

NATIONAL UNIVERSITY of LIFE and ENVIRONMENTAL SCIENCES of  
UKRAINE  
Ecobiotechnology and biodiversity department

**"APPROVED BY"**

Ac. of dean of the Faculty of Plant Protection,  
Biotechnologies and Ecology  
V.V. Kolomiyets

"15" June 2020

**CONSIDERED AND APPROVED**  
at a meeting of the Department of  
Ecobiotechnology and biodiversity  
Protocol №16 of "09" June 2020

Head of Department

Patyka M.V.

**CURRICULUM WORK PROGRAM**

**« Industrial Biotechnology »**

Specialty 162 «biotechnology and bioengineering»  
Educational program «Ecological biotechnology and bioenergy»  
Faculty of plant protection, biotechnology and ecology  
Associate Professor: V.V. Borodai

KYIV - 2020

**1. Description discipline  
"Industrial Biotechnology"**

| <b>Area of expertise, direction of training, Educational qualification</b> |   |
|--|---|
| Area of expertise  | Biotechnology                           |
| direction of training  | 162 «Biotechnology and bioengineering » |
| Educational qualification  | «Bachelor»                              |
| <b>Characteristics of discipline</b>                                       |   |
| Kind of discipline   | regulatory                              |
| Total hours  | 121                                     |
| The number of credits ECTS   | 3,4                                     |
| Number three content modules   | 3                                       |
| Course project (work)  |   |
| form of control  | Exam                                    |
| <b>Indicators discipline for full-time and distance learning</b>           |   |
|  | full-time learning                      |
| First training   | 1                                       |
| Semester   | 1                                       |
| Lectures   | 30                                      |
| Practical, seminars  | -                                       |
| Laboratory classes   | 30                                      |
| Independent work   | 61                                      |
| Number of weekly hours<br>for full-time students:                          | 4                                       |
| classroom:   | 1,3                                     |
| independent student work:  |   |

## 2. Purpose and Objectives and competencies of the discipline "Industrial Biotechnology"

**The purpose** of study of discipline is a capture to knowledge and abilities of cultivation of separate strains of industrial microorganisms students, by the methods of selection of biological agents for the receipt of separate products, government of cultivation of microorganisms, control of quality of the got product, directions of application of products of biotechnology, determination of them processes bases ecological safety, especially created on the basis of the genetically modified microorganisms. A course foresees preparation of bachelor and leans against knowledge of disciplines which form a specialist for different industries of national economy, including agroindustrial production.

A task to the course is making for the students of ability to manage the processes of cultivation of microorganism's pilot-scale by collection, working and analysis of information; experimental mastering of methods of work with different industrial microorganisms in the conditions of laboratory and during educational practices in research establishments and biochemical enterprises.

Students will get knowledge about the physiology features of industrial strains of microorganisms, condition of receipt of products on their basis, directions of application of such matters, and also prospects of development of bases of industrial biotechnology in Ukraine and in the world; will lay hands on the methods of control after the processes of biosynthesis of products on the basis of microorganisms and estimation of degree of their risk for a human and environment. The theoretical aspects of discipline are fastened on laboratory employments.

Information from discipline for students is contained in textbooks, manuals, methodical recommendations, departments developed by teachers, by scientists, in monographs, academic and periodic editions and network of Internet.

After mastering of course a student **must know** ecobiotechnological bases of plant-grower; biochemical, physiology and physical methods of analysis of biotechnological products; devices and equipments are for biotechnological processes; government and accident and labor protection prevention biotechnological processes bases are ill a biotechnological laboratory, on a production, constrained with the use of microorganisms.

A student must **be able** to use the obtained knowledge and skills in practice of national economy: able to prepare nourishing environments, reagents and tableware for sterilization, to modify them in obedience to the put tasks; to carry out control of biotechnological operations in laboratory and production terms; to estimate the results of biotechnological researches and processes; instrumental in introduction of results of biotechnological researches taking into account biosafety of environment.

Independent work is presented by the set of individual semester tasks with the purpose of verification of mastering of educational material and methodical pointing a student to implementation of works. Component part of control is an

estimation of knowledge on laboratory employments, during implementation of control works.

Semester control through verification and estimation of knowledge is carried out on the basis of module-rating systems on tests and examinations.

