Monitoring the textural and thermal analyzes of sugar-free chocolates by sensory evaluation: Effect of particle size distribution

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Background

Recently, sugar-free chocolates have received increasing attention duo to their reduced calorie value and their prominent effects on controlling weight and maintaining health conditions. However, the replacement of sucrose with sugar substitutes affects structural and thus the sensory properties of low calorie chocolates. In this regard, particle size distribution can be defined as one of the main relevant factors in developing sugar-free chocolate formulations by directly affecting the structural properties.
Therefore, the aim of current study was to monitor the effect of particle size distribution on improving the textural and thermal properties of sugar-free chocolate containing maltitol by evaluating the sensory perception of this product.

Methods

In the present study, maltitol as a sucrose replacer with different particle size distribution (D_{90}=90% finer than sizes of 14, 21 and 29 µm) was used with the aim of producing sugar-free chocolate. Melting behavior and textural parameters, from instrumental technique were investigated by differential scanning calorimetry (DSC) and textural analyzer, respectively.
Quantitative Descriptive Analysis (QDA) with a panel of 10 trained individuals in 4 replicates was performed using FIZZ software to rate the intensity of selected attributes of 4 sugar-free chocolate samples. Finally, an acceptance test was carried out to determine the degree of chocolate liking.

Results

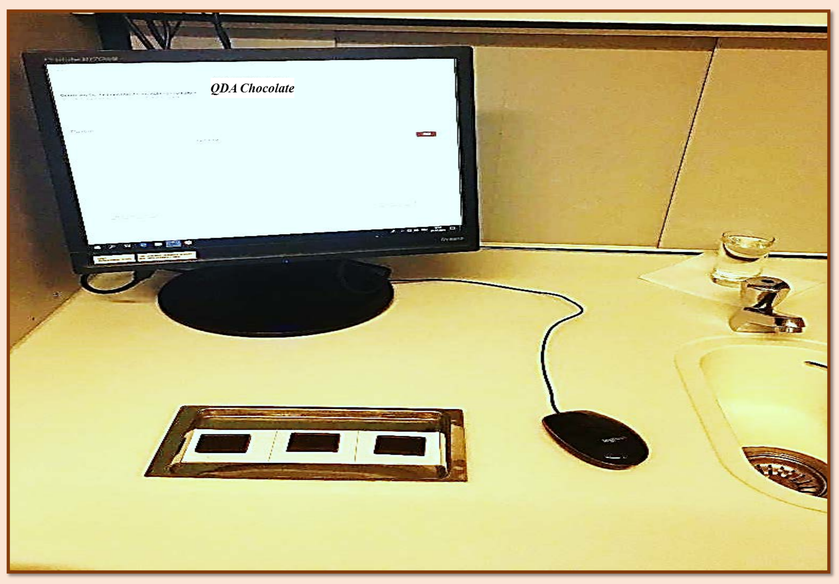
The results of DSC (Fig. 1) indicated that melting point and peak of enthalpy (ΔH_{melt}) were the highest in the sample with D_{90} of 14 µm, while the samples with D_{90} of 21 and 29 µm showed the lower values of mentioned parameters. These findings were confirmed by textural results presented in Fig. 2. The chocolate with D_{90} of 14 showed the highest firmness and stickiness values, in contrast, the lowest textural parameters were detected for chocolate with D_{90} of 29.

QDA sensory results (Fig. 3) showed that the sample with D_{90} of 21 µm had the highest smoothness with lower stickiness. Moreover, this sample quickly melted in the mouth, whereas the lowest melting rate and the highest firmness as well as stickiness were observed in the chocolate containing D_{90} of 14 µm.

Comparing the results, it was found that sensory properties and instrumental parameters were highly positively correlated ($r^2 > 0.9$). By refining the chocolate particle size from 29 µm to 21 µm, the sensory attributes such as smoothness and melting rate were highly increased. On the other hand, presence of high amount of fine particles in the sample with D_{90} of 14 µm resulted in more pasty and crystalline structure with negative effects on the quality of final product. Thus, the chocolate with D_{90} of 21 µm was selected as the most acceptable sample among the consumers.

