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In silico prediction of physicochemical properties and drug-likeness of omega-3 fatty acids

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Abstract. Omega-3 fatty acids, including alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA), are recognized for their crucial roles in human health, particularly cardiovascular and cognitive function. In this study, we employed computational methodologies, leveraging the SwissADME platform and ADMETLab 3.0, to predict and cross-validate the physicochemical properties and drug-likeness of these essential fatty acids. SwissADME predictions indicated molecular weights of 278.43 g/mol for ALA, 302.45 g/mol for EPA, and 328.49 g/mol for DHA, with consensus Log $P_{o/w}$ values of 5.09, 5.50, and 5.72 respectively, and varying degrees of water solubility. However, predictions from ADMETLab 3.0 were almost similar: ALA with a molecular weight of 278.22 g/mol, EPA at 302.22 g/mol, and DHA at 328.24 g/mol. Significant discrepancies were observed in lipophilicity, with ADMETLab 3.0 predicting Log $P_{o/w}$ values of 6.461 for ALA, 6.477 for EPA, and 7.006 for DHA, higher than those from SwissADME. Additionally, water solubility predictions from ADMETLab 3.0 showed ALA with a Log S of -5.034, EPA at -4.4, and DHA at -4.638, which differed from SwissADME's estimates. These differences reflect variations in computational approaches and algorithms. Comparison with literature data revealed general alignment in physicochemical properties, such as water solubility and lipophilicity. Furthermore, assessment of drug-likeness according to Lipinski's rule demonstrated compliance for all three fatty acids, albeit with variations in other criteria such as Ghose, Veber, Egan, and Muegge rules. These findings underscore the reliability and applicability of computational approaches in elucidating the physicochemical properties and drug-likeness of omega-3 fatty acids, offering valuable insights for pharmaceutical research and therapeutic applications.

***Keywords*:** alpha-linolenic acid; eicosapentaenoic acid; docosahexaenoic acid; SwissADME.

1. Introduction

Omega-3 fatty acids, including alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA), presented in Figure 1, are essential dietary components with significant physiological roles in human health [1]. These polyunsaturated fatty acids (PUFAs) are integral to various biological processes, ranging from cell membrane structure and function to the regulation of inflammation [2, 3], cardiovascular health [4], cognitive function [5], etc. [6–8].

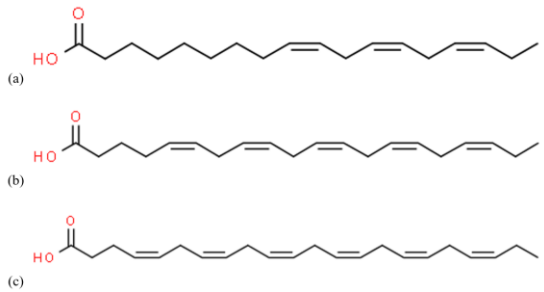

Figure 1. Chemical structures of (a) ALA, (b) EPA, and (c) DHA.

The importance of omega-3 fatty acids in human nutrition and health has garnered widespread attention, prompting extensive research into their biochemical properties, physiological effects, and therapeutic potential [1, 7]. ALA, EPA, and DHA are primarily obtained through dietary sources such as fish, seafood, flaxseed, and certain vegetable oils. However, their bioavailability and therapeutic efficacy can vary depending on factors such as dietary intake, metabolism, and genetic predisposition [9].

In recent years, computational methods have emerged as valuable tools for predicting the physicochemical properties and biological activities of bioactive compounds [10], including omega-3 fatty acids. These methods offer insights into the molecular characteristics, drug-likeness, and potential pharmacological effects of ALA, EPA, and DHA, facilitating drug discovery, nutritional research, and personalized medicine [11]. For instance, computational approaches have been utilized to assess the ADME properties of various drug-related molecules and food supplements [12–17]. Studies such as those by Mishra et al. [18], Mvondo et al. [19], and the work presented

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by Ranjith et al. [20] highlight the utility of tools like SwissADME in predicting drug-likeness and ADME properties, which are critical for evaluating the potential of compounds for therapeutic use.

