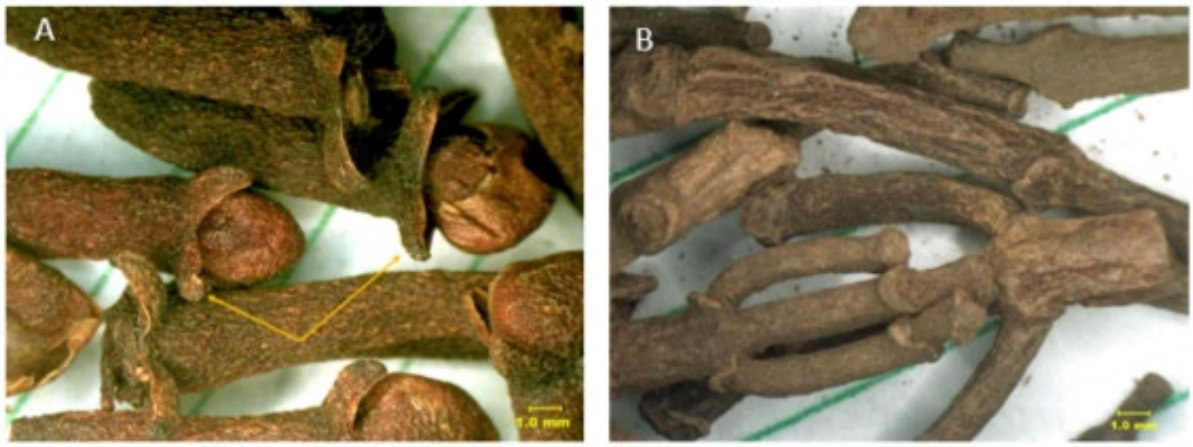

Figure V-8-A-1. Clove, *Syzygium aromaticum* (L.) Merrill & Perry **A.** Calyx with bud. Arrows pointing to sepals. (scale bar: 1.0mm). **B**. Branch material from a clove plant. (scale bar: 1.0mm). (Source: Photos courtesy of H. Loechelt-Yoshioka, FDA)

Figure V-8-A-2. Example of a large bulky botanical. (Source: Photo courtesy of H. Loechelt-Yoshioka, FDA).

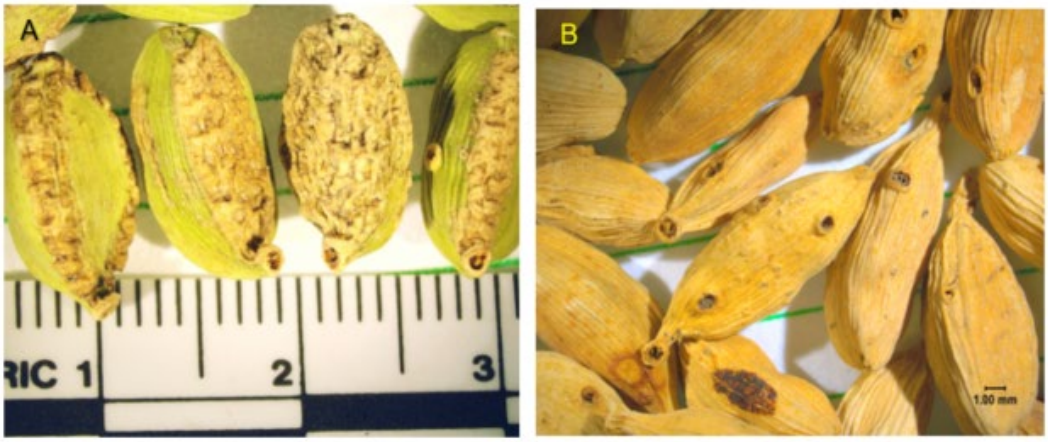

Figure V-8-A-3. Cardamom *Elettaria cardamomum* (L.) Matonâ **A.** Feeding damage from cardamom thrips, *Sciothrips cardamomi* Ramk. **B.** Unidentified insect feeding damage. (scale bar: 1.00mm). (Source: Photos courtesy of H. Loechelt-Yoshioka)

