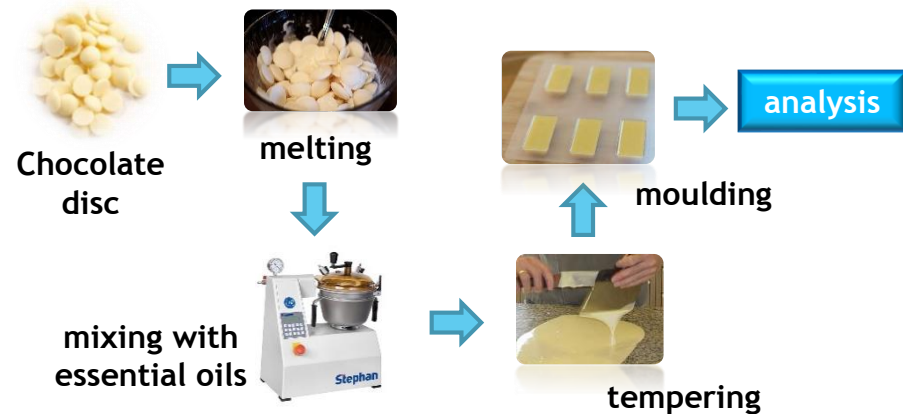


Dimas R.A. Muhammad^{1,2}, Valérie Lemarcq¹, Elien Alderweireldt¹, Pauline Vanoverberghe¹, Koen Dewettinck¹

Introduction

Chocolate with herbs or spices has become more popular in recent years. This may be due to the unique flavour and potential antioxidant capacity. However, studies on the herbs and spice-enriched chocolate are still limited. Among primary types of chocolate, white chocolate has the lowest level of specific chocolate flavor and antioxidant activity due to the absence of cocoa mass. In this study, the effect of cinnamon essential oils on the textural, rheological, melting profile and antioxidant activity of white chocolates are investigated. The term of essential oils is understood to mean a mixture of biochemical compound obtained from the plant volatile fraction by steam distillation.

Methods



Result and Discussion

Chemical properties and antioxidant activity of cinnamon essential oils

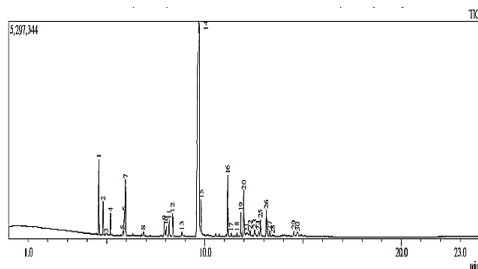


Fig 1. Chromatogram of cinnamon essential oils obtained by a Shimadzu GCMS-QP2010 SE instrument equipped with a Restek RTX-5MS low-bleed fused-silica capillary column. Cinnamaldehyde was detected as the major compound (Peak 14, relative content 55.45%).

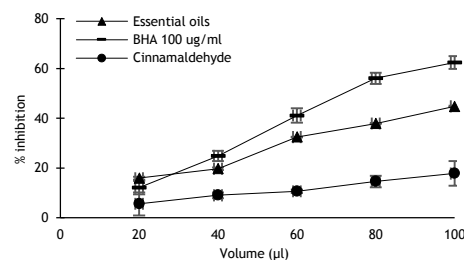


Fig 2. DPPH radical scavenging activity of cinnamon essential oils. The volume were varied and the incubation time was fixed at 30 min in dark condition. The absorbance was observed after the incubation under wavelength 517 nm.

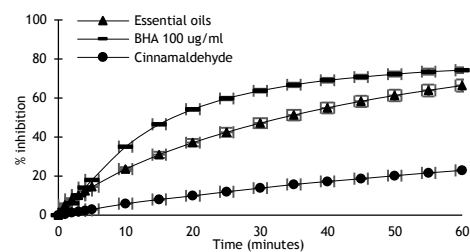


Fig 3. Kinetics of the DPPH radical scavenging activity of cinnamon essential oils. The volume was fixed at 100 μ l and the absorbance was continuously monitored under wavelength 517 nm in 60 minutes.

Parameter	Activity
FRAP activity (μ M AAE/g)	57.77 \pm 6.13
Total antioxidant activity (μ g TAE/g)	596.59 \pm 47.68

Table 1. Antioxidant activity of cinnamon essential oils determined by FRAP (Ferric Reducing Antioxidant Power) and phosphomolibdenum and method.

