INTRODUCTION

The most common sugar used in the production of chocolate is sucrose. However, the demand for healthier sweeteners in chocolate, and foods in general, is increasing.

Palm sap based sugar is claimed to be a healthy alternative because it does contain not only minerals and vitamins but also exhibits a low glycemic index (GI). The production of this sugar is achieved by boiling sap, collected from palm tree flowers, under agitation until supersaturation, whereby crystals are formed.

The variability within the palm sap-based sugars can be explained by the fact that they are traditionally produced by farmers applying distinct processing techniques/conditions.

Sucrose, the most common sugar used in chocolate, is considered as an inert ingredient, contributing "only" to sweetness. However, the usage of palm sap-based sugar, might affect the quality attributes of chocolate to some extent, such as colour, hardness, melting point of sugar in chocolate, flow behaviour of molten chocolate, fineness, and aroma profile of chocolate.

The main objective was to study the quality attributes of palm sap-based sugar and investigate its potency as chocolate sweetener.

CHARACTERIZATION

- Thermal analysis (Differential Scanning Calorimetry)
  Measured with Q1000 differential scanning calorimeter (DSC) equipped with a refrigerated cooling system (TA Instruments, New Castle, USA).

- Particle Size Distribution (Light Diffraction)
  Measured with malvern Mastersizer (Malvern Instruments Ltd., Worcestershire) equipped with 300 F and 1000 F lens.

- Sugar composition (Gas Chromatography)
  Measured with Gas Chromatography (GC).

- Microscopy (Scanning Electron Microscopy)
  The surface topography of the sugar was visualized using a JSM-7100 F TITLS LV TFESEM (Scanning Electric Microscopy) (Jeol Europe, Zaventem, Belgium).

- Moisture content
  Measured by means of Karl-Fisher titration method, performed using the 719 Titirio apparatus (Metrohm, Switzerland).

- Colour
  Measured with a colorimeter (Minolta Model CM-2500D Spectrophotometer, Tokyo, Japan).

- Crude protein
  Measured with Kjeldahl method.

- Density
  Measured with pycnometer method.

RESULTS

| Sugar samples | Palm sap-based sugar:
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CCS1: Coarse coconut sugar 1</td>
<td>CCS2: Coarse coconut sugar 2</td>
</tr>
<tr>
<td>CPS1: Coarse palm sugar 1</td>
<td>CPS2: Coarse palm sugar 2</td>
</tr>
<tr>
<td>Reference:</td>
<td>FS: Fine sucrose</td>
</tr>
</tbody>
</table>

- Colour
  Measured with a colorimeter (Minolta Model CM-2500D Spectrophotometer, Tokyo, Japan).

- Density, moisture and protein content
  Measured with a colorimeter (Minolta Model CM-2500D Spectrophotometer, Tokyo, Japan).

- Melting Profile
  Measured with a colorimeter (Minolta Model CM-2500D Spectrophotometer, Tokyo, Japan).

- Sugar composition
  Measured with a colorimeter (Minolta Model CM-2500D Spectrophotometer, Tokyo, Japan).

- Microscopy
  The surface topography of the sugar was visualized using a JSM-7100 F TITLS LV TFESEM (Scanning Electric Microscopy) (Jeol Europe, Zaventem, Belgium).

CONCLUSIONS

- Substitution of sucrose in chocolate with palm sap-based sugar has great potential for development of dark chocolate products with a distinctive flavour/aroma.
- Low particle density and high moisture content of palm sap-based sugar might influence colour, hardness and viscosity of chocolate.
- The presence of amorphous state in palm sap-based sugar and relatively high moisture content might induce particle agglomeration in chocolate.

ACKNOWLEDGMENT

This research was financed by the Indonesian Endowment Fund for Education (LPDP Indonesia).