### **3. Program of discipline "Industrial Biotechnology"**

### 3. Structure of discipline "General (industrial) biotechnology"

[illegible]

#### 4. Topics of seminars

| № | Title theme              | Hours |
|---|--------------------------|-------|
| 1 | Don't provide curriculum |       |

#### 5. Topics of practical training

| № | Title theme              | Hours |
|---|--------------------------|-------|
| 1 | Don't provide curriculum |       |

#### 6. Title themes laboratory studies, hours

##### Module 1. Enzymatic processes in the biotechnology industry

| Number  | Title theme   | Hours |
|---------|---|-------|
| Lab 1,2 | Principles and methods for culturing microorganisms-producers on media. Equipment and Materials of Laboratory of Industrial Biotechnology. Methods of sterilization equipment and culture media | 2     |
| Lab 3,4 | Preparation of nutrient media for culturing bacteria and fungi in the laboratory. Principles of nutrient media in biotech manufacturing   | 2     |
| Lab 5,6 | Getting a batch culture <i>Bacillus subtilis</i> , <i>Bacillus subtilis</i> var <i>mesentericus</i> , <i>Aspergillus niger</i>  | 2     |
| Lab 7,8 | Initial screening of microorganisms - antagonists in rhizosphere of plants. Isolation of pure cultures of microorganisms - antagonists  | 4     |

##### Content module 2. Scheme and main stage biotech industries.

|           |   |   |
|-----------|---|---|
| Lab 11,12 | Cultivation of yeast on nutrient media containing carbon substrates   | 5 |
| Lab 13,14 | Cultivation of microorganisms - antagonists on selective nutrient media   | 6 |
| Lab 15,16 | The investigation of microbial antagonism by perpendicular strokes. Determination of the sensitivity of microorganisms to antibiotics by paper disc | 5 |

##### Module 3. Getting biologically active substances and certain components of microbial cells.

|              |  |   |
|--------------|--|---|
| Lab 11,12    | Determination of enzymatic activity of oxidase and catalase microorganisms. Cultivation of <i>Aspergillus niger</i> on media of different composition of macro-and micronutrients  | 7 |
| Lab 13,14,15 | The formation of citric acid by the fungus <i>Aspergillus niger</i> through cultivation on liquid medium superficial way   | 8 |
| Lab 16,17,18 | The efficacy of biological products against bacterial blight pathogen of plants <i>Pectobacterium</i> spp. Standardization and quality assessment of biological titer determination by the drug. Standardization and quality assessment of biopharmaceuticals by determining the biological activity of microorganisms - producers | 7 |

## 7. Questions, test to determine the level of students learning

Form № H-5.05

NATIONAL UNIVERSITY of LIFE and ENVIRONMENTAL SCIENCES of UKRAINE

|                           |  |
|---------------------------|--|
| Faculty                   | Faculty of Plant Protection, Biotechnology and Ecology |
| Educational qualification | «Bachelor»   |
| Direction of training     | «Biotechnology»  |
| Form of education         | Full-time, distance learning                           |
| Semester, course          | 1 semester, course 1                                   |
| Discipline                | Industrial biotechnology                               |

«Approved»

Ecobiotechnology and biodiversity department

«\_\_\_» \_\_\_\_\_ 2020

Head of department \_\_\_\_\_ M.V.Patyka

Lecturer – Borodai V.V.

### Examination card №

**Question 1. *Xanthomonas campestris* bacteria used in industrial biotechnology for the production.....**  
(Fill in the form correct answer)

**Question 2. Move the target product from the aqueous phase in a non mixable with water organic matter:**

|    |             |
|----|-------------|
| 1. | flotation   |
| 2. | coagulation |
| 3. | extraction  |
| 4. | dialysis    |

**Question 3. Find the accordance between two columns:**

|                          |   |
|--------------------------|---|
| A. many cyclical process | 1. loading raw and inoculum occurs simultaneously, after fermentative liquid unloaded                                   |
| B. continuous process    | 2. A part of fermentative liquid material in the apparatus serves as the inoculum for further fermentation at discharge |
| C. periodic process      | 3. loading and unloading of media takes place at the same time for a long time  |

**Question 4. What methods are used to determine the activity of antibiotics in the lab?**

|   |  |
|---|--|
| 1 | The method of paper discs                          |
| 2 | method of Vinogradsky                              |
| 3 | The method of agar blocks                          |
| 4 | The method of calculation in the chamber Horyayeva |
| 5 | Method of perpendicular strokes                    |

