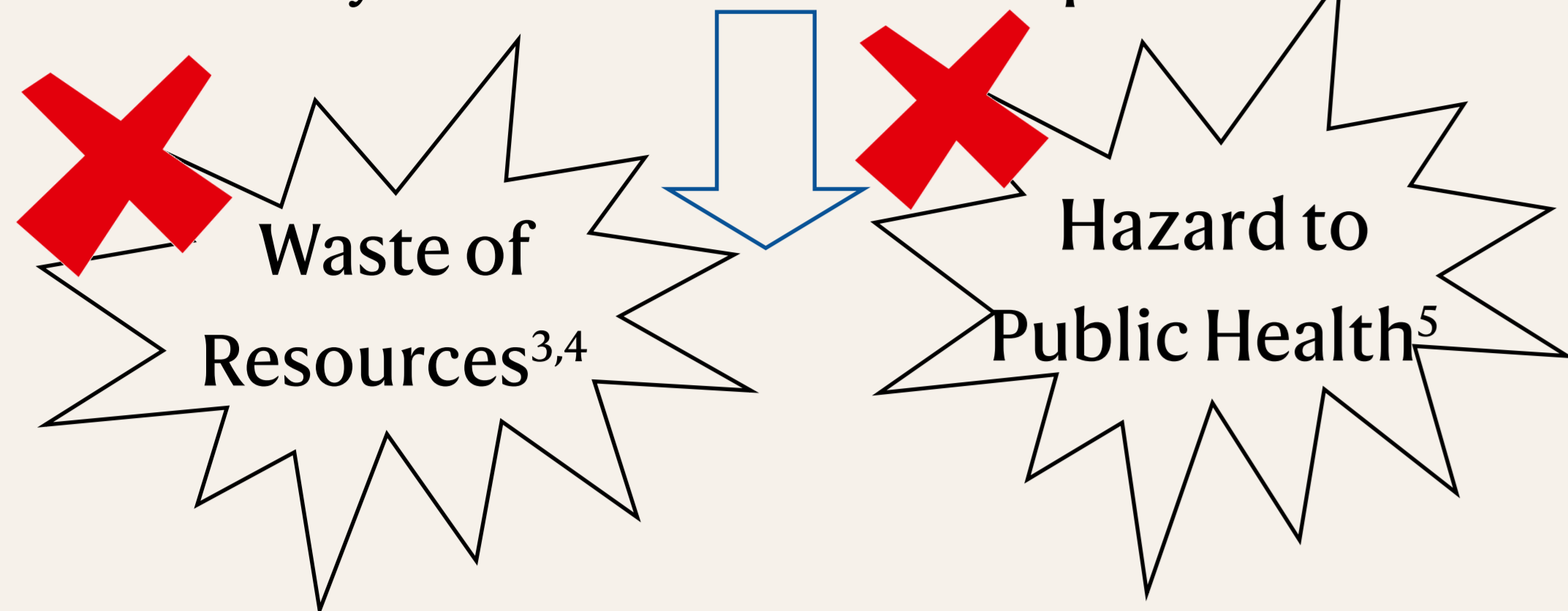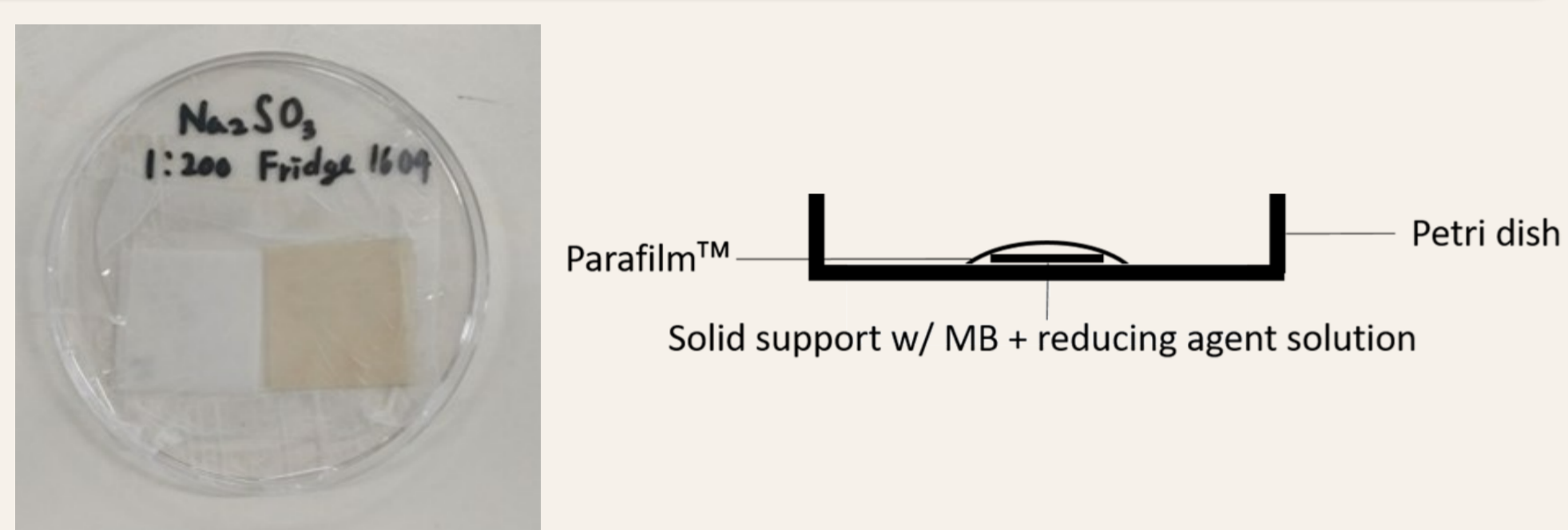# Background

1. Current expiry data predictors do not account for variations in storage environment[1]
→ Inaccurate
2. Temperature monitoring sensors to improve accuracy is uneconomical and impractical[2]

