ISSN 0026-2617, Microbiology, 2012, Vol. 81, No. 5, pp. 509–516. © Pleiades Publishing, Ltd., 2012.
Original Russian Text © I.B. Ivshina, 2012, published in Mikrobiologiya, 2012, Vol. 81, No. 5, pp. 551–560.

REVIEW

Current Situation and Challenges of Specialized Microbial Resource Centres in Russia[1]

I. B. Ivshina

Institute of Ecology and Genetics of Microorganisms, Ural Branch, Russian Academy of Sciences, Perm State National Research University, Perm, Russia

Received January 31, 2012

Abstract—Establishment of national biological resource centres (BRCs) is of special concern and requires harmonization of regulations on microorganisms' handling, improvement of legal control pertaining to intellectual property right, access to genetic resources and fair benefit sharing arising from their biotechnology application. As exemplified by the Regional Specialized Collection of Alkanotrophic Microorganisms (acronym IEGM, World Federation for Culture Collections # 768, www.iegm.ru/iegmcol) hosted at the Institute of Ecology and Genetics of Microorganisms, the role of specialized microbial collections is emphasized as the governing factors of innovative development of biotechnology and bioindustry. The publication aims at drawing attention to the regional BRC being formed in the Perm Krai which provides the appropriate information on the holdings and is responsible for screening, study and maintenance of valuable microbial gene pool to meet the needs of ecology, industry and biotechnology, and for developing novel methodological approaches to studying extremotolerant microorganisms. This centre also contributes to the development and application of advanced achievements in enzymatic transformation of carbon compounds, production of fodder using non-traditional raw material, oil- and gas-prospecting activities, monitoring and bioremediation of contaminated sites.

Keywords: microbial diversity, biological resource centres (BRCs), culture collections, biotechnology

DOI: 10.1134/S0026261712050098

The onrush of biotechnology has entailed a growing interest in microbial diversity and establishment of biological resource centres (BRCs). As the times dictate, BRCs assume the functions of providing services not only in conservation and distribution of biotechnologically valuable microbial cultures, but also in dissemination of useful scientific information on issues relevant to the current situation in microbial diversity and its potential applications in various biotechnological fields, namely detection of fossil fuel resources, xenobiotic biodegradation, development of state-of-the-art (ecologically friendly and economically reasonable) technologies for environmental protection, and production of novel medicinal preparations. The questions of BRC adaptation to a new social-economic environment are both of fundamental and economic importance as they are ultimately associated with biotechnology.

Against the critical state of the environment, the ecological situation has become extremely tense: the global atmospheric characteristics are no longer stable and tend to change for the worse, while the genetic material is rapidly degrading at the population level. According to the reliable prediction, if a continued loss in biological species will keep on at a current rate, the daily loss in biological species inhabiting the Earth will amount to 20–75 species by 2040. The only possible solution to the current situation is to preserve the biological diversity using novel technologies which advance depending mainly on the state of biological collections. In countries where the conservation of biological diversity is seen as the national priority task, biological collections are considered as national heritage.

SPECIALIZED MICROBIOLOGICAL RESOURCE CENTRES—UNDERPINNING THE MICROBIAL BIOTECHNOLOGY

Today, many countries witness the enhancement of collection activities. A greater variety of groups of microorganisms find their industrial applications following the rapid biotechnological development. Microorganisms are frequently involved in international initiatives (DIVERSITAS, 1991–2020; MOSAICC, 1997–1999; GBIF, 2007–2011; GBRCN, 2008–2011, etc.). The priority in these initiatives is given to the intensive study of microorganisms associated with human activities and participating in remediation of technogenically disturbed ecosystems. According to the Organization for Economic

[1] The article was translated by the author.
Corresponding author; e-mail: ivshina@iegm.ru

Cooperation and Development (OECD) concept [1], pre-genomics *ex situ* collections of microbial cultures will transform into BRCs, new depositaries and providers of high-quality biological materials and essential information [2, 3]. This reflects the evolutionary development of microbial material depositaries following the scientific and technical progress and under the influence of socio-economic, legal and political events. Microbial collections develop reactively from providers of microbial materials for the scientific sector to providers of resources for the society in whole [4]. Moreover, the preference is given to the establishment, strengthening and evolution of specialized collections interacting according to common standards and meeting the users' needs. These collections are specific in that they are up-to-date centres that not only acquire and preserve the microbial cultures, but also provide comprehensive information on their properties and potential applications that general-purpose collections actually cannot provide due to a number of reasons. The collection holdings of the latter swell extremely and affect their functioning. Therefore, the evolution of giant collections has been hampered across the world, while decentralized collections of microbial cultures are being established at a mass scale.

