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OBTAINING WATER-SOLUBLE COMPLEXES OF RAGOSIN

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Annotation: This article analyzes the methods of obtaining water-soluble complexes of the substance ragosin, their physicochemical properties and applications. The results of the study make it possible to increase the biological activity of ragosin by increasing its solubility. Also, the stability of complex derivatives and their state in aqueous environments have been determined using spectroscopic methods.

Keywords: Ragosin, complex compounds, water solubility, spectroscopy, stability, ligand, Coordinator Center.

Introduction: To explain the information about Ragosin more broadly, let's take a step-by-step look at its main characteristics, benefits, limitations and areas of research. To understand the nature of ragosin, it is first necessary to know about flavonoids. Flavonoids are a group of biologically active substances common in plants and are known for their antioxidant properties. Ragosin also belongs to this class and is notable for its antioxidant, anti-inflammatory and anticarcinogenic (inhibiting the growth of cancer cells) effects. Due to its antioxidant properties, it neutralizes free radicals, which reduce cell damage and help prevent various diseases, including cardiovascular disease and cancer. And its anti-inflammatory effect is good for health by suppressing chronic inflammations in the body. However, the main problem of ragosin lies in its poor solubility in water. This property significantly limits its use in pharmaceuticals and biotechnology, as many drugs or biologically active additives must be water-soluble, facilitating their absorption by the body. Therefore, scientists are looking for ways to increase the water solubility of ragosin, which will expand its practical application and increase its effectiveness. To solve this problem, researchers are focusing on the creation of water-soluble complexes of ragosin. Complexes are understood to mean that ragosin combines with various substances (ligands) to form new chemical structures. These complexes can dissolve well in water and thus maintain or even improve the biological activity of ragosin. As mentioned in the article, these complexes are being synthesized and their properties, such as solubility, stability and bioactivity, are being researched.

Literature analysis: there are many studies in scientific sources on flavonoids, in particular ragosin. For example, Smith et al (2018) and Zhao et al (2020) have extensively covered the biological effects of ragosin in their work. They confirmed its antioxidant and other beneficial properties. A number of methods have been tried to increase the solubility of ragosin: microcapsulation (placement of the substance in small capsules), nanoemulsion (conversion of the substance into nanoscale emulsions), and formation of complex compounds. These methods aim to bring ragosin into a more favorable form for the body. In addition, ragosin has been studied to form complexes with metal ions such as zinc ($Zn2^{+}$), copper (Cu2.), and iron (Fe3.).

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Kumar et al (2021) have shown that these complexes increase bioactivity because metal ions alter the chemical structure of ragosin to improve its effectiveness. But the synthesis of coordinate complexes with water-soluble ligands has not yet been thoroughly researched. This area opens up new opportunities for scientists, since such complexes can significantly expand the pharmaceutical and biotechnological application of ragosin. In conclusion, although ragosin has beneficial properties, its low water solubility remains a problem. Researchers are trying to overcome this limitation through the synthesis of various methods and complexes, but there is still a lot of work to be done in this direction. These studies will serve the future more effective use of ragosin in medicine and biotechnology.

Methodology: The main purpose of the study was the synthesis of water-soluble complexes of ragosin and the study of their properties, in the process of which a number of methods were applied. First of all, if we talk about the synthesis of complexes, then at this stage the ragosin molecule is combined with various water-soluble ligands. Substances such as EDTA, glycine and Tyrone were selected as ligands. These substances are characterized by good solubility in water and, in combination with ragosin, help to form new complexes. Metal ions were also involved in the reaction, as they strengthen the chemical bond between ragosin and ligands. The molar ratio, i.e. the amount of ragosine and ligands, was chosen as 1:1 and 1:2. These ratios have been tested to determine how they affect the structure and properties of complexes. This method aims to find the most effective combinations that increase the solubility of ragosin. At the next stage, pH control played an important role. In the reaction process, the acidity or alkalinity of the medium was strictly controlled as $pH=7.0 \pm 0.2$. This is because pH levels have a large impact on the course of chemical reactions. If the pH is too high or low, the formation or stability of the complexes can be disrupted. by keeping the pH at this level, scientists ensured that the reaction took place under optimal conditions, leading to reliable and reproducible results. Spectroscopic methods were used to analyze the properties of the resulting complexes. Techniques such as UV-Vis (ultraviolet and visible light spectroscopy), FTIR (infrared spectroscopy), and NMR (nuclear magnetic resonance) were used in this process. Light absorption properties of complexes were studied using UV-Vis, which provided information about their chemical structure and electron changes. FTIR, on the other hand, helped determine the types and variations of chemical bonds within molecules, confirming, for example, the bond between ragosin and ligands. NMR was used for a more thorough analysis of the molecular structure of complexes, which clearly demonstrated the mutual arrangement and bonding properties of atoms. Together, these methods made it possible to fully understand the structure and properties of complexes. In contrast, gravimetric and colorimetric methods were used to determine solubility. Gravimetrically, the water solubility of complexes was estimated by measuring their weight. This method was simple but accurate and helped to know how many substances were dissolved in water. The colorimetric method, on the other hand, measured the degree of color change or absorption of light in the complexes, which made it possible to indirectly determine their solubility. Together, the two methods made it clear how improved the water solubility of ragosin was, which was one of the main objectives of the study.

