

Chapter 15

FECAL ANALYSIS



Fecal Analysis Uses

Bleeding in gastrointestinal tract

Differential diagnosis of diarrhea

Steatorrhea, malabsorption, maldigestion

Hepatic, biliary, and pancreatic diseases

Bacterial, viral, or parasitic infestation

Fecal Formation

About 9000 mL of liquid enters intestines each day, and 150 mL exits in 100 to 200 g of feces normally passed each day

Small intestine

- Digestion and absorption

Large intestine

- Absorption of water, sodium (Na), chloride (Cl)

Diarrhea develops if water absorption inhibited or inadequate time allowed for absorption

Constipation results from stationary bowel contents or decreased intestinal motility

Diarrhea

Increased volume, liquidity, and frequency of bowel movements compared with individual's normal pattern

- Secretory
 - Increased solute secretions by intestine draws water and electrolytes into intestine
- Osmotic
 - Increased osmotically active solutes draw water and electrolytes into intestine
- Intestinal hypermotility
 - Decreases time available for absorption; can occur alone or with secretory or osmotic

Secretory Versus Osmotic

Both have osmotically active solutes, but source differs

To differentiate, measure fecal osmolality, sodium (Na), and potassium (K)

Calculate fecal osmolality from Na and K, and compare with actual osmolality

If difference is greater than 20 mOsm/kg, it is osmotic; less than 20, it is secretory

$$\text{Calculated fecal osmolality} = 2 \times (\text{Na}^+_{\text{fecal}} + \text{K}^+_{\text{fecal}})$$

Example Causes

Secretory

- Enterotoxin-producing organisms
- Damage to mucosa due to drugs or disease

Osmotic

- Maldigestion
- Malabsorption

Intestinal hypermotility

- Abdominal distention stimulates motility
- Laxatives, stress, drugs, other diarrheas

Steatorrhea

Fecal fat excretion greater than 7 g/day

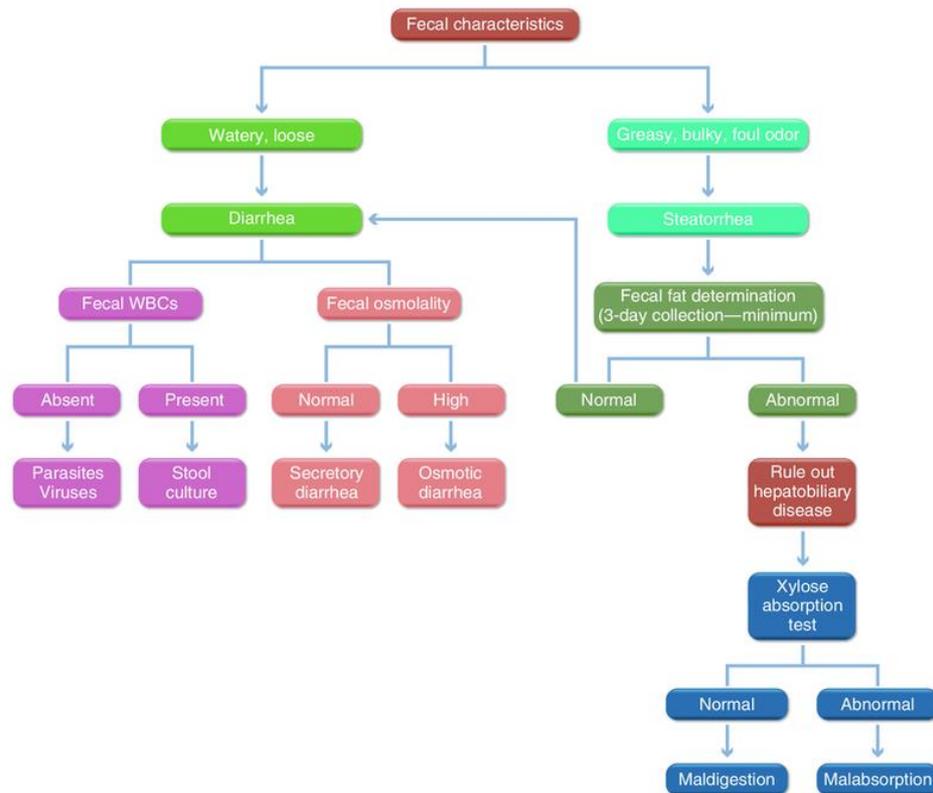
Common feature of malabsorption syndromes

Feces are pale, greasy, spongy, or pasty and very foul smelling

Differentiation from diarrhea is important; also both can occur together

Good patient history also valuable; can reveal significant information to aid in diagnosis

Figure 15-1. An algorithm to aid in the evaluation of diarrhea and steatorrhea. *WBCs*, White blood cells.