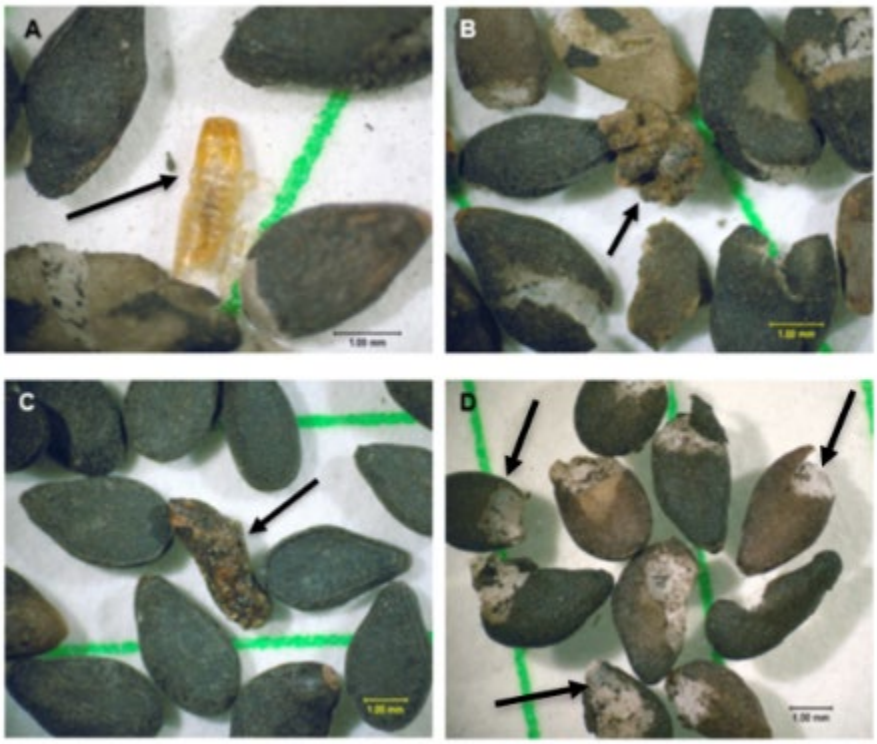

Figure V-8-A-4. Black sesame seeds, *Sesamum* sp. L. **A.** Insect feeding damage and larva of *Tribolium* sp. Macleay, indicated by arrow. (scale bar: 1.00mm). **B.** Insect feeding damage and Lepidoptera larval excreta pellets indicated by arrow. (scale bar: 1.00mm). **C.** Mouse, Mus sp. L., excreta pellet indicated by arrow. (scale bar: 1.00mm). **D.** Mouse feeding damage indicated by arrows. (scale bar: 1.00mm). (Source: Photos courtesy of H. Loechelt-Yoshioka, FDA).

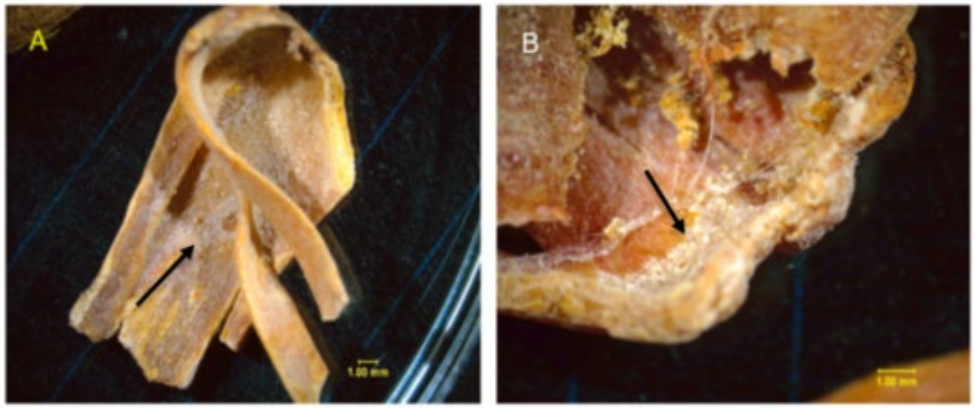

Figure V-8-A-5. Mace, Myristica fragrans, Houttuyn. **A.** A white mold growing on mace. Indicated by the arrow. (scale bar: 1.00mm). **B.** Arrow pointing to Lepidoptera larval excreta pellets and webbing found on some mace. (scale bar: 1.00 mm). (Source: Photos courtesy of H. Loechelt-Yoshioka, FDA).

