UNDERSTANDING THE IMPACT OF CONCHING ON CHOCOLATE FLAVOUR USING A COMBINATION OF INSTRUMENTAL FLAVOUR ANALYSIS AND TASTING TECHNIQUES

A. Fischer, T. Abubaker, A. HÄSSELBARTH, and F. Ullrich

Kraft Foods R&D Inc., Bayerwaldstrasse 8, D-81737 Munich, Germany

Abstract

The present study discusses a linked analytical–sensory approach for the elucidation of chocolate flavour changes induced by conching. Using a bundle of different sample preparation techniques prior to instrumental analysis and extensive sensory testing, insights into the chocolate flavour development were obtained. A strong relationship between analytically measurable aroma profile, perceived sensory attribute intensity and texture development was observed. It was shown that conching reduces the concentration of most aroma compounds especially in the fat phase, whereas the aroma content in water-soluble material (sugar, protein) and in the insoluble material (cocoa solids) remains constant. Although the aroma concentration is overall clearly declining during conching, chocolate with high conching time is perceived as richer in chocolate flavour. It is concluded that improving texture properties enable a more balanced flavour perception. It is therefore highly important to optimise the texture formation process as a prerequisite to optimal aroma perception.

Introduction

Chocolate conching is known to be one of the key quality driving steps in chocolate manufacturing, which is still very time-consuming and energy-intensive. The initial dry conching phase is very important to decrease moisture and to improve rheology. It is also believed to be the most critical step for flavour development. The final liquid conching phase, initiated by lecithin and cocoa butter addition, is believed to be less critical for final chocolate quality.

In the present study we focus on the development of aroma properties which progress parallel to changes in texture (1-4). Special care has been taken to develop suitable analytical and sensory tools to track the analytically measurable development between different chocolate phases and the overall perceived sensory profile.

Experimental

Manufacturing of milk chocolate. For this study five milk chocolates (ingredients: sugar, milk powder, cocoa butter, cocoa flakes, lecithin as emulsifier) differing in the dry conching time (1 h, 2 h, 4 h, 10 h, 24 h; final temperature 75°C) were produced in a 6 kg Austin conche. All other production parameters were kept constant.

Sample preparation. In order to track the distribution of potent aroma compounds inside the various chocolate phases during conching a special preparation technique

has been set up. For that purpose, chocolate has been dissolved in water and centrifuged.

30 g of molten chocolate were dissolved in 70 g of warm water (50 °C). The pH of the slurry was adjusted to 4. After spiking the chocolate slurry with a set of different internal standard compounds the slurry was equilibrated by stirring for 30 minutes. Afterwards the slurry was separated into three phases by centrifugation (30000 g) at 4 °C for 45 minutes. The low temperature is required to form a solid fat phase which can be easily removed from the other phases and analysed.

Quantification of potent aroma compounds. The aroma compounds contained in the fat phase were quantified by thermodesorption-GC-MS analysis. The quantification of the aroma compounds in the water-soluble phase was conducted by GC-MS after solid phase extraction (SPE) (5). The aroma compounds remaining in the insoluble residual material were extracted with diethyl ether, purified by high vacuum distillation, concentrated and quantified by GC-MS. The aroma profiles in the entire, non separated chocolates were determined by thermodesorption-GC-MS analysis (6).

Sensory evaluation. Sensory evaluation of the milk chocolates was performed with a trained sensory panel (10 panellists) on solid chocolate and molten chocolate, respectively. The overall aroma intensity of the water-soluble phases was rated on a scale from 0 = no aroma perception until 6 = strong aroma perception. Also the intensity of the fat phases separated simply by centrifuging molten chocolate without addition of water was rated.

Results and Discussion

Quantification of potent aroma compounds in different phases. After phase separation the well-known potent aroma compounds of milk chocolate (7) were quantified in the separated fat by thermodesorption-GC-MS. As illustrated in Figure 1 the concentrations of most aroma compounds were reduced during conching.