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Specimen Collection

Clear instructions to patient critical

Clean, sealable, leakproof containers

Amount needed and dietary restrictions depend on test ordered

Avoid contamination of fecal specimen with urine, toilet tissue, or toilet water

Open closed containers of feces with disposable covering to prevent splatters from gas formation

Macroscopic Examination

Color

- Normal brown color from bile pigments (urobilins) that are orange-brown
- Food, medicine, or blood can cause unusual colors
- Pale or clay-colored due to posthepatic obstructions

Consistency and form

- Normal feces formed, cylindrical masses
- May be bulky due to undigested foodstuffs or increased gas
- Soft stools indicate increased water content

Macroscopic Examination (Cont.)

Mucus

- Not normally present in feces
- Presence associated with many conditions

Odor

- Normal odor comes from metabolic by-products of the intestinal flora bacteria
- If normal flora disrupted or a change in foods occurs, a change in odor can occur

TABLE 15.5 Fecal Macroscopic Characteristics

	Characteristic	Cause
Color	Clay-colored or gray, pale yellow, or white	Posthepatic obstruction Barium (ingestion or enema)
	Red	Blood (from lower GI tract) Beets Food dyes Drugs (e.g., BSP dye, rifampin)
	Brown	Normal
	Black	Blood (from upper GI tract) Iron therapy Charcoal ingestion Bismuth (e.g., medications, suppositories)
	Green	Green vegetables (e.g., spinach) Biliverdin (during antibiotic therapy)
Consistency	Formed	Normal
	Hard	Constipation (i.e., scybalum)
	Soft	Increased fecal water
	Watery	Diarrhea, steatorrhea
Form	Cylindrical	Normal
	Narrow, ribbonlike	Bowel obstruction Intestinal narrowing (e.g., strictures)
	Small, round	Constipation
	Bulky	Steatorrhea
Other	Foamy, floating	Increased gas incorporated into feces
	Greasy, spongy	Steatorrhea
	Mucus	Constipation, straining Disease (e.g., colitis, villous adenoma)

Qualitative Microscopic Examination

White blood cells (WBCs)

- Not normally present
- Even a small number indicates invasive or inflammatory condition of intestinal wall

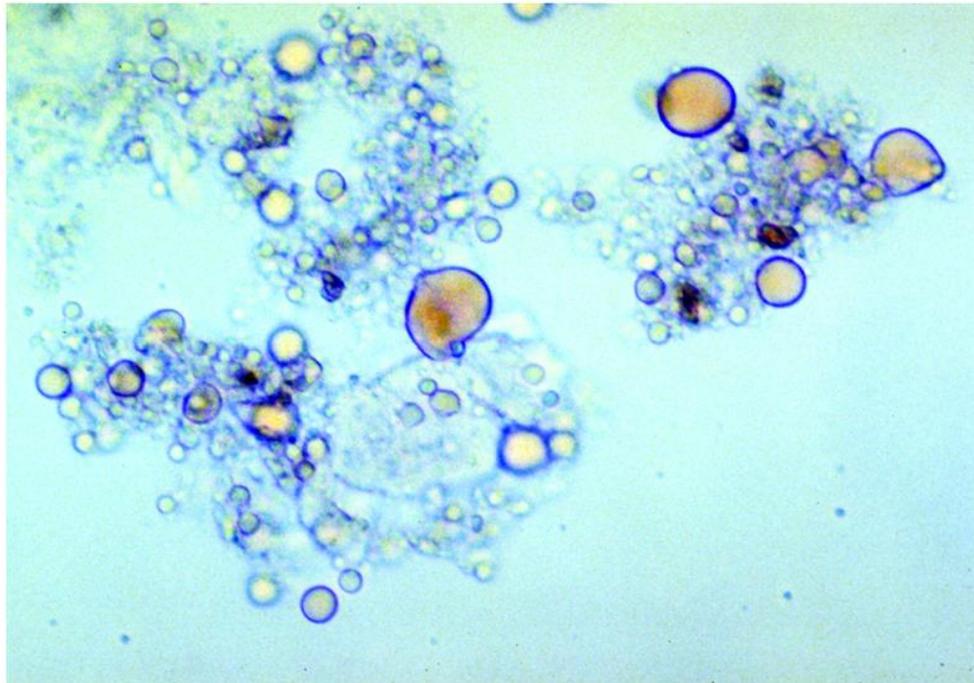
Fecal fat

- Qualitative orange-red staining of neutral fats with Sudan III, Sudan IV, or oil red O
- Second slide acidified and heated before staining; detects total fats