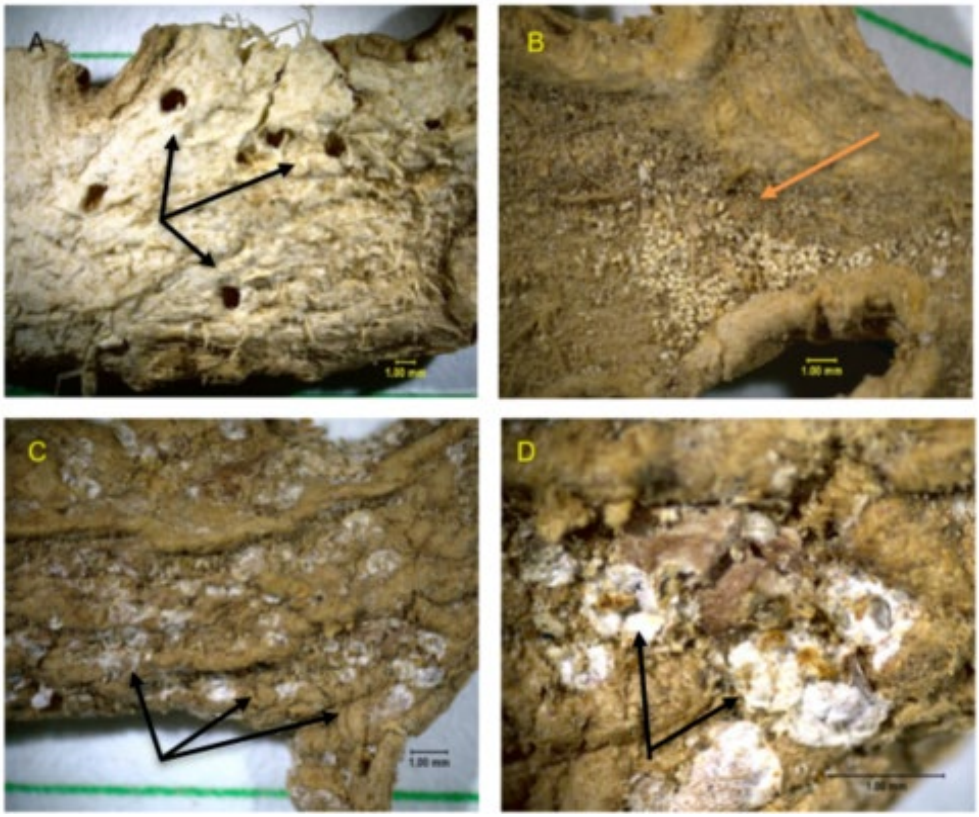

Figure V-8-A-6. Ginger Rhizome, *Zingiber officinale* Roscoe **A.** Insect feeding damage indicated by arrows. (scale bar: 1.00mm). **B.** Arrow pointing to insect excreta pellets. (scale bar: 1.00mm). **C. & D.** Scale insects, *Aspidiella hartii* (Cockerell) found on the rhizome. Indicated by arrows. (scale bar: 1.00mm). (Source: Photos courtesy of H. Loechelt-Yoshioka, FDA).

