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The right to food, food donation and microbiological problems of food safety: an experience in the territory of Florence

Guglielmo Bonaccorsi[1], Chiara Lorini[2], Francesca Pieralli[3], Luca Pieri[3], Antonino Sala[3], Tommaso Tanini[3], Marco Nasali[4], Beatrice Dall'Olio[5] and Francesca Santomauro[2]

[1]*Dipartimento di Medicina Sperimentale e Clinica, Università degli Studi di Firenze, Florence, Italy*
[2]*Dipartimento di Scienze della Salute, Università degli Studi di Firenze, Florence, Italy*
[3]*Scuola di Specializzazione in Igiene e Medicina Preventiva, Università degli Studi di Firenze, Florence, Italy*
[4]*Azienda Sanitaria Firenze, Florence, Italy*
[5]*Tecniche della Prevenzione dell'Ambiente e dei Luoghi di Lavoro, Università degli Studi di Firenze, Florence, Italy*

Abstract
Aim. The aim of this study is to understand whether the freezing without a rapid blast chiller represents a storage method for food at the end of shelf life that guarantees microbiological food safety, so to be considered an effective tool for the appropriate management of food in charitable organizations.
Methods. The study has been performed on 90 food samples, among those that a charitable foodservice trust receives by the large-scale distribution. The products have been frozen using a domestic refrigerator. The indicators used were: total aerobic microbial count, *Escherichia coli, Salmonella* spp, *Staphylococcus aureus, Campylobacter* spp, sulphite reducing clostridia.
Results. The results show that the preservation of the chosen fresh products at the end of shelf life in refrigerators, frozen without the use of chillers, is a potential management strategy to avoid the loss of edible food, while maintaining the safety standards.

Key words
- microbiological food safety
- right to food
- food donation
- charitable foodservice trust

INTRODUCTION

The right to food is one of the fundamental human rights [1] and is achieved when all people, at all times, have physical and economic access to safe and nutritious food, in order to satisfy their nutritional needs to live an active and healthy life. The right to food is an obligation that each Member State must ensure to all citizens [2].

Poverty and hunger are widespread phenomena, even in industrialized countries [3]. In Italy, in 2012, 12.7% and 6.8% of families live in condition of "relative poverty" or "absolute poverty", respectively [4]. This phenomenon indicates how much the average monthly expenditure of poor families is below the poverty line: the percentage value is equal to 19.9% for "relative poverty" and 17.3% for "absolute poverty".

Poverty and food shortages go hand in hand with food waste. Analysis carried out by FAO in 2011 estimates food waste in the world at about one-third of the total food production for human consumption [5]. In Italy, every year, every family wastes food equivalent to 7.06 euro/week (accounting for 0.5% of GDP) [6].

Losses and food waste generate negative environmental [7] and economic impacts [8], and have significant ethical and social implications [9]. In order to fight social inequalities, also in Italy there are many food networks that deal with the recovery, preparation and distribution of free food, in order to provide a balanced diet to people in need. One of these organizations is Caritas, which in the area of Florence serves about 1000 free meals/day to people in need [10], namely persons who do not have access to food and/or are unable to prepare and consume it because of temporary or permanent condition of poverty.

The food is provided in part by the European Union (HDPE-European Programme of Food Help) and in part is recovered from the surplus of the large-scale food distribution.

The problem of food donated by large-scale distribution is that it is not possible to make its amount constant during the year, and most of this has been donated near the end of shelf life. For example, after the Christmas holidays it is quite difficult to store and serve the great amount of recovered food within the shelf life, while in other periods the food recovery is scarce, so oblig-

Address for correspondence: Francesca Santomauro, Dipartimento di Scienze della Salute, Università degli Studi di Firenze, Viale G.B. Morgagni 48, 50134 Florence, Italy. E-mail: francesca.santomauro@unifi.it.

ing the ONGs (charitable foodservice trusts) to prepare simultaneously different types of foodstuffs, with an increased risk of cross-contamination or improper cooking, to satisfy the demand.

This very particular kind of food serving needs a standardized method to preserve food with the aim of making constant the amount of foodstuffs prepared for each single meal round (lunch and dinner): the use of a system of safe food storage next to the end of shelf life in order to satisfy the demand of people in need becomes therefore essential.

