

# **SPICE ADULTERATION**

## **A Safety & Regulatory Issue**

Presented by: Martin Mitchell

Date: October 15, 2014

ASTA 2014 Regulatory &  
Legislative workshop

Arlington, Virginia



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- HISTORY
- TRADITIONAL DEFINITIONS
- MICROBIAL ADULTERATION
- “FILTH” ADULTERATION
- ECONOMIC ADULTERATION
- FSMA AND ADULTERATION



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# Adulteration in History

- Greeks and Romans acted to prevent wine makers from coloring and flavoring wine
- Athens had “public wine inspector”
- England proscribed “scanting weight” of bakery goods
- Coffee, tea and cocoa placed under control of parliament

# Adulteration in History

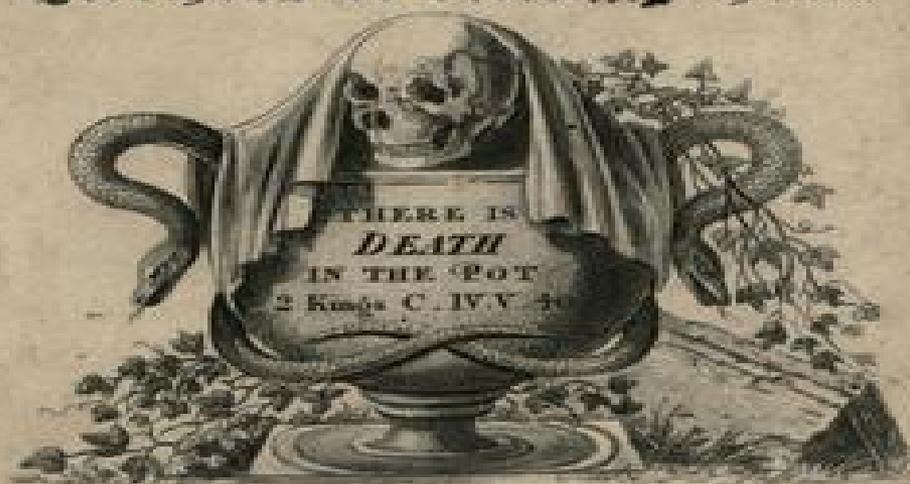
- Edward the Confessor provided public punishment for brewers of “bad ale”
- Pliny the Elder mentioned adulteration of bread
- Addition of chalk to flour during WWII
- Addition of sand to brown sugar and rice to make heavier
- Addition of colors to disguise poor quality

# Adulteration in History

- By middle 1800's chemical and microbiological knowledge increases so food products could be analyzed
- Food adulteration then could be studied from standpoint of consumer safety
- Dr. Harvey Wiley's poison squad

1870

A TREATISE  
ON  
**ADULTERATIONS OF FOOD,**  
AND  
**Culinary Poisons,**  
EXHIBITING  
*THE FRAUDULENT SOPHISTICATIONS*  
OF  
BREAD, BEER, WINE, SPIRITUOUS LIQUORS, TEA, COFFEE,  
Cream, Confectionery, Vinegar, Mustard, Pepper, Cheese, Olive Oil, Pickles,  
AND OTHER ARTICLES EMPLOYED IN DOMESTIC ECONOMY.  
AND  
**Methods of detecting them.**



*THE SECOND EDITION.*

BY **FREDRICK ACCUM,**

*Operative Chemist, Lecturer on Practical Chemistry, Mineralogy, and on Chemistry applied to the Arts and Manufactures; Member of the Royal Irish Academy; Fellow of the Linnean Society; Member of the Royal Academy of Sciences, and of the Royal Society of Arts of Berlin, &c. &c.*

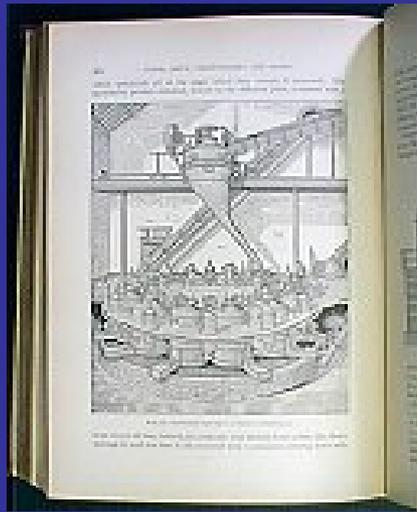
London :

SOLD BY LONGMAN, HURST, REES, ORME, AND BROWN,  
PATERNOSTER ROW.

1820.

# Accum was obviously an industry insider.

Spurious black pepper (*Piper nigrum*, Piperaceae) was manufactured with a mixture of **spent** linseed (*Linum usitatissimum*, Linaceae) cakes, powdered clay, and a little cayenne (*Capsicum annuum*, Solanaceae), pressed through a sieve then rolled inside a cask to produce granules of appropriate size. Once he exposed the adulteration, he offered methods for detection:



**Harvey W. Wiley**  
**Foods and Their Adulteration**  
**1907**

Origin, Manufacture, and composition of food products;  
description of common adulterations, food standards, and national  
food laws and regulations.

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# Food Adulteration

- A food is adulterated if one or more of the following conditions exist:
  - It bears or contains any poisonous or deleterious substance which may render it injurious to health (i.e. salmonella)
  - It is a raw agricultural commodity and it bears or contains a pesticide chemical which is unsafe
  - It is, or it bears or contains, any food additive which is unsafe (i.e. sudan)
  - It consists in whole or in part of a diseased, contaminated, filthy, putrid or decomposed substance, or it is otherwise unfit for food (i.e. filth elements)
  - It has been produced, prepared, packed or held under insanitary conditions whereby it may have become contaminated with filth, or whereby it may have been rendered diseased, unwholesome or injurious to health (see filth)

# Food Adulteration

continued....

- A food is adulterated if one or more of the following conditions exist:
  - Any required constituent has been omitted or abstracted in whole or in part (i.e. spent meal)
  - Any substance has been substituted in whole or in part for a substance normally found in the food
  - Damage or inferiority has been concealed in any manner
  - Any substance has been added to the food or mixed or packed with the food so as to increase its bulk or weight or reduce its quality or strength or make it appear better or of greater value than it is.
  - It is or bears or contains any color additive which is unsafe

# Adulteration Criteria

- **Magic words:**
  - *Poisonous and deleterious*
  - *Added substances*
  - *May render injurious to health*
  - *Ordinarily injurious*

## Concerns about Fraud, Adulteration and Counterfeiting Usually focus on the Quality Aspects

A food product that is adulterated, counterfeit or fraudulent may not have been subjected to the rigorous quality control and hygiene procedures; there will be a greater potential risk from toxins, allergens and food poisoning microorganisms; and the manufacturer or supplier may well be unqualified and therefore unaware (or simply not care) about the hazards to consumers. Examples of these dangers are the Spanish rapeseed oil incident, Melamine in milk, potential for triggering fatal allergies, and wine containing ethylene glycol.

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# IMPORT ALERT #99-19

DETENTION WITHOUT  
PHYSICAL EXAMINATION OF  
FOOD PRODUCTS DUE TO THE  
PRESENCE OF SALMONELLA",  
ATTACHMENT REVISED -  
10/07/2014

**Table 4.5. Observed prevalence of *Salmonella*-contaminated imported**

Exporting Country	# Positive	N	Salmonella Shipment Prevalence (%)	95% Confidence Interval <sup>a</sup>
Canada	1	110	0.9	0-5
China	9	245	4	2-7
India	92	1057	8.7	7.1-11
Indonesia	2	82	2	0-9
Mexico	19	136	14	8.6-21
Pakistan	6	205	3	1-6
Thailand	6	111	5	2-10
Vietnam	7	149	5	2-9
All other countries <sup>b</sup>	45	749	6.0	4.4-8.0

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# ASTA HISTORY

## From Preface of Cleanliness Guidelines

- In September 1968, ASTA called a meeting to consider a proposal of the New York Regional Office of the Food and Drug Administration (FDA).
- The object of the meeting was “to reach a self-regulation understanding with spice importers so as to shift most of the work of spice sampling and analysis from the District over to industry members themselves.”
- The agreement sought by the FDA would give the industry the “privilege” of importing spices under conditional release without formal FDA inspection.
- In exchange for this “privilege,” importers would guarantee that spice shipments which they found, by sampling and macroscopic analysis by an ASTA Approved Laboratory, to be adulterated, would be properly cleaned or reconditioned before being put into consumer channels or would be returned to the exporting country.
- In 1969 ASTA adopted its first Cleanliness Specifications for Unprocessed Spices, Seeds, and Herbs.

# ASTA HISTORY

## From Preface of Cleanliness Guidelines

continued...

- In 1988 ASTA's Board of Directors charged the Standards Committee to revise ASTA's Cleanliness Specifications so that they would be at least as stringent as FDA's Defect Action Levels (DALs).
- In 1989, our trade unanimously voted in favor of changes, which created a unified set of macroscopic standards. In addition, macroscopic analytical procedures were updated accordingly.
- In 1992, the trade unanimously voted in favor of the first non-macroscopic specification, providing for all oregano imported under ASTA contracts to be "Sumac negative."
- In 1994, the name of ASTA's Cleanliness Specifications was changed to delete the term "unprocessed." This was done to reflect the fact that in addition to, compliance with ASTA Cleanliness Specifications at would also signify compliance with FDA's DALs.