Meat fibers

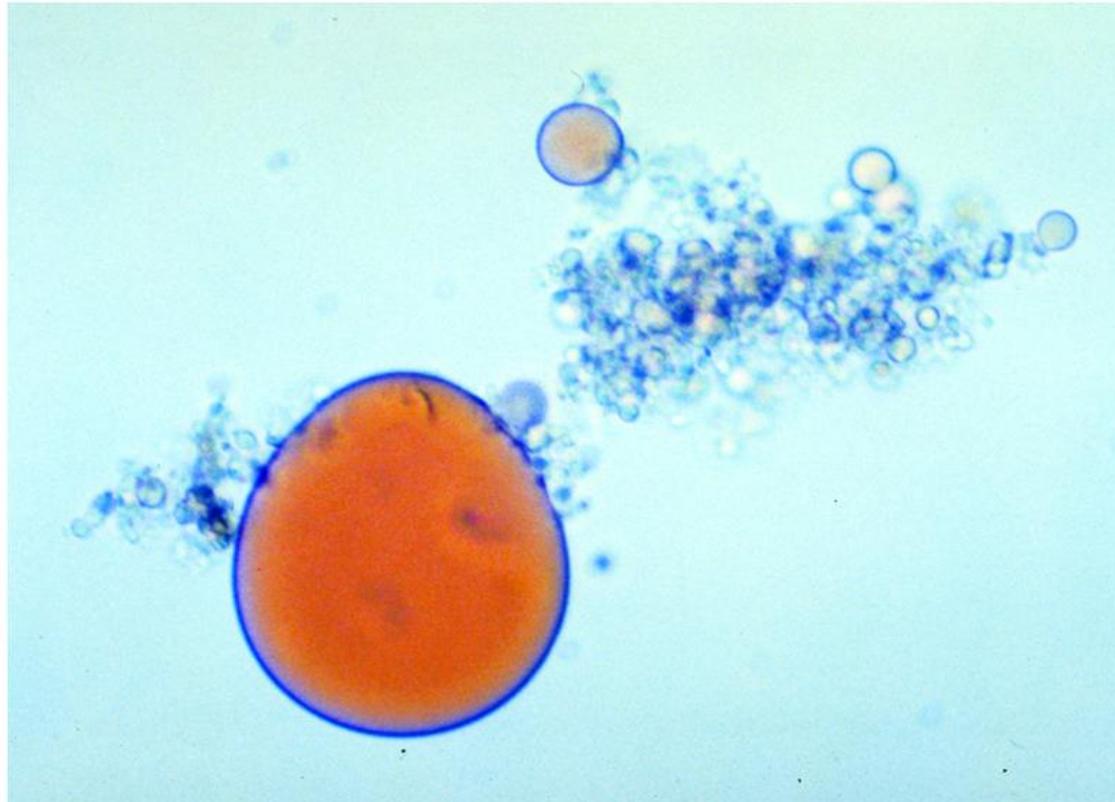
- Can be seen on fecal fat slides; increase is abnormal

Figure 15-2. Numerous globules of neutral fat stained with Sudan III. The orange-red coloration is characteristic. Fat present in fecal suspension during qualitative fecal fat microscopic examination. Brightfield microscopy, $\times 200$.

