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Linguistic representation of the category of "object" in English biotechnology terminology

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Abstract. The relevance of this article is determined by the need to examine how the category of "object" is represented in English biotechnology terminology. The aim of the study was to identify the subcategories of the concept of "object" that find their lexical expression, as well as to investigate the linguistic mechanisms – particularly morphological and syntactic structures – used to denote them. To achieve this aim, a set of selective, analytical, morphological, structural-semantic, classificatory, systemic, and statistical methods was employed. It was found that within the English biotechnology terminological system, the category of "object" comprises four main subcategories: biological (36.5%), chemical (23.8%), technological (21.0%) objects, as well as materials and products (18.7%). Both simple and compound structures are employed to represent the category of "object" linguistically in English biotechnology terminology. Biological objects are predominantly expressed by simple nouns, whereas technological objects, materials, and products are more frequently represented by compound phrases. Chemical objects exhibit an almost equal distribution between simple and compound forms. Overall, the majority of terms are nouns, which is consistent with the norms of scientific and technical terminology. The obtained results confirmed the findings of modern studies regarding the dominance of nominal structures and the

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tendency to use compound names in biotechnology terminology, which is driven by the need for precision and systematicity in professional nomination. The practical significance of the study lies in the potential application of its results in teaching English for Specific Purposes to students majoring in Biotechnology and Bioengineering

Keywords: categorisation; subcategories; nominal structures; phrases; lexical expression

Introduction

The relevance of the article lies in the need to study the object categorisation in the formation, structuring, and functioning of English biotechnology terminology, which requires a systematic analysis of linguistic means representing the object category. The study of the processes of categorisation of natural objects and phenomena, as well as how they are represented in language, is a key issue in cognitive semantics. Categorisation serves as a fundamental cognitive mechanism that ensures the organisation of knowledge about objects, phenomena, and events of reality. Its linguistic representation reflects the specificity of human thinking, as well as cultural and social factors, and the cognitive processes underlying the formation of concepts. Linguists have long investigated the terminology of various scientific fields using diverse approaches. The issue of linguistic categorisation of terminology, which attracts interest not only from linguists but also from the broader scientific community, is increasingly becoming a subject of scholarly research. Within language, researchers classify scientific concepts into categories based on specific characteristics. This classification is grounded in the existence of conceptual types within each terminological system, which determines the organisation and distribution of core terminology within a given field of knowledge. Scientific concepts, as expressed through linguistic means, are categorised according to shared and distinctive features.

The relevance of researching the problem of categorisation in various scientific fields is confirmed by a large number of linguistic studies dedicated to this issue. For example, M.X. Dalieva (2023) investigated the processes of conceptualisation and categorisation in English-language terminology. The study emphasised the cognitive and linguistic aspects of term formation and systematisation, illustrating how categories were constructed within terminological systems. The author highlighted the role of prototypical concepts in organising knowledge and demonstrated the interrelation between cognitive structures and their linguistic representation. The work provided a theoretical framework for understanding how scientific terms reflected underlying conceptual categories and offered guidance for further research on terminology development in specialised domains. Although the article reported a high proportion of neologisms in the lexicon of specialised domains (>90%), it remains unclear which corpora or datasets supported this claim, and no specific examples were provided. Overall, the article is largely theoretical; incorporating practical empirical research, such as an analysis of a specific terminological field, would have strengthened the argumentation.

O. Syrotina & V. Lashkul (2023) focused their attention on conceptual categories represented by English terms in the food industry. The study constituted a valuable theoretical and terminological contribution, providing a systematic understanding of food industry terminology from the perspective of conceptual categories. At the same time, it was primarily oriented toward descriptive classification rather than an in-depth empirical investigation of the specific mechanisms of term formation and functioning. Although quantitative data were provided (eight categories, with respective percentages), it would have been desirable to include more examples of terms from each category, along with their linguistic analysis, including morphology, word formation, and the interrelations between categories.

The study by T.V. Stasyuk (2020) examined how primary conceptual categories are represented in the terminology sphere of modern technologies. The author analysed mechanisms of term formation, systematisation, and classification, emphasising the interrelation between cognitive structures and linguistic forms, and further explored the cognitive and sociolinguistic factors that influence the emergence and evolution of specialised terminology, providing a comprehensive framework for understanding categorisation in high-tech domains. Similarly, the research by I. Voloshchuk & O. Mukhanova (2021) focused on term formation and conceptual categorisation in healthcare, highlighting the role of cognitive structures and frame-semantic modelling. The researchers concluded that categorisation organised medical knowledge by defining phenomena, objects, symptoms, and their interrelations. Although the study provided a strong theoretical foundation, empirical analysis was limited, with few examples of terms or word-formation patterns. Nonetheless, it offered valuable insights into conceptual organisation and terminological structuring in specialised fields.

In a more recent contribution, H. Whitaker & E. Hawthorne (2025) examined the conceptualisation of the category "property" in English food industry terminology, focusing on the linguistic representation of qualitative and quantitative characteristics of products. The authors applied cognitive and corpus-linguistic approaches to reveal how the property concept functions as a core semantic and categorising element in terminological structures. They demonstrated that adjectives, compound nouns, and attributive constructions play a crucial role in shaping domain-specific categories. The study's integration of empirical examples and corpus evidence makes it a strong complement to earlier, more theoretical works, contributing both to terminological linguistics and applied lexicography. According to M. Taubaldiyev *et al*. (2024), the broader issue of terminology organisation was addressed. The authors analysed the challenges of unifying and stabilising general scientific terminology, emphasising the need for methodological approaches for categorisation and systematisation. The paper reviewed linguistic, cognitive, and interdisciplinary approaches to the structure of scientific terms and highlighted the need for standardisation to ensure terminological consistency across disciplines. Although primarily theoretical, this work contributes to the broader understanding of how categorisation underpins terminological coherence and interdisciplinary communication.

