

# Bio-Markers Misdiagnosed as Intestinal Parasites and Related Findings in Fecal Preparations

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#### Abstract

In the comprehensive stool analysis (CSA) performed at 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.

Keywords: Biomarkers; Intestinal Parasites; Misdiagnosis; Artifacts

### Introduction

At the Parasitology Center, Inc. (PCI), in Scottsdale, Arizona, Sonora, Mexico, London, UK, and Mali, West Africa, we perform one of the most accurate comprehensive stool analyses in the United States [1,2] with highest yield of positive results compared to others reported elsewhere [3]. 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 original illustrations (water-marked) and annotations for easy identification and enlightened awareness of their implications to patients' health.

#### **Materials and Methods**

Upon the execution of comprehensive stool analysis [1,2], all parasitic organisms as well as observations of related non-parasitic structures are noted on Diagnostic Report forms. Initial light microscopy observations are 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:

Based on a preliminary report in Explore for the Professional, 2011.

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- 1. Undigested plant tissues (Figure 1) are reported in stool specimens when present at elevated levels. Many commonly reported plant food items include tomatoes (Figure 2) and potatoes (Figure 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 accidently 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 (Figure 4), morel mushroom spores (Figure 5), citrus parts (Figure 6), bean sprouts (Figure 7), and plant hairs (Figure 8), as well as non-plant material such as mucus casts which can be confused with worms (Figure 9).
- 3. Mucus is a natural secretion of the intestinal lining that protects it from compromising factors such as parasites, toxins, unfavorable PH, etc. (Figure 10 and 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 (Figure 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 have a high level of granulocytes and a very low level of beneficial bacteria, if any. The presence of RBC (Figure 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 (Figure 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.
- 6. Starch granules presence (Figure 15) indicates that carbohydrates are not being digested properly and calls for the use of digestive enzymes that include a good percentage of amylase.
- 7. Normal bacilli are the rod-shaped good bacteria that include the *Bifidus* and *Lactobacillus* forms (Figure 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.
- 8. Pollen grains (Figure 17 and 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.
- 9. Squamous epithelial cells (Figure 19) line the lower intestine. Their presence in significant numbers indicate damage to the intestinal area from where they were shed. Columnar epithelial cells (Figure 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.

- 10. Charcot-Leyden crystals (Figure 21) are the product of the destruction of eosinophils mostly by the action of parasites or occasionally by toxic factors. Amin [3] 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 (38%) were not infected with parasites and toxic elements or cyclic parasites were suspected as the causative agents. See Amin [3] for a more detailed discussion of other reports of the crystals in association with other parasitic species.
- 11. Other crystals include antibiotic crystals (Figure 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.



Figure 1: Plant tissue (X 1000).



Figure 2: Tomato skin can be easily confused with tapeworms (X 400).



Figure 3: Undigested potato cells (X1000).

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Figure 4: A mite egg, looks like a nematode egg (X400).



Figure 5: Morel mushroom spores resembling nematode eggs (X400).



Figure 6: Citrus parts appear like worms (X100).



Figure 7: Bean sprouts can be easily mistaken for nematodes (X100).



Figure 8: Undigested plant hair looking like a nematode (X400).



Figure 9: Common form of mucoid tubes (mucus casts) often mistaken for worms (100).



Figure 10: Heavy mucus presence in a patient with very heavy Blastocystis infection (X1000).



Figure 11: Another case of heavy mucus presence in another patient (X1000).



Figure 12: A large number of WBC from an HIV patient (X1000).



Figure 13: A large number of RBC from a patient infected with Entamoeba histolytica with bloody diarrhea (X1000).



Figure 14: Fatty acid crystals in a patient with a compromised gall bladder (X1000).



Figure 15: Starch granules in a patient deficient in digestive enzymes especially amylase (X1000).

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Figure 16: Normal friendly bacteria mostly of the Bifidus and Lactobacillus forms (X1000).



Figure 17: A pollen grain of broccoli (X1000).



Figure 18: Another of many other types of pollen grains (X1000).



*Figure 19: Squamous epithelial cells from the lower intestine (X 1000).* 



*Figure 20: Columnar epithelial cells from the upper intestine (X1000).* 



Figure 21: Charcot Leyden crystal from a patient infected with Blastocystis hominis (X1000).



Figure 22: Antibiotic crystals in fecal specimen of a heavily medicated patient (X1000).

#### Conclusion

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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