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BEI Resources: a biological resource center for parasitologists

Robert E. Molestina
Protistology Department, American Type Culture Collection, Manassas, Virginia, USA

Infections with protozoan parasites represent a major cause of morbidity and mortality across the developing world. In spite of years of effort, effective vaccines have not been developed for routine immunization against these pathogens. In addition, the use of inadequate methods to control the transmission of these parasites, particularly of drug-resistant populations, contributes to the burden on public health.

To succeed as parasites, organisms such as *Toxoplasma gondii*, African trypanosomes, *Trypanosoma cruzi*, *Leishmania*, *Giardia*, and *Plasmodium* have evolved a series of complex strategies to evade the host immune system and establish chronic infections [1-4]. Deciphering the mechanisms used by these highly adapted parasites to block or subvert cellular processes in the host offers new targets for therapeutic intervention or vaccine development. Importantly, the accessibility of reference parasite strains and reagents is critical to the generation of studies aimed at elucidating the intricate aspects underlying the host-parasite relationship. Protozoan strains deposited in culture collections are in fact 'biological standards' as they are key components of comparative studies. Thus, such collections, better known as biological resource centers (BRC), have contributed significantly to the development of scientific research by making reference strains available to the wider scientific community.

The Biological and Emerging Infections Resources Program (BEI Resources) was developed by the National Institute of Allergy and Infectious Diseases (NIAID) as a centralized BRC for research reagents to the scientific community (see: http://www.beiresources.org/). The primary role of BEI Resources is the acquisition and authentication of several categories of materials for registered scientists, with a focus on emerging and re-emerging infectious diseases (see: http://www.niaid.nih.gov/topics/emerging/pages/list.aspx). A major goal of this BRC is to provide reference standards to scientists carrying out basic research to develop improved diagnostic tests, vaccines, and therapies. Centralization of these functions within BEI Resources allows monitored access and use of these materials by the scientific community and quality control assurance of the reagents.

The American Type Culture Collection (ATCC®) has been responsible for the management of BEI Resources since September 2003. BEI materials available to the parasitology community include several strains of *Entamoeba histolytica* and *Giardia lamblia* as well as antisera against *Toxoplasma gondii* and *Cryptosporidium parvum* (Table 1). The repository also holds nearly fifty clonal lines of *T. gondii* derived from genetic crosses between IxIII and IIxIII parental strains [5,6]. In addition, BEI Resources is the distribution center of expression clones for different *Giardia*, *Entamoeba*, *Cryptosporidium*, *Babesia*, and *Toxoplasma* proteins

Corresponding author: Molestina, R.E. (rmolestina@atcc.org).

targeted by the NIH Seattle Structural Genomics Centers for Infectious Diseases (SSGCID). The primary mission of the SSGCID is to determine the structure of 75 to 100 protein targets from NIAID Category A, B, and C agents in addition to emerging and re-emerging infectious disease organisms (see: http://www.ssgcid.org/). All structures are to be submitted to the Protein Data Bank, and all materials (clones and protein) generated are to be made publicly available through deposition in BEI Resources.

Protozoan strains deposited at BEI Resources are characterized using a variety of tests, including: (i) verification of viability and purity; (ii) phenotypic properties (morphology, antibiotic susceptibility); and (iii) genotypic analysis (PCR-based tests, restriction fragment length polymorphism, sequencing). Establishing seed and distribution stocks for every strain is a common practice to make certain that cultures distributed to the scientific community are closely similar to the original material provided by the depositor. These practices are performed under a strict quality management system which complies with ISO 9001:2000 certified and accredited by the British Standards Institute. ISO 9001:2000 is an internationally recognized standard for quality management systems promulgated by the International Organization for Standardization (ISO), a network of national standards institutes from 157 countries. The standard prescribes that key processes surrounding the provision of products and services by ATCC® are monitored to ensure that product quality objectives and customer needs are met.

If at all possible, biological material used to generate peer-reviewed studies should always be deposited into an appropriate BRC as this allows future projects even after many years of the original work. It is particularly important that strains used in virulence and genomic studies are available to the wider scientific community and that they are held in a stable state that minimizes genotypic and phenotypic changes. Thus, BEI Resources encourages and supports the deposit of materials from researchers and institutions in addition to supplying materials to the science community. Depositor benefits include secure storage, community access, and distribution, all while protecting the intellectual property rights of the contributor. Investigators registered with the BEI program benefit from requesting materials on line at no charge with the exception of shipping and handling fees. In addition, registered scientists have web access to the resource center for accessioned scientific information regarding the reagent (i.e. product sheet information, certificate of analysis, etc.).

Since 2003 the mission of the collection of protozoan parasites at BEI Resources has been to provide, among an array of biological materials, reagents for emerging and re-emerging infectious disease pathogens to the scientific community. The focus of the collection is currently expanding to trypanosomes and *Leishmania*. Through the continued support of BEI Resources for an additional seven years starting in 2010, the goal of this program is to provide NIAID with a central repository of unique and quality assured research materials for the broader infectious diseases community that will aid in the development and evaluation of vaccines, therapeutics, and diagnostics.

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Table 1

Collection of protozoan parasites available at BEI Resources[a]

Organism	Cultures	Genomic DNA	Expression clones	Antisera
Achantamoeba sp.	●			
Babesia sp.	●		●	
Entamoeba histolytica	●		●	
Giardia lamblia	●		●	
Cryptosporidium sp.		●	●	●
Toxoplasma gondii	●	●	●	●

[a]The list does not include materials under development nor future acquisitions. For a complete description of reagents visit http://www.beiresources.org/.