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Evaluation of the use of "best before" in ready-to-eat foods of the retail market

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Abstract

The correct indication of the commercial life of some products, although specifically regulated by Regulation (EU) 1169/2011, could be difficult to apply for the Food Business Operator. The consequence is to attribute a "date of minimum durability" (DMD) to some foods, which, being perishable from a microbiological point of view, should carry a "use by" date, as they could represent a potential risk for the consumer. This study aims to evaluate the correct use of the "best before" date instead of the "use by" date in different ready-to-eat (RTE) foods, for which it is conceivable that they perish after that date. The analysis was carried out on 43 RTE products, divided into 26 dairy and 17 meat products (4 raw cured and 13 cooked), which had the term "best before" and were characterized by medium perishability, purchasing two sampling units of the same lot to carry out microbiological, chemical-physical, and sensory analyses. The first sampling unit was analyzed at the expiry of the DMD, and the second one 7 days later by storing the sample at 7°C (DMD+7), simulating a condition of thermal abuse at the domestic storage level. The results of the microbiological analysis showed that 13 cooked meat products at DMD 3 (ID 3 - roast turkey; ID 6 - Lyoner; ID 9 - cooked shoulder) and 4 (ID 3 - roast turkey; ID 6 - Lyoner; ID 9 - cooked shoulder; ID 12 - mortadella) at the DMD and DMD+7, respectively, presented "unsatisfactory" microbial loads, such as to be considered "in a state of alteration" according to the Ce.I.R.S.A guideline. Regarding 26 dairy products, at DMD only one sample (ID 20 - sweet gorgonzola) was to be considered "in a state of alteration", while at DMD+7 the samples were 2 (ID 20 - sweet gorgonzola; ID 24 - Brie cheese). Microbiological results were confirmed by the sensory analysis. The state of alteration found in the products examined means that they fully fall within the definition of unsafe food as reported in Regulation (EC) 178/2002, which therefore requires that they be marketed with the "use by" date.

Key words: perishability, date of minimum durability, shelf-life, food microbiology, specific spoilage organisms.

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Introduction

According to Regulation (EU) 1169/2011, the date of minimum durability (DMD) of a food (or "best before" date) is "the date until which the food retains its specific properties when properly stored" (European Commission, 2011). The DMD is replaced by the "use by" date "in the case of foods which, from a microbiological point of view, are highly perishable and are therefore likely, after a short period, to constitute an immediate danger to human health. After the "use by" date, a food shall be deemed to be unsafe in accordance with Article 14(2) to (5) of Regulation (EC) No 178/2002" (European Commission, 2002). In Article 14, food is considered unsafe if it is: i) injurious to health and ii) unfit for human consumption. In paragraph 5, it is implied that "in determining whether any food is unfit for human consumption, regard shall be had to whether the food is unacceptable for human consumption according to its intended use, for reasons of contamination, whether by extraneous matter or otherwise, or through putrefaction, deterioration or decay". Therefore, in such cases, the term "unfit for human consumption" refers to the alteration of the sensory quality of the food due to microbial growth which does not necessarily affect human health and is therefore not related to the proliferation of pathogenic bacteria. In this regard, fresh foods labelled with a "best before" date, such as ready-to-eat (RTE) dairy or meat products, although generally safe from a food safety point of view, due to their physico-chemical characteristics [pH, activity water (aW), *etc*.] could go through spoilage phenomena, due to the proliferation of bacteria that result in sensory defects such as discoloration, unpleasant odors, fat exudation, viscosity formation and slime, all of which lead to a reduction in shelf-life (Micheli *et al*., 2023). These categories of products, which are marketed whole or sliced, vacuum-packed (VP) or in modified atmosphere packaging (MAP), may be marketed with either "best before" or "use by" date on the label, based on the discretion of the food business operator. Considering that food with DMD can be bought and stored by the consumer for several days after this date, it can be assumed that this is in contrast to the definition of the Regulation (EC) 178/2002, where food that undergoes sensory changes, such as spoilage or putrefaction, is considered unfit for human consumption. Furthermore, it is well known that a basic requirement for

