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## Contents

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# ANTIMICROBIAL PEPTIDES: BASIC FACTS AND PROSPECTIVE AS AN ALTERNATIVE TO ANTIBIOTICS

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## ABSTRACT

The availability of complete genome sequences and development of information technology have provided a greater opportunity for peptide based drug designing. The field of structure based drug designing is a rapidly growing area and the exposition of genomic, proteomic and structural information has provided new targets and opportunities for drug lead discovery. In the meat industry, the use of antibiotics as growth enhancers is a common practice and is reported that out of total , globally 50% of the antibiotic is used to promote growth. Wide spread and some time indiscriminate use of antibiotics has been accompanied by the emergence of microorganism that are resistant to these agents. Antibiotic resistance has been posing increasingly serious concern to the public, health specialist and animal food producers. To overcome antibiotics resistance and to retain consumer confidence in a safe food supply, health specialist and food animal producers are searching for alternative, yet effective means of preventing and treating emerging and re-emerging diseases. Thus, new approaches to the problem of antimicrobial resistance and development of novel classes of antimicrobial agents with less likelihood to gain resistance are needed. Antimicrobial peptide also known as host defense peptides are prevalent throughout the nature as a part of the intrinsic defenses of most organisms and have been proposed as a blueprint for the design of novel antimicrobial agents.
**Keywords** - Antimicrobial Peptides, Antibiotic resistance, Novel antimicrobial agents, host Defense Peptides

## 1. INTRODUCTION

Different drugs use in livestock production, particularly in intensive management has created a build-up of chemicals in the food chain and the environment. There are a very few numbers of laboratories assessing the potentials impact of different drugs to the environment. Among different drugs, antibiotics are commonly used in animal industry across the world for treatment, prevention and control of diseases. Besides these, in meat industry the antibiotics are used at low concentration as growth enhancers. Low dose antibiotics are given as feed and water additives which improve daily weight gain and feed efficiency through alterations in digestion and disease suppression. It is stated that low dose of antibiotics in swine results in healthier animals and reduces the “microbial load” on meat resulting in an assumed decrease in potential food borne illness risk. While the benefits of sub therapeutic antibiotic administration are welldocumented, there is much concern and debate regarding the antibiotic residue in meat and development of antibiotic resistance microbes associated with their use. Antibiotics residue may deposit/accumulate or otherwise be stored within the cells, tissues, organs

or edible products of animals. The over drug residues are public health and economically related. The palatability, aroma and quality of meat could be affected by antibiotic residues and also threaten human health as these are allergenic, organotoxic, mutagenic, teratogenic or carcinogenic. Residues of penicillin, tetracyclines, sulphonamides and aminoglycosides are the most frequently cited causes of allergic penicillin, tetracyclines, sulphonamides and aminoglycosides are the most frequently cited causes of allergic reaction , aminoglycosides (e.g. streptomycin) can cause varying degree of nephrotoxicity and ototoxicity .

The availability of complete genome sequences and development of information technology have provided a greater opportunity for peptide based drug designing. The field of structure based drug designing is a rapidly growing area and the exposition of genomic, proteomic and structural information has provided new targets and opportunities for drug lead discovery. The use of antibiotics as growth enhancers is a common practice and extensive use of antibiotic in meat industry causes an alarming increase of antibiotic resistance microbes across the world [1]. Antibiotic resistance has been posing increasingly serious concern to the public, health specialist and animal food producers.Therefore, there is a need of alternative group of drugs which are active in vivo and are able to act fast and has broad-spectrum activity, do not induce bacterial resistance and have limited or no side effects.Antimicrobial peptides are prevalent throughout the nature as part of the intrinsic defenses of most organisms. These peptides represent ancient host defense molecules and act as key elements in non-specific immunity [1]. Their wide spread distribution throughout the animal and plant kingdoms suggest that antimicrobial peptides have served a fundamental role in the successful evolution of complex multicellular organisms [2]. New strategies are required for synthesis of novel antimicrobial agents to deal with the threat of bacterial resistance [3]. Antimicrobial peptides hold promise as broad-spectrum alternatives to conventional antibiotics [4].

The rapidly responsive and phylogenetically ancient innate immune system of host defense is generating increasing interest due to its broad spectrum of effectiveness. Epithelial physical and chemical barrier system represents an important part of the innate immune system preventing primary infection as these surfaces are equipped with various antimicrobial substances [5]. The most common sites of initial encounter with microbes are the epithelial lining of the different organ as well as different physiological system. The epithelial layer of the vertebrates provide the first line of defense against pathogens and hostile environment [6]. If this barrier is breached, microorganism invades and an acute inflammatory response occurs .The activation and deployment of pathogen specific immune responses occurs slowly relative to the potential kinetics of microbial proliferation and restricted to higher eukaryotes which contain immune cells capable of recognizing antigens and responding with effectors cells. The acquired immune system is primarily cellular in composition, relying on the actions of B and T cells which are not triggered rapidly enough to protect against exposure to any pathogen or infection.

But the non-specific innate immune response is more immediate which depends upon the activity of phagocytic cells such as macrophages and neutrophils and in the expression of a number proteins and peptides. The rapidity of the innate immune system provides effective host defense against a vast array of microbes in a manner that is independent of previous exposure to any pathogen [7].

Specific antigens recognition by lymphocytes plays a limited role during initial encounter by microbes. Epithelial physical and chemical barrier system represents an important part of the innate immune system preventing primary infection as these surfaces are equipped with various antimicrobial substances [8]. These epithelial derived molecules can restrain microbes by causing structural disruption or metabolic injury. The absence of functionally important immune system in lower vertebrates, invertebrates and plants indicates that innate immune system plays vital role to defend them in survival. Peptide based host defense can be considered as a pervasive and evolutionary ancient mechanism of immunity. The innate immunity is very fast and multifunctional in nature [9] and is mediated, at least in part by the potent antimicrobial action of cationic peptides against gram positive and gram negative bacteria, fungi, parasites and even some viruses [10] and [11].

Antimicrobial peptides with broad spectrum activity are widely distributed in nature and have been characterized from plants, insect, amphibian as well as mammals, including human [12, 13 and 14].

Multicellular organisms live by and large, harmoniously with microbes. Antimicrobial peptides are distributed ubiquitously in plant, bacteria, insects, amphibian and mammals and by virtue of their broad spectrum antimicrobial activity use to fend off a wide range of microbes including bacteria, fungi and protozoa [15]. Bombinins, magainins and dermaseptins are best characterized group of antimicrobial peptide and has been isolated from amphibians [16]. Antimicrobial peptides are expressed from those parts of animals that are most likely to come into contact with pathogens from the environment. Thus they are found in skin, epithelial surfaces of tongue, gut, trachea and lungs [17].

Antimicrobial Peptides have considerable therapeutic potential as these peptides prevents from colonizing and growing to a point where they can cause life threatening infection. As antimicrobial peptides are effective components of host defense, that can be explored as possible alternative to conventional antibiotics. Traditional antibiotics usually have single or limited types of target molecules, which can be mutated easily by bacteria to gain resistance. The action of antimicrobial peptide involve the direct electrostatic interaction with negatively charged microbial cell membrane, followed by physical disruption and capable of killing broad range of microorganism due to lack of involvement of specific receptors [18]. These peptide kill micro-organism rapidly compared to conventional antibiotics and appear to be refractory to the development of resistance. All these attributes make them attractive candidates as next generation therapeutic agents for treating multi-drug resistant bacterial infections.

Antimicrobial peptides cover a wide spectrum of encoded and ribosomally synthesized molecules from bio-synthetic precursors that display a considerable diversity in size and structure. The primary translation product is generally pre-protein which is processed by definite pathway to pro-protein and processed further to mature active peptides by specific pathways [19]. Antimicrobial peptides of various families differ in size, amino acid sequence and certain structural motif. Families of antimicrobial peptides genes are located in clustered, in close proximity on the same chromosome, which suggests that they may have evolved from a common ancestral defense gene by duplication [20]. These antimicrobial peptides represent a unique and quite complex host defense tool [21]. Mammalian defensins and cathelicidins are the two broad classes of antimicrobial peptides constitute a large family of endogenous peptide antibiotics with broad-spectrum activity against various bacteria, fungi and viruses. All defensins are polycationic 3.5-4.5 kDa, relatively arginine rich nonglycosylated peptides and are characterized by the presence of six conserved cysteine residues forming three intermolecular disulfide bonds with a compact triple stranded -sheet structure [22]. Based on the positions of six cysteine residues and linkages of the disulfide bonds and overall molecular structure, defensins are divided further into three classes: -defensin, -defensin and defensin. -defensin are 29-35 residues in length containing three disulfide bridges in 1-6, 2-4 and 3-5 alignment and reveal a triple stranded -sheet structure with -hairpin loop that contains cationic amino acids [23].. -defensin are 36-42 residues in length and possesses disulfide alignment at 1-5, 2-4 and 3-6 position [24]. A novel class of defensins also has been isolated and named -defensin for its circular structure in which cysteine residues linking at 1-6, 2-5 and 3-4 [25]. Many -defensin are expressed by epithelial cells and other cells of body [26]. Their expression in nonmyeloid cells may occur constitutively or in response to signal that are generated during infection, inflammation or and tissue repair.

Cathelicidins are mostly synthesized from the bone marrow progenitor cells of mammalian species. Precursors of the cathelicidin family possesses a Nterminal signal peptide of 29-30 amino acids, a pro sequence of approximately 99-114 amino acids which is highly conserved both intra and inter species and the C-terminal region there is substantial heterogenesity which encode mature peptide, containing 12 to 100 amino acids.

Expression of human cathelicidin namely hCAP-18 and LL-37 is reported respectively in the reproductive tract and skin epithelial cell [27]. Several β-defensin namely, human β-defensin-4 from testis [28]. ,cryptidin from mouse sertoli cells [29]. Bin1b from rat epididymis [30]. (has been isolated. Antimicrobial peptide gene in the uterine tract has been characterized from Bubalus bubalis and the potency of the individual amino acids has been analyzed [31]. On the basis of amino acid sequence of natural antimicrobial peptides various analogues can be prepared by replacing with desired amino acid. Antimicrobial peptide gene from buffalo tongue has been sequenced and characterized [32 and 33].

## II. CONCLUSION

Synthesis of different length of natural analogue of buffalo lingual antimicrobial peptide and functional study revealed its potency against both gram positive and negative bacteria. Designed and synthesized antimicrobial peptides qualifies as prototypes of innovative drugs that can be widely explored as novel antimicrobial drugs to reduce the adverse affect of antibiotic.

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# ON THE CHARACTERISTICS OF APHARISMS RELATING TO THE CONCEPT OF "TONGUE" IN ENGLISH

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## A B S T R A C T

The article studies paremiological units in modern linguistics and their specific features which investigates aphorisms related to the concept of "tongue" in English. The use of paremiological units related to the concept of "Tongue" is not only dependent on events, situational changes, even a specific context has the ability to choose the appropriate option. In order to use the aesthetic function of the language, the creator chooses one of the inexhaustible expressive possibilities of the language according to his purpose - the one he wants. The variants of proverbs and proverbs do not mean the same thing, there is a very subtle difference in meaning between them. The author or speaker chooses only one of them to express his opinion more sharply and clearly, according to the speech situation and purpose. These peculiarities of the topic are investigated which are given in conclusions and suggestions on the topic

**Keywords -** Aphorism, Paremiological Unit, Proverb, Saying, Phraseological Unit.

## 1. INTRODUCTION

In modern linguistics, paremiological units are units that have a great potential in terms of informativeness in the language, were prepared by ancestors, have the quality of stability as the main features, and exist as the integrity of communicative content and grammatical form. They are traditional sentences, formed on the basis of certain patterns. Paremiological units have all the characteristics of speech derivatives (devices) in the form of a text, the signs of sociality and non-repeatability in them are similar to such signs of speech sounds, words, affixes. A unique approach is required in the modeling of paremiological units related to the concept of "tongue" in English. In determining their attitude to language and speech, an exceptional approach to other speech phenomena is appropriate. Paremiological unit in all languages is different from phraseologism. Phraseological unit, first of all, has the status of a word (lexeme), while proverbs and proverbs are of speech nature, that is, they are formed grammatically; the speaker does not feel the need to give a grammatical tone in the

process of using it. It can be called internal stability that words in stable compounds cannot be replaced by synonyms and variants, and that sentences in proverbs are grammatically formed and become stable. Even when proverbs and proverbs take place in another sentence
as a ready-made syntactic device, their sentence status remains intact[4].