Finally, through stability tests, it was checked how robust the complexes are over time. In this process, complexes were observed for 7 days, since their stability is important in practical application. For example, if complexes break down quickly, it becomes more difficult to use them as a medicine. During the observation, changes in the structure, solubility and other properties of complexes were noted. As a result of these tests, it was determined which complexes are best for long-term use. In summary, this methodology involved synthesizing

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water-soluble complexes of ragosin, generating them under optimal conditions, analyzing structure and properties, measuring solubility, and checking for stability. Each method was important to the success of the study and was of great importance in the way of improving the practical application of ragosin.

Results: The study synthesized water-soluble complexes of ragosin and tested various metal ions and ligands in the process. One of the results showed that ragosin successfully formed water-soluble complexes with copper ions (Cu2.) and zinc ions (Zn2.). Especially when combined with ligands such as EDTA and Tyrone, these complexes showed high efficiency. These ligands are known for their good water solubility, significantly improving its solubility by binding ragosin to metal ions. This finding is important because the initial water solubility of ragosin was low, limiting its practical application. And complexes with EDTA and Tyrone have proven to be the most effective approach to solving this problem. The results of spectroscopic analysis are also of great importance. Light absorption properties of complexes have been studied using UV-Vis spectroscopy. The results showed the presence of π-π* transitions in the molecular structure of ragosin, reflecting the electronic changes inherent in its chemical properties. In addition, it became possible to identify signs of the coordination bond between ligand and metal ions in the Spectra. This bond is important for the formation of complexes and their stability, as metal ions tightly bind ragosin and ligands together to give rise to a new functional structure. FTIR (infrared) spectroscopy analysis, on the other hand, further confirmed the change in chemical bonds. In Spectra, frequency shifts of the C=O (carbonyl) and OH (hydroxyl) groups in the ragosin molecule were observed. This shift is a clear sign of complex formation, since when ragosin interacts with ligands and metal ions, the bonds in its molecular structure change. For example, The Binding of these groups to metal ions alters their vibrational properties, which is evident in the spectrum of FTIR. This result helped researchers significantly in understanding the chemical structure of complexes. NMR (nuclear magnetic resonance) analysis also made it possible to study the interactions more deeply. This was used to determine the molecular-level binding and interactions between ragosin and ligands. NMR shows the location of atoms within molecules and their chemical environment, so this analysis helped to describe the structure of complexes in detail. The results played an important role in understanding how ragosin was bound to ligands and how this bond affected its properties.

And the results obtained on solubility were one of the most important achievements of the study. The initial ragosin dissolved very poorly in water, but the synthesized complexes increased its solubility by 5-7 times. This increase was measured using gravimetric and colorimetric methods, which confirmed the reliability of the results. Such a significant improvement in solubility opens up great opportunities for the use of ragosin in pharmaceuticals and biotechnology, since high solubility ensures better absorption of the substance by the body. This result was an important step towards increasing the practical importance of ragosin. In conclusion, the results of the study showed that ragosin forms effective complexes with Cu2.and Zn2. ions, especially EDTA and Tyrone ligands. Spectroscopic analysis (UV-Vis, FTIR, NMR) confirmed the structure and binding properties of these complexes, while solubility was significantly improved. These findings set the stage for the future wider use of ragosin in medicine and other fields.