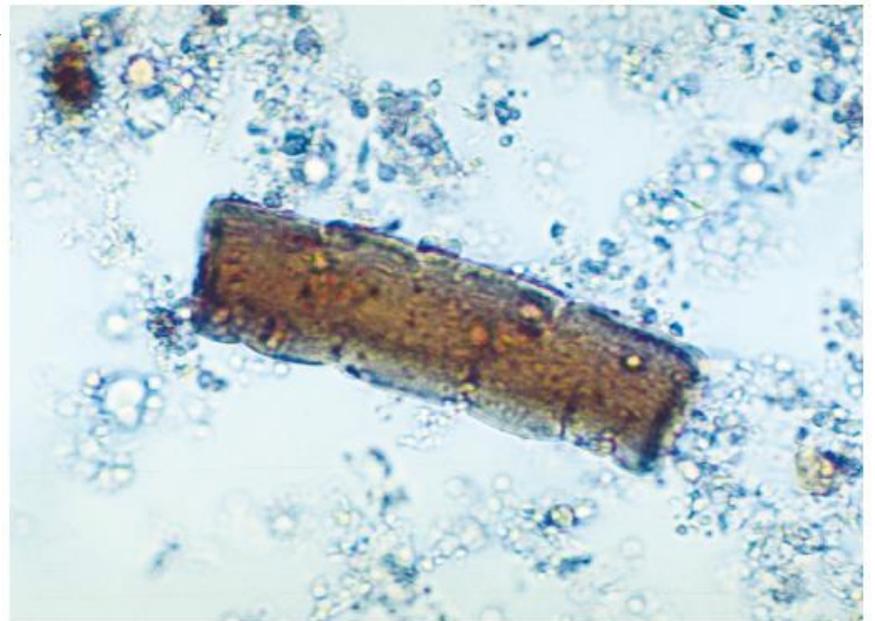
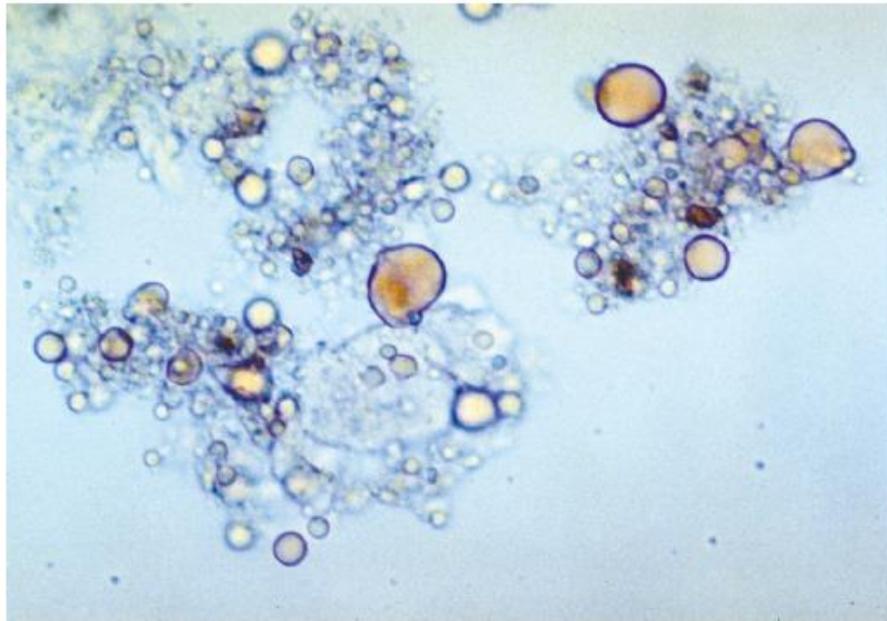


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Figure 15-3. Large globule of neutral fat stained with Sudan III. The orange-red coloration is characteristic. Brightfield microscopy, $\times 200$.



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Chemical Examination—Occult Blood

Occult blood = blood not visually apparent

Any increase in blood is significant

Bleeding anywhere in gastrointestinal tract can result in blood in feces

Fecal blood is an early symptom of colorectal cancer

Dark or black stools can indicate bleeding in upper gastrointestinal (GI) tract

Occult Blood Testing

Most commonly used is commercially prepared slide test system to test samples from three different days

Three methodologies:

- Guaiac-based
 - Based on pseudoperoxidase activity of hemoglobin heme resulting in color change
- Immunochemical
 - Based on reaction of polyclonal antihuman antibodies to globin portion of undegraded hemoglobin
- Porphyrin-based
 - Based on chemical conversion of heme to fluorescent porphyrins

Apt Test for Fetal Hemoglobin

Used to differentiate between fetal and maternal blood in a newborn's stool

- Blood may have come from the GI tract of the neonate or could be maternal blood ingested during delivery

Qualitative test based on alkaline resistance of fetal hemoglobin

Specimen must contain fresh red blood for testing

Dilute sodium hydroxide (NaOH) will degrade maternal but not fetal hemoglobin

TABLE 15.6 Fecal Reference Intervals**Physical Examination**

Color	Brown
Consistency	Firm, formed
Form	Tubular, cylindrical

Chemical Examination

Total fat, quantitative (72-hour specimen)	<6 g/day and <20% of stool
Osmolality	285–430 mOsm/kg H ₂ O
Potassium	30–140 mEq/L
Sodium	40–110 mEq/L