# **ASTA HISTORY**

## **From Preface of Cleanliness Guidelines**

continued...

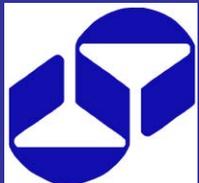
In applying these Specifications to the everyday conduct of business, it is important to recognize that they are an integral part of the American Spice Trade Association's contracts.

All products listed in these Specifications, both foreign and domestic, must comply before they can be introduced into commerce or further processed.

# FDA Filth Charge

- Spice adulterated within meaning of 21 U.S.C. 342(a)(3), in that it consists wholly or in part of a filthy substance by reason of presence therein of insects, and/or insect webbing, and/or insect excreta, and/or insect damaged spice, and/or mammalian excreta rodent hairs and in that it consists in part of a decomposed substance by reason of presence therein of moldy, decomposed spice.

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## FDA defined “economically motivated adulteration” as the:

“fraudulent, intentional substitution or addition of a substance in a product for the purpose of increasing the apparent value of the product or reducing the cost of its production, i.e., for economic gain. EMA includes dilution of products with increased quantities of an already-present substance (e.g., increasing inactive ingredients of a drug with a resulting reduction in strength of the finished product, or watering down of juice) to the extent that such dilution poses a known or possible health risk to consumers, as well as the addition or substitution of substances in order to mask dilution.”

# The United States Pharmacopeial Convention (USP)

Food fraud in the context of food ingredients refers to the fraudulent addition of non-authentic substances or removal or replacement of authentic substances without the purchaser's knowledge for economic gain of the seller. It is also referred to as economic adulteration, economically motivated adulteration, intentional adulteration, or food counterfeiting.

# **The Grocery Manufacturers Association (GMA)**

“Economic adulteration is defined as the intentional fraudulent modification of a finished product or ingredient for economic gain through the following methods: unapproved enhancements, dilution with a lesser-value ingredient, concealment of damage or contamination, mislabeling of a product or ingredient, substitution of a lesser-value ingredient or failing to disclose required product information”

## Potential Adulterants

<b>Product</b>	<b>Adulterant</b>	<b>Suggested Method to be Used to Detect</b>
Ground Spice	Spent Spices (defatted)	New ASTA Methods 26.1, 27.0
Capsicums	Tomato Skin	Lycopene
Capsicums	Dextrose or other Mono or Di-saccharides	HPLC carbohydrate profile
Ground Spice	Starch	ASTA Starch Method, Microscopic
Ground Spice	Grains	Microscopic
Ground Spice	Hulls	Microscopic
Ground Spice	Added Oleoresins	
Oregano	Foreign Leaves (i.e. Sumac, Cistus)	ASTA Method 26.0
Oregano	Non-Compliant Herbs (i.e. Savory, Thyme, Marjoram)	Microscopic
Saffron	Floral Waste	Microscopic
Saffron	Added Artificial Color	TLC
Ground Black & White Pepper	Buckwheat Millet Seed	Microscopic
Cinnamon	Coffee Husks	Microscopic
Nutmeg	Coffee Husks	Microscopic

**If spice is found to be adulterated, take aggressive action. All of the suspect product should be destroyed to prevent it from being blended down or used in smaller portions in the hopes of avoiding detection. Failure to destroy the product and remove it from the supply chain will only result in further contamination. Purchasers of raw ground spices should consider sampling and testing when it appears warranted.**

