An IBiS study reveals a key new genetic mechanism for protein production in cells

- **This study has identified a novel molecular mechanism that allows cells to maximize the expression of certain essential genes through a single regulatory factor, Sfp1.**

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An international study by the **Institute of Biomedicine of Seville (IBiS)** has identified an innovative mechanism in the regulation of gene expression that could transform our understanding of how cells produce essential proteins. The findings, published in the scientific journal *eLife*, reveal the role of the Sfp1 factor as an integral regulator that controls both the synthesis and stability of messenger RNA (mRNA), optimizing protein production from specific genes.

Gene expression is the process by which cells convert the genetic information stored in DNA into proteins, which enable the biological processes essential for life. This process involves several fundamental steps, including the synthesis of a transient molecule, **messenger RNA (mRNA), which carries DNA instructions** to the cell's "protein factories" in the cytoplasm. Until now, it was assumed that mRNA synthesis and subsequent degradation were independently controlled processes. However, this new study reveals that a single factor, called Sfp1, regulates both aspects simultaneously in a subset of specific genes, maximizing their expression.

"The significance of this discovery lies in describing a new molecular mechanism for maximizing gene expression," emphasizes **Sebastián Chávez**, one of the study's authors and leader of the "**Gene Expression**" group at **IBiS**. According to the findings, Sfp1 acts as a true "integral activator of gene expression," regulating the entire process from the initiation of mRNA synthesis in the cell nucleus to its stabilization in the cytoplasm, where it is finally translated into protein. "Until now, it was thought that these two processes were independently controlled," explains the researcher. "What we have demonstrated is that a single cellular factor regulates the entire process: from the beginning of synthesis to the final degradation of messenger RNA ".

Sfp1: a key player for messenger RNA

The study has shown how Sfp1 initially interacts with DNA in the nucleus to promote gene transcription (the process of converting DNA into mRNA). Following this first stage, the molecule continues to accompany the newly synthesized mRNA as it travels to the cell cytoplasm, ensuring that the mRNA remains stable and protected from degradation. This protection allows the mRNA to remain functional long enough to produce the necessary amount of protein for the cell's needs.

Unlike traditional models, in which mRNA synthesis and degradation are managed by separate factors, **Sfp1 is a unique regulator coordinating both stages**. This ability to manage the complete cycle makes Sfp1 a crucial element for optimizing the expression of specific genes that require high levels of protein production, such as those involved in growth and responses to cellular stress.

One distinctive aspect of the process described in this study is that Sfp1 does not regulate all genes within the cell. **Its action is limited to a specific subset of genes**. This selective regulation allows cells to precisely adjust the amount of protein produced to perform vital functions under specific conditions and at particular times. This is especially critical for genes whose high activity is essential in situations such as stress adaptation or activation of survival mechanisms.

Researchers point out that this level of control by Sfp1 could represent an evolutionary advantage, enabling cells to maximize energy efficiency and focus protein production during times of need. The discovery marks a significant advancement **in understanding how our cells manage resources and optimize fundamental life processes**. Through factors like Sfp1, cells can adapt their function and respond to situations requiring high protein demand.

The discovery of Sfp1 as an integral regulator of gene expression resulted from an interdisciplinary collaboration between laboratories at renowned institutions: the **Institute of Biomedicine of Seville (IBiS),** the **University of Valencia**, the **University of Edinburgh** (United Kingdom), and the **Israel Institute of Technology**. The research was supported by **Spain's State Research Agency**, which funded IBiS's participation and backed the Spanish contribution to this globally impactful discovery in genetics and molecular biology.