The National Law 155/2003 [11], known as the "Good Samaritan Law", puts on the same level the non-profit organizations to the final (domestic) consumers with regard to the transport and handling of food: for this reason, it is a common practice to freeze food without a chiller, in compliance with hygienic standards. This procedure let us think doubts and potential criticalities, since there are no references in literature which demonstrate the microbiological food safety, especially for foodstuffs at the end of shelf life.

The aim of this study is to understand whether the slow freezing, without a rapid blast chiller, represents a safe method of storage for food at the end of shelf life and can be considered an effective tool for the appropriate management of food in charitable organizations.

MATERIALS AND METHODS

The study has been performed on samples of precooked pizzas, raw poultry and raw rabbits which are among the more frequent foodstuffs Caritas receives by the large-scale distribution. The collection of the samples has been made in Florence (Tuscany) at the Caritas main centre of preparation and serving where volunteers provide on average 1000 free meals daily.

Caritas volunteers verified at each delivery that the products did not have evident signs of deterioration, nor package damages.

At the Caritas centre, the products have been frozen at -18 °C in the original packaging within the sell-by date in order to control potential manipulation. The freezing process has been monitored every hour for 24 hours by measuring the temperature of both the foods and the freezer. It has been used a domestic refrigerator, without the use of a thermal chiller, which owed the following technical characteristics.

All the products have been frozen for a period of 45 days, thawed at 4 °C for 48 hours and cooked within 24 hours.

The criteria adopted in food sampling are consistent with those required by law for official sampling (ex DM 16/12/93), with the exception of the number of samples collected for each single foodstuff: since it was not an official analysis, we collected single aliquots to investigate the food safety of the identified foodstuffs. Of each product, 250 grams were collected in three different moments: raw at the time of delivery (from now on "raw"), raw after thawing at refrigeration temperature (from now on "thawed"), and cooked.

The samples (30 for each of the above three moments) were transported within a portable refrigerator to the bacteriology laboratory of the Department of Public Health, University of Florence.

Microbiological analyses were performed in accordance with ISO/IEC 17025:2005 [12].

The analytical parameters related to the presence of foodborne pathogens or used as process indicators, were: total aerobic microbial count (TAMC), *Escherichia coli, Salmonella* spp, *Staphylococcus aureus, Campylobacter* spp, sulphite reducing clostridia [13].

The microbiological analysis was carried out according to the guidelines of Tuscan legislation, DGRT 55/98 [14] which has more restrictive reference cut-offs, thus more conservative than the European regulations.

The DGRT 55/98 identifies four hazard classes based on the levels of microbiological contamination: no hazardous (class I), potentially dangerous (class II), probably hazardous (class III), hazardous (class IV) (*Table 1*). The sample is assigned to the hazard class on the basis of the highest measured parameter.

RESULTS

The results of the microbiological tests performed on 90 samples of food expressed as colony forming unit per gram of sample – CFU/g are shown in *Figure 1*.

As regards the TAMC, 53% of the raw products (n = 16, 9 poultry and 7 rabbits) and 73% of the thawed products (n = 22, 4 pizzas, 9 poultry and 9 rabbits) appear to be in class IV. The TAMC is significantly reduced in all samples after cooking: 26 out of 30 samples analyzed (86%) appear to be in class I, 3 in class II and 1 in class III. A sample of cooked pizza and one of cooked poultry (values: $5x10^2$ CFU/g) and a sample of cooked rabbit (value: $3.5x10^2$ CFU/g) belongs to class II; a sample of cooked pizza belongs to the class III (value: $2x10^3$ CFU/g).

Regarding *Escherichia coli*, all samples belong to class I, except 4 undercooked samples classifiable in class II.

