POSTBIOTIC AND OTHER PROTECTIVE MOLECULES RECOGNIZING AND BINDING GLYCOCONJUGATES IN MUCOSAL ORGANS

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Abstract. New aspects of human mucosal cavity protection systems are under consideration. On the basis of own data it was suggested that mucosal cavities function as mucosal organs. New players of mucosal organ were proposed. They included system probiotic lectins and probiotic microorganisms, and system synthetic polymeric multivalence pattern glycoconjugates. Lectins and glycoconjugates (mucin-like or imitating, antigens, polysaccharides and other high molecular mass metabolites and postbiotics) were suggested to communicate to other glycoconjugates-recognizing molecules and receptors of the human higher hierarchic protection systems. Concept of functioning mucosal organs is supported by own proposals, strategies, approaches, methods and algorithms. The data are useful for constructing biotope ordered pro/synbiotic microbiocenoses for application in medical biotechnology.

Аннотация. Рассмотрены новые аспекты защитных систем открытых полостей организма. На основе собственных данных предложили функционирование открытых полостей как специфических мукозальных органов. Отражен прогресс развития представлений о мукозальных органах, распознающих и связывающих гликоконъюгаты. Предложены и описаны новые игроки мукозального органа, представленные системами пробиотических/симвиотических лектинов, пробиотическими/симвиотическими микроорганизмами и природными и синтетическими полимерными мультивалентными гликоконъюгатами. Предположено, что лектины пробиотиков и гликоконъюгаты (в том числе синтетические муцины-подобные, имитирующие антигены, полисахариды и другие высокомолекулярные метаболиты и постбиотики) могут кофункционировать в коммуникациях с другими гликоконъюгаты распознающими молекулами не антителной природы, рецепторами клеток более высокоорганизованных иерархических систем врожденного иммунитета организма. Концепция функционирующих упорядоченных распознающих и обратимо связывающих гликоконъюгаты мукозальных органов поддержана собственными предложениями, стратегиями, подходами, методами и алгоритмами. Данные будут полезны для конструирования специфических для типа биотопа упорядоченных микробиоценозов, направленных на решение задач медицинской биотехнологии.

Keywords: Mucosal organ, mucosal barrier, biotope, microbiocenosis, probiotic, postbiotic, lectin, glycoconjugate, antimicrobial, antiviral, synbiotic, leader microorganism, pathogen, innate immunity.

Ключевые слова: Мукозальный орган, мукозальный барьер, биотоп, микробиоценоз, пробиотик, постбиотик, лектин, гликоконъюгат, антимикробный агент, синбиотическая система, лидерный микроорганизм, патоген, врожденный иммунитет.

Abbreviations
GC : Glycoconjugates
MGC : Mucin type glycoconjugates
MO : Mucosal organ
L : Lectins
LL : L of lactobacilli
LB : L of bifidobacteria
LS : Lectin system(s)
LSPB : LS of PB
PA : Polycrylamide
PAG : Polycrylamide gel
PB : Probiotic bacteria
SLS : Super lectin system(s)
QS : Quorum sensing

Introduction
A lot of diseases are connected to altering processes in human organism involving changes in glycome [1-5]. On the one hand, a number of human recognition systems protect interactome of organism [6, 7]. Such systems involve a lot of examples of recognition between lectins and glycoconjugates (GC) [6, 8, 9]. Indeed, cytokines, defensins, pattern recognition receptors and molecules, components of complement and blood clotting, protein hormones and their receptors are important participants of the human metabolome network and reveal properties of true lectins [3, 6, 7]. Lectins act as universal cofunctioning recognition systems regulating human interactome involving GC [6, 10-15]. On the other hand, microbiocenoses are important part of any human biotope. Together with complement and other human innate immunity recognition systems, microbiocenoses are also involved in protection against diseases. Pro/synbiotic compartments of microbiocenoses, biotope, mucus and mucosal open cavities counteract opportunistic (relatively pathogenic) compartments at hierarchical levels of structure-functional organism [16].

The aim was using own published data for both: a) development of concept of mucosal organs (MO) within functioning human open cavities involving recognition of GC supported with symbiotic/probiotic lectins and probiotic/symbiotic microorganisms; b) description of biotechnological resources of MO which simplify applications of MO against pathological processes in organism for goals of medical microbiology.

**Concept and strategies**

Concept of functioning mucosal opened cavities of organism as its MO includes the following general positions.