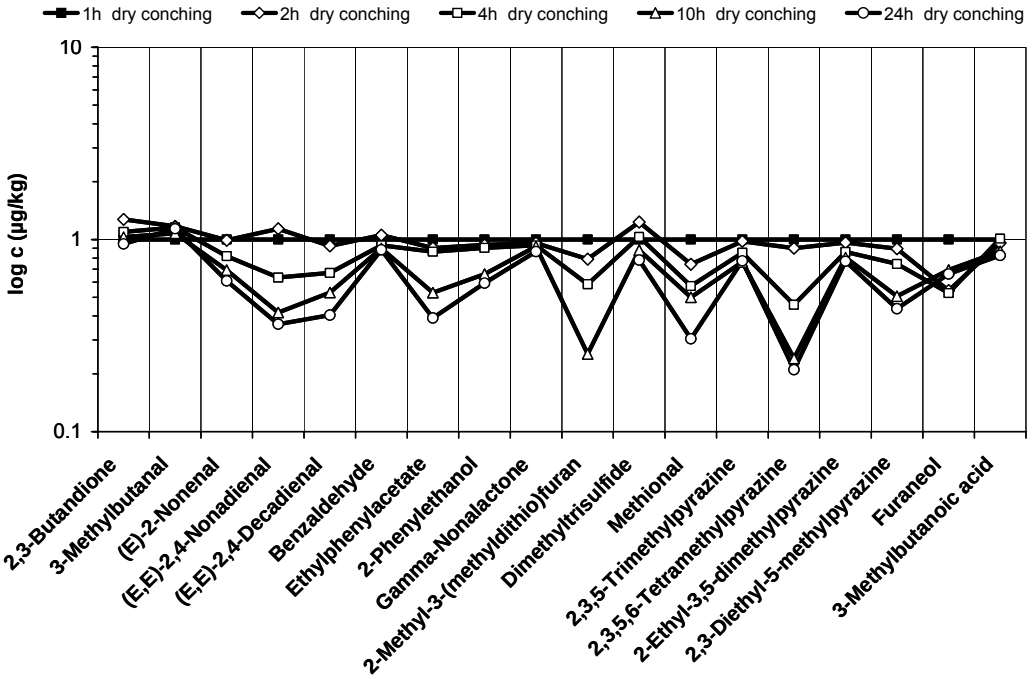

Figure 1. *Relative concentration of aroma compounds in the separated fat phase developing with increasing time.*

Contents of the fatty smelling aldehydes (E)-2-nonenal, (E,E)-2,4-nonadienal and (E,E)-2,4-decadienal and the honey-like smelling ethylphenylacetate and 2-phenylethanol were significantly reduced in fat by conching. Also, the pyrazines, which are very important for the overall chocolate aroma, and the sulphur compounds methional and 2-methyl-3-(methyldithio)furan decreased with longer conching times.

In order to further differentiate potential binding sites the aroma dissolved in the water phase and the aroma remaining attached to the insoluble material were also quantified. It was found, that although the aroma concentration for many compounds is declining in the fat phase, the aroma profile of two latter phases is not changing (data not shown).

The quantitative results of the whole chocolate without preceding separation is dominated by the decrease in concentrations as observed in the fat phase of the respective chocolate.

In an additional experiment it was demonstrated that conching of non-deodorized cocoa butter alone (same conche, same times) is resulting in steeply declining aroma concentrations (data not shown). It is assumed that the reduction of aroma compounds during conching of chocolate is primarily caused by evaporation.

Sensory evaluation. In order to assess the impact of conching time on the aroma profile, the conching trials were accompanied by a trained sensory panel. For this purpose solid chocolate, molten chocolate, the separated fat phase from molten chocolate, and the water-soluble phase were evaluated. Sensory evaluation of the separated fat phase showed that the overall aroma intensity decreased with extended conching (Figure 2). This confirms the analytical results (Figure 1).

