

ISOLATING ARA H

- Unsure if shaking alone would be enough to bring Ara H from the food into solution or if a mechanical digestion system would need to be added to the Sample Vial
- Conducted an SDS-PAGE with 3 different preparation of peanuts (roasted peanut, washed peanut, and peanut butter). This simulated different degrees of mechanical digestion
- We were able to detect Ara H proteins in all three preparations, although the washed peanut and peanut butter showed much stronger (as expected).

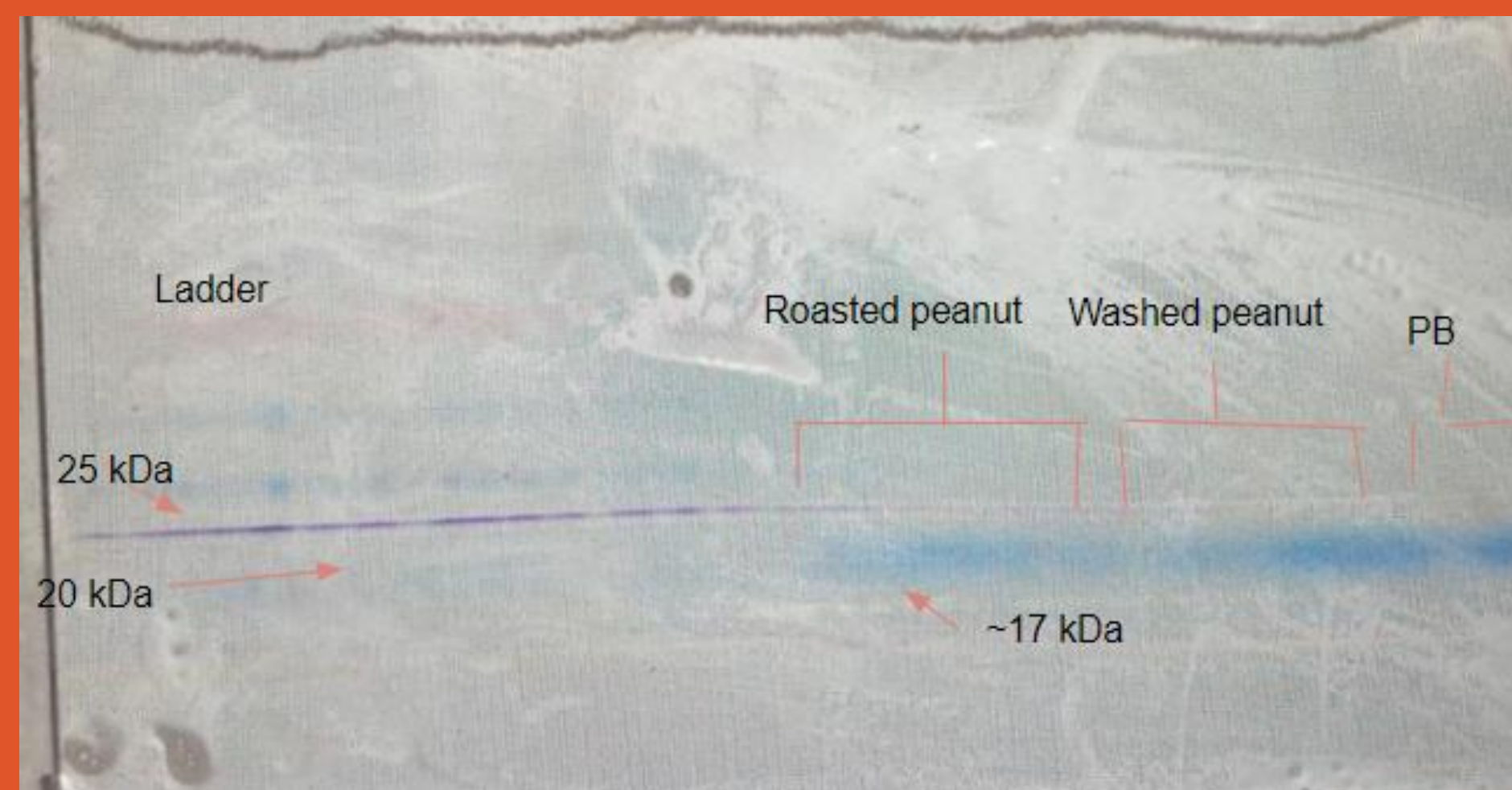


Figure 3: Photo of the SDS-Page. Ara h has a weight of 17kDa. The blue shows that proteins have been detected. The darker the blue, the more Ara h was detected.

