

THE SIGNIFICANCE OF BIO-MARKERS IN THE INTERPRETATION OF COMPREHENSIVE STOOL ANALYSIS RESULTS

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Abstract

In the comprehensive stool analysis performed by Parasitology Center, Inc. (PCI), we report about 45 different species of parasites found in humans in all continents. In addition, we also report on 11 bio-markers that have an underlying physiological or pathological significance and that may be missed by some observers. These include various cells, crystals, undigested matter, and granules. These structures are presented, illustrated, and their significance delineated for easy recognition and for better understanding of their implication to patients health and well being. All illustrations are the products of our light microscopy examination of patients' fecal specimens for parasites at PCI.

Introduction

At the Parasitology Center, Inc. (PCI), in Scottsdale, Arizona, Sonora, Mexico, and Mali, West Africa, we perform one of the most accurate comprehensive stool analyses in the United States (Amin, 2000, 2005) with highest yield of positive results compared to others reported elsewhere (Amin, 2002). We report 47 species of protozoans, trematodes, cestodes, nematodes, and fungi as well as others not included in the tabulated Diagnostic Report. In addition, we also report 11 other non-parasitic structures that represent bio-indicators to physiological or pathological conditions that deserve the attention of practitioners to manage underlying dysfunctions that may compromise patients' health. These bio-indicators are accompanied by illustrations and annotations for easy identification and enlightened awareness of their implications to patients' health.

Materials and Methods

Upon the execution of comprehensive stool analysis (Amin, 2000, 2005), all parasitic organisms as well as observations of related non-parasitic structures are noted on Diagnostic Report forms. Initial light microscopy observations were made using an Olympus-BH2 two way Biological Microscope model CHS, Millville, N.Y. Images were captured by a Hitachi color camera VK-C150, Compton, CA, viewed in a 13-inch Panasonic Color Video Monitor CT-1384Y, Mississauga, Ontario, and printed using a Sony Color Video Printer CVP-M3, Tokyo, Japan.

Results and Discussion

The reference range of the 11 bio-indicators (as with parasites) is reported on a scale of 1 to 4 with 1 indicating very light presence and 4 indicating very heavy presence. Normal value equals 0 (absent). These are:

1. **Undigested plant tissues** (Fig. 1) are reported in stool specimens when present at elevated levels. Many com-

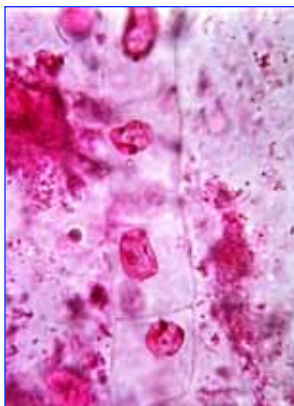


Fig. 1. Plant tissue.



Fig. 2. Tomato skin can be easily confused with tapeworms.

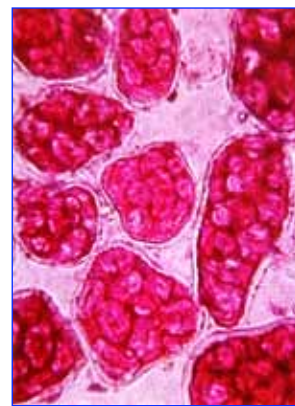


Fig. 3. Undigested potato cells.



Fig. 4. A mite egg, looks like a nematode egg.

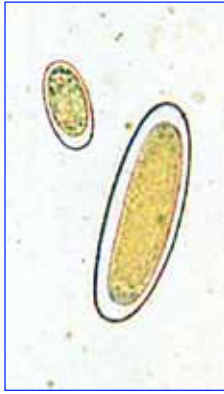


Fig. 5. Morel mushroom spores resembling nematode eggs.



Fig. 6. Citrus parts appear like worms.



Fig. 7. Bean sprouts can be easily mistaken for nematodes.



Fig. 8. Undigested plant hair looking like a nematode.



Fig. 9. Common form of mucoid tubes (mucus casts) often mistaken for worms.

monly reported plant food items include tomatoes (Fig. 2) and potatoes (Fig. 3), among others. Improper digestion will change the stool constitution, cause constipation, and impact parasite presence and passage in the fecal flow. Meat fibers are also indirect indicators of maldigestion which could be attributed to inadequate mastication of food or insufficiency of hydrochloric acid, pepsin, and pancreatic enzymes. Digestive enzymes are recommended in those cases with a special emphasis on enzymes relevant to specific undigested foods.