As for *Staphylococcus aureus*, some raw and thawed samples show values belonging to class III or IV, while all the cooked samples are in class I. In particular, a sample of raw rabbit belongs to class III (value: $6.6x10^2$

Table 1
Food Hazard classes according to Tuscan Law (each single value is the exponential to base 10)

HAZARD RISK	Raw and thawed (CFU/g)				Cooked (CFU/g)			
	TAMC	*E. coli*	*S. aureus*	Clostridia	TAMC	*E. coli*	*S. aureus*	Clostridia
Class I	< 5	< 2	< 1	< 1	< 2	< 1	<1	< 1
Class II	> 5 - < 6	> 2 - < 3	> 1 - < 2	> 1 - < 2	> 2 - < 3	> 1 - < 2	> 1 - < 2	> 1 - < 2
Class III	> 6 - < 7	> 3 - < 5	> 2 - < 3	> 2 - < 3	> 3 - < 4	>2 - < 3	> 2 - < 3	> 2 - < 3
Class IV	> 7	> 5	> 3	> 3	> 4	> 3	> 3	> 3

CFU: Colony Forming Unit

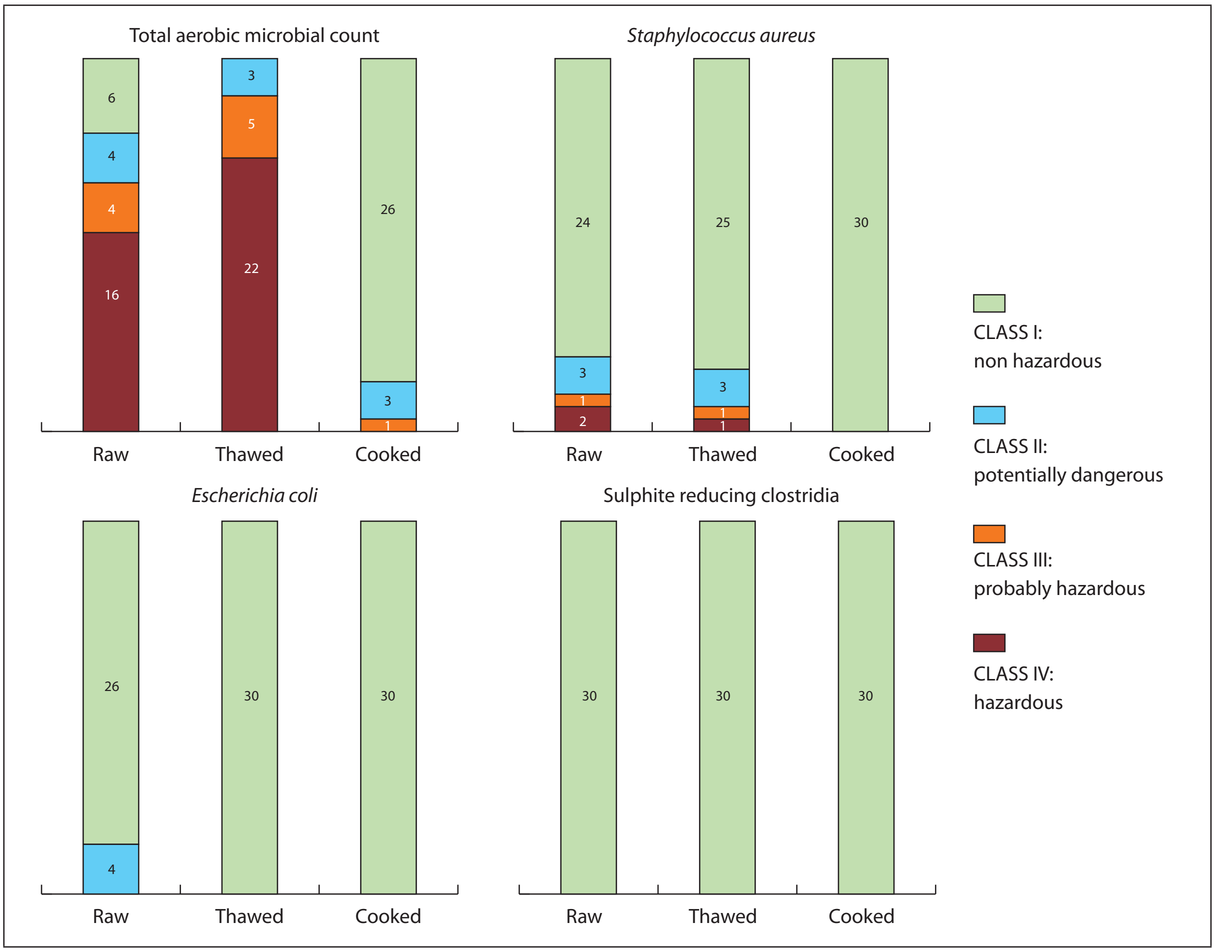

Figure 1
Microbiological results (N = 90; 30 raw, 30 thawed and 30 cooked)

