



Advanced Molecular Biology Concepts: Oral Medicine Rejuvenated - A Systematic Review

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Abstract

Background: Hachimoji is a double DNA helix that has an additional 4 nucleotide bases. In normal RNA and DNA, combination of four base pairs enables the storage and transmission of genetic information. The 4 new letters P, B, Z and S approximated the structures and functionally of regular DNA. This is of significance because DNA has always been thought to be unique. DNA is the only materials for which we have the ability to design sequences that have predictable stability, this new four letters satisfy every aspect of this predictable stability as well.

Aim of The Study: To evaluate and emphasize the sensitivity and specificity of Hachimoji DNA in oral therapeutics.

Research Question: Is Hachimoji actually significant enough in detecting and treating specific oral diseases and lesions.

Materials and Methods: With the Medline database taken as a source for authenticated scientific research data, articles were selected having undergone randomized control trial. Out of these, articles (studies) were chosen which met the criterion for systematic review.

Results and Conclusion: We can interpret that Hachimoji DNA comes up with numerous advantages. To name a few, better understanding of its complex structure. Enhanced understanding of different base pairs with its modified properties. Minimising the complexity of nano structures. Synthesis of protein from unusual amino acid. The complexity of DNA and the nucleic acid which once seemed daunting have now been discerned. Thereby, not only modifying and improving the cellular galaxy at a molecular level but also enhancing the approach towards various disease therapeutics which have been so far a challenge to medical and dental science.

Keywords: Advanced Molecular Biology; Oral Medicine Rejuvenated; DNA; RNA

Introduction

Molecular biology is a branch of biology that concerns with the molecular basis of biological activity between bio molecules including the interaction between DNA, RNA, proteins and their bio synthesis. Synthetic biology aims at the design and fabrication of

biological components and combines chemical synthesis of DNA with growing knowledge of genomics. To quickly manufacture catalogue DNA sequence and assemble them into a new genome. Hachimoji DNA (from Japanese hachimoji, "eight letters") is a synthetic nucleic acid analogue that uses four synthetic nucleotides in

addition to the four present in the natural nucleic acid DNA and RNA. This leads to four allowed base pairs: two unnatural base pairs formed by the synthetic nucleobases in addition to the two normal pairs. Hachimoji bases have been demonstrated in both DNA and RNA analogs, using deoxyribose and ribose respectively as the backbone sugar.

Aim of The Study

To evaluate and emphasize the sensitivity and specificity of Hachimoji DNA in oral therapeutics.

Research Question

Is Hachimoji actually significant enough in detecting and treating specific oral diseases and lesions.

Materials and Methods

Various researches and studies have documented that hachimoji is sensitive and specific. With this fact in mind, a literature based systematic review was carried out to fulfill the aim of the study. With Cochrane collaboration and various other scientific literatures like Medline and Medknow, about 14 research articles which would have undergone RCTs were selected for the systematic review, after having undergone a scrutinisation panel and a lot of inclusions and exclusions. The selection criteria for the articles/studies have been described below (Figure 1).

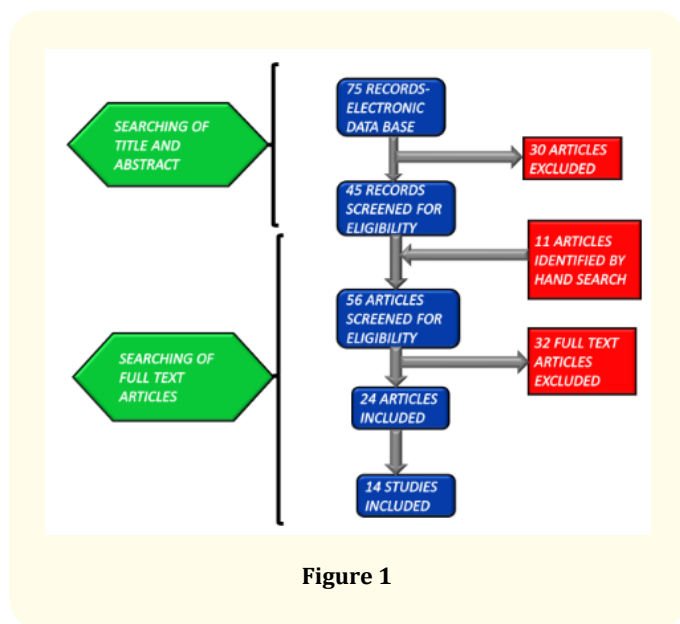


Figure 1

Result

- Better understanding of its complex structure.
- Enhanced understanding of its base pairs and it’s modified properties.
- Minimizing the complexity of nanostructures.
- Synthesis of proteins from unusual amino acids.
- Diagnosis of human diseases [1-8].

Discussion

Conventional DNA is comprised of the familiar A, C, G, and T base pairs, but a newly created genetic system is packed with eight, thus doubling the number of letters normally found in self-replicating molecules. The Hachimoji DNA includes these four natural bases, plus four more synthetically-made nucleotide bases: P, B, Z and S. In addition to the conventional four base pairs, this genetic system has an extra four building blocks, dramatically increasing the information density compared to regular DNA. Importantly, hachimoji also met the Schrödinger requirements, which defines a Darwinian system of molecular-based evolution Schrödinger described four requirements of evolution: information storage, transmission, structural integrity, and a discernible, yet malleable, physical shape or structure.