# ASTA Analytical Methods

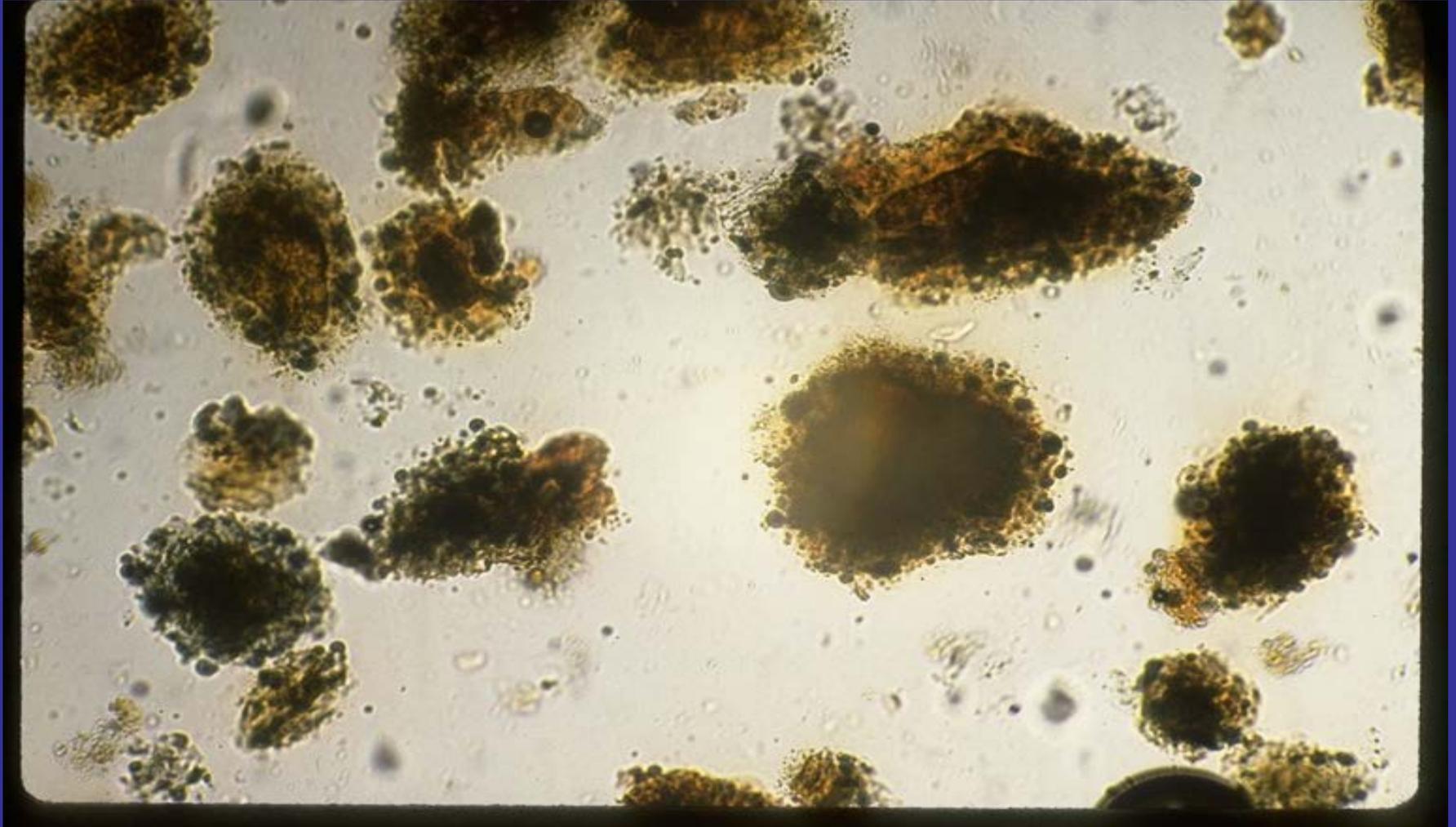
## Method 26.1

### Screening Method for the Determination of Defatted Paprika Meal in Paprika

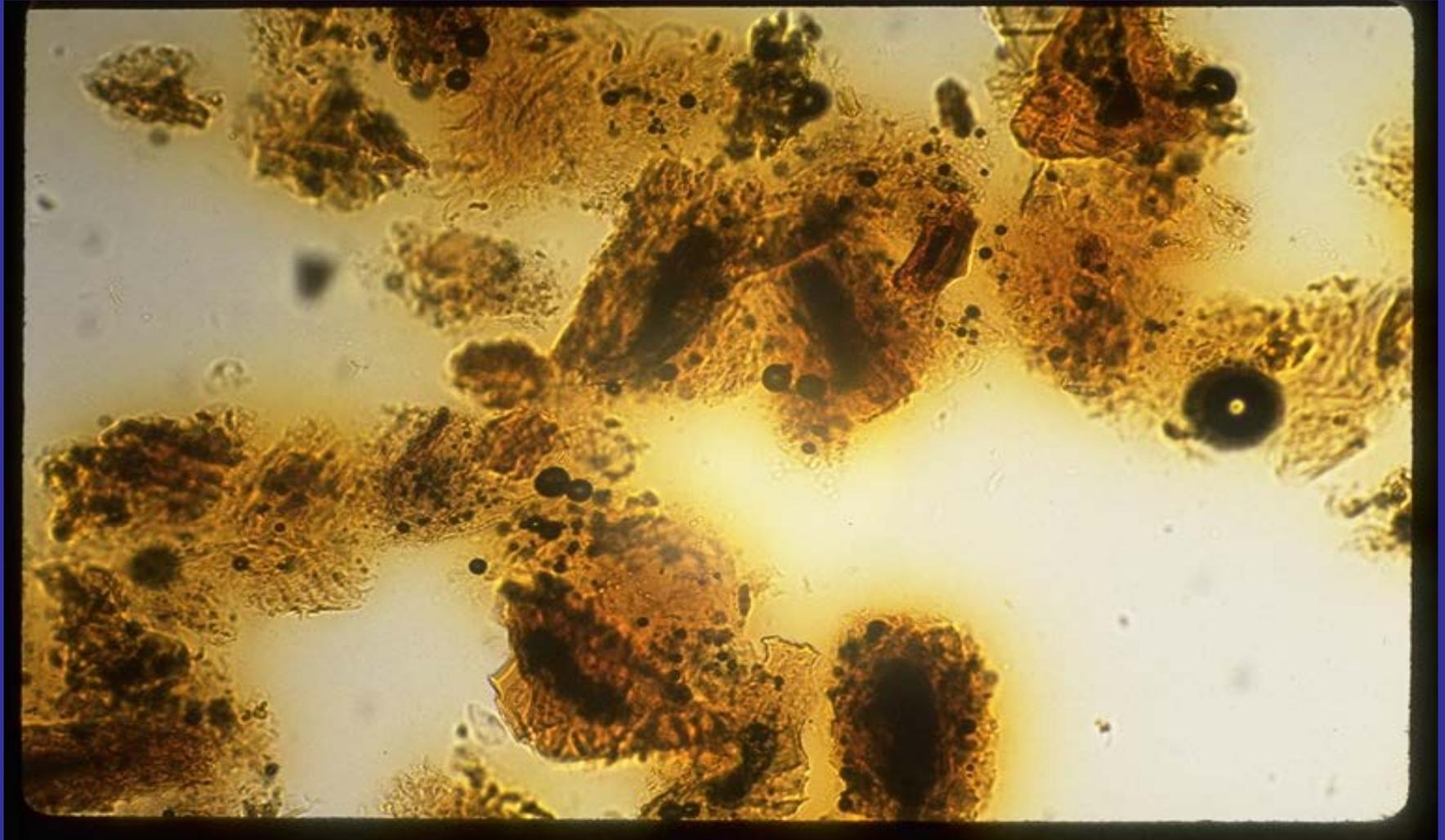
#### Purpose:

To screen for the presence of defatted paprika meal in ground paprika. Because the addition of spent paprika meal will be in high concentrations (usually more than 20%), this rapid screening method will differentiate between pure paprika and paprika that has been blended with extracted paprika meal.

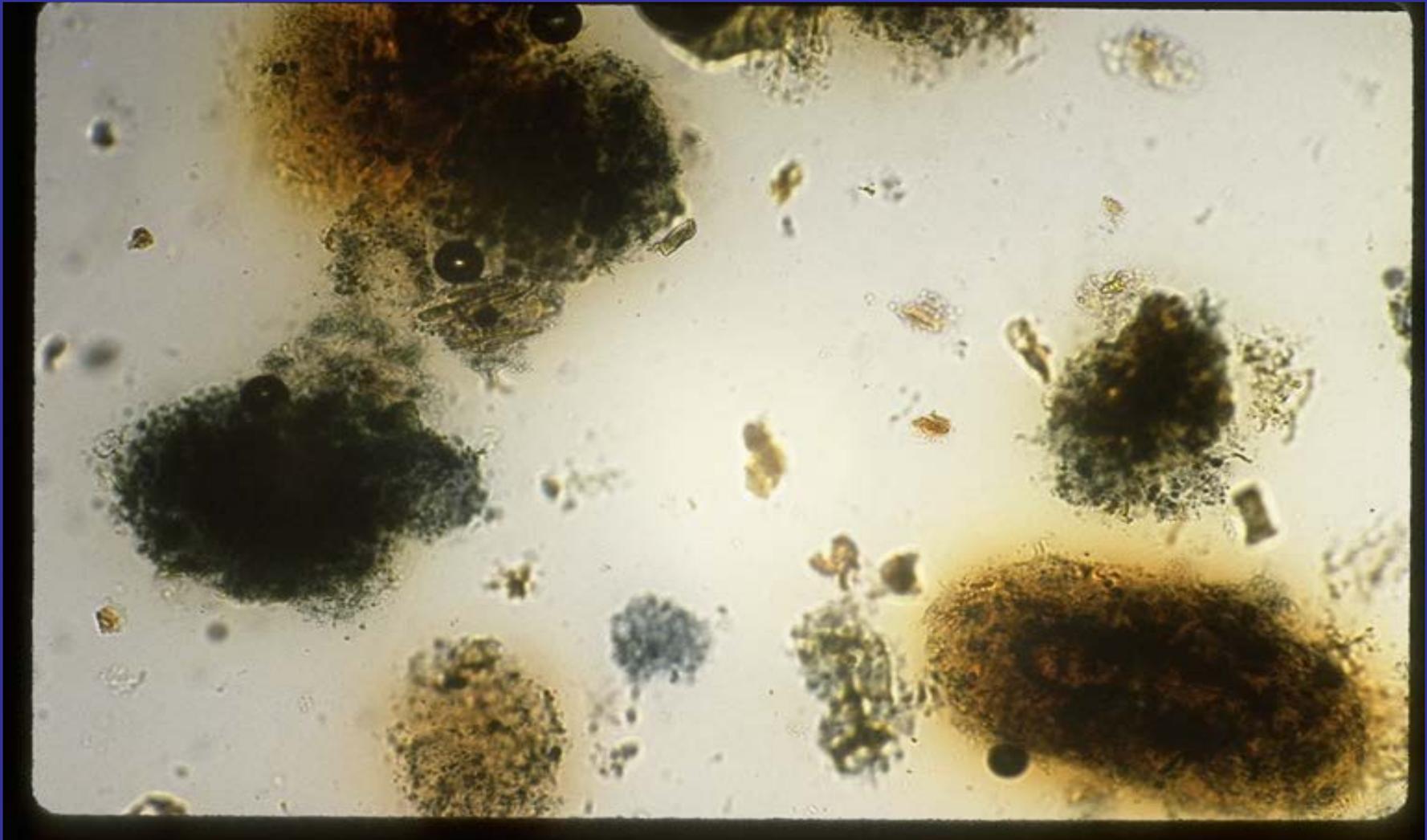
# Pure Paprika with Reagent



# Defatted Paprika with Reagent



# Mixed Sample with Reagent



# **ASTA Analytical Methods**

## **Method 27.0**

### **Total Hexane Content in Extracted Meals (Headspace Gas Chromatography)**

#### **Purpose:**

**To determine the total amount of hexane present in extracted meals.**

# **Adulteration of Paprika in Hungary**

## **December 1994**

- The Hungarian Government is desperately trying to restore consumer confidence in one of the country's most famous products - ground paprika - after large quantities of the popular spice were found to be contaminated with lead oxide.

# Update on Chili Warning

- On January 15, the UK Food Standards Agency updated an earlier warning that foods may contain the chemical dye **Sudan I**.
- According to the agency, Sudan I is not allowed to be used in food in the UK and it could cause cancer.
- It is understood that three chili suppliers in India had been adulterating their chili powder with the red dye Sudan I, which is not permitted for use in food.

# SUDAN

(3/10/2004)

- Food manufacturers continue to face the costly process of food recalls as the UK's Food Standards Agency brings more food products contaminated by the illegal carcinogenic food dye Sudan to light.
- Requires that imports of chilli and chilli products - including curry powder – can only cross the EU border with proof they are free of the illegal chemical dyes - Sudan I, Sudan II, Sudan III or Scarlet Red (Sudan IV).

# ASTA ANALYTICAL METHOD

## 28.0

Determination of oil soluble dyes in capsicum and turmeric samples and products by high performance liquid chromatography

*Purpose: To determine the presence of Para Red, Sudan I, Sudan II, Sudan III, Sudan IV, Sudan Orange G, Sudan Red B, Dimethyl Yellow, and cis-Bixin dyes in capsicum and turmeric samples.*

# ASTA ANALYTICAL METHOD

## 29.0

### Determination of dyes in capsicum and turmeric samples and products by high performance liquid chromatography with MS/MS detection

*Purpose: To determine the presence of various dyes in samples of paprika, capsicum, turmeric and oleoresin paprika.*

*Principle: This method uses HPLC separation with tandem mass spectrometer (MS/MS) detection. MS/MS detection is employed using electrospray ionization (ESI) in positive and negative-ion modes. Dyes are detected using dye-specific MRM (multiple reaction monitoring) transitions.*

*Safety concerns: dyes are known hazardous chemicals and appropriate care in handling such standards should be exercised. Consult the MSDS documentation for best handling practices. HPLC waste should also be properly disposed off according to local laws and regulations.*