Existing studies mainly focused on general term categories, while certain categories, in particular "object," remain insufficiently explored, which justifies the need for their detailed analysis. In biotechnology terminology, the category "object" requires further investigation due to its semantic ambiguity: it can refer to cells, genes, proteins, or experimental materials, which complicates understanding and translation. Analysing the linguistic representation of this category makes it possible to identify the cognitive structure of terms and ensures standardisation and accuracy in the development of glossaries, educational materials, and scientific publications.

The purpose of this article was to study the linguistic means used to verbalise the category of "object" in English biotechnology terminology. To achieve this aim, the following research objectives were set: to identify the terms denoting the category of "object" and group them into four conceptual subcategories; to characterise the linguistic means employed to represent the category of "object" in

English biotechnology terminology; to analyse the structural and semantic characteristics of the terms representing this category in biotechnological discourse.

Materials and Methods

The terminological data were also taken from specialised dictionaries such as A. Zaid *et al*. (1999) and N. Kimball (2002). Other reference sources included A. Slater *et al*. (2008), Encyclopaedia of Biotechnology (n.d.), G. Miglani *et al*. (2025). General reference dictionaries such as the Britannica Dictionary (n.d.), and Collins (n.d.) were also used to clarify meanings and usage.

The sample of 400 terminological units was compiled through expert sampling. Initially, terms were identified across the designated sources, after which only those fulfilling predefined inclusion criteria were retained. The criteria comprised: demonstrable relevance to biotechnology as a scientific and applied discipline; classification within the semantic category of "object"; and alignment with one of the examined morphological patterns. Terms that were overly general, context-dependent, lacking direct relevance to biotechnology, or duplicated across sources were excluded. This systematic, stepwise selection procedure ensured the construction of a representative and thematically coherent sample, suitable for rigorous linguistic analysis. To achieve the research aim, a combination of methods was employed in a structured and sequential manner. At the first stage, a selective method was applied, involving the identification and collection of linguistic material from various sources, including the dictionaries and reference works mentioned above. Attention was focused on selecting terms related to the category of "object" that were represented by various morphological patterns, providing a broad sample for comprehensive analysis of the linguistic material. At the second stage, an analytical approach was implemented, entailing a multi-level examination of English biotechnology terms to identify and classify the linguistic means used to represent the category of "object". The terms identified through the analytical approach were systematised and grouped into four conceptual subcategories: Biological Objects, Chemical Objects, Technological Objects, and Materials and Products.

The classification of terms into Biological Objects, Chemical Objects, Technological Objects, and Materials and Products was based on specific semantic and functional criteria. Biological Objects include terms that denote living organisms or their parts, such as cells, tissues, organs, and organelles, as well as microorganisms and viruses that participate in life processes. Terms were assigned to this category if their primary characteristic is the biological or living nature of the entity. Chemical Objects comprise terms referring to molecules, chemical compounds, metabolites, enzymes, hormones, and other substances involved in biotechnological processes. A term was included in this category if it represents an entity with a defined chemical structure or a biochemical function. Technological Objects cover terms denoting instruments, equipment, methods, and technological means used in biotechnology. Terms were placed in this category if their main characteristic is technological or engineering purpose, facilitating experimentation, manipulation, or production. Materials and Products include terms referring to raw materials, biomaterials, modified organisms, and biotechnological products. A term was assigned to this category if its primary role is as an input or output within a biotechnological process. Each term was categorised based on its predominant semantic and functional features to ensure consistency and mutual exclusivity among the subcategories.

The classification of terms denoting the category of "object" in English biotechnology terminology is based on four key criteria – ontological, functional, epistemological, and pragmatic. According to the ontological criterion, objects are differentiated by their nature of existence: Biological Objects represent living organisms or tissues (cell, bacterium, plant tissue), while Chemical Objects denote biomolecules and reagents involved in bioprocesses (enzyme, protein, substrate). The functional criterion defines the role of these entities in biotechnological processes – as active agents, substrates, instruments, or products. The epistemological criterion reflects the level of conceptual abstraction, distinguishing between natural scientific entities (Biological and Chemical Objects) and applied or engineered constructs (Technological Objects, Materials and Products). Finally, the pragmatic criterion considers their purpose and practical relevance: Technological Objects serve as tools for experimentation and production, whereas Materials and Products embody the tangible outcomes of biotechnological innovation, such as biofuel or pharmaceutical compounds. At the third stage of the study, the linguistic means representing the category of "object" were systematically characterised. The morphological method was employed to determine the part of speech of each term component, establish the morphological structure, and classify terms according to typical patterns that reflect their internal grammatical and semantic organisation. Structural-semantic analysis was applied to identify word-formation patterns within each conceptual subcategory. Additionally, classification, quantitative analysis, and both systemic and statistical methods were used to assess the quantitative distribution of linguistic means representing the category of "object". The fourth stage was devoted to summarising and comparing the research findings, which involved the application of a systemic method to integrate and interpret the results.

Results and Discussion

A prominent theoretical perspective emphasised the central role of the object within cognitive and conceptual frameworks, providing a basis for understanding its significance in specialised fields such as biotechnology. G. Lakoff (1987) emphasised the significance of the object as a fundamental component in the conceptual structuring of events and cognitive representations. Similarly, according to the cognitive model of the world proposed by R.W. Langacker (1991), the object occupied a central position within the event participant schema, which consisted of the agent, process, and object. Biotechnology, as an applied interdisciplinary field, primarily deals with material and concrete entities such as cells, genes, proteins, enzymes, tissue cultures, vectors, nanoparticles, and biomaterials, which determines the object-oriented nature of its terminological system. In most quantitative studies the "object" category accounts for the largest proportion of terms in technical and natural sciences – up to 40-60% of the system – due to the continuous emergence of new material entities and their corresponding terms.