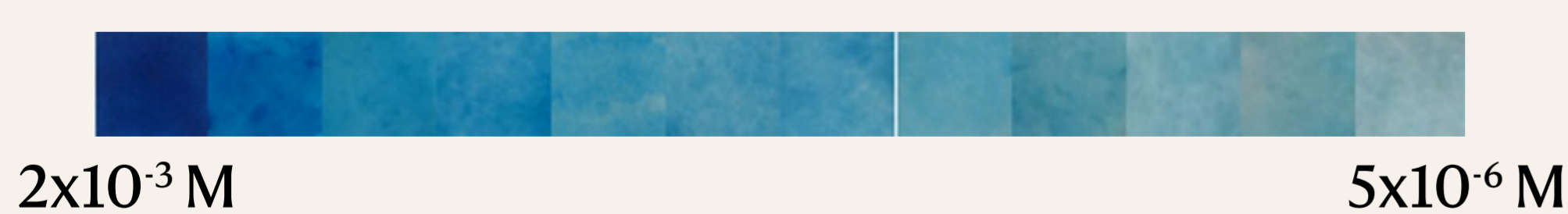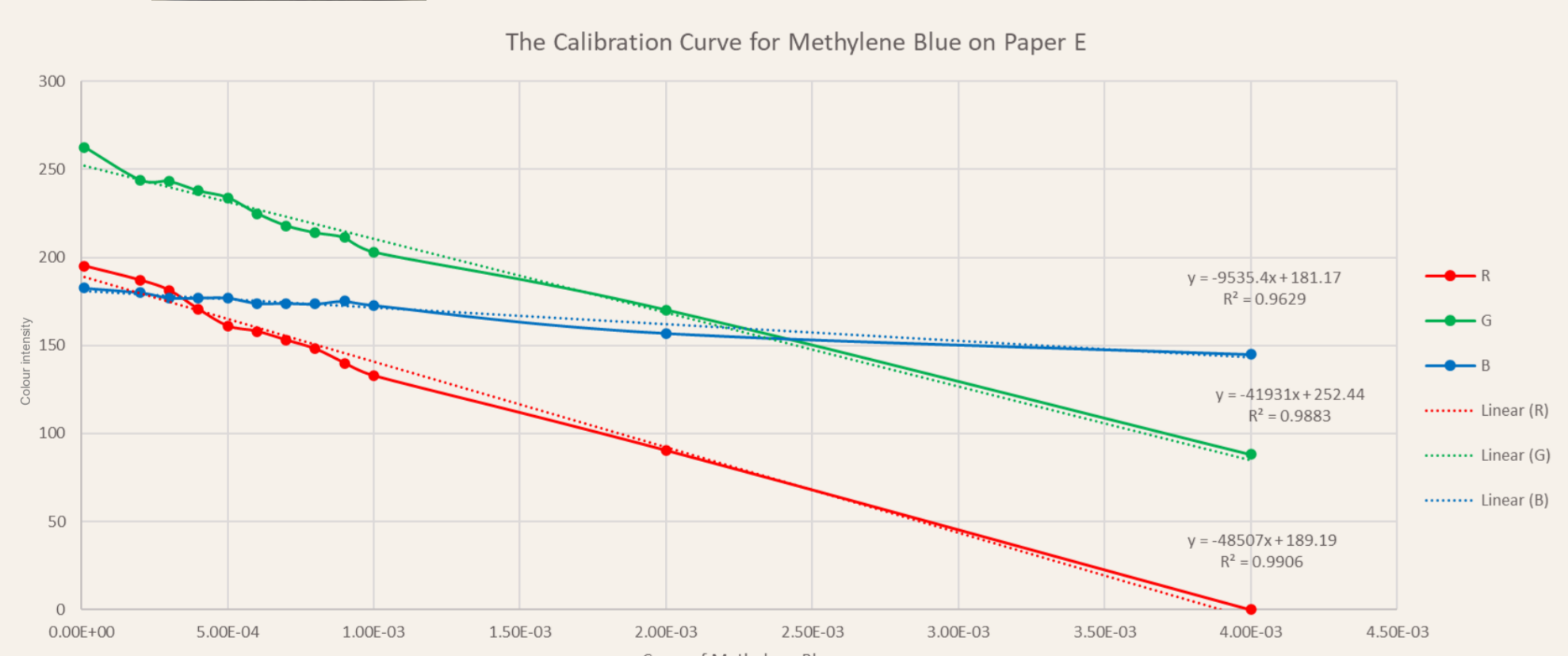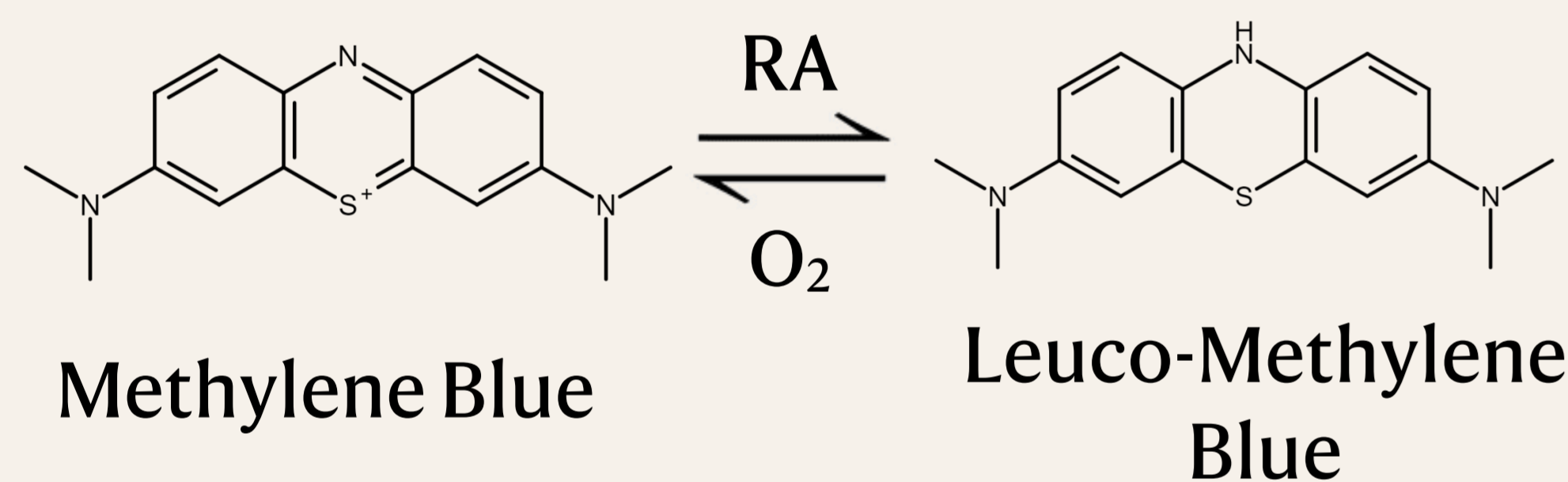Waste of Resources[3,4]

Hazard to Public Health[5]

Objectives

1. To investigate the rate of oxidation of methylene blue under different parameters
→ Devise a environment-dependent visual indicator model to predict food spoilage
2. To establish a correlation between the rate of oxidation under different parameters and the real-life storage requirements
→ Develop a quantitative indicator