## II. LITERATURE REVIEW

The use of paremiological units related to the concept of "Tongue" is not only dependent on events, situational changes, even a specific context has the ability to choose the appropriate option. In order to use the aesthetic function of the language, the creator chooses one of the inexhaustible expressive possibilities of the language according to his purpose - the one he wants. The variants of proverbs and proverbs do not mean the same thing, there is a very subtle difference in meaning between them. The author or speaker chooses only one of them to express his opinion more sharply and clearly, according to the speech situation and purpose. In the aphorisms related to the concept of "tongue" in English, language is considered as the heart, pride, symbol of independence, future of the nation. In contrast, in a number of the most powerful and significant works of art, the language first of all touches the heartstrings. Then it is mentioned as a means of conveying the words to the listener.

## III. METHODOLOGY

In English, paremies, aphorisms and texts form the symbolic, objective, imaginative and evaluative layers of the "tongue" concept and allow to fill in the cognitotype of the lower terminals of the mentalinguistic model of the language. Aphorisms, along with proverbs, are artistic summaries of folk wisdom and express various aspects of folk thinking. Aphorisms occur as an independent genre, but they can also be "inserted" into a nonaphoristic context. The main features of aphorisms, i.e. philosophical, definitiveness, generalized character of semantic categories, are naturally reflected in the compositional construction of the word. Such a microtext, compared to other gnomic units, is also called a "product of life experience" by great personalities. In this, the author abandons the subjective worldview of the statement and brings the ready-made formula to the reader's simple honest thinking: Euch is the residue of design: Bi Rickey Library is thought in cold storage: Lord Samueh The compositional features of aphorisms, together with artistic and stylistic means, provide words in the gnomic sense of the language with an obligatory feature for them - unconventionality. In the process of scientific research, we witnessed a lot of use of the following stylistic devices in aphorisms related to the concept of "tongue" in the English language.

**I. Antithesis -** Methodological use of contrasting ideas, concepts, etc. Ex: 1. Talking should be an exercise of the brain not of the tongue (Gapirishtilningemas, balkimiyaningmashqlaribo'lishikerak) (Anonymous)

2. Queen. Hamlet, thou hast thy father much offended. Ham. Mother, you have my father much offended. Queen. Come, come, you answer with an idle tongue (William Shakespeare). As can be seen from the above examples, "brain and language or thought and language" are opposed to each other and antithesis is created in these aphorisms.

II. Comparisons - is an artistic image tool based on bright and exaggerated depiction of the object of the image by simulating it with another thing phenomenon, which relies on common signs and characteristics for the things-phenomena that being compared. Ex: 1. ―English is the most beautiful language, but not rhymed tongue‖ (John Lennon). (Ingliztilichiroylibo'lishimumkin, lekinqofiyalitilemas) 2. ―Silence is foolish if we are wise, but wise if we are foolish‖. As you can see from the examples, although English is a very beautiful and popular language today, it is difficult to arrange the rhymes when writing poems and ghazals in this language.[5] A lot of poetic works of English poets reach people in a way that is not in accordance with the norms of worldly works.

III. Irony (Greek: eígopeía - literally, to make a fool of oneself) in contemporary linguistics, it comes in the meaning of sarcasm, irony, sarcasm. Ex: 1. A woman's tongue is sharp enough to pierce the toughest flesh [1] (Ayolningtiliengqattiqgo'shtni ham teshishiuchunyetarlichao'tkir). 2. Woman's tongue is he weapon, her sword, which she never permits to rest or rust (Ayolningtili – u qurol, uningqilichi, u hechqachon dam olishgayokizanglashgaruxsatbermaydi). The given examples are a set of concepts that indicate the style of irony to the respective interlocutor during the conversation. Such aphorisms are dialogic and are a case of irony applied to some opinions of the second person.

IV. Parallelism (юн. parallelos–yonma-yon yokiboruvchi) - due to the similarity or contradiction between what is described, it allows validating of emotion and feelings of emotion. ―That curry is heaven on the tongue but hell in the tummy.‖ plays on the oppositional dichotomy of the concepts of heaven and hell. [1]. In the aphorism given above, it is said about the actions of heaven and hell that are contradictory to each other, pointing out that language is the road that leads to heaven and hell, and parallelism characterizes the stylistic device.

V. Chiasmus (Greek: chiasmus - from the letter X of the Greek alphabet, i.e. located in the form of this letter) - syntactic parallelism in the reverse order, a stylistic figure based on the repetition of words (fragments) in the verse in the reverse order. Ex: 1. But as for prophecies, they will come to an end; as for tongues, they will cease; as for knowledge, it will come to an end [2] (Afsonalarkeladiketadi, tillargakelsak u o'ladi, shuningdek, bilim ham tugaydi.) 2. Gifts of prophecy, tongues and knowledge will cease/faith, hope and love will abide [2] (Bashorattilvabilimsovg'alariiymon, sevgivaumidbilandavometadi). In the above aphorisms, the repetition of words in the reverse order of

legend, linguistics, and words constitutes a stylistic figure of chiasm. This stylistic device, or chiasm, is a form of people's experiences, expressed in a lot of oral speech and decorates communication.VI. Ellipsis (Greek: elleírsís - dropping, dropping) is one of the stylistic figures, deliberately omitting a word (part) of a sentence in speech. Ellipsis is carried out with a specific artistic and aesthetic goal in mind. If there is a question about a quote, either don't use it or ask the speaker (language specialist)to clarify." (Agar iqtiboshaqidasavolbo'lsa, uniishlatmangyokima'ruzachi (tilegasi)dananiqlikkiritishiniso'rang). There are such

aphorisms that always come to the mind of a person and when they are conveyed to the listeners, they feel that some word is needed or missing, and even if the word is added and changed, the meaning remains the same. in the aphorism given above, if the word "speaker" is replaced by the word "language owner", it can be understood in the same sense.

VII. Rhetoric (Greek: rhetorike - oratory) is the science of the art of speaking. The subject of rhetoric is speech, and all related issues (choice of material, placement, sentence construction, proof and disproof of an idea, choice of words, style, use of stylistic figures, reading a speech and h.) learns. Ex: 1. My home tongues are the languages I speak with my sisters and brothers, with my friends. [3] (tilimmeni aka-uka, opasingilvado'stlarimbilanmuloqotqiluvchivositadir). In the above aphorism, the word order is correctly set, organized, fluent and expressive. As a result, rhetoric is embodied in this aphorism. In many aphorisms, we find the expression of speech in a chaotic form. But it is precisely in rhetoric that the sequence of words requires its superiority.

VIII. Gradation: (lat. gradatío - to strengthen consistently) is a stylistic figure based on consistently strengthening the content. One of the speech fragments "the meaning of the second. Ex: 1. O, I could prophesy, But that the earthy and cold hand of death Lies on my tongue. No, Percy, thou art And food for – [4].KelibketdinechadunyolarKeldihayotyig'ladio'limSen deb jafochekdibobolar Ularketdisenqoldingtilim

2. —I do not regret, I do not call, I do not cry‖(Afsuslanmayman, achinmayman, yig'lamayman ham). It can be seen from this quote that the words "world, death" strengthen the meaning of the word "language" and create a gradation in the poem.IX. Anaphora (юн. апaphora — yuqorigachiqarish). The use of a style consisting of the repetition of exactly one element at the beginning of parallel structured speech fragments (eg, verses)Long tongue of cat looks beautiful, Like fire Lord cat's tongue powerful. Looking red colored tongue of cat, Life gets lesson that creation is best. In this aphorism, an anaphoric stylistic device appears in the repeated repetition of the English word "tongue" and the comparison of the semantics of "tongue" to the language of various creatures. Our scientific research has shown that among the above stylistic tools, antithesis and simile are the leading tools for aphorisms. The use of such aphorisms in many materials seems natural to us and has become a habit.[7]Aphorisms perform a certain aesthetic function in the epic narrative, the author, characters' speech or other parts of the plot,

sometimes as they are, sometimes partially changed or created completely anew. Universal aphorisms are irrefutable summative expressions and consist of one or two parts such as "Tongue is the mirror of the nation", "Tongue is the pride of the nation". In the individual aphorism, they are found expanded. For example, "A poet is, before anything else, a person who is passionately in love with language" (The tongue may hide the truth but the eyes—never) can hide the truth, but the eyesnever can). "The best time for you to hold your tongue is the time you feel you must say something or bust" we see the following four-part version of the aphorism: Language - enjoyment "Language - nation, language - pride, language - disaster." Taking into account the above, we have selected examples of aphorisms expressing the concept of "tongue" in English. After seeing some of them, we divided into the above groups. Language is a feeling of perversion: in aphorisms involving the word "tongue" in English, it is given to a human child and appears as a measure of a person's ability to enjoy life. The following aphorisms express such meanings as the enjoyment of language and act as a bridge to understand the events that make it happy in the process of communication.[6]

And this, our life, exempt from public haunt, finds tongues in trees, books in the running brooks, sermons in stones, and good in everything; 1. ―In the English language there are orphans and widows, but there is no word for the parents who lose a child.‖; 2. A bitter man needs to place his troubles on the front of his tongue so that they; 3. Like a child who saves their favorite food on the plate for last, I try to save all thoughts of you for the end of the day so I can dream with the taste of you on my tongue.‖; 5. The language we use creates the reality we experience. (Michael Hyatt); 6. Just remember, when someone has an accent, it means that he knows one more language than you do.‖; 7. We feel free because we lack the very language to articulate our unfreedom.‖; Language is a nation: language is the heart, pride, symbol of independence, future of every nation. No nation can be a complete nation without language. Without him, the Motherland has no will. In the aphorisms about the concept of "tongue" in the English language that we are studying, it is a means of communication that contributes to the world recognition of the nation. [3]

As proof of our word, we analyzed the following aphorisms. 1. There are many things which cannot be expressed by words. There are many words which cannot be spelled by human tongue. There are many tongues which utter one single truth; 2. Language is my nation, my village, my wife, my pen-friend, my check-out girl. Language is a complimentary moist lemon-scented cleansing square or handy freshen-up whippet; 3. The limits of my language means the limits of my world; 4. silence is the language of god, all else is poor translation; 5. Political language... is designed to make lies sound truthful and murder respectable, and to give an appearance of solidity to pure wind

Language is pride: language is a person's pride, a mirror of the soul. It is not only the heart and pride of a person, but also the language is the clothing of a person. How to wear this dress is up to each individual. Language is the translator of the soul. Because in the process of communication, each word is the first to

be clicked on the strings of the heart. Then it is polished in sentences and conveyed to the listener. We also analyzed the aphorisms that express the semantics of the language in English, and those that mean pride, pride, and heart. 1. ―Nothing complements a fast mind better than a slow tongue. And nothing aggravates a slow mind better than a fast tongue; 2. I go silent so I can write. When my tongue is wagging my fingers are silent; 3.A woman's weapon is her tongue 4. Her beauty was enough to get her into most any situation she desired and her tongue—sharp and venomous—was enough to get her out again; 5. If you talk to a man in a language he understands, that goes to his head. If you talk to him in his language, that goes to his heart‖; 6. ―But if thought corrupts language, language can also corrupt thought‖; 7. ―For last year's words belong to lastyear's language And next year's words await another voice.‖

Language is a disaster: a disaster is talking about trivial things. We studied and analyzed all the disasters in the language: the appearance of enmity and mutual enmity between people, gossip, backbiting, lies, arguments, making fun of each other, discrediting each other by revealing secrets, and expressing them. 1. Thieves and liars kill indirectly, unintentionally, and with no other weapon than their tongues and malice; 2. Remember that it is quicker to destroy than build, so be careful of what you do even with your own tongue.‖ 3. The tongue is the soft weapon that kills subtly 4. Ignorance is no reason with a fool for holding his tongue; 5. Words can be medicines; they can also be poisons. Words can heal; they can also kill... It all depends on how, when and where they are use and against whom! Let us not abuse our words. It's a misuse of the tongue; 6. I see a tongue! Some asshole is licking my peephole; 7. ―It's not all bad. Heightened self-consciousness, apartness, an inability to join in, physical shame and self loathing—they are not all bad. Those devils have been my angels. Without them I would never have disappeared into language, literature, the mind, laughter and all the mad intensities that made and unmade me‖; 8. We have a natural right to make use of our pens as of our tongue, at our peril, risk and hazard.[7]

Literary aphorisms as an element of literary language, the role of aphoristic expressions in the artistic language of stories is studied. Aphorisms aimed at artistic reflection of a wise, instructive thought in a concise form are a means of creating imagery in the work, expressing the thought clearly and effectively, giving depth to the content and advancing the mind. When elucidating the nature of language phenomena, including the development of any literary language, the formation of metalanguage norms, interaction with other languages, and other issues, it is necessary to work and draw conclusions based on the laws of language development. Otherwise, it will not be possible to come to correct and accurate conclusions.

