Impact of Ohmic Heating on Coconut Water Volatile Compounds

PRADES Alexia[1], PICART-PALMADE Laetitia[2], DORNIER Manuel[3], PAIN Jean-Pierre[4]

[1]CIRAD, UMR Qualisud, France; [2]UM2, UMR IATE, France;
[3]Montpellier SupAgro, UMR Qualisud, France; [4]UM2, UMR Qualisud, France

www.cirad.fr

Contact : alexia.prades@cirad.fr

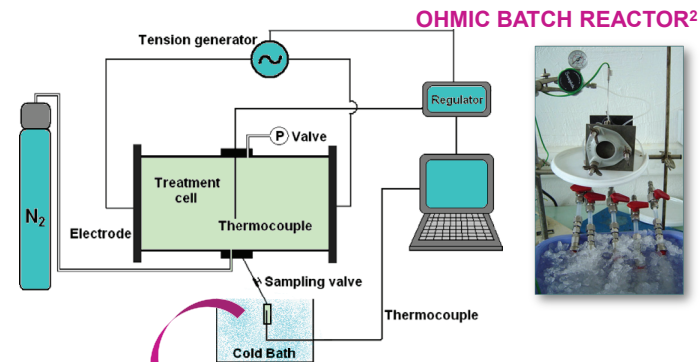
Immature coconut water is a low acid fruit juice mainly composed of sugars and minerals[1]. Beside its healthy feature, it can also be a pleasant refreshing drink especially when coming from aromatic coconut varieties.

Unlike conventional thermal processes, ohmic heating is an innovative technology using volumetric heating to pasteurize or sterilize food products. As such, it is known to overcome the overheating problem in fruit juices and to improve aroma preservation. This work aimed at obtaining a commercially safe coconut water beverage by ohmic heating while looking at the kinetics of volatile compounds evolution.

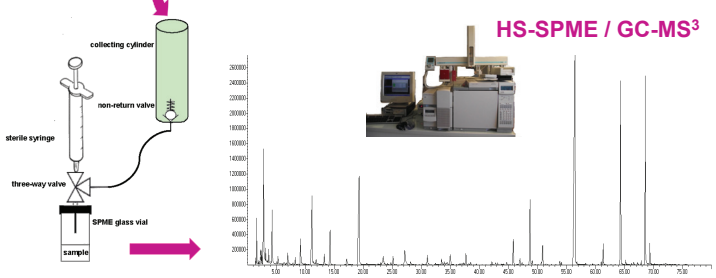
Material and Methods

Immature coconut water from an aromatic Thailand Green Dwarf variety was submitted to different treatments ranging from 100°C to 140°C and from 0 to 600s (85 trials). Volatile compounds from the fresh and heated samples were extracted by headspace-solid phase microextraction (HS-SPME) on CAR/PDMS fibers (Supelco, USA) before being identified[3] by gas chromatography coupled to mass spectrum analysis (GC-MS) (Agilent Technologies, USA).

OHMIC BATCH REACTOR[2]



HS-SPME / GC-MS[3]



60 volatile compounds were identified in coconut water. Even after high temperature treatments (180s at 140°C), flavor compounds responsible for the typical coconut water aroma[3] (ethanal, hexanal, 1-hexanol or ethyloctanoate) remained in samples headspace.

Results and discussion

At least two volatile molecules were apparently good indicators of the treatment level: 3-penten-2-one and ethyloctanoate. No variation of the normalized GC/MS peak area (S/S_0) of both molecules was observed during the heating stage whereas a rapid increase was observed just after the beginning of the isothermal stage (Fig.1). During the isothermal stage, the kinetic approach led to an activation energy of 67.7 kJ.mol^{-1} for the 3-penten-2-one increase.

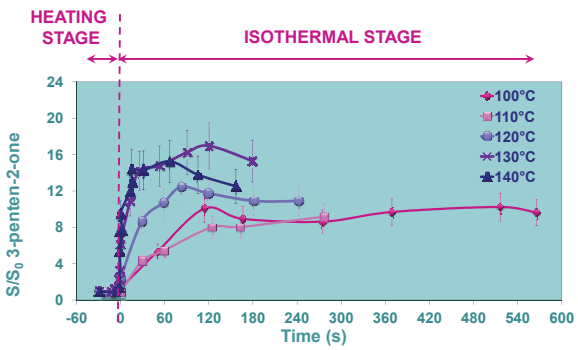


Fig 1. Kinetic evolution of the 3-penten-2-one normalized area during different ohmic heating treatments of immature coconut water

A first principal component analysis allowed us to select 12 relevant volatile compounds among the 60 previously identified. An additional PCA performed on the normalized area of these selected molecules (Fig.2a) found in coconut water issued from the 13 most severe treatments (F_0 value ranging from 3 to 220 min. with Z=10°C and T_{ref}=121.1°C) showed that samples treated at 140°C during 5s and 10s was close to the untreated one (Fig.2b). These conditions induced the less changes of the coconut water flavor quality.

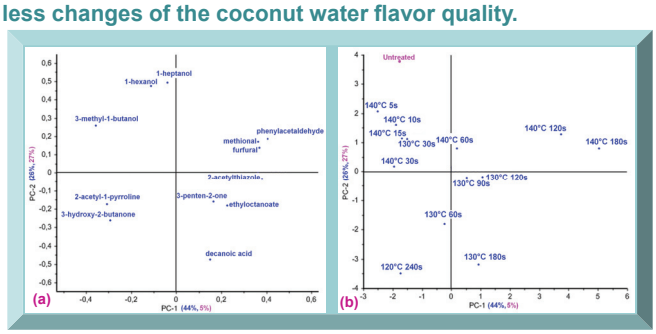


Fig 2. PCA loadings (a) and scores (b) of the normalized area of 12 volatile compounds detected in the coconut water samples treated by Ohmic Heating

Conclusions and perspectives

- The variations of the volatiles composition of coconut water during ohmic treatment were explored. We confirmed that the higher the temperature (combined to short time *i.e.* HTST), the less the impact on the global aromatic profile, thus on flavor quality.
- Coconut water sterilization by ohmic heating is a good solution to preserve the quality of aromatic coconut varieties. The next step will implement a semi-industrial ohmic pilot plant.

References

[1]Prades A., Dornier M., Diop N., Pain J.P. (2012). Coconut water uses, composition and properties: a review. *Fruits*, 67 (2) : 87-107.
[2]Roux S., Courel M., Picart-Palmade L. and Pain J.P. (2010). Design of an ohmic reactor to study the kinetics of thermal reactions in liquid products. *Journal of Food Engineering*, 98 : 398-407.
[3]Prades A., Assa R. R. A., Dornier M., Pain J.-P. and Boulanger R. (2012). Characterisation of the volatile profile of coconut water from five varieties using an optimised HS-SPME-GC analysis. *J. Sci. Food Agric.*, 92: 2471–2478.