**Manual:**  
**Microscopic Identification  
Of  
Spices**



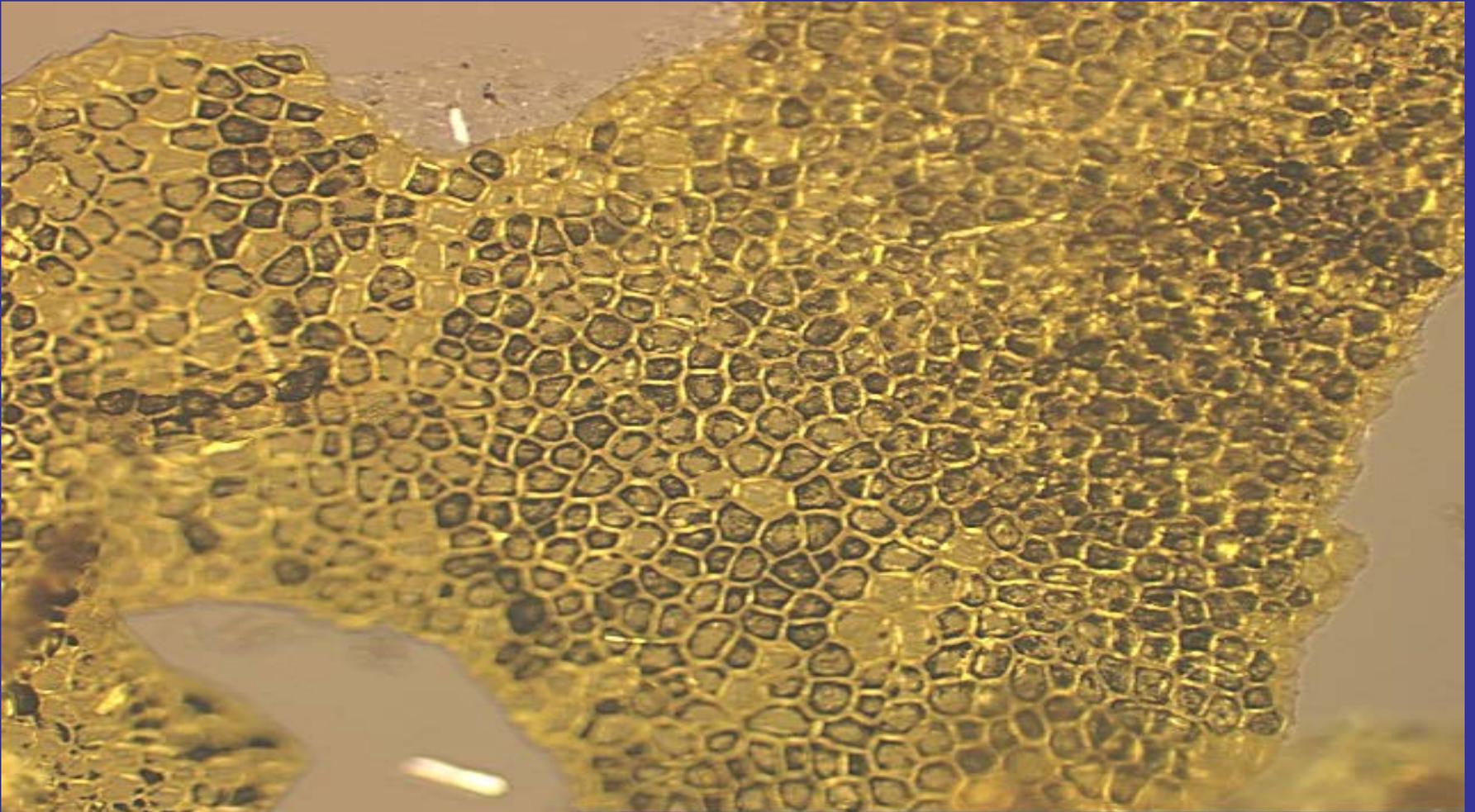
**American Spice Trade Association, Inc.  
2025 M Street, NW  
Washington, DC 20036**

2003

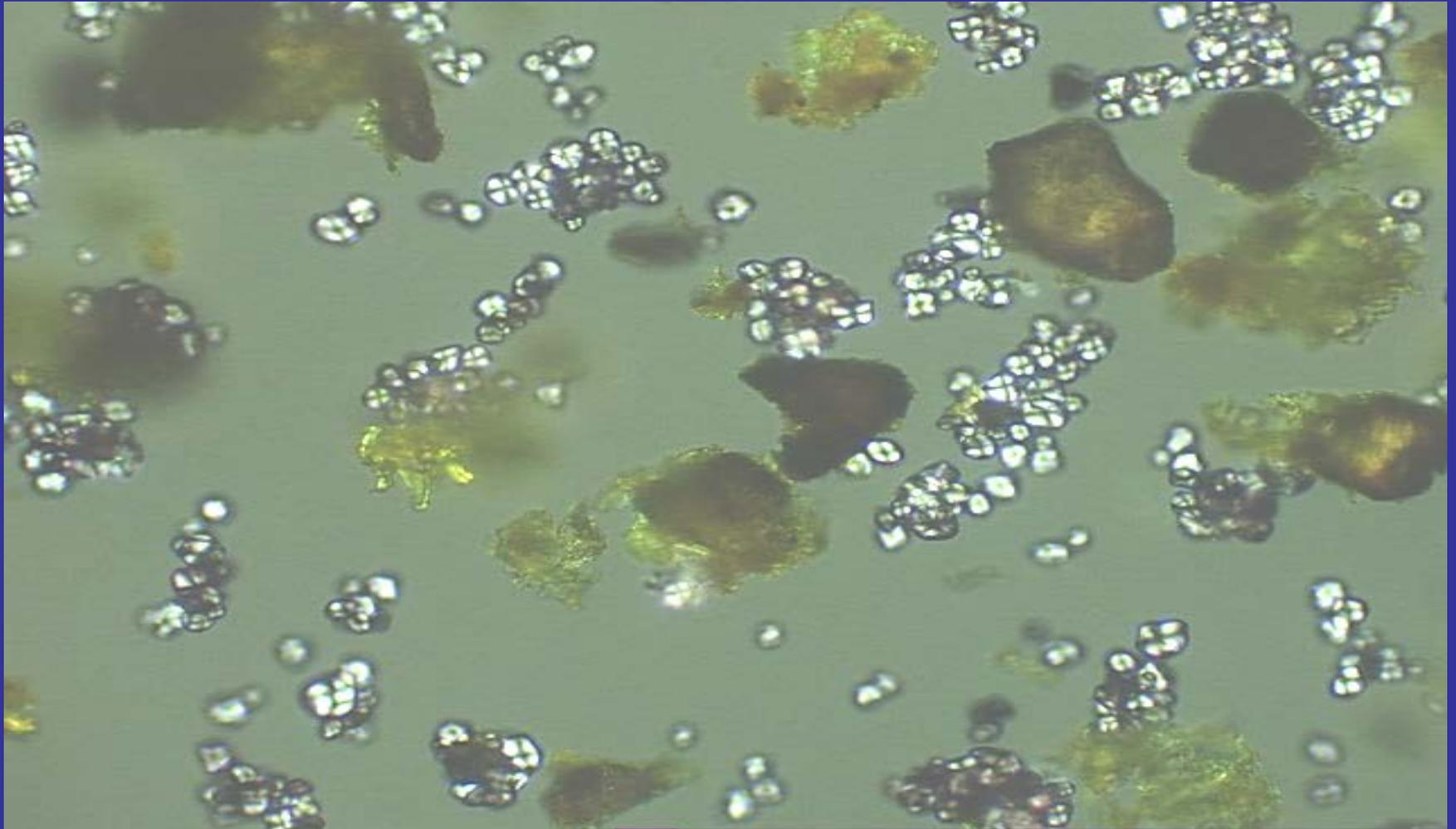
# ACKNOWLEDGEMENT

Work done on the manual for Microscopic Identification of Spices is courtesy of McCormick & Company, Inc. and Warren G. Ocus, Microscopist.

