



# Food Choices in Snacking Moments and Biogenic Amines Exposure: A Preliminary Observation of Children from the Abruzzo Region <sup>†</sup>

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**Abstract:** Snacking outside of main meals is common and often a dietary requirement, especially for children and toddlers. This habit has both social and educative dimensions, as it has become an established moment in people's daily routines. We conducted an easy online survey involving students and their families from schools in the Abruzzo region, Italy. The aim of the survey was to understand the participants' habits, food choices, and meal composition during snack time. Additionally, we inquired about their general health state. Our interest lies in knowing more about this population, with sufficient data to observe whether habits and food choices may be accountable for exposure to biogenic amines (BAs). BAs are unavoidable natural compounds that come from the catabolism of amino acids in tissues. They are possibly involved in reactions such as allergic-like manifestations, abdominal pain, and more severe symptoms depending on individual sensitivity. The action of BAs can be augmented by the intake of foods, mainly fermented products, which are common in everyday diets. We collected 300 responses from students ranging from 11 to 18 years old. The most popular foods eaten were sweets (pastries, cakes) and sweet bakery products, followed by yogurt-based and milk-based products (30% and 23%, respectively). Most students (58%) reported having a snack moment daily. The population was generally in good health, but some reported experiencing light discomfort after snacking, such as transient gastrointestinal pain, headache, and dermatological symptoms (8.7%, 2%, and 0.7% of the total, respectively). All this information may be linked and added to the knowledge about BA content in foods and their potential impact on health.

**Keywords:** snacking; meal composition; food choices; biogenic amines



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## 1. Introduction

Meal composition and structure follow continuous changes depending on the habits of people. Nowadays, principal meals (breakfast, lunch, and dinner) are restricted in time or shifted to later in the day/night. Moreover, they are easily substituted by high-convenience and time-saving options [1]. In this frame, snacking outside of or in substitution of principal meals is of growing importance among all population groups. Aside from these considerations, snacking covers a social dimension also contributing to socialization, and mainly among young subjects, these moments are often routine actions separating school time from free time, for example [2].

Snacking is tremendously flexible and personally tailored to satisfy multiple exigencies when it comes to choosing what foods to include. These features are principally responsible for shaping possible exposure to biogenic amines (BAs) [3]. This hazard is generally not recognized as a risk for human health, and among BAs, only the level of histamine must be examined in specific foods (some fresh fishes and their derived products) according to the official rules posed by Commission Regulation (EC) No 2073/2005 [4]. BAs, with particular

interest in histamine and tyramine, can be drivers of several negative manifestations with multiple targets. Moreover, severity is highly variable due to factors that are not standardizable, including sensitivity that is individual-specific, the assumption of mono-amino and di-amino oxidase drugs (MAO/DAO), and personal choice about meal composition and food/beverage inclusion in the diet [5].

The goal of this study is to better understand the food habits of a sensitive population (children and toddlers) when snacking. In fact, the potential hazardous intake of BAs may be assumed for common foods such as chocolate and salami, and even beverages such as tea and soft drinks. The limitations of data on threshold limits for many BAs make it difficult to define the real exposure of people, and especially children and toddlers, who very often eat items with very limited contents of histamine and tyramine. Additionally, other amines that are not recognized as directly toxic may interact with each other and magnify the effects of histamine and tyramine (even traces). To fit with the objective of this study, a survey was specifically designed for capturing the most realistic situation among students at some schools in the Abruzzo region (central Italy).

The study is still ongoing, and, for this reason, the data shown here prevalently refer to participants' habits.

## 2. Materials and Methods

### 2.1. Survey Elaboration

A very easy and short questionnaire was designed to determine frequency of snacking and for building up a profile of the most common snacking moments of children and toddlers. Because of privacy and age issues related to the subjects, families were directly involved in filling all the sections. Active collaboration with the schools made it possible to reach the highest number of families, assuring their total involvement. Teachers and directors were informed in advance about the project, and we explained the objectives and the importance of the issue.

Before starting survey sharing, all the questions were evaluated by the ethics committee of the provinces of L'Aquila e Teramo, receiving a positive statement both for rights protection and for the comprehension and clarity of each question.

The Google Forms service of the Google platform was used. The survey was divided into 2 sections. The general recommendation for participants was to complete the form with the constant surveillance of one guardian (specifically parents or legal tutors where indicated). The first section was dedicated to at least one member of the family and the student; questions included were about sex, age, food intolerances/allergies, drugs taken, and/or therapy. The second section was dedicated to the students, who were asked to describe how many times a week they have a moment in the day when they are snacking and to tell us which foods and beverages are mostly chosen and in which quantities. The final question was about symptoms possibly attributed to BAs.

### 2.2. Determination of BAs in Foods/Beverages Samples

Contents of BAs from foods and beverages were in part determined ex novo, from several food matrices, and taken from an internal database especially for fermented (animal-origin) foods. Experimental data were determined according to [6]. Different classes of foods and beverages were analyzed and divided into meat-based foods, cheese- and milk-derived products, bakery products (sweet and salty), chocolate, and other sweet items (mainly nuts, spreads, and others) and beverages. Most of the items indagated are known for their medium/high content of BAs and especially of histamine and tyramine; others were indagated because of a scarcity or absence of data. From a methodological point of view, we restricted the exploration of exposure to histamine and tyramine since they have established threshold limits to which we could compare. Based on the report of the EFSA (2011), for tyramine, the thresholds were 6 mg/meal/person for patients treated with monoaminooxidase inhibitor (MAOI) drugs; 50 mg/meal/person for patients receiving third-generation MAOI drugs, so called RIMAs (reversible inhibitors of MAO-A); and

600 mg/meal/person for healthy individuals. For histamine, the safe threshold considered for the healthy population was 25 mg/meal/person as the most conservative level.

Calculation of exposure will be executed once a consistent number of responses is achieved. @Risk 7.0 (Palisade Corporation, NewField, NY, USA) software will be used, allowing us to calculate several distributions and models. The goodness of fit will be evaluated using the Chi-square ( $\chi^2$ ) test. The best-fitting distributions describing tyramine or histamine contents and their consumption will be selected as an input for the assessment of exposure to these compounds by probabilistic estimation using the Monte Carlo simulation technique with 10,000 iterations. Exposure will be the result of crossing quantities of product eaten per occasion (g/snacking time) with contents of histamine and tyramine (mg/kg of product) and summing all the products eaten/drunk for that occasion.

### 3. Results and Discussion

Until now, 300 responses have been collected from students ranging from 11 to 18 years old. The population is nearly fifty–fifty male and female subjects (52.7% and 47.3%, respectively). The most popular foods eaten are sweets (pastries, cakes) and sweet bakery products, followed by yogurt-based and milk-based products (30% and 23%, respectively). Most students (58%) reported having a snack moment daily. The population is generally in good health, but some reported experiencing light discomfort after snacking, such as transient gastrointestinal pain, headache, and dermatological symptoms (8.7%, 2%, and 0.7% of the total, respectively). Our literature review [7–10] and our preliminary determination of BAs contents in foods and beverages indicate safe contents in the foods analyzed; moreover, the quantities eaten by young consumers do not seem to indicate hazardous scenarios. At any rate, final calculations are still not available for the risk assessment of this population.

### 4. Conclusions

A new perspective on BAs is needed for recognizing the real exposure of people to them. The scientific community and medical doctors must collaborate more to communicate to consumers the risk connected to BAs, but especially to stress the importance of testing personal sensitivity and MAO/DAO impairment, and educating people on dietary patterns, meal choice, and food inclusion in daily life.

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**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** Data are available in this study.

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