CFU/g), two samples of raw rabbit belong to class IV (value: 2.8x10^3 CFU/g and 1.3x10^4 CFU/g). A sample of thawed rabbit is in class III (value: 4.6x10^2 CFU/g) and one in class IV (value: 2x10^3 CFU/g).

As regards sulphite reducing clostridia, all the values recorded are in class I.

Salmonella spp and *Campylobacter* spp are absent in all the samples.

Overall, considering the contamination of each commodities (pizza, poultry and rabbit), no differences were observed in raw products vs thawed ones.

DISCUSSION AND CONCLUSION

Results show that cooked products have an acceptable risk profile and can be consumed by Caritas hosts, because almost all values belong to class I (no hazard).

The identification of 3 cooked samples in class II and one in class III, in regard to the total aerobic microbial count, seems not to have consequences on the safety of cooked products, since this is an indicator of hygiene, but not directly related to the pathogenicity of the foodstuff [15].

The products have proved to be safe with regard to the isolation of human pathogens such as *Salmonella* spp, which was not detected in all the raw food samples, as well as in thawed and cooked ones.

As for *Escherichia coli*, which is an indicator of fecal contamination, all the microbiological values were lower than 1000 CFU/g.

Campylobacter spp were absent in all samples. The research of *Campylobacter* spp allowed us to verify the effectiveness of the processes applied (cooked in the oven, steamed and grilled) confirming the safety of the cooking process.

The preservation of the products in the original packaging has significantly reduced the risk of human contamination [16]. *Staphylococcus aureus* in cooked samples showed values always less than 10 CFU/g (no hazard), confirming proper handling of foods by the volunteers.

The good level of process hygienicity is also confirmed by the presence in the class I of all samples analyzed with regard to the search of sulphite reducing clostridia, indicators of environmental contamination [17].

The limits of the study are the small number of samples analyzed and the fact that the results have been obtained for a single structure, though this is, in the territory of Florence and its surroundings, probably the most excellent soup kitchen as regards to the application of Hazard Analysis and Critical Control Points (HACCP) system.

The use of Tuscan legislation cutoffs for the risk classification is a strength point, since it adopts more restrictive criteria than those used by the existing Community legislation [12]. This has allowed us to adopt a "precautionary principle" approach, in accordance with the aim of evaluating the food safety at the end of shelf life.

Our study, without claiming to be exhaustive, represents one of the first researches that aims, through freezing, to prolong the shelf life of a product at the end of it.

Our study showed that the shelf life of a product does not necessarily correspond to its "real life" of usability in such a way to preserve consumers' safety and with acceptable (or, in the best cases, no) loss of nutritional principles. This consideration is particularly important in a period of economic crises like this, and for food systems which try to give concrete answers to a growing number of people in starvation, with temporary or chronic inability to buy and prepare food.

Considering only microbiological results, the preservation of the chosen fresh products at the end of shelf life in refrigerators, frozen without the use of chillers, can be performed with acceptable risk profile.

These results are consistent only in the case in which the procedure offers experimental safety warranties: in our case, we have tested and validated food safety for periods of cold storage not exceeding 45 days, and with the following operating parameters: minimum performance requirements refrigerating equipment; freezing of packaged products without manipulation; thawing in the refrigerator at a temperature of + 4 °C for no more than 48 hours; cooking the products within the 24 hours after thawing.

The use of a standardized procedure is a potential management strategy to avoid the loss of edible food; it can help in the achievement of sustainability and, though partially, in fighting against poverty by improving food accessibility, while maintaining the safety standards.

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Conflict of interest statement

None to declare.

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