Cheese making results in a liquid whey by-product, which is the starting material for whey protein concentrate (WPC). WPC is produced by concentrating liquid whey through steps of ultrafiltration and diafiltration, followed by spray drying. Tillamook’s production facility in Boardman, Oregon produces WPC 80.

**Design Selection**

Our design needed to be simple, easy to use, and be able to provide operators with accurate results. We needed a software that would act as the basis of our model that would allow us to achieve these goals. Based on our parameters, both Excel and PowerBI were chosen as the best fit for our design. However, due to access and time limitations, we decided it would be best to condense our model to use Excel only.

**Predictive Model**

We created an interface that would be easy for the operators to include within their typical routine that would help aid them in deciding on various machine settings across the WPC production process. Our model utilizes the coding language Visual Basic, which is embedded into excel, to create 3 custom functions and 1 macro. Shown below is the input section of our model. This is where the operator must input the PDB and mass for both streams and then press the “Run Model” button.

**Mass Balance**

A mass balance was performed over the entire liquid whey to WPC process to track protein movement throughout the system. The only mass input considered is liquid whey and the two mass outputs are WPC powder and the lactose permeate stream coming from filtration. The equations used are shown in the tables below. We performed the mass balance in an Excel workbook. A python script was written to compile all the raw data so that all information for a batch is homogeneous. This “Master Data Sheet” can be used by experts at Tillamook to sort through historic data.

**Predictive Model Economics**

Our hope is the tools we created will allow the Boardman, OR plant to get their future FG PDB yields closer to 82%. As seen in Figure 2, Tillamook gives away a lot of high-quality protein since yields are frequently above 82%. There isn’t currently a method for quantifying the revenue lost from protein give-away, but reducing protein give-away will save Tillamook money. We used the sale price (per lb.) of WPC 80 to determine the lost revenue for all the product that had to be downgraded in 2022 due to FG PDB yields being below 82%. This amounted to around $500,000 of potential annual savings if Tillamook was able to maintain yields above 82% to avoid downgrading the product.

**Conclusion & Future Steps**

In conclusion, the production of WPC is a complex problem that involves many different steps and variables to consider. Our model should allow Tillamook to get a better picture of their data and how each variable affects the output. A future team would be able to build off of our work and include AI or Machine Learning into a model to allow for accurate prediction of the finished good PDB.

**Acknowledgements**

- **Client:** Tillamook
- **Faculty Advisor:** Dr. Bahar Aliakbarian
- **Team Contributions:**
  - Ben Alexander – Data Analyst
  - Ava Borri – Communications Lead
  - Kate Mann – Statistics Lead
  - Stephanie Nomoto – Literature Management

**Select References**