maintaining the safety and quality of all perishable products is to control the temperature of food along the cold chain (from producer to consumer), since temperature is one of the main factors regulating the growth of microorganisms (Jofré *et al*., 2019; Ovca *et al*., 2021). In this regard, according to several studies, domestic refrigerators reach temperatures higher than the storage temperatures indicated on the product label, causing thermal abuse and faster spoilage of perishable foods (James *et al*., 2017; Antoci *et al*., 2019; Ovca *et al*., 2021). To assess the microbiological perishability of a food product, Ce.I.R.S.A (*Centro Interdipartimentale di Ricerca e Documentazione sulla Sicurezza Alimentare*) of the Piedmont Region has developed guidelines to identify different categories of microbiological food quality, ranging from "satisfactory" to "potentially harmful", to which correspond specific intervention measures to be taken by the competent authority. The present study, therefore, aims to investigate whether certain RTE foods reporting a DMD in the label, characterized by presumed medium perishability, may show spoilage (sensory and microbiological) as defined in Article 14 of Regulation (EC) 178/2002. These aspects were evaluated at the DMD indicated on the label and 7 days later, after simulating domestic thermal abuse at +7°C (DMD+7).

Materials and Methods

Sample collection

In the present study, 43 food products of animal origin were sampled in different retail markets in the cities of Messina and Palermo (Italy) during the period between November 2023 and April 2024. The products were selected on the basis of specific characteristics, such as being: i) RTE food; ii) pre-packaged: in VP, in MAP, in heat-sealed plastic packaging (H-SPP) or packaged in paper packaging; iii) stored at refrigeration temperature; iv) labelled with a "best before" date (therefore characterized by the DMD and not by the "use by" date); v) characterized by a potential spoilage residual flora. All selected products were purchased in duplicate (two sampling units of the same lot) to carry out a twofold analysis at different times and under different conditions.

The samples were transported under refrigerated conditions to the Food Microbiology Laboratory of the Department of Veterinary Sciences, Messina, Italy. As reported in Table 1, all samples were uniquely identified with a number (ID) and stored in the laboratory's refrigerating room (+4°C), continuously monitored by a data logger. The following data were recorded for all samples: i) product type; ii) DMD reported on the label; iii) any anomalies of the products (swelling, loss of vacuum, presence of mold, *etc*.).

For each product, the day reported in the "best before" (DMD), both sampling units were taken from the +4°C cell, checking and noting any anomalies.

One sampling unit was immediately analyzed according to the sections below, while the second one was, instead, moved to a cell at +7°C for 7 days (continuously monitored by a data logger) to simulate the thermal abuse condition at the domestic storage level (DMD+7) (James *et al*., 2017; Ovca *et al*., 2021). After the additional 7 days, the second sampling unit was subjected to under-reported microbiological, physico-chemical, and sensory analyses.

Microbiological analysis

For all the products and sampling units, two aliquots were sampled with sterile instruments and placed in stomacher bags.

The first aliquot (~15 g) was diluted with buffered peptone water (Biolife, Milan, Italy) in a ratio of 1:9 w/v and homogenized with a stomacher (400 Circulator; International PBI s.p.a., Milan, Italy) for 60 s at 230 rpm, for the following bacteriological determinations: i) enumeration of aerobic mesophilic microorganisms (AMM) at 30°C according to ISO 4833-1:2013 (ISO, 2013), with Plate Count Agar (Biolife, Milan, Italy) incubated at 30±1°C for 72±3 h; (ii) enumeration of Enterobacteriaceae (ENT) according to UNI EN ISO 21528-2:2017 (ISO, 2017a), with Violet Red Bile Glucose Agar (Biolife, Milan, Italy) incubated at 37±1°C for 24±2 h; iii) enumeration of mesophilic lactic acid bacteria (LAB) according to ISO 15214:1998 (ISO, 1998), with Man, Rogosa and Sharpe Agar (M.R.S.) (Biolife, Milan, Italy) incubated at 30±1°C for 72±3 h; iv) enumeration of *Pseudomonas* spp. (PSE) for meat products, according to ISO 13720:2010 (ISO, 2010), on plates of Pseudomonas Agar Base supplemented with CFC Supplement (Biolife, Milan, Italy) while for dairy products according to ISO/TS 11059:2009 (ISO, 2009) on plates of Pseudomonas Agar Base supplemented with PP Supplement (Biolife, Milan, Italy) both incubated at 25±1°C for 48±2 h; (*v*) isolation and enumeration of yeasts and molds according to ISO 21527-1:2008 (ISO, 2008a) for products with aW >0.95, on plates of Dichloran-Rose Bengal Chloramphenicol Agar (Biolife, Milan, Italy) and to ISO 21527-2:2008 (ISO, 2008b) for products with aW≤0.95 on DG18 (Dichloran Glycerol 18%) agar both incubated at 25±1°C for 5 days; (*vi*) count of *Listeria monocytogenes* according to ISO 11290-2:2017 (ISO, 2017b) on Listeria Agar plates according to "Ottaviani and Agosti" (ALOA, Biolife, Milan, Italy) incubated at 37±1°C for 48±2 h.