At present, the World Data Centre for Microorganisms (WDCM, http://wdcm.nig.ac.jp) has records for 592 collections from 68 countries [5]. In the World Directory of Collections of Cultures of microorganisms, Russia is represented by 16 collections. Russian collections of microorganisms function as structural units of various public organizations and can be classified into three types. (1) General-purpose collections (service, complex and public) of reference cultures of known species of microorganisms for systematic studies and development of classification schemes and methods of their identification. As a rule, these collections are patent depositaries and expert centres in the field of systematics and taxonomy of microorganisms. (2) Specialized collections (institutional or academic) meant for study and conservation of microorganisms of particular taxonomic groups isolated from natural ecosystems and having potentially valuable properties. (3) Research (private, most often monographic) collections organized by individual researchers for strains to be used in highly specialized research projects.

THE COLLECTION OF ALKANOTROPHS THAT MEETS THE REQUIREMENTS OF A NATIONAL SPECIALIZED MICROBIOLOGICAL RESOURCE CENTRE

Amongst specialized nodes in the intensively growing network of interacting collections is a Regional Specialized Collection of Alkanotrophic Microorganisms (acronym IEGM, World Federation for Culture Collections # 768, www.iegm.ru/iegmcol) located in the Urals. The collection is a part of the Laboratory of Alkanotrophic Microorganisms at the Institute of Ecology and Genetics of Microorganisms, Ural Branch of the Russian Academy of Sciences (IEGM UB RAS) and focuses on non-pathogenic actinobacteria able to oxidize natural and anthropogenic hydrocarbons. The collection concept was formulated based on that the Perm Krai is a prospective oil- and gas-producing region in the Russian Federation and so confronts ecological problems, including oil pollution.

IEGM collection evolved from the personal research collection of hydrocarbon-oxidizing cultures (including those that utilize higher gaseous methane homologues C_2–C_4) that was initiated in 1975 to study this group of microorganisms as candidate bioindicators of oil- and gas-prospecting, and environmental pollution. The analogous collections are not found elsewhere. In the Ural region and in the range of 8000 kilometers eastwards, there are no collections of microbiological resources. In Siberia, there is a Collection of Luminous Bacteria hosted by the Institute of Biophysics, Siberian Branch of the Russian Academy of Sciences, and in the Far East—a Collection of Marine Bacteria at the Pacific Institute of Bioorganic Chemistry, Far-Eastern Branch of the Russian Academy of Sciences.

The holding of the IEGM collection consists of over 2000 pure identified non-pathogenic strains isolated from samples of soil, rhizosphere, surface and stratal waters, snow, air, and core sampled in contrast ecological and geographical regions (Perm Preduralje and Eastern Siberia; Uljyanovsk Povolzhje and Krasnoyarsk Krai, etc.). The bacterial fund of the collection is being regularly enlarged by newly isolated strains from natural substrates. Strains deposited in the collection are selected by taxonomic and functional characteristics based on their potential applications in the field of biotechnology and environmental protection. The collection is significant in that many bacterial species are represented by not only individual (frequently type) strains, but numerous natural isolates from various habitats covering major geographical zones in the Commonwealth of Independent States. This allows studying the ecological versatility of bacterial species, sorting through active bioproducers of valuable compounds, and biodegraders of organic pollutants.

In the collection, widely represented are extremotolerant forms (psychroactive strains with a wide temperature range, halo-, baro-, osmo-, xero-, acido- and alkalotolerants) with high oxygenase activities and of considerable industrial potential; strains–bioproducers of amino acids, enzymes, lipids with high polyunsaturated fatty acid contents, biosurfactants (bacterial surface-active compounds) with considerable advantages over synthetic detergents used and perspective in biotope clean-up of hydrocarbon aggregates; strains–biodegraders of various pollutants, including crude oil and oil products (table). Extremo-

Organic pollutants metabolized by actinobacterial cultures from the Regional Specialized Collection of Alkanotrophic Microorganisms

Saturated hydrocarbons	Gaseous: C_3–C_4; volatile: C_5–C_{10}; liquid: C_{11}–C_{16}; solid: C_{17}–C_{20}	Aromatic amines	Aniline, toluidines, *o*-, *m*-, *p*-)
Aliphatic alcohols	Monohydric: ethanol, propanol-1, butanol-1, pentanol-1, octanol-1, hexanol-1, isopropanol, isobutanol	Natural gas fuels	Gaseous hydrocarbon mixtures
Phthalic acid esters	Dimethyl phthalate, dibutyl phthalate, dimethyl terephthalate, diethylhexyl phthalate	Crude oil	Oils of various compositions, oil products
Aromatic hydrocarbons and their derivatives	Methyl benzene, xylol, naphthalene, PAHs	Natural fats and oils	Cutting fluids of various compositions
Aromatic acids	*m*-Oxybenzoic, *p*-oxybenzoic, salicylic, terephthalic	Surfactants	Alkamon-D, alkyl sulfonate, alkylbenzene sulfonate
Isoprenoides	Dehydroabietinoic and isopimaric acids, β-sitosterol	Antimicrobials	Oxacillin, chloramphenicol, erythromycin, etc

