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Shelf Life Accelerated for the Confectionery Sector: New Protocol

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Abstract

The objectives expected by the company are essentially those of identifying a new approach to the accelerated determination of the shelf life of products intended for human consumption and more precisely for the confectionery sector, developing new methods currently not present in the sector and in the literature. The aim of the project is to develop and test an accelerated model for determining the shelf life on confectionery products. In the research, methods and methods were therefore used in a planned way, with records of both the process followed by the results that led to the development of new models that could then be put on the market in the following years. As regards the results obtained by the company, while the codification of knowledge and its dissemination are part of the usual practice in universities and research institutes (although there may be restrictions on knowledge deriving from contract work or in the context of a collaboration), in the commercial sphere the results will be protected by secrecy or other means of intellectual property protection. However, the process and results are expected to be recorded for use by other researchers and employees of the company.

Keywords: Shelf life, food products, chemical characteristics, microbiological characteristics, sensory characteristics

1. Introduction

La Dolce Tuscia S.a.s was founded in 2007, with the mission of producing and selling high quality artisanal frozen pastry products, such as to guarantee a result that could keep up with the best competitors on the market. Horeca (Hotel, Restaurant and Catering) is identified as the preferred sales channel with the belief that it could be the only channel capable of accepting an offer of highly qualified products, with an absolutely outstanding price / quality ratio. The start of production and staff training is entrusted to a pastry chef consultant who, together with the

owner, design and manufacture a line of products that starts the Dolce Tuscia business. The distribution is aimed directly at the restaurateurs of the province who appreciate the quality and the service offered. Encouraged by the achievements, he begins product development and coverage of other markets. First at the regional level, then nationally and internationally [1-7]. Dolce Tuscia currently develops its turnover to 75% on the national market, serving distributors / wholesalers of the Horeca channel specialized in frozen food, and 25% on foreign markets, supplying importers of Italian specialties. With a view to pursuing its goal, made up of continuous product innovation and the search for particular tastes and presentations, in the belief that the affirmation on the market could only pass through the proposal of high quality products but with distinctive elements of innovation, it is The decision was made to convert the entire existing range into gluten-free products, with particular attention also to reducing sugars. In this way, a growing demand for quality products with healthy connotations would have been met, effectively widening the base of potential consumers, including all those who suffer from diseases related to the presence of gluten and who up to that moment did not have the possibility of having such a wide range of pastry products available. This is why we dedicate most of our production to gluten and lactose free and we have started research with the University of Tuscia that has the important goal of reducing sugars and cholesterol in all our products.
With the certainty that the goal would have been extremely difficult to achieve, both for the objective complications in the production of products, and for the great uncertainty of the time needed to develop the semi-finished products and then the finished product, he took courage from the fact that, in the case of success, we would have been the only company on the market to offer such a vast assortment in the frozen desserts sector, and unique in the single-portion pastry segment. Furthermore, in this segment, we have developed a particular formulation that allows the end user to keep the single portion in the freezer at -18 °, extract it when needed and serve it immediately "ready for consumption", without waiting for the canonical lead times. Thawing, with this innovation, we have practically eliminated the waste due to the end of life or deterioration of the product that is generated when it is defrosted, to the great happiness of the restaurateur and with great benefits regarding the quality of the product. Keeping the product in the freezer effectively blocks its organoleptic qualities making it comparable to a freshly made product.

2. The new Shelf life

The shelf life of a food can be influenced by many factors which can be divided into intrinsic and extrinsic factors. The intrinsic factors are influenced by variables such as the type of raw material, the formulation of the product and its structure; these factors refer to the final product and include, for example, water activity (aw), pH, redox potential (Eh), nutrients, natural microflora, enzymes. The extrinsic factors, on the other hand, are influenced by the production process and post production and include for example time-temperature profiles during the process, relative humidity during the process, storage and distribution, exposure to light

during the process, storage and distribution, presence of microorganisms in the environment during the process, storage and distribution, composition of the atmosphere in the packaging and its evolution during storage and distribution, handling by the consumer. The extrinsic and intrinsic factors influence the variation over time of a specific quality attribute of the product up to the achievement of critical values which will cause the end of the marketability of the product itself; it is essential for a correct determination of the shelf-life, therefore quantifying the minimum acceptable quality level for the quality attribute considered during the study. These levels are also defined "Indices of failure", are classified into attributes of a chemical, physical, microbiological and sensory nature and can be monitored and evaluated with sensory or instrumental tests (color, consistency). The factors connected to the presence and possibility of development of microorganisms are the ingredients and additives used, the processing methods, the packaging system, the storage temperatures and, in particular, the chemical-physical characteristics of the food, such as values of pH, free water (Aw) and Temperature [8-9]..
The latter affects the relative speed of the loss of quality of a product. In particular, the Arrhenius equation was used to describe the effect of temperature on the speed of different reactions responsible for the loss of quality.$K = K_0 * \exp(-Ea/RT)$
where is it:
• Ea = indicates the dependence of the degradation process on temperature and is expressed in kcal / mole;
• K = reaction rate;
• T = temperature.