In the Britannica Dictionary (n.d.), an object is defined as "something that is a visible entity, something that can be perceived by the senses". Similarly, the Collins (n.d.) defines an object as "anything that has a fixed shape or form, that you can touch or see, and that is not alive". In everyday language, the term "object" is often used to refer to inanimate things. However, in specialised fields such as biotechnology, the category of "object" may also include living organisms, when they are considered as subjects of study, experimentation, or classification. Modern cognitive science offers new perspectives on the concept of "object" from psychological, philosophical, and linguistic viewpoints. Cognitive psychology, in particular, investigates how humans mentally represent and process objects. It examines the ways in which the brain categorises and recognises objects, focusing on concepts such as object permanence – the understanding that objects continue to exist even when not directly observed – and mental representation. Research on visual perception and attention further reveals how objects in the environment were processed, identifying features such as shape, colour, and size in order to recognise and interact with them effectively.

The concept of "object" can be examined from multiple disciplinary perspectives, each providing unique insights into its nature and role. In philosophy, it is approached through metaphysical, epistemological, and phenomenological lenses. For instance, the principle of linguistic relativity suggests that the language spoken influences how one's perception and think about the world. Cognitive linguistics, which intersects with cognitive science, examines how conceptual metaphors and mental schemas affect the ways language is used to describe objects and actions. From a metaphysical perspective, philosophers debate the nature of objects, examining the relationship between an object and its properties and the conditions of its existence. Epistemologically, attention is given to the processes through which objects are known and to the ways in which sensory experience and cognitive mechanisms shape their perception. Linguistics contributes an additional dimension by analysing how language structures and classifies objects. The terminology and descriptive frameworks applied to objects play a significant role in shaping their conceptualisation. From a metaphysical perspective, philosophers debate the nature of objects, examining the relationship between an object and its properties and the conditions of its existence. Epistemologically, attention is given to the processes through which objects are known and to the ways in which sensory experience and cognitive mechanisms shape their perception. Linguistics contributes an additional dimension by analysing how language structures and classifies objects. The terminology and descriptive frameworks applied to objects play a significant role in shaping their conceptualisation.

The issue of categorisation processes and their linguistic representation has been thoroughly examined in numerous studies by cognitive linguists. G. Lakoff (1993) highlighted the influence of conceptual metaphors on thought and language. B. Ross (1997) showed the impact of categorisation on classification processes in experimental studies. Universal human concepts and culture-specific categories in cognitive representation were emphasised by A. Wierzbicka (1992). J. Taylor (2003) explored the structure of categories and the role of prototypes in linguistic categorisation. E. Rosch & B. Lloyd (1978) examined the processes of human cognition and the ways in which people categorise objects and concepts, exploring how mental categories are formed, structured, and used to organise knowledge. The interaction between syntax, semantics, and cognitive representation was demonstrated by B. Rudzka-Ostyn (1988). Their research covered various dimensions of categorisation and conceptual representation in language, forming a strong theoretical basis for further investigation. These approaches were systematically summarised in the book of H. Cohen & C. Lefebvre (2017), where categorisation is defined as "the basic cognitive process of organising objects into categories", and a category is described as "a set of objects, ideas, or events grouped together based on shared features or properties". It was emphasised in the book that categories are not merely linguistic labels, but cognitive structures that reflect the ways in which humans perceive, organise, and interpret the world. From this perspective, in terminological systems, particularly in scientific and technical terminology, categories function as conceptual frameworks that group terms according to shared characteristics, while the process of categorisation serves as a mechanism for organising, structuring, and interrelating terms within a coherent conceptual system. This cognitive-linguistic approach provides a solid foundation for analysing the internal structure of specialised terminologies.

In the context of biotechnology, the category of "object" refers to a defined group of items, entities, or materials that share common features, functions, or characteristics and are studied, developed, or utilised within biotechnological applications. These categories often correspond to the biological, chemical, or technological components fundamental to biotechnology. In this field, the category of "object" typically includes biological entities, such as living organisms like cells, bacteria, or plants, as well as biological systems that are studied, manipulated, or engineered. It also encompasses materials and products, including raw materials used in biotechnological processes, such as enzymes, biomolecules, or substrates, as well as final products like pharmaceuticals, biofuels, or genetically modified organisms. Technological tools and equipment, such as instruments, devices, and bioreactors employed in research, experimentation, or production processes, are also considered objects. Finally, research targets, including specific genes, proteins, or metabolic pathways that are the focus of study or engineering, fall within this category.

H. Syrotina (2022) examined the conceptual categories expressed in English biotechnology terminology, focusing on their structure and frequency. In this study, the category of "object" was identified as one of the key categories, primarily including biological entities – cells, bacteria, plants, biomaterials, and other organisms that serve as the main objects of scientific research and technological processes. The author emphasised that terms denoting objects provide the structural basis of the terminology system and serve as a foundation for forming other categories, such as processes or methods. However, technological tools, materials, and final products were not considered part of the "object" category, and the functional role of this category in methodology or communication was not specifically addressed, making the approach somewhat framework-based and limited. Thus, the "object" category in the work of H. Syrotina (2022) was shown to represent the primary cognitive and conceptual foundation of biotechnology terminology, but without the detailed elaboration provided by a more comprehensive classification. In biotechnology, the category of "object" can be understood as a system for grouping entities – biological, chemical, and technological – based on shared characteristics. This classification supports the effective organisation, analysis, and practical application of knowledge in both biological research and industrial processes. Within biotechnology terminology, the "object" category encompasses terms that designate biological objects, label chemical objects, mark technological objects, and indicate materials or products. Table 1 presents the classification of the "object" category in English biotechnology terminology.