tolerant microorganisms have recently acquired ever growing importance and are intensively studied because of the avalanche-like increase in the number of habitats where these organisms dwell under extreme conditions. The collection comprises type and reference strains belonging to the genera *Agromyces, Arthrobacter, Brachybacterium, Brevibacterium, Clavibacter, Corynebacterium, Curtobacterium, Dermacoccus, Dietzia, Gordonia, Kocuria, Microbacterium, Micrococcus, Mycobacterium, Nocardia, Nocardioides, Rhodococcus, Terrabacter*, *Williamsia*, and actinobacteria (totally 86 species).

The core of the collection is represented by the genus *Rhodococcus* bacteria belonging to the actinomycete lineage of prokaryotes within the class *Actinobacteria* and dominating in natural populations of hydrocarbon-oxidizing microorganisms. Rhodococci are famous for their extremely wide industrial potential and are one of the most elaborated bacterial groups in contemporary biotechnology. Recently, there has been a significant increase in publications and patents involving these microorganisms. However, the collection holdings of this taxon are severely limited across the world. All-Russian Collection of Microorganisms (VKM) maintains 38 *Rhodococcus* strains, Japanese Collection of Microorganisms (JCM)—92, Pasteur Institute Collection (CIP)—66, United Kingdom National Culture Collection (UKNCC)—88, German Collection of Microorganisms and Cell Cultures (DSMZ)—217, and American Collection of Type Strains (ATCC)—77. The IEGM Collection possesses the most complete collection of non-pathogenic *Rhodococcus* strains in the country and elsewhere in the world. Accumulation of numerous strains of a particular taxonomic group isolated from various natural and climatic areas, and their availability create new possibilities in developing a qualitatively novel methodology and new concepts in the systematics of microorganisms.

Rhodococcus strains isolated from natural samples at sites with high anthropogenic loading are characterized by marked emulsifying and biodegrading abilities towards individual hydrocarbons and oil products; an increased activity to heavy metal salts (Cd, Zn, Ni, Cu, Mo, Pb, Cr, V), and also by a stable activity in extreme acidic (pH 2.0–6.0) and saline (2–6%, NaCl) environments. The accumulated non-pathogenic cultures with high oxygenase activities are suitable in quest of novel producers of valuable substances, destructors and transformers of xenobiotics and active bioaccumulators of heavy metal ions, and also for devising novel strains and biological technologies. *Rhodococcus* featuressuch as a typical bacterial growth pattern, cell aggregation, growth on minimal media using various xenobiotic compounds, biosurfactant production, specific oxidoreductases, multiply biocatalytic pathways, complex network of gene-regulating interactions, numerous catabolic genes and ultimately high catabolic activity in extreme environments are evidences of the extraordinary genome versatility of these microorganisms [6–9]. The above indicates the obvious technological advantages of using these actinobacteria as potential biocatalysts in degradation and transformation processes of all known classes of organic compounds.

Potential applications of alkanotrophic rhodococci in numerous fields of biotechnology and environmental protection (ranging from biological prospecting of hydrocarbon accumulations to enhancement of biodegradation processes in oil contaminations, and biocatalysis in fine organic synthesis) depend on reliable methods ensuring viability and stability of original properties of these biologically significant cultures. The collection experience shows that each particular taxonomic group of microorganisms requires an individual set of effective preservation methods. Many years of investigation at the IEGM Collection involving investigated structural and physiological peculiarities of rhodococci resulted in the optimal conservation

and lyophilization regimes for cultures with pre-induced alkanotrophic metabolism. Why is it important to pre-grow rhodococci with hydrocarbons? When grown on hydrocarbon-containing media, *Rhodococcus* cells exhibit elevated levels of unsaturated fatty acids that cater for less viscosity of the membrane lipid stroma and optimal elasticity of a cell wall, hereof the resistance of cells to low temperatures. To prevent the possible oxidation of unsaturated fatty acids resulting from the long-term preservation of collection cultures, appropriate antioxidants and original protectors were selected that protect cells from low temperature exposure and enhance the barrier functions of cell membranes. The predicted sustainable time for bacterial cultures to preserve their viability is ranging from 20 to 40 years.

Considering the high scientific and commercial significance of *Rhodococcus* as well as the adequate storage of microbial cultures, it seems appropriate to raise a question of re-distributing rhodococcal strains maintained in different collections, accumulating them in one collection, and establishing a *Rhodococcus* centre.