## IV. CONCLUSION

Thus, in English language aphorisms, the concept of "tongue" appears as a standard by which nationality, communication, and the possibility of enjoying life are evaluated. Completing the subject layer of the "Tongue" concept, the authors of the aphorism call to use the language in the right ways, to live in life and do good deeds. It is important to use language correctly - to direct it to the welfare of society and not to allow ignorance to dominate. All these aphorisms mainly lead to the positive aspects of the language, to the rules of etiquette, and serve to illuminate its spiritual side.

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# ENGLISH-MEDIUM INSTRUCTION IN HIGHER EDUCATION IN UZBEKISTAN: TEACHERS' CHALLENGES AND BELIEFS

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## A B S T R A C T

This article outlines the need to explore university instructors‟ perceptions toward the use of the English-medium instruction (EMI) in Uzbek context. It starts by providing a brief overview of EMI globally and role of English in Uzbekistan. Semi-structured interviews with ten EMI instructors from different universities are conducted. Primarily qualitative method was used to gather and analyze the data. The main focus of the study is to explore the pedagogical beliefs of teachers‟ perceptions of EMI in Uzbekistan and examine participants‟ beliefs about benefits and challenges of EMI in higher education (HE). The responses of semi-structured interview questions demonstrate that despite common beliefs of EMI lecturers, some interesting variabilities in their perceptions, relating to the challenges and final thoughts about EMI could be detected. The findings of this study suggest that further investigation of mixed research study might provide much more information about how the phenomenon of EMI is being introduced and accepted in Uzbek context.

**Keywords** - English-Medium Instruction (EMI), Teachers‟ Perceptions, Higher Education, Englishization, Anglophone Countries, Lingua Franca.

## 1. INTRODUCTION

The present study reports on a small-scale comparison of instructors in various universities situated in Uzbekistan and analyses their perceptions of the growing phenomenon of English-medium instruction (EMI) in higher education. EMI implementation has been growing fast in the countries of Kachru‟s outer and extended circles in recent decades. EMI refers to the "teaching of academic subjects through the medium of English in non-Anglophone countries" [1]. It is a phenomenon which is growing rapidly in Higher Education (HE) [2] [3].EMI is mostly used for educational programs at a tertiary level where professional knowledge is taught through English with the purpose of enhancing students‟ knowledge-specific ability as well as their English [4].

Recent research has provided more data showing that English is increasingly used as a language of university teaching in European countries [5] [6]. A substantial body of research has shown that the focus of EMI delivery in HE is Englishization and establishing recognition by attracting international students from different foreign countries. Coleman identified seven reasons for this Englishization of

European HEIs: content and language integrated learning (CLIL), internationalization, student exchanges, teaching and research materials, staff mobility, graduate employability, and the market in international students [4]. Vinke et al. claim that "whereas the main purpose seems to be an internalization which means to support student and staff mobility, what lies beneath the reality is to increase the competitiveness of higher education institutions (HEIs). Recruitment of international staff and students are essential to enhance an institution‟s prestige [7].

The local students did not have a sufficient command of English, while a majority of the enrolled international students came from non-English speaking countries. EMI implementation involved primarily local teachers whose English proficiency and delivery skills could hardly satisfy the requirements. „The teaching quality of the EMI program and the learning obstacles have hence become one of the major issues that deserve in-depth investigation, and understanding teachers‟ perceptions of the EMI courses, in particular, would help to improve the teaching practices and the effectiveness of EMI‟ [8]. Follow-up studies with their outcomes measured from multiple perspectives are necessary for assessing the lasting benefits of an EMI program.

Content lecturers are the bridge between the objectives of an HEI and students‟ expectations. Lecturers‟ perceptions of EMI, including the challenges they experience in EMI delivery could play a key role in the effective implementation of institutional language policy. Lecturers are therefore the principal agents capable of checking whether the EMI system is working for the students. In this context, the present study aims to explore the pedagogical beliefs of teachers‟ perceptions of EMI in Uzbekistan and seeks to examine participants‟ beliefs about benefits and challenges of EMI in HE. The findings of present research can add a distinctive dimension to the existing knowledge about EMI programs in HE in Uzbekistan.

This qualitative study is thus an attempt to fill a gap. The research suggests how to implement EMI more effectively by taking into consideration instructors‟ responses to the way EMI are currently implemented in the Uzbek EFL context in HE.

For it would be difficult to judge the problems based on responses to a survey of perceptions, it was decided to look into the process of EMI delivery in Uzbek HE context through the open-ended questions of semi-structured interviews in the light of the following research questions:

1. What are instructors‟ perceptions of EMI at universities of Uzbekistan?
2. What are the challenges of English-medium instructors at Uzbek universities?
3. What are the similarities and differences of perceptions of EMI instructors at tertiary level in Uzbekistan?

**Limitations of the study**

The major limitation of the study is that research data was collected just using one data collection

instrument. Semi-structured questionnaire surveys could have also been used to benefit from triangulation. As the present study was carried out with 10 participants and only at universities in Andijan and Tashkent (Uzbekistan), it is suggested that similar studies with a larger number of participants all over Uzbekistan be replicated.

## II. LITERATURE REVIEW

A growing body of research has contributed to the ongoing discussion over English-medium instruction in non-Anglophone countries. In the higher-education context of many countries, EM education is mainly used in internationalization strategies adopted in response to increasing globalization [4] [9] [10] [11].Over the last decades, researchers have investigated various aspects of EMI in HE, such as policy evaluation [13] [14] [6], student perceptions and performance [15] [16] [17] [6] and content lecturers‟ perceptions and attitudes. Nevertheless, there is limited research investigating the issue in depth. The issue of EMI efficacy is a major topic for investigation and discussion, and has been attracting a great deal of interest in previous decades. The success of EMI implementation mainly depends on students‟ and teachers‟ English proficiency level and a number of other factors that can be determined by exploring these stakeholders‟ perceptions of EMI.

However, despite the fact that a substantial body of studies has assessed the effects of EMI delivery, the studies conducted so far have revealed more negative than positive results [18] [19] [20] [21]. One of the basic problems is that L2-speaker lecturers at universities in non-English speaking countries deliver their courses through English-medium, which affects the teaching efficacy. The challenges of L2 lecturing seem to be unavoidable due to both teachers‟ and students‟ insufficient command of English. Some instructors conduced to have problems with pronunciation, accent, fluency, intonation, and even non-verbal behavior [22] [6]. According to lecturers‟ reports, they experienced difficulties in using English for communication purposes, such as using humor, telling anecdotes, making digression, and giving spontaneous examples [12] [6]. It took much time even for highly proficient instructors to get preparation for lessons or look up in a technical vocabulary when teaching EM courses for the first time [23] [7][12].

teaching involves code switching [6] or lecturing in both L1 and L2. In content-based classrooms, code switching has been similarly adopted as a pedagogical strategy [24] [25] [26] [27] [28]. EMI teachers have been found to switch to a students‟ L1 to support students‟ comprehension in English, manage student-teacher relationship [26] [27]. According to Ekoç, there are large numbers of lecturers using Turkish in EMI courses but with limited comprehensibility of their lectures because of the lack of pedagogical content knowledge[29].

Moreover, the bulk of EMI studies have brought to the fore the key issue that problems of EMI setting are related not only to instructors‟ language proficiency, but also to their teaching approaches as well. In many European countries (European Commission 2013) traditional, monologic lectures are the most common form of teaching. Costa and Coleman based on the perceptions of 71% surveyed Italian universities concluded that "changing the language of delivery has not led to any change in teaching style" [30]. Similar comments can be found in international studies such as those of Miller [31] in Hong Kong and Dafouz and her colleagues [32] in Spain.

According to Ball and Lindsay, teaching in a non native language, especially at advanced conceptual levels, demands a great focus on methodology and practice [33]. Yet "for many lecturers, the shift from L1 to EMI is reduced to a mere change in the vehicle of communication, according to Cots [34], and does not take into account the need to adapt teaching methodology" [35]. In Cots‟ view, the shift in methodology that EMI should entail is a "process of decentering of the focus of pedagogic action from the instructor to the students, giving the latter a much more predominant space during the class" [34]. This implies that lecturers themselves change the way they perceive their role, moving away from a top-down approach of knowledge transmission and helping students to construct knowledge by themselves [35]. Therefore, both teachers‟ linguistic competence and pedagogical competence are needed for successful EMI implementation.

In this light, as Klaassen and De Graaff put it, EMI also requires that lecturers become aware of the difficulties of their students who may meet challenges in taking EMI instructed classes and need support and guidance due to the fact that they also are learning their subjects in a foreign language [22]. For this reason, not only a greater understanding of issues in EMI, but also exploring the lecturers‟ experience of EMI is crucial for effectiveness of EMI setting in Uzbek context. The study highlights that its findings might help university lecturers and students to raise awareness of the differences that are likely to occur when the medium of instruction changes from L1 to English.

## III. THE ROLE OF ENGLISH IN EDUCATION OF UZBEKISTAN

Education is a strong tool in positioning the status of language in society. Therefore, perhaps the government by introducing changes into language policy of modern Uzbekistan envisages the time when English will "penetrate into society" [36] and become as common as Russian has been until now.Hasanova claims that "while English has not achieved deep social penetration in Uzbekistan, its roles and functions in educational and social domains have been increasing rapidly due to the favorable attitudes of Uzbek people toward English and the unique role of English in the international arena"[36]. To put it different, English language ought to penetrate in all fields of our society, education in particular. This allocates to stakeholders and policymakers‟ responsibility for implementation of

English medium instruction in higher education in Uzbekistan.

The roles of the languages spoken in the country have begun to alter since the Republic of Uzbekistan was proclaimed independent in 1991, changing in dominance and importance in all spheres of Uzbek society. Russian was given the status of a foreign language and lost its power as "Uzbek's second mother tongue" [37], but it managed to preserve its significance in communication and its role as a lingua franca for ethnic minorities. In contrast, the Uzbek language gained its position as the only official state language. English, on the other hand, has steadily gained popularity and become the most preferable foreign language to learn [38].

The growth of English in Uzbekistan differs substantially from that of Russian at the beginning of the twentieth century, being characterized as a desirable rather than a suppressive process [39] [40]. When it comes to pursuing international education, obtaining a good profession, and keeping up with the rapid pace of world developments, Uzbek people recognize the importance of English in all aspects[41]. They favour the English language and consider it as the key to a successful and prosperous life. A language specialist, Rod Bolitho [36], observed that a significant interest in the English language was generated by two factors: the desire of studying and working overseas, and the idealization of the UK and US. These are the two most compelling reasons for Uzbeks to study English. According to Hasanova, the continuously increasing interest in studying English stems from the language's international significance[36]. Despite a limited body of research on the role of English in Uzbekistan, there are language specialists who have explored the matter, giving their empirical observations and experiences. English in Uzbekistan is mostly acquired through educational training. Bolitho predicts that English will completely replace Russian in a few decades. In their investigation, Duff and Dickens brought attention to English education and language levels in rural areas as opposed to urban parts of the country [42]. Snow, Kamhi-Stein, and Brinton investigated teacher preparation experiences in the country [43], highlighting a unique English medium program that prepares English language instructors - IELTE (Institute of English Language Teacher Education) [41].

In Uzbekistan, English is recognized as a foreign language [44] [41]. The government, on the other hand, wishes to see the language become a second language, fluently used by society, particularly the younger generation. This government objective is clearly visible in the presidential decree (December 10, 2012), where the role of English is greatly highlighted and both education and media are forced for reformation and upgrading to support the country's pervasiveness of English. Dearden emphasizes the presidential decree's significance in increasing attention to the English language in educational establishments at all levels of education[45].

