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REUSE OF SANITIZING SOLUTION IN TOMATO HYGIENIZATION (*Lycopersiconesculentum Mill*) IN INDUSTRIAL KITCHENS

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ABSTRACT

Fruits and vegetables are factors that promote microorganisms that can associated with a food infection and, consequently, to transmitted diseases for food. There are numerous causes for the presence of high load microbial in this type of product, among which are the cultivation techniques, storage, transportation and distribution for consumption. Handling and preparation and vegetables for human consumption are crucial to reducing microbial in these types of products and consequently reduce the incidence of Foodborne diseases. The choice and proper chemicals are critical to the food industry. These sanitizers their effectiveness in the elimination of microorganisms. on an industrial scale, water consumption has been increasing greatly to sanitation of the food in question. Aiming at improving safety and consumption of water in industrial kitchens, it becomes necessary to determine an appropriate proportion of sanitizing solution that may reduce water consumption and consequently ensure effective food.

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INTRODUCTION

tomato (*Lycopersiconesculentum Mill*) is one of the most produced fruits in Brazil and consumed worldwide, its cultivation is widespread in all the continents and represents one of the main sources of vitamins and minerals for the population, it is cultivated in more than one hundred countries for both consumption in nature and as industrialized products (BRITO, 2010; CASTRO, 2017; VILELA, 2012). It is considered one of the healthiest foods because of its low caloric potential, favors the supply of micronutrients, fibers and other components with functional properties. A healthy diet plays an important role in maintaining health, especially fruits, vegetables and vegetables, which bring significant benefits. However, if consumed inadequately, they are one of the ten main risk factors for diseases (CAMPOS, 2010 and FONTES, 2005). The occurrence of foodborne diseases is a public health problem and is directly related to food hygiene procedures, so many microorganisms can adversely affect the quality and safety of these products, considering that pathogenic microorganisms, normally not present in the fruits and vegetables, may become part of the contaminating microbiota, resulting from the handling to which they are submitted (RISSATO, 2015; BRUNO, 2004). Fruits and vegetables are potential carriers of microorganisms that may be associated with foodborne infections and, consequently, foodborne diseases. There are many causes for the presence of high microbial load in this type of product. These include cultivation, storage, transport and distribution techniques for consumption, the use of organic fertilizer, the use of contaminated water for irrigation (SANTOS, 2012). In this way, the correct handling and preparation of fruits and vegetables for human consumption, in order to reduce the microbial load in these types of products and consequently to reduce the incidence of foodborne diseases. Thus, the sanitization and sanitization of fruits and vegetables are necessary in order to avoid microbiological contamination of food (CASTRO, 2017). Among the sanitizers most used in the food industry for hygiene purposes, chlorinated compounds stand out. However, the reduction of microbiological efficiency coupled with the potential toxicity of chlorination by-products has made this process increasingly less attractive

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(SILVA, 2011). Chlorine is the most widely used sanitizer in food, and although chlorination slows down the spread of foodborne infectious diseases, the effect of chlorinated compounds on the environment is of great concern (COSTA, 2014). Thus, sodium hypochlorite, due to its fast action, easy application, complete dissociation in water, is the only sanitizing agent allowed by Brazilian legislation (NASCIMENTO, 2010). In this context of prioritization to the health and efficiency of the sanitizing agent, the present work had as objective to evaluate the possibility of reuse of the solution, used in the sanitization of tomato, in industrial kitchens and to improve the sanitization process.

MATERIALS AND METHODS

The experiments were carried out in the chemistry laboratories, at the Campus of Exact and Technological Sciences - Henrique Santillo - State University of Goiás, located in the city of Anápolis, Goiás. The tomato samples were collected at the State Supply Center (SSC), in the Municipality of Anápolis - GO, transported and selected for size and red coloration. After the tomatoes were selected, they were washed in running water for total removal of soil surface contamination. Then, in the second cleaning step, the fruits were submitted to the sanitization process in NaClO aqueous sanitizing solution, at a concentration of 2.4% in chlorine, the fruits were kept immersed in this solution for 10 minutes. Microbiological tests were performed on the first wash water, denominated Sample A. After the sanitization of the tomatoes the sanitizing solution was stored for reuse and a sample of the same was collected to verify the efficacy of the removal of the bacterium. And this solution was called Sample B. This procedure was repeated in all sample shipments. A new solution for washing water was collected in each replicate to remove dirt (Sample A). while the sanitizing solution was reused, aiming to evaluate its sanitizing capacity, due to the number of samples submitted to the same procedure. Then, using the iodometric method, the chlorine content in the sanitizing solution, which was again stored properly, was determined to be reused in the next step. The analyzes were carried out in 5 sample stages, collected on different days and the whole preparation process of the tomatoes for consumption was also repeated. The whole process of collection and sanitization of the samples is described in the flowchart shown in Figure 1