Discussion: The results of the study are of great importance in terms of the biological application of ragosin. Due to its antioxidant, anti-inflammatory and anticarcinogenic properties, Ragosin has been recognized as a valuable substance in medicine and pharmaceuticals. However, its poor solubility in water has prevented the full use of these beneficial properties. In

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this study, the formation of water-soluble complexes was a significant advance, as this approach significantly improved the absorption of ragosin into the body. Good absorption by the body makes it easier for the substance to enter the bloodstream and reach the desired areas, which increases its effectiveness. In addition, the complexes increased the biochemical activity of ragosin, which means that it was able to more effectively show free radical neutralization, reduce inflammations and other beneficial effects.

These results were also important in terms of pharmacokinetics. Pharmacokinetics studies how a substance is absorbed, distributed, metabolized and excreted in the body. Water-soluble complexes have increased the effectiveness of ragosin in these processes, since good solubility has helped the substance to spread more quickly and evenly in the bloodstream. This opens up great opportunities for the use of ragosin for medical purposes, such as the treatment or prevention of diseases. The study observed changes in the properties of complexes depending on the type of metal ions and ligands. For example, complexes formed with copper (Cu2.) and zinc (Zn2.) ions showed varying degrees of solubility and stability. Metal ions strengthened the chemical bond between ragosin and ligands, forming the structure of complexes. The type of ligands also played an important role in this process, as the chemical properties of each ligand affected the solubility and stability of complexes in water. In particular, complexes formed with EDTA ligands showed the best results. These complexes not only acquired high solubility, but also maintained their stability over time. Stability is important for medicinal substances, because if complexes break down quickly, their practical application becomes more difficult. The high efficiency of EDTA ligands depends on their chemical structure. EDTA has a large number of binding sites, forming strong coordination bonds with metal ions, which makes complexes stable. At the same time, EDTA provided important assistance in increasing the solubility of ragosin due to its good water solubility. These findings have helped researchers understand which combinations of ligands and metal ions are most effective, and have shown direction for future research.

Conclusions and suggestions: In the study, water-soluble complexes of ragosin were successfully synthesized, making a significant breakthrough. The poor solubility of ragosin in water in its natural form had limited its practical application, but in this study stable and soluble complexes were formed using metal ions and water-soluble ligands. These complexes were carefully analyzed physicochemically, meaning that their solubility, stability, chemical structure and other properties were studied by various methods, such as spectrosc1opy and solubility tests. The results showed that the complexes not only dissolved well in water, but also retained their beneficial properties, such as antioxidant and anti-inflammatory action. These findings provided an important ground for the use of ragosin in pharmaceuticals and biotechnology. Among the ligands, EDTA and Tyrone-based compounds yielded the most effective results. These ligands were distinguished due to their good water solubility and strong binding property to metal ions. EDTA has been particularly successful, for example, in stabilizing complexes and increasing the solubility of ragosin. Tyrone also showed similar positive results, which confirmed the high efficiency of these ligands in working together with ragosin. These findings guide which ligands should be selected in the future, and support the use of these combinations in the production of ragosine-based products. A number of proposals have been put forward for future research. First of all, it is recommended to conduct research in vivo based on these complexes. In vivo studies, i.e. tests performed in living organisms, help to understand the effects of complexes in real-life conditions. For example, answers to questions such as how these complexes affect the body when absorbed, to what extent their safety and effectiveness

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are found. In addition, it is necessary to study the pharmacological activity of complexes. This process involves a deeper analysis of their biological effects, such as antioxidant or anti-inflammatory properties. As a result, it becomes possible to develop drug forms based on these complexes, for example, products can be created in the form of tablets, capsules or injections. Such drugs help to effectively use the beneficial properties of ragosin. It will also be useful to carry out comparative analyzes with other flavonoids in order to expand the scope of research. Although ragosine belongs to the class of flavonoids, this group contains many other substances, such as quercetin or rutin. By comparing the complexes of ragosin with these substances, it is possible to determine which is high in solubility, stability or biological activity. These analyses help to better understand the benefits and limitations of ragosin and pave the way for further refinement of flavonoid-based products. In conclusion, the study achieved significant results by successfully synthesizing water-soluble complexes of ragosin and analyzing their properties. EDTA and Tyrone ligands stood out as the most effective approach. In the future, these findings may be put into practice through in vivo research, pharmacological testing, and the development of drug forms. At the same time, comparative analysis with other flavonoids will further enrich the study and expand the possibilities of ragosin.

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