The second aliquot (~25 g) was processed for the *L. monocytogenes* detection according to ISO 11290-1:2017 (ISO, 2017). It involves dilution in Half-Fraser Broth Base (HFBB) (Biolife, Milan, Italy) with a ratio of 1:9 w/v and subsequent homogenization in a stomacher (400 Circulator; International PBI s.p.a., Milan, Italy) for 60 s at 230 rpm. The homogenate thus obtained was incubated at 30±1°C for 24±1 h, followed by passage in Fraser Broth Base (FBB) (Biolife, Milan, Italy) with incubation at 37±1°C for 24±1 h. The first (from HFBB) and the second enrichment (from FBB) were seeded on Listeria Agar plates according to "Ottaviani and Agosti" (ALOA, Biolife, Milan, Italy) and on Listeria Palcam Agar (Biolife, Milan, Italy), both incubated at 37±1°C for 48±2 hours. The results of the microbiological analyses were evaluated on the basis of the parameters reported in the "Guidelines for Risk Analysis in the Field of Food Microbiology" drafted by Ce.I.R.S.A. (2013), which allow to distinguish a microbiologically altered food from a non-microbiologically altered one.

Chemical and physical analysis

All sampling units were analyzed for pH value, too, according to AOAC method 981.12-1982 (AOAC, 1982) with pHmeter Xs with immersion probe (Giorgio Bormac S.r.l., Carpi, Italy), after homogenization of the sample with distilled water at a ratio of 1:10. aW was performed according to ISO 18787:2017 (ISO, 2017d) using the AcquaLab 3Te series (Decagon Device, Pullman, Washington, U.S.A). All determinations were conducted in duplicate, and the value expressed is the average of the two results obtained.

Sensory analysis

The sensory analysis was performed to assess the organoleptic appearance of the products at DMD and DMD+7. For this purpose,

Table 1. Products analyzed in the present study and their category, ID, type, packaging, and pH and activity water (aW) values (mean value) at Date of Minimum Durability (DMD) and DMD+7.