## IV. METHODOLOGY

### Participants

The sample of this study consisted of 10 Uzbek EMI instructors of universities in Uzbekistan

| Instructor | Institution | Nationality | Age | Gender | Teaching experience |
|---|---|---|---|---|---|
| Uz-1 | Tashkent State Pedagogical University | Uzbek | 44 | F | 10 |
| Uz-2 | Tashkent State University of Uzbek language and Literature | Uzbek | 50 | M | 18 |
| Uz-3 | Andijan State Medical Institute | Russian | 50 | F | 20 |
| Uz-4 | Andijan State University | Russian | 44 | F | 6 |
| Uz-5 | Andijan State University | Uzbek | 44 | F | 20 |
| Uz-6 | Andijan State University | Uzbek | 34 | M | 5 |
| Uz-7 | Andijan State University | Uzbek | 32 | F | 8 |
| Uz-8 | Andijan State University | Uzbek | 35 | F | 8 |
| Uz-9 | Andijan State University | Uzbek | 30 | F | 6 |
| Uz-10 | Andijan State University | German | 42 | M | 4 |

**Table 1: List of participants**

### Research Tools

Individual semi-structured interview was carried out in order to determine teachers‟ perceptions of EMI at their universities. For this purpose, an original semi structured interview protocol was employed. The participants were informed of the study aim. They were guaranteed anonymity, and given code numbers to protect their identities.

## V. DATA COLLECTION AND ANALYSIS

A small-scale qualitative study of Uzbek university teachers was carried out.Data were collected through individual semi-structured interviews. The interviews were conducted through face to face and telephone calls lasted about 30-40 minutes each. They were guided by interview protocol.

The interview protocol was made up of four parts. The first part was an introduction. The second part consisting of the questions, enquired into the respondents‟ background information, such as age, gender, workplace, years of teaching experience in higher education. The third part, comprising open ended questions, investigated the respondents‟ views about the role of EMI and challenges instructors meet in their teaching process. The last part inquired about participants‟ final thoughts about the role of EMI in HE.

The interviews were transcribed by the researcher and analyzed qualitatively. The transcribed interview answers were carefully read to identify and noted salient comments regarding participants‟ responses to each question. To ensure anonymity, numerical indexes were used in the data extracts. Data analysis aims to inquire teachers‟ opinions about the role of EMI, including its benefits, along with their challenges. For this purpose, individual semi structured interviews were carried out. Participants‟ responses to open-ended questions were studied to find educational implications for better EMI programs.

## VI. RESULTS AND DISCUSSION

Data were collected from individual semi-structured interview created by researcher specifically for instructors. The participants‟ demographic data were presented in mentioned below tables.
The results were categorized and analyzed according to research questions.

**RQ-1: What are instructors' perceptions of EMI in universities of Uzbekistan?**

In response to research question 1 regarding the instructors‟ perceptions of EMI in universities of Uzbekistan, an interview question 1 was performed, yielding the views of teaching the content subjects in English-medium in Uzbekistan. Almost all of them mentioned that EMI is new in Uzbekistan and there are financial advantages of teaching in EMI, as some interviewees explained:
Uz-1:EMI is relatively new in our country. Currently our government is promoting EMI by different ways, for example offering 100 % bonuses for those content teachers who deliver their subjects in English. In 2018 the Foundation called "El Yurt Umidi (The Hope of the Nation)" was founded. The aim of this foundation is to send teachers of higher education to Europe and to the USA for teacher training courses for free.
Uz-6:Content subject teachers try to deliver their courses in English medium in spite of the fact that EMI in our country is a new approach. However, they need appropriate methodology.
Uz-2:EMI is becoming one of the requirements in higher education nowadays our country. Free English courses have been organized by the government for teachers of higher education. Teachers are demanded to improve their English as a part of their Continuous Professional Development.Participant Uz-3 bounds the popularity of teaching in EMI with internationalization by opening foreign faculties and private joint universities.
Uz-3:Nowadays teaching EMI in Uzbekistan is very popular due to extending international affairs in our Institute and opening foreign faculties in many higher educational institutions of Uzbekistan.The same participant noting the duties of EMI instructors claimed that "EMI teacher should produce very qualified educational programs and select appropriate literature. Besides, EMI teacher has to speak English in a native-like level, he/ she has to think and analyze his content subject concepts in English in spite of the fact that some foreign students have English level insufficient for academic study.Another participant Uz-4 stated that "EMI is rather a new concept. It is welcomed by majority of institutions, but not all of them are ready to implement EMI in their teaching context".
Participant 10 (Uz-10), who is not native to Uzbekistan (German) and has been working at university in Andijan for 2 years, responded that EMI is welcomed in Uzbekistan, but limited to private universities:
Uz-10: Of course, I would welcome more EMI in Uzbekistan. I guess private education will be leading

the way as EMI can most likely not be implemented in public schools or universities. Such a move would be unexpected in a country where the second language is Russian rather than English. Therefore, EMI is and probably will be limited to private schools (universities) for privileged children

**RQ-2: What are the challenges of Uzbek EMI instructors?**

In response to research question 2 regarding to challenges of EMI instructors of tertiary education in Uzbekistan, the researcher employed the second question of semi-structured interview, which helped collect the important data for analysis. According to the participants‟ responses, the most serious challenges are connected to the proficiency level of both students and teachers, lack of skilled lecturers, working in overloaded and mixed ability classes:

Uz-6:The language levels of both teachers and students are below the required criterion. So, they need to improve it first. Besides, the content of course should be simplified and adopted to students' levels, which is time consuming, and which may serve as a stumbling block for the process.

Uz-1:Emm. That's a tough question as there are some problems in teaching EMI and the biggest challenge is working in overloaded classes. It is difficult to interact with each of them in English due to their different levels, which is time consuming.

Uz-4:I suppose, one of the underlying problems of teaching EMI is lack of highly skilled content teachers with appropriate level of English.

Uz-7:The basic problems of EMI teaching are at least two: students' different language levels or mixed ability classes and different cultures and mentality.

Uz-8:First of all, lack of specialists who can teach in EMI, materials available, course books, translating problems, students' motivation serve as basic problems of EMI teaching.

Participant 10 (German by nationality) named challenges of EMI and several reasons why EMI hasn‟t really caught on in Uzbekistan yet. These reasons are following: Uz-10: 1) Practically speaking, EMI is hard to implement as teachers fluent English are in short supply. This also includes English teachers. And even if that was not the problem, EMI also relies on adequate materials to meet local demands.2) Teaching is traditionally seen as imparting knowledge and not so much as building skills. Knowledge needs understanding, skills need practice. Viewed through that lens, EMI could seem more obstructing than facilitating the teaching process.3) Due to ethnonationalism people feel that their identity is inborn and static. One is born Uzbek and will be just that for one's entire life. They may not expect of themselves to be thinking in another language as part of the learning process, nor may they regard that as something desirable or achievable.

To the interview question: "What should a teacher do to get the level of being good enough to teach in EMI?" most of the Uzbek interviewees shared a common idea of having or improving English to the

required level the teachers needed in order to deliver the courses in EMI at universityin following way:

Uz-1:I think a teacher should get the required minimum level of English proficiency in order to become competent to teach in EMI.

Uz-3:In order to get the level of being good enough to teach in EMI teacher should constantly develop himself/herself by raising English proficiency level, by reading literature in English, by improving teaching skills.

Uz-5: To my view, a teacher should work on his English regularly to improve his current level as an EMI instructor.Another interesting opinion articulated by the Uzbek participant:

Uz-8:A teacher should realize his (her) own capability as well as great responsibility for the results of educational process and decide: to be or not to be (to teach EMI or not to teach)!

One participant suggested "providing some training courses to EMI instructors by the authority"(Uz-7), which was supplemented with the idea of another respondent that "teachers need to have intensive course due to their lack of time and busyness. They need to have encouragement from their faculties and departments for learning English and support of the authority".(Uz-4)

**RQ-3: What are the similarities and differences of perceptions of EMI instructors at tertiary level in Uzbekistan?**

To figure out the answer to this research question all the participants‟ responses were analyzed. Some similarities between the responses of participants were identified when they were asked about theirperceptions of EMI. Most of respondents came to one mutual opinion that EMI implementation is not an easy issue not only for teachers, but also for students as well and teachers have to work on themselves reading a lot, participating in professional courses in order to improve their English and get the level of being good enough to teach in EMI.

There was a common belief in the participants' perceptions of challenges of teaching through EMI at university. Some teachers assumed that "the biggest challenge is working in overloaded classes" "they have to focus on the content of their own lessons; they don't have any chances to check students' understanding", but at the same time, some subtle differences emerged between their views. Whereas some participants‟ perceptions of the challenges of teaching EMI concerned students‟ understanding the subject, particularly concepts in English, other respondents are of opinion that "one of the underlying problems of teaching EMI is lack of highly skilled content teachers with appropriate level of English".

The individual semi-structured interview aimed to inquire teachers‟ opinions about the role of EMI, including its challenges teachers meet in their teaching process. It also investigates similarities and differences of perceptions of Uzbek EMI instructors.The participants‟ responses were compiled,

analyzed, and summarized as following:

**Differences of perceptions:**

While some EMI instructors adhere to the opinion that both teachers and students prefer to have native language instruction, other respondents wish the EMI was implemented in their universities;

Whereas some Uzbek participants‟ perceptions of the challenges of teaching EMI concern students‟ understanding the subject, particularly concepts in English, other respondents are of opinion that they lack of highly skilled content teachers with appropriate level of English.

**Similarities of perceptions:**

EMI courses are beneficial for both of students and teachers, but at the same time challenging and time consuming in terms of preparation for implementing in universities;

EMI implementation is not an easy issue not only for instructors, but also for students as well due to lack of appropriate level of English language;

Instructors came to one mutual opinion that EM instructors have to work on themselves reading a lot, participating in professional courses in order to improve their English and get the level of being good enough to teach in EMI;

There is a common belief in EM instructors‟ opinions about the challenges in working in overloaded and mixed ability classes.

## VII. CONCLUSION

The present research was a small-scale study with 10 participants and conducted only in universities in Andijan and Tashkent (Uzbekistan). Another limitation of the study is that research data were collected just using one data collection instrument. Semi-structured questionnaire surveys could have also been used to benefit from triangulation. Therefore, the limitations do not allow the researcher to generalize the findings to other contexts. However, there is no doubt in the sincerity of their responses as all the participants responded the interview questions willingly. There were found some common beliefs of EMI teachers, which have been the “concern of previous empirical studies and commentaries, and our data has added to the layers of evidence of what the critical issues are in the implementation of EMI”[46]. Besides, there slight variance was identified in the perceptions of EM instructors with regard to EMI benefits in Uzbekistan. Whereas majority of the participants articulated that “EMI certainly benefit students learning”, the minority had a vague belief that “EMI benefits student learning

in some extent".“This variation may be partly explained by the age and/or English proficiency level of the teachers" [46].Some differences have been highlighted between participants‟ views and these appear to relate to the concerns of EMI implementation at their universities, challenges of EM instructors and the level of English proficiency for teachers to deliver their courses inEMI. It could be seen from the results of the research study that support of administration was lacking which is a must in successful implementation of this mode of teaching. EM instructors are in need of administration‟s support in all means, for example, in providing them with necessary equipment, improving students‟ level of English proficiency (by organizing some language courses), attraction native speaker EMI professionals (to organize some master classes for EMI teachers) etc. As aforementioned, semi structured questionnaire surveys are important to be used to benefit from triangulation. More research investigations of comparative nature, is definitely needed in order to gain much more valuable data concerning EMI implementation in HE, its challengesand possible measures of their elimination. The contribution of additional research studies would clearly be beneficial for better implementation of English-medium instruction at tertiary level for such pioneering in this field country as Uzbekistan.

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## APPENDIX 1

**About Measures for Further Improvement of System of Learning Foreign Languages**

10.12.2012 20:25

**Resolution of the President of the Republic of Uzbekistan**

"To note, that within implementation of the Law of the Republic of Uzbekistan "About education" and the National program on personnel training in the country the complex system of training in teaching foreign languages is created, directed on formation harmoniously developed, highly educated, modern conceiving younger generation, further integration of the republic into the world community.For years of independence over 51,7 thousand teachers of foreign languages are prepared, multimedia textbooks on English, German and French languages for 5-9 classes of comprehensive schools, electronic resources on English studying in initial classes are created, over 5 thousand language laboratories at comprehensive schools, professional colleges and the academic lyceums are equipped.