LATERAL FLOW ASSAY

- Needed to check that a change in solution viscosity wouldn't significantly affect the amount of time a test would take to complete
- hCG solutions were made with varying cornstarch wt% concentrations to simulate different viscosities
- Each concentration was tested and timed 4 times. The times were then graphed and a trendline was set to find the average time each concentration took to complete the test (Figure 6).
- We found that up to 10 wt% resulted in no change in time compared to the control. Although, even at 50%, the time it took for a positive result is still within a reasonable time for the total time for the test to be completed in.

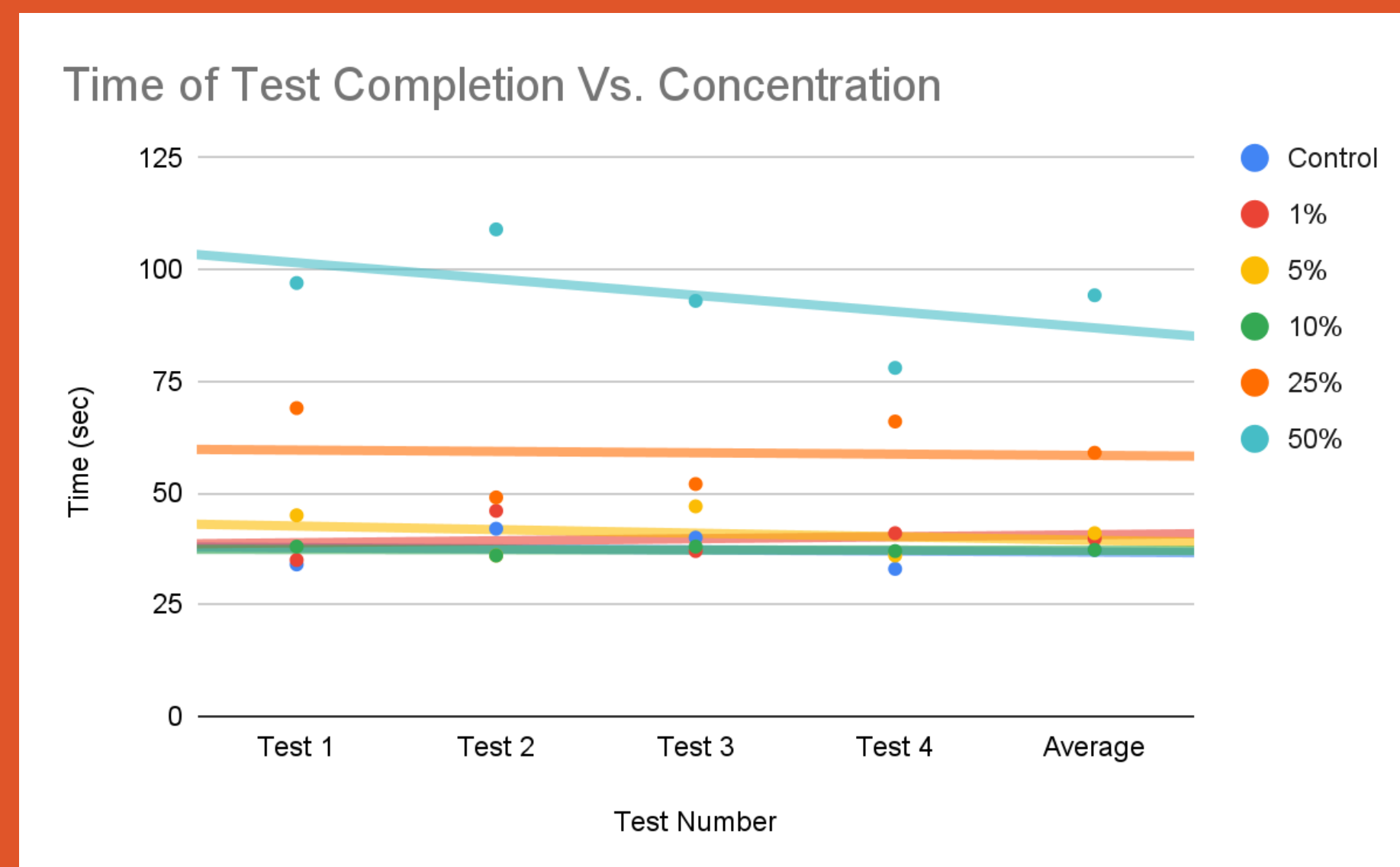


Figure 4: Graph of the amount of time for a positive result vs. various concentrations.

