Concentration of anthocyanins from roselle (*Hibiscus sabdariffa* L.) by nanofiltration

Mady Cisse[1,2*], Manuel Dornier[2], Mama Sakho[1], Dominique Pallet[2], Max Reynes[2]

[1] ESP, Département Génie Chimique & Biologie Appliquée, 5085 Dakar Fann, Sénégal
[2] UMR QualiSud - CIRAD, Montpellier SupAgro, TA B-95/16 F-34398 Montpellier cedex 5, France

*Corresponding author: madycisse@ucad.sn

THIS work describes the feasibility of nanofiltration in order to concentrate anthocyanins in a roselle extract.

Materials and Methods

To prepare a roselle extract, dried calyces of Hibiscus sabdariffa cultivar CLT 92 from Senegal, were mixed with plain water at a mass ratio of calyx to water of 1 to 10, and then kept at 35 °C for 3 hours.

Nanofiltration trials were performed in a pilot unit equipped with the Osmonics Sepa® CF II Membrane Cell system (USA) with an effective membrane area of 0.0155 m2. Three membranes of different materials and cut-off were tested (**Table 1**). Permeate flux and physico-chemical characteristics of the different products were determined for each membrane by varying the transmembrane pressure from 5 to 20 MPa. Also, retention values for each compound were calculated from the equation below:

$$R = \left(1 - \frac{C_p}{C_f}\right) . 100$$

with R retention value of the compound, Cp concentration of the compound in permeate and Cf concentration of the compound in feed.

Table 1 Membrane properties provided by the manufacturers

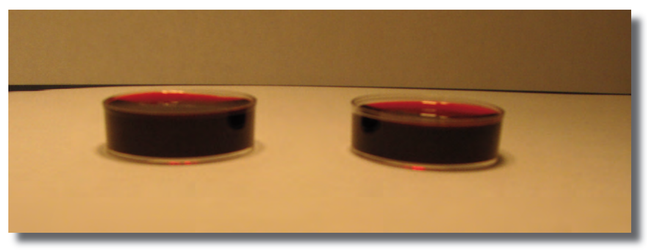
Membrane type	Manufacturer	MWCO	Material:type
DL	GE osmonics	150-300	Thin-film membrane
NF 270	Dow	200-400	Polyamide thin-film composite
NP 030	Nadir	-	Polyethersulfone

Results and discussion

Characteristics of roselle extract

Calyces of Hibiscus sabdariffa from Senegal (CLT 92).

The aqueous extract obtained has a pH of 2.4. Roselle extract was characterized by a content of anthocyanins of 215 $mg.kg^{-1}$, a high acidity expressed in citric acid of 33 $g.kg^{-1}$ and total soluble solids of 36 $g.kg^{-1}$.



Roselle extract.

Evaluation of membrane performance

Using the roselle extract, the measured permeate fluxes plotted against applied transmembrane pressure for the three membranes tested are presented in **Figure 1.** As shown, all membranes presented a similar tendency with higher permeate flux as transmembrane pressure increases. The flux densities ranged between 1 and 37 $kg.h^{-1}.m^{-2}$. DL membrane from GE Osmonics presented the highest permeate flux at 20 bar.

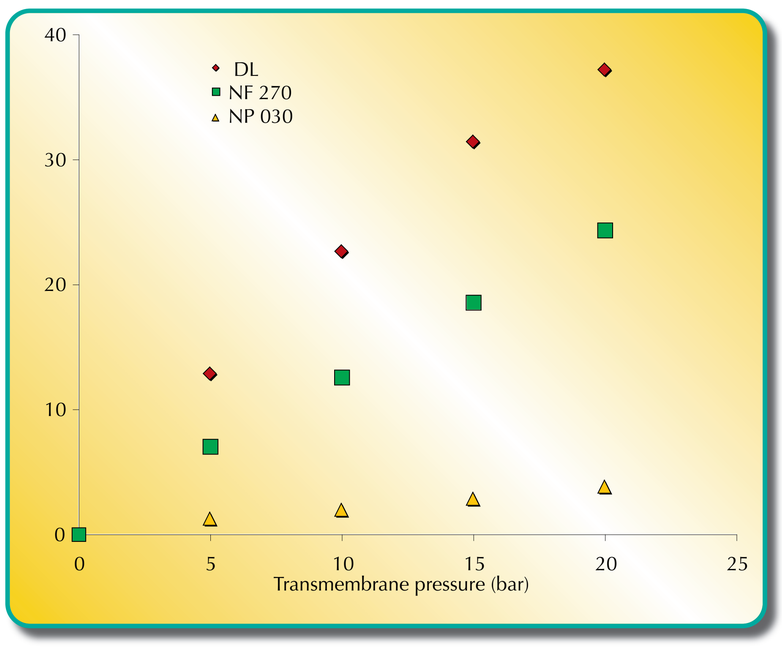


Figure 1. Variation of the permeate flux as a function of the transmembrane pressure for different membranes (T =35 °C, V = 5 L)

The retention values of citric acid, soluble solids and anthocyanins for different membranes and applied transmembrane pressures are presented in **Table 2.** The retention rises with increasing transmembrane pressure. Retention of total anthocyanins ranged between 92% for NP 030 membrane at 0.5 MPa transmembrane pressure and 100% for DL and NF 270 membrane at 2 MPa.

Table 2. Retention values for different membranes and applied transmembrane pressures

		Retention factor (%)		
	Ptm (bar)	Titratable acidity	Total soluble solids	Total anthocyanin
DL	5	79	86	98
	20	92	100	100
NF 270	5	81	88	98
	20	100	98	100
NP 030	5	50	50	92
	20	75	75	97

Conclusion

RESULTS showed that DL membrane (GE Osmonics) at 2 MPa of transmembrane pressure presents the highest potential to concentrate anthocyanins in the roselle extract, with a high permeate flux. Also at 2 MPa, the permeate flux is 37 $kg.h^{-1}.m^{-2}$ with a retention rates in citric acid, soluble solids and anthocyanins between 92 and 100%. These results are being validated on a semi-industrial nanofiltration pilot featured with a DL membrane of 2.5 m^2.

Design and production: CIRAD, Martine Dupontel, October 2009