

Secondary Shelf Life of Pesto

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The secondary shelf life (SSL) is defined as the time after package opening during which the food product retains a required level of quality. The SSL, indicated in labels as “best if used within x days after opening”, could lead to domestic food waste if not correctly evaluated. This work aimed to estimate the SSL of two brands of industrial shelf-stable pesto products. The SSL reported on the labels of both pesto brands was 5 days from opening, under refrigerated storage. However, such indication does not have any scientific support and may even mislead consumers, thus contributing to turn foods that are still perfectly suitable for consumption, into waste. The assessment of the SSL was performed by simulating two levels of domestic use and storage in five different house environments and through monitoring microbiological, sensory, and chemical quality descriptors.

Keywords: household food waste ; stability evaluation ; sensory acceptability ; period after opening (PAO)

1. Overview

The secondary shelf life (SSL) is defined as the time after package opening during which the food product retains a required level of quality. The SSL, indicated in labels as “best if used within x days after opening”, could lead to domestic food waste if not correctly evaluated. In this context, the SSL of two brands of industrial shelf-stable pesto products (with an indicated SSL of 5 days) was studied through a domestic use simulation performed in five households under two scenarios simulating real opening and storage conditions. The quality of pesto after opening was assessed through microbiological and sensory analyses, determination of instrumental colour parameters, pH and volatiles profiling. For both pesto sauces tested, a SSL ≥ 20 days was proven. Irrespective of the intensity of use (scenarios 1 and 2), the pesto was microbiologically stable: the maximum count for total aerobic mesophilic bacteria (TMB) observed during 20 days of storage was $9.64 \pm 1.7 \times 10^2$ CFU/g, starting from a commercially stable product. Colour parameters L^* and ΔE did not change significantly during storage ($p > 0.05$), while the a^* and BI values significantly changed ($p < 0.05$) during the first 5 days, and then stabilized during the rest of the household storage. Nevertheless, the slight colour modifications were not perceived by the sensory panel. Moreover, sensory assessors were not able to discern pesto samples stored for up to 20 days after first opening, from a just-opened reference sample, proving that the sensory appreciation of pesto was not influenced by the time after opening.

2. Food waste and Secondary Shelf Life

In the context of sustainability improvement in the food sector, various measures have been proposed, especially related to the mitigation of environmental impacts of processes and materials, the optimization of distribution and logistics, and the minimization of food losses and wastes (FLW) along the food chain ^[1]. It is widely accepted in the scientific community that FLW are responsible for a high fraction of global environmental impacts ^{[2][3]}. FLW represent an economic, social, and environmental issue, and for this reason, the EU has targeted the halving of food wastes by 2030, according to Sustainable Development Goals (SDGs) ^[4]. Specifically, SDG 12.3 aims to “by 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses”. The most recent estimates report that 17% of overall food production is wasted ^[5]. Most of this waste is produced in the downstream of the chain, especially at the household level: available data range from 33–38% ^[6], through 45% ^[7] to 61% of total FLW ^[5]. Recent evidence ^[5] has shown that consumer food waste has been significantly underestimated and that figures related to food waste at consumer and food service level (also referred to as “avoidable food wastes”) are more than twice as much as previously estimated ^[6].

It should be highlighted that domestic food waste: (i) cannot find alternative uses; (ii) represents the highest fraction of total FLW and (iii) is responsible for the highest environmental impact, since wasted products represent the highest level of resource consumption and emissions. Indeed, the resource consumption necessary for food production is in vain when

food is lost or wasted and misses its goal of human consumption [8][9]. Given the need for FLW prevention and based on the awareness of the importance of domestic food waste [10], it is urgent to adopt effective mitigation measures.

