

Thermoanalytical and Kinetic Study of Sweeteners using Thermal Analysis

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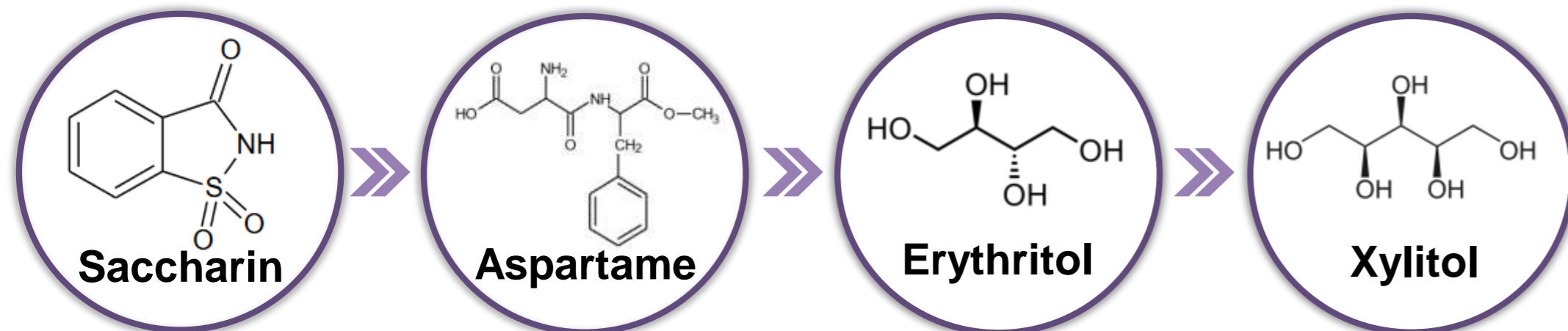
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INTRODUCTION



890 millions
obese adults worldwide
in 2022
WHO, 2024

The food industry has been replacing sugar in beverages and foods with low or zero calorie sweeteners.



OBJECTIVE

Study the thermal decomposition process of sweeteners samples (artificial and natural) to determine their kinetic parameters and physicochemical characterizations.

MATERIALS & METHODS

Materials



A1
(aspartame, dextrose, and maltodextrin)



C1
(saccharin, and dextrose)



Erythritol



Xylitol

TG & DSC

- SDT Q600 model, TA Instruments
- Heating rate: 5, 10, and 20 °C min⁻¹
- T_{range} = 25 - 600 °C

Kinetic Methods

- Borchardt-Daniels (ASTM E-2041)

$$\frac{d\alpha}{dT} = A \cdot \exp\left(-\frac{E_a}{RT}\right) \cdot (1 - \alpha)^n$$

- ASTM E-698

$$\beta \cdot \frac{d\alpha}{dT} = A \cdot \exp\left(-\frac{E_a}{RT}\right) \cdot (1 - \alpha)$$