Experimental Set-up

Parafilm™ — Petri dish
Solid support w/ MB + reducing agent solution

Methylene Blue

Methylene Blue — Leuco-Methylene Blue

The Calibration Curve for Methylene Blue on Paper E

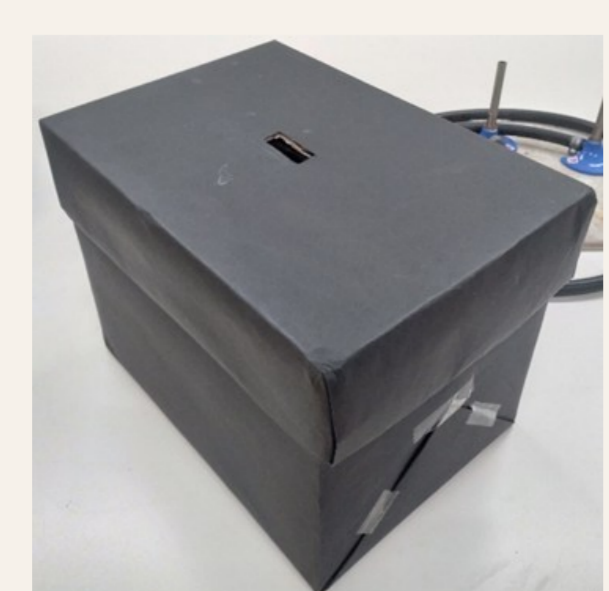2×10^{-3} M 5×10^{-6} M

Data measurement
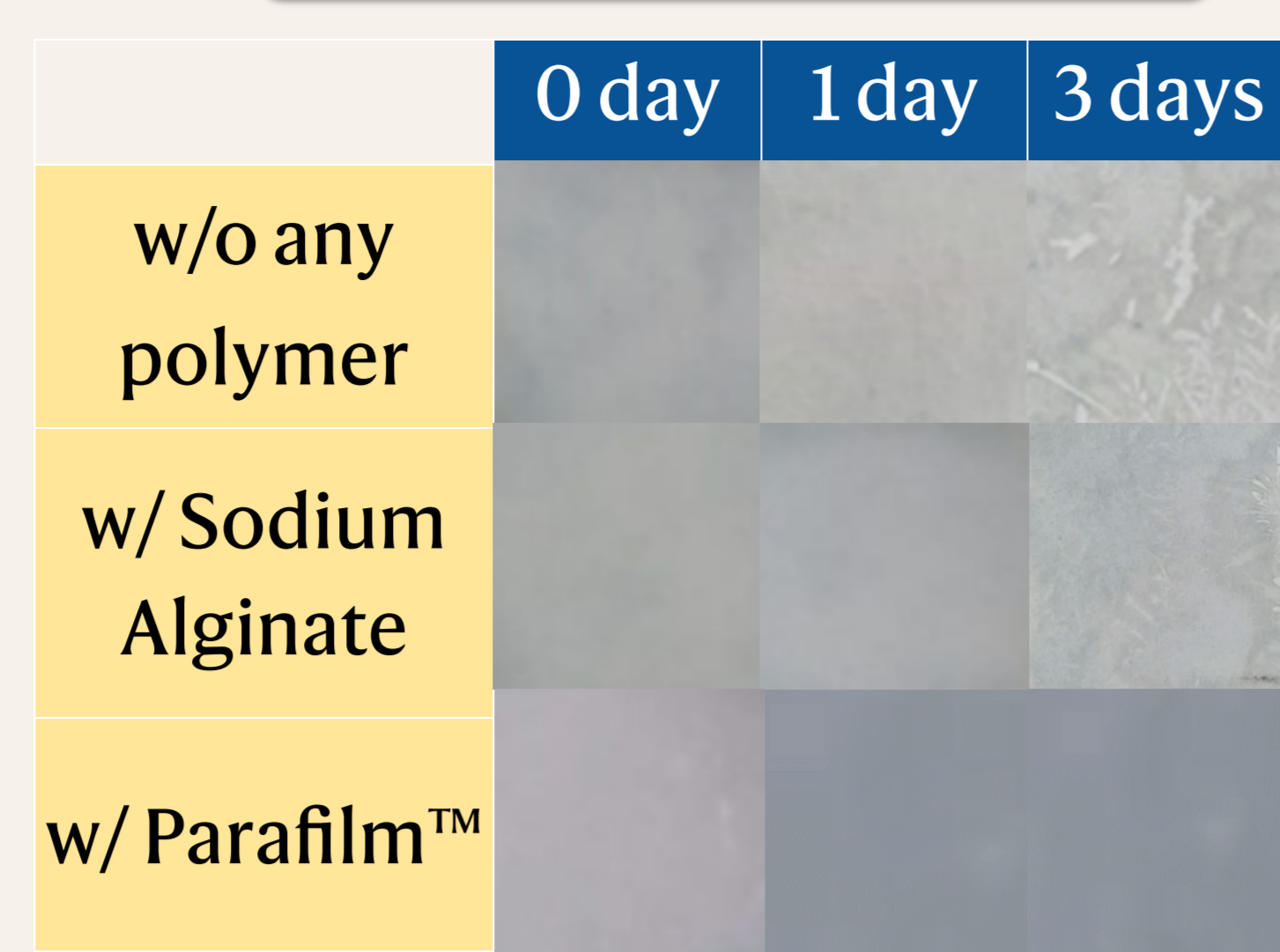
1. ChemEye
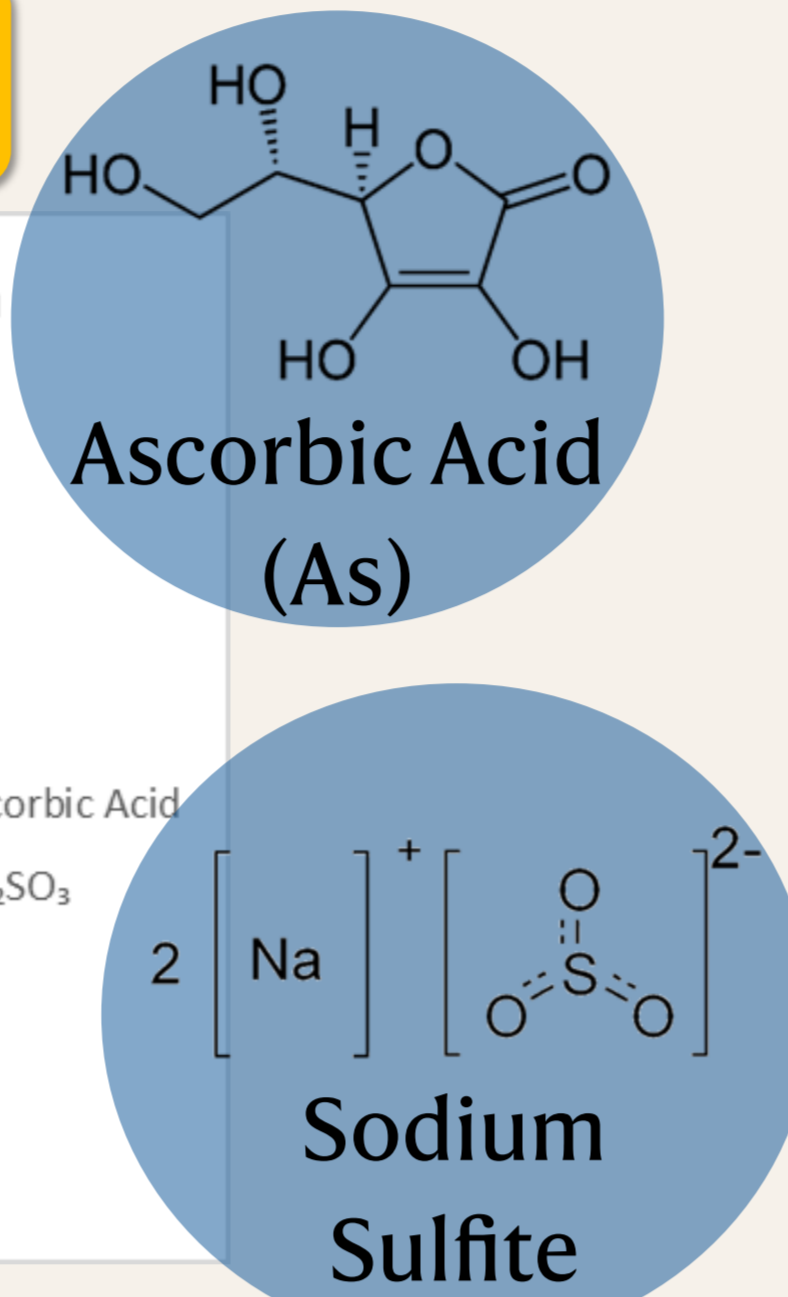2. Manual Colour Picker
3. AI-Driven Data Taker 👍

Black box used for data measurement

Experimental Parameters and Data

Use of Polymer

	0 day	1 day	3 days
w/o any polymer			
w/ Sodium Alginate			
w/ Parafilm™			

Reducing agents

Relationship between R-intensity and time with MB:Reducing agent at 1:500 under 30°C

