INTRODUCTION

Polyphenols found in plants can be used in food industry as additives and be applied as antibiotics and anti-diarrheal, anti-ulcer, and anti-inflammatory agents. They can also be beneficial in the treatment of diseases include hypertension, vascular fragility, allergies and hypercholesterolemia. Extraction, concentration and accurate specification of polyphenols in natural sources in food and beverages are vital for evaluation and quantification of the safe level of intake.

Membrane separation processes could be utilized as better alternative in concentration and separation process with potential advantages of greater separation efficiency, high purity, mild operation parameters and avoidance or reduced use of solvent. However, membrane fouling could compromise separation performance and require regular cleaning, therefore needs to be examined.

This study aim to investigate the separation efficiency using nanofiltration (NF) process in concentration of polyphenolic compounds extracted from black tea and evaluate the operation factors affects membrane flux, polyphenol rejection or concentration rates. The total and composition of major polyphenol compounds in the feed and permeate will be evaluated and compared.

METHOD

Commonly used hot water extraction method was evaluated at various conditions to compare the obtained total polyphenols using spectrophotometric method [Jurišić, 2005].

The total polyphenols in tea solution was measured using spectrophotometry method.

Based on major polyphnols presented in tea solution, nanofiltration membranes with MWCO of 270 (NF270, polyamide TFC) and 700 (NTR-7450) were tested for flux and rejection of polyphenols using a stirred cell rig.

The extracted tea solution from try tea leave was vacuumed filtered with filter paper (Whatman Grade No. 42, Ashless, Particle Retention of 2.5 µm)

RESULTS

Nanofiltration conducted with two membranes suggested that the membrane with a smaller nominal molecular weight cut-off (NF270) has a higher flux than the NTR-7450 membrane, while rejections higher than 90% were achieved for both membranes as shown in Figure 1.
At increased operation pressure, both membranes exhibited higher permeate flux as shown in Figure 2. However, the flux reduction over filtration time at higher pressure was also higher at higher pressure, indicating a more profound membrane fouling.

Increase in stirring rate from 2 to 4 slightly improved flux at initial stage of filtration, similar flux was observed in the second 60 minutes. The rejection at stirring rate of 2 and 4 are similar. Further increase in stirring rate to 6 resulted in much reduced flux as well as reduced rejection as shown in Figure 3.

Application of ultrafiltration to the tea solution using 5 kDa CR membrane prior nanofiltration resulted in slightly lower but much stable flux during NF process, this indicates a much reduced membrane fouling. A 57% polyphenol rejection during UF filtration was also observed. It was possibly due to the retention of larger molecular weight components in the tea solution.

Figure 2: Flux measured at different operation pressure for NF270 (a) and NTR7450 (b) membrane.
**CONCLUSIONS**

While the superficial MWCO of two membranes were different, NTR7450 with MWCO of 700 achieve total polyphenol rejection of 94% at moderate pressure of 5 bar. NF270 with MWCO of 270 produced higher permeate flux and relatively lower rejection of 90%.

Permeate flux increased with the increase of pressure to a certain degree, further increase resulted in flux reduction.

Increase in stirring rate had detrimental effect on membrane flux and rejection in the tested condition in this study, further investigation in membrane fouling mechanism will be conducted.

**REFERENCES**