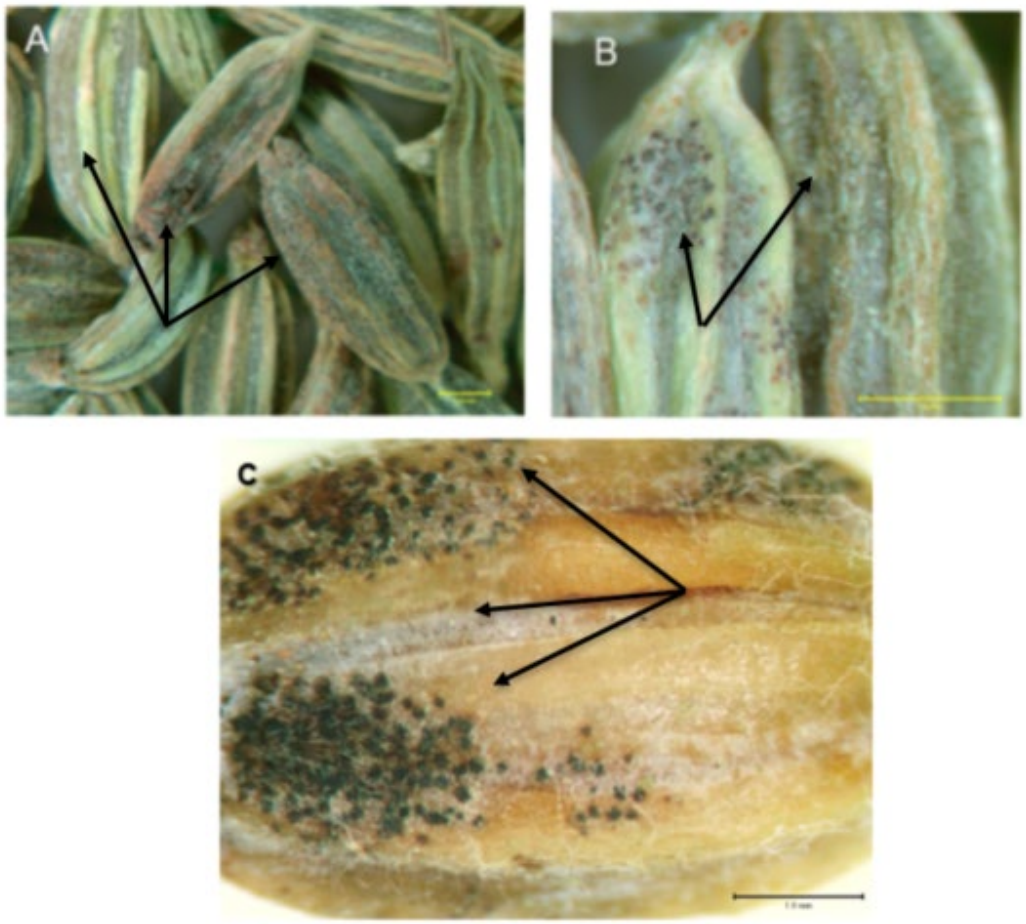

Figure V-8-A-7. Fennel, *Foeniculum* sp. Miller **A.** Fruit with mold damage, indicated by arrows. (scale bar: 1.00mm). **B.** Arrows pointing to mold damage. (scale bar: 1.00mm). **C.** Arrows pointing to close-up view of mold damage. (scale bar: 1.00mm). (Source: Photos courtesy of H. Loechelt-Yoshioka, FDA).