1. Universality of structure-functional organization of mucus, individuality of biotope mucus, tropism of local mucus, state of locally changeable mucus in on duty regime.

2. Phenotypes of local MO depend on relationships between probiotic compartment and relatively pathogenic compartment of biotope [17].

3. Due to contribution of interactions between mucins and between lectins and GC, mucus as MO is characterized by 3D-architecture organization of host cells and microbiocenoses [18, 19]. Directed organization of MO is programmed by evolutionary molecular, cellular and other mechanisms including biorhythmic assembling-disassembling (periodical abruption and changing of mucus; inducing biosynthesis and degradation).

4. MO reveals itself as multifunctional organ possessing different adaptive network properties. MO reveals itself as trapping, delivering, adjuvant, stabilizing, preventive, immune modulating, vaccinating, and therapeutically reacting instrument in its replies on any form of stress.

MO is open one to such communications as quorum sensing (QS) and cross-talking.

MO repairs and corrects protection processes of recognition/ isolation/ conservation/ elimination/ prolongation in regime of retaining and keeping functioning on duty reversible relationships together with surroundings.

5. Main structures of MO are ranged as synchronized in direct supervising supported with opposite control in relationships: MO—Mucosal layer (external, intermediate, inner)—Cell barrier—Epithelial cell surface—Membrane mucins [18, 20, 21]. It takes play multilevel regulation of mucosal barrier by human and microbiocenoses’ systems.

6. MO reflects microbiocenoses balance, antagonistic relationships between probiotic and potentially pathogenic microbiota [17, 22, 23]. MO orders mucosal and cellular barrier for localization, submission, fixation and inactivation of pathogens, exclusion of pathogens distributed all over the organism, prevention of cellular transformation of epithelial cells into cancer cells [1, 17]. Gradient disposition of microorganisms in MO must be taken into consideration [21].

7. Interactome network reveals coupled relationships between antioxidant, antimicrobial, antiviral and antitumor activities of MO [7,10, 11, 12, 13, 17, 24].

8. Sensitivity of eukaryotic pathogens (yeast like mediators between bacterial compositions and associates of microbiocenosis and tissues of the host biotope) to antimicrobials (LSPB, antibiotics, mucin like substances) serves one of important infrastructural indicators of communicative potential of MO [19, 25-31].

9. In cases of appearance of tumor like cells possessing decreased level of cell surface differentiation, MO functions in accordance to the strategy of reversible compensation and immediate reparation when changed mucosal surrounding medium and cellular decors are rebuilt in direction of original healthy status (images of normally functioning MO) [32]. As a result MO will prevent further “cell surface steps”- depended amplification of tumor like cells and development of tumors. Resources for reparation and stabilization of changed MO can be presented by therapeutically active free and solid phased LS and GC (for example, from nutrients, bioactive additives, therapeutics, specially directed compounds).

10. MO serves the library/ catalog/ memory and source of spectra of mucin type GC (MGC) of human and microbiocenosis origin, as well as diagnostic indicator and sensor accumulator and amplifier of tumor antigenic signals of diagnostic and prognostic significance.

11. MO (natural or artificial) can be used for delivery of metabiotics, depositing and further release of therapeutic agents (therapeutic Ab against tumor antigens, antimicrobial agents of pathogen suppression).

12. Current recognition by mucus and local binding to molecular-cellular targets within MO pass by ways on duty regime involving super LS (SLS). SLS of MO influence organization (net of pores of regulated size, permeability into gel) and regulation of MO.

13. SLS adapts architecture of MO for successful operations including delivery of therapeutic and signal MGC, their retaining and further release by portions
system SLS-MO as macro adjuvant device). SLS increases and supports antipathogenic control within MO.

14. SLS act as metabolomebiotics [33]. SLS initiates, stabilizes, supports (provides deeper resistance due to increasing “buffer reactivity”) and conserves microbiocenoses of healthy status of biotopes within MO.

15. Biotopes of MO function as symbiotic biotopes (synbiotopes) supporting biotope probiotic microbial compartment [16, 34].


17. On duty network of SLS-MGC increases potential of MO against viral and other inducers of tumors [1]; supports MO as reliable source of therapeutic GC and their cascades.

18. LSPB act against relatively pathogenic microbiocenoses as against communicative “bodies” of pathogenic massifs [25]. In extended terms, MO and its microbiocenoses function as hierarchic communicative “bodies” which are exchanged by signals with surroundings including other protective systems of organism.