Category	ID	Product type	Packaging	pH		aW	
				DMD	DMD+7	DMD	DMD+7
Cooked meat products	1	Mortadella	Slices - MAP	6.04±0.01	5.96±0.01	0.974±0.000	0.971±0.001
	2	Cooked ham	Slices - MAP	5.39±0.00	5.35±0.02	0.968±0.001	0.9648±0.000
	3	Roast turkey	Slices - MAP	6.05±0.01	5.97±0.01	0.978±0.001	0.980±0.000
	4	Pork shoulder	Slices - MAP	5.34±0.00	5.46±0.02	0.968±0.000	0.9689±0.000
	5	Mortadella	Slices - VP	6.03±0.01	5.98±0.01	0.973±0.000	0.972±0.001
	6	Lyoner	Slices - MAP	6.05±0.00	6.01±0.02	0.971±0.001	0.973±0.001
	7	Roast chicken	Slices - MAP	5.80±0.01	5.84±0.01	0.973±0.001	0.972±0.000
	8	Turkey breast	Slices - MAP	5.17±0.01	5.96±0.01	0.978±0.000	0.967±0.000
	9	Cooked pork shoulder	Slices - MAP	5.25±0.01	5.17±0.00	0.982±0.000	0.975±0.001
	10	Cooked ham	Slices - MAP	5.43±0.02	5.29±0.01	0.979±0.001	0.979±0.000
	11	Cooked ham	Slices - VP	6.13±0.01	6.17±0.01	0.978±0.001	0.975±0.000
	12	Mortadella	Slices - VP	5.66±0.00	6.04±0.00	0.971±0.000	0.975±0.001
	13	Roast turkey breast	Slices - VP	6.15±0.01	6.27±0.01	0.981±0.000	0.984±0.000
Raw cured meat	14	Smoked bacon	Slices - VP	5.41±0.01	5.70±0.02	0.939±0.001	0.939±0.001
	15	Raw ham	Slices - MAP	6.22±0.02	6.00±0.01	0.912±0.000	0.913±0.001
	16	Hungarian Salami	Slices - MAP	4.40±0.01	4.80±0.00	0.937±0.001	0.939±0.001
	17	Naples Salami	Slices - MAP	5.48±0.00	5.37±0.01	0.943±0.000	0.941±0.001
Dairy products	18	Smoked provola cheese	Slices - MAP	5.32±0.01	5.11±0.00	0.966±0.000	0.967±0.001
	19	Goat's fresh cheese	Whole - H-SPP	5.25±0.01	5.08±0.01	0.983±0.001	0.976±0.000
	20	Sweet Gorgonzola cheese	Slice - MAP	5.50±0.01	5.54±0.01	0.972±0.001	0.966±0.001
	21	Brie cheese	Whole - PPP	7.26±0.01	7.21±0.00	0.937±0.000	0.925±0.001
	22	Cottage cheese	H-SPP	4.68±0.01	4.55±0.01	0.997±0.001	0.996±0.000
	23	Cottage cheese	H-SPP	4.64±0.02	4.61±0.01	0.997±0.001	0.996±0.001
	24	Brie cheese	Whole - PPP	7.38±0.01	7.44±0.00	0.975±0.000	0.975±0.000
	25	Brie cheese	Whole - PPP	7.4±0.01	7.50±0.01	0.977±0.001	0.982±0.001
	26	Maasdamer cheese	Slices – VP	5.68±0.00	5.56±0.01	0.955±0.000	0.958±0.000
	27	Emmenthal cheese	Slices – MAP	5.51±0.01	5.64±0.00	0.962±0.001	0.961±0.001
	28	Mozzarella slices	Slices – MAP	5.36±0.01	5.12±0.01	0.971±0.001	0.981±0.001
	29	Bergader cheese	Slices - VP	5.25±0.01	5.40±0.01	0.937±0.001	0.925±0.001
	30	Brie cheese	Whole - PPP	6.85±0.02	7.40±0.00	0.990±0.001	0.979±0.001
	31	Cottage cheese	H-SPP	4.51±0.01	4.50±0.01	0.998±0.000	0.997±0.001
	32	String cheese	Slices - MAP	5.28±0.01	5.17±0.02	0.980±0.001	0.984±0.001
	33	Brie cheese	Whole - PPP	7.27±0.00	7.59±0.01	0.983±0.001	0.976±0.001
	34	Cottage cheese	H-SPP	4.41±0.01	4.43±0.01	0.999±0.001	0.998±0.000
	35	Cottage cheese	H-SPP	4.52±0.01	4.44±0.00	0.999±0.001	0.995±0.001
	36	Gouda cheese	Slices - MAP	5.45±0.02	5.34±0.01	0.963±0.000	0.966±0.001
	37	Emmenthal cheese	Slices - MAP	5.49±0.00	5.05±0.01	0.971±0.001	0.960±0.001
	38	Spicy Gorgonzola cheese	Slice - MAP	5.81±0.01	5.29±0.02	0.969±0.001	0.949±0.001
	39	Asiago cheese	Slices - MAP	5.34±0.01	5.13±0.01	0.966±0.001	0.967±0.001
	40	Smoked provola cheese	Slices - MAP	5.26±0.01	5.15±0.00	0.970±0.001	0.970±0.001
	41	Bavarian Emmenthal cheese	Slices - VP	5.44±0.02	5.50±0.01	0.955±0.001	0.953±0.001
	42	Provola cheese	Slices - MAP	5.54±0.01	5.39±0.00	0.977±0.001	0.982±0.000
	43	Emmenthal cheese	Slices - MAP	5.51±0.00	5.64±0.01	0.962±0.001	0.963±0.001