At the same time the analysis of operating system of the organization of learning of foreign languages shows that educational standards, training programs and textbooks not fully conform to modern requirements, especially regarding use of front lines information and media technologies. Training is conducted generally by traditional methods. The organization of a continuity of learning of foreign

languages demand further improvement at all levels of an education system, and also work on professional development of teachers and their providing with modern educational and methodical materials.For cardinal improvement of system of training foreign languages of younger generation, the training of specialists, masterfully using in them, by introduction of the advanced methods of teaching with use of modern pedagogical and information and communication technologies and on this basis of creation of conditions and opportunities for their broad access to achievements of a world civilization and world information resources, development of the international cooperation and communication:

1. To establish that, since 2013/2014 academic years:

Learning of foreign languages, mainly English, step by step in all territory of the republic begins with the first classes of comprehensive schools in the form of game lessons and lessons of informal conversation, and since the second class – with assimilation of the alphabet, reading and grammar;

Teaching in higher educational institutions of separate special subjects, especially on technical and international specialties, is conducted in foreign languages;

Providing pupils and teachers of the general averages, average special, professional educational institutions textbooks and educational and methodical complexes on foreign languages is carried out on a free basis at the expense of current assets of Republican trust book fund at the Ministry of Finance of the Republic of Uzbekistan with observance of established periods on their reprinting…

3. To form constantly operating Coordination council on further development of learning of foreign languages (further – Coordination council) in structure according to the appendix No. 2, having determined it by working body the Uzbek state university of world languages.To coordination council (to Ikramov A.) together with the interested ministries, departments and involvement of leading scientists and experts:

Till March 1, 2013 to provide the approval of the new educational standards providing concrete criteria of level of knowledge of foreign languages at each step of training;

Till May 1, 2013 to provide the approval of new curricula and programs of comprehensive schools, the average special, professional and higher educational institutions providing introduction of continuous training in foreign languages since the first class of comprehensive schools, and also continuity of this education at all steps of training;

To attract for development of educational standards, training programs and plans, textbooks, and also the organizations of educational process conducting foreign training centers, the international experts and specialists in the corresponding foreign languages;

To provide cardinal revision and strengthening of system of training to foreign languages on the job, with delivery of the standard tests following the results of training…

5. To the state center of testing together with the interested ministries and departments in two-month term to make in the Cabinet offers on introduction from 2015/2016 academic years of a foreign

language in the block of entrance tests in all higher educational institutions…

President of the Republic of Uzbekistan I. Karimov

Tashkent City, December 10, 2012

**APPENDIX 2**
**Interview Protocol**

| | |
|---|---|
| Introduction (5 minutes) | Thank you for agreeing to participate in the research study. I am Gulchehra Rahmanova *(a senior teacher at Andijan State Institute of Foreign Languages, Department of English Language and Literature, Uzbekistan; aPhD student at Gazi University, Ankara, Turkey).*<br>I am working on the project devoted to investigating Uzbek higher education instructors' perceptions of English-medium instruction. Your answers will be treated as confidential. Any information that could identify you will not be included in the study or reports. The notes and will be destroyed after completing the study and publishing results.<br>You are free to ask any questions about the study. |
| Topic 1 (5 minutes) | To begin, I would like to ask you some demographic questions:<br>1. What is your age?<br>2. What is your native language?<br>3. How many years of teaching experience at higher education do you have? |
| Topic 2 (20 minutes) | Now I would like to discuss your perceptions of EMI.<br>1. What are your perceptions of teaching in English – medium in your country?<br>2. What are the challenges of teaching through English – medium?<br>3. What should a teacher do to get the level of being good enough to teach in EMI? |
| Final thoughts (5 minutes) | Those were all of the questions that I wanted to ask.<br>Do you have any final thoughts about the role of EMI in higher education in your country?<br>Thank you for your time. |

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# DETECTION OF E. COLI O157:H7 IN SEVERAL FOOD IN DIFFERENT AREAS OF BAGHDAD

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## A B S T R A C T

This study was conducted to detect E. coli O157:H7 in some food( minced beef , beef burger , white soft cheese and salads ) from different areas in Baghdad from September 2019 until November 2019 , (SMAC) Medium was used to detect the bacteria and to differentiated it from other Entero bacteriaceae .The number of obtained isolates reached 283 ,231,219 isolation respectively for September , October and November , the results showed rise in the total number of the isolations that were obtained from September comparison with October and November. The sorbitol fermentative isolates percentage reached 85% ,88% and 94% while non sorbitol fermentative isolates reached 11%, 5% and 4% .Isolates were non sorbitol fermentative subjected to cultural and morphological examinations, the isolates appeared in a pale golden color, with a rod shape, G-, moving ,and 42 isolates were non-sorbitol fermentative identified using VITEK-2, one isolate was E.coli O157:H7 that was obtained from the burger with a probability percent of 97% ,and was also identified genetically with PCR using the Escherichia coli O157:H7C1-057,Escherichia coli O157:H7 FRIK944 ,Escherichia coli O157:H7 FRIK2455, Escherichia coli O157:H7 FRIK2069,Escherichia coli O157:H7 FRIK2533, (accuracy of 100%) and with Escherichia coli O157:H7 AR-0427(accuracy of 99%), which was matched with the sequence of O157:H7 strain FS94 also were subjected to latex test a specific test to the strain E. coli O157:H7.

**Keywords** - E. Coli O157:H7, PCR ,Latex Test

## 1. INTRODUCTION

Escherichia coli is a bacteria that belong to Enterobacteriaceae witch has a rod shape, gram negative , aerobic and facultative aerobic, it is optimum temperature is 37c but it can grow in a wide range in between 15-45 c ,Capable of fermenting sorbitol, lactose and glucose fermentative , gas and acid forming and can produce β-glouconidase (1) (2) (3)(4).E.coli is considered a huge contributor in human pathogen but at the same time it is conceded to have a huge impact on the health of human instance (5) .E.coli bacteria is divided into 6comon types depending on its characteristics and to its virulent factor to :Enter invasive E. coli (EIEC) , Enterotoxigenic E. coli (ETEC), Enteropathogenic E. coli (EPEC), Enteroaggregative E. coli (EAEC) , Diffusely Adherent E. coli (DAEC) and Enterohaemorrhagic E. coli (EHEC) this group is a It is a subgroup of Escherichia coli producing shiga

toxins(STEC)It causes bloody diarrhea and acute hemorrhagic colitis in children and infantsEHEC, which causes epidemic diseases, and was diagnosed as an epidemiological cause for the first time in the United States of America in 1982.(2)(6) Bacteria is transmitted through contaminated food, such as consuming contaminated foods including mined meat, dairy products, salads, and burgers. It is also transmitted through the feces of infected people and through drinking water and direct contact with infected animals and humans. (7)

E.coliO157: H7 is found in all seasons, and likely to be found more in the summer, especially when the temperatures are high, which facilitates their spread and survival(8) .Hemorrhagic coliform bacteriaare characterized by being sorbitol nonfermentative, not producing the enzyme Glocuonidase-, and unable to grow in the presence of potassium cyanide KCN (9).The shiga toxin produced from type STEA, Toxin is characterized by its resistance to heat, as the production of shiga toxin is necessary for the virulence of Escherichia coli O157: H7, but it is not the only one responsible for pathogenicity, as the bacteria must colonize the intestinal mucosa and the possession of pO157 is also associated with the ability to cause disease (10).Stx1 toxins are identical to those produced by Shigella dysenteriae, with one difference in amino acids. Stx2 is known to be more toxic, and its production is more associated with hemorrhagic colitis or hemolytic uremic compared to group A toxins.(11),(12) Type II toxins, STx2, lead to kidney injury and severe weight loss. The O157: H7 pattern is due to the fact that it contains two antigens. The first is the autosomal O antigen, which binds to the lipopolysaccharide being a thermally stable antigen and may be common in the gut. The O antigens are commonly used in the serotyping of many gram negative intestinal flora, and the second antigen is the flagellar antigen related to the H flagellum that is not related to bacterial pathogenesis. Thus only motile colonies such as Escherichia coli have these antigens(13).

## II. MATERIALS AND METHODS

Collecting samples: 300 samples of food (minced meat , burger , white soft cheese and salads )were collected from various places of Baghdad included al baya'a , tobji , abo gahareeb and bab- alsharji ( eastern gate ) for 3 months ( september , October November) 75 specimen , samples were kept in a disposable boxes in the fridge at 4 C. Initial activation of samples was made using Trypticase Soya Broth (TSB) by adding 1 gm of the sample to 9 ml of the TSB broth and incubation on 41.5c for 24 hours (14).

**Bacterial isolation:** culture was made using pour plate method for the initial samples after incubation period is over using peptone water decimal up to 106 using MacConkey Sorbitol Agar that was prepared according to(10) (15) plates were incubated at 37c for 24 hours , non-sorbitol colonies were chosen usingstreaking method on Cefixime -Tellurite – Sorbitol MacConkey Agar (CT-SMAC)

according to (16) (17)(18) clarification processes were conducted on the last medium until having clear colonies

**Morphological and cultural identification test:**

Cultural identification: isolated and growing colonies on selective media (SMA)by inoculating the medium by streaking method and incubation at 37c for 24 hours and colonies characteristics were noted including colonies shape, surface, ledges ad colonies height.

**Microscopical identification:** bacterial cells were gram stained and then seen by the microscope at magnifying power X1000, cell's response for gram stain, shape of cell and cells assembly were observed.Motility Test: test was conducted in to methods by using in the hanging drop method and using the large objective lens of microscope, second method were stabbing the motility test medium, growing outside the stabbing line was observed.

**Vitek-2 identification:** 64 biochemical test were conducted automatically.

**PCR molecular identification:** Isolate was cultivated on nutrient agar using 1ml for 24 hours at 37c then centrifuged at 13000 rpm then assembling the biomass to be used for PCR 16s rRNA amplification using the following primers

| Primers | Nitrogen base sequins |
|---|---|
| 27 Forward | 5-AGAGTTTGATCCTGGCTCAG3- |
| 1492 Rivers | 5-TACGGTTACCTTGTTACGACTT3- |

**Table1: primers used for16s rRNA amplification**

| Component | Size (micro liter) |
|---|---|
| Master mix | 12.5 |
| DNA extract | 2 |
| Forward primer10 bicomoll | 1 |
| Reverse primer10 bicomoll | 1 |
| Free Water Nuclease | 8.5 |
| Total size | 25 |

**Table2:Master mix amplification compounds**

| Number of cycles | Time in minutes | Temperature | Steps |
|---|---|---|---|
| 1 | 05:00 | 95 | Initial Denaturation |
| 30 | 00:30 | 95 | Denaturation |
| | 00:30 | 60 | Annealing |
| | 01:00 | 72 | Extension |
| | 07:00 | 72 | Final Extension |
| 1 | 10:00 | 10 | Cooling |

**Table3: Additives of the reaction tube to amplify16S rRNA by PCR**

The Electrophoresis Of DNA Amplification Products On Agarose Gel: Agarose gel was prepared by dissolving 1.1 gm agarose in 100mlof XTAE solution and heated by microwave ,1 microliter of ethidium bromide was added then mixed well and left to cool at 50c then. The sample was subjected to electrophoresis assay for 1 hour, 100v/m Amp for 1 hour .in order to initiate the movement from

negative poles toward positive poles. The DNA bands were detected by using UV light Tran's illuminator device

**Latex agglutination test identification:** Colonies of bacterial suspension were placed on a latex strep provided by oxiod company and them mixed with a drop of sterilized water and a drop of the O157 latex test reagent (13)

## III. RESULTS AND DISCUSSION

**The detection of E. coli O157: H7 in several foods:**42 sorbitol non fermentive isolates were obtained from a total 300 isolates using Sorbitol MacConkey Agar a selective Media for E.coli O157:H7 and as shown in table (6) (19) and (1) total number of isolates obtained 283 ,231, 219 isolates for September October and november respectively and the percent of sorbitol fermentative isolates 85% ,88% and 94% while sorbitol non fermentative isolates were 14% , 11% and 5% respectively that might contain E.coli O157:H7because E.coli is sorbitol non fermentative and it can be seen in golden pale while fermented isolates of sorbitol appeared purple , number of the isolates obtained in September was rising in conformation for the temperature is optimum in September rather than colder months .

| Number of sorbitol non fermentative isolates | Number of sorbitol fermentative isolates | Total number of isolates | Isolation source |
|---|---|---|---|
| 12 | 58 | 70 | Soft cheese |
| 9 | 66 | 75 | Burger |
| 7 | 58 | 65 | Salads |
| 12 | 61 | 73 | Mined beef |
| 40 | 243 | 283 | Total |