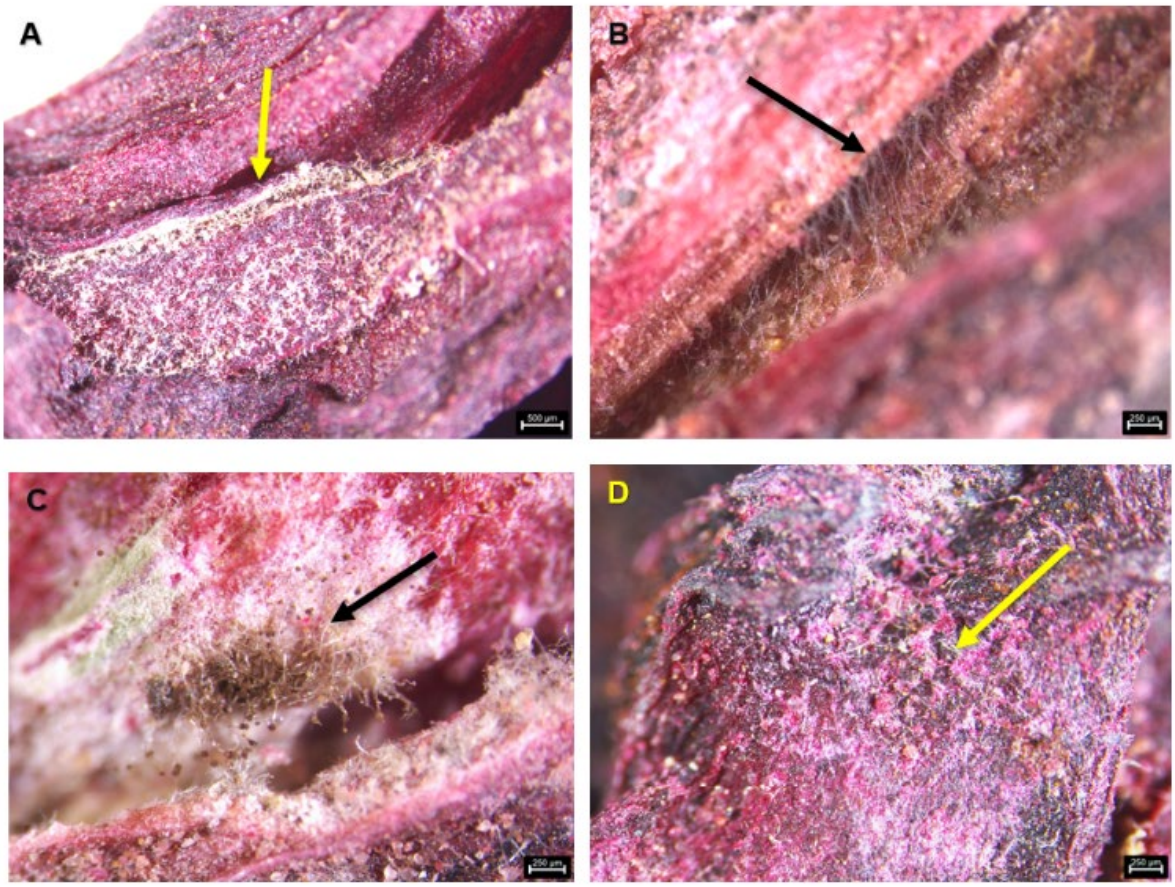

Figure V-8-A-8. **A.** Hibiscus, *Hibiscus* sp. L. trichomes indicated by arrow. (scale bar: 500 microns). **B.** Mold hyphae on hibiscus indicated by arrow. (scale bar: 250 microns). **C.** Mold hyphae with fruiting bodies on hibiscus indicated by arrow. (scale bar: 250 microns). **D.** Mix of plant trichomes and mold hyphae indicated by arrow on hibiscus. (scale bar: 250 microns). (Source: Photos courtesy of H. Loechelt-Yoshioka, FDA).

