Annals of the University of Craiova
The Chemistry Series
Volume XLIX, No. 2 (2023) 34-37
homepage: chimie.ucv.ro/annals/
10.52846/AUCCHEM.2023.2.08

Thermal stability of banana and strawberry flavouring food additives

Bogdan Tutunaru, Alina Voicu*

University of Craiova, Faculty of Sciences, Department of Chemistry, Calea București 107 I, Craiova, Romania

* E-mail: tutunaruchim@yahoo.com

Received: 18.08.2023 / Accepted: 19.08.2023 / Published: 20.12.2023

Abstract:
Food additives are substances or mixtures of substances added to food products in a set amount to maintain or increase their safety, freshness, taste, nutritional values, texture and appearance. Heat treatment is frequently used for food and consequently the processes in which the additive that is added to the raw material participates must also be studied. In this study, the results of the thermal analysis of two flavors used especially in the processing of confectionery products, banana and strawberry flavours, in an inert atmosphere of nitrogen gas are presented. Experimental results indicate a lower relative stability of banana flavor (180 °C) compared to strawberry flavor (225 °C).

Keywords: banana flavour, strawberry flavour, thermal stability

1. INTRODUCTION

Food additives, also known as E, are natural or chemical substances that are not consumed as food itself, but are used as ingredients in the production, processing, preparation, packaging, packaging, transportation, storage or other modifications of food, with the purpose of adding technological properties (including organoleptic changes) [1-9].

These additives may or may not have nutritional value and may affect the characteristics of foods in different ways [1-9].

Various analytical techniques have been used to investigate the interaction of food additives with hemo-proteins such as myoglobin and hemoglobin, revealing changes in protein structure and conformation. Studies confirm the interaction of food additives with hemo-proteins and provide information on the thermodynamic and kinetic factors affecting these proteins following interactions.

The thermal stability of two flavours, namely those providing banana and strawberry flavours, was studied to determine the activation energy required for the thermal degradation process.

2. MATERIALS AND METHODS

The thermal analysis of flavors used as additives in the food industry was performed in a temperature range between 20 and 500 °C, using a Perkin Elmer thermoanalyzer for recording TG/DSC thermograms. The sample was heated at a heating rate of 10 °C·min^{-1}. The study of the degradation energies was carried out by recording the thermal decomposition curves using three different heating speeds of the sample; 10 °C·min^{-1}, 20 °C·min^{-1} and 30 °C·min^{-1}. The thermal degradation processes were carried out in an inert atmosphere of nitrogen gas, with a purge flow rate of 150 mL·min^{-1} throughout the experiment. Both reference and working crucibles were made of aluminum.

3. RESULTS AND DISCUSSION

The thermogravimetric (TG) curves and its differential variation of the first order (dTG) corresponding to the thermal degradation of the banana flavour showed that up to the temperature of 88 °C a percentage decrease in mass of 5% is registered. This decrease is due to the evaporation of moisture and/or the evaporation of solvents present in the sample, residual solvents of the obtaining process. The thermogravimetric curve (TG) indicates in the following temperature range, 88 ÷ 182 °C, a decrease of approximately 2%, the temperature at which strongly adsorbed solvent molecules and/or certain slightly volatile fragments evaporate.

At temperatures higher than 182 °C, the greatest decrease in percentage mass is recorded, of 77%. This temperature range is observed up to 360 °C and indicates the thermal degradation of the flavor constituent compounds. The process of splitting C-C, C-H, C-O, O-H bonds with the elimination of gaseous combustion compounds is also identified on the differential curve with the maximum peak corresponding to the temperature of 314 °C.

At temperature values higher than 360 °C, the mass decreases constantly by another 8.5% until the end of the experiment, so that at a temperature of 600 °C a residue of approximately 8.5% representing combustion products is recorded in the crucible and /or unburned compounds.

In the case of the strawberry flavour, it is observed that a percentage decrease in mass of 10% is recorded up to a temperature of 225 °C. This decrease is due to evaporation of moisture and/or evaporation of solvents. The thermogravimetric curve (TG) indicates in this temperature range, ambient ÷ 225 °C, the evaporation of strongly adsorbed solvent molecules and/or certain slightly volatile fragments. At temperatures higher than 225 °C, the greatest decrease in percentage mass is recorded, of 72%.

4. CONCLUSION

Experimental results indicate a lower relative stability of banana flavour. At temperatures higher than 180 °C, degradation processes occur with the irreversible splitting of chemical bonds. Once this temperature is reached, structural changes appear accompanied by changes in physical and chemical properties, the activation energy being 94.5 $kJ \cdot mol^{-1}$. Similarly, the strawberry flavour shows relative stability up to temperatures of 225 °C, and the activation energy obtained is 176.4 $kJ \cdot mol^{-1}$.

REFERENCES

[1] A. Ribezzo, G. Falciani, L. Bergamasco, M. Fasano and E. Chiavazzo. *J. Energy Storage*, 53 (**2022**) 105140.

[2] R. Vaishnav and A. Radha. Mater. Today: Proc., Article in press, **2022**.

[3] S.M. Oliveira, A. Gruppi, M.V. Vieira, G.S. Matos, A.A. Vicente, J.A.C. Teixeira, P. Fucinos, G. Spigno and L.M. Pastrana. *J. Food Eng*., 294 (**2021**) 110394.

[4] T. Hay, S. Prakash, V.D. Daygon and M. Fitzgerald. *Trends Food Sci. Technol*., 129 (**2022**) 74–87.

[5] M. Primacella, N.C. Acevedo and T. Wang. *Food Hydrocoll*., 98 (**2020**) 105241.

[6] A.L. Kelly, M.E. Baugh, M.E. Oster and A.G. DiFeliceantonio. *Appetite*, 178 (**2022**) 106274.

[7] A. Alimohammadi, M.-H. Moosavy, M.A. Doustvandi, B. Baradaran, M. Amini, A. Mokhtarzadeh and M. de la Guardia. *Food Chem*., 358 (**2021**) 129910.

[8] J.H.F. de Jesus, I.M. Szilágyi, G. Regdon Jr. and E.T.G. Cavalheiro. *Food Chem*., 337 (**2021**) 127770.

[9] D.A. Gálico, C.V. Nova, R.B. Guerra and G. Bannach. *Food Chem*., 182 (**2015**) 89–94.