19. SLS serve the necessary affinity macro scaffold in action of such protective systems as complement, blood clotting, pattern recognition receptors and molecules, protein hormones and their receptors.

Strategies Based on Concept of MO

Aforementioned above concept of MO possesses resources and can serve the basis for further development, choice and application of proposals against pathogenic factors.

Strategies based on probiotic/symbiotic microbial cells and probiotics

It is of reason to use probiotic combinations of lactobacilli and bifidobacteria together because of lactobacilli can stimulate bifidobacteria (the opposite influence is possible). In addition, LS of probiotic bacteria (LSPB) (lectins of lactobacilli and bifidobacteria: LL and LB) as imitators of probiotic cell activities can be used together with PB that provides support of balance, resistance and reliability of molecular-cellular recognition processes in biotopes of MO [34, 35].

Probiotic leader microorganisms influencing biotope metabolically coupled microbial populations of MO can be used. For example, leader strains of *L. acidophilus, L. casei/paracasei, L. helveticus, L. brevis* against *Candida* species [24, 36-39].

Strategies based on metabolic imitators of probiotic microbial cells

LSPB act as relatively high molecular mass polymeric probiotic effectors (in contrast to low molecular mass acidic cultural agents and bacteriocins). LSPB act as members of new class of destructors of biofilms of pathogens, and signal regulators of communications (also of QS type) [8, 10, 25, 33, 35, 40]. Examples of LSPB include the following probiotic microbial sources investigated: *Lactobacillus* sources such as multistrain probiotic Acilact, *L. casei* K3III24, *L. helveticus* NK1, *L. helveticus* 100ash, *L. paracasei* VKPM B-6253, *L. plantarum* 8R-A3; *Bifidobacterium* probiotic strains of human origin such as *B. adolescentis* spp. longum MS-42, *B. bifidum* No 1, *B. infantis* 302-87, *B. breve* 23, *B. longum* B 379 M, *B. angulatum* OV-15, *B. pseudocatenulatum* OV-2 [40, 41].

Strategies of using free (non-cellular) LSPB against eukaryotic and Gram positive pathogens can be of interest [10, 12, 25-31, 42, 43].

Antimicrobial strategies of MO using LSPB can include the following dominating synergistic combinations of LL and BL: a) against pathogenic yeast like fungi (*Candida albicans*, BL > LL) and pathogenic Gram positive bacteria (*Staphylococcus aureus*, LL > BL); b) anti-*C. albicans*—cascade “Acidic BL—Alkaline LL”; c) anti-*C. albicans*—combinations of LSPB and phytolectins. BL and azoles. Advantages of such system combinations are in non-dependence on the presence of PB (PB need special conditions for survival including the absence of a lot of types of antibiotics and other antimicrobials); possibility to use BL in the vagina which is not comfortable for bifidobacteria. Disadvantage is inability to use PB-barrier immediately within MO (later events are possible).

Protective microbial synergistic SLS involving reversible LSPB—MGC systems possess extended antipathogen potential [17, 25, 30, 42]. This position is supported by the facts that complexed LSPB retain spectrum of lectin recognizing activities (increased or decreased, or modulated as quite new).

In case of delivery of LSPB into MO, constructions of LSPB—MO will increase structure-functional stability (in term of deeper “buffer” reply reactions) of healthy status of biotope, its resistance to changes in surroundings (for example, in respect of appearance and amplification of pathogenic microbes and viruses, appearance of pathogen induced tumor like cells, their associates and tissues) [42].

It is expected that exogenic delivery of constructed “Artificial MO based on LSPB” into altered biotope will promote exchange between MO and altered mucus (similar to process for mucus saturating with MGC from surroundings) that will allow redistribution of processes to support healthy status of biotope (for example, in cases of vaginal and rectal ones).

Supersystem LSPB—GC possesses ability of distant control of landscape surroundings [6, 7, 25, 45, 46, 50]. Delivery of constructed LSPB—“Chosen panel of GC” into MO will increase not only current state of biotope but also allow using construction as source of addressed antimicrobial and antiviral preparations and vaccine ingredients which are based on participation of MGC. For example, sulfated GC reveal activity against human immunodeficiency virus (HIV) and chitosans (soluble imitators of chitin) as carriers of therapeutic effectors themselves contribute to sum of antimicrobial actions.