Table 1. *Classification of the "object" category in English biotechnology terminology*

Category of object	Definition	Number of terms	Percentage (%)
Biological objects	Living organisms or biological systems studied or used in biotechnology	146	36.5
Chemical objects	Biomolecules, reagents, or chemical substances involved in biotechnological processes	95	23.8
Technological objects	Instruments, equipment, or devices used in research or production	84	21.0
Materials and products	Raw materials, intermediates, or final products applied or obtained in biotechnology	75	18.7
Total	-	400	100.0

Source: *created by the authors*

Table 1 illustrates the classification of the "object" category within English biotechnology terminology, encompassing four principal subcategories: biological, chemical, and technological objects, as well as materials and products. Biological objects account for the largest share of terms (36.5%), which can be explained by their fundamental role in biotechnological research and experiments, where they serve as the basis for generating new knowledge and technologies. The high frequency of these terms is also due to the fact that they are predominantly expressed as simple nouns, which are easier to incorporate into scientific texts and dictionaries. In contrast, materials and products are less represented (18.7%) because they are mainly the end results of technological processes and often require complex or specialised word combinations, which limits their frequent use and prevalence in the terminological corpus. Chemical objects account for 23.8%, emphasising the importance of biomolecules and reagents in biotechnological processes. Technological objects represent 21.0% and reflect the technical aspect of the field related to the use of instruments and equipment. Overall, the table demonstrates a balanced structure of the terminology system, with a dominant focus on the biological component.

The first subcategory under consideration was "biological object". Terms in this category are among the most representative, accounting for 146 entries, or 36.5% of the total sample. This group includes living organisms, as well as their parts, molecules, and other components that play a crucial role in biological processes and biotechnological applications. Examples: cell, bacterium, yeast, plant, animal, tissue, organelle, virus, algae, fungus, spore, embryo, microbe, prokaryote, eukaryote, nucleus, cilium, pathogen, symbiont, parasite, microalga, mycelium, prion. Linguistic Representation of the terms in this subcategory is that they are often expressed through direct nouns, which serve to clearly and unambiguously denote specific biological entities. These nouns can be simple nouns, single-word terms that represent fundamental biological units or components (cell, bacterium) or complex nouns: combinations of two or more words that specify complex entities or structures (mitochondrion, bacteriophage). Word combinations frequently used in this subcategory: cell membrane, stem cell, bacterial culture, viral particle, tissue sample. These combinations are widely employed to specify biological objects more precisely and are commonly found in English biotechnology terminology.

Noun + Noun phrases are often used to denote complex or specific biological objects, where the first word defines the category or type, and the second specifies the particular element or function. Examples include: stem cell*,* plant cell*,* cell membrane*,* tissue sample (Zaid *et al.*, 1999). Adjective + Noun phrases describe the properties, type, or origin of an object. For example: bacterial culture – a collection of bacteria grown under laboratory conditions; viral particle – an individual virus unit (virion) capable of infecting host cells; microbial strain – a genetically distinct variant of a microorganism within a species. Participle + Noun phrases describe the state or function of an object. For instance: replicating virus – a virus actively reproducing; differentiated cell – a cell that has completed the differentiation process; activated T-cell – an immune system cell in an active state (Zaid *et al.*, 1999). The use of such constructions allows for precise and unambiguous identification of biological objects, which is critically important in biotechnology, molecular biology, experimental protocols, and scientific publications.

The next frequently verbalised subcategory within the terminology of biotechnology is "chemical object" (95 terms, which represents 23.8% of the total sample of biotechnology terminology). This subcategory encompasses a wide range of chemical compounds, that play essential roles in biotechnological applications, from enzyme-catalysed processes and pharmaceutical production to bio-based materials and molecular biology techniques. Chemical objects are fundamental for conducting experiments, producing biopharmaceuticals, and enabling industrial biotechnological applications. Examples: protein, lipid, carbohydrate, metabolite, peptide, vitamin, coenzyme, reactant, solvent, ion, acid, base, polymer, sterol, pigment, metabolite, nucleotide, nucleoside, phospholipid, polysaccharide, thiol, ester, aldehyde, ketone, aldehyde. Linguistic Representation: terms in this subcategory are primarily expressed as nouns, which can be divided into simple nouns representing basic chemical entities or biomolecules: enzyme, protein, lipid, substrate, coenzyme, ion, molecule, acid, base and complex nouns denoting more complex chemical structures or functional entities: polysaccharide, carbohydrate, nucleotide, oligosaccharide.

The category "chemical object" is also frequently represented by multi-word expressions, which provide precise and unambiguous designations of chemical compounds. Unlike simple nouns, these expressions combine multiple terms to describe a compound's composition, structure, or function. Examples include: amino acid, nucleic acid, polysaccharide chain, protein complex, carbohydrate polymer, peptide hormone, metabolite intermediate, and lipid bilayer (Kimball, 2002). These combinations specify the type of molecule, its chemical nature, or its role in a biological or experimental context. Noun + Noun phrases explain specific chemical compounds, where the first word defines the type or class, and the second specifies the molecule or function. Examples: amino acid, nucleic acid, peptide hormone, protein complex, polysaccharide chain, lipid bilayer. Adjective + Noun phrases describe the properties, type, or function of a chemical object. Examples: activated enzyme, oxidised coenzyme, soluble protein, recombinant Deoxyribonucleic Acid (DNA) (Kimball, 2002).

Participle + Noun phrases indicate the state, reaction, or functional status of a chemical object. Examples: synthesised compound, inhibited enzyme, denatured protein, activated enzyme, oxidised coenzyme. Additionally, abbreviations are widely used in biotechnology terminology to denote chemical compounds, biomolecules, or reagents concisely. Common examples include ATP (Adenosine Triphosphate), DNA, RNA (Ribonucleic Acid), rRNA (Ribosomal RNA), tRNA (Transfer RNA), NAD^+ (Nicotinamide Adenine Dinucleotide, oxidised form), PCR (Polymerase Chain Reaction), SDS (Sodium Dodecyl Sulfate), FAD (Flavin Adenine Dinucleotide), FMN (Flavin Mononucleotide), CoA (Coenzyme A) (Kimball, 2002).