2.1 Use of sensory analysis in the shelf-life study

Sensory analysis is the key factor in determining the shelf life of many products. Microbiologically stable foods, such as biscuits or crackers, owe their shelf-life to the change in organoleptic characteristics. Even fresh foods, such as stracchino, can be microbiologically stable near the expiration date but not acceptable from a sensory point of view. For this reason, sensory analysis is fundamental in shelf-life studies, precisely because it allows us to define the acceptability of the product from the point of view of texture, flavor, smell and other organoleptic parameters.
There are different sensory methods used but in particular they are divided into: sensory analysis of the analytical type and sensory analysis of the hedonistic / affective type [12-13].
In the analytical sensory analysis there is a panel of experts trained to describe or discriminate products, regardless of their personal opinions; the affective sensory analysis, on the other hand, involves a panel made up of consumers who express their opinion on the acceptability of one or more products.
In the shelf-life tests, a hedonistic type test is generally used, i.e. the product is tasted by a panel of untrained consumers, but habitual of the product to be evaluated, and they are asked to express a score for the different characteristics of the product. : for example, a score from zero to four can be expressed for the characteristics of taste, smell, consistency, where zero is equivalent to an unpleasant

taste and four to a very pleasant taste. This type of sensory analysis is used for shelf-life tests because the goal is to understand when the product is no longer acceptable to the consumer from an organoleptic point of view. It is therefore possible to estimate the expiry date or minimum storage term of the food considering both the result of the microbiological analyzes and the result of the sensory analysis.

2.1 PFM predictive microbiology

Predictive microbiology PFM (Predictive Food Microbiology) is a branch of food microbiology that studies the behavior of microorganisms (growth, production of metabolites and death of microorganisms) in different environmental conditions, important for the conservation and hygienic safety of food, using mathematical models, in order to simplify the procedures for determining food risk. One of the most widely used models in predictive microbiology is the Arrhenius linear kinetic model and describes the rate of microbial growth in relation to some environmental parameters such as temperature [15]. The effect of temperature on the growth rate is described by this equation:

$$\mu = A \cdot \exp(-E\mu / RT)$$

where is it:
• μ is the specific growth rate expressed in log (CFU / g) d-1;
• A is the pre-exponential factor or Arrhenius factor, it is a constant that expresses the dependence of the kinetic constant K on the temperature expressed in log (CFU / g) d-1;
• Eμ is the activation energy expressed in kJ / mol;
• R is the gas constant and is equal to 8.31 J / kmol;
• T is the absolute temperature expressed in kelvins.

The large amount of data generated by researchers and scientists from all over the world in the field of predictive microbiology is collected and managed by ComBase, a public database created and supported by a consortium of research institutions, universities of various countries, government organizations and centers of business research. The calculation tools that are used in this branch of microbiology are represented by specific mathematical and statistical software available online: an example is ComBase predictor, present on the ComBase website, consisting of growth, thermal inactivation and survival models for various microorganisms. as a function of the 3 main growth factors (pH, aw and temperature) and secondary factors such as preservatives and CO2. There are also software for microbial modeling that are specific for the study of certain microorganisms or foods (Perfringens Predictor and Seafood spoilage and safety predictor).

4. Conclusion

This project stems from the need to have a unified protocol for carrying out shelf life and to be able to determine the durability of a product in significantly shorter

times than the standards.
Production companies can thus have results without having to wait for the natural course of the product. The impact generated by this project within the company can be considered medium-high. The potential in terms of an expansion of the market to which the company is targeting is not negligible. The impact in terms of professional growth of the staff employed in research is also positive and that can be used in the provision of specific services.

The results of the two shelf lives reported almost the same results. This indicates that the two methods of carrying out the shelf-life analysis are equivalent and therefore the expected acceleration protocol is applicable. In order to make the evaluation of the project objective, the main success factors of the project are evaluated on the basis of a numerical scale and the descriptors of the technical and scientific literature.

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