Hachimoji DNA is legitimate and can be used as a genetic code as it can reliably form matching base pairs, keeps its shape when mutations occur and be read and translated into RNA.

BASE	NAME	FORMULA
P	2Aminoimidazo[1,2-a][1,3,5] triazin 4(1H)-one	C ₅ H ₅ N ₃ O
Z	6-Amino-5-nitropyridin-2-one	C ₅ H ₄ N ₂ O ₃
B	Isoguanine	C ₅ H ₅ N ₃ O
S	rS Isocytosine dS 1-Methylcytosine	C ₄ H ₅ N ₃ O C ₅ H ₇ N ₃ O

Figure 2: Structural and chemical composition of the extra base pairs in hachimoji DNA and RNA.

Configuration and spatial arrangement in hachimoji DNA and RNA

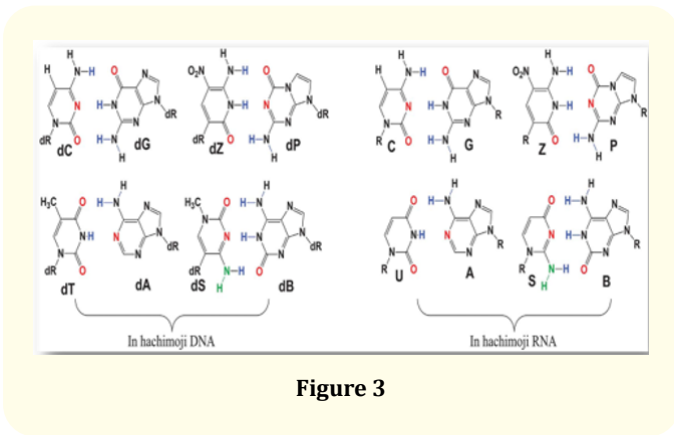


Figure 3

Properties of hachimoji

One of the most significant properties of the Hachimoji which makes it more specific and sensitive is its fluorescent property. Small strings of DNA can be used to make a molecular probe called the aptamer. Based on the sequence, these aptamers can locate specific molecules like the compounds that are only found in or on the cancer cells. This property can help target medications or light up tumors so doctors know what to remove.

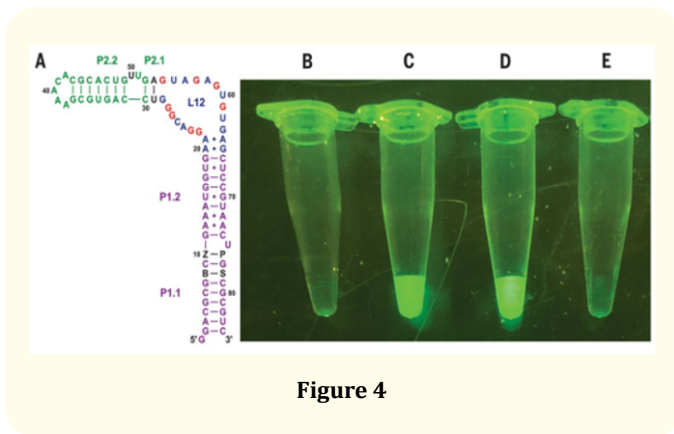


Figure 4

Applications of hachimoji DNA and RNA in medicine and dentistry

- **Diagnostics for human diseases:** Hachimoji DNA can help diagnosis of human diseases mostly malignancy due to its fluorescence property which helps to locate the cancer cells and light up the tumor.

- **Dna data storage:** DNA data storage will be more efficient than our current DNA storage mechanisms. Due to the efficiency of DNA storage, the storage capacity of DNA is massive; a single gram of DNA can store over 215 peta bytes data.
- **Self assembling nano structures:** Synthetic DNA molecules have shown great potential in formation and construction of Nano structures and devices. Intermolecular interactions can be reliably predicted, thus these properties of DNA as effective as genetic material also make it an excellent molecule for programmed self-assembly.
- **To make protiens with unusual amino acids:** Unnatural\unusual amino acids are not naturally embodied amino acids. These modified amino acids often contribute to special biological activity, and often incorporate into therapeutic peptide mimetic ligands for enhancing peptide pharmacological activity and potency
- **Dna barcoding:** It can be used in an effort to identify unknown species, parts of an organism, or simply to catalogue as many taxa as possible, or to compare with traditional taxonomy in an effort to determine species boundaries.

Conclusion

The complexity of DNA and the nucleic acid which once seemed daunting have now been discerned. Thereby, not only modifying and improving the cellular galaxy at a molecular level but also enhancing the approach towards various disease therapeutics which have been so far a challenge to medical and dental science. Hachimoji DNA can do everything that DNA does to support life. The research is significant because DNA has always been thought to be unique. For example, DNA is the only material for which we have the ability to design sequences that have predictable stability.

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