Abbreviations allow scientists to refer to complex molecules concisely, ensuring clarity in protocols, diagrams, and research papers. Standardised abbreviations also support international consistency and reduce the risk of misunderstandings in collaborative and multidisciplinary research. The third numerous subcategory within the terminology of the biotechnology field "technological object" (84 items, 21% of the sample) encompasses tools, instruments, equipment, and devices used in biotechnological research, laboratory procedures, and industrial applications. Terms in this subcategory are typically expressed through nouns or noun phrases, which unambiguously denote specific technological entities. Examples: centrifuge, spectrophotometer, incubator, fermenter, bioreactor, pipette, microplate, microscope, autoclave, chromatograph, shaker, bioprinter, biosensor, electrophoresis unit, laminar flow cabinet, PCR machine, water bath, vortex mixer, microtome, cryostat (Kimball, 2002). Linguistic Representation: terms in this subcategory are expressed as simple nouns representing individual devices or equipment (centrifuge, pipette, incubator) or as complex nouns/compound phrases specifying functional characteristics, usage, or type (PCR machine, laminar flow cabinet, electrophoresis unit). Multi-word expressions are widely used to convey precise technical meaning, for example: stirred-tank bioreactor, high-performance liquid chromatograph, microplate reader, automated DNA sequencer (Zaid *et al.*, 1999). Such constructions ensure clarity and prevent ambiguity, which is critical for laboratory protocols, experimental design, and scientific publications.

Noun + Noun phrases are often used to denote specific tools, instruments, or devices, where the first word defines the type or category, and the second specifies the element or function. Examples include: centrifuge tube, Petri dish, culture flask, micropipette tip, biosafety cabinet. Adjective + Noun phrases describe the properties, type, or purpose of a technological object. For instance: sterile container, magnetic stirrer, reusable glove. Participle + Noun phrases describe the state, function, or operational condition of the object. Examples include: automated pipette, calibrated instrument, sterilised equipment, heated incubator, autoclaved flask (Zaid *et al.*, 1999). Abbreviations are also frequently used to denote technological objects, particularly for instruments and laboratory techniques. Examples include: HPLC (High-Performance Liquid Chromatography), ELISA (Enzyme-Linked Immunosorbent Assay), FACS (Fluorescence-Activated Cell Sorting), GC-MS (Gas Chromatography – Mass Spectrometry) (Encyclopaedia of Biotechnology, n.d.). Standardised abbreviations facilitate concise communication in research papers, protocols, and collaborative projects, ensuring international consistency.

The fourth subcategory under consideration is “materials and products”. Terms in this category represent final or intermediate biotechnological products, raw materials, reagents, and consumables, which are essential for laboratory work, industrial processes, and applied biotechnology research. This subcategory accounts for 75 entries, or 18.7% of the total sample, reflecting its significant role in experimental and practical applications. Examples: growth medium, culture broth, bioplastic polymer, recombinant protein, antibiotic solution, sterile medium, purified enzyme, synthetic polymer, activated charcoal, lyophilised powder, fermented broth, processed tissue, modified enzyme (Miglani *et al.*, 2025) Linguistic Representation: terms in this subcategory are typically expressed through nouns or word combinations, which clearly denote specific materials, products, or applications. These can be simple nouns: single-word terms representing basic products or materials (enzyme, protein, polymer, substrate) or complex nouns: multi-word terms specifying more detailed products, materials, or their functions (recombinant protein, bioplastic polymer, growth medium, culture broth) (Zaid *et al.*, 1999). Word combinations frequently used in this subcategory: Noun + Noun phrases denote specific products or materials, where the first word defines the type or category and the second specifies the particular product or function. Examples include: growth medium, culture broth, bioplastic polymer, recombinant protein, antibiotic solution. Adjective + Noun phrases describe properties, type, or function of products and materials. Examples: sterile medium, synthetic polymer, recombinant DNA. Participle + Noun phrases describe the state, treatment, or application of products and materials. Examples: lyophilised powder, fermented broth, processed tissue, modified enzyme, activated substrate, purified enzyme (Zaid *et al.*, 1999). Abbreviations commonly used in this subcategory include: GMO (Genetically Modified Organism), BSA (Bovine Serum Albumin), FBS (Fetal Bovine Serum), LB (Luria-Bertani medium), PCR (Polymerase Chain Reaction), IPTG (Isopropyl β-D-1-thiogalactopyranoside), DMEM (Dulbecco’s Modified Eagle Medium), SDS (Sodium Dodecyl Sulfate) (Encyclopaedia of Biotechnology n.d.).

The use of such constructions ensures precise and unambiguous identification of materials and products, which is critically important in biotechnology, industrial processes, laboratory protocols, and scientific publications. In all subcategories of biotechnology terminology, both simple nouns and compound phrases (Noun + Noun, Adjective + Noun, Participle + Noun) are used. Their frequency of use, however, depends on the specific subcategory of objects: simple nouns are more frequently used for biological objects and chemical compounds, whereas compound phrases predominate in the subcategories of technological objects and materials and products. This pattern can be explained by the need for precision and specificity in terminology. Biological objects and chemical compounds are often well-established entities with widely recognised names, so a simple noun is usually sufficient for identification. In contrast, technological objects and materials or products often require more detailed descriptions to specify their function, composition, or state, making compound phrases more appropriate for accurate and unambiguous designation. Table 2 presents the results of the quantitative analysis of the linguistic representation of the "object" category in English biotechnology terminology.

Table 2. *Linguistic representation of the "object" category in english biotechnology terminology*

Subcategory	Simple Nouns (units / %)	Compound Phrases (units / %)
Biological Objects	85 / 58.2	61 / 41.8
Chemical Objects	52 / 54.7	43 / 45.3
Technological Objects	39 / 46.4	45 / 53.6
Materials and Products	28 / 37.3	47 / 62.7
Total (400 units)	204 / 51.0	196 / 49.0

Source: *created by the authors*

Table 2 demonstrates that English biotechnology terminology within the "object" category includes both simple and compound structures. Overall, simple nouns (51.0%) slightly outnumber compound phrases (49.0%), indicating a relatively balanced distribution between single-word and multi-word terms. Biological Objects are predominantly represented by simple nouns (58.2%), reflecting the concise naming of living entities. In contrast, Materials and Products (62.7%) and Technological Objects (53.6%) favour compound phrases, which is typical for complex systems, equipment, and materials. Chemical Objects show an almost equal distribution between the two structures. The quantitative analysis revealed that most terms in the "object" category are noun-based, which is consistent with the norms of scientific and technical terminology. The total number of such terms is 204 out of 400, accounting for 51.0%, confirming their dominant presence in the dataset.

