Microbiological quality of organic and conventional tomatoes

Qualidade microbiológica de tomate convencional e orgânico

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Sila Mary Rodrigues FERREIRA[1*], Renato João Sossela de FREITAS[2], Cesar Aparecido da SILVA[1], Elisa Noemberg Lazzari KARKLE[3], Thaís Carolina Bassler MAIA[4]

*Endereço para correspondência: [1]Departamento de Nutrição, Universidade Federal do Paraná – UFPR, Av. Prefeito Lothário Meissner, 632, Jd. Botânico - Curitiba/Paraná, Brasil. CEP 80210-170. Tel: (41)33604017. E-mail: sila@ufpr.br, PR Brasil.

[2] Programa de Pós-Graduação em Tecnologia de Alimentos, Universidade Federal do Paraná-UFPR.

[3] Kansas State University, Grain Science and Industry, 785-532-6011, Manhattan - KS, EUA.

[4] Universidade de Cuiabá – UNIC, Mato Grosso, Brasil.

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ABSTRACT

In view of the need to inform the producers, dealers and consumers about the capability of the vegetables in being a vehicle for microorganisms, they should receive suitable hygienic and sanitary treatment. This paper aimed at evaluating the microbiological quality of organic and conventional tomatoes (*Lycopersicon esculentum Mill.*) commercialized in Curitiba city, southern Brazil. Eight samples of conventional tomatoes and four samples of organic tomatoes were collected from different sites. The microbiological analyses for detecting *Salmonella* spp and molds and yeasts were conducted according to the Compendium of Methods for Microbiological Examination of Foods. Total coliforms and *Escherichia coli* were analyzed by the Petrifilm™ methodology. The data were analyzed by variance analysis and Tukey tests. No *Salmonella sp* was isolated from 25 g of tomato samples. The total coliform counts ranged up to $1.4x10^3$ CFU/g and *Escherichia coli* up to $2.3x10^2$ CFU/g in conventional tomatoes. Yeasts and molds were found in conventional tomato samples up to 2.1x10, and up to 1.04×10^{12} CFU/g in organic tomato samples. This study clearly shows that the tomatoes ought to receive suitable hygienic and sanitary treatment before being commercialized.

Keywords. organic tomato, conventional tomato, microbiological quality.

RESUMO

Em razão da necessidade de mostrar aos produtores, fornecedores e consumidores que os vegetais são veículos de microrganismos e que devem receber tratamento higiênico-sanitário adequado, o presente estudo avaliou a qualidade microbiológica de amostras de tomate (*Lycopersicon esculentum Mill.*) orgânico e convencional, comercializados na região metropolitana de Curitiba – Sul do Brasil. Foram coletadas oito amostras de tomate convencional e quatro de tomate orgânico de diferentes locais. A detecção de *Salmonella* spp, fungos e leveduras foi efetuada de acordo com o *Compendium of Methods for Microbiological Examination of Foods*. Para a pesquisa de coliformes totais e Escherichia coli foi empregada a metodologia de petrifilm™. Os dados foram submetidos à análise de variância e teste de Tukey. *Salmonella sp* não foi detectada em 25 gramas de amostras de tomate; os coliformes totais variaram até $1,4 \times 10^3$ CFU/g e a *Escherichia coli* até $2,3 \times 10^2$ CFU/g nas amostras de tomate convencional. Os bolores e as leveduras foram isolados das amostras de tomate, cujos valores foram de 2,1 x 10 no tomate convencional, e de até $1,04 \times 10^{12}$ UFC/g no tomate orgânico. Este estudo evidenciou a necessidade da realização de tratamento higiênico-sanitário adequado nos tomates antes de sua comercialização.

Palavras-chave. tomate orgânico, tomate convencional, qualidade microbiológica.

INTRODUCTION

The importance in characterizing the hygienic conditions of vegetables and fruits is evident, especially those that are consumed raw, since they act as a vehicle for microorganisms transmission that might cause food intoxication. Sanitation procedures can decrease the presence of microorganisms, thus being a quality control measure in the whole development and manipulation process[1,2].

The highest risk of contamination is caused by agricultural practices that involve use of animal and vegetal fertilizers[3]. The situation is serious in less developed countries, where the use of natural or partially treated fertilizers is a common practice. The risk is even greater in vegetables that grow next near the soil. Besides the natural composition, the soil presents other factors such as moisture, temperature and pH that favor the survival of a large number of microorganisms[2].

The interest for products of agro-ecological agriculture has been rising over the past years. As a consequence, consumers have an expanded possibility of choosing between products arising from organically grown or conventional products in big city retailers. However, despite the practical difference in the growing systems, consumers have no information about the quality and properties of products grown in different production systems.

The organic system of agriculture has been emerging rapidly. As part of a strategy to sustainable development, there is a tendency of substituting the conventional systems by organic ones in the area of Curitiba (city in southern Brazil), as a protection measure to the manancial area. Few works[1,3] have reported the quality characteristics of organic products, specially tomatoes.

