

MedNut Mail

The How, What, Which, Where, When and Why of pharmaconutrition



Albumin and vitamins

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<https://medicationsandnutrition.com/mednut-mail/>

Albumin and vitamins are essential for body function as albumin is either a primary or secondary carrier for most vitamins. Many factors can alter albumin's structural shape and therefore its ability to carry nutrients, pharmaceuticals and other compounds.

Vitamins are essential for the metabolism of proteins, fats and carbohydrates, and to support energy production, growth and cell maintenance.

Human and bovine albumin commonality

Human (HSA) and bovine (BSA) albumins have 76% commonality and similarity in their 3D structures. A significant differentiator is the number of tryptophan binding sites –

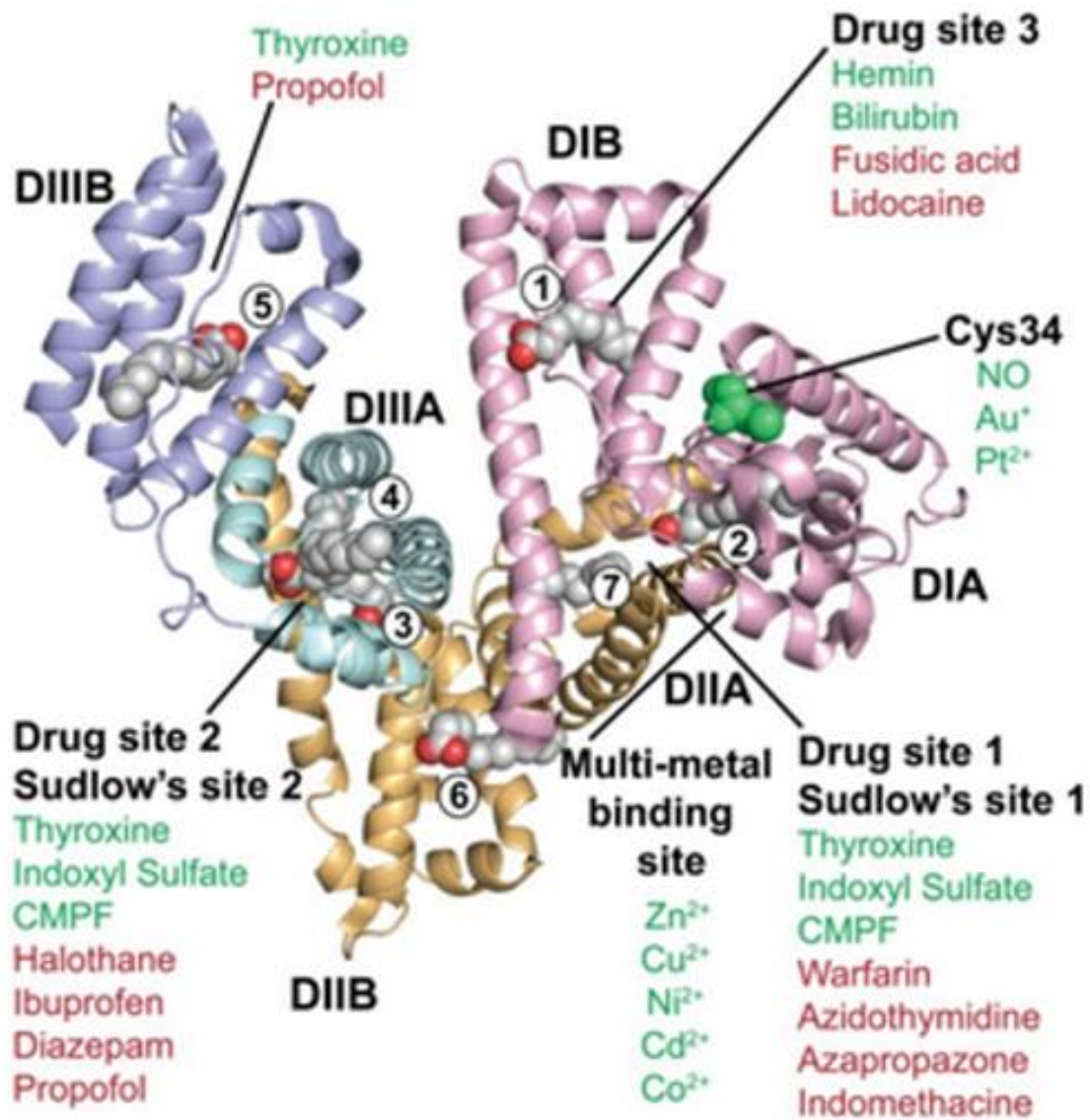
- Human - one tryptophan site - Trp-214 in subdomain IIA;
- Bovine - two tryptophan sites - Trp-134 (subdomain IIA), Trp-212 (subdomain IIIA).