ARAFLOW

An at-home peanut allergen test

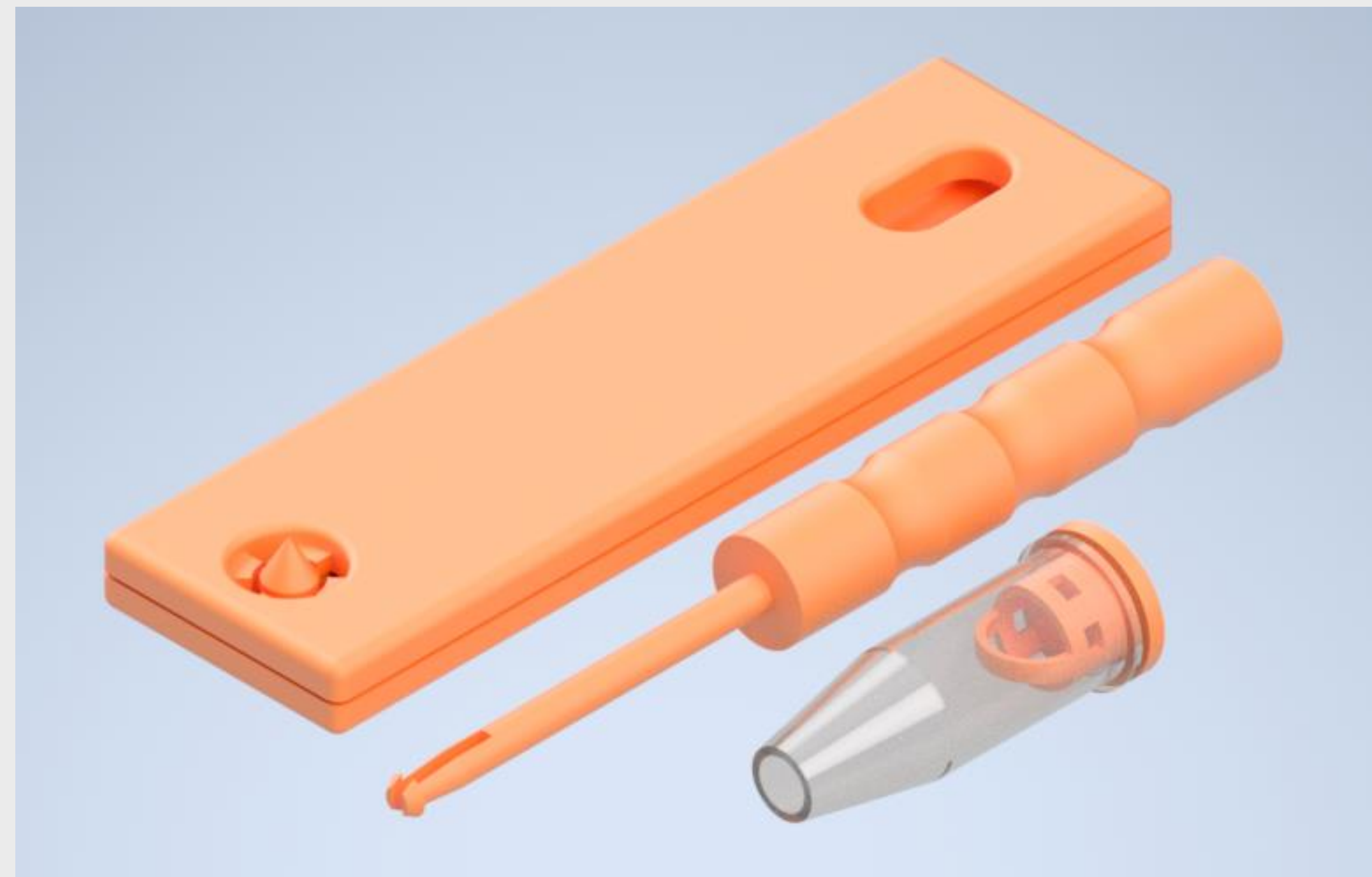


Figure 1: The components of AraFlow testing kit. From left to right you can see: the Testing Card, the Collection Wand, and the Sample Vial with the Collection Tip inserted.

OPPORTUNITY

- Peanut allergies are the most common food allergy among children, and often persists into adulthood.
- There are 3 million people in the US alone with peanut allergies.
- 200,000 people in the US each year need emergency medical care due to food allergy reactions.
- There are currently very few preventative options, and they are expensive, not meant for at-home use, and/or unreliable.

HOW DOES ARAFLOW WORK?

- AraFlow is an at-home peanut allergen (Ara h) testing kit.
1. The user collect a sample of food using the Collection Wand and Tip.
  2. The tip is then inserted as the cap of the Sample Vial and the Collection Wand is detached to be reused in further tests.
  3. The user then shakes the Sample Vial to dissolve the food sample into the solution that is contained in the vial.
  4. The Sample Vial is pushed down on the spike of the Testing Card, releasing the solution onto a lateral flow assay (LFA). Figure 2 shows how a LFA works.
  5. Once the assay is complete, the user will be able to read the results and tell if the food is safe for them to consume.

CONCLUSIONS

- We were able to provide many proof-of-concept tests, but still lack complete testing (ex: testing with hCG vs. Ara h)
- Because we were rushed for time at the end, our SDS-PAGE should be redone to hopefully get clearer results. The current SDS-PAGE is still valuable to draw initial conclusions (i.e. we may not need any mechanical processing to bring our sample into solution).
- Despite the setbacks and limitations, our experiments show very promising results that Araflow would be a valid and useful device should it be introduced in the market.

