IOCFB 2024 Conference
Journal of Functional Biomaterials an Open Access Journal by MDPI
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XUNTA DE GALICIA
Universidade de Vigo
GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

Biomaterial-based nanoencapsulation for drug delivery in treating eating isorders, overcoming challenges, and enhancing therapeutic efficacy

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1. Introduction

Eating disorders (EDs) have evolved into severe, complex, and life-threatening conditions, inflicting significant physical and psychological repercussions These disorders impact individuals of all ages, spanning the entire lifespan. Those with EDs are at increased risk of suicide attempts, mortality, and comorbid conditions. These disorders encompass a range of behaviors:

- **Including binge eating;**
- **Restrictive eating;**
- **Compulsive eating;**
- **Irregular eating patterns;**
- **Anorexia;**
- **Bulimia and;**
- **Orthorexia nervosa**.

Despite advances in therapeutic interventions, many individuals with EDs continue to experience limited treatment effectiveness and high rates of relapse. Yet, novel approaches are required to enhance their effectiveness further. At this point, **the biomaterial-based nanoencapsulation (BBNE) for drug delivery (DD) approach may be an encouraging way to help fill the gaps in treating EDs**.

2. Methods

Systematic database search for integrating **BBNE for DD in treating EDs.**

Prioritize **peer-reviewed** articles from **high-impact journals** with detailed design.

Data were selected on overcoming **challenges** & enhancing therapeutic **efficacy.**

3. Biomaterial-based nanoencapsulation for drug delivery

BBNE has emerged as a cutting-edge approach for enhancing DD efficiency. This technique involves the encapsulation of therapeutic agents within biocompatible nano-scale carriers, **offering precise control over drug release kinetics and biodistribution. Table 1** highlights key features.

Key Feature	Description
Targeted drug delivery	BBne delivers therapeutic agents directly to brain regions associated with eds, enhancing efficacy with minimal side effects.
Controlled release	BBne ensures sustained drug effects over time, improving treatment adherence and optimizing symptom management.
Enhanced stability & bioavailability	BBne protects drugs from degradation, increasing their effectiveness and reducing dosing frequency.
Combination therapies	BBne enables the delivery of multiple agents in a single carrier, allowing for tailored, comprehensive treatment approaches addressing diverse symptoms.

Table 1. Concise overview of the key characteristics of BBNE.

4. Biomaterial-based nanoencapsulation applications in eating disorders treatment

–Targeted delivery of appetite regulators: BBNE can facilitate the targeted delivery of appetite suppressants or satiety-inducing agents to brain regions involved in appetite regulation. This targeted approach may help normalize dysfunctional eating behaviors and reduce binge eating episodes in individuals with EDs.

–Modulation of neurotransmitter systems: Dysregulation of neurotransmitter systems, such as dopamine, serotonin, and gamma-aminobutyric acid (GABA), is implicated in the pathophysiology of EDs. BBNE-based delivery systems can precisely modulate these neurotransmitter systems, restoring balance and alleviating symptoms of EDs.

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–Enhanced bioavailability of nutritional supplements: In cases of severe malnutrition or nutrient deficiencies associated with EDs, BBNE can improve the bioavailability of essential nutrients, vitamins, and minerals.
Nanoencapsulation protects these nutrients from degradation in the gastrointestinal tract, ensuring their efficient absorption and utilization by the body.

4. Biomaterial-based nanoencapsulation for drug delivery

Incorporating DD via BBNE for treating EDs involves (**Figure 1**):

i. **Nanocarrier selection:** Choose a suitable nano-carrier based on factors like biocompatibility, stability, and drug loading capacity.

ii. **Drug loading:** Incorporate therapeutic agents into the nano-carrier using method like solvent evaporation or emulsification.

iii. **Surface modification:** Optionally modify the nano-carrier surface to enhance targeting or stability.

iv. **Characterization:** Analyze the physicochemical properties of the nanoencapsulated formulation using suitable techniques.

v. ***In vitro* testing:** Evaluate the formulation's effects on cellular models relevant to eating disorders.

vi. ***In vivo* studies:** Assess the formulation's efficacy and safety in animal models.

vii. **Clinical trials:** Evaluate the formulation's effectiveness and safety in patients with eating disorders.

viii. **Regulatory approval:** Obtain approval for the formulation from relevant authorities based on clinical trial results.

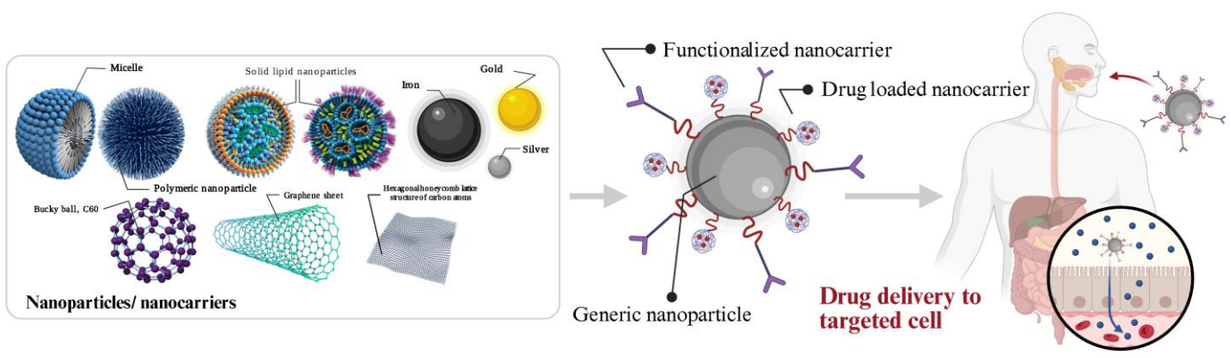

Figure 1. Targeted delivery system. Created with BioRender.com.

5. Concluding remarks

In summary, BBNE presents a promising approach to improving drug delivery, enhancing drug bioavailability, and ultimately improving therapeutic outcomes in treating EDs. Its personalized approach enables tailored treatment regimens that address the individual biological and psychological factors of each patient. However, challenges such as scalability, regulatory approval, and long-term safety need to be addressed for BBNE to be widely adopted in clinical practice.

Acknowledgments

The research leading to these results was supported by MICINN supporting the Ramón y Cajal grant for M.A. Prieto (RYC-2017-22891), by University of Vigo for the predoctoral grant of P. Barciela (PREUVIGO-23), and by Xunta de Galicia for supporting the program EXCELENCIA-ED431F 2020/12 that supports the work of F. Chamorro. In addition, the authors are grateful to the National funding by FCT, Foundation for Science and Technology, through the individual research grants for the individual research grants of J. Echave (2023.04987.BD) .