

## Introduction

- Medical advances have increased demand for blood and blood products
- Current preservation technologies<sup>1</sup> have high costs for cold chain management
- Shelf life of red blood cells preserved by refrigeration is just 35-42 days
- Drying red blood cells (RBCs) involves many challenges to preserve structure and function. Figure 1 is a picture of red blood cells

## Materials and methods

- Range of excipients and protectants tested
- Biopolymer technology for intracellular protectant loading and concentration techniques studied
- Range of freeze drying parameters investigated e.g. cooling rate, temperature, drying time
- Ultraviolet (UV) spectrophotometry was used to measure haemoglobin (Hb) for cell death and Hb oxidation

Table 1 – Variables studied

Variable	Option 1	Option 2	Option 3
Buffer type	Buffer 1	Buffer 2	Buffer 3
Buffer concentration	High	Medium	Low
Protectant type	Non-polymer 1	Non-polymer 2	Non-polymer 3
Protectant concentration	High	Medium	Low
Cooling rate	High	Medium	Low
1°D shelf temperature	High	Medium	Low
Rehydration solution	Salt	Buffer	Polymer

## Results

- RBC survival of 96% was achieved for the combination highlighted (grey) in table 1, in the absence of the biopolymer. Vials of the freeze dried RBC's are shown in Figure 2
- Oxidation levels of Hb was however quite high at 60% with the above conditions
- The novel biopolymer led to haemoglobin oxidation levels below detectable limits (less than 10%), but the maximum survival was 85%

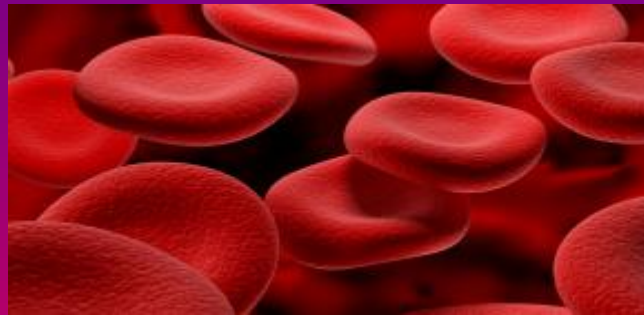


Figure 1 – Red Blood Cells

## Discussion

- The biopolymer did not necessarily lead to higher RBC survival under the conditions employed here, however it was only in samples containing the biopolymer that the haemoglobin oxidation was below detectable levels (typically below 10%)
- Prevention of haemoglobin oxidation may have been attributable to the direct action of the polymer itself and/or the presence of intracellular protectant facilitated by the presence of the biopolymer



Figure 2 – Vials of freeze dried blood

## Conclusion

- This study has shown that red blood cells can be successfully freeze dried and rehydrated with minimal degradation
- The results indicate it may be possible to achieve levels close to 100% cell survival and 0% haemoglobin oxidation

## Future work

The results of the present study, and the lessons learned from undertaking the project will be useful in understanding how freeze-drying can be applied more widely to nucleated cells and other regenerative medicine therapeutics

## References

- Holovati J. et al., Transfusion Medicine Reviews, Vol 23, No. 1 (2009) pp25-41

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