Chocolates with longer conching times were found to contain lower levels of analytically measurable aroma. This is supported by sensory results obtained in molten chocolate and in the separated fat phase. Sensory results obtained from solid chocolate, however, show an increase in perceived aroma intensity (Figure 2). It is concluded that improving texture properties enable a more balanced flavour perception. In other words the harsh and poorly melting chocolate texture, as obtained with short conching times, is believed to act like a masking effect for flavour perception. The sensory properties of the water-soluble phase are not changing with progressing conching time and are therefore in agreement with the analytical results.

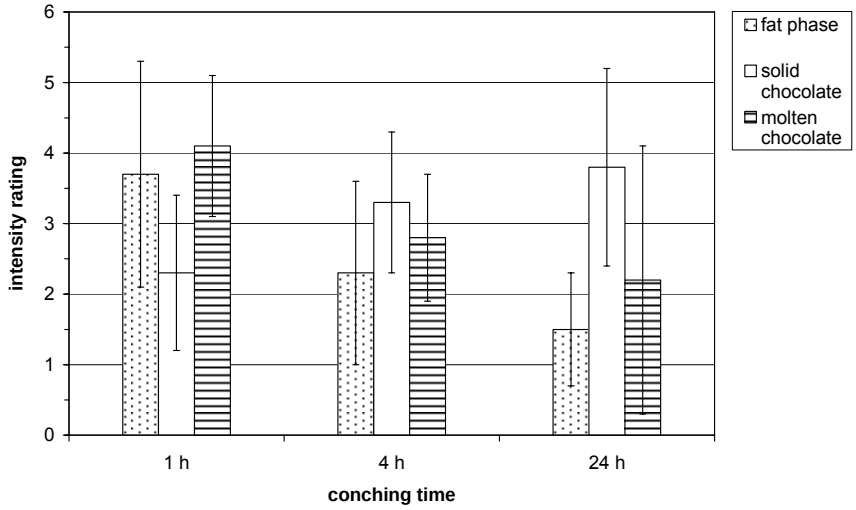

Figure 2. *Development of overall aroma intensity with increasing conching time in solid chocolate, separated fat phase, and molten chocolate.*

Since lower levels of aroma compounds lead to a lower perceived aroma intensity in molten chocolate, it is concluded that melting chocolate is removing the masking effect of a poorly conched chocolate and is also indicating that the aroma perception is driven by the aroma contained in the fat phase.

Conclusion

The total aroma contained in chocolate is distributed over three different chocolate phases (fat, water-soluble material, insoluble material). Conching is primarily affecting the aroma content in the fat phase. The aroma attached to water-soluble binding sites is found to be unaffected. Key driver for aroma perception, however, seems to be the aroma contained in the fat phase. Beside that, texture development during conching has a critical impact on a balanced perception of chocolate aroma.

References

1. Ziegleder G., Balimann G., Mikle H., Zaki H. (2003) *Süsswaren* 3: 14-16.
2. Ziegleder G., Balimann G., Mikle H., Zaki H. (2003) *Süsswaren* 4: 16-18.
3. Ziegleder G., Balimann G., Mikle H., Zaki H. (2003) *Süsswaren* 5: 14-16.
4. Counet C., Callemien D., Ouwerx C., Collin S. (2002) *J. Agric. Food Chem.* 50: 2385-2391.
5. Naef R., Jaquier A., Velluz A., Maurer B. (2006) *J. Agric. Food Chem.* 54: 9201-9205.
6. Pfnür P., Hässelbarth A., Schulze M., Ullrich F. (2003) In *Flavour Research at the Dawn of the Twenty-first Century* (Le Quéré J.L., Étiévant P.X., eds.); Editions Tec & Doc, Londres-Paris-New York, pp 698-701.
7. Schnermann P., Schieberle P. (1997) *J. Agric. Food Chem.* 45: 867-872.