Other studies have explored similar trends in terminology formation. For instance, A. Tyutyunyk (2021) analysed the structural and semantic features of biotechnology terms, focusing on their morphological types (simple and compound) and the specifics of naming scientific objects. According to the author, although simple terms continue to hold a leading position in the biotechnology term system (45.5%), compound structures also account for a significant proportion (41.34%). This indicates the growing role of multi-component units, which allow for more precise and specialised naming of complex scientific concepts, objects, and processes. These findings generally align with observations made in this study, as they confirm the increasing prominence of compound term units in modern biotechnology terminology. At the same time, a slight divergence can be noted: while the author emphasises the predominance of simple terms in the overall corpus, current analysis showed that in certain subcategories – such as technological objects and materials – compound terms already prevail. This suggests that the rise in structural complexity within different subsystems of the field may occur unevenly.

At the same time, the analysis also highlighted a clear tendency toward the increased use of multi-component terms in biotechnology terminology. This trend has been noted by O. Syrotin (2012), who examined the structural organisation of biotechnology terms and the challenges associated with their translation, focusing on simple one-word units as well as two- and multi-component term combinations. The study emphasised that multi-word terms were increasingly used to provide greater precision in naming complex scientific concepts. The findings of the author generally aligned with the results of the present study: a substantial proportion of compound and multi-component terms was also observed in the compiled corpus. While simple terms remained frequent in some groups – consistent with the general observations of the author – current analysis showed that in certain subcategories, such as technological objects and materials, compound terms already predominated. Thus, the author's study is conceptually consistent with the present findings, while the current research adds quantitative evidence on the distribution of simple and compound terms across specific semantic subgroups.

M. Collins (2025) studied the etymological and lexico-structural mechanisms of term formation in biotechnology and noted the increasing role of multi-component terms for more precise communication of complex scientific concepts. Results of this study confirmed those findings and are considered valid, as extensive use of complex terms was also observed. At the same time, current study added a quantitative analysis and shows that in the subcategories of technological objects and materials, complex terms already predominate, which differs from the general picture described by M. Collins. Thus, current work confirmed main trends while expanding them with new empirical data.

O. Myshak (2017) investigated the occurrence and structural characteristics of multi-component terms in biotechnology discourse. The author observed that such terms appear frequently and that their number increases with the growing complexity of the subject area. The author also noted that the more components a term contains, the lower its polysemy, which reflects a higher level of precision and clarity – an aspect particularly important for professional scientific communication. These findings highlight the functional role of multi-component terms in reducing ambiguity and enhancing the accuracy of terminology in specialised fields. Overall, these conclusions were considered accurate and consistent with the findings obtained in this study, while the research provides a more detailed, empirical perspective on the uneven development of terminology complexity in biotechnology.

In biotechnology, terms denoting object category can be classified as simple (single-component) terms formed from a single element through reinterpretation, affixation, or complex (two-component) terms that are semantically completed and created by compounding, rethinking, or borrowing words; and terminological phrases (multi-component terms), which are semantically complete expressions combining two or more elements. Single-word terms may contain different numbers of word-formation components. Terms consisting only of the base (10 terms, 4.90%) include cell, gene, virus, enzyme, plasmid, protein, agent, frame, stem, and embryo. Terms formed by one base combined with one or more affixes include prefixal derivatives (5 terms, 2.45%) such as antibody, anticodon, antigen, anti-oncogene, and remark; suffixal derivatives (13 terms, 6.37%) such as nucleotide, peptide, recombinant, mutant, oxidant, polymerase, ligase, protease, amylase, albumin, actin, histone, and codon; and prefixal-suffixal derivatives (4 terms, 1.96%) such as biomarker, probiotic, antioxidant, and polymerase. Terms formed by compounding (9 terms, 4.41%) include bacteriophage, bacteriostat, immunosensor, bioengineer, bioreactor, carcinogen, biotechnology, biofuel, and pharmacogenomics (Zaid *et al*., 1999).

Complex terms used to denote object categories in biotechnology frequently incorporate neoclassical combining forms derived from Latin and Greek, including bio-, eco-, gen-, macro-, micro-, phyto-, and -plast. Examples include biotechnology, biofuel, biogas, biopesticides, biosensor, biotin, biotope, biochip, bioreactor, biosorbents, biotin, biotoxin, biotope, ecobiotechnology, ecotype, ecosystem, genomics, genotype, pathogen, macromolecule, macrophage, macronutrient, microsatellite, phytoplankton, phytochemicals, phytohormones, chloroplast, and cytoplast (Zaid *et al*., 1999). According to E. Mattiello (2022), neoclassical combining forms in English derivational morphology should be considered a distinct class of combining forms. They occupy an intermediate position between roots and affixes, carrying their own lexical meaning while not functioning as independent words. These forms are productive elements of the word-formation system, enabling the creation of new terms through regular morphological rules. This perspective allows for a more precise description of the structure and mechanisms of term formation in modern biotechnology. G. Booij (2005) similarly emphasised the semi-autonomous nature of these forms and their capacity to generate new words according to regular, though somewhat limited, patterns. O.L. Garmash (2014; 2017) also noted the active use of neoclassical morphemes in forming complex scientific terms, particularly in bio-centric and techno-centric concepts, reflecting developments in genomics, bioinformatics, proteomics, and related fields. Table 3 presents word-formation patterns of single-word terms used for the linguistic representation of the category of "object" in English Biotechnology terminology.

