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# Food and Beverages

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## Optimization of supercritical fluid extraction of bioactive compounds from *Stevia rebaudiana* (Bertoni) leaves by Response Surface Methodology (RSM) and Artificial Neural Network (ANN) modeling

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**Statement of the Problem:** *Stevia rebaudiana* as South American shrub is well-known worldwide and consists of more than 100 phytochemicals including phenolic and flavonoid compounds. The toxicity of synthetic antioxidants has also increased demand of natural antioxidants. Traditional extraction involves high consumption of solvent, time and energy and renders lower extraction yields due to poor efficiency. Supercritical Fluid Extraction (SFE) as modern green extraction method has garnered attention in recent years.

**Methodology & Theoretical Orientation:** Conventional Maceration Extraction (CME) for 24 h was used for extracting stevia extracts. In this study, Response Surface Methodology (RSM) and Artificial Neural Network (ANN) modeling were compared for their estimation capabilities to build effective models with maximum response values:  $Y_1$  (Total Phenolic Content: TPC) and  $Y_2$  (total flavonoid content: TFC). SFE process was optimized by central composite design of RSM to achieve maximum TPC and TFC as function of independent SFE process parameters with following ranges:  $X_1$ =modifier concentration (0–40%),  $X_2$ =extraction temperature (25–65°C) and  $X_3$ =pressure (75–375 bar).

**Findings:** Maximum values of target responses from SFE extracts were TPC of 29.56 mg GAE/g DM and 23.51 mg CE/g DM under optimum SFE conditions of  $X_1$  of 40%,  $X_2$  of 45 °C and  $X_3$  of 225 bar. ANN model proved its superiority as potential alternative to RSM owing to improved estimation and predictive capabilities. Moreover, results indicated that SFE yielded higher yields TPC and TFC in comparison with time-consuming CME.

**Conclusion & Significance:** SFE yielded higher TPC and TFC in comparison with time-consuming CME and was more efficient as a green extraction method with less  $CO_2$  emission and significantly reduced consumption of solvent, time and energy. Hence, the phenolic and flavonoid compounds from stevia may be employed as natural antioxidants with pertinent health benefits.



#### Recent publications

- 1. Ameer K, Shahbaz H M and Kwon J H (2017) Green extraction methods for polyphenols from plant matrices and their byproducts: a review. Comprehensive Reviews in Food Science and Food Safety 16:295-315.
- 2. Ameer K, Bae S W, Jo Y, Lee H G, Ameer A and Kwon J H (2017) Optimization of microwave-assisted extraction of total extract, stevioside and rebaudioside-A from *Stevia rebaudiana* (Bertoni) leaves, using response surface methodology (RSM) and artificial neural network (ANN) modelling. Food Chemistry 229:198-207.
- 3. Ameer K, Bae S W, Jo Y, Chung N, Gao Y and Kwon J H (2017) Optimization and modeling for heat reflux extraction of total yield, stevioside and rebaudioside-A from *Stevia rebaudiana* (Bertoni) leaves. Separation Science and Technology 52:1193-1205.

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- 4. Ciulu M, Quirantes Piné R, Spano N, Sanna G, Borrás Linares I and Segura Carretero A (2017) Evaluation of new extraction approaches to obtain phenolic compound-rich extracts from *Stevia rebaudiana* Bertoni leaves. Industrial Crops and Products 108:106-112.
- 5. Maeng J H, Shahbaz H M, Ameer K, Jo Y and Kwon J H (2017) Optimization of microwave-assisted extraction of bioactive compounds from Coriolus versicolor mushroom using response surface methodology. Journal of Food Process Engineering 40(2):e12421.

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