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Reduction of Oxidative Stress and Storage Lesions (RCSL) in Red Blood Cells - Analysis of Ascorbic Acid (AA), N-Acetylcysteine amide (AD4), and Serotonin (5-HT)

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Review of Research: Reduction of Oxidative Stress and Storage Lesions (RCSL) in Red Blood Cells - Analysis of Ascorbic Acid (AA), N-Acetylcysteine amide (AD4), and Serotonin (5-HT)

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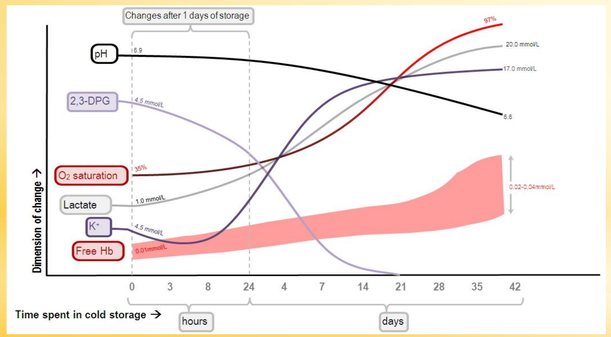
Introduction

- Routine standard blood storage with SAGM-CDP additive solutions helps preserve red blood cells (RBCs) for up to 42 days before they are discarded.
- However, during those 42 days, significant biochemical and physiological changes occur within the RBCs due to oxidative stress due to storage.
- Although the current storage system won't adequately protect the RBCs, a new combination of additives that focus on alleviating oxidative stress could increase the shelf-life of these RBC stored units.
- A combination of Ascorbic Acid (AA), N-Acetylcysteine amide (AD4), and Serotonin (5-HT) seem to be an valid and promising concoction that helps curb storage-induced oxidative stress.



Changes in red blood cells during storage. Retrieved from http://www.derangedphysiology.com/php/Haematology-and-Oncology-in-Critical-Illness/images/changes%20in%20packed%20red%20blood%20cells%20d

Methods

- I conducted literature review by studying various journal articles that looked from metabolism to proteomics and the synergy of the different additives.
- The journal articles examined were scholarly and peer reviewed.

Results

- Vitamin C enhanced the antioxidant defenses but could not protect susceptible protein groups, so alone, the antioxidant could not combat the current issue. (Vani et al., 2015, p. 6).
- Although Vitamin C and NAC alone didn't have statistically significant values compared to the saline control stored units, A combination of Vit. C and NAC showed sign of less oxidative stress in the red blood cells through the 42 days of storage (Pallotta et al., 2014, p. 378).
- AD4 restored 91% of the endogenous thiol, unlike 15% restored by NAC of the GSH pathway within the RBC membranes suggesting that AD4 works even better than NAC at alleviating oxidative stress (Amer, Altas, & Fibach, 2008, p. 254).
- Serotonin (5-HT) has an extrinsic protective effect on the RBCs which adds an holistic coverage comapred to the other additives (Amireault, 2013, et al. p. 4)

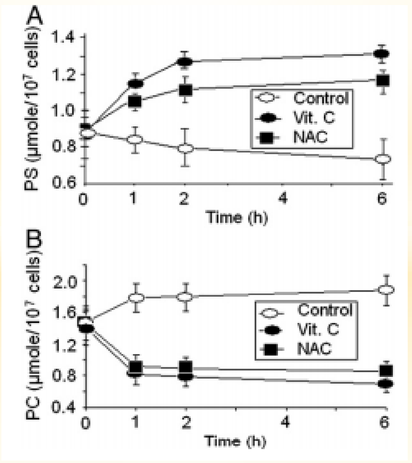


Fig. 5. Kinetic analysis of anti-oxidants effect on RBC phospholipids. Thalassemic RBCs were incubated with 1 mM vitamin C (Vit. C), N-acetyl cysteine (NAC) or PBS (Control) at room temperature. (Freikman, 2008, *et al.* p. 2391)

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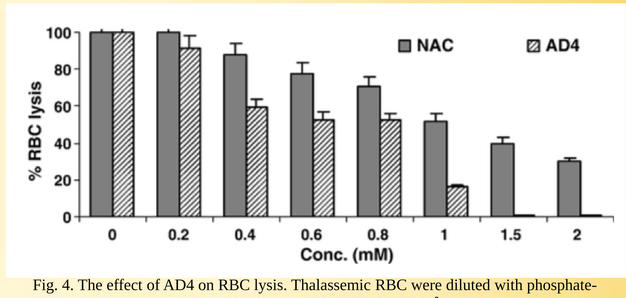

Fig. 4. The effect of AD4 on RBC lysis. Thalassemic RBC were diluted with phosphate-buffered saline to 5 × 106/ml and incubated overnight at 37 ° C with the indicated concentrations of AD4 and NAC.
(Amer, Altas, & Fibach, 2008, p. 252)

Conclusions

- Although the routine standard doesn't protect the RBC from oxidative stress, the combination of novel additives such as Ascorbic Acid (AA), Acetylcysteine amide (AD4), and Serotonin (5-HT) are valid additvies that combat oxidatives stress by replenishing GSH, decreasing percent hemolysis and lysis, inhibiting the phospholipid rearrangement, and encouraging ATP production
- Future research should be conducted focusing on the proper concentrations of each of the additives that would work to effectively have the highest benefits with the least amount of side effects due to the addtives.
- In addition, research into other combinations of novel additives to see if they would be better than the presented combination.

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Further Information

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