Valorisation of Food Processing Waste Streams

Katherine Preece[1,2], Ardjan Krijgsman[1], Klaas-Jan Zuidam[1], Philip Cox[2] & Clive Marshman[2]
1. Unilever, Olivier van Noortlaan 120, 3133 AT Vlaardingen, The Netherlands
2. School of Chemical Engineering, University of Birmingham, Edgbaston B15 2TT

A number of health benefits have been associated by including soy foods in the diet, such as: reduced incidences of cardiovascular disease (CVD), hormone-related cancers and reduced levels of cholesterol. Soymilk is a beverage popular in Asia, but it is becoming more popular in the western world. Not only can soymilk be consumed as a drink, but it is also used as the basis for the protein-rich food tofu, which is formed by coagulation of the milk. Conventionally soymilk is produced from raw soybeans using the Illinois process (shown in Figure 1, including optional steps of 3 & 11).

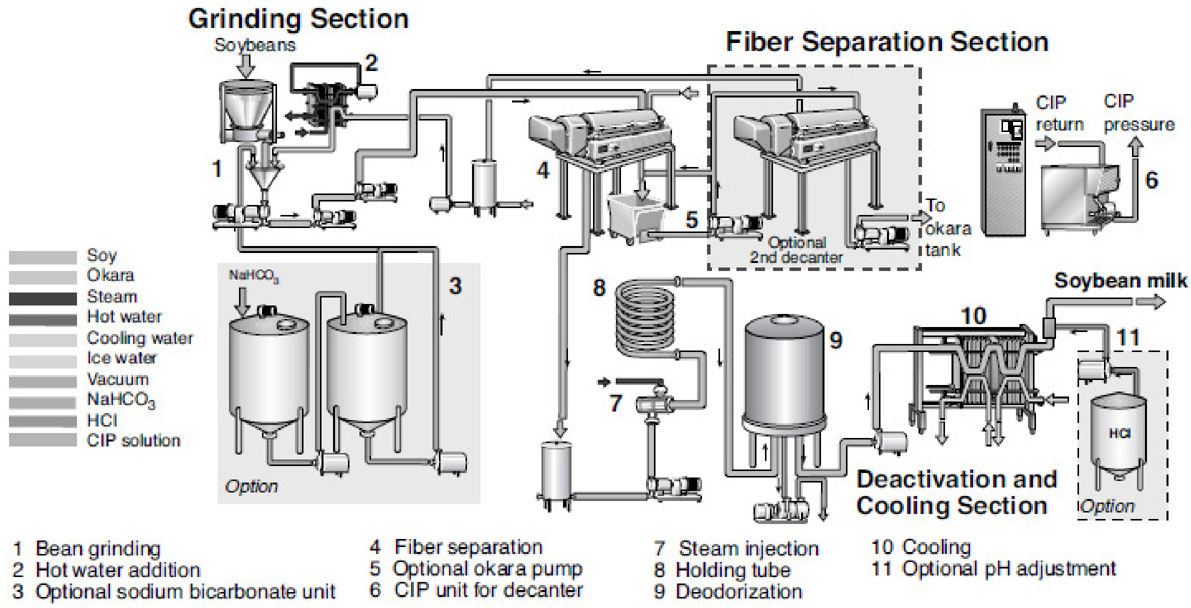

Figure 1 – A commercial Tetra Alwin processing line to produce soymilk based on the Illinois process [1]

An insoluble fibrous waste product, termed okara is produced whilst manufacturing soymilk. From 1 kg of dry soybeans 1.1 kg of fresh okara can be produced (wet basis) [2]. Okara is currently seen as relatively value-less as it is either discarded or sold as animal feed. Analysis shows that this waste material produced during soymilk manufacture contains about 25% protein, 10-15% oils, but only a small amount of carbohydrates [2], some of these components could potentially bring value to this food processing waste. Most approaches are limited due to the nature of the material and the potential of rapid microbiological spoilage of okara due to its high water activity [2].

To improve the timely processing of okara, various methods for the treatment could be employed, including pH adjustment, temperature and enzymatic treatment. As part of an initial assessment the effect of pH adjustment on the solubilisation of the remaining proteins from within okara has been made. The solubility of a protein depends upon its isoelectric point (pI), which is specific to each protein; this is the pH the protein carries no overall net charge.

Preliminary assessment methods of the protein solubilisation for extraction from okara were explored:

1. BCA assay gives the total protein content of a sample. This colorimetric test involves the construction of a calibration curve using samples with known protein content and measuring absorbance at 562 nm. The total protein initial pH is dependent upon the milk processing methods as the dried soybeans are soaked in sodium bicarbonate producing an alkaline okara. For this data set, an expected total protein of okara of 4% (wet basis) was used to determine total percentage protein solubilised [2].

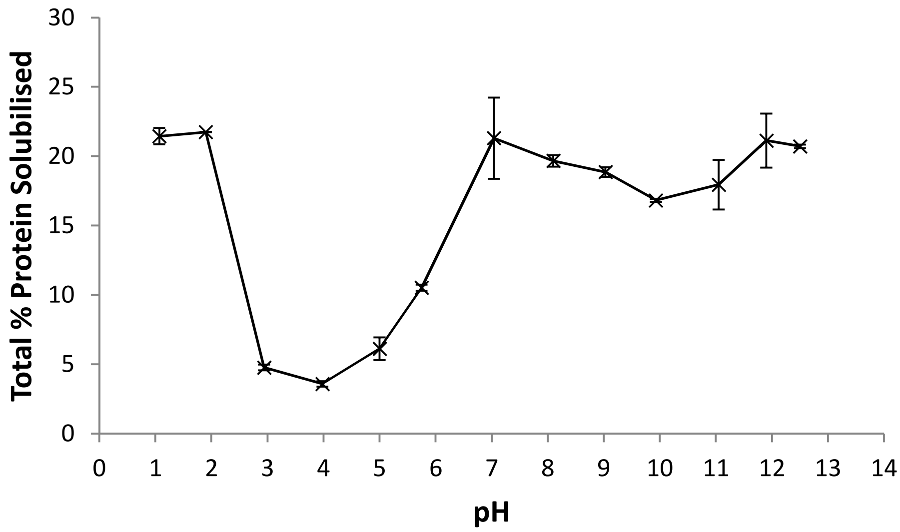

Figure 2 – Total % Protein solubilised from okara after mixing for 30 min. at 25 °C

2. Sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) separates proteins for potential identification with respect to their size alone. SDS is added to heated samples to denature the protein which are then loaded into a gel immersed in the buffer solution; when an electric current is applied the proteins are separated by their electrophoretic mobilities.

This work has shown that a large concentration of proteins are found within the waste at various pH values; future work needs to be undertaken to determine the properties and potential uses of these proteins, as well as designing a route of cheap efficient extraction. In future work it will be determined if extraction of other components found within okara could be deemed cost effective.

References

1. Riaz M. N., *Soy Applications in Food*, 2006, London: CRC Press, p.121-122
2. O'Toole D. K., *Characteristics and Uses of Okara, the Soybean Residue from Soy Milk Production- A Review*, J. Agric. Food Chem., 1999, **47**(2) p.363-371