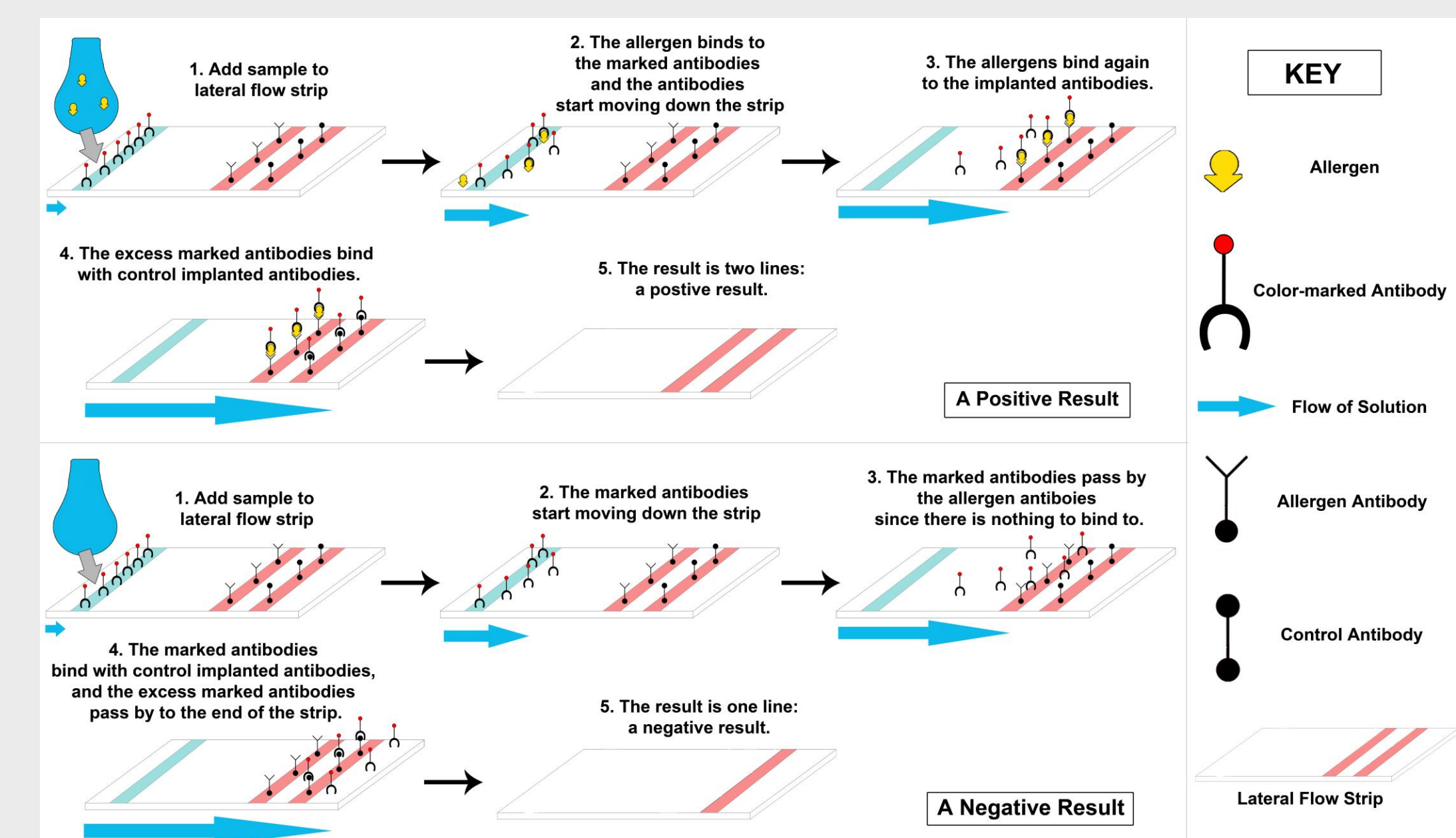


Figure 2: Flow process diagram of how a lateral flow assay functions

TIP DESIGN

- ~30 tip variations were designed and tested to see which would collect the largest sample of food. See Figure 5 for some examples.
- 7 "food" types were tested: liquid (water), viscous liquid (ranch dressing), compressible solid (bread), firm fruit (apple), fibrous vegetable (cooked asparagus), compressed meat (sausage), fibrous meat (chicken)
- Each tip was given a score based on the weight of the food collected.
- The highest scoring tip was our tall basket design (seen in Figure 1). Our 2<sup>nd</sup> and 3<sup>rd</sup> place tips (a crown design, seen in the top right of Figure 5) were actually the same shape, just different thicknesses.



Figure 5: A variety of tip shapes that were tested.

DISCUSSION

- The current best tip design would result in 42 wt% solution concentration (if the entire sample dissolves). This would result in an increased, but acceptable, time before results are displayed.
- Initial testing of bringing the sample into solution shows promising results that we will not need to include grinding mechanisms in the Sample Vial.
- The change in viscosity does not significantly affect the processing time of the lateral flow test until 25 to 50 wt%.

FUTURE WORK

- Test a combined tip design of the tall basket and crown designs (the top two designs)
- Test if trace amounts of Ara H can be detected when the sample is just shaken (to confirm that no grinding is needed)
- Test the full system with actual anti-Ara H antibodies to gauge the time it takes to complete the entire test

ACKNOWLEDGEMENTS

We would like to thank Dr. Joe Baio, Patrick Geoghegan, and their amazing Tas, Angel-Rose Villegas and Ward Shalash, for their knowledge and guidance in our development process. Thank you also to Dr. Elain Fu for providing feedback on our initial designs. And a huge thank you to Dr. Christine Kelly and Casey Kanalos for providing the SDS-PAGE equipment and supplies.