Conclusion

Based on the obtained results, the production of sugar-free chocolate with high sensory quality is possible by manipulating the particle size distribution. The refining of chocolate particles to certain extent, leads to a desirable smooth texture and melting characteristics with high acceptability of the product among consumers.



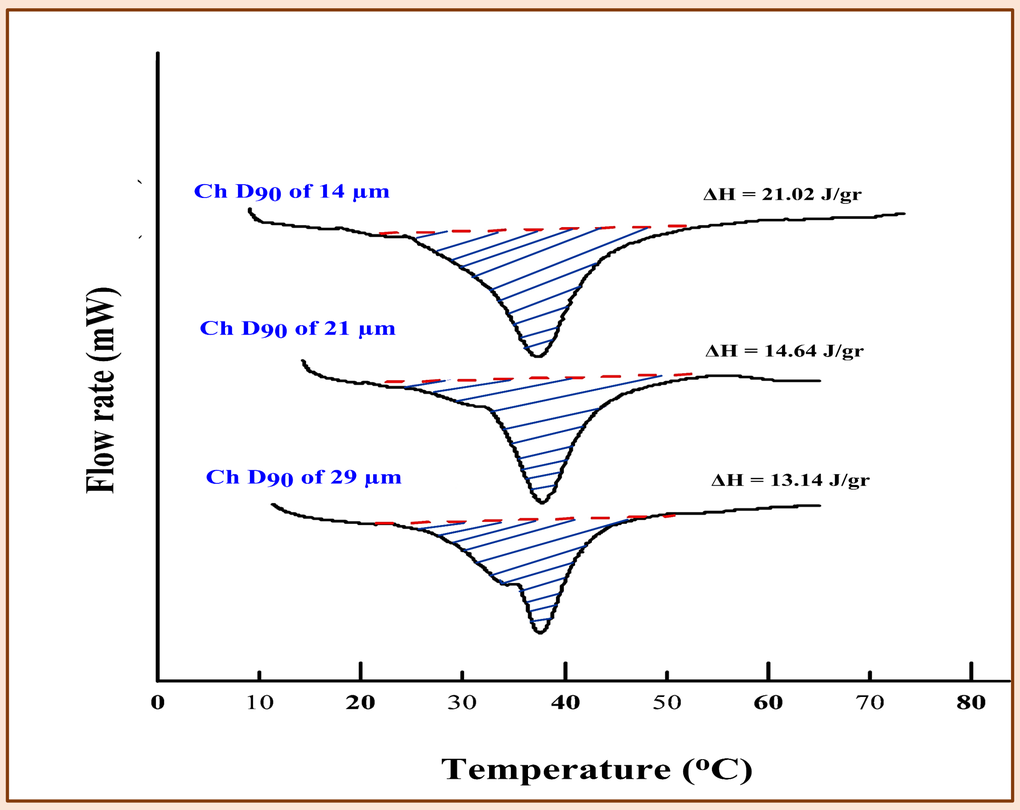


Fig. 1. Thermal properties of sugar-free chocolate samples obtained by DSC.