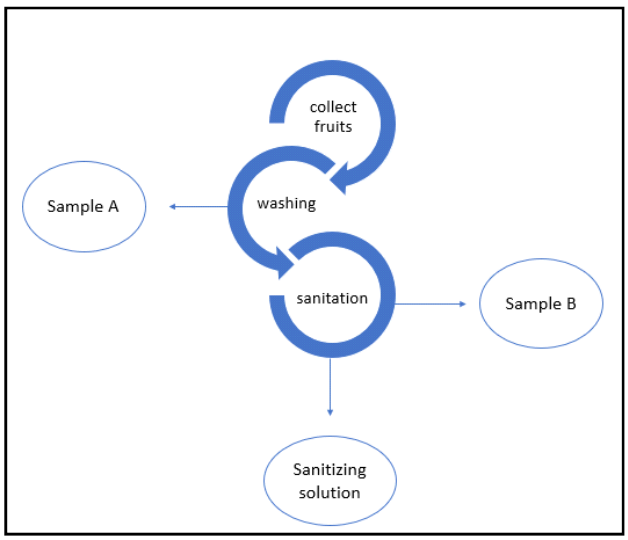

Figure 1. flowchart of the sample collection and sanitization process

A solution of 0.2 mol L -1 H_2SO_4 was used to avoid CO_2 conversion of the medium into carbonic acid, since the CO_2 produced by the microorganisms in the sample solutions was used to monitor the presence of microorganisms as well as the proliferation in microbiological solutions. Monitoring of the existence and proliferation of microorganisms in the sample solutions was performed as described below: A 1 mL aliquot of each sample solution was separated into glass vials and 5 mL of a sample medium were added to each vialculture called minimal medium. The culture medium was used to promote the proliferation of possible microorganisms present in the sample solutions. The solutions of the samples and the culture medium were separated into four distinct nomenclatures, being:

- Sample A - water from the first wash of each sample; without the presence of sanitizing solution;
- Sample B - sanitizing solution after sanitization of tomatoes, reused on all consignments;
- Sample C - culture medium, used as a blank in relation to the presence of microorganisms;
- Sample D - culture medium inoculated with the bacteriumEscherichia coli(*E. coli)*, used as reference medium in relation to the presence of microorganisms.

The *E. coli* bacterium was chosen as a reference because it shows a greater vestige in food contamination, by the ingestion of unhealthy foods unhygienized or improperly processed [1]. The aliquots of the test samples were packed in glass vials and kept in a water bath for 4 hours at 37 °C. During this period, monitoring was performed to detect the presence of microorganisms in said solutions. This procedure was performed using a continuous flow analysissystem.

Equipment and Accessories: The continuous flow system built in the laboratories of the CCET-UEG Campus (Figure 2), is constituted with a peristaltic pump, Milan, model 204, equipped with Tygon tubes, for pumping the solutions, PTFE tubes with internal diameter of 0.8 mm, for channeling of the solutions, two solenoid valves three-way, Nresearch 225T031, Housing, MA, USA; two semiautomatic timers, built in the laboratory, to connect the valves for a defined time; a gaseous diffusion chamber, constructed in acrylic, composed of a teflon membrane, to allow the separation of the analyte (CO_2) from the sample medium; a TECNAL Conductor, Model, Tec-4MP, a conductivity cell for flow system, to monitor variations in CO_2 concentration produced by the microorganisms in the sample solutions. A water bath Solab, Model: SL 155, was used to maintain the temperature of the solutions around 37^{o}C, an ideal condition for the proliferation of inoculated microorganisms; analytical balance of the Gehaka brand.

Description of operation of the flow system: It is a closed system, offering adequate conditions for analysis involving microorganisms, with the purpose of avoiding or minimizing contamination of the laboratory with them. According to the analysis module shown in Figure 2, with the valves v_1 and v_2 being switched off, the carrier solution flows through the path c_1, through the separation chamber Cd, to the discard. To insert the sample solution, the valve (v_1) is connected for a predetermined time interval and at a given flow to delimit the volume of sample to be inserted in the analytical path of the flow system.

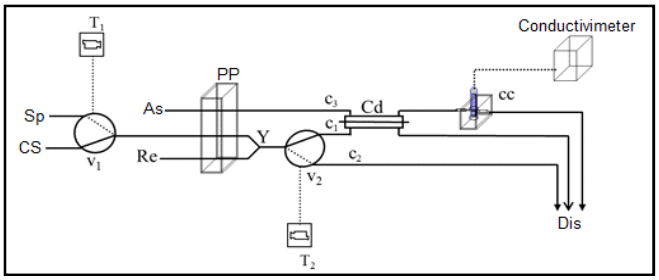

Figure 2. Streaming system analysis module

Description of the system: Sp= sample; CS= Carrier solution, deionized H_2O; Re = Reagent (H_2SO_4); As = acceptor solution, deionized H_2O; v_1 and v_2 = three-way solenoid valves; PP = peristaltic pump; Y = point of confluence; c_1 = path 1; c_2 = path 2; c_3 = path3; Cd = gas diffusion separation chamber; T_1 and T_2 = semi-automatic timers; cc = conductivity cell; Dis = discard.