Quality attributes of cinnamon essential oils-enriched white chocolate

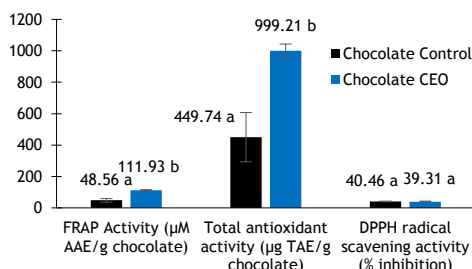


Fig 4. Antioxidant activity of white chocolate enriched with cinnamon essential oils (CEO). Samples with different notation are significantly different from each other ($\alpha=5\%$).

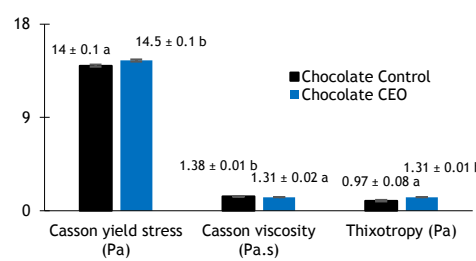


Fig 5. Rheological behaviour of white chocolate enriched with cinnamon essential oils (CEO). Different notations indicate significant differences ($\alpha=5\%$) between the samples.

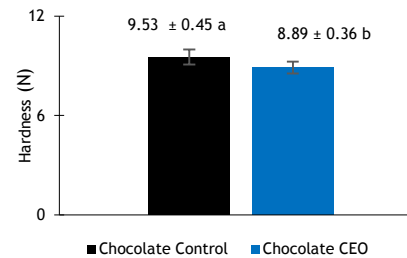


Fig 6. Hardness of white chocolate enriched with cinnamon essential oils (CEO). Different notations indicate significant differences ($\alpha=5\%$) between the samples.

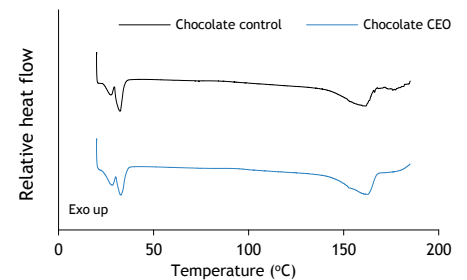


Fig 7. Melting profile of white chocolate enriched with cinnamon essential oils (CEO) observed by Differential Scanning Calorimetry (DSC).

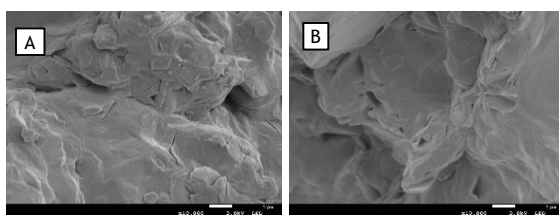


Fig 8. Microstructural properties of white chocolate (A) and white chocolate enriched with cinnamon essential oils (B) observed by Cryo-SEM. The presence of the essential oils has no significant impact on the microstructural properties of the chocolates.

Cinnamon essential oils that consist of a number of volatile compounds exhibit antioxidant activity. Cinnamaldehyde and possibly other volatile compounds play a role in the increase of antioxidant activity. Addition of the essential oils into white chocolate (0.1% w/w) slightly improved the FRAP activity and total antioxidant activity of the white chocolate. The DPPH radical scavenging activity was not significantly different between samples.

White chocolate enriched with cinnamon essential oils has lower hardness and casson viscosity. However, it has higher yield stress and thixotropy than the chocolate control. There is no remarkable difference between the samples in terms of melting profile and microstructural properties.

Essential oils from various herbs and spices have an good potential to enrich the flavor properties of chocolate, but not antioxidant property. The method for making chocolate in this research can be adopted by the small scale confectionery producer.

Conclusions

Adding cinnamon essential oils is strategically and technologically feasible to enrich flavor properties of white chocolate. The results show some deviating behaviour of the enriched chocolate in rheological and textural properties. However the differences are not insuperable in industrial application. Even though an improvement in antioxidant activity of the chocolate was observed, cinnamon essential oils did not satisfactorily enhance antioxidant activity of the chocolate. Adding whole powder or oleoresins of cinnamon may be more effective to improve antioxidant activity of white chocolate.

Corresponding author

Email: DimasRahadianAji.Muhammad@UGent.be

¹Lab. of Food Technology and Engineering, Dept. of Food Safety and Food Quality Ghent University, Belgium

²Lab. of Food Engineering, Dept. of Food Science and Technology Universitas Sebelas Maret, Indonesia