**Question 5. Sources of carbon nutrition are:**

|   |   |
|---|---|
| 1 | molasses, hydrological, starch, ammonium sulfate          |
| 2 | starch, hydrological, lactose, corn flour, methyl alcohol |
| 3 | ammonium sulfate, ammonium nitrate, urea, hydrol          |
| 4 | ammonium nitrate, urea, corn extract                      |

**Question 6. Preparation of catalytic agent refers to the stage:**

|   |                                  |
|---|----------------------------------|
| 1 | Concentration of the product     |
| 2 | Separation of liquid and biomass |
| 3 | Purification                     |
| 4 | Biotech stage                    |
| 5 | Preparation stage                |

**Question 7. Mechanism of action of  $\beta$ -lactam antibiotics**

|   |  |
|---|--|
| 1 | mechanism of action is different             |
| 2 | disturbance of synthesis of cell wall        |
| 3 | irreversible inhibition of protein synthesis |
| 4 | reversible inhibition of protein synthesis   |
| 5 | violation of plasma membrane                 |

**Question 8. Over- synthesis of citric acid is possible at ...**

|   |   |
|---|---|
| 1 | limitation the producer of K and Mg, excess sucrose, low pH                   |
| 2 | limitation the producer of P and Fe, excess sucrose, low pH                   |
| 3 | limitation the producer of N and C, an excess of ammonium sulfate, pH neutral |
| 4 | limitation the producer of Zn and S, an excess of ammonium sulfate, high pH   |



**Question9. Autotrophs used as sources of carbon:**

|   |                          |
|---|--------------------------|
| A | lipids                   |
| Б | carbohydrates            |
| B | organic matter           |
| Г | amino acids and proteins |
| Д | carbon dioxide           |

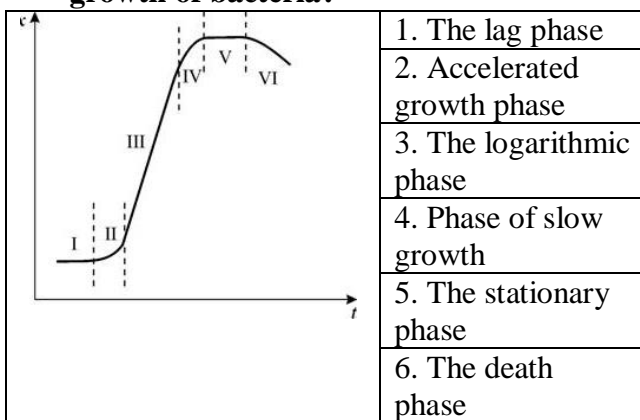
**Question10. By the universal physical mutagens include:**

*fill in the form of answers correct answer*

**Question11. Which the metabolic products related to primary and secondary products of catabolism and anabolism?**

|                                  |  |
|----------------------------------|--|
| A. Primary products of anabolic  | 1. Lipids, vitamins, biomass, polysaccharides and cellular biosynthesis intermediates: nucleotides and amino acids |
| B. Secondary products anabolic   | 4. Acetone, butanol.   |
| V. Primary Products catabolism   | 3. Ethanol, acetic acid, CO <sub>2</sub> , ATP.  |
| G. Secondary products catabolism | 4. Antibiotics, alkaloids, toxins.   |

**Question12. What is the correct sequence of phases of cell population growth of bacteria?**



**Question13. Rapid freezing at temperatures from -35 to -78 ° C, transfer vials into a vacuum-drying apparatus and drying under a pressure 13,33-1,33 Pa within 25-30 h, following sealing vials of dried cultures in an atmosphere of inert gas is called ... ..**

*Fill in the form of answers correct answer*

**Question14. The main advantage of microbial synthesis of amino acids is to get them ... ..**

*Fill in the form of answers correct answer*

**Question15. The name of process of protein biosynthesis is.....**

|   |                |
|---|----------------|
| 1 | transcription  |
| 2 | replication    |
| 3 | translation    |
| 4 | transformation |
| 5 | restriction    |

**Question 16. For adsorption ... .. contains protein molecules on the surface of the carrier by electrostatic, hydrophobic, dispersion interactions and hydrogen bonds**

*Fill in the form of answers correct answer*

**Question17. Chemical factors mutagenic action:**

*Fill in the form of answers correct answer*

**Question 18. The trophophase includes:**

|   |                          |
|---|--------------------------|
| 1 | Accelerated growth phase |
| 2 | The stationary phase     |
| 3 | The death phase          |
| 4 | The logarithmic phase    |
| 5 | Phase of slow growth     |
| 6 | The lag phase            |

**Question19. High-purity enzymes**

**are:....**

|   |     |
|---|-----|
| 1 | 10x |
| 2 | 20x |
| 3 | 3x  |

**Question 20. Cell membranes of bacteria built with:**

- 1) protein and carbohydrates;
- 2) lipids and proteins;
- 3) cellulose;
- 4) nucleic acids and lipids.