This study aims to utilize computational approaches to elucidate the physicochemical properties, water solubility, and drug-likeness of ALA, EPA, and DHA [21]. By integrating computational predictions with experimental data and information from chemical databases, we seek to deepen our understanding of the molecular features and biological implications of these omega-3 fatty acids. The findings from this study may provide valuable insights into the therapeutic potential of ALA, EPA, and DHA, contributing to advancements in healthcare, nutrition, and biomedical research.

2. Methods

The chemical structures of alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) were retrieved from chemical databases. Relevant literature data on the physicochemical properties and drug-likeness of omega-3 fatty acids were collected from peer-reviewed journals and databases for comparison with computational predictions.

The SwissADME online platform (http://www.swissadme.ch/index.php#top) was utilized for predicting the physicochemical properties and drug-likeness of ALA, EPA, and DHA. Molecular weight, lipophilicity (Log $P_{o/w}$), water solubility (Log S), and other relevant physicochemical descriptors were computed using SwissADME [21]. For evaluating the drug-likeness of the omega-3 fatty acids Lipinski's rule [22, 23], Ghose filter [24], Veber rules [25], Egan rules [26], and Muegge rules [27] were applied, based on the canonical SMILES representations of the compounds.

To ensure the robustness and accuracy of our results, we employed ADMETLab 3.0 [28–30] for detailed ADMET predictions. This tool was instrumental in cross-validating the results obtained from SwissADME, thereby enhancing the reliability of our findings. A comparison was made between these predictions, experimental data, and existing database information to verify their consistency and accuracy.

3. Results and discussion

Our study utilized computational tools to predict the physicochemical properties and drug-likeness of ALA, EPA, and DHA. These predictions provide a foundation for understanding the potential biological activities and therapeutic applications of these omega-3 fatty acids.

3.1. Physico-chemical properties

ALA, EPA, and DHA are three important omega-3 fatty acids with distinct molecular structures and physiological roles. In this study, we employed computational methods to predict their physicochemical properties, providing insights into their molecular characteristics and potential biological activities. Results from the SwissADME prediction are presented in Table 1.

Table 1. Physicochemical properties assessment of omega-3 fatty acids by SwissADME.

Physicochemical properties	**ALA**	**EPA**	**DHA**
Formula	$C_{18}H_{30}O_2$	$C_{20}H_{30}O_2$	$C_{22}H_{32}O_2$
Molecular weight	278.43 g/mol	302.45 g/mol	328.49 g/mol
Number of heavy atoms	20	22	24
Number of aromatic heavy atoms	0	0	0
Fraction Csp^3	0.61	0.45	0.41
Number of rotatable bonds	13	13	14
Number of H-bond acceptors	2	2	2
Number of H-bond donors	1	1	1
Molar refractivity	88.99	97.66	106.80
TPSA	37.30 Å²	37.30 Å²	37.30 Å²

Comparison of the physicochemical properties of ALA, EPA, and DHA reveals both similarities and differences. All three fatty acids possess similar numbers of heavy atoms and hydrogen bond acceptors and donors, indicating comparable potential for molecular interactions such as hydrogen bonding.

However, notable differences are observed in other properties. ALA has the lowest molecular weight among the three fatty acids, while DHA has the highest. This variation in molecular weight reflects differences in their carbon chain lengths and degree of unsaturation.

The fraction of sp^3-hybridized carbon atoms (Fraction Csp^3) provides insights into the degree of saturation of the carbon backbone. ALA exhibits the highest Fraction Csp^3 (0.61), indicating a higher proportion of saturated carbon-carbon bonds compared to EPA (0.45) and DHA (0.41). This difference in saturation levels contributes to variations in their physical and chemical properties, including melting point and stability.

The number of rotatable bonds in a molecule is a crucial factor in drug-likeness and bioavailability assessments. Rotatable bonds contribute to the molecular flexibility, which can significantly impact a compound's ability to interact with biological targets and permeate cell membranes. Molecules with a higher number of rotatable bonds tend to be more flexible, which may enhance their ability to adopt different conformations and interact with various biological targets. However, excessive flexibility can also lead to reduced oral bioavailability due to increased molecular entropy and difficulty in achieving a stable conformation that is necessary for efficient absorption and transport.