Table 3. *Distribution of single-word terms by word-formation structure*

No.	Type of word-formation structure	Number of terms	Share (%)
1	Base only	10	24.39
2	Prefixal derivatives	5	12.20
3	Suffixal derivatives	13	31.71
4	Prefixal-suffixal derivatives	4	9.76
5	Compounding (compound terms)	9	21.95
Total		41	100

Source: *created by the authors*

The word-formation analysis of single-word terms revealed varying productivity among different patterns. Suffixal derivatives formed the largest group (31.71%), indicating their high productivity. Compounds (21.95%) and base-only terms (24.39%) also contributed significantly, reflecting lexical economy and semantic richness. Prefixal and prefixal-suffixal derivatives together accounted for 21.96%, highlighting their auxiliary but stable role in term formation. Similar findings were reported by O. Rak *et al*. (2023) in their analysis of English terminology of infectious diseases, where suffixal formations also dominate. This demonstrates common word-formation patterns in both medical and biotechnological English terminologies.

The relative low productivity of prefixal nouns in terminology systems is also confirmed by other studies. In this context, Y. Togano (2024) emphasised that prefixation in English mostly does not change the grammatical category of a word but only expands its lexical-semantic meaning. According to him, prefixes function more as lexemes or fully meaningful units rather than as classical morphemes, which further limits their role in the formation of nouns in scientific terminology.

At the same time, in the study by M. Bogachyk & D. Bihunov (2020), devoted to the structural-semantic features of English computer terminology, it was shown that prefixal formations account for 14.3% of all analysed units, while prefixal-suffixal ones make up only 1.8%. This indicates that the productivity of word-formation models largely depends on the sectoral specificity of the terminology system. In biotechnological terminology, models related to the description of biological structures dominate, where suffixation and compounding play a more important role, whereas in the computer field, prefixes are more often used for the rapid creation of new functional terms. Prefixes mostly only modify the meaning of a word without changing its grammatical category, which limits their word-formation potential.

In the considered terminology, alongside complex words, terminological phrases also function as semantically coherent combinations of two or more components. Among these, attributive phrases (80 units, 40.8%) are formed by a stem noun and a fully inflected adjective in the pattern "adjective + noun". In such phrases, the noun in the nominative case serves as the main element, while the adjective functions as a prepositive modifier. The noun conveys the general concept, while the adjective specifies a particular feature. Examples include: bioactive component, genetic code, microfluidic reactors, protein structure, nucleotide sequence, genetic sequence, genetic map, genomic library, transgenic organism. Object phrases (60 units, 30.6%) consist of a noun combined with a defining component in the genitive case, specifying the concept of the object. Examples: cell membrane, protein structure, gene sequence, molecule composition, gene guns, cell culture. Mixed phrases (56 units, 28.6%) involve multiple syntactic relationships within a single term, reflecting more complex conceptual structures. Examples include: protein structure of the enzyme, cell culture medium of the bacteria, nuclear protein complex, antigen-presenting cell, genetic mutation rate, viral vector system, cell signaling pathway, enzyme-substrate complex, genetic make-up of an organism. Table 4 presents the distribution of terminological phrases by structural type.

Table 4. *Distribution of terminological phrases by structural type*

No.	Type of terminological phrase	Number of units	Share (%)
1	Attributive phrases	80	40.82
2	Object phrases	60	30.61
3	Mixed phrases	56	28.57
Total		196	100

Source: *created by the authors*

The analysis of terminological phrases shows that attributive phrases (40.82%) dominate, highlighting the role of adjectives in specifying biotechnological concepts. Object phrases (30.61%) and mixed phrases (28.57%) reflect relational and complex syntactic structures, demonstrating how morphology and syntax together ensure precise expression of scientific terms. A similar conclusion was reached by H. Syrotina (2022), who, within the conducted study devoted to the conceptual categories represented in English-language biotechnological terminology, analysed the grammatical models of terminological phrases. The author established that, despite being less productive than the A + N model, the N + N structure remains relevant for denoting substantive terms with attributive meaning, where the head component occupies the final position in the phrase. In turn, O. Brona (2023) found that in English scientific texts, the frequency of noun modifiers exceeds that of adjective modifiers. Although linguistic tradition favours the use of relational adjectives as terminological attributes – forming complex term phrases that convey qualitative features and ensure the synthetic integration of knowledge necessary to reveal a term's semantic potential – the predominance of noun modifiers reflects the specificity of scientific discourse. The composition of terminology also depends on the field of science – humanities, social sciences, natural sciences, or technical disciplines. While all of them name entities, objects, and phenomena, humanitarian and social sciences tend to use more nouns, whereas natural and technical sciences demonstrate a higher quantitative presence of nominal components.

In the analysed terminology, the use of multicomponent terms is widespread. Since biotechnology deals with living organisms (bacteria, cells, plants, animals) and their genetic, physiological, and biochemical characteristics, the detailed and precise definition of terms is essential for describing complex biological entities. For example, terms such as genetically modified organisms (GMOs), microbiological strains for bioremediation, microscopic cell cultures, and stem cell cultures make it possible to specify which organisms are involved in a particular biotechnological process, indicating their modifications, properties, or functions. The prevalence of terminological phrases in modern scientific fields, including biotechnology, is explained by the need to name complex conceptual components and to specify professional notions and objects as their nature becomes better understood and new aspects of the studied phenomena are revealed. Terminological phrases not only denote and differentiate newly emerging concepts but also systematise paradigmatic relations among them, reflecting the structural and conceptual interconnectedness within a specific terminological system.