**Question21. The most common amino acids, obtained by microbiological synthesis, are:**

|   |   |
|---|---|
| 1 | tryptophan, dextran, proline, lysine, surfaktyn                     |
| 2 | proline, tsiankobalamid, lysine, glutamic acid, leucine, tryptophan |
| 3 | glutamic acid, leucine, tryptophan, dextran, proline, lysine        |
| 4 | proline, lysine, glutamic acid, leucine, tryptophan                 |

## 8. Teaching methods

The success of learning as a whole depends on the intrinsic activity of students, the nature of their activities, it is the nature of the activity, degree of autonomy and creativity should be important criteria in choosing a method.

Explanatory and illustrative technique. Students acquire knowledge by listening to the story, lecture on educational or instructional materials through the on-screen guide in the "ready" form. Perceiving and interpreting facts, evaluations, conclusions, they remain within the reproductive thinking. This method is used widely as possible to transmit large amount of data. It can be used for presentation and assimilation of facts, approaches, assessments and conclusions.

Reproductive method. This refers to the application of learned from sample or regulations. Activities of trainees is algorithmic, corresponding instructions, orders, rules - similar to the present sample situations.

The method of problem presentation. Using any source and means lecturer before teaching material, poses the problem, formulating cognitive tasks, and then exposing the system is proved by comparing the views, different approaches shows way to solve the problem. Students are like witnesses and accomplices in scientific research.

Partly-search or heuristic method. Its essence - to organize the active solver nominated teacher (or self-contained) or cognitive tasks under the supervision of the teacher or based on heuristic programs and guidelines. The process of thinking becomes productive nature, but it gradually directs and supervises the teacher or the students on the basis of the above programs (including computer) and manuals. This method is one of the varieties of which are heuristic conversation - a proven way to enhance thinking and motivation to learning.

The research method. After reviewing the material, production problems and tasks and short oral or written instruction by those who teach self-study literature sources are monitoring and measurements and perform other search action. Initiative, independence, creativity manifested in research activities fully. Methods of training is directly transferred to the methods which mimic and sometimes implement scientific research.

So, considered the six approaches to the classification of teaching methods.

## 9. Forms of control

### Exams, Tests, final tests

#### Methods and scale assessing students

#### Ratings of student knowledge

#### Indicative distribution of points, awarded to students

| type of control | module | theme | Training sessions (preparation and execution) | Individual tasks | modular (module control) | Total |
|-----------------|--------|-------|---|------------------|--------------------------|-------|
| 0 5 4 3         |        | 1.1.  | 2   | 2                | 3                        | 7     |

|               |         |      |    |    |    |     |
|---------------|---------|------|----|----|----|-----|
|               |         | 1.2. | 3  | 3  | 3  | 9   |
|               | Total 1 |      | 5  | 5  | 6  | 16  |
|               |         | 2.1. | 4  | 4  | 4  | 12  |
|               |         | 2.1. | 4  | 4  | 4  | 12  |
|               | Total 2 |      | 8  | 8  | 8  | 24  |
|               |         | 3.1. | 6  | 6  | 3  | 15  |
|               |         | 3.2. | 6  | 6  | 3  | 15  |
|               | Total 3 |      | 12 | 12 | 6  | 30  |
| Total         |         |      | 25 | 25 | 20 | 70  |
| Exam          |         |      |    |    |    | 30  |
| General total |         |      |    |    |    | 100 |

### **Module system of teaching of discipline and a rating evaluation of knowledge of students is after its mastering**

In accordance with «Statute about credit-module system of studies in educational material of discipline « Industrial biotechnology» it parts on 4 semantic modules, by a volume 5.8 credits of EST seach.

Rating of student from mastering of discipline is determined on a 100 ball scale. He consists of rating from educational work at the evaluation of which 70 points target, and rating, from attestation (to examination) - 30 points. Every semantic module is also estimated on a 100 ball scale. By the form of control of knowledges from the semantic module 1 there is implementation of calculation work will build on transformer substation (a task is given out to every student). Semantic module 2 estimated as a result of defence of reports from laboratory works.