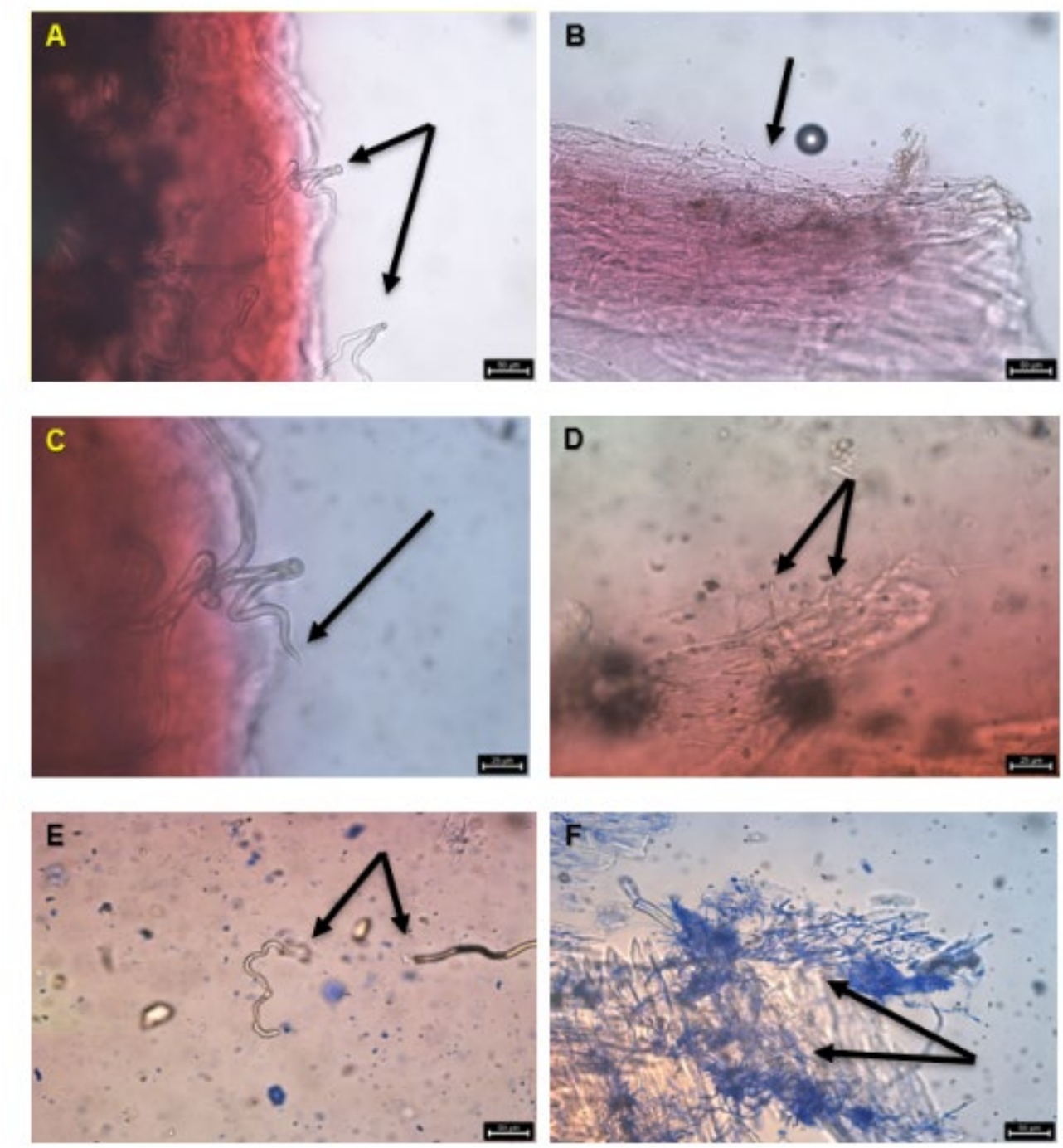

Figure V-8-A-9. Hibiscus trichome indicated by arrows. (scale bar: 50 microns). **B.** Mold showing branching and septation indicated by arrow. (scale bar: 50 microns). **C.** Hibiscus trichome with a pointed tip indicated by arrow. (scale bar: 25 microns). **D.** Mold with rounded tips indicated by arrows. (scale bar: 25 microns). **E.** Hibiscus trichome in lactophenol cotton blue indicated by arrows. (scale bar: 50 microns). **F.** Mold in lactophenol cotton blue indicated by arrows. (scale bar: 50 microns). (Source: Photos courtesy of H. Loechelt-Yoshioka, FDA).

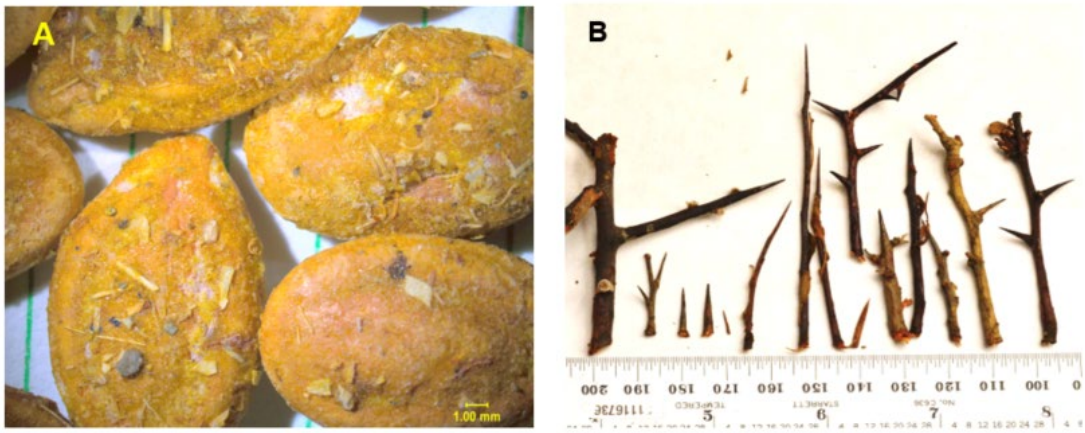

Figure V-8-A-10. A. Extraneous material adhering to processed watermelon seeds, *Citrullus lanatus*, (Thunberg) Matsumura & Nakaj. (scale bar: 1.00mm). **B.** Hard and Sharp thorns found in dried leaves of *Crataegus* sp. L.. (Source: Photos courtesy of H. Loechelt-Yoshioka, FDA).

References Cited in Section

American Spice Trade Association (2016), *Spice List.* https://www.astaspice.org/wordpress/wp-content/uploads/dlm_uploads/2016/02/SpiceList2016.pdf

Official Method 962.20 Excrement (Bird) on Food and Containers Microchemical Test for Uric Acid. *Official Methods of Analysis of AOAC INTERNATIONAL,* Chapter 16.

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Official Method 988.17 Mammalian Feces: Thin-Layer Chromatographic Method for Coprostanol. *Official Methods of Analysis of AOAC INTERNATIONAL,* Chapter 16.

Additional Information

Informational articles not cited in the above section, but still useful:

American Spice Trade Association (2014). *ASTA Cleanliness Specifications for Spices, Seeds, and Herbs (Foreign and Domestically Produced).* ASTA,

Parry, J. W. (1962) *Spices - Their Morphology, Histology, and Chemistry*, Chemical Publishing Co., Inc., New York, NY, 226pp.

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Revision History

Version No.	Purpose of change	Date
V0	New process	1984
V1	Electronic Version	1998
V2	Increased list of spices, added more applicable documents, images, method aid table. Updated general format and references	2025