Microscopic Examination

Fat, Qualitative Assessment

Neutral fat	Few globules present per high-power field
Total fat	<100 fat globules (diameter ≤ 4 microns) per high-power field
Leukocytes (qualitative)	None present
Meat and vegetable fibers (qualitative)	Few

TABLE 15.7 Fecal Occult Blood Tests (FOBT)

Test	Principle	Advantages	Disadvantages
Guaiac-based (gFOBT)	Based on the pseudoperoxidase activity of heme to oxidize colorless guaiac in the presence of hydrogen peroxide to form a blue color	<ol style="list-style-type: none"> 1. Inexpensive 2. Test fast and easy to perform 3. Extensively studied 	<ol style="list-style-type: none"> 1. Dietary restrictions required 2. Medication restrictions required 3. False-negative owing to vitamin C intake or hemoglobin degradation 4. Manual method only
Immunochemical-based (iFOBT)	Antibody/antigen: Labeled antihuman antibodies to the globin portion of <i>undegraded</i> human hemoglobin bind; hemoglobin-antibody complexes are detected visually (manual) or photometrically (automated)	<ol style="list-style-type: none"> 1. No dietary or medication restrictions 2. High specificity; detects <i>only</i> undegraded human hemoglobin 3. Test fast and easy to perform 4. Some iFOBTs are automated 	<ol style="list-style-type: none"> 1. False-negative owing to hemoglobin degradation 2. Higher cost compared to gFOBT 3. Upper GI bleed* not detected⁶
Porphyrin-based	Fluorescence quantitation of heme-derived porphyrins	<ol style="list-style-type: none"> 1. No dietary restrictions from fruits or vegetables 2. Quantitative assessment of fecal blood; not affected by hemoglobin degradation 	<ol style="list-style-type: none"> 1. Test is labor-intensive and time-consuming. 2. False-positive owing to ingestion of red meat (nonhuman heme)

Quantitative Fecal Fat

Definitive test for steatorrhea

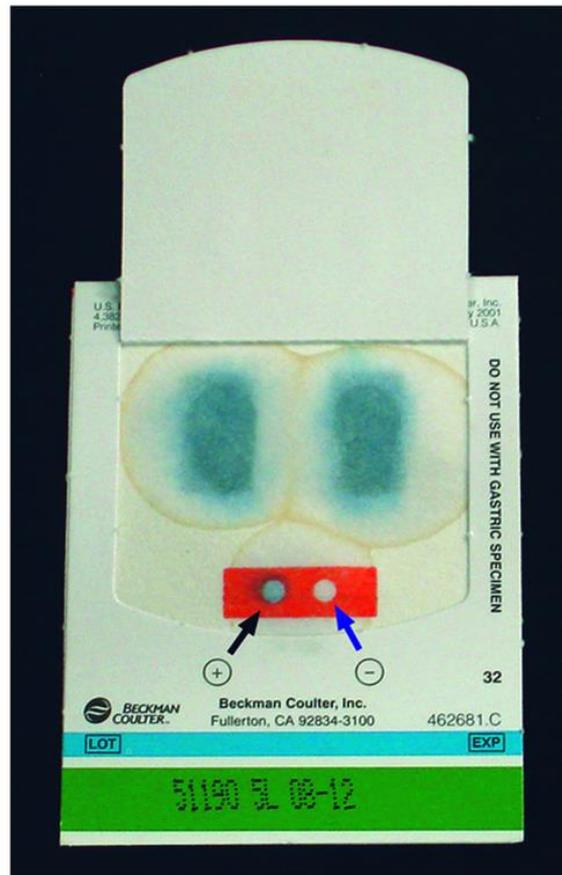
Does not identify cause

Feces collected for 2 to 3 days

Fat measured on well-mixed aliquot by gravimetric, titrimetric, or nuclear magnetic resonance (NMR) spectroscopy

Fecal fat reported as grams of fat per day with normal adults excreting 2 to 7 g/day

Figure 15-5. Positive guaiac-based fecal occult blood test.



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Fecal Carbohydrates

Undigested carbohydrates in stool result in bloating, flatulence, and explosive diarrhea due to fermentation by normal flora

Stool will be acid (pH 5 to 6), whereas normally pH of feces is greater than 7

Clinitest tablets based on copper reduction principle can detect reducing sugars and other reducing substances (sucrose not detected)