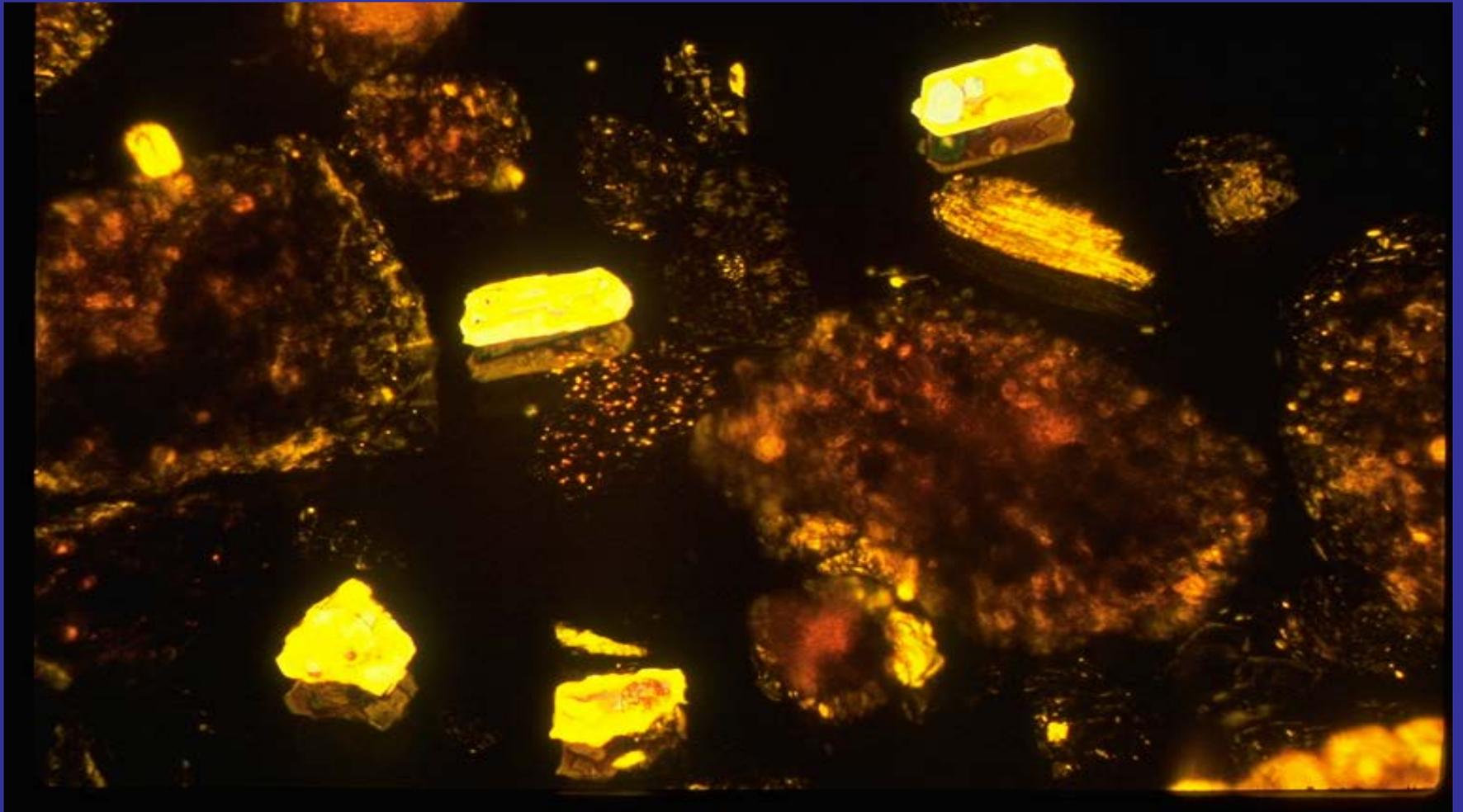
# Tomato Pomace (Capsicum Adulterant)



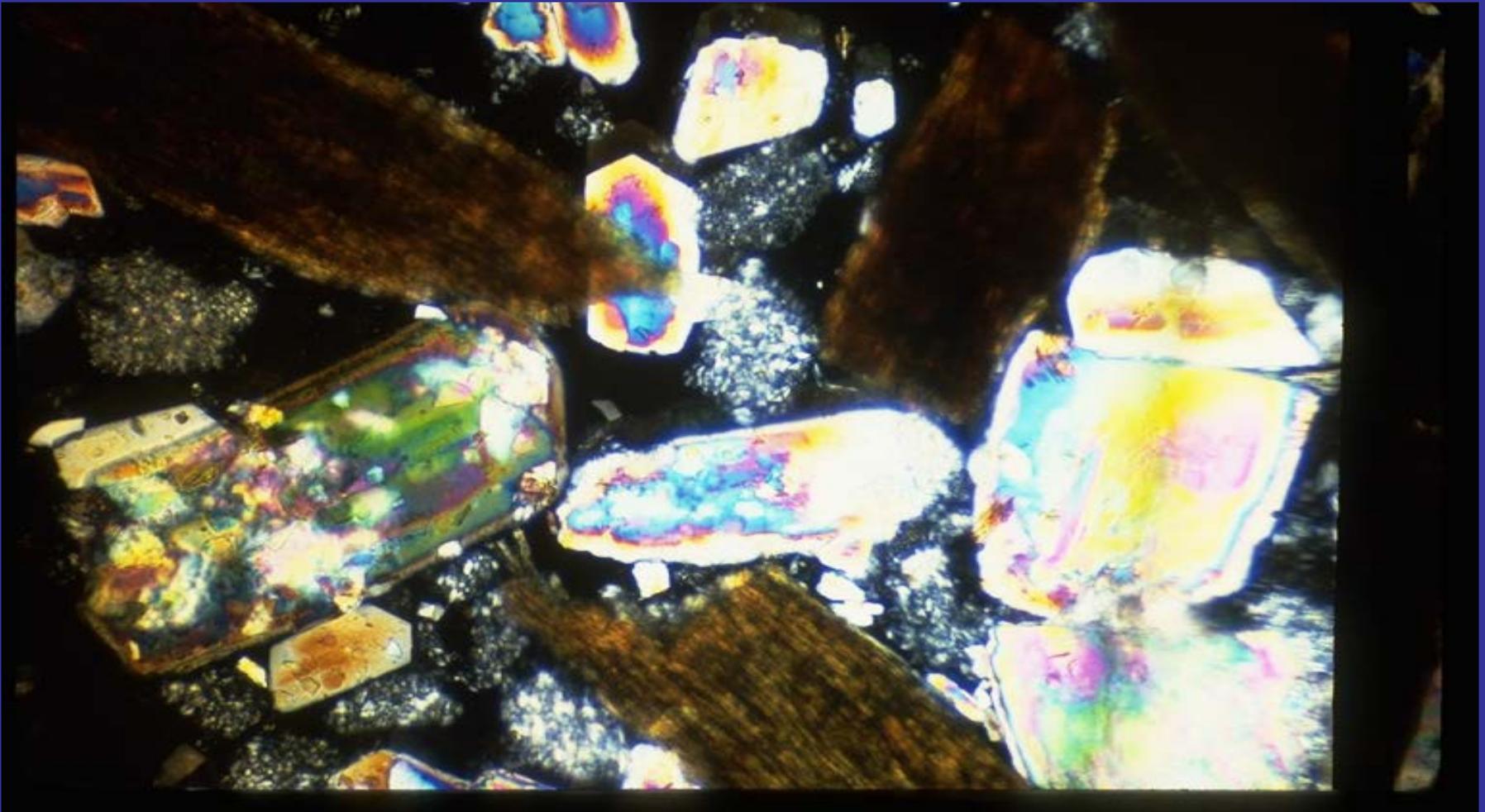
# Turmeric, Ground, Adulterated *Curcuma longa* L.



# CHILI PEPPER WITH DEXTROSE



# BLACK PEPPER WITH HULLS, STARCH AND DEXTROSE



# Five Common Adulterants of Mediterranean Oregano

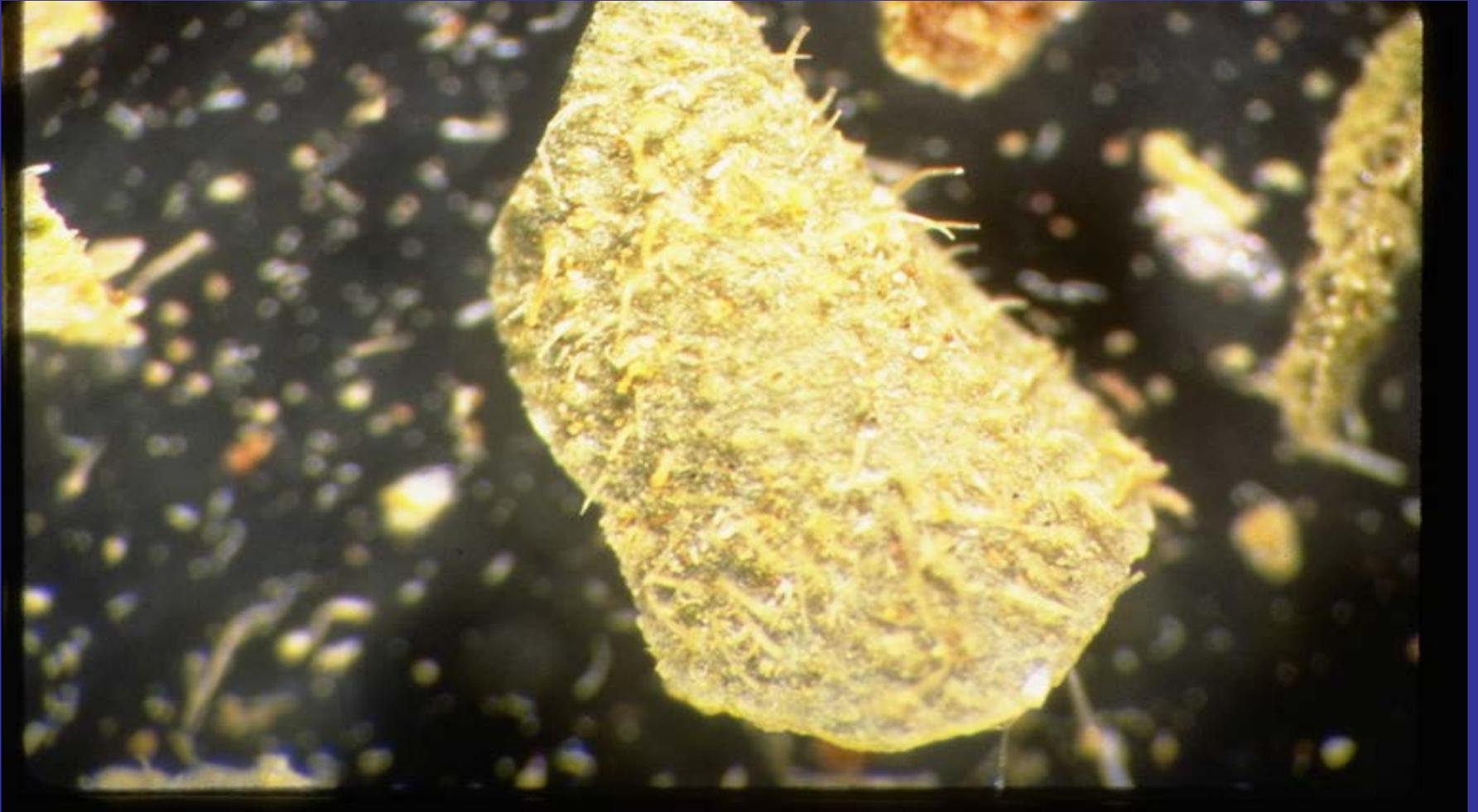
- **Sumac Leaf,**
- **Pink Rock Rose,**
- **Marjoram,**
- **Savory, and**
- **Thyme**