- Ascorbic Acid
- Na2SO3

Ascorbic Acid (As)

Sodium Sulfite

Temperature

The Relationship Between R-intensity and time with 1:100 MB:Na2SO3

- 30°C
- 4°C
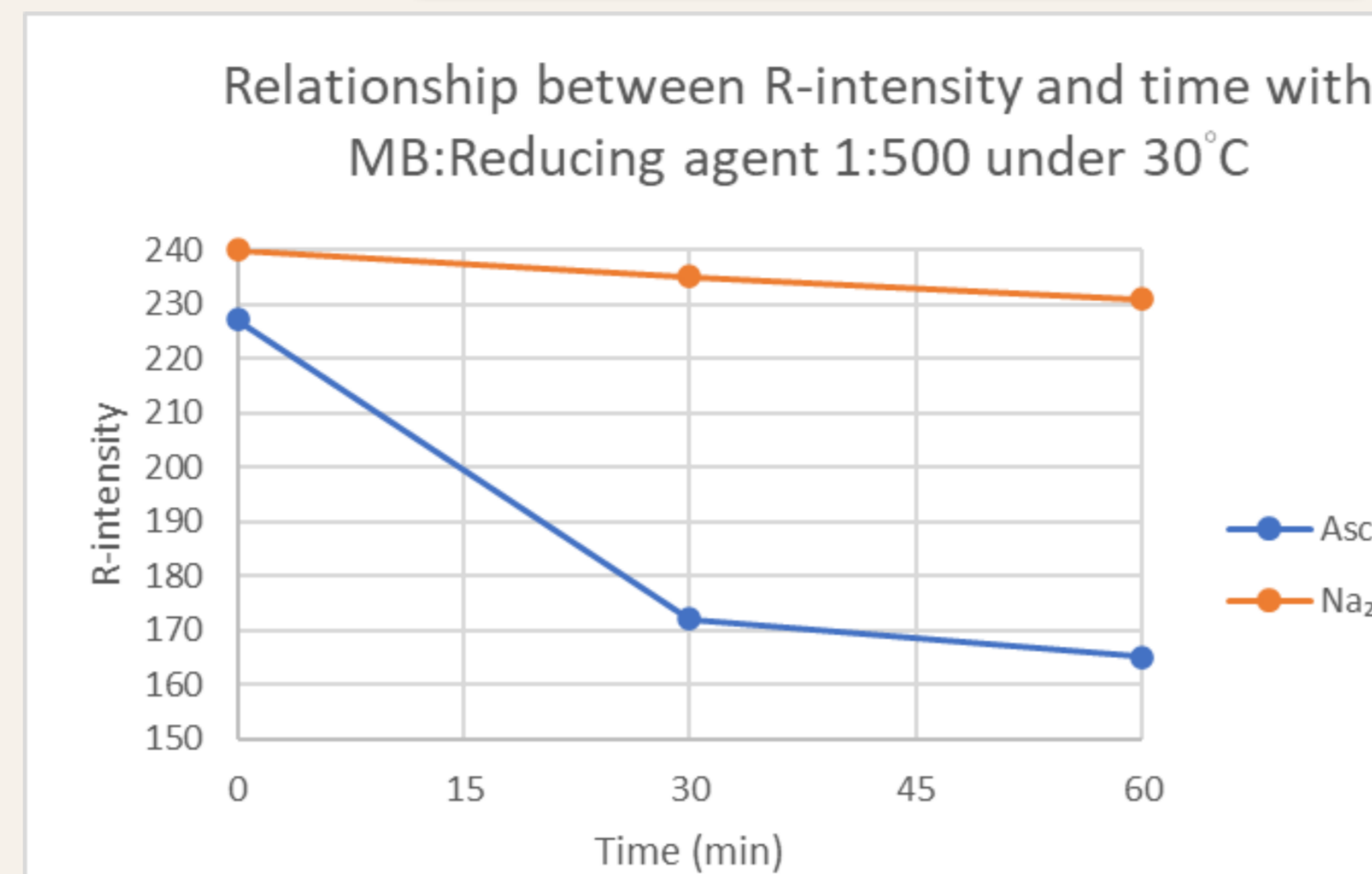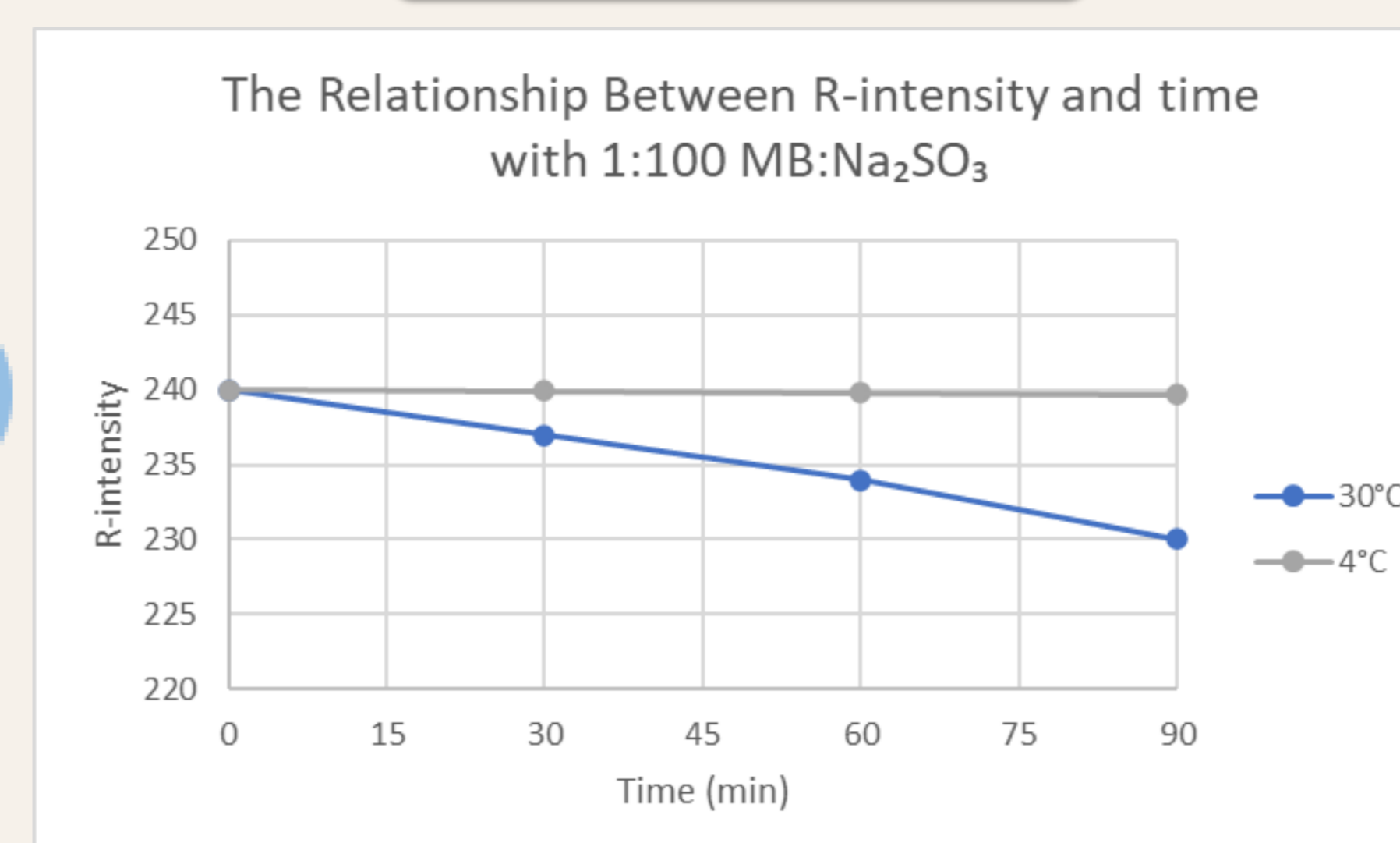
Selection of Solid Support