It is possible that upon their delivery, constructions LS—(Chosen panel of GC) will co-
function to therapeutic Ab, antigens, enzymes, antibiotics and bacteriophages [8, 9, 10, 12, 24, 26]. Co-functioning Ab-independent network LSPB—MGC together with on duty complement system using C3- and C4-subsystems of protection against pathogens (in normal states and upon systemic diseases) is additional possibility to increase effectiveness of MO against pathogens [7, 44]. Adequacy of chosen model system “LS of probiotic bacteria in polyacrylamide (PA) gel (LSPB-PAG)—Mucin GC-PA” in respect of MO (its mucosal layer, cell surface mucins and epithelial membranes) serve the reliable basis for development of constructions for medical biotechnology and medical microbiology [1, 43].

**Strategies of metabolite-cellular systems of probiotic cells/probiotics/synbiotics and LSPB involving in functioning MO**

MO functions at the level of symbiotic biotopes [34]. LSPB can act as carriers and adjuvants of different GC (artificial GC as metabolites: therapeutics, probiotics and/or postbiotics). Prebiotic and postbiotic GC will increase symbiotic action of MO and final resulting target-dependent effectiveness of the delivered molecular-cellular probiotic system. Some food phytolectin glycoproteins can reveal additional prebiotic properties towards probiotic microbiota.

Delivery of recombinant therapeutics (glycoprotein hormones, monoclonal Ab, other GC) into or within symbiotope using probiotic microbes regulated with bacteriophages is of perspective significance (cases for lactobacilli) [55, 56].

**Biotechnological resources of MO applications** [27-29, 45-47, 60, 61]

Sub-concepts, additional strategies, approaches, algorithms and methods supporting MO application are summarized in Table 1.

The structure-functional principles of the complement system (the highest achievement of evolutionary innate protective systems) can be used as a prognostic model system for any other protective system involving LS—GC recognition. In our opinion, any recognizing biosystem (known or to be established) in human organism partially function according to LS—GC principles. Anti-infectious (antimicrobial and antiviral) potential of MO against groups of diseases can be recognized [15, 28, 43, 44, 57, 58, 60].

**Table 1.**

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<tr>
<th>No, MO Sub-conceptions, Strategies, Approaches, Algorithms, Methods of LSPB, Symbiotic lectins, GC as effectors, References.</th>
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**General directions**

1 Sc. LSPB as regulators of QS in microbicenoses and cross talking in human interactome [35].

A and M. Identified expressed major and minor components of probiotic LS as potential therapeutics and signals [14, 15, 41].

2 Sc. LSPB as a new class of imitators of probiotics and synbiotics [12, 25, 33, 34, 52, 59].

S, A and M. Antimicrobial synergistic LSPB revealing synergy together with other type antimicrobials and factors [47, 48].

C and M. Cofunctioning LSPB and (exo)polymeric GC in themselves’ assembled porous hydrophilic swelling gels [12, 16].

S. LSPB as inducers of cytokines [10, 12].

3 Sc1. LSPB as a new class of metabolomebiotics distinct from other biotics and metabolites (as important constituent of metabolites) [8, 25].

Sc2. S, A and M. LSPB as navigator in early assembling and later degradation [27-29].

S and M. Lactobacillus system of LSPB and antioxidans as antifungal potential factor [50].

M. Maximal and minimal LS of PB cultures for screening desire combinations of probiotic effectors [41].

A. A number of different LS (GC type depended LS) among the same proteome as functionally active kinetic sequential cascades [41].

M. Recognition of GalNAc-containing artificial polymeric soluble glycoantigens by LSPB [10, 41].

4 Sc. LSPB as a new class of pathogen biofilm destructors [25].

A and M. Space and time cascade synergistic actions of antimicrobials and other anti-pathogenic factors involving LS [25].

5 Sc. Postbiotics as the systems within a network acting in coupled metabolic axes “Intestine—Non-intestinal parts of the body” against groups of diseases [57, 58].

6 Sc. Postbiotic systems as conversional forms of LSPB of potential therapeutic significance [14, 15].

7 Sc and A. Functional superfamly of symbiotic lectins as prognostic instrument for revealing new properties of LSPB [51].

8 Sc1. Therapeutic potential of the artificial GC systems imitating natural glycopolymers [42, 53].

Sc2. Polymeric GC as inducers of increased antimicrobial protection [30].

