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Consumer-driven Shelf-life Determination and Consumer Perception of Chicken Samples

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Abstract: During storage, raw chicken meat produces off-odours and off-tastes due to microbial growth. The speed of this process mainly depends on storage conditions (temperature, moisture, and presence of preservatives), as well as the initial contamination. Consumers consider the product unfit for consumption once it reaches a certain level of spoilage.
The expiry date is one of the key quality and safety indicators that producers provide for consumers. However, determining the actual expiry date can be challenging, as many factors are at play, such as batch variation and storage environments, which contribute to the gradual spoilage of products.
Currently, research linking storage time, microbial growth, sensory changes, and consumer perception is limited. Studies investigating the various aspects of product spoilage are necessary for determining the appropriate shelf life for raw chicken.
This study aims to address the following objectives:

1) Determine consumers' sensory perception of chicken samples stored under different time points and conditions and identify the time points at which consumers deem the products unfit for consumption.
2) Link consumer scores of sensory quality and fitness for consumption to measurable parameters that can be used to establish shelf life (e.g., bacterial counts, microbiota, sensory profile).
3) Integrate consumer, sensory, and microbial results from the laboratory experiment into shelf-life determination methods applicable to the food industry.

The experiment was conducted in three countries: Hungary, Norway, and Portugal. Chicken samples were obtained from one local producer per country, and the same batch of chickens was used for the analysis. A cutting-edge reversed storage design was employed; with sampling plans tailored to each country based on the original expiration date set by the producer. The plan included storing the samples in their original packaging at different time points and at two storage temperatures: 4 °C and 8 °C. The samples were tested for total microbiological load and microbiome composition, and at the end of the shelf-life storage test, all samples were used for consumer and semi-trained sensory analyses. For the consumer analysis, a minimum of 120 participants were recruited in each country to evaluate the degree of disliking and overall acceptance of the samples. Meanwhile, in the semi-trained test, a 9-point hedonic scale was used to assess the intensity of 11 sensory attributes.
Results from the consumer test showed that in Norway and Portugal, higher intensity scores were observed for samples stored at abusive temperatures (8 °C). In Hungary, however, storage conditions did not significantly affect the intensity scores. An increase in intensity scores and

disliking was observed in Hungary between 3 and 6 days, in Norway between 7 and 15 days (8 °C) and at 18 days (4 °C), and in Portugal at 7 days (8 °C) and between 7 and 11 days (4 °C). For the semi-trained panel test, all sensory attributes related to spoilage were highly correlated in all countries. The most important attributes contributing to perceived spoilage were total intensity, cloying, sour/fermented, ammonia/burnt/pungent, and sulphur.

The predominant microbiota identified in the three countries differed significantly, as shown in the table below.

Country	4 °C	8 °C
Hungary	*Photobacterium*	*Photobacterium*
Norway	*Carnobacterium*	*Hafnia*
Portugal	*Brochothrix* (& *Serratia*)	*Serratia* (& *Brochothrix*)

The *Photobacterium* was discovered through microbiota analysis, but it was likely underestimated by conventional PCA total count methods, as we cannot be certain what grew on the plates.
The total intensity score from the semi-trained panel test seems to depend primarily on the total bacterial counts and the aggregated bacterial load. For industry recommendations, total intensity can be suggested as a reliable indicator for producers. However, variability observed in microbial analyses is not always detectable through sensory analysis, so further investigation is needed.
The majority of consumers accepted all samples across all countries. The data support that, provided raw chicken is stored under proper conditions, an additional 2 days of shelf life can be recommended for Norwegian and Portuguese chicken samples.
Additionally, we will report the results of a recently concluded digital survey in Hungary which was also done in 9 other European countries. A total of 1006 respondents were gathered in Hungary using stratified random sampling and a predefined criterion. The questionnaire was divided in different sections involving aspects like purchase decision making, food waste data, new innovations in measuring shelf-life, acceptability of two different food preservation methods, and whether they will support government and policy initiatives to support the improvement of shelf life and reduce food waste.

Keywords: shelf-life study, consumer science, food microbiology

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