

Modeling of Particle Reduction and Volatile Compounds Profile during Chocolate Conching by Electronic Nose and Genetic Programming (GP) Based System

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Abstract : Conching is one critical procedure in chocolate processing, where special flavors are developed, and smooth mouth feel the texture of the chocolate is developed due to particle size reduction of cocoa mass and other additives. Therefore, determination of the particle size and volatile compounds profile of cocoa bean is important for chocolate manufacturers to ensure the quality of chocolate products. Currently, precise particle size measurement is usually done by laser scattering which is expensive and inaccessible to small/medium size chocolate manufacturers. Also, some other alternatives, such as micrometer and microscopy, can't provide good measurements and provide little information. Volatile compounds analysis of cocoa during conching, has similar problems due to its high cost and limited accessibility. In this study, a self-made electronic nose system consists of gas sensors (TGS 800 and 2000 series) was inserted to a conching machine and was used to monitoring the volatile compound profile of chocolate during the conching. A model correlated volatile compounds profiles along with factors including the content of cocoa, sugar, and the temperature during the conching to particle size of chocolate particles by genetic programming was established. The model was used to predict the particle size reduction of chocolates with different cocoa mass to sugar ratio (1:2, 1:1, 1.5:1, 2:1) at 8 conching time (15min, 30min, 1h, 1.5h, 2h, 4h, 8h, and 24h). And the predictions were compared to laser scattering measurements of the same chocolate samples. 91.3% of the predictions were within the range of later scattering measurement $\pm 5\%$ deviation. 99.3% were within the range of later scattering measurement $\pm 10\%$ deviation.

Keywords : cocoa bean, conching, electronic nose, genetic programming

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