Relationship between R-intensity and time for MB:Na2SO3 1:150 and 1:250 under 30°C using different solid supports

- 1:250 Kaimei Oriental Paper
- 1:150 Kaimei Oriental Paper
- 1:250 Chinese Rice Paper
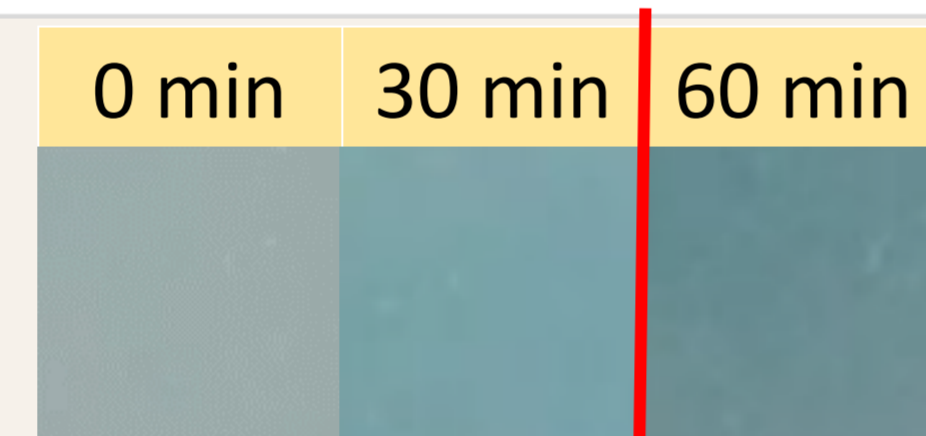- 1:150 Chinese Rice Paper
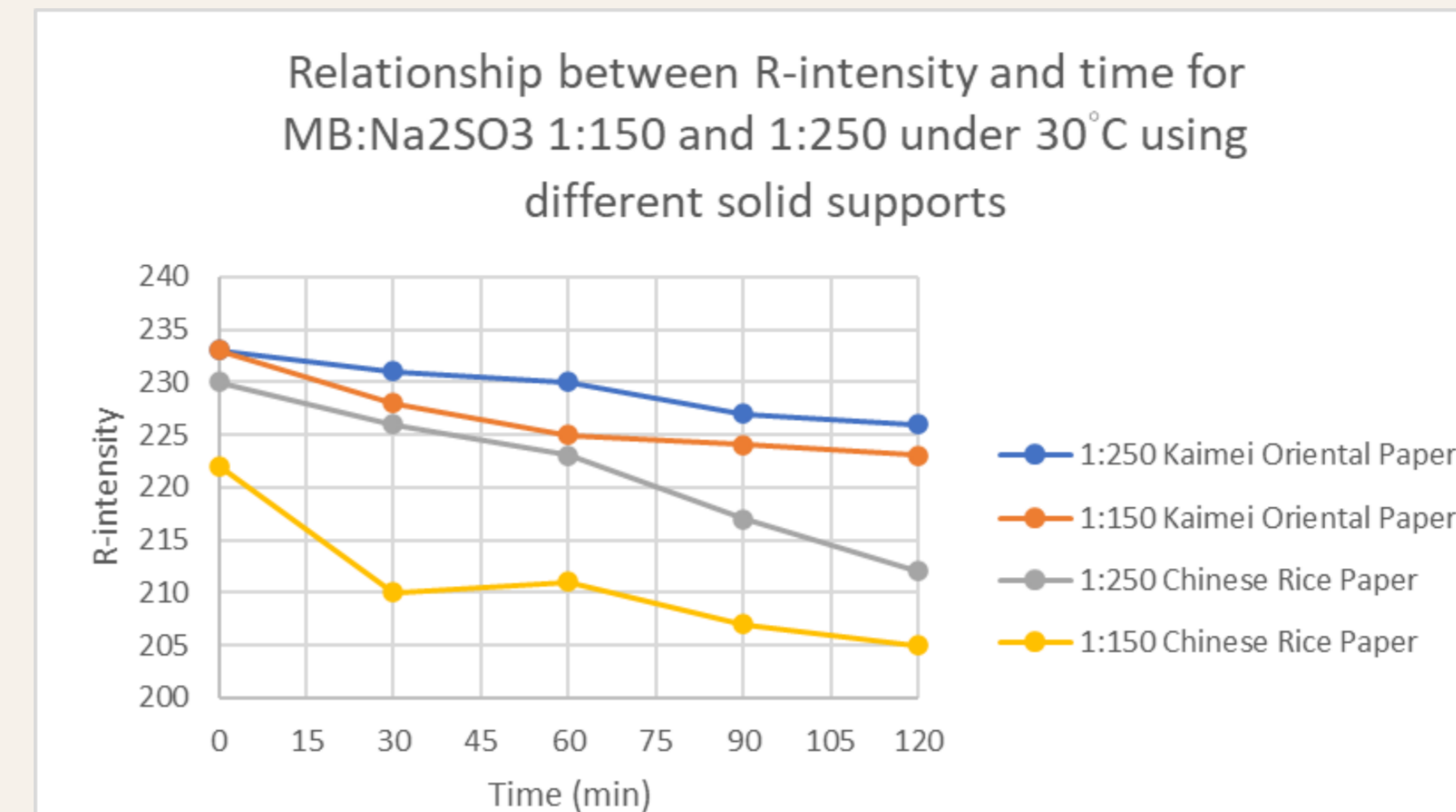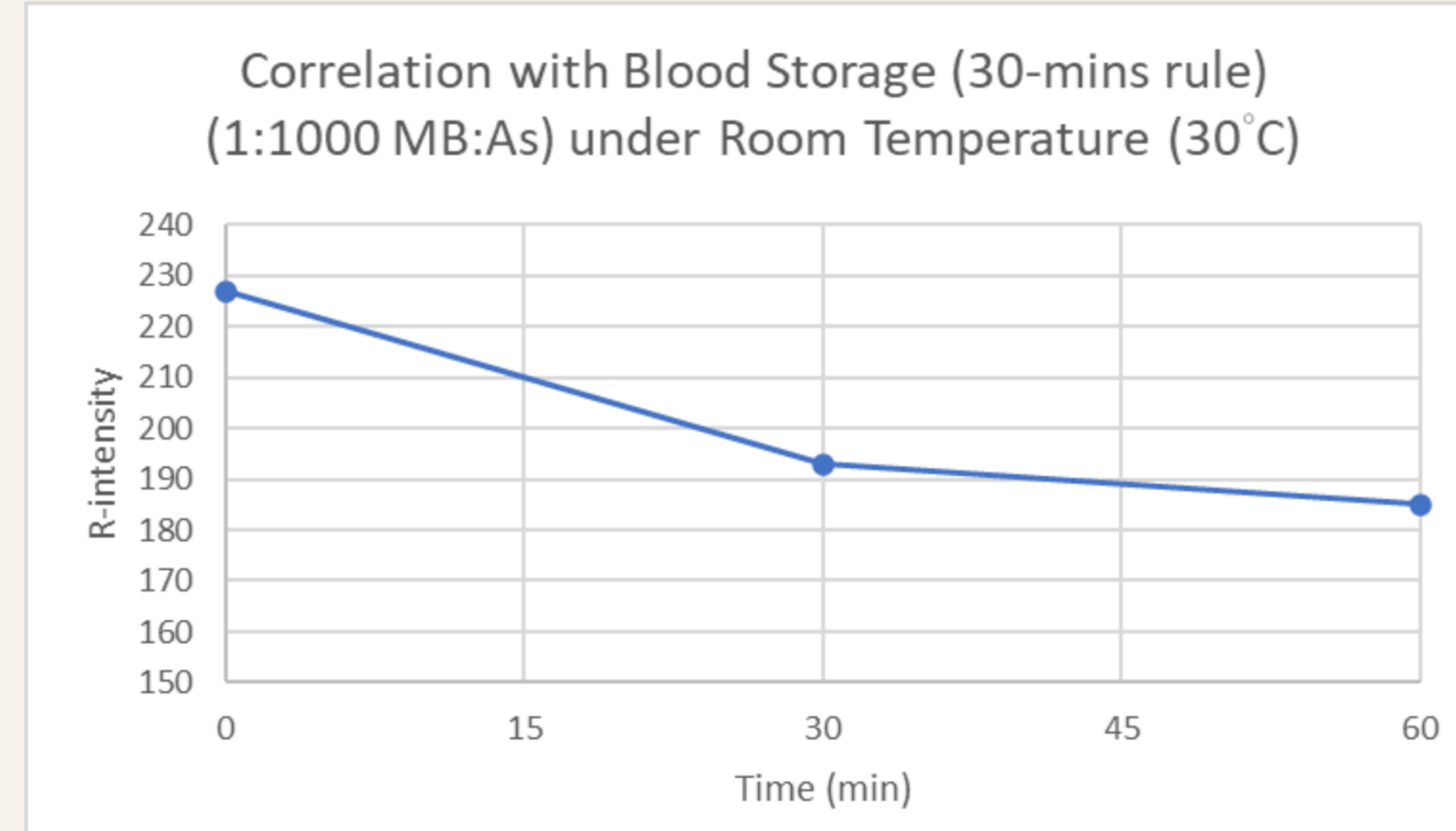
Real-life Application