aW, activity water; DMD, date of minimum durability; MAP, modified atmosphere packaging; VP, vacuum packed.

the sensory evaluation was carried out according to ISO 6658:2017 (ISO, 2017e) and ISO 8589:2007 (ISO, 2007), with the participation of 10 people with experience in food microbiology, selected from the staff of the Laboratory of Inspection of Food of Animal Origin, Department of Veterinary Sciences, University of Messina (Messina, Italy). For each sample, the panelists evaluated the following parameters: "appearance", "odor", "color", and "taste or consistency", assigning a score to each descriptor of 0 if "acceptable", 1 if "acceptable but with minor modification", 2 if "not acceptable".

Results and Discussion

Out of the total of 43 samples analyzed, 17 were meat products, while the remaining 26 were dairy products. Considering the directions of the Ce.I.R.S.A. guidelines, in which the microbiological parameters evaluated for cooked and raw meat products were different, outcomes were analyzed by dividing the meat products into two categories: 13 were cooked meat products, while 4 were raw cured.

Physicochemical and microbiological analysis

According to the values reported in Regulation (EU) 2073/2005 (European Commission, 2005), the results of the physicochemical investigations on the total 43 RTE foods examined (Table 1) showed that 41 (95.4%) had pH and aW values such that they were considered "able to support the growth" of *L. monocytogenes*, while only 2 (4.6%) (raw ham, ID 15 and Hungarian salami, ID 16) were "not able to support the growth". Despite these outcomes, *L. monocytogenes* was detected with values <10 CFU/g in only one product (Brie cheese, ID 21). It can be hypothesized that the reason for the absence of the pathogen in almost all the products, despite pH and aW values which support its growth, is due to several factors, including: post-packaging heat treatments (*e.g.*, pasteurization); vacuum or MAP, which can reduce oxygen and slow down its growth such as the addition of any antimicrobial additives and preservatives (*e.g.*, nitrates, lysozyme) and, finally, excellent hygiene practices in modern industrial facilities, where attention is paid especially to the final stages of production, which are crucial for pathogen contamination. Indeed, *L. monocytogenes* may be part of the initial microbiota of RTE dairy and cooked meat products, which, even if inactivated during the cooking stage of these products, can re-contaminate the food at a later stage through indirect or direct contact of the product with contaminated surfaces, utensils, slicers, and environments (Nalbone *et al*., 2023; Nalbone *et al*., 2024a). This pathogen is of great concern due to its ability to grow during cold storage (Horita *et al*., 2018; Nalbone *et al*., 2024b; European Commission, 2005; Rodrigues *et al*., 2016).

Evaluation of meat products

The results of the microbiological analysis of all meat products examined are summarized in Figure 1. Concerning 13 cooked meat products, the AMM had an average load of 5.72±2.13 log CFU/g at DMD and 6.40±2.41 log CFU/g at DMD+7 days. The limit for the guideline recommended value of 10^6 CFU/g is beyond what is considered "not acceptable". In detail, 38.4% of the products had an unsatisfactory AMM load at DMD, while this condition was found in 53.8% of the samples 7 days later. However, this value, as rightly stated in the guidelines (if an unsatisfactory value is obtained, proceed to mesophilic LAB count), should be evaluated in relation to the possible lactic acid flora present; in fact, "*the food is considered to be in an altered state*" if the ratio of AMM/LAB is >100. As shown in Figure 2, 3 (ID 3; ID 6; ID 9) (23.1 %) and 4 (ID 3; ID 6; ID 9; ID 12) (30.7 %) products had values at DMD and DMD+7, respectively, that were considered to be deteriorated. A correlation was observed between the deteriorated products detected in the two analyses. For the ENT parameter analyzed, all products (raw and cooked) had loads below the detection limit (<10 CFU/g). The mean load values of PSE in meat products were 1.29±2.23 log CFU/g at DMD and 1.67±2.46 log CFU/g at DMD+7. In the smoked bacon sample (ID 14), an increase in yeasts and molds was observed from 3.72 log CFU/g at DMD to 8.11 log CFU/g at DMD+7. These loads explain the organoleptic changes found in the product at the sensorial analysis and are reported in sensory analysis results.