**Table4: September isolation results using sorbitol MacConkey Agar and CT- sorbitol MacConkey Agar**

| Number of sorbitol non fermentative isolates | Number of sorbitol fermentative isolates | Total number of isolates | Isolation source |
|---|---|---|---|
| 8 | 42 | 50 | Soft chees |
| 5 | 43 | 48 | Burger |
| 4 | 61 | 65 | Salads |
| 9 | 59 | 68 | Mined beef |
| 26 | 205 | 231 | Total |

**Table5:October isolation results using sorbitol MacConkey Agar and CT- sorbitol MacConkey Agar**

| Number of sorbitol non fermentative isolates | Number of sorbitol fermentative isolates | Total number of isolates | Isolation source |
|---|---|---|---|
| 5 | 41 | 46 | Soft chees |
| 2 | 49 | 51 | Burger |
| 1 | 61 | 62 | Salads |
| 4 | 56 | 60 | Mined beef |
| 12 | 207 | 219 | Total |

**Table 6: November isolation results using sorbitol MacConkey Agar and CT- sorbitol MacConkey Agar**

**Isolates identification:**

**Cultural and Morphological for isolates:**

Initial identification of sorbitol non fermentative isolates was conducted based on the isolate's characteristics on CT-SMA medium incubation for 24hours at 37C, colonies were seen in a pale gold color thus being sorbitol non fermentative smooth and concaved surface and perfect edges table 7 (20).All results of morphological test shown that sorbitol non fermentative isolates were all rod-shaped gram negative with pink reddish color (figure1) (21).

| **Culturing Properties** | **Notes** |
|---|---|
| Colonies' Pigment | Pale gold or colorless |
| Colonies Shape | Round |
| Colonies Height | Convexed |
| Colony's Outer Perimeter shape | Perfect |
| Colonies surface | Smooth(slimy) |
| **Morphological Properties** | **Notes** |
| Reactivity of Cells to Gram Stain | Negative |
| Shape of Cells | Short rod |
| Cells' Group | Shows as individuals, pairs or chains of cells |

**Table7: Cultural and Morphological for isolates**

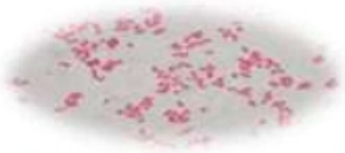


**Fig. 1: Non fermented bacterial isolates under an optical microscope**

**VITEK 2 apparatus identification:**

42 sorbitol non- fermentation isolates were subjected to VITEK, results showed that only 1 sorbitol non fermentative isolate was E.coli O157 with a probability 97% . the use of VITEK 2 technology is a good and fast way to identify the O157 serotype, (22).

**Molecular Identification:**

DNA extraction:The DNA was extracted from isolate based on VITEK that the isolate was E.coli O157 and the purity of DNA was examined by Nano Drop with a purity of 1.9 which is adequate for Polymerase Chain Reaction (PCR) process. (23) reported that the did not need a large quantity of DNA which may instead produce unlimited amplifying products. On other hand, an adequate quantity of DNA may reduce the accuracy.

**Polymerase Chain Reaction (PCR):**

A PCR for the isolate was conducted depending on 16S rRNA gene was carried out. The electrophoresis on 1% agarose show (by using U.V detector), that there was a clear band represents the genes amplifications (Fig.2). The molecular size of gene amplification band was over 100 bp comparing with

ladder size at the same conditions, which refers to the prime binding to the complete sequence inDNA pattern.(14)

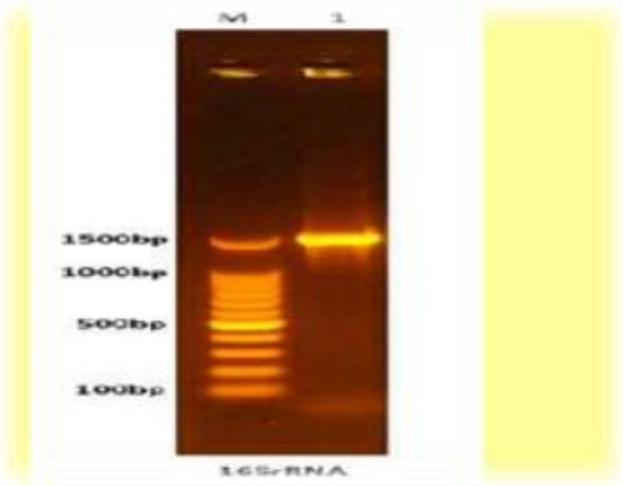



**Fig. 2:Electrophoresis of the amplification products of the 16S rRNA gene by PCR technique on a 1% acarose gel using a 100-1500 base pair of DNA volume index.**

**Sequence analysis of amplification products**

The sequence of nitrogen bases, of the16S-rRNA gene, for the local bacterial isolatewas studied by sending the amplification products to the Korean company Macrogen.

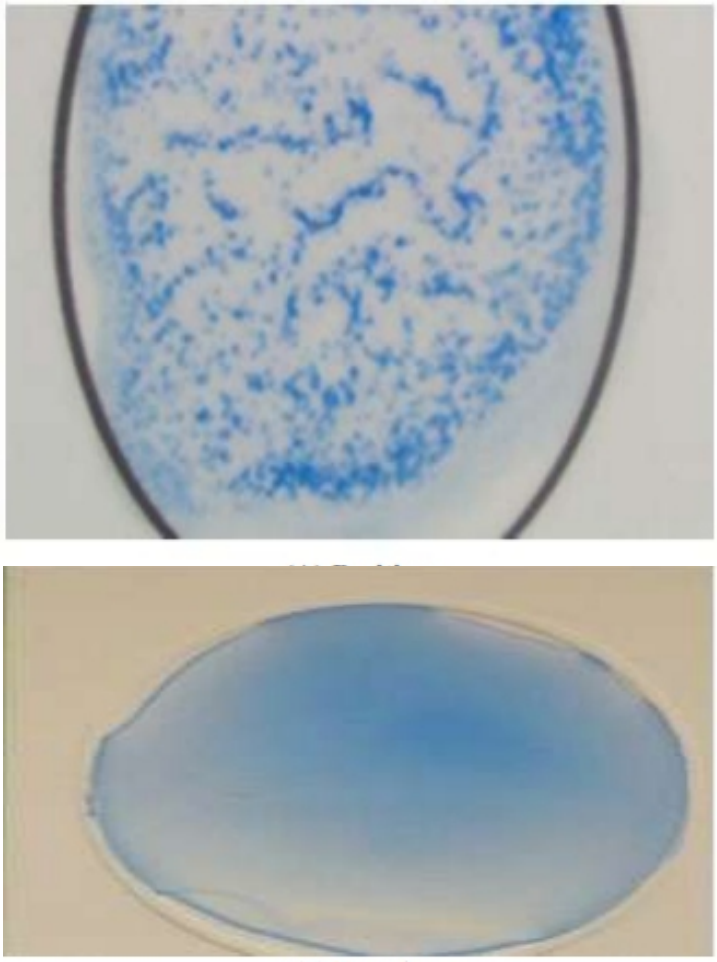
The nitrogen bases sequencewere (1356base-pair) which was taken from the local isolate sequence The BLAST program has been used to find out the similarity of gene with the bank information (NCBI). The results showed that there is a match between isolation and100% with global isolation sequences globalRegistered on the NCBI website and registered in the United States of America Which included Escherichia coli O157:H7C1-057100%, Escherichia coli O157:H7 FRIK944 100% ,Escherichia coli O157:H7 FRIK2455,100% , Escherichia coli O157:H7 FRIK2069100%,Escherichia coli O157:H7 FRIK2533,100%matching 99% strain Escherichia coli O157:H7 AR-0427as shown in table 8 .sequence ID: Mn824766

| Strain | Identity | ID |
|---|---|---|
| Escherichia coli O157:H7 C1-057 | 100% | CP035366.1 |
| Escherichia coli O157:H7 FRIK2455 | 100% | CP015843.2 |
| Escherichia coli O157:H7 FRIK944 | 100% | CP016625.1 |
| Escherichia coli O157:H7 FRIK2069 | 100% | CP015846.1 |
| Escherichia coli O157:H7 FRIK2533 | 100% | CP015842.1 |
| Escherichia coli O157:H7 AR-0427 | 99% | CP043942.1 |

**Table8: Shows the ratio of match of the nitrogen base sequences of E.coli O157: H7 Strain FS94 isolated from the burger with 6 strains of E.coli O157: H7 bacteria recorded in NCBI.**

**Latex agglutination test E.coli O157: H7**

Latex is considered a conclusive and easy test designed for the presumptive identification of Escherichia coli serogroup O157:H, for this purpose latex kit was used Control negative , Control positive , O157 test latex , O157control latex prepared by oxoid , result showed an observable agglutination while using drops of the O157 Test Latex reagent (figA 3) compared to (fig B 3) which represent the comparing treatment thus shows that the isolate contain the antigen O157 and belongs to serogroupE.coli O157:H7 (13).Latex test One of the most important rapid confirmatory tests for the serotype of E. coli O157: H7, which is easy to use due to the short time and the lack of effort.(24)



**(B) Negative**

**Fig.3: Latex agglutination test E.coli O157 :H7**

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# COURSE SYLLABUS COMPARISON USING ONTOLOGY DESIGN AND NLP

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## ABSTRACT

Designing an ontology can be viewed as a knowledge management model in which data and information collected from various sources are transformed into knowledge for improvised reuse. Classes or concepts (entities) are grouped together systematically to create a taxonomic structure that forms the backbone of an ontology. This study aims to demonstrate the step-by-step development of a method to match and compare two or more ontologies of similar domains using NLP. The domain here focuses on subjects in the curriculum structure offered by various universities. This paper shows the automatic ontology matching and comparison process and gives a systematic evaluation of the relationships between features of matching ontologies. The subject chosen in this instance is software engineering and the ontology is designed according to the information provided by the particular university in its curriculum. Further, The paper discusses the use of python libraries like RDFLib, spaCy, NLTK and Count Vectorizer which plays an important role in parsing, processing, matching and comparison of ontologies. The automatic matching and comparison is made on the basis of lexical, structural and semantic similarity measures.

**Keywords** - Knowledge Management, Ontology, Ontology Matching, Ontology Comparison, OWL, RDF, NLP, Feature Extraction.

## 1. INTRODUCTION

Ontologies are described as a way of managing and sharing knowledge by showing the properties of a subject area and how they are interrelated by defining a set of concepts and categories that represents the subject [2]. The main building blocks of Ontology are concepts, relationships and instances which are similar to the triplets that we see in the RDF model. The Web Ontology Language (OWL) is a semantic web language designed to represent Ontology. It is used to represent rich and complex knowledge about things, groups of things and the relation between them.

In recent years, several scientific fields and industries have started to use ontology for research and knowledge management purposes; G. Nie[4] have developed Ontology mapping system for e-commerce and logistics industry; SWAN[5] designs ontologies to a form knowledge ecosystem in the bio-medicine field; ChEBI[6] uses ontology to provide high quality annotated controlled vocabulary for chemical and bio-chemical field.

There are a large number of universities around us and having prior knowledge about its curriculum structure can greatly benefit students as well as the faculty members. Designing an ontology based on

the university's curriculum starts from the information extraction from their proposed syllabus.These information are further converted in turtle format which leads to formation of detailed ontology using Protege tool [3].

The manual process of ontology matching and comparison requires a lot of money, time as well as effort; (Nezhadi, Noy) [8,9]. It would be extremely difficult to match those big ontology (OWL) files, hence an algorithm for automation of this procedure must be developed. Ontology alignment is the term used to describe the process of matching and comparing two or more ontology (OWL) files and returning a list of matched entities and their relationships as output [10].

The process of ontology matching and comparison can be carried out using a variety of strategies, including lexical, structural, semantic, instance-based, and combinations of these. It is frequently noted that while the matching process based on one technique in a certain domain is good to some extent, it is insufficient for accurate alignment [7]. When using the lexical similarity technique, for instance, concepts with the same nomenclature and meaning will match up accurately. However, problems can occur when concepts with the same meaning are given a different nomenclature and set of defining strings. This scenario is considered in the paper, which discusses the combined use of the structural, lexical and semantic similarity techniques and taking an average of these similarity measurements on a whole.

## II. RELATED WORK

The construction of ontologies in different domains and their application for effective knowledge transfer are discussed in several research papers. Ontology is used for study in almost every field, including chemical, medicinal, industrial, educational, and smart systems. Numerous research papers highlight the idea of ontology matching and alignment on different similarity measures.