Blood for Human Transfusion

Pre-transfusion: 30-minute Rule[6]
- 1:1000 MB:As Ratio

Correlation with Blood Storage (30-mins rule) (1:1000 MB:As) under Room Temperature (30°C)

0 min	30 min	60 min

Cut-off Colour Intensity

Transfusion: 4-hour Rule[6]
- 1:150 MB:Na2SO3 Ratio

Correlation with Blood Storage (4-hrs Rule) (1:150 MB:Na2SO3) under Room Temperature (30°C)

0 h	1 h	2 h	3 h	4 h	5 h
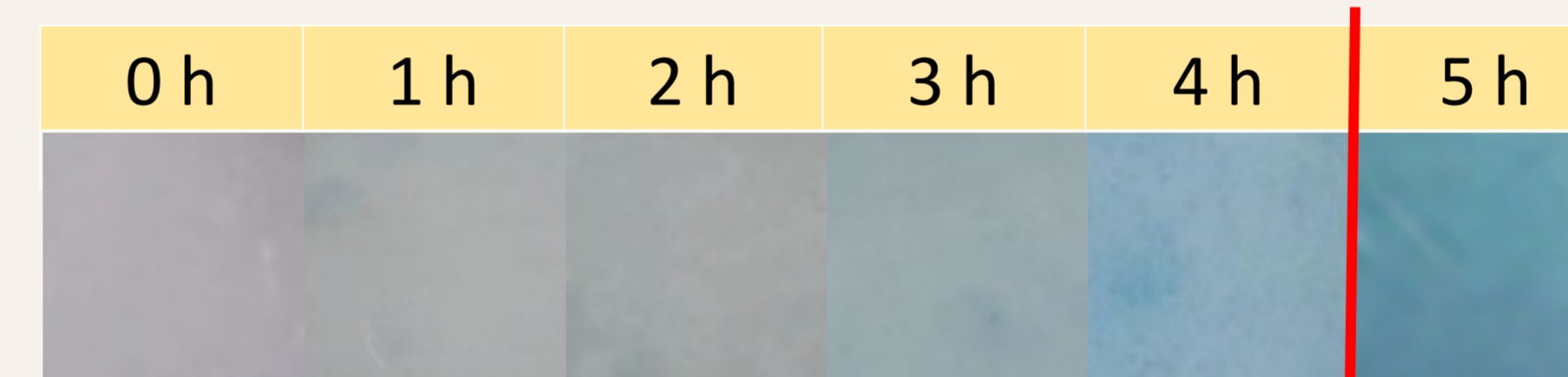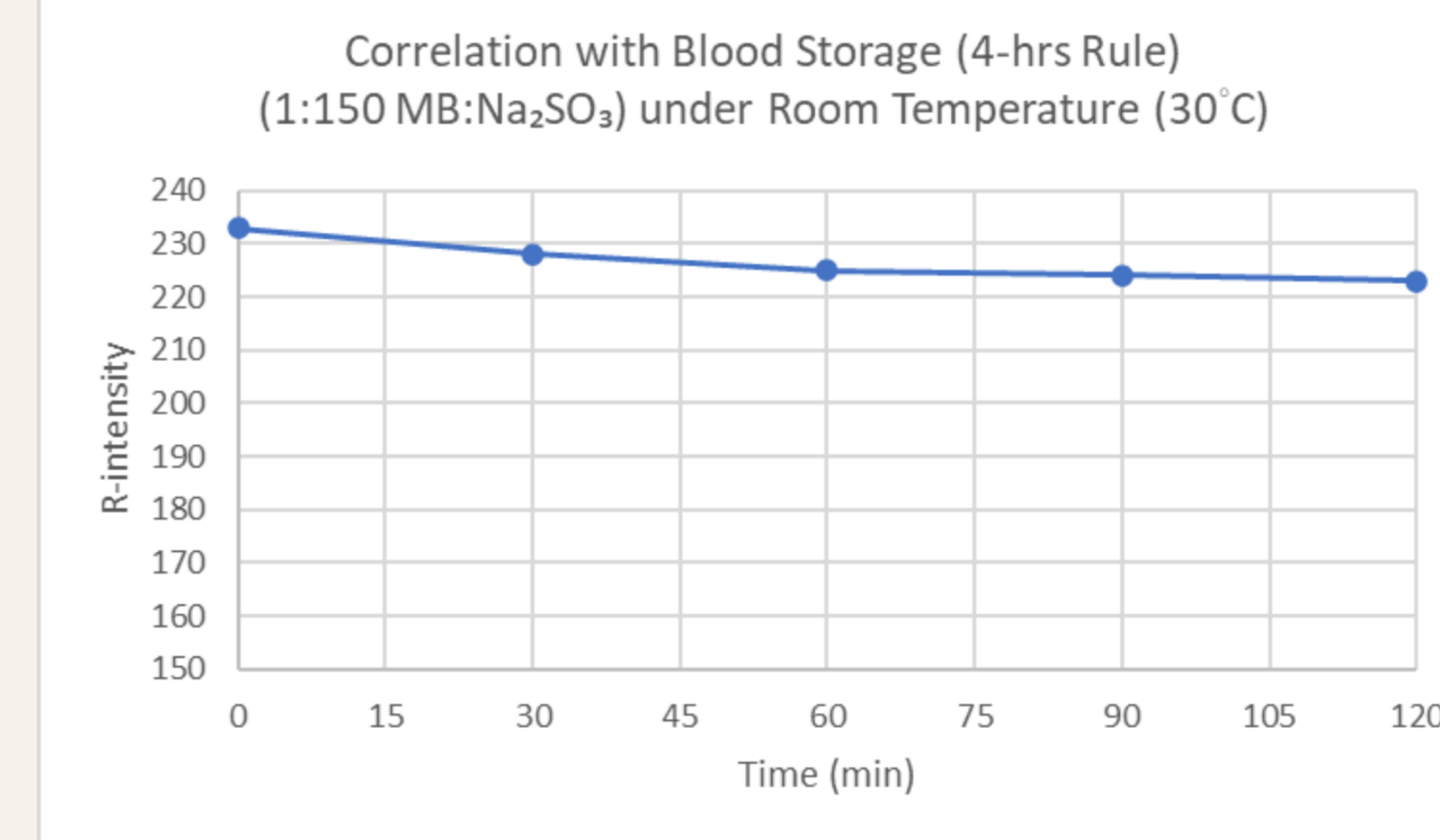
Cut-off Colour Intensity