2. **Artifacts** are plant or animal structures that are ingested accidentally and can be easily confused with diagnostic stages of parasites, hence leading to incorrect diagnosis and faulty treatment that may impact the patient's health adversely. Artifacts commonly found in fecal specimens that look like worms or worm eggs include mite eggs (Fig. 4), morel mushroom spores (Fig. 5), citrus parts (Fig. 6), bean sprouts (Fig. 7), and plant hairs (Fig. 8), as well as non-plant material such as mucus casts which can be confused with worms (Fig. 9).
3. **Mucus** is a natural secretion of the intestinal lining that protects it from compromising factors such as parasites, toxins, unfavorable PH, etc. (Figs. 10, 11). It is secreted in proportion to the degree of aggravation the intestinal lining has to contend with. In heavy infections with parasites, mucus can completely saturate large portions of the intestinal tract thus blocking absorption surface in these areas. The extent of mucus formations is a bio-marker of the degree of pathology in the gut.
4. **Occult blood** is monitored and the level of WBS and RBC presence is carefully reported when present; with a normal value of 0 (absent). The presence of WBS (Fig. 12) indicates an attempt to contain the operation of infective processes or punishing toxicological factors. We often see granulocytes and sometimes lymphocytes. HIV-AIDS patients often

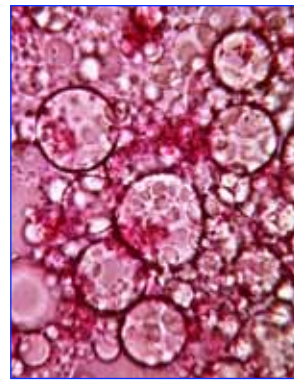


Fig. 10. Heavy mucus presence in a patient with very heavy *Blastosystis* infection.

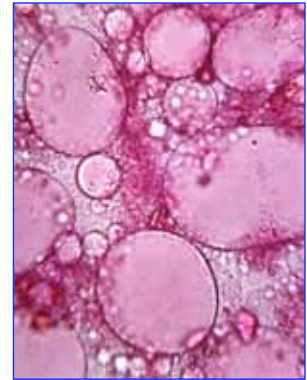


Fig. 11. Another case of heavy mucus presence in another patient.

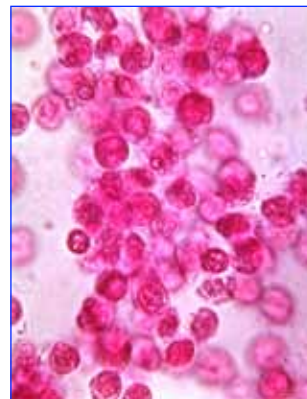


Fig. 12. A large number of WBC from an HIV patient.

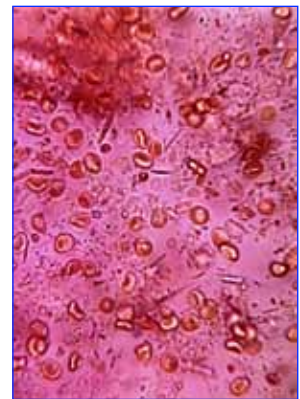


Fig. 13. A large number of RBC from a patient infected with *Entamoeba histolytica* with bloody diarrhea.

have a high level of granulocytes and a very low level of beneficial bacteria, if any. The presence of RBC (Fig. 13) indicates bleeding in the digestive tract. Many factors can cause bleeding including the active feeding of parasites such as worms like hook-worms, *Ancylostoma duodenale*.

5. **Fatty acid crystals** (Fig. 14) are found when the fatty acids, mostly triglycerides, are not broken down by pancreatic lipases. This is usually seen in patients with problematic gall bladders and pancreatic dysfunction. Attention should be drawn to the management of these organs.



Fig. 14. Fatty acid crystals in a patient with a compromised gall bladder.

6. **Starch granules** presence (Fig. 15) indicates that carbohydrates are not being digested properly and calls for the use of digestive enzymes that include a good percentage of amylase.

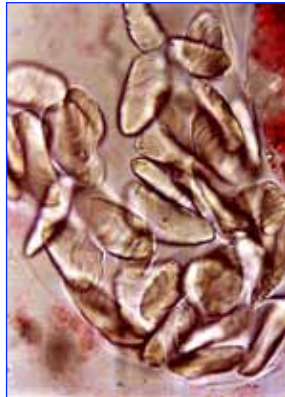


Fig. 15. Starch granules in a patient deficient in digestive enzymes especially amylase.

7. **Normal bacilli** are the rod-shaped good bacteria that include the *Bifidus* and *Lactobacillus* forms (Fig. 16). These friendly bacteria are important for balanced GI function including vitamin synthesis, antibiotic production, immune defense, and detoxification. Of a reference range of 1-4, level 2 or 3 are considered average. Level 1 indicates a low level that needs supplementation. Level 1 is often seen in patients heavily infected with parasites or fungi such as *Candida* where the pathogen occupies all the available surface area of the intestinal lining and successfully competes with normal bacteria for feeding and attachment; a phenomenon known as competitive exclusion.