Co-operative drug-nutrient interactions

Subdomain IIA is the preferred binding site for both folate and methotrexate, however folate only binds to IIA whilst methotrexate binds to IIA and IIIA. When both drugs are present, folate binds to IIA and methotrexate binds to IIIA -this is deemed a cooperative interaction to minimize alteration to albumin's structure.

<https://doi.org/10.1021/acsomega.7b01437>

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The crystal structure of human albumin

From - Unraveling the Interaction between FcRn and Albumin: Opportunities for Design of Albumin-Based Therapeutics

<https://doi.org/10.3389/fimmu.2014.00682>

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Distribution of vitamins and their binding sites

Table of vitamins and their known binding sites on albumin	
Vitamin	Binding site
Thiamine	Subdomain IIA – Trp-214
Riboflavin	Subdomain IIA
Niacin	Sudlow site 1 Subdomain IIA
Pantothenate	No apparent evidence of carriage by albumin.
pyridoxine	Subdomain IIA - Lys-190
biotin	No apparent evidence of carriage by albumin.
Folate	Sudlow site I Subdomain IIA - on or near Tyr-214
Cobalamin	Subdomain IIA
Vitamin C	Binding site I (Sudlow site 1) Subdomain IIA
Vitamin A/retinol	Subdomain IIA – Trp-214 Subdomain IIIA – Asp-451
Vitamin D	Metabolites - calcitriol and cholecalciferol Domains 2 + 3, preferred option domain 2
Vitamin E	α -tocopherol – Fatty Acids 3+4 sites, Subdomain IIIA Tocopherol - Site II Subdomain IIIA
Vitamin K	Unable to verify domains, subdomains or binding sites

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Note - Vitamin E is a generic name that refers to two tocochromanols, tocopherol (Toc) and tocotrienol (T3). Albumin mediates the difference in the cellular uptake of Toc and T3.

Bilirubin binding to albumin at subdomain IB inhibits lipid peroxidation, and protects α -tocopherol from peroxy radicals

Table of vitamin binding sites on albumin, by domain and subdomain

Table of domains and subdomains and their vitamin distribution	
Subdomain	Vitamins
IA	
IB	
IIA	B1, B2, B3, B6, B9, B12, Vit C, Vit A
IIB	
IIIA	Vit A, Vit E
IIIB	
Domain	
II	Vitamin D metabolites (calcitriol, cholecalciferol)
III	Vitamin D metabolites (calcitriol, cholecalciferol)

Clinical Concerns

The evidence in relation to albumin-based drug-nutrient interactions is remarkably limited. A range of factors, including nutrients and pharmaceuticals, can alter albumin structure and therefore it's carrying capacity. Our knowledge of albumin-based vitamin binding sites and vitamin-induced changes to albumin structure, is in dire need of further clarification.

There may also be nutrient-nutrient competition for some of albumin's binding sites, and their access process also requires clarification. Is nutrient access based on first-come, or is there a pecking order and if so what is it?

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How can we apply the likely albumin-based drug-nutrient interactions evidence in our clinical reports? At this stage I suggest increased monitoring of nutrients that share the same subdomain as each prescribed medicine. The limitations with this suggestion are that it does not take into account -

- drug-induced, or possibly nutrient-induced, impacts on the domain(s) and/or subdomain(s) it is, and is not, occupying;

- some nutrients and drugs being able to share the same subdomain as they access different binding sites.

Albumin-based drug-nutrient interactions also further emphasize the importance of a comprehensive Diet History that includes nutrient supplements. If there is contradiction between oral intake and blood test findings, then external causes of the anomaly should be considered. The mechanisms of action of external sources likely include inhibiting transporters, and/or altering access to albumin.

Clinical Questions

What actions will you initiate as you review a person whose prescribed medications profile includes one or more drugs that utilize albumin as a carrier, will you -

- clarify and monitor adequacy of intake of nutrients carried by albumin that are potentially affected by their prescribed medicines?

Conclusions

Albumin and vitamins are both directly and indirectly impacted by a broad range of prescribed medicines as they can alter their effectiveness and availability.

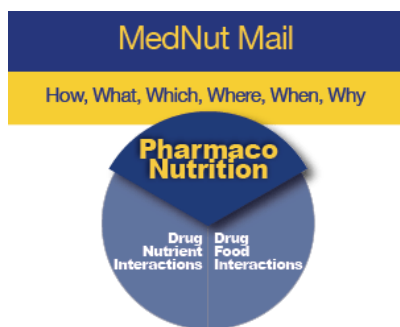
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The information in this article is provided to support Health Professionals. It is not an exhaustive protocol and Health Professionals are advised that adequate professional supervision is accessed to ensure that Duty of Care obligations with respect to safe administration of medicines is met for each consumer.

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