Membrane technology to manufacture concentrated colored polyphenolic extracts from tropical vegetal biodiversity

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H. Sabdariffa - bissap


Carapa procera - kondou

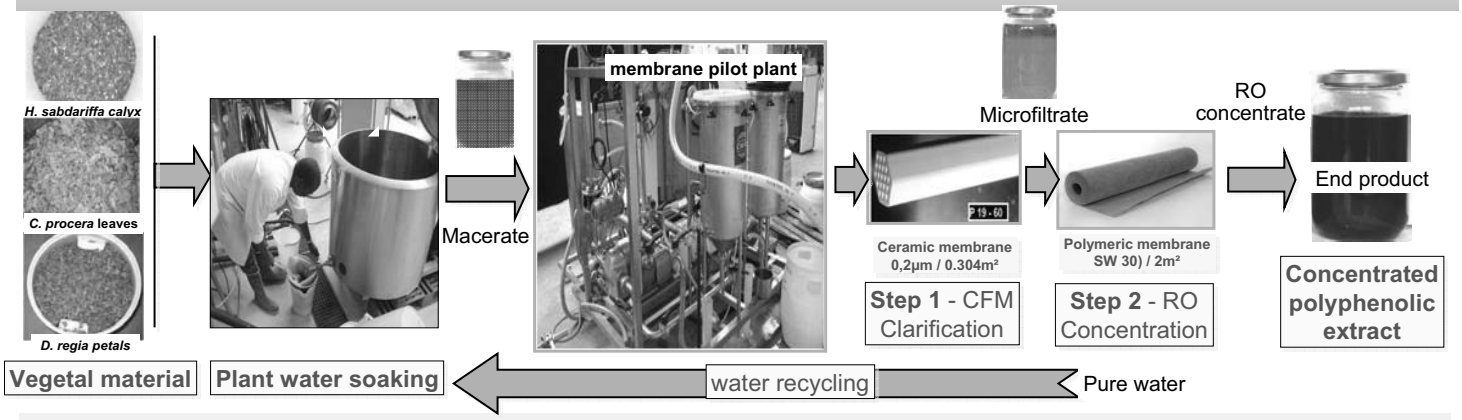

Delonix Regia - Flamboyant

Hibiscus sabdariffa, Carapa procera and ***Delonix regia*** water-extracts are traditionally used in Developing Countries (DC) for medicinal, pharmaceutical, cosmetic and beverage preparations. A **coupled process,** including **separative membrane technology** such as **Cross-Flow Microfiltration** (CFM) and **Reverse Osmosis** (RO), was used to mimic and scale up traditional village-level extraction recipes, to manufacture natural and concentrated extracts of **coloured and bioactive polyphenols**.

MATERIAL AND METHODS

Water maceration of dried plants

Hibiscus calyx, Carapa leaves and Delonix petals were harvested from Ivory Coast (Yamoussoukro area), Senegal and from Thailand (Bangkok area) and oven-dried at **40°C**. Plant polyphenols were extracted overnight by acidified-water soaking (250L) of 2.5 kg samples of Delonix and Carapa, and by tap water maceration of Hibiscus.



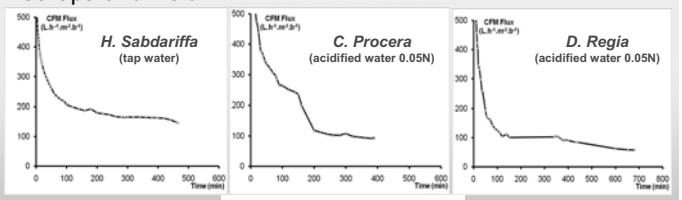
Membrane extraction-concentration coupled process : CFM + RO

Plant maceration medium (200-300L) were roughly filtered through a nylon cloth. Using a CFM pilot plant unit equipped with an industrial-type ceramic membrane P19-60, the filtrate was clarified at room temperature and at constant transmembrane pressure (TMP=0.6 bar). The CFM filtrate (240 L) was then concentrated by RO at a constant TMP= 40 bars and at room temperature, using a pilot plant unit with an industrial-type organic membrane SW30. The final concentrate was a coloured polyphenolic extract.

RESULTS AND DISCUSSION

Cross-Flow Microfiltration

CFM fluxes stabilized at 200 $L.h^{-1}.m^{-2}.b^{-1}$ for 5.5h operation for Hibiscus and at 100 $L.h^{-1}.m^{-2}.b^{-1}$ for 3h operation for both Carapa and Delonix.



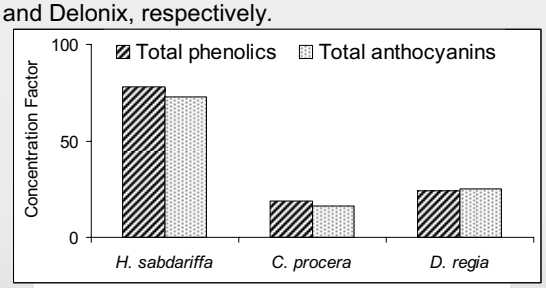
CFM fluxes of raw extracts

Reverse Osmosis

RO concentration of microfiltrated macerates removed pure water at stabilized fluxes of 20 $L.h^{-1}.m^{-2}$ (dP=40 bar) for Hibiscus, 16 $L.h^{-1}.m^{-2}$ for Carapa and 17 $L.h^{-1}.m^{-2}$ for Delonix, at in the same working conditions : TMP=40 bar and room temperature.

Concentration Factor – FC

Microfiltrated extracted polyphenolics were concentrated by RO : total phenolics were concentrated 78, 19 and 24 times, as total anthocyanins were concentrated 73, 16 and 25 for Hibiscus, Carapa and Delonix, respectively.



Concentration Factor of polyphenolic extracts

Dry matter (d.m.) contents were 15, 12, and 10% d.m. for Hibiscus, Carapa and Delonix, respectively. Starting microfiltrated extract contents were generally 0.3% d.m. Dry matter concentration for the 3 end-products were only 50, 40 and 33 times, respectively.

CONCLUSION

Membrane technology have new **eco-friendly applications** to produce **added-value water-extracts** from tropical plants. This coupled process can be operated by small-scale or semi-industrial enterprises in southern developing countries, even in **low technical environments**. Process performances were of good levels to **manufacture marketable polyphenol concentrates** from various local plants already used by village communities as medicinal, cosmetic or food ingredients to make traditional healthy bio-products.

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