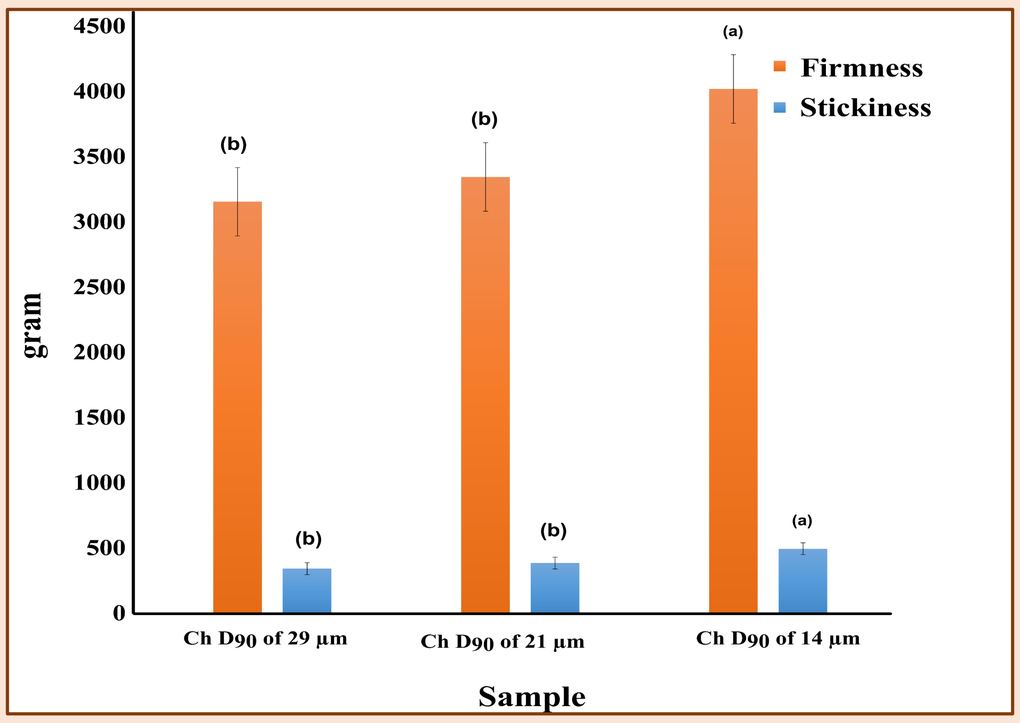


Fig. 2. Textural parameters of sugar-free chocolate samples determined by Texture Analyser.

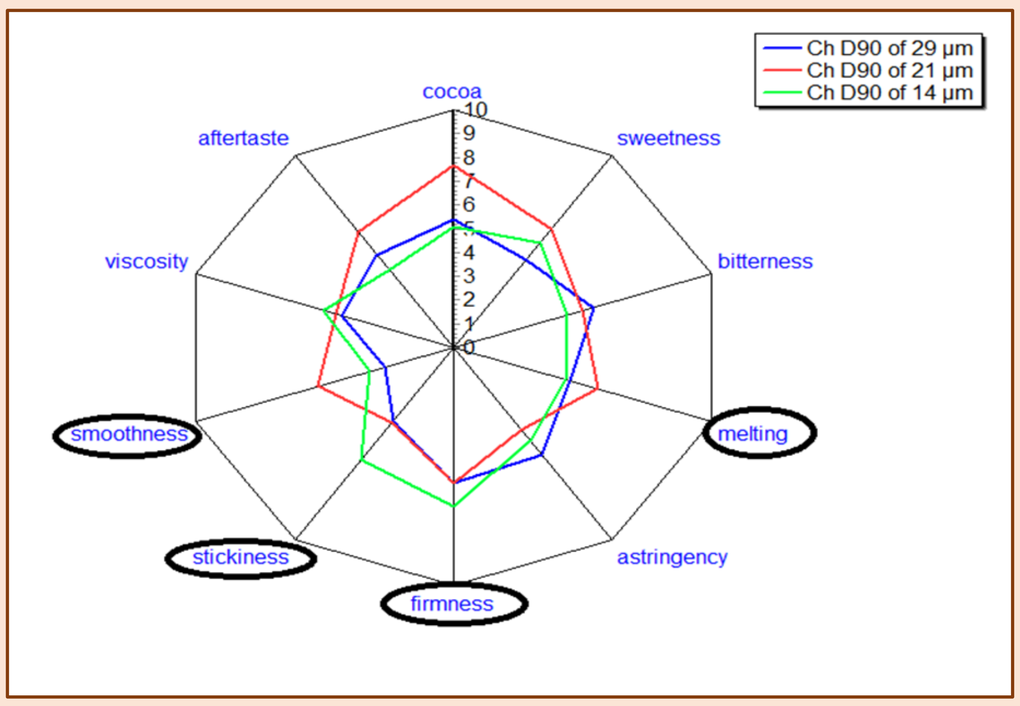


Fig 3. QDA sensory profile of sugar-free chocolate samples.