On rating from educational work in decision of department, rating can influence from additional work - to 20 points and rating penalty (with a negative sign) - to 5 points.

Rating of student from educational work **of R<sub>nr</sub>** is determined after a formula

$$R_{ew} = 0,7(R^{(1)om} + R^{(2)om})/K_{disc} + R_{awP} - R_p, 2$$

where **R<sup>(1)OM</sup>**, **R<sup>(2)OM</sup>** ratings estimations accordingly 1th and 2th semantic modules after by a 100-ball by a scale;

**R<sub>aw</sub>**, **R<sub>p</sub>** rating from additional work and rating is penal accordingly.

Students which collected from educational work 60 and more points can not make examination, but get in examination estimation "Automatically", in accordance with the collected amount of points, translated in a national estimation and estimation of ESTs in obedience to a table. 2.6. In such case rating of student from discipline **R<sub>disc</sub>** equals his rating from educational work.

$$R_{disc} = R_{ew}$$

If a student wishes to promote rating and become better estimation from discipline, he must пройти semester attestation - to make examination. Last students, which from educational work collected less than, than 60 points, take place in an obligatory order. For admitting to attestation a student must collect less

than 60 not points from every semaritic module, but oh the whole not less than, than 42 points are from educational work.

Rating of student from attestation of  $R_{at}$  isdetermined after by a 100-poins by a scale.

Rating of student from discipline of  $R_{disc}$  is calculated on a formula

$$R_{disc} = R_{ew} + 0,3 R_{AT}$$

Rating of student from discipline is translated in a national estimation and estimation of ESTs

#### 10. Between national and ESTs by estimations and rating from discipline

| Estimation national | Rating from discipline, points |
|---------------------|--------------------------------|
| Excellent           | 90 -100                        |
| Good                | 74-82                          |
| Satisfactorily      | 60-73                          |
| Unsatisfactorily    | 0-59                           |

A national estimation is written down in the test book of student, and an estimation of ESTs a book of rating estimation of knowledges of student.

Intermediate control of knowledge of students is carried out regularly on lecture and practical employments by their questioning from passed material. Form of control of knowledges from the semantic module 1 is implementation of calculation work from the calculation of ground will build on transformer substation. Semantic module 2 estimated as a result of defence of reports from laboratory works.

Final control of knowledges is carried out **on examination**.

An estimation is "*excellent* proposed" to the student which during a semester worked systematic, on examination rotined scalene and deep knowledges of programmatic material, able freely to execute tasks which are foreseen by the

program, mastered basic and acquainted with additional literature, intercommunication of separate sections of discipline, their value feels for a future profession, found out creative capabilities in understanding and use educational-programmatic to material, showed a capacity for an independent update and addition to knowledges.

An estimation is "**Good** proposed" to the student which found out complete knowledge educational-programmatic to material, successfully executes the foreseen program tasks, mastered basic literature which is recommended by the program, proof character of knowledges rotated from discipline and apt at their independent addition and renewal during subsequent studies and professional activity.

An estimation is "**Satisfactorily** proposed" to the student which discovered knowledge basic educational-programmatic to material in a volume, to the necessity for subsequent studies and next work after a profession, produced with implementation of tasks, foreseen by the program, assumed separate errors in an answer on examination and at implementation of examination tasks, but owns necessary knowledges for their overcoming under the direction of scientifically pedagogical worker.

An estimation is "**Unsatisfactorily** proposed" to the student which did not find out sufficient knowledges basic educational-programmatic to material, assumed of principle errors in execution the tasks foreseen by the program, it does not can unassisted scientifically pedagogical to use a worker knowledge at subsequent studies, not able to lay hands on skills of independent work.

## **11. Methodology Support**

1. Guidelines for the study of the subject "Industrial Biotechnology" for bachelors direction 6.051401 "Biotechnology" distance learning.
2. Guidelines for the study of the subject "Industrial Biotechnology" for bachelors direction 6.051401 "Biotechnology" for independent study courses.
3. Guidelines for the study of the subject "Industrial Biotechnology" for bachelors direction 6.051401 "Biotechnology" - a course of lectures.
4. Guidelines for writing a term paper on the subject "Industrial Biotechnology" for bachelors direction 6.051401 "Biotechnology".