In raw meat products, none of the evaluable microbiological parameters reported in the guidelines were exceeded at DMD and DMD+7. These products are considered stable due to several factors, including aW, pH, NaCl percentage, and type of microflora,

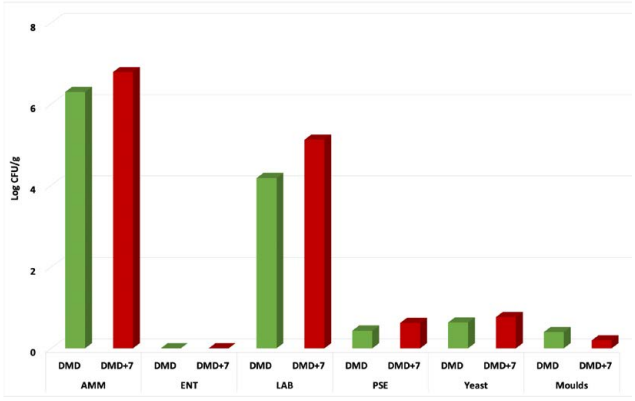

Figure 1. Mean value of the microbiological parameter of 17 meat products at the date of minimum durability (DMD) and DMD+7. AMM, aerobic mesophilic microorgasnim; ENT, Enterobacteriaceae; LAB, lactic acid bacteria; PSE, *Pseudomonas* spp; DMD, date of minimum durability; DMD+7, 7 days after the Date of Minimum Durability.

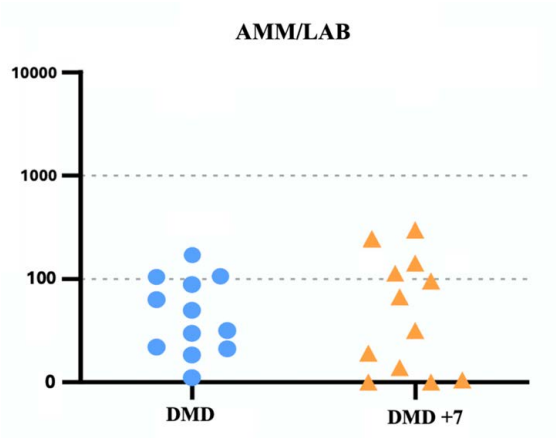

Figure 2. Ratio of aerobic mesophilic microorganisms (AMM)/lactic acid bacteria (LAB) of cooked meat products at date of minimum durability (DMD) and DMD+7; according to the Ce.I.R.S.A. guidelines, with a ratio value > 100 "the food is considered to be in an altered state".

and it is rare to find a significant microbial proliferation (Tiecco, 2001; Micheli *et al*., 2023).

Evaluation of dairy products

Figure 3 details the results of each microbiological parameter for dairy products. The results were evaluated according to the Ce.I.R.S.A. guidelines, where the "unripened cheese and string cheese" are considered in "an altered state" if the AMM parameter is $\geq 10^7$ CFU/g with yeasts $>10^6$ CFU/g, *Pseudomonas* spp. $>10^6$ CFU/g and LAB mesophilic $>10^8$ CFU/g.