When analysing multi-component terms used to verbalise the object category in biotechnology, it is important to consider the role of abbreviations. In this field, as in many other scientific and technical domains, abbreviations greatly simplify communication and save time. Given the complexity of terminology and the need for rapid information exchange, long names of compounds, processes, or methods are often replaced with shorter forms. Abbreviations allow scientists to convey information concisely and avoid misunderstandings, especially in international contexts. Graphic abbreviations used to denote object categories in biotechnology are divided into monolexemic and polylexemic types. Monolexemic abbreviations consist of a single lexeme, typically formed by shortening or acronyms, and are often applied to molecules, genes, proteins, or chemical compounds. They include initial abbreviations (A – adenine, C – cytosine, G – guanine, T – thymine, Ab – antibody, Da – Dalton), frame abbreviations (ala – alanine, cv – cultivator, lys – lysine), and truncations (sperm – spermatozoon, exo – exonuclease, mono – monocyte). Polylexemic abbreviations are formed from several lexemes or word combinations and convey more complex information, for example, GMO, ATP, RNA, and DNA. They include proper-initial abbreviations formed from initial letters, such as GMO, HAC (Human Artificial Chromosome), ESC (Embryonic Stem Cell), BAC (Bacterial Artificial Chromosome), and YAC (Yeast Artificial Chromosome). Other types comprise initial-combined abbreviations that include service parts of speech, such as GMOs (Genetically Modified Organisms), mAbs (Monoclonal Antibodies), PIPs (Plant-Incorporated Protectants), and partial-initial abbreviations formed by shortening parts of words, such as Bt corn (biotechnological corn), GM food (genetically modified food), HT crops (Herbicide-Tolerant crops), and GE fish (Genetically Engineered fish) (Zaid *et al.*, 1999).

The growing number of abbreviations and acronyms in biotechnology reflects the rapid evolution and increasing complexity of the field. As areas such as synthetic biology, gene editing, and bioinformatics continue to expand, new terms are created and quickly adopted in abbreviated forms to enhance clarity and efficiency in scientific communication. The obtained results confirmed the conclusions of modern studies regarding the dominance of nominal structures in scientific and technical terminology, which can be explained by their ability to concisely convey the essence of a concept and ensure unambiguity in professional communication. The revealed tendency toward the use of compound names in the field of biotechnology indicates the dynamic development of the industry, where new concepts require precise linguistic representation through the combination of basic and specifying components.

Conclusions

The study showed that the category "object" in English biotechnology terminology is multidimensional and includes four main subcategories: Biological, Chemical, and Technological Objects, as well as Materials and Products. Biological Objects account for the largest share of terms (36.5%), which is explained by their key role in research and their predominance as simple nouns. Materials and Products are less frequent (18.7%) because they are the final outcomes of processes and are more often represented by complex terms, which limits their prevalence in the terminological corpus. The distribution of terms reflects a balance between fundamental biological and chemical research and the applied aspects of technology and production, highlighting the complex nature of the object category in the field of biotechnology. For the linguistic representation of the category "object" in English biotechnology terminology, both simple and complex structures are used. Simple nouns slightly outnumber complex phrases (51.0% vs. 49.0%), with Biological Objects mostly represented by simple nouns (58.2%), while Materials and Products (62.7%) and Technological Objects (53.6%) are more often expressed as complex forms. Chemical Objects show an almost even distribution between these two structures. Overall, most terms in the "object" category are nouns (51.0%), which aligns with the norms of scientific and technical terminology. Simple terms are formed by using the word base alone, adding prefixes or suffixes, combining prefixes and suffixes, or compounding base components. Suffixal derivatives formed the largest group (31.71%), indicating their high productivity. For the linguistic representation of the category "object", terminological phrases are used as semantically coherent units. Attributive phrases (40.8%) combine a noun with a prepositive adjective, specifying the features of the concept (e.g., bioactive component, genetic code). Object phrases (30.6%) include a noun with a genitive modifier, defining relationships between components (e.g., cell membrane, gene sequence). Mixed phrases (28.6%) involve multiple syntactic links, reflecting more complex conceptual structures (e.g., enzyme-substrate complex, genetic make-up of an organism).

Thus, understanding the nature of an object in biotechnology allows for a more precise determination of which biological, chemical, or technological components serve as the basis for research, product development, and process optimisation. The study of terms representing these objects is crucial for systematising knowledge in the field and ensures accurate and unambiguous representation of concepts in scientific and technical texts. In this way, the terminology that represents objects forms the foundation for effective knowledge exchange, the description of technological processes, and the advancement of biotechnological practice. A promising direction for further research is the study of the linguistic representation of the category "feature" in English biotechnology terminology, as it will help clarify how the specific characteristics of biological, chemical, and technological objects are conceptualised and reflected in terms, as well as how they relate to the development of biotechnological products with enhanced properties.

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Лінгвістична репрезентація категорії «об'єкт» в англомовній біотехнологічній термінології

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Анотація. Актуальність статті зумовлена необхідністю дослідження, спрямованого на вивчення того, як категорія об'єкт репрезентується в англомовній біотехнологічній термінології. Мета роботи полягала у виявленні підкатегорій категорії «об'єкт», які мають своє лексичне вираження, а також у дослідженні лінгвістичних механізмів, зокрема морфологічних і синтаксичних структур, що використовуються для їх позначення. Для досягнення поставленої мети було застосовано комплекс вибіркового, аналітичного, морфологічного, структурно-семантичного, класифікаційного, системного та статистичного методів. Встановлено, що в англомовній біотехнологічній терміносистемі категорія «об'єкт» включає чотири основні підкатегорії: біологічні (36,5 %), хімічні (23,8 %), технологічні (21,0 %) об'єкти, а також матеріали та продукти (18,7 %). Для мовної репрезентації англомовної біотехнологічної термінології в категорії «об'єкт» використовуються як прості, так і складні синтаксичні конструкції. Біологічні об'єкти переважно виражаються простими іменниками, тоді як технологічні об'єкти та матеріали і продукти частіше представлені складними синтаксичними конструкціями. Хімічні об'єкти демонструють майже рівномірний розподіл між простими та складними формами. Загалом більшість термінів є іменниковими, що відповідає нормам науково-технічної термінології. Отримані результати підтвердили висновки сучасних досліджень про домінування іменникових структур та тенденцію до використання складних синтаксичних конструкцій у біотехнологічній термінології, що зумовлено потребою у точності й системності фахової номінації. Практичне значення дослідження зумовлене можливістю використання отриманих результатів у процесі викладання іноземної мови за професійним спрямуванням для студентів спеціальності «Біотехнології та біоінженерія»

Ключові слова: категоризація; підкатегорії; номінальні структури; фрази; лексичне вираження