Based on the discussion above and on the lack of comparative information on tomato contamination, this work was conducted in order to evaluate the microbiological quality of tomato samples (*Lycopersicon esculentum Mill*) commercialized in Curitiba city, southern Brazil.

Table 1. Samples of organic and conventional tomatoes commercialized in Curitiba city, southern Brazil

Sample[1]	Group	Cultivar	Origin
C1	Oblong, Santa Cruz	cv. Santa Clara	Producer[3]
C2	Round, Salad	cv. Raísa (LL)[2]	Producer[3]
C3	Round, Salad	cv. Raísa (LL)[2]	Producer[4]
C4	Round, Salad	cv. Raísa (LL)[2]	Producer[4]
C5	Oblong, Santa Cruz	cv. Santa Clara	Supermarket
C6	Round, Salad	cv. Carmen (LL)[2]	Supermarket
C7	Round, Salad	cv. Carmen (LL)[2]	Supermarket
C8	Round, Salad	cv. Raísa (LL)2	Producer[4]
O1	Oblong, Santa Cruz	cv. Santa Clara	Producer[5]
O2	Oblong, Santa Cruz	cv. Santa Clara	Producer[6]
O3	Oblong Santa Cruz	cv. Santa Clara	Producer[6]
O4	Oblong, Santa Cruz	cv. Santa Clara	Producer[4]

NOTE: (1) Production system: C = Conventional and O = Organic; (2) LL = long life; (3) State supply center = Curitiba; (4) Colombo city; (5) Campo Magro city; (6) Campo Largo city

MATERIAL AND METHODS

Samples

There were collected of different places, 12 tomatoes samples (*Lycopersicon esculentum* Mill.), being 8 samples of conventionally grown (C) and 4 organically grown (O), commercialized in the area of Curitiba. Four wooden boxes arising from different positions were collected in each commercial point selected (Table 1). The boxes were transported to the laboratory, homogenized in a stainless steel container and fruits from different points were caught. Following a completely randomized design, 5 fruits were collected for the analyses. The time between the collection of the samples and its separation did note take more than 12 hours.

Analysis

The microbiological analyses were conducted according to the Compendium of Methods for Microbiological Examination of Foods[4] for *Salmonella* spp. and molds and yeasts (CFU/g). For total coliforms (CFU/g) and *Escherichia coli* (CFU/g) the method Petrifilm™ was applied[5]. For the sample preparation was used five tomatoes. From crushed fruits was withdrawal a portion of 25 grams that was diluted in 225 mL of buffered peptone water (BPW) at 0.1%. Preparations of subsequent decimal dilutions were performed in tubes containing 9 mL of the diluent up to 1/1000. The petrifilm™ method, carried out in two stages, was used to determine colony forming colony-forming units per gram (CFU/g) of total coliforms e *Escherichia coli* at 35 °C for 48 hours[5]. *Salmonella* spp. was detected in four successive steps. The sample contained in the saline peptone water was incubated at 37 °C for 18-24 hours. The sample was transferred to two different tubes of enrichment selective and incubated at 37 °C for 24 hours. After the incubation period, each sample was seeded in plates of Petri with brilliant green agar (BGA) and in *Salmonella Shigell*a agar (SS) and, after that, they were incubated again at 37 °C for 24 hours. Since there was no development of colonies it was not necessary the identification of the sort of *Salmonella*[4]. For of count yeasts and molds were used 1 mL aliquots of each dilution were grown using potato dextrose agar (PDA). After the culture medium solidification, the plates were incubated at 30 ºC for 48 hours days, and the colonies were quantified[4].

The standards and criteria for *Salmonella* spp. (absence in 25 g) according to the general legislation for vegetables[6] since there are no standards specifically for tomatoes. For *Escherichia coli* we followed the standard recommended for faecal coliform (10^2 CFU/g) in accordance with current legislation for vegetables[6]. For total coliforms (CFU/g) and yeast count, the acceptable limit of $<10^2$ was adopted[7]. This count ensures consumer health protection, since counts above 10^4 CFG/g indicate potentiality to form micotoxins. The results were submitted for variance analysis using the software Excel®. The comparison among the averages was performed by Tukey test (p > 0,05).

RESULTS AND DISCUSION

Microbiologic characterization of tomatoes is really important. Since this produce is often consumed raw, there is a strong reason for the increase of the quality control by hygienic monitoring and sanitary practices from harvest to sale.

The results of microbiological analyses of organically grown and conventional tomatoes are demonstrated in Table 2.

The results show that all of the samples presented absence of *Samonella* spp. in 25 g, complying with the Brazilian legislation for vegetables[6] and confirming the results of Bandekar[8] and Pingulkar[9], who found low levels of contamination by this microorganism in vegetables. On the other hand, Nguz et al.[3] detected *Salmonella* spp. in 13.3% of fresh-cut organic mixed vegetables analysed.