RESULTS & CONCLUSION

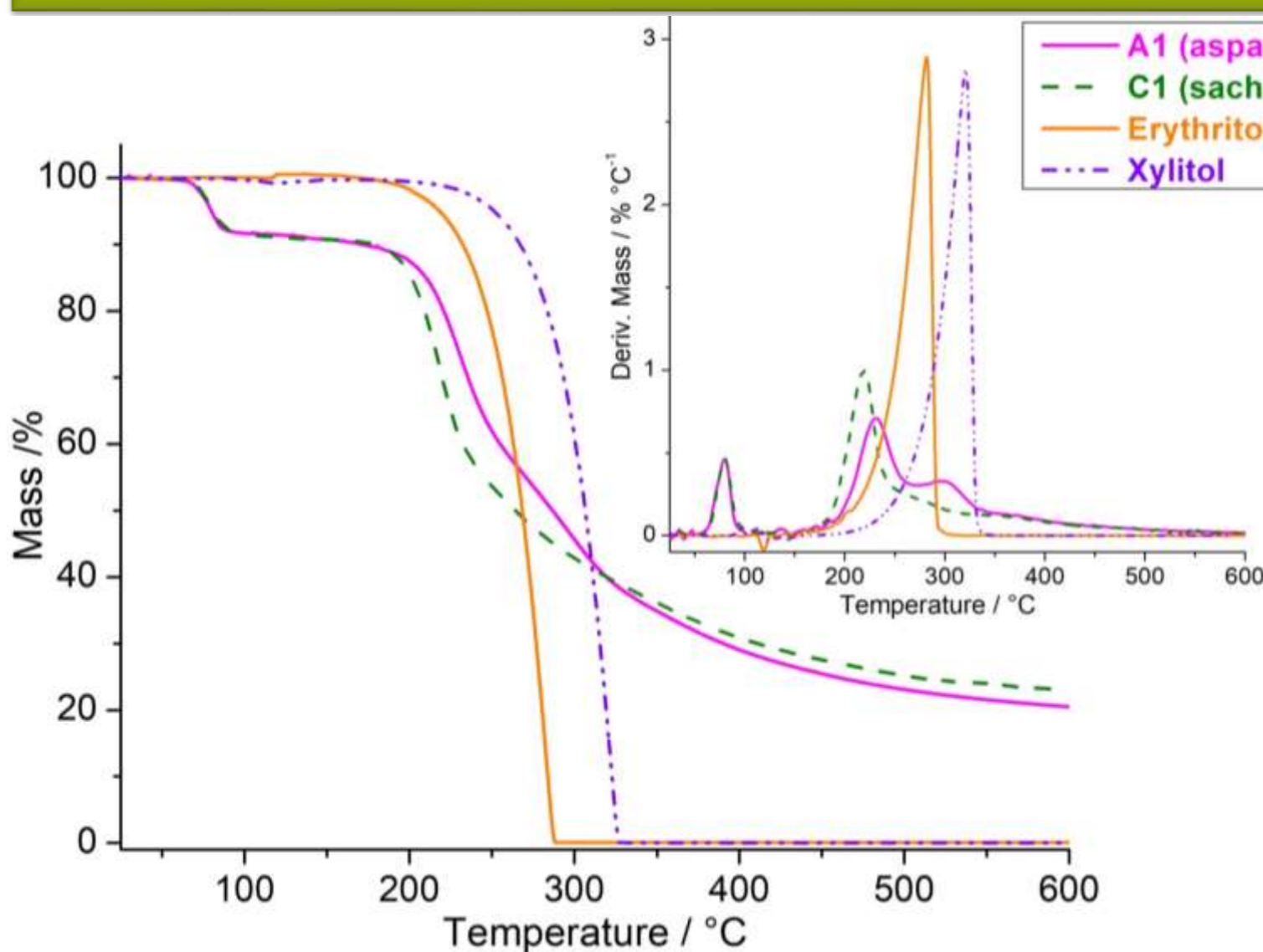


Fig.1 – TG/DTG curves of commercial sweeteners samples

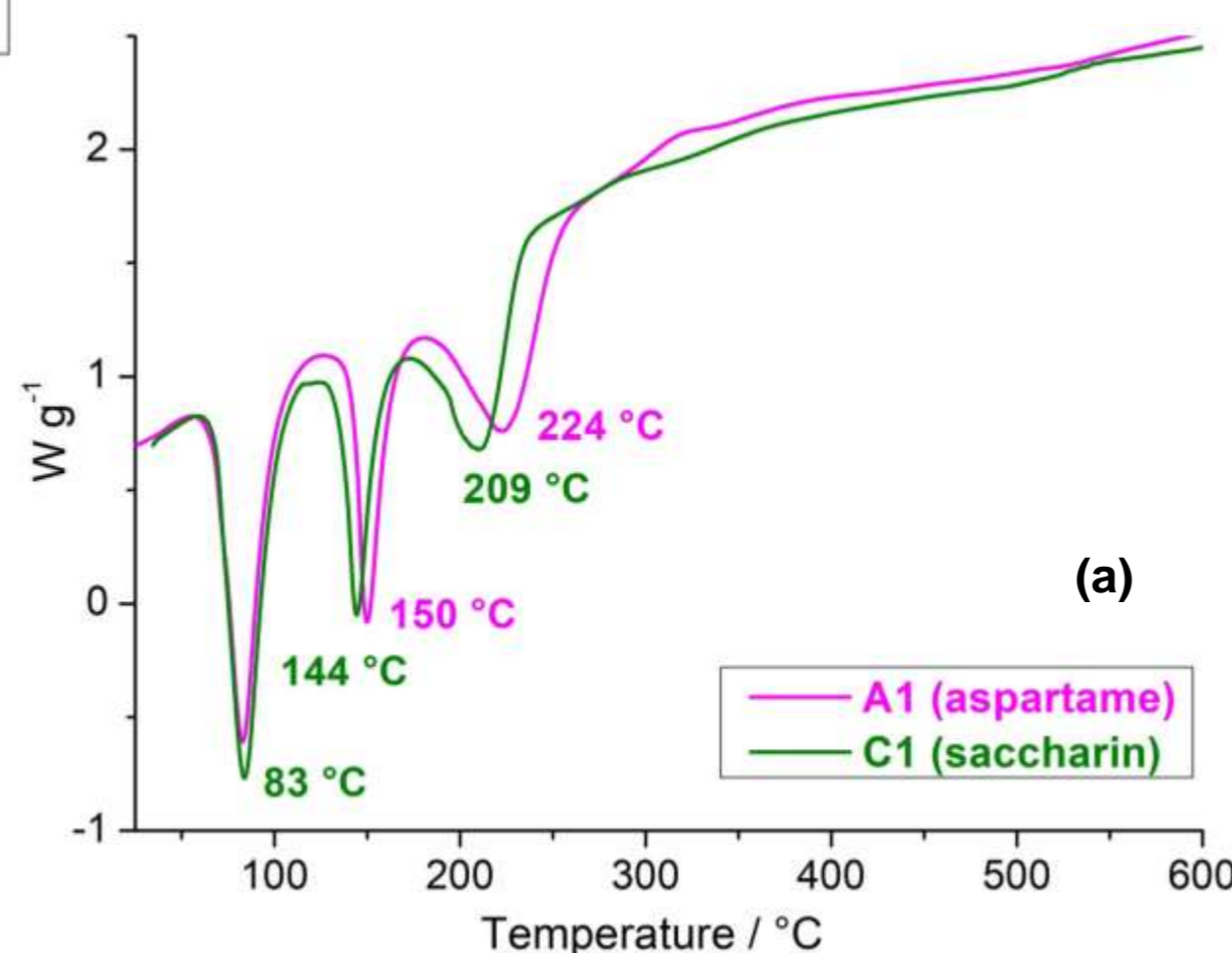


Fig. 2 – DSC curves of commercial samples of (a) artificial, and (b) natural sweeteners

A1 ⇒ 65 - 100 °C
130 - 600 °C

C1 ⇒ 65 - 100 °C
160 - 600 °C

Erythritol ⇒ 170 - 290 °C

Xylitol ⇒ 200 - 330 °C

Sample	ASTM E-2041		ASTM E-698	
	E _a / [kJ mol ⁻¹]	lnA / [s ⁻¹]	E _a / [kJ mol ⁻¹]	lnA / [s ⁻¹]
A1	126.88	25.47	98.02	8.19
C1	154.55	33.46	112.20	9.97
Erythritol	162.09	30.24	104.43	7.73
Xylitol	201.22	35.99	90.95	5.82

Table 1 – Kinetic parameters of commercial sweetener samples

REFERENCES

ASTM E698 (2023). Standard Test Method for Kinetic Parameters for Thermally Unstable Materials Using Differential Scanning Calorimetry and the Flynn/Wall/Ozawa Method. <https://doi.org/10.1520/E0698-23>

ASTM E2041 (2018). Standard Test Method for Estimating Kinetic Parameters by Differential Scanning Calorimeter Using the Borchardt and Daniels Method. <https://doi.org/10.1520/E2041-13R18>

ACKNOWLEDGMENTS