In order to achieve better ontology interoperability in distant environments, Guihua Nie [4] developed an E-commerce logistics ontology mapping system that can handle a variety of difficulties between e commerce and logistics ontologies. As a result, the information-driven modern and effective system benefits the e-commerce logistics sector. The study discusses semantic similarity metrics based on WordNet and the EC Semantic Dictionary (e commerce and logistics integration domain semantic dictionary).

In order to capture the meaning of a concept from its position in the contained ontology as well as its stated properties, D. Zhang[11] proposes a study to provide a method for conceptual comparison between two ontologies by providing four measures based on the semantic distance. Intention (property set), super concepts set (parent nodes), sub-concepts set (child nodes), and extensional difference on accessible instances set are the four views of difference used for comparison of ontology.

In 1993, T.R. Gruber [2] discussed the use of formal ontologies in artificial intelligence research as a means of defining content-specific agreements for knowledge transfer and reuse across software entities. He talks about formal ontologies, which were created as planned artifacts primarily to support knowledge sharing activities. Clarity (meaningful), Coherence (logical consistency), extendibility, minimal encoding bias, and minimal ontological commitment are the design criteria that T.R. Gruber[2] discusses.

(Nezhadi, Shadgar, Osareh) [8] provided a technique for effectively aligning various ontologies by combining similarity measurements. For better ontology alignment, they applied KNN, SVM, Decision trees, and AdaBoost classifiers. They use wordnet for semantic similarity, OLA's tools [12] for structural similarity, and a number of string based similarity measures for lexical similarity, including N-gram, Dice coefficient, Jaccard measure, etc. AdaBoost outperforms the other ML approaches used for cumulative similarity accuracy, where f-measure criteria goes near 99%.

(J.David, F.Guillet, H.Briand) [13] offers the AROMA methodology, which tries to identify equivalence and subsumption relations between elements of two dissimilar hierarchical structures given textual input. It focuses on matching the vocabulary that builds up the hierarchical structure (OWL ontology). They are using the association rule model to eliminate redundancy and filter out unnecessary data by developing an interestingness metric termed implication intensity. To improve the equivalence matching relation and taxonomy information, they apply string-based similarity measures at the conclusion.

(T. Thuy, A. Nguyen, S. Conrad) [1] gives LESSON, an automatic ontology matching method that integrates lexical, structural, and semantic similarity measures to obtain the ontology's final alignment. The process is divided into two phases: first, lexical and structural similarity is determined using entities containing names, labels, and comments; second, semantic similarity is determined using WordNet. The system is evaluated based on the OAEI 2008 benchmark dataset and achieved a F-measure of 0.87.The paper [14] discusses the difficulties scholars have while attempting to automate activities in higher education (HE) through the use of machine reasoning and ontologies. In order to identify, extract, analyze, and output semantically enriched data in a machine understandable format from various educational resources, they introduced the HEAPAF framework. In order to accommodate the HE data and execute analysis and reasoning on it, they additionally presented higher education ontology (HEO). They conducted a case study on identifying, selecting, and analyzing the best resources for teaching a certain course. They mostly used faculty member's resumes and information from course syllabi as their data sources.

Using NLP approaches, G.LAME [15] presented a broad strategy for discovering legal ontology items and the semantic relationships between them. He used 57 French law codes that are available on the official government website for the experiment. The corpus for experiment consists of all these codes.

He employed Syntex (a syntactical analyzer) to identify nouns, verbs, adjectives, and other structural dependencies in a corpus. In order to find relationships between phrases, he also used statistical analysis, pattern matching, and coordination relations (terms separated by "and" or "or").

To improve user engagement, (Cohen, William W., P. Ravikumar) [17] introduces PANTO, a portable natural language interface for ontology systems. It accepts generic natural language (NL) queries as input and outputs SPARQL queries. PANTO integrates WordNet[16] and string metrics methods[18] to make NL queries meaningful. PANTO analyzes the mapping on target and modifiers to construct SPARQL queries from QueryTriplets (nominal phrase pair derived from parse tree) to OntoTriplets (entities in ontology).

(J. Gracia, E. Mena) [19] Introduced CIDER, a schema- based alignment algorithm that contrasts every pair of ontological contexts before merging the measurement of several techniques like lexical distance, vector space modeling, and others. They are calculating the linguistic similarity of terms, taking into account their label and description and after moving on to the structural similarity by using properties of concepts. On OAEI 2008 benchmark evaluation they have achieved precision of 97% and recall of 62%.

According to (S. Chuan, X. Xue, J. Shyang, X. Wu) in [20], ontology is modeled in vector space since the attributes that describe its concepts take up space and have a dimension. They are modeling ontology in vector space using structural information, and are reducing the dimension of this vector space by employing linguistic information. Additionally, they are adding discrete optimization to the vector cosine distance measure technique to detect similarity and improve the measurement.

## III. ONTOLOGY MODEL

Ontologies are a crucial element in semantic web technology i.e. web 3.0 or web of data rather than web of documents [21]. This connection of interrelated data on the web can be referred to as linked data where the goal is to make the internet data interpretable to humans as well as machines and automate a lot of work on the web. Ontology is about conceptualization (abstract and simplified view) [2] where it consists of several relevant concepts. Modeling an ontology is gathering the domain's concepts and establishing relation in between them. The model has to be explicit making it not only machine readable but also machine understandable.

### A. Related Definitions

**OWL:** A semantic web language called OWL (Web Ontology Language) [21] was created to represent ontologies. Fast and flexible data modeling and effective automated reasoning are its two

main applications.

**RDF:** A common model for data exchange on the web called RDF (Resource description framework) [21] is built on the idea of expressing statements about resources in the form of triplets, or "subject-predicate- object" statements.

**Protege tool:** Protege [3] is a free open source ontology editor and knowledge management system that also has deductive classifiers to verify model consistency and infer new information from ontology analysis.

**B. Ontology Design**

The process of creating an ontology for a university's curricular structure begins with acquiring the course catalog from the institution's official website. The syllabus typically merely includes the concepts rather than the specifics and references. Collecting information on these subjects from a variety of sources, including the suggested book on the syllabus, is necessary for designing a thorough ontology. For instance, information on the topic of our chosen subject, "Software Engineering," was obtained from a variety of websites and books, including "Software Engineering a Practitioner Approach by Roger S. Pressman" [22], "Fundamentals of Software Engineering by Rajib Mall" [23] and others.

**Figure 1: Class hierarchy example developed on Protege.**

The class structure of the ontology is depicted in figure 1. This comprises the subjects (concepts) that represent the classes and their annotations (comments), which are composed of pertinent facts and information. Making a turtle format [24] of the topics covered in the syllabus is the first step in creating the class hierarchy. Figure 2 displays the object attributes of classes, which adds to the ontology's informational richness. Here are the steps taken to create an ontology.

Step 1. Constructing the class hierarchy.

Step 2. Define the properties/attributes.

Step 3. Describe and define the class that was created in step 1.

Step 4. Invoke reasoner.

Step 5. Create certain individuals

Step 6. Execute the reasoner and DL queries

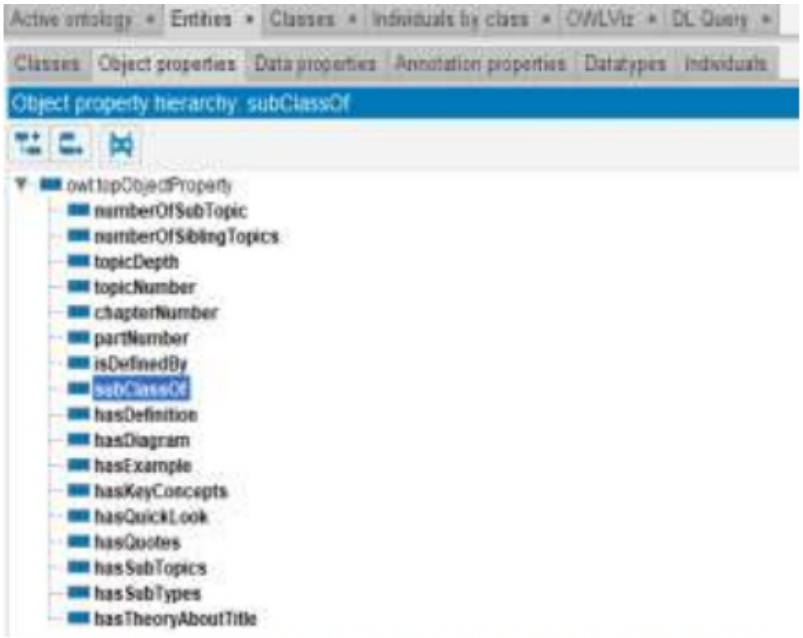


**Figure 2: Object property hierarchy example developed on Protege.**

## IV. ONTOLOGY MATCHING APPROACH

By incorporating semantic data (meaning of the data), ontology plays a significant role in improving the educational data. It promotes readability and makes the facts more plausible, which facilitates the process of making relevant decisions. The educational data must be discoverable, accessible, interoperable (use and exchange of information), and reusable out of a concern for transparency (FAIR) [25].

An automatic framework for ontology matching and comparison is discussed in this section for

improving educational data which will enhance one's making ability. Names, labels, comments, relational information, and structural information among entities are the ontology components employed in the system. The ontology (OWL) [21] file needs to be parsed, cleaned, and processed to convey only useful information in organized format before using the matching and comparison algorithms. The RDFLib [24] python library is used to parse the OWL file created by the Protege tool and to convert the OWL file to a graph containing triplets (subject-predicate object). These triplets of data are cleaned, filtered, and duplicate entities are combined to produce a significant amount of information that is valuable for further analysis.

Figure 3 shows the framework of the system depicting 5 phases where phase 1 of the framework entails developing, parsing, and processing an OWL file. In phase 2, the Levenshtein distance [26] and Count Vectorizer algorithms are used to compare words lexically. Phase 3 performs structural similarity using the lexical similarity data from Phase 2. Phase 4 uses Word Net for semantic similarity. Finally, in phase 5, weighted average sum is evaluated with threshold value to ensure the related items between source and destination ontologies. These entities and similarity metrics are subsequently examined to gain knowledge of two or more university curricula. The details of the process is explained in the sub section.

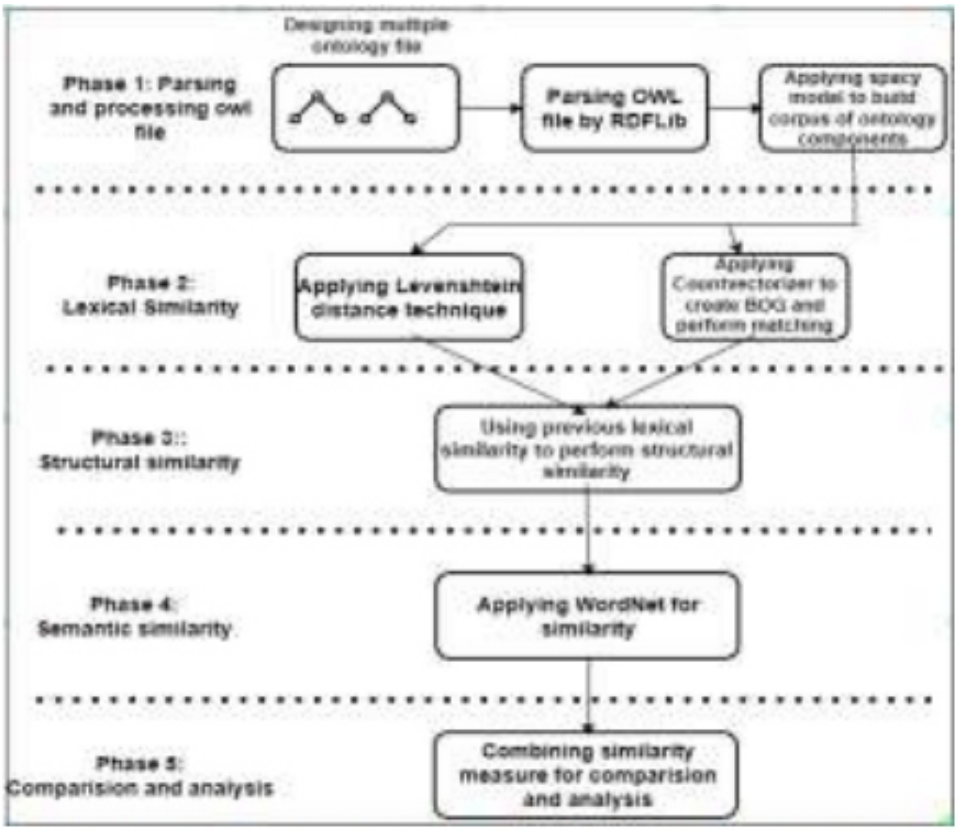


**Figure 3: Ontology matching and comparison framework.**

The course syllabus OWL file generated from Protege tool consists of huge information in form of name, labels, comments, object properties etc. Once this file is parsed using RDFLib, these information is converted in from of graph of triplets i.e. "Subject Predicate-Object". The subject denotes the resource, the predicate denotes the aspect of the resource and expresses a relation between the subject and object. The information from these triplets are extracted and then converted into a list of objects. The object here belongs to well defined class having data members like "subject", "comment", "sub Class Of", "objectType", "is Defined By", "predicate", "part Number", "topic Number", "topic Depth" etc. The text from these fields are combined to form a bucket of information. There is a lot of redundant data which is also merged [11] and brought under the same object.The collective text is utilized and spaCy's "nlp" model is applied to create a doc object on this text. The text enters a processing pipeline once the nlp model is applied, which breaks down the text first and then performs a sequence of operations i.e. tagging, parsing, and describing the data. Figure 4 shows the pipeline of the nlp model.

