

Chapter 4

Technologies for Monitoring the Safety of Perishable Food Products

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ABSTRACT

Food safety and eradication of food waste are current concerns of society and governments due to health, ethics, and sustainable economics. There are multiple technologies for monitoring food safety at different chain stages, among them, time-temperature integrators (TTI). Temperature is a major factor affecting food quality and safety during its life cycle. This parameter can be monitored using TTI devices on food packages, allowing users to know the thermal exposure. This chapter addresses food safety issues, namely factors related to microbial growth responsible for food deterioration. Moreover, TTI monitoring technologies are also described, focusing on features, advantages, disadvantages, applicability, and product examples. Analysis of the current state of TTI and technological evolution, a prediction is provided for future TTI devices designed for more assertive, traceable, safe, and quality food products.

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INTRODUCTION

Food waste is a persistent reality in the actual society. This is an upmost issue with substantial relevance, not only by the intrinsic ethical questions, but also to the relation between food consumer and producer (APIC, 2006). Food shortage in the world are due to lack of socio-economic conditions of parts of the population, this causes an immorality that condemns the existence of food waste, specially that 925 million people suffer of malnutrition in the world (APIC, 2006). Additionally, food waste is translated into costs to final consumers, distributors and producers. Lastly, food waste leads to degradation of natural resources such as water, soil, or energy consumption, affecting biodiversity preservation and air quality (ANCIPA, 2005). In recent years, a major priority for distributors is to provide high quality food (in a good state of conservation) to consumers, which became more aware and concerned with food quality standards (ANCIPA, 2005).

The Food and Agriculture Organization of the United Nations (FAO) estimates that one-third of the total food produced for human consumption is lost or wasted, approximately 1.3 billion of tons. This corresponds to annual costs of 750 billion dollars (FAO, 2011). The economical impact is significant due to loss of product value, nevertheless the environmental impact has to be accounted too, food waste leads also to waste of natural resources, such as water, land, energy, and unnecessary green gas emissions leading to global warming and climate change. This, in turn, affects agriculture and food production. Moreover, the FAO CEO, Graziano da Silva, reported during the Global Green Growth Forum (3GF) realized in Copenhagen (Denmark) in October of 2013, that food waste reduction to zero could provide sufficient food for 2 billion people. Thus, the FAO appeals for innovative ways to control and reduce this global food waste problem. FAO indicates that the major food waste happens in post-production phase, as well as during the harvest, transportation and storage. In developing countries, food waste is related with inadequate infrastructures, while in developed countries is a problem between commercialization and consumption phases (Gogou *et al.*, 2013).

In the 27-member states of the European Union (EU), annual food waste is about 89 million tons, with a prediction of a rise to 126 million tons in 2020. In the case of perishable food products, such as the horticultural products, 30% of the European production is wasted after harvest (FAO, 2013). According to 2012 data, only in Portugal, about 1 million tons of food is wasted, i.e., about 17% of the total production (O'Connor, 2014).

The European Parliament declared 2014 as the European Year against the Food Waste, in order to take measures to solve this problem.

This is a worldwide problem, from agricultural field to consumers. Significant part of the problem is due to consumer behaviour, i.e. avoiding to buy “imperfect” horticultural products or with “small dimension” or products with closer expiry date.

To overcome this problem with serious ethical, social, environment and economic consequences, the European Parliament called a collective and urgent action to reduce food waste in half until 2025. Nonetheless, European Commission hopes to reach this target by 2020, since the “Roadmap to a Resource Efficient Europe” has been given a priority (Baptista *et al.*, 2012) This ambition involves an assertive effort between all food chain parties. Additionally, many initiatives and campaigns have started to sensitize producers, sellers and consumers for the food waste problem.

Alternatively, ensuring food safety will reduce waste in the production, transportation and food display, and will help consumers to change their behaviour (APIC, 2006).

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