The presence of a higher number of rotatable bonds in ALA, EPA, and DHA reflects their polyunsaturated nature, characterized by multiple double bonds along their carbon chains. While this increased flexibility might contribute to their ability to interact with lipid bilayers and other molecular targets, it also suggests potential limitations in terms of oral bioavailability. The flexibility introduced by these rotatable bonds may

impact the fatty acids' ability to be absorbed effectively when administered orally, potentially influencing their therapeutic efficacy.

Molar refractivity reflects the polarizability of a molecule, influencing its interactions with electromagnetic fields and polar solvents. DHA exhibits the highest molar refractivity (106.80), followed by EPA (97.66) and ALA (88.99). This trend suggests that DHA may have a greater ability to undergo polar interactions compared to ALA and EPA.

To enhance the reliability of our computational predictions, we used ADMETLab 3.0 to cross-validate the physicochemical properties of ALA, EPA, and DHA, initially predicted using SwissADME. The results from ADMETLab 3.0 are summarized below, focusing on molecular weight differences.

The molecular weights predicted by ADMETLab 3.0 for the omega-3 fatty acids ALA, EPA, and DHA were nearly identical to those predicted by SwissADME, with differences confined to decimal variations. The following differences were noted:

- ALA: The predicted MW was 278.22 g/mol compared to 278.43 g/mol in SwissADME.
- EPA: The predicted MW was 302.22 g/mol compared to 302.45 g/mol in SwissADME.
- DHA: The predicted MW was 328.24 g/mol compared to 328.49 g/mol in SwissADME.

These minor discrepancies in molecular weight are within an acceptable range, demonstrating consistency between the two tools. The observed variations likely result from slight differences in rounding methods or algorithmic nuances between SwissADME and ADMETLab 3.0.

In comparing our results with the existing literature on ADMET properties of drug-related compounds and food supplements, it is clear that computational methods offer valuable insights. For example, studies on other bioactive compounds often emphasize the significance of physicochemical properties like molecular weight, lipophilicity, and water solubility in predicting ADMET outcomes. Research has shown that accurate predictions of these properties can streamline drug discovery by identifying compounds with favorable absorption and distribution profiles early in the development process [31].

Lipophilicity, often quantified by the partition coefficient (Log $P_{o/w}$), is a physicochemical property that influences the distribution, absorption, and metabolism of a compound within biological systems [32]. Here, we analyze the predicted Log $P_{o/w}$ values of ALA, EPA, and DHA obtained through computational methods.

Among the calculation methods employed, variations in the predicted Log $P_{o/w}$ values for each fatty acid are observed. Results are presented in Table 2. These discrepancies may arise from differences in the used algorithms.

For all three fatty acids, the XLOGP3 and WLOGP predictions consistently yield higher Log $P_{o/w}$ values compared to iLOGP and MLOGP. This discrepancy may be attributed to differences in the calculation methodologies, with XLOGP3 and WLOGP incorporating additional molecular descriptors to improve accuracy.

The consensus Log $P_{o/w}$ values, derived from the aggregation of multiple predictions, provide a comprehensive assessment of each fatty acid's lipophilicity. ALA, EPA, and DHA exhibit consensus Log $P_{o/w}$ values of 5.09, 5.50, and 5.72, respectively. These values suggest moderate to high lipophilicity for all three fatty acids, indicating a propensity for partitioning into lipid-rich environments such as cell membranes.

Table 2. Lipophilicity assessment of omega-3 fatty acids by SwissADME.

Lipophilicity	ALA	EPA	DHA
Log $P_{o/w}$ (iLOGP) [21]	3.36	4.44	4.03
Log $P_{o/w}$ (XLOGP3) [33]	6.46	6.29	6.19
Log $P_{o/w}$ (WLOGP) [34]	5.66	5.99	6.55
Log $P_{o/w}$ (MLOGP) [22, 35, 36]	4.38	4.67	5.03
Log $P_{o/w}$ (SILICOS-IT)	5.59	6.11	6.81
Consensus Log $P_{o/w}$	5.09	5.50	5.72

The differences in Log $P_{o/w}$ values among ALA, EPA, and DHA may reflect the variations in their molecular structures, including chain length, degree of unsaturation, and spatial arrangement of functional groups. These structural differences influence the distribution and interaction of each fatty acid with lipophilic and hydrophilic environments within biological systems.

