INTRODUCTION

Tyrainine and histamine are the biogenic amines (BA) most commonly found at high concentrations in foods. The ingestion of histamine-rich food can cause scumbroid syndrome characterized by adverse neurological, gastrointestinal, circulatory, and respiratory symptoms. Similarly, the consumption of foods rich in tyramine can cause toxicological reactions (headaches, migraine, neurological disorders...). Together, they are known as the “cheese reaction.” In fact, the European Food Safety Authority (EFSA) deems them to be the most toxic of all BA and to have a negative impact on food safety. However, histamine is the only BA for which legal limits have been set by the EFSA, and for scumbroid fish (200 mg/kg) and fish products (400 mg/kg), although it can also be present at high concentrations in fermented foods. Recently, the EFSA Panel on Biological Hazards (BIOHAZ) conducted a qualitative risk assessment for BA in fermented foods, and concluded that our present knowledge of their toxicity is limited and further research is needed. Therefore, the goal of this study was to investigate the in vitro cytotoxicity of tyramine and histamine in human intestinal cells using the Real-Time Cell Analyser (RTCA) technology, and to determine their mode of action [Linares et al., 2016]. Importantly, tyramine and histamine commonly appear together at high concentrations in fermented foods, such as cheese. However, the knowledge of the toxicity of dietary BA combinations is even more limited. Therefore, we further examined if there could be some kind of interaction (synergistic, additive or antagonistic) between histamine and tyramine [del Rio et al., 2017].

OBJECTIVES

- Determine the in vitro cytotoxicity of tyramine and histamine and their mode of action
- Analyse the cytotoxicity of these dietary BA in combination and the nature of their interaction

RESULTS

Tyrainine and histamine are toxic at concentrations commonly reached in BA-rich foods

To investigate the cytotoxicity of BA, an in vitro model of the human intestinal epithelium was developed based on the HT29 cell line and the RTCA technology. Tyramine (Fig. 1A) and histamine (Fig. 1B) were found to be cytotoxic at concentrations that can be easily found in BA-rich foods as some cheeses. Surprisingly, tyramine had a stronger and more rapid cytotoxic effect than histamine, the only BA for which legal limits have been established both in Europe and USA.

The mode of action of tyramine and histamine is different

While tyramine caused the necrosis of the HT29 cells (Fig. 2), histamine induced apoptosis (Fig. 3).

CONCLUSIONS

The RTCA technology was shown to be a useful way to assess the toxicity of BA on an in vitro model of the human intestinal epithelium. Using this technology we found that unexpectedly, tyramine was more cytotoxic than histamine. In both cases, the concentrations found to be toxic are commonly reached in BA-rich foods. Their mode of action was also different, while tyramine caused cell necrosis, histamine induced apoptosis. Moreover, we found that tyramine and histamine have synergistic cytotoxicity in the range of concentrations that can be found in foods. The results of this work should be taken into account to establish the legal limits of both BA in food.

REFERENCES


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