Reference: *The zinc-finger transcription factor Sfp1 imprints specific classes of mRNAs and links their synthesis to cytoplasmic decay*

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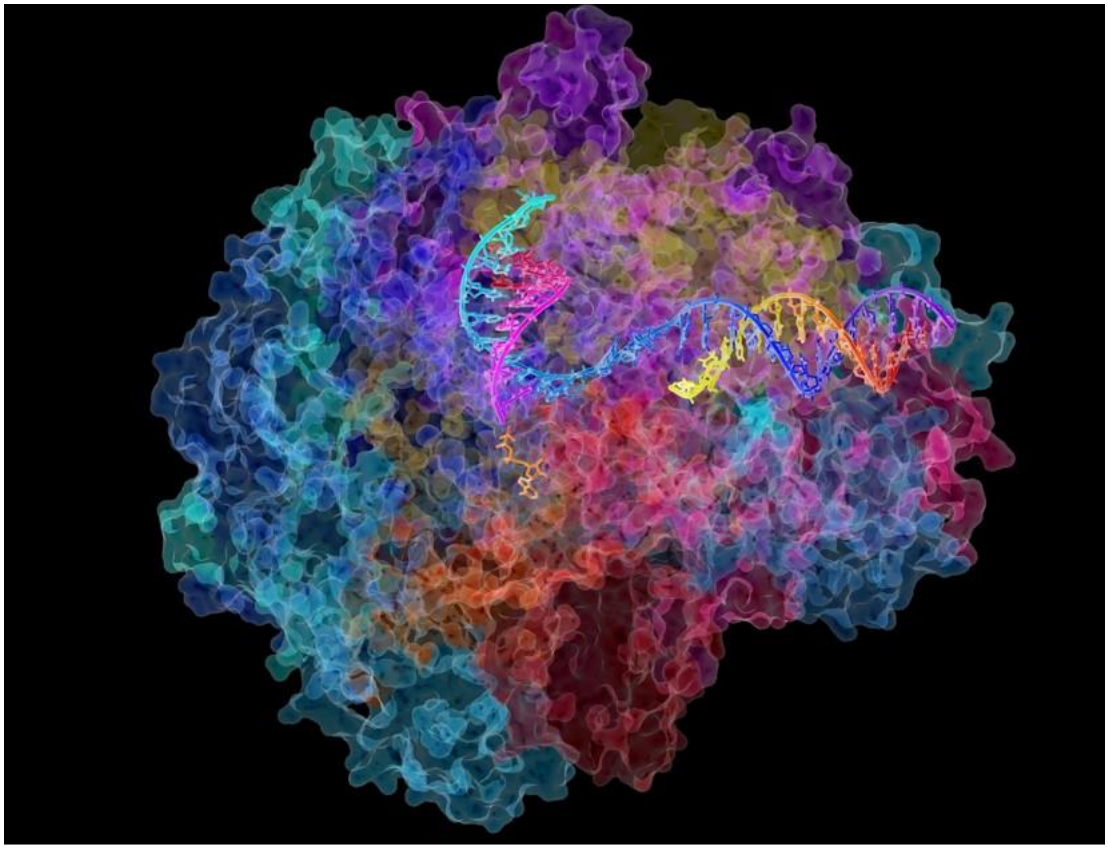

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Image 1: "Structure of RNA polymerase II, the enzyme in mammalian cells that catalyzes the transcription of DNA into messenger RNA, which, in turn, dictates the order of amino acids in proteins".

Sobre IBiS

The Institute of Biomedicine of Seville (**IBiS**) is a multidisciplinary center focused on carrying out fundamental research on the causes and mechanisms of the most prevalent pathologies in the population and the development of new methods to diagnose and to treat diseases.

IBiS is made up of 41 consolidated groups and 39 affiliated groups led by researchers from the University of Seville, the Spanish National Research Council (CSIC) and the Virgen del Rocío and Virgen Macarena University Hospitals and Valme, organized around five thematic areas: Infectious Diseases and Immune System, Neurosciences, Onco-hematology and Genetics, Cardiovascular Pathology, Respiratory / Other Systemic Pathologies and Liver, Digestive and Inflammatory Diseases.

IBiS depends institutionally on the Department (Consejería) of Health and Consumption of the Junta de Andalucía; the Andalusian Health Service (SAS); the Department (Consejería) of University, Research and

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