In many cases, it is the overly short secondary shelf life (SSL), i.e., the timespan from the first opening to unacceptability, that turns food products into wastes. This timespan, also referred to as “period after opening” (PAO) is mandatory for some cosmetics [11]; for foods, it is usually communicated to consumers through the package label in terms of instructions for use after the first opening with sentences such as “after opening, store refrigerated and consume within x days”, where x ranges from 24 h to a few days, depending on the product category and, within the same product category, depending on the producer. Such indications, however, does not have any scientific support and may even mislead consumers, thus contributing to foods which are still perfectly suitable for consumption being discarded.

Pesto alla genovese is a traditional Italian sauce made from basil, olive oil, grated hard cheese, pine seeds, salt, and garlic commonly used as a dressing for pasta. It is widely available as a shelf-stable product in glass jars, with a shelf life of 2–3 years; however, its stability after opening has never been assessed.

The SSL assessment was performed using a deterministic approach, as suggested by Nicoli and Calligaris [12], which consists in storing the opened food product under the expected environmental conditions (i.e., at home in the case of shelf-stable pesto) and the worst-case scenario. The pesto samples were divided into five lots, each referred to a different domestic environment. Pesto jars were stored at ambient temperature until use, according to protocols described hereafter. Among the possible way to simulate the worst-case found in literature, repeating the container opening and closure during the household storage was the selected approach for this study [12]. Two levels of use (referred to as “scenarios”, based on the number of openings and duration of each opening) were tested in the five home environments mentioned above, to simulate a real utilization by the consumer, while the analytical determinations were carried out at the laboratories of the Department of Life Sciences of the University of Modena and Reggio Emilia. This is an innovative feature that distinguishes this study from most of the research in the field of SSL [13, 14, 15]. Scenario 1 (S1) consisted of a single opening for each jar, corresponding to the beginning of SSL, hence referred to as time zero (t_0). Two tablespoons of pesto were removed from each jar, which remained uncapped for 2 min, then the jars were closed and stored in the domestic refrigerator, where they were kept for 20 days. Scenario 2 (S2) consisted of three openings of each jar at 2-days intervals. At each opening, two tablespoons of pesto were removed from each jar, which remained uncapped for 3 min, then the jars were closed and kept at ambient temperature for 30 min before placing in the domestic refrigerator, where they were stored for 20 days. Dataloggers were used to monitor conditions of the five domestic refrigerators where samples were stored, by recording temperature and humidity at 1-h intervals up to 168 h (one week). The opening procedure described above for each scenario was performed simultaneously on four pesto jars in each home environment. Following the opening protocols, pesto jars were stored in domestic refrigerators and delivered to the laboratory on day 5, 11, 16, and 20 after the first opening for microbiological, sensory, and chemical-physical analyses.

3. Conclusions

Industrial shelf-stable pesto, irrespective of the intensity of domestic use, can be still suitable for consumption after 20 d from the first opening, upon refrigerated household storage. Therefore, our findings suggest the possibility to extend the indication of SSL for the studied pesto sauces from 5 to 20 d. Since the chosen samples well represent the array of industrial pesto sauces commercially available, based on the comparison of pH and a_w , results could apply to the category of shelf-stable pesto sauces, having similar intrinsic parameters.

In a wider context, this work could have relevant practical outcomes both for the industry and the end consumer. The consciousness of the suitability for consumption even after the end of the indicated SSL could have consequences on the producer’s decision concerning the SSL to be declared on the food label. Indeed, selling a product with an increased SSL means paying attention to food waste, giving the image of a sustainable business. Furthermore, the extension of the labelled SSL based on its objective assessment would contribute to add value to the packaged food product, without anyway modifying ingredients, formulation, or production process. This innovation might increase competitiveness, leading the consumer to choose the product which lasts longer, rather than other products of the same commercial category but with a lower duration after opening. Overall, a company might improve its market positioning through the reassessment of the SSL of its products.

In addition, the increase of the useful period for food consumption after first opening would bring advantages for the end user, leading to an improvement of the household food management, with consequent cost savings. The enhanced consumer awareness following the modification of SSL in the label might lead to lower food wastes generation.

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