# Sumac Leaf

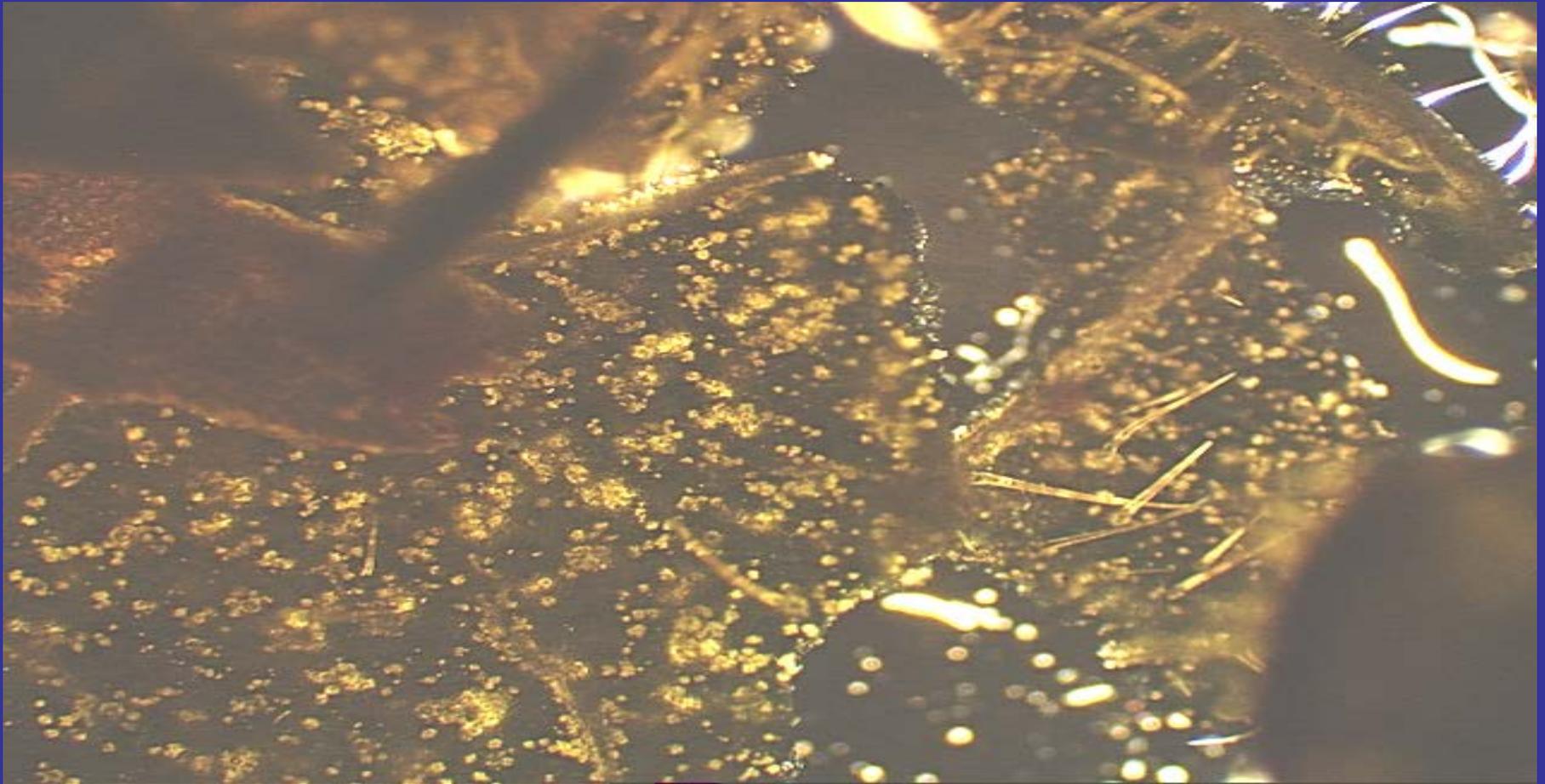
*Rhus* spp.