## **12. Educational - methodical materials from discipline**

### ***Main:***

1. Машины и аппараты пищевых производств : учебник для вузов/ [Антипов С.Т., Кретов И.Т., Остриков А.Н. и др. ]; под ред. В.А. Панфилова. - М.: Высшая школа, 2001. - 704 с. – (в 2 кн., кн.1).
2. Промышленная микробиология : учеб. пособие для вузов / [Аркадьева З.А., Безбородов А.М., Блохина И.Н. и др. ]; под ред. Н.С. Егорова. - М.: Высшая школа, 1989. - 688 с.
3. Безбородов А.М. Биотехнология продуктов микробного синтеза: Ферментативный катализ, какатернатива органического синтеза / А.М. Безбородов - М.: Агропромиздат, 1991. – 238 с.
4. Бекер М.Е. Биотехнология / Бекер М.Е., Лиепиныш Г.К., Райпулис Е.П.– М.: Агропромиздат, 1990. – 334 с.
5. Егоров Н.С. Биотехнология : микробиологическое производство биологически активных веществ и препаратов: учеб. пособие для вузов. / Н.С. Егоров, В.Д. Самуилов. - М.: Высшая школа, 1997. – 143 с. – ( в 8 кн., кн.6).
6. Воробьева Л.И. Промышленная микробиология: учеб.пособие / Воробьева Л.И. – М.: Изд-во МГУ, 1989. – 294 с.
7. Пирог Т.П. Загальна мікробіологія: підручник / Пирог Т.П. — К.: НУХТ, 2004. — 471 с.
8. Пирог Т.П. Загальна біотехнологія: підручник / Т.П. Пирог, О.А. Ігнатова. – К.: НУХТ, 2009. – 336 с.
9. Сельскохозяйственная биотехнология / [Шевелуха В.С., Калашникова Е.А., Кочиева Е.З. и др. ]; под ред. В.С.Шевелухи. – [3-е изд., перераб. и доп.] – М.: Высшая школа, 2008. – 710 с.

### ***Additional:***

10. Антипова Л.В. Прикладная биотехнология: Учеб. пособие для вузов / Антипова Л.В., Глотова И.А., Жаринов А.И. - Воронеж: Воронеж. гос. технол. акад., 2000.- 283 с.
11. Биотехнология. Принципы и применение / [Бич Г., Бест Д., Брайерли К. и др. ] Пер. с англ. ; под ред. И. Хиггинса, Д. Беста, Дж. Джонса. – М.: Мир, 1988. – 480 с.

12. Биотехнология микробных ферментов / [Лобанок А.Г., Астапович Н.И., Михайлова Р.В., Безбородов А.М.] – Минск: Наука и техника, 1989. – 204 с.
13. Бирюков В. В. Основы промышленной биотехнологии / Бирюков В. В. — М.: КолосС, 2004. — 296 с.
14. Витол И.С. Экологические проблемы производства и потребления пищевых продуктов: учеб.пособие. / Витол И.С. - М.: МГУПП, 2003. – 93 с.
15. Микробиология / [Воробьев А.А., Быков А.С., Пашков Е.П., Рыбакова А.М. ] — М.: Медицина. — 1998. — 336 с.
16. Голубев В.Н. Пищевая биотехнология / В.Н.Голубев, И.Н. Жиганов. – М.: Делипринт, 2001.– 123 с.
17. Елинов Н.П. Основы биотехнологии: Для студентов институтов / Елинов Н.П. – СПб: Наука, 1995. – 600 с.
18. Кавецкий Г.Д., Васильев Б.В. Процессы и аппараты пищевой технологии / Г.Д. Кавецкий, Б.В. Васильев. - М.: Колос, 2000.- 551 с.
19. Неверова О.А. Пищевая биотехнология продуктов из сырья растительного происхождения/ О.А. Неверова, Г.А.Гореликова, В.М.Позняковский. – Новосибирск: Сиб.унив.изд-во, 2007. – 415 с.
20. Современная микробиология. Прокариоты / Под ред. И. Ленгелера, Г. Древса, Г. Шлегеля. — М.: Мир, 2005. — Т. 1. — 654 с.

### **13. Information Resources**

1. <http://www.biotechnolog.ru>
2. <http://fp7-bio.ru/biotech/nkt-in-russia>
3. <http://www.processindustries.mwgroup.net/ru/glavnaja>