The Log $P_{o/w}$ values for ALA, EPA, and DHA were cross-validated using ADMETLab 3.0 which utilizes the Ghose-Crippen method for lipophilicity prediction, giving the ALOGP value. Significant differences were observed in the predicted lipophilicity (Log $P_{o/w}$) between the two tools:

- ALA: ADMETLab 3.0 predicted a Log $P_{o/w}$ of 6.461.
- EPA: ADMETLab 3.0 predicted a Log $P_{o/w}$ of 6.477.
- DHA: ADMETLab 3.0 predicted a Log $P_{o/w}$ of 7.006.

These higher lipophilicity values suggested by ADMETLab 3.0 could have important implications for the pharmacokinetic behavior of these compounds, particularly concerning their absorption, distribution, and membrane permeability. The enhanced lipophilicity values suggest that ALA, EPA, and DHA might interact more strongly with lipid membranes, potentially affecting their bioavailability and tissue distribution.

The discrepancies between SwissADME (which provides consensus Log $P_{o/w}$ values derived from multiple algorithms) and ADMETLab 3.0 (which uses the Ghose-Crippen ALOGP method) highlight the importance of using multiple predictive tools to gain a comprehensive understanding of a compound's properties. Different computational approaches, such as those employed by SwissADME and ADMETLab 3.0, can lead to variations in predicted values, with ADMETLab typically yielding higher ALOGP estimates.

Despite the differences in computational approaches between SwissADME and ADMETLab 3.0, the computed Log $P_{o/w}$ and ALOGP values consistently reveal that ALA, EPA, and DHA are highly

hydrophobic molecules, regardless of the algorithm used to compute them. Both tools show elevated lipophilicity for all three omega-3 fatty acids, confirming their strong affinity for lipid environments.

Water solubility is a physicochemical property that influences the distribution, bioavailability, and pharmacokinetics of a compound in biological systems. Here, we analyze the predicted water solubility values of ALA, EPA, and DHA obtained through various calculation methods, shedding light on their aqueous solubility profiles and potential implications for drug development and formulation. Results are presented in Table 3.

The predicted water solubility values for ALA, EPA, and DHA exhibit variability across different computational methods, indicating the influence of modeling approaches and molecular descriptors on the predictions.

For ALA, the ESOL and SILICOS-IT predictions suggest moderate to soluble water solubility, with log S values ranging from -4.78 to -3.96. In contrast, the Ali prediction indicates poor water solubility for ALA, with a log S value of -7.04. These discrepancies highlight the importance of considering multiple predictions to account for inherent uncertainties in computational models.

Similarly, for EPA and DHA, the water solubility predictions vary among different methods. While ESOL and SILICOS-IT predict moderately soluble to soluble water solubility for both EPA and DHA, the Ali prediction suggests poor water solubility. Notably, the SILICOS-IT prediction yields the highest water solubility values for EPA and DHA among the three methods considered.

Table 3. Water solubility assessment of omega-3 fatty acids by SwissADME.

Water solubility	**ALA**	**EPA**	**DHA**
Log S (ESOL) [37]	-4.78	-4.82	-4.85
Solubility	$4.64e^{-03}$ mg/ml; $1.67e^{-05}$ mol/l	$4.58e^{-03}$ mg/ml; $1.51e^{-05}$ mol/l	$4.62e^{-03}$ mg/ml; $1.40e^{-05}$ mol/l
Class	Moderately soluble	Moderately soluble	Moderately soluble
Log S (Ali) [38]	-7.04	-6.86	-6.76
Solubility	$2.55e^{-05}$ mg/ml; $9.16e^{-08}$ mol/l	$4.16e^{-05}$ mg/ml; $1.38e^{-07}$ mol/l	$5.74e^{-05}$ mg/ml; $1.75e^{-07}$ mol/l
Class	Poorly soluble	Poorly soluble	Poorly soluble
Log S (SILICOS-IT)	-3.96	-3.32	-3.39
Solubility	$3.08e^{-02}$ mg/ml; $1.11e^{-04}$ mol/l	$1.46e^{-01}$ mg/ml; $4.82e^{-04}$ mol/l	$1.33e^{-01}$ mg/ml; $4.05e^{-04}$ mol/l
Class	Soluble	Soluble	Soluble

The differences in water solubility predictions may stem from the diverse physicochemical properties and structural features of ALA, EPA, and DHA, such as chain length, degree of unsaturation, and presence of functional groups. These factors influence the molecules' interactions with water molecules and their propensity to form solvated species.