Only 2 samples were classified as "in an altered state": the ID 20, sweet Gorgonzola cheese, at DMD and DMD+7, and the ID 24, Brie cheese, at DMD+7. The ID 20 (sweet Gorgonzola) at DMD showed, in fact, an AMM load of 8.11 log CFU/g with PSE load of 6.60 log CFU/g, while at DMD+7 an AMM load of 7.30 log CFU/g with PSE load of 6.67 log CFU/g. The ID 24 (Brie) at DMD+7 was characterised by an AMM load of 8.61 log CFU/g with a PSE load of 7.30 log CFU/g.

The sample ID 20 (sweet Gorgonzola) was also characterized by a high ENT value of 3.04 log CFU/g and 3.60 log CFU/g at DMD and DMD+7, respectively. ENT were also found in the other 4 (ID 21, ID 24, ID 29, ID 30) dairy products with a value <2 log CFU/g at DMD and DMD+7.

Results of sensory analysis

Out of the total of 43 products, at DMD 1 (ID 3) (2.3%) sample was "not acceptable" while 2 (ID 7; ID 20) (4.6%) were "acceptable with minor modifications" at sensory analysis. At DMD+7, the samples "not acceptable" were 3 (ID 2; ID 3; ID 24) (6.9%), while the samples "acceptable with minor modifications" were 5 (ID 6; ID 7; ID 9; ID 14; ID 25) (11.5%).

The alterations observed were mainly related to the odor (off-flavor) (ID 3; ID 6; ID 7; ID 20; ID 24; ID 25), the presence of liquid in the package (ID 2), greying that was observed in a roast turkey (ID 3), and sour taste in dairy products (ID 20; ID 24; ID 25). In the sample ID 14 (smoked bacon) on the surface was present a mold, presumably due to a micro-opening in the packaging.

The obtained results showed a good correlation between microbiological load and sensory analysis in meat (mainly in cooked meat products) and cheese (mainly Brie cheese) products.

The increase in the number of microbiologically and sensorially altered products between the first and second analysis is in line with the reports of several studies, systematically summarised by James *et al.* (2008) and James *et al*. (2017), which show that refrigerator temperatures, especially for RTE foods, should never exceed 6°C (preferably should be between 2 and 4°C). Adherence to reduced storage times can help avoid significant microbial growth before consumption.

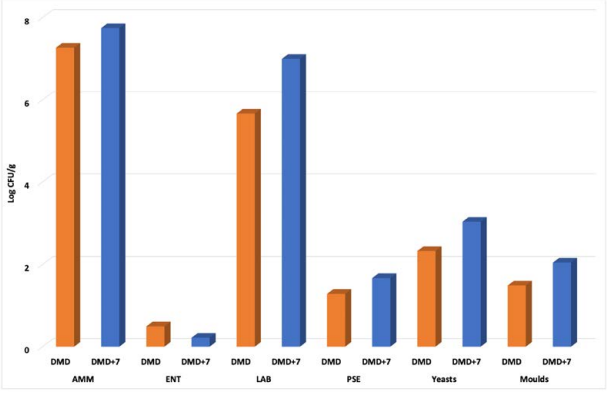

Figure 3. Mean value of the microbiological parameter of 26 dairy products at the date of minimum durability (DMD) and DMD+7. AMM, aerobic mesophilic microorgasnim; ENT, Enterobacteriaceae; LAB, lactic acid bacteria; PSE, *Pseudomonas* spp; DMD, date of minimum durability; DMD+7, days after the date of minimum durability.

Conclusions

The microbial and sensory changes observed in this study, according to Regulation (EC) 178/2002, highlight the need to label for some of these products with the "use by" date and not with the DMD, given their perishability and considering that, from a hygienic-sanitary point of view, a product that loses some or all of its typical characteristics due to organoleptic and/or nutritional modifications (non-perishable products) is not comparable to products in which the organoleptic changes are the consequence of microbial proliferation processes. In this regard, EFSA in its "Guidance on date marking and related food information" (EFSA, 2020) has stated that the indication of the "use by" date is mainly based on food safety considerations and does not take into account the state of spoilage, and therefore unacceptability for consumption, that certain products bearing the DMD may present.

The results of this study suggest that it is not fair to consumers to market food products that, although they can be consumed several days after the date indicated on the label, may be in a state of spoilage, with odors and unpleasant flavors, especially when stored at home.

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