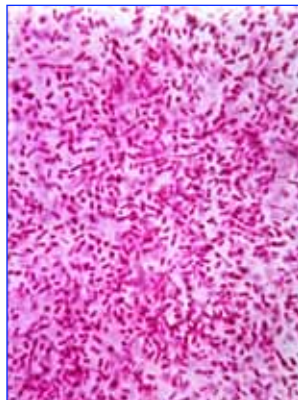


Fig. 16. Normal friendly bacteria mostly of the *Bifidus* and *Lactobacillus* forms.

8. **Pollen grains** (Figs. 17, 18) from various pollen carrying plants are readily identifiable. They are either ingested in with food or breathed in during pollen season. While they have no immediate pathological significance, they are still regarded as a factor in host allergies. When present, especially in large numbers, in allergic patients, preventive and protective precautions need to be made.

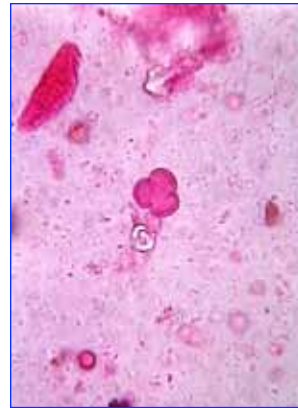


Fig. 17. A pollen grain of broccoli.

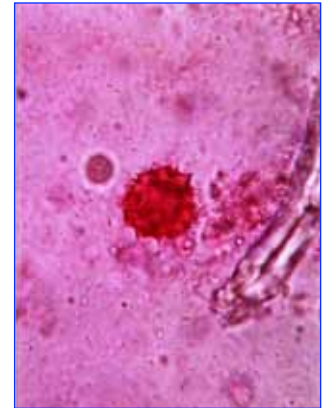


Fig. 18. Another of many other types of pollen grains.

9. **Squamous epithelial cells** (Fig. 19) line the lower intestine. Their presence in significant numbers indicate damage to the intestinal area from where they were shed. **Columnar epithelial cells** (Fig. 20) line the upper intestine and they are bio-markers of damage in that area. The damage may be due to biological or toxic factors. While epithelial cells have a certain rate of turn over of generations, they are only reported when their presence is detected at levels that we deem significant enough to report.



Fig. 19. Squamous epithelial cells from the lower intestine.

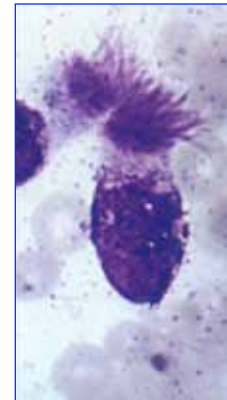


Fig. 20. Columnar epithelial cells from the upper intestine.

10. **Charcot-Leyden crystals** (Fig. 21) are the product of the destruction of eosinophils mostly by the action of parasites or occasionally by toxic factors. Amin (2002) reported the presence of Charcot-Leyden crystals in 34 patients of whom 9 (26%) were infected with *Blastocystis hominis*, 8 (24%) with *Entamoeba histolytica*, 3 (9%) with *Giardia lamblia*, and 1 (3%) with *Cryptosporidium parvum*. The remaining 13 patients



Fig. 21. Charcot Leyden crystal from a patient infected with *Blastocystis hominis*.

(38%) were not infected with parasites and toxic elements or cyclic parasites were suspected as the causative agents. See Amin (2002) for a more detailed discussion of other reports of the crystals in association with other parasitic species.

11. **Other crystals** include antibiotic crystals (Fig. 22). These dark crystals are very readily recognizable in patients who were requested to stay off antibiotics for two weeks before collecting stool specimens for parasite testing (Stool Specimen Collection Procedure) but they didn't. In those cases, the CSA is compromised: light infections may be missed and heavy or moderate infections may present as light infections thus affecting treatment protocols.

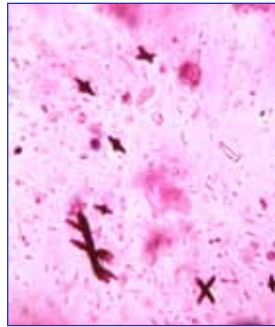


Fig. 22. Antibiotic crystals in fecal specimen of a heavily medicated patient.

The implications of the above observations on the correct diagnosis or misdiagnosis of parasites are very important for the proper management of infections with the appropriate protocols. It is amazing to have become aware

of the number of parasite infections that get under diagnosed as a result of misinterpretation or lack of familiarity with artifacts and with the many different variations within a parasite population. The understanding of the underlying pathological implications of such structures as fatty acid or charcot Leyden crystals, among others, is equally important in the proper management of parasitic cases. 🌸

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