Al. Algorithms of Screening and choice of Probiotic Strains and Their Consortia Possessing New Antimicrobial Potential for Constructing Multi-strain Probiotics [36, 37, 39, 48, 60, 61].

**Special directions**

**Biotope microbicenoses**

9 Sc. Support of biotope functionally balanced antagonistic microbicenoses [17, 34].

10 Sc. Microbial massif as communicative body possessing one or more centers [25].

S. Multipoint organized attack of antimicrobials (firstly in sensor regions, and secondly in internal regions of exposed pathogenic mixed communicative body) [25].
**Synbiotopes**
11 Sc. The presence of mobile synbiotopes involving in organism protection [34].
S. Support of probiotic microbiocenoses in analytical small volumes (1 ml- insulin syringes) [51].
M. Symbiotic Screening System Involving Participation of Lectins of Probiotics and Synthetic Glycopolymer [52].

**Leader strains of multi-knot biotope**
12 Sc. Multiknot functioning biotope characterized with leaders of functionally coupled microbial populations [38].
C. Leader strains as supervisor microbes in cofunctioning microbiocenoses [39].
Al. Identification of leaders among coupled microbial populations [36].
Al. Calculation of the coupled system “Lactobacillus-Candida” of balanced multispecies knot of biotope network depending on biofilm forming [38].
Al. Identification of group of Candida possessing increased potential of pathogenicity [37, 43].
Al. Search of compositions of consortia-like strain pools which provide biotope stability [36, 38].

**Cases of using of antibiotics**
13 Sc. The presence of biotope biomarker biosensor coupled to communicative antagonistic microbial populations systems increasing biotope resistance in the presence of antibiotics [16, 24].
14 Sc. Antibiotics act as selective agents rearranging current hierarchical distribution of taxonomic pools within biotope coupled microbiocenoses [12].
A. Prognostic relationships between probiotic bacteria, yeast-like fungi and antibiotics in urban population biotope [54].
15 Sc. Bifidobacteria as sources of antimycotic-like systems [48].

**Collaboration of protective microbiocenoses together with higher hierarchic protective systems of human organism**
16 Sc. Complement as a prognostic model system for any innate protective system involving “Lectin-GC” recognition [12].
C and S. Prediction of human interactome based on communications between innate GC-recognizing systems [6, 7].
A and M. Potential usefulness of lectin-like sub-isotypes of C4A and C4B of human complement in diagnostics of autoimmune and infectious diseases [12].

**Comments:** A= Approach, Al= Algorithm, M= Method, S= Strategy, Sc= Sub-concept.

**Conclusion**
Aforementioned concept of MO and its sub-concepts, strategies, results and other our data published indicate importance of prospects of pro/synbiotic systems (LSPB, SLS and their cellular producers) and GC system (MGC and others, natural and artificial ones) in supporting antipathogenic and antitumor resistance of MO biotopes (intestinal, urogenital, others). Methodological approaches, methods and algorithms which support MO to increase mucosal immunity of organism are indicated. Concept of MO uses principles of balanced application of probiotic lectins and probiotics that increase natural resistance to stress. Strategies against pathological processes in organism underline prospects of MO constructing for improved therapy of system and chronic diseases. Concept of MO may be useful for further development of experimental approaches in biomedical engineering. Supersystem LSPB—MGC opens further new possibilities of innate protection in organism. Synbiotic SLS integrate known molecular-cellular protection systems. Concept of MO can serve the basis to create new combinative ways against microbial and viral pathogens and tumor like cells as well as to develop new approaches for using new hierarchic systems of drugs in medical biotechnology.

**References**

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[ISSN: 0869-2084 in Russian]
5. Lakhtin MV, Lakhtin VM, Aleshkin VA, Afanasiev SS. Lectin-dependent diversity of natural killer populations and communications against tumors and viruses. Medical Immunology (Saint Petersburg, Russia) [Meditsinskaaya immunologiya (Sankt Peterburg, Rossiya)], 2019; 21(4):595-602. DOI: https://doi.org/10.15789/1563-0625-0-0
[p-ISSN 1563-0625, e-ISSN 2313-741X]
7. Lakhtin MV, Lakhtin VM, Afanasiev SS, Aleshkin VA. Relationships between complement system, Toll like receptors, antigens CD and cytokines in normal and pathology: The review. Bulletin of


