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Bioaccessibility: A Critical Pre-Animal Testing Assessment

Opinion

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Opinion

Bioaccessibility refers to the proportion of a substance that is released from a food, supplement, or pharmaceutical product and becomes available for absorption in the gastrointestinal tract. This concept is particularly relevant when evaluating the safety and efficacy of new compounds before conducting animal studies. In this opinion piece, we explore the significance of bioaccessibility assessment and its impact on research outcomes. Biodisponibility refers to the rate and extent to which a therapeutic compound (e.g., drug or nutrient) is absorbed and becomes available at the target site. It encompasses gastrointestinal (GI) digestion, absorption, metabolism, tissue distribution, and bioactivity.

Pharmacological View: In pharmacology, biodisponibility focuses on drug absorption and its availability for therapeutic action.

Nutritional Perspective: For nutrition, biodisponibility relates to the fraction of ingested nutrients that is stored or available for physiological functions. Not all ingested bioactive compounds are effectively utilized by the body.

Bioaccessibility represents the quantity of a compound that is released from its matrix in the gastrointestinal tract, becoming available for absorption (e.g., entering the bloodstream).

Digestive Transformations: Bioaccessibility includes digestive transformations of foods into material ready for assimilation, absorption into intestinal epithelium cells, and presystemic, intestinal, and hepatic metabolism.

Vitro Assessment: Researchers evaluate bioaccessibility using *in vitro* digestion procedures, simulating gastric and small intestinal digestion.

Missed Benefits: Definitions based solely on absorption miss beneficial effects of unabsorbed nutrients (e.g., calcium binding of bile salts).

The INFOGEST protocol is a harmonized method that simulates the physiological conditions of the upper GI tract. It allows controlled testing of a wide range of food items without the constraints of human trials (e.g., ethics, cost, time).

Suitable Foods for INFOGEST:

- Olive Oil: Rich in healthy fats and antioxidants.
- Green Leafy Vegetables: Spinach, kale, and collards provide essential nutrients.
- Nuts: Almonds and walnuts offer heart-healthy fats.
- Fatty Fish: Salmon, mackerel, tuna, and sardines provide omega-3 fatty acids.
- Fruits: Strawberries, blueberries, cherries, and oranges are packed with antioxidants.

Why Bioaccessibility Matters

a) Ethical Considerations: Animal testing is a crucial step in drug development and safety evaluation. However, subjecting animals

to unnecessary experiments is ethically problematic. By assessing bioaccessibility early in the research process, we can identify compounds with low absorption potential, sparing animals from unnecessary exposure.

b) Resource Optimization: Animal studies are resource-intensive, requiring time, funding, and specialized facilities. Focusing on compounds with high bioaccessibility ensures that these valuable resources are allocated efficiently.

c) Predictive Value: Bioaccessibility studies provide insights into how a compound interacts with physiological barriers (e.g., the gut lining). High bioaccessibility correlates with better chances of successful absorption, making it a predictive indicator for subsequent animal studies.

Methods for Bioaccessibility Assessment

A. *In Vitro* Models: Cell-based assays simulate the gastrointestinal environment and measure compound release. These models allow researchers to evaluate solubility, dissolution, and permeability.

B. Physiologically Based Pharmacokinetic (PBPK) Modeling: PBPK models predict drug behavior in humans based on *in vitro* data. Incorporating bioaccessibility data enhances model accuracy.

C. Formulation Optimization: Bioaccessibility can be influenced by formulation (e.g., nanoparticles, liposomes). Tailoring formulations to enhance bioaccessibility improves overall drug delivery.

Challenges and Future Directions

i. Standardization: Lack of standardized protocols for bioaccessibility assessment hinders comparability across studies. Establishing guidelines is essential.

ii. Complexity: Bioaccessibility depends on various factors (pH, enzymes, food matrix). Researchers must consider these complexities during assessment.

iii. Integration with Toxicology: Bioaccessibility data should inform toxicological evaluations, ensuring a comprehensive safety assessment.

Conclusion

Remember, assessing bioaccessibility before concluding health effects is crucial. By understanding these terms, we enhance research efficiency and informed decision-making in drug development and nutrition. Bioaccessibility assessment bridges the gap between *in vitro* experiments and animal studies. By prioritizing compounds with high bioaccessibility, we can enhance research efficiency, reduce animal use, and make informed decisions in drug development.

References

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