By its concept, the collection is both a research and an educational centre. Using the IEGM collection facilities, pupils of the municipal biology lyceum carry out research work and generally continue their education at the Perm State National Research University, Biology Faculty followed by studies at the joint Immunology and Microbiology Chair at IEGM UB RAS. The most gifted post-graduates pursue postgraduate studies and produce PhD theses at the Institute. Due to the lyceum—classical university—postgraduate studies "chain" at the academy institute, we have not only extra assistants in person of PhD students, graduates, and pupils, but also are able to quest for people devoted to research work. Many postgraduates following this microbiological education work at regional industrial enterprises. However, due to a great demand for microbiologists across the world, there is an ever growing concern about young scientists' drain from this country.

IEGM Collection is included in the network of Russian specialized microbiological non-medical collections [10]. Based on the evaluation of its scientific and industrial significance, the collection was registered (September 1996) with the World Federation for Culture Collections, WFCC (http://www.wfcc.nig.ac.jp/index.html) and also in the European Culture Collections' Organization, ECCO (http://www.eccosite.org). The collection possesses an electronic database operating in the Oracle and supported by the dialogue search system, 15 staff members trained in handling of hydrocarbon-oxidizing microorganisms, and with taxonomic expertise and experience in adequate preservation of cultures. According to the proposed [11] classification, the collection can be placed in a "Healthy and safe" category. It is not, however, easy to retain in this category because maintaining a collection is labor-consuming and expensive. It is estimated that more than US$ 100000 is required to annually support a collection of 2000 strains.

The IEGM collection stock review is carried out once in two years. This is performed using state-of-the-art methods of culture characterization and identification describing "classical" features, cell wall and ultra-structure, fatty acids, chemotaxonomic markers, species-specific PCR, DNA sequencing, and immunochemical methods. The collection possesses a unique bank of polyclonal immune sera against *Rhodococcus* species. Immunochemical analyses are applied to detect and differentiate rhodococci in pure cultures and mixed natural populations.

In 1994 the first issue of the catalogue of strains (both in Russian and English) was published in a hard copy [12], while the recent issue (electronic version) appeared in 2010. An electronic catalogue is available at the IEGM website (www.iegm.ru). Figure 1 shows sample catalogue information available for public access via Internet (www.iegm.ru/iegmcol/). This also includes complete history of a collection strain. Together with common data (scientific genus and species names according to the official bacteriological nomenclature, accession numbers and histories of strains, isolation substrates, nutrient medium formulations, and conservation regimes), the catalogue information also includes a list of pollutants metabolized and bibliographic manual (in taxonomy, morphology, physiology, practical application of strains, contemporary methods for their study) indicating the state of knowledge on strains maintained in the collection. The biographical part in the catalogue information is updated and replenished based on the results obtained in research performed by the collection staff and recent literary sources.

Amongst users of the IEGM collection are various national and foreign higher educational establishments and research institutions, experts in microbiology, biotechnology, ecology and medicine, industrial engineers and technicians, lecturers and students. Cultures listed in the catalogue are supplied according to generally accepted rules. For educational purposes, the cultures are free. However, extraordinary up-front costs are a serious challenge to executing the users' orders from abroad. As shown in Fig. 2, one should draw up 27 officials documents (along with necessary sanitary, phyto-sanitary, and veterinary certificates) for the cultures to be released abroad. Total expenses associated with the above procedure amount to US$ 700.00 whereas the agreed price is US$ 70.00 per strain.

IEGM Collection provides short-term training courses in isolation, cultivation, and identification of alkanotrophic microorganisms. For educational purposes, the collection strains are used during the practical work on microbiology and identification of bacteria at the Immunology and Microbiology Chair, Perm State National Research University. The

REGIONAL SPECIALISED COLLECTION OF ALKANOTROPHIC MICROORGANISMS

***Rhodococcus ruber*[1](Kruse 1896) Goodfellow and Alderson 1977[AL2]**

IEGM[3] 231[4]

<- I.B. Ivshina, IEGM, OEGM 29-1B-1[5]. Isolated from: water, spring[6], Olkhovski oil-extracting enterprise, Perm region, Russia[7]. Taxonomy/description: (55, 95, 97, 245)[9]. Shows positive result with *Rhodococcus ruber* primers in species-specific PCR (245)[9]. Properties: uses propane and *n*-butane as sole carbon source (95)[9]; produces biosurfactants when growing on *n*-alkanes C_{12}-C_{17} (74, 248, 254)[9]; degrades high-porous ceramic materials (237)[9]; degrades paracetamol (265)[9]; forms cholesterol oxidase; resistant to Cd^{2+}, Mo^{6+}, Ni^{2+}, Pb^{2+}, VO^{2+}, VO_3^-, VO_4^{3-}, accumulates molybdenum and nickel (286)[9]. (Medium 5 or 8, 11; 28°C; F-3, L-2, S-4)[8].