The conventional tomato samples C1 and C2 and the organic samples O2 and O3 showed a total coliform count above 10^2 CFU/g (Table 2), indicating poor practices of post-harvest. Results above 10^3 CFU/g were also found in fruits and vegetables[2,3,8,9]. Pingulkar, Kamat and Bongirwar[9] found total bacterial counts in 10^4 CFU/g and a higher range of bacterial (10^6 - 10^8 CFU/g) counts were noticed in ready-to-eat salads from restaurants. This count is considered high[6], which indicates that these products need adequate washing before consumption. Although tomatoes are not grown in direct contact with soil, the contamination may occur due to irrigation water and/or contamination during harvest by the handler. It is also a common practice among the workers to place the tomatoes on the ground while waiting the transportation boxes.

Table 2. Microbiological analysis of conventional and organic tomatoes commercialized in Curitiba city, southern Brazil

Sample	*Salmonella* spp. (Presence in 25g)	Total coliforms (CFU*/g)	*Escherichia coli* (CFU/g)	Molds and yeast (CFU/g)
C1	Absence	$>1.11x10^3$a	$2.3x10^2$a	$5x10^2$a
C2	Absence	$1.11x10^3$a	1x10b	2.8x10b
C3	Absence	1.5x10b	Nd**	$3.92x10^3$b
C4	Absence	3.33x10b	2x10b	$1.31x10^4$b
C5	Absence	Nd**	Nd**	2.4x10b
C6	Absence	7.2x10b	7.2x10c	2.1x10b
C7	Absence	Nd**	Nd**	2.2x10b
C8	Absence	15c	Nd**	$3.27x10^4$d
O1	Absence	1x10c	1x10b	8x103c
O2	Absence	$1.73x10^2$d	Nd**	$1.04x101^2$e
O3	Absence	$1.4x10^3$a	1x10b	$2.47x10^4$d
O4	Absence	Nd**	Nd**	$1.11x10^4$d

*NOTE: * CFU = Colony-forming unity; **Nd = not detected; a,b,c,d. Values in the same column followed by different superscripts are significantly different (p< 0.05)*

Tomato contamination may be caused by the use of wooden boxes, which are reused without proper cleaning and favor microbiological growth. This is considered a favorable condition for fruit contamination since this type of box cannot be sanitized. Once externally contaminated and with no aseptic treatment, the fruit may become a vehicle for human contamination and for contamination of the inner part of the fruit, through cracks caused by injuries. The container used for unprocessed vegetables such as tomatoes can be disposable or returnable. When it is returnable, the box must be resistant to handling and sanitizing, cannot be a contamination vehicle and must follow the specifications of good practices applied to food.

Regarding *Escherichia coli*, only the sample C1 had a count above 10^2 (CFU/g)[6]. These results are similar to those from other studies about the organic and conventional vegetables[1,3,8,9]. Nguz et al.[3] reported levels of *Escherichia coli* in fresh-cut organic vegetables of up 10^3 (CFU/g).

The presence of total coliforms and *Escherichia coli* indicates unsatisfactory hygienic-sanitary conditions and represents a threat to consumers since this group of microorganisms indicates contamination by human or animal faces.

The molds and yeast count in conventional and organic tomatoes (Table 2) were compared to the limit of 10^2 (UFC/g)[7], since there is no legal limit for tomatoes or vegetables. The results demonstrate that half of the conventional tomato samples had a count above 10^2 (UFC/g). Similar results were also found for fresh-cut organic vegetables mixed[3].

The samples C4, C8, O2, O3 and O4 had yeast count above 10^4, a potential risk to consumers if not properly washed before raw consumption. Similar results (10^4 CFU/g) were also found for tomatoes by Pingulkar[9].

Based on the results of the microbiological analyses, it was observed that the counts were higher for organically grown tomatoes. The highest contamination of organic tomatoes might be explained by the use of animal fertilizer, the irrigation water and/or contamination during harvest by the handler.

The results indicate that both organic and conventional tomatoes commercialized in Curitiba city, southern Brazil, need be properly washed before consumption. Also they need of good practices applied to food.

CONCLUSION

Based on the microbiological analyses of organic and conventional tomatoes commercialized in Curitiba city, it can be concluded that: there is no contamination by *Samonella* spp. in both conventional and organic samples; for total coliforms in samples C1, C2, O2 and O3 the count was above 10^2 (CFU/g); only sample C1 has a count above 10^2 (CFU/g) for *Escherichia coli*; half of the conventional samples and all of the organic samples had a yeast and mold counts above 10^2 (CFU/g);

The results confirm the need of a better control of good practices, from the harvest to commercialization of tomatoes. There is also the need of proper sanitation of the product before consumption.

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