Vaccine Storage

Storage condition	Shelf life[7]
Thermal shipping container (-90°C to -60°C)	18 months
Refrigerator (+2°C to +8°C)	31 days
Temperature Excursion	Immediate discardment

Correlation
- 1:500 MB:As Ratio

30°C

0 min	15 min	30 min	60 min

High-risk transportation process

Cut-off Colour Intensity

The Population of *E. Coli* in Pasteurized Milk at Diff. Time and Temperature[8]

Hazardous Bacterial Population Level[9]

- 4°C
- 20°C
- 25°C
- 30°C
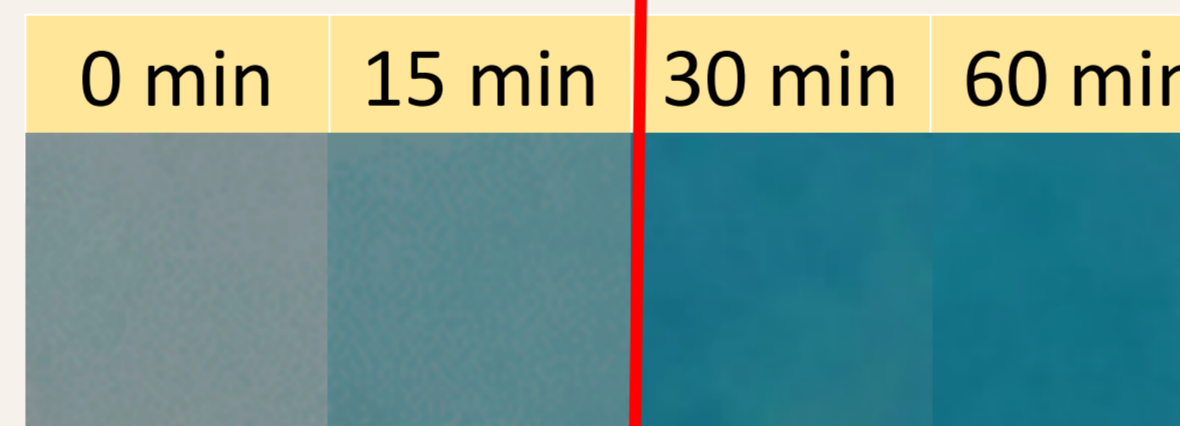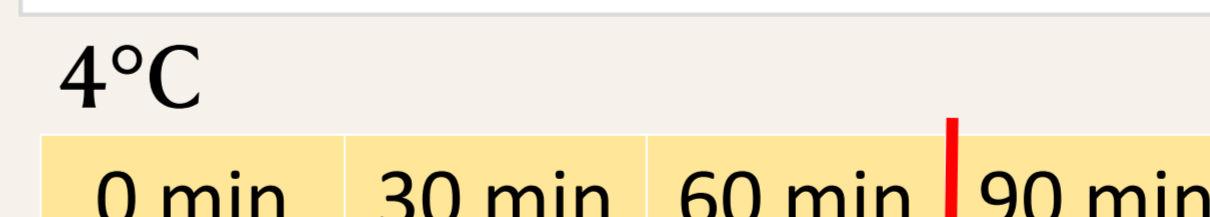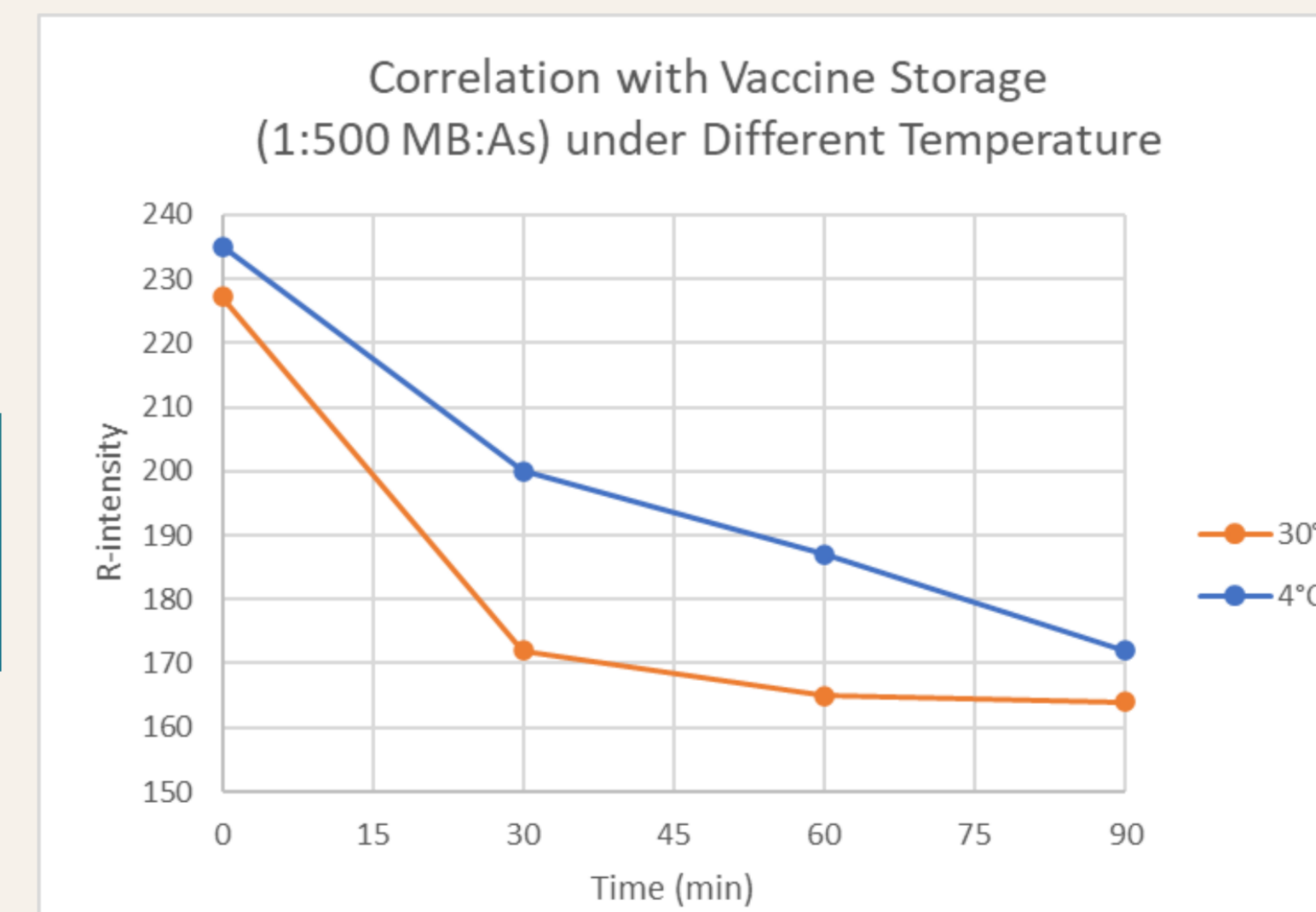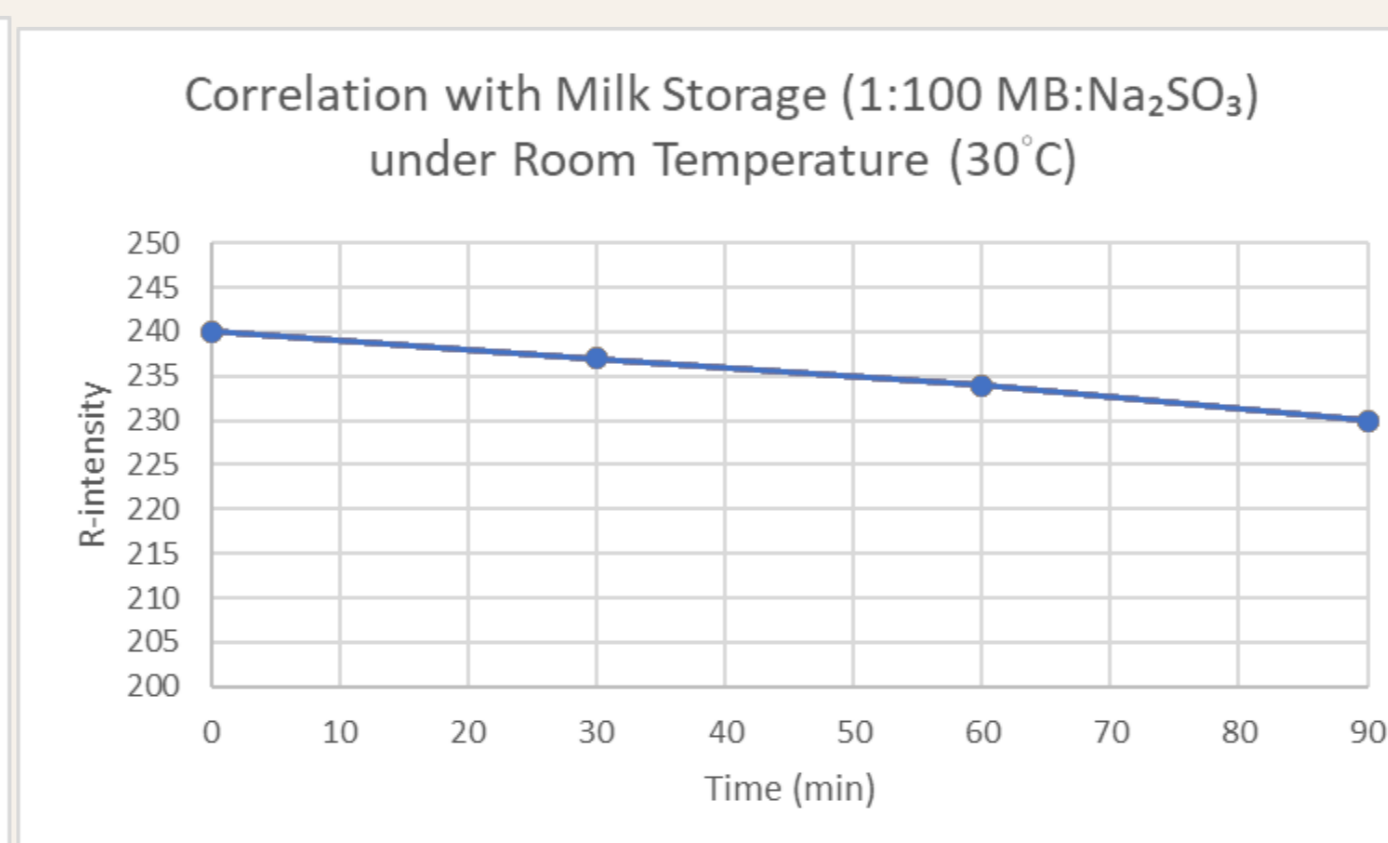
Milk Storage