Medium: 5, 8, 11

Reference (s): 55, 74, 95, 97, 237, 245, 248, 252, 253, 254, 257, 258, 261, 263, 264, 265, 267, 268, 269, 271, 275, 277, 286, 294

Fig. 1. Sample catalogue information on *Rhodococcus* strains maintained at the Regional Specialized Collection of Alkanotrophic Microorganisms.

[1]—Valid genus/species name of bacteria; [2]—authors who described and re-described the species, year of validation; [3]—collection acronym; [4]—strain accession number in the collection; [5]—individual or organization from where the strain was received; strain accession number upon acquisition; [6]—isolation substrate; [7]—geographical location of the strain isolation site; [8]—nutrient medium, cultivation temperature, conservation and storage methods; [9]—references to publications where this strain was used.

obtained information is further included in lecture-based training relevant to Microbiology and Virology, Systematics of Prokaryotic Organisms, Petroleum Microbiology, Environmental Biotechnology, and Technogenous Ecosystems and Environmental Risks.

Along with performing the basic research (comprehensive study of alkanotrophs' biology, their adaptation mechanisms in anthropogenically disturbed ecosystems) and collection-relevant activities, a specialized collection is involved in applied research using the alkanotrophic pool and promotes various biotechnological applications (production of novel preparations, development and improvement of leading-edge technologies). The collection bioresources were used to obtain an effective biopreparation of novel formulation and novel (oleophilic) form useful for oil-contaminated soil clean-up in extreme climatic environments [13]. A multi-disciplinary collaboration of PermNIPIneft Co. (LLC LUKOIL-PERM, Perm, Russia), Napier University (Edinburgh, UK), and Contaminated Land Assessment and Remediation Centre (CLARCC) at Edinburgh University (Edinburgh, UK) resulted in the original technique for biosurfactant production and ecologically friendly rapid bioremediation technology for oil-contaminated soils [14, 15]. The above technology involves application of bacterial surfactants and allows for an ecological effect within one vegetation period (including cold climatic regions), and also possible wide duplication of the above technology at oil-producing plants and oil-refineries. Furthermore, based on the collection holding and in collaboration with Nesmeyanov Institute of Organoelement Compounds, RAS (Moscow, Russia), a process for immobilized microorganisms' carriers (matrices) was developed [16]. This methos was further used to obtain laboratory-scale samples of rela-