The water solubility predictions from ADMETLab 3.0 were used to cross-validate the SwissADME results, revealing additional differences:

– ALA: ADMETLab 3.0 predicted a Log S of -5.034, which is higher (indicating lower solubility) than the range provided by SwissADME.
– EPA: ADMETLab 3.0 predicted a Log S of -4.4, reflecting a higher solubility compared to some of the SwissADME predictions.
– DHA: ADMETLab 3.0 predicted a Log S of -4.638, which is slightly lower than the highest solubility value from SwissADME but within the range of the other predictions.

Differences in predictions across computational tools like SwissADME and ADMETLab 3.0 can arise from distinct algorithms used.

The comparison of physicochemical properties between ALA, EPA, and DHA from our study and data obtained from the PubChem database [39] provides valuable insights into the consistency and reliability of computational predictions in assessing the molecular characteristics of omega-3 fatty acids.

In terms of molecular weight, our results closely align with those from PubChem, demonstrating high agreement between the two datasets. For example, both sources report a molecular weight of approximately 278.4 g/mol for ALA, 302.5 g/mol for EPA, and 328.5 g/mol for DHA. This consistency reinforces the accuracy of computational methods in predicting molecular weights, which are fundamental descriptors for characterizing chemical compounds.

Similarly, the hydrogen bond donor count, hydrogen bond acceptor count, and rotatable bond count exhibit close agreement between our study and PubChem data for all three fatty acids. These properties play crucial roles in determining the intermolecular interactions and conformational flexibility of molecules, and their consistency across datasets further validates the reliability of computational predictions.

However, some discrepancies are observed in the XLogP3 values, which represent the logarithm of the partition coefficient between *n*-octanol and water and serve as indicators of lipophilicity. While our study reports XLogP3 values of 5.9 for ALA, 5.6 for EPA, and 6.2 for DHA, slightly higher values are obtained from PubChem for EPA (5.6) and DHA (6.2). These differences may arise from variations in the computational algorithms and parameterizations used in different prediction tools.

Despite these minor disparities, the overall trends and patterns in physicochemical properties observed in our study remain consistent with PubChem data. For example, both sources indicate that DHA exhibits higher molar refractivity compared to ALA and EPA, suggesting a greater ability to undergo polar

interactions. Additionally, ALA demonstrates a higher fraction of sp^3-hybridized carbon atoms (Fraction Csp^3) compared to EPA and DHA, reflecting differences in saturation levels among the three fatty acids.

Comparing our computational prediction of ALA water solubility with experimental data from the National Toxicology Program (NTP) [40] and Meylan et al [41]. reveals reasonable agreement. Our prediction aligns closely with the solubility reported by Meylan et al. at 25 °C. However, a qualitative discrepancy exists with the NTP database, which reports solubility as less than 1 mg/mL at 22 °C This variation may stem from differences in experimental conditions and measurement techniques. Despite differences, our study underscores the utility of computational methods in estimating ALA solubility, supporting trends observed in experimental data. Continued validation and refinement of computational models will enhance their predictive accuracy for omega-3 fatty acid solubility.

Our predictions for water solubility and lipophilicity of omega-3 fatty acids align with trends observed in similar compounds. For instance, computational models for drug-like compounds frequently highlight how lipophilicity affects drug absorption and distribution [42]. Omega-3 fatty acids, with their high lipophilicity, are consistent with findings that lipophilic compounds often demonstrate substantial interactions with biological membranes [43]. This aligns with other studies showing that lipophilicity significantly influences the bioavailability of dietary supplements [44].