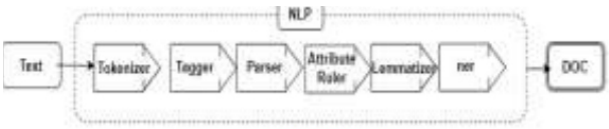


**Figure 4: NLP Pipeline**

The next step is to exclude commonly used terms like "a" and "the" (stop words) that don't need to be tagged as carefully as nouns, verbs, and modifiers. The default collection of stop words needs to be greatly modified to reflect the context of the content. The text is also cleared of extra punctuation and undesired sequence numbers. In order to recognisepatterns in text and extract certain information, such as "text describing a figure/diagram", "text describing tables", "text describing examples" etc., Matcher, a rule-based matching tool present in spaCy library, is also employed. The result of this filtration process generates a rich corpus file for further analysis and used as input for lexical similarity measure phase which is discussed in subsequent sections.

### B. Phase 2: Lexical similarity

Lexical similarity, also known as string-based similarity, is used to compare components like names, labels, and comments, which contain the majority of the theoretical data. In order to achieve similarity between ontology components, this comparison is helpful.

AROMA's [13] matching functionality is mainly based on the linguistic approach that if an entity A's vocabulary (i.e., terms and data used to describe A, its offspring, and its occurrences tend to be included in that of B), then an entity A will be more detailed than or equivalent to the entity B. Below are the two approaches used to calculate similarity.

1) Levenshtein distance approach: Levenshtein distance [26] is one of the edit distance (ed) methods used to determine how similar or dissimilar two strings are from one another. It calculates the bare minimal number of edit operations required to match both strings. The definition of the edit function is the activity of adding, replacing, or removing a character from a string. Consider the strings "Rocket" and "Racket", for instance. The edit distance (ed) will be 1 in this case as there is only one character that needs to be changed from either string. Below mentioned equation (eq1) [28] is used to calculate Levenshtein distance in our case

$$Sim(L_i, L_j) = max\left(\frac{0, min(|L_i|, |L_j|) - ed(L_i, L_j)}{min(|L_i|, |L_j|)}\right)_{(eq_1)}$$

The above Sim() function produces a similarity score between 0 and 1, where 1 represents perfect similarity and 0 represents bad similarity. In our example, the Sim() function will return 0.8 for the strings "Rocket" and "Racket.". Here, Li and Lj represents the two strings, while length of two string are represented by |Li| and |Lj|.

2) CountVectorizer method: In order for machines to process and evaluate textual material easily, it is crucial to convert it to numerical data. Text documents can be represented as vectors of numerical values using the Vector Space Modeling (VSM) technique, which commonly employs the CountVectorizer method [29]. A class in the scikitlearn library called CountVectorizer can be used to turn a group of text documents into a VSM representation. A lot of textual information is carried in the comments, name and labels in the entities of the ontology component. CountVectorizer plays an important role in feature extraction. With the help of CountVectorizer, which creates a feature dictionary and turns the document into a feature vector. Stopwords filtering, tokenization, and text preprocessing are all included in this python package. Each vector in this situation can be seen as a collection of words (also known as bag of words). Further these vectors are compared and if the similarity measure is greater than the threshold value, then the matching entities are recorded in a similarity matrix.

When the similarity measure alone doesn't quite add up to 1 or 100%, taking the weight of each component into account aids in solving the issue. The formula (eq2) [1] below demonstrates how weight is used combined with a component or concept's similarity to calculate the true degree of similarity.

$$Sim(e_1, e_2) = \frac{\sum_{k=1}^{n}(w_k * sim_k(e_1, e_2))}{\sum_{k=1}^{n} w_k}$$

Where e1 and e2 are entities of ontology O1 and O2, wk is the feature's weight and simk(e1, e2) are component's similarity measure. By utilizing the above equation (eq2), the overall lexical similarity equation (eq3) [1] between e1 and e2 is given by:

$$Sim\,(e_1, e_2) = \frac{w_n * lexname(e_1, e_2)}{w_n + w_l + w_c} + \frac{w_c * lexcomm(e_1, e_2)}{w_n + w_l + w_c} + \frac{w_l * lexlabel(e_1, e_2)}{w_n + w_l + w_c} \quad (eq_3)$$

Where wn, wc and wl are the weight of the class name, comment and labels respectively. lexname(e1, e2), lexcomm(e1, e2) and lexlabel(e1, e2) are component similarity of name, comment and labels. A similarity matrix that depicts the total lexical similarity across ontology components is created as a result of this similarity calculation.

### C. Phase 3: Structural similarity

Ontologies, which have a taxonomical or hierarchical structure, mainly display the property of inheritance, where a certain node or entity inherits the properties of its parent node and conveys those same properties to its child node. It is crucial to compare things based on their structural data because doing so improves the similarity metric. Even when two items are lexically and semantically similar, when parent, sibling, and child nodes are examined, they can belong to different contexts [30]. The opposite of the aforementioned statement is also true. Take two entities as an example (figure 5), both of which have the name "Apple".

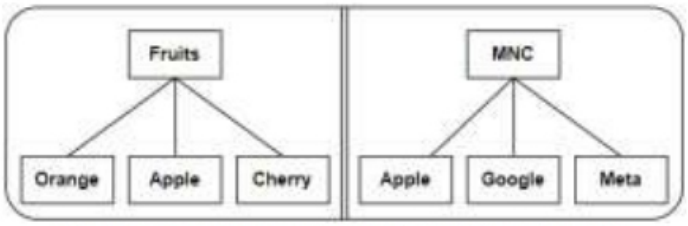


**Figure 5: Ontology example for structural similarity.**

Due to the ambiguity of the names of these two entities, which are equal when compared based on lexical approach, but when parent, sibling and child nodes are also analyzed then the entities are different.The method of choosing the centroid and division set as indicated in [30] is the foundation for the structural similarity computation process. This similarity measure's input is the lexical similarity phase's output similarity matrix. The centroid of each pair of lexically related entities is chosen as the beginning point for the partition set, and comparisons between the concepts are made. The structural similarity matrix contains all the similarity values

**D. Phase 4: Semantic similarity**

In NLP, text comparison is a common technique. When working with text, Word Net should always be taken into consideration as a tool. Word Net is used as the foundation for the semantic similarity, also known as knowledge-based similarity. The Natural language toolset (NLTK) for Python includes WordNet and is used in our approach. The Word Net database contains several English nouns, verbs, adverbs, and adjectives. These are compiled into a collection of cognitive synonyms known as Synset. Synset serves as the NLTK library's interface for searching the Word Net database for words. The collection of words that communicate the same idea synonymously is known as a Synset instance. A word's meaning in Word Net is primarily expressed through its relationships to other words and a collection of synonyms, with the database's structure mirroring the most recent psycholinguistic research on the mental lexicon (information in terms of phonological, morphological, semantic, and syntactic) [16].

WordNet is used to compare the entities that contain names, labels, and comments, which are the information sources of ontologies. The equation (e4) (provided in [1]) below shows how conceptually similar ontologies are overall:

$$Sim(e_1, e_2) = \frac{w_n * semanticname(e_1, e_2)}{w_n + w_l + w_c} + \frac{w_c * semanticcomm(e_1, e_2)}{w_n + w_l + w_c} + \frac{w_l * semanticlabel(e_1, e_2)}{w_n + w_l + w_c} \quad (eq_4)$$

Here wn, wc and wl are the weight of the class name, comment and labels respectively. Semantic name(e1, e2), semantic comm(e1, e2) and semantic label(e1, e2) are component semantic similarity of name, comment and labels.

**E. Phase 5: Comparison and Analysis**

The degree of general similarity between the concepts of different ontologies is determined by integrating the similarity matrices acquired in the previous phases. This gives the overall match percentage of ontologies. The matched entity pair is considered comparable if the similarity measure between them exceeds the minimal threshold value.

To gain a deeper understanding, the following attributes of the related entities in the curriculum

ontologies are compared and subsequently studied.As stated, these ontologies are designed on the syllabus structure of different universities. All the analysis is limited to the subject "Software engineering" (for which the ontologies are designed) to maintain the vastness of scope.

**Chapter and Part number comparison:** When comparing the syllabus structures of various colleges, one can use this information to determine which entity will be taught earlier or later than the other by looking at the sequence number of the matching chapter in two or more ontologies.

**Concept name and label:** This feature's comparison determines whether or not the corresponding topics of different ontologies have the same name and label, which can provide information about the naming conventions used by various universities.

**Topic Number:** The topic number of matched entities is compared to learn about the chapter number, the topic's real sequence, and the topic's depth in the syllabus structure to learn whether it is specific or general.

**Number of siblings:** To determine how many pieces each matching entity is broken into, the number of siblings of each matching entity is compared. Which entity has more modularity can be inferred.

**Number of subtopic:** To determine the degree of information dissemination for each entity, the number of subtopics of matching entities is compared. This provides information about how information is delivered in various syllabus structures, including whether the information is provided as a whole or in segments.

**Figure, table, example**: The matched entities are checked whether they are having figure/diagram, tables or examples that support the description of the concepts and enhance the information presentation.

**Subclass of:** The matching entities of ontologies are also checked on the basis of their parent node to determine whether they fall under the same or different class.

## V. RESULT AND DISCUSSION

It is shown that unprocessed primary data can be used and shared for a number of purposes by transforming it into a semantically enriched form. Users have access to a vast amount of information that educational institutions hold and can use to automate a variety of duties and procedures in academic programmes [14].

For instance, our automatic ontology matching and com- parison system is capable of analyzing the degree of similarity between any number of ontologies based on syllabus structures proposed by various universities. For now, we have performed similarity matching between two ontologies and 71% of second Ontology (O2) matched with the first ontology O1). Following the discovery of similarity, every matched item is examined based on the aforementioned features, and a thorough analysis is

provided as a text file.

Figure 6 gives a glimpse of the output showing the comparison result of two ontologies. As shown in the image one can infer which syllabus structure has more details, good presentation of information, overall number of topics covered, etc. To show assurance of the scope of our framework and its applications, our framework tends to provide solutions to the below competency questions [31] and statements.

What amount of specificity does a certain university's curriculum structure have ?

In what order are the topics covered in a certain university's course syllabus taught ?

How effective is the syllabus's information presentation (important ideas, figures/diagrams, tables, examples, etc.) ? Does the syllabus meet the user's needs?

Is it satisfactory in light of what the user wants ?

If a student is not admitted to a certain institution, he or she might search for another university that offers a similar course programme.

For representing the syllabus in a rich format for humans and for machines as well. For quick comparison of syllabus structure of different Universities.


**Figure 6: Comparison output.**

## VI. CONCLUSION

The study introduces an automatic ontology matching and comparison framework that can match and compare any number of ontologies created using the structure of different institution's course syllabi as input and deliver a complete analysis of ontologies interms of their similarity. The framework employs lexical, structural, and semantic similarity approaches for similarity calculation, and the results are merged to produce an overall similarity matrix that represents matched entities from ontologies. When

the identified related entities (concepts) of ontologies satisfy the minimum threshold value requirements, further analysis is done to acquire a complete understanding of the proposed syllabus structure by institutions.

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