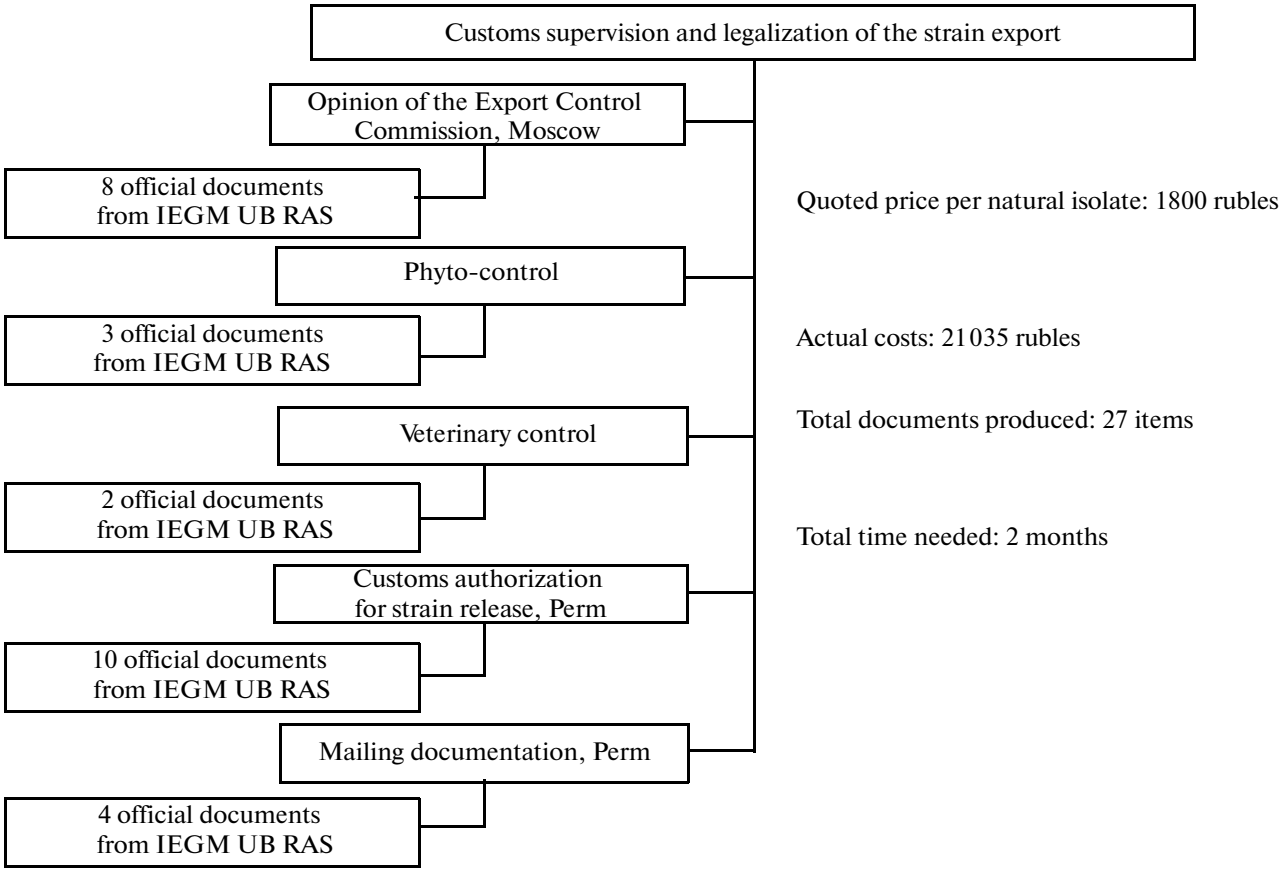

Fig. 2. Procedure for authorization of collection culture export on requests from abroad.

tively stable multi-purpose biocatalysts with basic process parameters that meet the requirements of industrial biotechnology. Potential applications of the developed biocatalysts include production of practically valuable biosynthetic products on hydrocarbon raw material; bioremediation of oil- and oil product-contaminated ecosystems, and production of biologically active intermediates for pharmaceutics.

Thus, the Regional Specialized Collection of Alkanotrophic Microorganisms in its holding, species diversity, a range of basic and applied research involving the collection strains is comparable with holdings of the leading microbial bioresource centres in Europe, and is placed among those Russian collections that meet the requirements of BRCs. The program of successive actions of IEGM Collection as a BRC can be represented as a scheme (Fig. 3) of various activities ranging from adequate acquisition of natural material, classification and taxonomic description of cultures, estimation of their biotechnology potential, development of techniques for durable preservation of cultures and maintenance of their functional diversity, upgrading of information content in accordance with international standards to sustainable supply of strains and the relevant information to users that, in fact, is the reason for any resource collection to exist.

ISSUES AFFECTING SPECIALIZED MICROBIOLOGICAL RESOURCE CENTRES

It should be noted that microbial collections provide a great variety of research and information services (acquisition, comprehensive study, adequate storage of authentic bacterial strains, taxonomic analysis of strains using advanced methods of polyphasic taxonomy, training in methods of isolation, cultivation and identification of microorganisms, particularly alkanotrophic bacteria, consultancy in taxonomy, biological peculiarities and conservation of collection cultures as well as screening for microorganisms with desired properties, and supply of living cultures on users' requests for educational, research and industrial purposes, and useful information to stakeholders and institutions). Meanwhile, the collections themselves are in need of sustainable target support of the government and public. To be in pace with scientific advances, the collections require (1) adequate staffing (training of well-qualified and technical staff, securing specialists, and staff promotion); (2) improved technical support, including adequate workspace and equipment, and advanced research facilities; (3) information services, routinely upgraded databases using current information technologies, and also development of skills of microbial collection staff; and (4) facilitated