However, our study also identified discrepancies in water solubility predictions. Variability among computational methods reflects the challenges in modeling solubility, a critical factor for drug formulation and bioavailability. Similar discrepancies have been observed in other studies, emphasizing the need for a range of prediction methods to account for these uncertainties [45].

3.2. Drug-likeness

The evaluation of drug-likeness for ALA, EPA, and DHA provides a comprehensive assessment of their potential suitability as drug candidates based on established criteria set forth by various drug-likeness rules.

Lipinski's rule, a widely utilized guideline in drug discovery, assesses four key parameters: molecular weight, lipophilicity (expressed as MLOGP), number of hydrogen bond acceptors, and number of hydrogen bond donors. According to Lipinski's rule [22, 23], a molecule with no more than one violation among these parameters is considered drug-like. In our analysis, all three fatty acids meet Lipinski's rule with only one violation each, primarily concerning MLOGP exceeding the threshold of 4.15. This violation indicates a potential challenge in terms of lipophilicity, which may influence the compounds' pharmacokinetic properties, including absorption, distribution, metabolism, and excretion.

Ghose's rule [24] evaluates drug-likeness based on the physicochemical properties of compounds. It considers molecular weight, lipophilicity (expressed as WLOGP), molar refractivity and number of atoms. According to Ghose's rule, a compound is considered drug-like if it falls within specified ranges for these properties. None of the three fatty acids meet Ghose's criteria due to violations related to WLOGP exceeding the threshold of 5.6. This violation suggests potential challenges in terms of hydrophilicity, which may impact the compounds' solubility and bioavailability.

Veber's rule [25] focuses on oral bioavailability and evaluates the number of rotatable bonds in a molecule. Compounds with fewer than ten rotatable bonds are considered more likely to be orally bioavailable. However, all three fatty acids violate Veber's rule due to the presence of more than ten rotatable bonds, indicating potential limitations in oral bioavailability.

Egan's rule [26] considers multiple factors, including lipophilicity, size, flexibility, polarity, and chirality, to assess drug-likeness. According to Egan's rule, compounds with high water solubility and moderate lipophilicity are more likely to be orally bioavailable. ALA is identified as drug-like according to Egan's rule, while EPA and DHA exhibit violations related to WLOGP exceeding the threshold of 5.88, suggesting potential challenges in terms of water solubility and bioavailability.

Muegge's rule [27] evaluates drug-likeness based on molecular XLOGP3 and considers compounds with values less than 5 to be more likely to be orally bioavailable. However, all three fatty acids violate Muegge's rule due to XLOGP3 exceeding the threshold of 5, indicating potential issues with lipophilicity and bioavailability.

To further illustrate the suitability of ALA, EPA, and DHA for oral bioavailability, we utilized radar graphs obtained from the SwissADME platform. The radar graphs illustrate that, with the exception of molecular flexibility, which is notably higher for the investigated molecules, the other physicochemical properties align with those of compounds that typically exhibit good bioavailability. This suggests that while ALA, EPA, and DHA have higher flexibility compared to ideal drug-like compounds, their other properties such as molecular weight, lipophilicity, and hydrogen bond characteristics support their potential for effective oral bioavailability. The radar graphs are presented in Figure 2.

Despite the observed violations in certain drug-likeness rules, all three omega-3 fatty acids exhibit favorable bioavailability scores of 0.85, indicating potential for absorption and distribution in the body. This suggests that while they may not fully meet all criteria for traditional drug candidates, their properties make them promising candidates for further exploration in drug discovery and development, particularly in the context of nutraceuticals and dietary supplements. Continued investigation and optimization may help address the identified challenges and enhance their potential therapeutic utility.