Correlation
- 1:100 MB:Na2SO3 Ratio

Correlation with Milk Storage (1:100 MB:Na2SO3) under Fridge Temperature (4°C)

Correlation with Milk Storage (1:100 MB:Na2SO3) under Room Temperature (30°C)

Correlation with Vaccine Storage (1:500 MB:As) under Different Temperature

- 30°C
- 4°C

30°C

0 min	30 min	60 min	90 min	120 min

Cut-off Colour Intensity

4°C

0 day	7 days	14 days	21 days	28 days

AI-Driven Mobile App

Camera preview
Shutter button
Sample display
Data display

Redox Testing Tag
Red I-Intensity 190
MB concentration (M) 2.5E-4
Time (m:s) 15

👍 Convenient and quantitative measurement of colour intensity
👍 User-friendly mobile APP interface

Competitive Advantages

	Temperature Sensors	Expiry Date System	Redox Testing Tags 👍
Cost	High	Low	Low
Reliability	✓	✗	✓
Monitored Period	Bulk Transport Only	No Real Time Monitoring	Constant Real Time Monitoring
Bulkiness	✗	✓	✓
User-Friendly	✗	✓	✓

Conclusion

- Our project investigated the rate of oxidation under different parameters and successfully correlate the result to real life scenarios and application
- Invented the Redox Testing Tags to provide a cheap and effective solution to monitor the combination of storage temperature and time
- An AI-driven App is designed to enhance user experience

→ Reduce waste and health hazard to general public

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(3) Greene, J.; Skolnik, C. L.; Merritt, M. W. How Medicine Becomes Trash: Disposability in Health Care. *The Lancet* 2022, 400 (10360), 1298–1299. https://doi.org/10.1016/S0140-6736(22)01941-9.

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(8) Açai, P.; Valík, L.; Medved'ová, A.; Rosskopf, F. Modelling and Predicting the Simultaneous Growth of *Escherichia Coli* and Lactic Acid Bacteria in Milk. *Food Sci. Technol. Int.* 2016, 22 (6), 475–484. https://doi.org/10.1177/1082013215622840.

(9) Vedøy, O. B.; Steinsland, H.; Sakkestad, S. T.; Sommerfelt, H.; Hanevik, K. Strong Association between Diarrhea and Concentration of Enterotoxigenic Escherichia Coli Strain TW10722 in Stools of Experimentally Infected Volunteers. *Pathogens* 2023, 12 (2), 283. https://doi.org/10.3390/pathogens12020283.