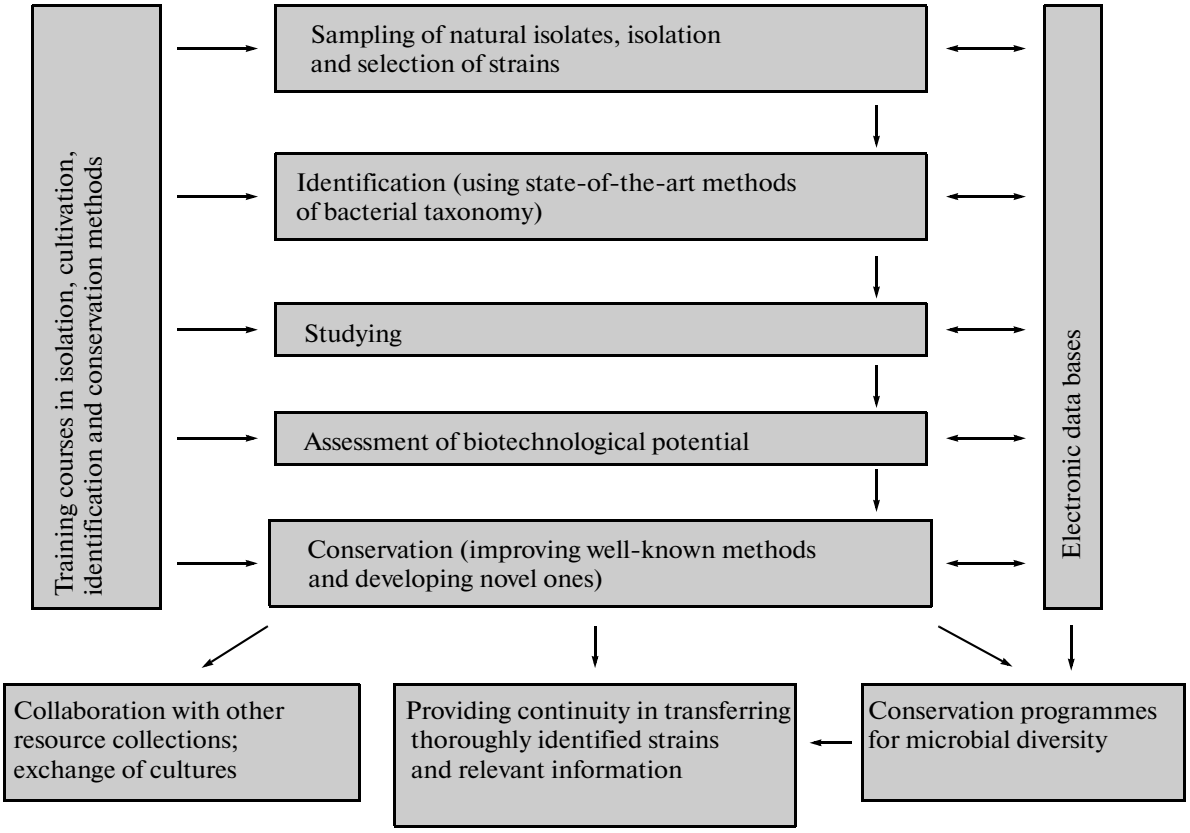

Fig. 3. Sequential stages in studying, conservation and sustainable use of collection holding.

culture exchange via harmonization of culture distribution regulations.

The vital issue is the lack of financial stability and insufficient funding. As evident from the recent stock review of collections of microorganisms in the Russian Federation, due to inadequate funding and organizational support, separate domestic collections are suffering hard times, almost ceasing their existence or have been irretrievably lost. Unfortunately, Russia is the only country in the world that has been demonstrating the negative dynamics in the units of issue of microbiological resources since 1995 [17].

ACTIONS TO BE TAKEN TO PROVIDE GOVERNMENTAL SUPPORT FOR SPECIALIZED MICROBIOLOGICAL RESOURCE CENTRES

To overcome the critical stage in the evolution of Russian collections of microorganisms and biotechnology, it is necessary to establish a wide network of microbiological resource centres imparting them the status of national centres of target sustainable funding.

National centres (NCs) could be established on the basis of generally accepted domestic collections such as the All-Russian Collection of Microorganisms (VKM) and All-Russian Collection of Industrial Microorganisms (VKPM) with their holdings, functions, potential capabilities and principles meeting the requirements of NCs. It seems timely to put a question of establishing specialized regional (territorial) centres, e.g. the Far-Eastern National Centre of Marine Bacteria, Siberian National Centre of Luminous Bacteria, Ural National Centre of Microbial Resources, and etc.

Effective functioning and sustainable existence of the next generation collections will require (1) developing an evaluation and identification system to determine the usefulness of specialized collections for both scientific community and users, and to compile a list of collections of national significance; (2) establishing an official coordination body supervising the collections, and (3) working out and adopting the Law on Microbial Genetic Resources. The Law should define the forms of governmental support, rights and duties of microbiological centres, and ultimately legislative acts are necessary to govern and protect those who produce and preserve collection values.

It is also necessary to work out a program of governmental support and mechanisms of sustainable funding and to establish a permanent advisory commission of experts in biological collections involving representatives of different sectors of scientific community to discuss issues and proposals on improvement the col-

lection activity, and be authorized to take, if and when needed, preventive measures. Establishing a national foundation of microbiological resources for biotechnology will require the improvement of the rule-making in the fields such as access to microbial genetic resources, intellectual property rights, and equitable benefit sharing arising from the use of resources in biotechnological developments that are successful depending on the correct choice of one or another microorganism.

In summary, the meeting held on June 9, 2011 at the Committee on Science and High Technology, State Duma of the Russian Federation, and initiated by Ovchinnikov Society for Biotechnologists, Russia has inspired certain hopes for raising collection activities in Russia since the issues were considered relating to a civilized legal environment for domestic biological collections, standardization of microbiological resources allowing for their safe applications in different spheres, sustainable governmental support of the existing resource collections, strengthening of their economic efficacy, and a basically new infrastructure for innovative biotechnological development in Russia. The above specified problems require a first-aid solution. This should focus on regulating collection and information services in this country in the nearest future, establishment of biological resource centres (actually, national biotechnology centres) that meet the highest world standards, and acquire due legal and economic consideration.