# SUMAC



# Sumac Leaf



40x; polarized; xylene-mount

# Pink Rock Rose

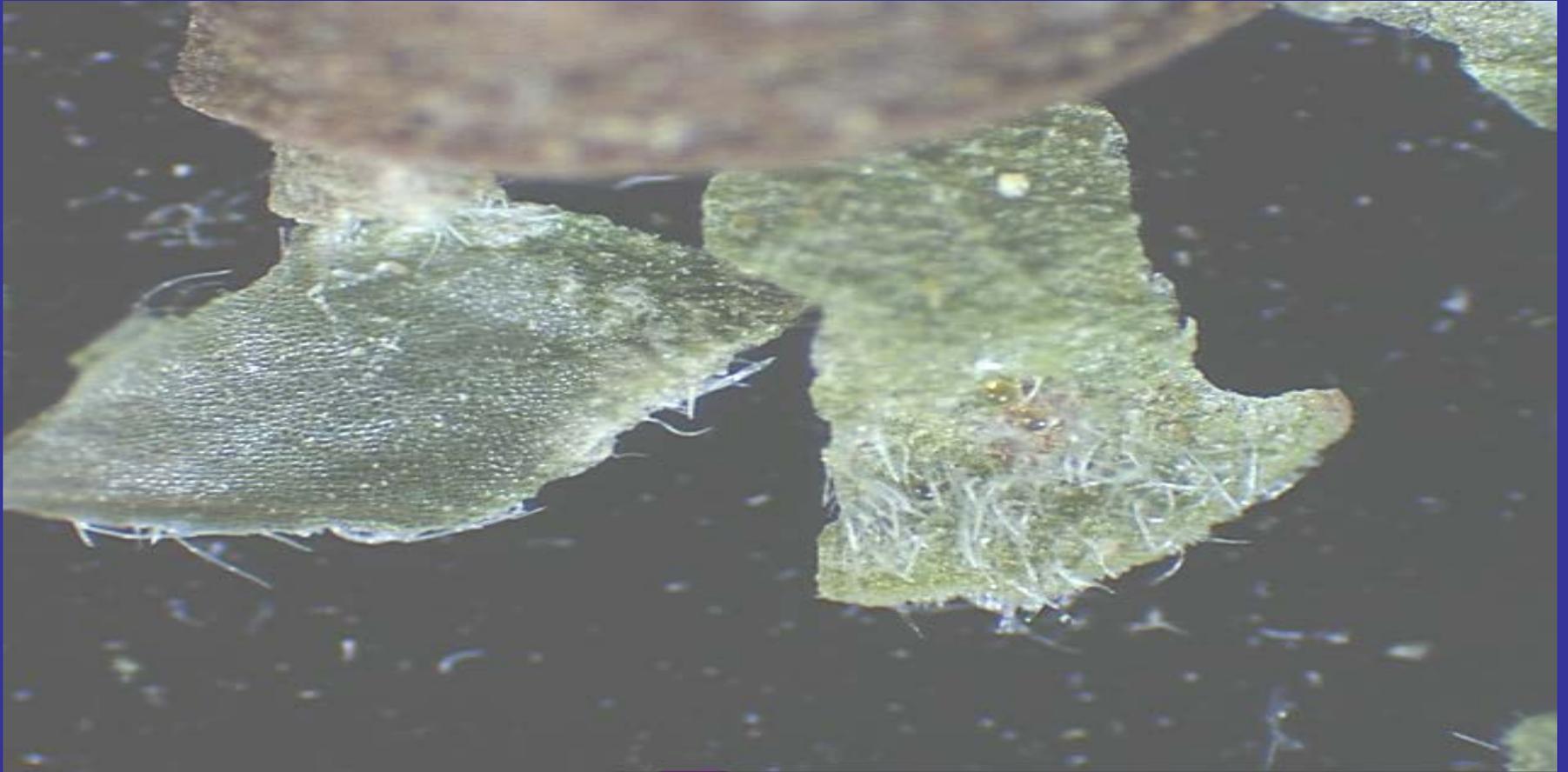
## *Cistus* spp



200x; top-lighted;  
polarized

# Whole Marjoram Leaves

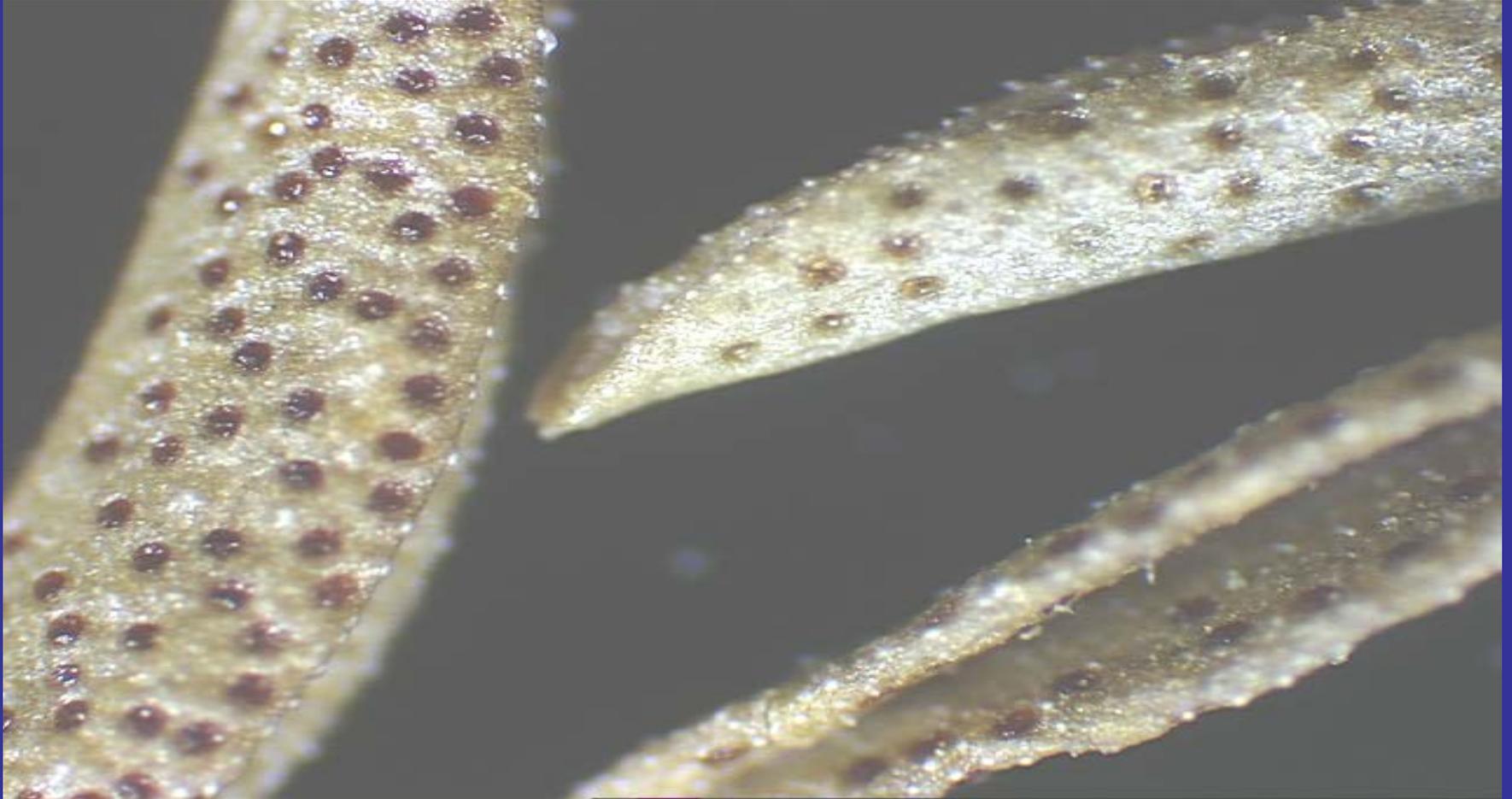
*Majorana hortensis* M



40x; polarize

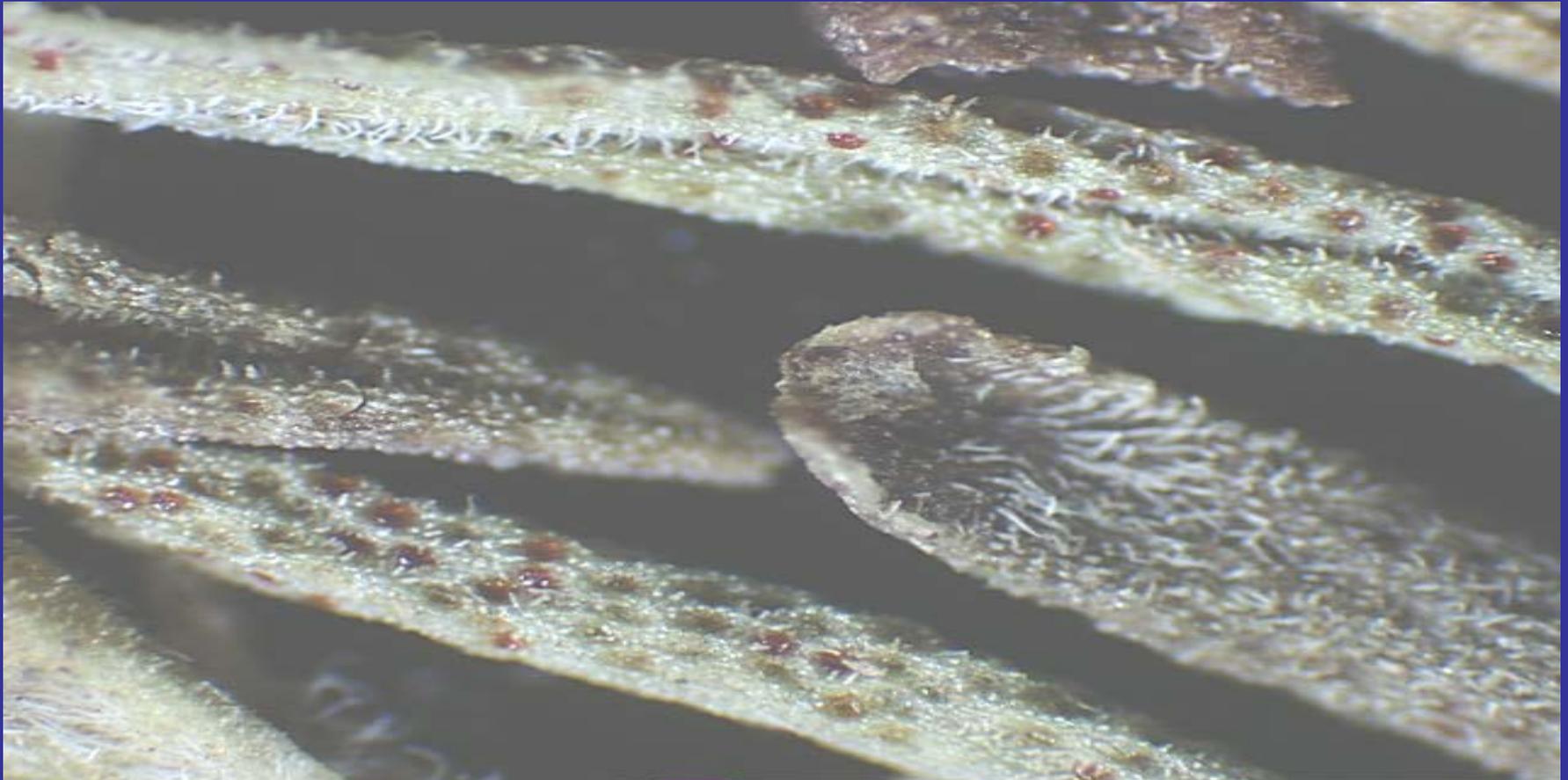
# Whole Savory Leaves

*Satureia hortensis* L



# Whole Thyme Leaves

*Thymus vulgaris* L



40x; polarized

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# Food Fraud and “Economically Motivated Adulteration” of Food and Food Ingredients