33. Lakhtin VM, Lakhtin MV, Afanasiev SS, Aleshkin VA. Symbiotic lectins – metabolomebiotics and carriers of metabolics. Gastroenterology of Saint-Petersburg (Saint-Petersburg, Russia) [Gastroenterologiya sanked-peterburga (Sankt-Peterburg, Rossiya)], 2016; No 3-4: M15 [ISSN: 1727-7906 In Russian]


35. Lakhtin MV, Bajrakova AL, Lakhtin VM, Afanasiev SS, Aleshkin VA. Lectins of probiotics – new class of signal molecules of quorum sensing. Russian Clinical Laboratory Diagnostics (Moscow) [Klinicheskeysaya Laboratornaya Diagnostika (Moskva)], 2012;9:82-3 [ISSN 0869-2084 in Russian]


[ISSN 1561-6916 (in Russian)]


[ISSN 2575-7999 in Russian] https://elibrary.ru/contents.asp?id=34550142


[ISSN 2312-2776 in Russian].

**Definitions** [12, 57, 58, 62, 63, 64, completed]

**Biotope** - structure-functional organized local space (3D-solid phased landscape together with internal and external surroundings) of mucus of opened cavities in organism (rectal and vaginal biotopes as suitable for delivery of therapeutics).

**Glycoconjugates (GC)** - covalently bound carbohydrate/ glycoside-containing polymeric compounds of artificial or natural origin (glycoproteins, proteoglycans, glycolipoproteins, glycolipids, lipopolysaccharides, other natural or artificially modified and synthetic polysaccharides and glycoantigens); GC as metabiotics (therapeutic agents, prebiotics, postbiotics, etc.).

**Leader microorganisms** – biotope microorganisms when, isolated strains of one taxonomic group significantly influence ranging/ordering biofilm forming of another taxonomic group in mixed cultures (for example, probiotic bacteria versus yeast-like fungi).

**Consortium microorganisms** - microorganisms which reveal themselves as normally coexisted monotonaxonomic or mixed functionally coupled groups in balanced biotope (similarly to multistrain pro/synbiotics).

**Lectins (L)** – carbohydrates- and GC-binding/ GC-recognition proteins and (oligo)peptides-containing compounds and their complexes. Limitations: a) L are of non-immunoglobulin or enzyme of carbohydrate metabolism nature (with exceptions of enzymes containing CBM [carbohydrate binding modules]); b) L reversibly bind to target without chemical altering contact covalent structure.

**Lectin systems (LS)** – multiple lectin forms possessing different coupled biological and physiological activities.

**Maximal LS** – maximal number of visualized and identified lectin forms (LS represented by varying mosaics of major and minor forms; the latter is responsible for observed signal or firstly expressed biological activities).

**Metabolomebiotics** – SLS of organism which influence human metabolome according to principles “SLS network-within-Interactome network”, “SLS network-against-Opportunistic microorganism and viral network”.

**Metabiotics** – compounds possessing known, standard or established biochemical) structures of possible therapeutic significance.

**Microbiocenosis** - cofunctioning microbiota; sum of microorganisms placed and functionally ordered in biotope; it always consists of antagonistic compartments (pro/synbiotic and relatively pathogenic one; both compartments function in balanced manner.

**Minimal LS** – minimal number of visualized and identified lectin forms (LS represented by major/main forms which are responsible for the main observed and registered biological activities).

**Mucosal Organ (MO)** – mucus/ mucosal barrier as structure-functional organized and exposed actively within open cavities of organism.

**Postbiotics** – probiotic cultural simple and complex metabolite substances and compounds with systemic combinative action on organism.

**Probiotic L** – L of different origin revealing useful properties for human (LSPB, phytolectins, functional food L, LS of human protective systems).

**Super LS (SLS)** – ordered sum of LS of all type protection systems of organism (integrated SLS of MO: SLS as “coordinative hierarchic sum of LS of organism’ plus network of GC [free and in complexes with LS]; SLS as carriers of GC).

**Superorganism** – human organism together with microbiota which function as inherent constituent of human body.

**Synbiote** – synbiotic biotope supporting probiotic microbiota and health; biotope possessing properties of preferential support of probiotic microbiota (for example by prebiotics of GC or non-GC origin).

**Systems** – multiple forms of the core bioactive agent(s) (for example, LSPB including major and minor functionally different sub-systems); hierarchically structure-functionally ordered (for example, in case of a number of co-functioning innate immunity major protective systems, recognizing and binding GC).