ACKNOWLEDGMENTS

The work was supported by the grant of the Federal Targeted Programme "Research and Development in Priority Fields of S&T Complex of Russia for 2007–2012", Activity 1.8 "Research undertaken with the use of unique facilities and scientific infrastructure (including observation stations, botanic gardens, scientific museums, etc.), research institutions and higher educational institutions" (State Contract no. 16.518.7069), and the "FP7 Cooperation Work Programme: Food, Agriculture and Fisheries, and Biotechnologies" (Proposal no. 266106 "BRIO").

REFERENCES

1. Biological Resource Centres: Underpinning the Future of Life Sciences and Biotechnology, *OECD Sci. Inform. Technol.*, 2001, vol. 7, pp. 1–68 (http://www.oecd.org/dataoecd/55/48/2487422.pdf).
2. Réchaussat, L., The OECD Initiative: Towards a Global Network of Biological Resources Centers, in *Innovative Roles of Biological Resources Centers. Japan Society for Culture Collections and World Federation for Culture Collections*, Watanabe, M.M., Suzuki, K., and Seki, T., Eds., pp. 289–292.
3. Kalakutskii, L.V. and Ozerskaya, S.M., Biological Resource Centers: Present State in Russia and Worldwide, Organizational Problems, and Prospects of Development, *Vestn. Biotekhnol.*, 2011, vol. 7, no. 1, pp. 28–40.
4. Desmeth, P. and Bosschaerts, M., The Necessary Adaptation of Culture Collections to the New Socio-Economic Environment at Global Level, *Proc. 3rd Int. Conf. "Microbial Diversity: Current Situation, Conservation Strategy and Biotechnological Potential"*, Perm, Russia, 2008, pp. 144–146.
5. *World Directory of Collections of Cultures of Microorganisms*, 2011 (http://www.wdcm.org/ 05.09.2011).
6. Larkin, M.J., Kulakov, L.A., and Allen, C.R., Biodegradation by Members of the *Rhodococcus*: Biochemistry, Physiology, and Genetic Adaptation, *Adv. Appl. Microbiol.*, 2006, vol. 59, no. 1, pp. 1–29.
7. Martínková, L., Uhnáková, B., Pátek, M., Nesvera, J., and Křen, V., Biodegradation Potential of the Genus *Rhodococcus, Environ. Int.*, 2009, vol. 35, no. 1, pp. 162–177.
8. De Calvalho, C.C.R. and Da Fonseca, M.M.R., The Remarkable *Rhodococcus erythropolis, Appl. Microbiol. Biotechnol.*, 2005, vol. 67, pp. 715–726.
9. Philp, J.C., Kuyukina, M.S., Ivshina, I.B., Dunbar, S.A., Christofi, N., Lang, S., and Wray, V., Alkanotrophic *Rhodococcus ruber* as a Biosurfactant Producer, *Appl. Microbiol. Biotechnol.*, 2002, vol. 59, no. 2-3, pp. 318–324.
10. Consolidated Catalogue of Microbial Cultures Held in Russian Non-Medical Collections. CD version, release 1.0 (Fall 2002). www.vkm.ru
11. Yamasato, K., Deteriorated/Deteriorating Culture Collections, in *Endangered Culture Collections. Proc 1st and 2nd Int. Symp.*, Colwell, R.R., Ed., WFCC, Maryland, USA: Biotechnology Institute. Technical Publication, 1992, pp. 45–50.
12. *Katalog shtammov Regional'noi profilirovannoi kollektsii alkanotrofnykh mikroorganizmov* (Strain Catalogue of the Regional Specialized Collection of Alkane-Utilizing Microorganisms), Ivshina, I.B., Ed., Moscow: Nauka, 1994.
13. RF Patent no. 2180276, 2002.
14. Kuyukina, M.S., Ivshina, I.B., Philp, J.C., Cristofi, N., Dunbar, S.A., and Ritchkova, M.I., Recovery of *Rhodococcus* Biosurfactants Using Methyl Tertiary-Butyl Ether Extraction, *J. Microbiol. Meth.*, 2001, vol. 46, no. 2, pp. 149–156.
15. RF Patent no. 2193464, 2002.
16. RF Patent no. 2298033, 2007.
17. Ozerskaya, S.M., Kochkina, G.A., Ivanushkina, N.E., Zaprometova, K.M., Eremina, S.S., and Knyazeva, E.V., State of Microorganism Collections in Russia, *Vestn. Biotekhnol.*, 2006, vol. 2, no. 3, pp. 51–61.