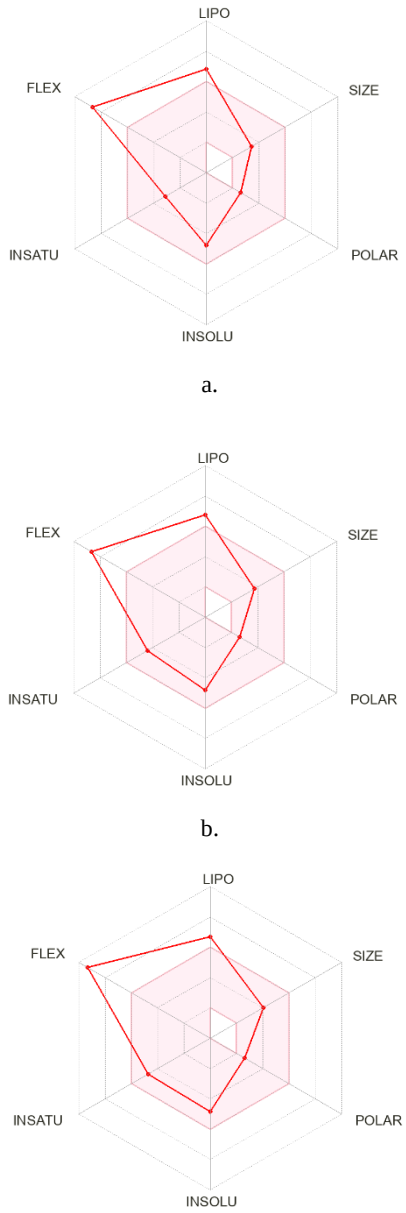

Figure 2. Radar graphs of physicochemical properties for ALA, EPA, and DHA: (a) ALA; (b) EPA; (c) DHA. The pink area represents the optimal range for each property of a compound with a good bioavailability.

The assessment of drug-likeness based on established rules (e.g., Lipinski's, Ghose's, Veber's) provides a comprehensive view of the omega-3 fatty acids' potential as drug candidates. While violations of some rules were noted, such as Lipinski's and Muegge's, the favorable bioavailability scores indicate that these compounds have properties that could be beneficial for therapeutic applications. Previous studies have shown that while adherence to drug-likeness rules can provide valuable guidance in drug discovery by helping to avoid compounds with poor pharmacokinetics or safety profiles, deviations from these rules are not uncommon, particularly for nutraceuticals and dietary supplements. It is crucial to balance drug-like property guidelines with other factors such as potency and specific therapeutic objectives, as these rules are often based on historical data and may not fully apply to novel therapeutic strategies or new chemical spaces [46].

Computational methods, such as those used in this study, are invaluable for initial screening and optimization of drug-like properties. They allow researchers to predict and refine the ADMET properties of compounds before costly and time-consuming experimental validation [47].

By integrating computational predictions with experimental data and published research, we enhance our understanding of the omega-3 fatty acids' potential benefits and limitations. The findings support the utility of computational approaches in drug discovery and nutritional science, providing a basis for further exploration and optimization of omega-3 fatty acids for therapeutic use.

4. Conclusions

In conclusion, our study utilized computational methods to predict the physicochemical properties, water solubility, and drug-likeness of ALA, EPA, and DHA, three important omega-3 fatty acids. Through a comprehensive analysis, we gained insights into their molecular characteristics, aqueous solubility profiles, and potential suitability as drug candidates.

The comparison of computational predictions with experimental data and information obtained from databases such as PubChem highlighted the reliability and consistency of our results. We observed close agreement in molecular weight, hydrogen bond counts, and other physicochemical properties between our predictions and experimental findings, demonstrating the accuracy of computational methods in characterizing omega-3 fatty acids.

Our analysis revealed variations in water solubility predictions across different computational methods, underscoring the importance of considering multiple predictions to account for inherent uncertainties. Despite discrepancies, our results support trends observed in experimental data and provide valuable insights into the aqueous solubility profiles of ALA, EPA, and DHA.

Evaluation of drug-likeness using established rules such as Lipinski's, Ghose's, Veber's, Egan's, and Muegge's provided a comprehensive assessment of the omega-3 fatty acids' potential as drug candidates. While violations were observed in certain drug-likeness rules, all three fatty acids exhibited favorable bioavailability scores, indicating potential for absorption and distribution in the body.

Overall, our findings suggest that ALA, EPA, and DHA hold promise as candidates for further exploration in drug discovery and development, particularly in the context of nutraceuticals and dietary supplements. Continued investigation and optimization of these omega-3 fatty acids may lead to the development of novel therapeutic interventions for various health conditions, contributing to advancements in healthcare and wellness.

Conflict of interest

The authors declare that they have no conflicts of interest.

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