**Renée Johnson**

Specialist in Agricultural Policy January 10, 2014

**CRS REPORT**

Prepared for Members and  
Committees of Congress

# Leading Food Categories with Reported Cases of Food Fraud

- **Olive Oil.** Olive oil is often substituted with a lower cost alternative, whether it is regular olive oil instead of higher-priced extra virgin olive oil or a less expensive variety from Greece or Turkey, instead of from Italy as the label claims. In such cases the fraud was associated with efforts to defraud the European Union's farm support program, which subsidizes olive oil, as part of the Common Agricultural Policy (CAP). In some cases an alternate seed or nut oil may be sold as or thinned out with hazelnut, soybean, corn, peanut, sunflower, safflower, walnut, vegetable, canola, or palm oil, and in one case, lard. Some combinations contained no olive oil. The use of nut or legume oils could pose a problem for those with certain food allergies. In rare cases, non-food-grade oil may be added, such as rapeseed.
- **Fish and Seafood** . Some higher-value fish and seafood are replaced with cheaper, more abundant fish. A report by Oceana found that fish samples purchased at grocery stores, restaurants, and sushi bars in major cities were often mislabeled, including red snapper (actually tilefish); white tuna and butterfish (actually escolar); wild Alaskan salmon (actually farmed Atlantic salmon); caviar (actually catfish roe); and monkfish (puffer fish). Other types of substitutions have involved halibut, sole, grouper, and striped bass. Some substitutions have involved fish or seafood associated with certain types of fish poisoning or allergens. Other substitutions are intended to evade import and other restrictions.
- **Milk and Milk-based Products** . Milk from bovine cows has had milk from other types of animals, such as sheep, buffalo, and goats-antelopes, added to it, but also adulterated with reconstituted milk powder, urea, and rennet, among other products (oil, detergent, caustic soda, sugar, salt, and skim milk powder). Adulterated milk may also be watered down and then supplemented with melamine to artificially raise the apparent protein content and hide dilution. Melamine, an organic base chemical, is widely used in plastics, adhesives, and other consumer products, and is known to pose a public health threat. Adulterated milk might also be added into infant formula and other milk-based products. Baby formula is a common target.
- **Honey, Maple Syrup, and Other Natural Sweeteners.** Honey might have added sugar syrup, corn syrup, fructose, glucose, high-fructose corn syrup, and beet sugar, without being disclosed on the label. Honey from a "non-authentic geographic origin" is also common, such as cases where honey from China is transhipped through another Asian country and falsely sold as honey from the second country—usually to avoid higher customs duties and tariffs that would be imposed on honey from China. Some of this honey might also contain unapproved antibiotics or other additives and heavy metals. Maple syrup is sometimes thinned out with sugar or corn syrup.
- **Fruit Juice** . Juices might be watered down, or a more expensive juice (such as from pomegranates or other "super" fruit) might be cut with a cheaper juice (such as apple or grape juice). Some juice may be only water, dye, and sugary flavorings, although fruit is the listed ingredient on the label. Orange juice has been shown to sometimes contain added unlisted lemon juice, mandarin juice, grapefruit juice, high fructose corn syrup, paprika extract, and beet sugar. Apple juice has been shown to have added unlisted grape juice, high fructose corn syrup, pear juice, pineapple juice, raisin sweetener, fig juice, fructose, and malic acid.
- **Coffee and Tea.** Ground coffee might be cut with leaves and twigs, as well as roasted corn, ground roasted barley, and roasted ground parchment. Instant coffee may include chicory, cereals, caramel, more

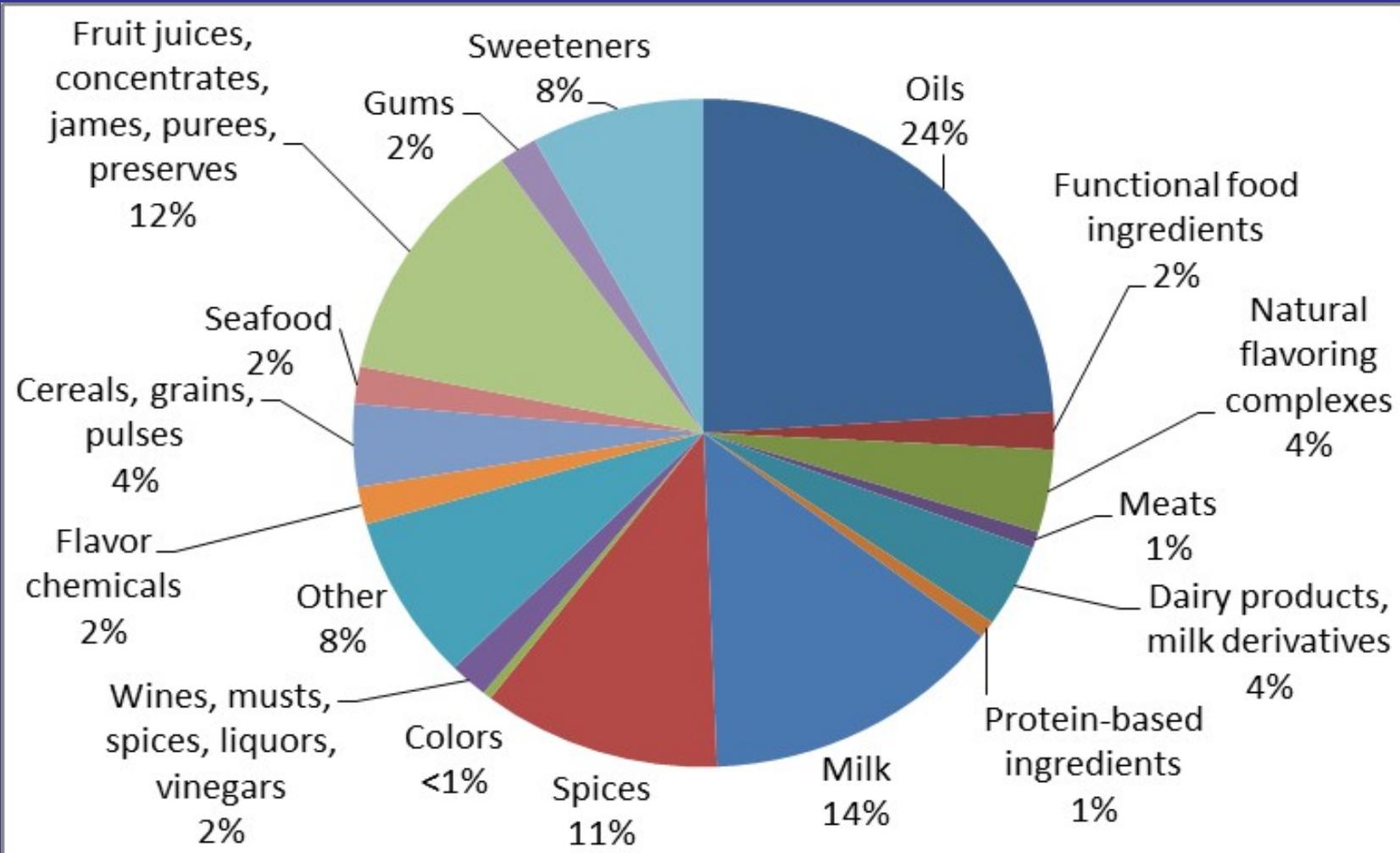
# Spices.

- Saffron is the world's most expensive spice, and has been found to have added glycerin, sandalwood dust, tartrazine (a yellow dye), barium sulfate, and borax.
- Ground black pepper has been shown to have added starch, papaya seeds, buckwheat, flour, twigs, and millet.
- Vanilla extract, turmeric, star anise, paprika, and chili powder are other spices prone to fraud.
- Sudan red dyes have been used to color paprika, chili powders, and curries, but are also known carcinogens and are banned for use in foods.

Source: CRS compilation from information reported by USP, Michigan State University, NCFPD and researchers at the University of Minnesota, Oceana, Consumers Union, Food Chemical News, and the Rodale Institute. Unless otherwise indicated, "adulteration" and "misbranding" of foods is prohibited under various FDA and USDA laws.

# Leading Reported Types of Fraud, USP Scholarly Records (1980-2010)

## By Food Ingredient Category, USP Food Fraud Database



**Federal Register / Vol. 79, No. 188 / Monday,  
September 29, 2014 / Proposed Rules**

DEPARTMENT OF HEALTH AND HUMAN SERVICES

Food and Drug Administration

21 CFR Parts 1, 16, and 117

[Docket No. FDA–2011–N–0920]

RIN 0910–AG36

**Current Good Manufacturing Practice  
and Hazard Analysis and Risk-Based  
Preventive Controls for Human Food**

AGENCY: Food and Drug Administration,  
HHS.

ACTION: Proposed rule; supplemental  
notice of proposed rulemaking.

# **Request for Comments**

## **Economically Motivated Adulteration**

- **we previously acknowledged that some kinds of intentional adulterants could be viewed as reasonably likely to occur, “**
- **we concluded that economically motivated adulteration would be best addressed through the approach in the preventive controls rules for human food and for animal food (including hazard analysis, preventive controls, monitoring, corrective action, verification, and recordkeeping) rather than through the vulnerability assessment-type approach for intentional adulteration**
- **We also explained our view that the primary purpose of economically motivated adulteration is to obtain economic gain rather than to impact public health, although public health harm may occur**

# Potential Requirements To Address Economically Motivated Adulteration

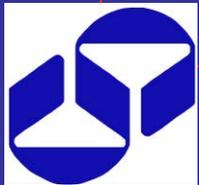
“A hazard would be an agent that is reasonably likely to cause illness or injury in the absence of its control. Thus, the focus of the potential requirement would be on those economically motivated adulterants that are reasonably likely to cause illness or injury in the absence of their control, not on economically motivated adulterants that solely affect quality and value with little or no potential for public health harm.”

- **“We believe that it is practicable to determine whether economically motivated adulteration is reasonably foreseeable. , we would expect facilities to focus on circumstances where there has been a pattern of such adulteration in the past, suggesting a potential for intentional adulteration even though the past occurrences may not be associated with the specific supplier or the specific food product.”**
- **“There are other well-known substances that have been used in economically motivated adulteration schemes, have potential to cause public health harm, and would be prudent to consider in the types of food products that have been the subject of these schemes. For example, dyes containing the heavy metal lead have been added to ingredients such as spices to enhance color.**

# FDA

“Under the definitions that would be established in the rule, a hazard would be an agent that is reasonably likely to *cause illness or injury* in the absence of its control. Thus, the focus of the potential requirement would be on those economically motivated adulterants that are *reasonably likely to cause illness or injury* in the absence of their control, *not on economically motivated adulterants that solely affect quality and value with little or no potential for public health harm.*”

**The End**  
**Any Questions?**



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