After sampling, v_1 is switched off, flowing back to the carrier solution carrying the sample solution, passing through the confluence point Y, where it meets the reagent (H_2SO_4 0.2 molL-1). The mixture flows through channel c1, through the separation chamber, where CO_2 is separated from the reaction medium, passing from channel c_1 to channel c_3, intercalating in the receiver solution that is transported to the discharge, passing through the conductivity cell cc of the conductivity meter, where a signal proportional to the concentration of CO_2 produced by the microorganisms in the sample solution is generated. The valve (v_2) positioned in the analytical path is only switched on during exchange of sample solution, this is used to deflect sample solution residues, via path c_2 going straight to the discharge,without passing the detector. Thus, v_2 is coupled together with v_1 for a suitable time interval to effect the exchange of sample solution and thereby speeding up the analytical frequency. Then, v_1 and in sequence v_2 are switched off, flowing back the carrier solution by c_1.

In this condition you can start a new sampling cycle. As for semiautomatic timers, they are devices constructed in the laboratory, with a time scale ranging from 0.5 seconds to 5 minutes. These accessories allow electronic components to be switched on and off, in a time interval defined by the analyst. It is made up of a key that once activated, turns on the appliance and keeps it switched on during the previously defined time interval, at the end of this period it automatically switches it off. For this flow system, the timers were constructed with the purpose of turning on and off the three-way solenoid valves v_1 and v_2 required for chemical analysis. Sampling is performed using timer t_1 to turn on v_1, which must be held constant to accurately reproduce the volume of sample to be inserted in the analytical path of said system.Upon shutting down v_1 and keeping v_2 on for a longer time, the carrier solution will continue flowing through c_2, discarding all the residue generated during the exchange of sample solution.

All optimization conditions of the analyzes were defined experimentally. The separation chamber (Cd) consists of two acrylic plates, both containing a channel on the surface that allows the passage of the acceptor and carrier solutions, separated by a permeable membrane of polytetrafluoroethylene (PTEE) to the volatile species, as shown in Figure 3, which evidences the PTEE membrane with the blue coloration.

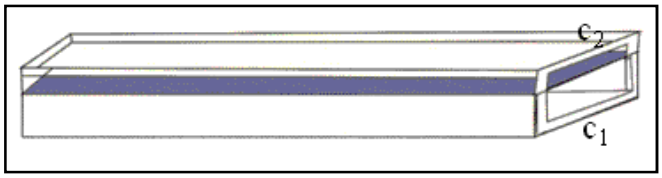

Figure 3. Gaseous diffusion separation chamber channels C_1 and C_2

The sample solution is pumped through the chamber channel c_1, where the CO_2 produced by the microorganisms permeates the PTEE membrane into the c_2 channel and meets the acceptor solution (deionized water). When CO_2 meets with water it is converted to carbonic acid, which in aqueous medium undergoes ionization as shown in Equation 1. These ions pass through the conductivity cell of the conductivity meter, where the ion concentration is monitored continuously, generating a real-time reading signal.

$$CO_2 + H_2O \; HCO_3^- + CO_3^{2-} + H^+ \longrightarrow \text{Eq.1}$$

The efficiency of process in the microbial control, depends on the quality and the initial microbial load of raw material [4].

RESULTS AND DISCUSSION

The evaluations of solutions A, B, C and D of each sample were carried out over a period of 4 hours, and the readings were performed at 25 minute intervals. The sanitizing solution was reused as soon as its efficiency in eliminating the microorganisms in said solutions was observed, as shown in the graphs of Figures 4 and 5. It can be observed in the results shown in the graphs of Figure 4 that in all samples a high microbiological load was found. In the graphs (Figure 4I, 4 II, 4III and 4IV), solutions A, generated in the first wash of each tomato sample and solutions D, constituted of culture medium inoculated with *E. coli*bacterium, used as reference medium, presented positive microbiological test, this information was related to the population growth of the microorganisms in the medium, over time. In the comparison of the graphs between both solutions, a more pronounced proliferation was observed in solutions A, evidencing a larger population of microorganisms in the same or the existence of different microorganisms with characteristics similar to the *E. coli*bacterium. For sample B (sanitizing) up to the sanitation process of the fourth stage, no variation was observed in the signal, thus showing its efficiency in the elimination of the microorganisms present in the sample solutions. In samples C, used as a blank culture medium, that is, without inoculation with the *E. coli* bacterium, no variation was observed in the signal either, thus ensuring that it was free of contamination by microorganisms. In the fifth sample, whose results are represented in the graphs of Figure 5, it can be observed that solutions A, C and D maintained the evidence recorded in Figure 4. The same did not occur with solution B (sanitizing), since a marked variation in the signal was observed, meaning the beginning of an inefficiency of the same, due to the elimination of the microorganisms present in the sample solutions.This demonstrates that the content of the active principle of the sanitizer has been degraded, making it unsuitable for microbiological control. In this condition the chlorine content was 1.7%, lower than the recommended 2.4%, thus confirming the information described above.

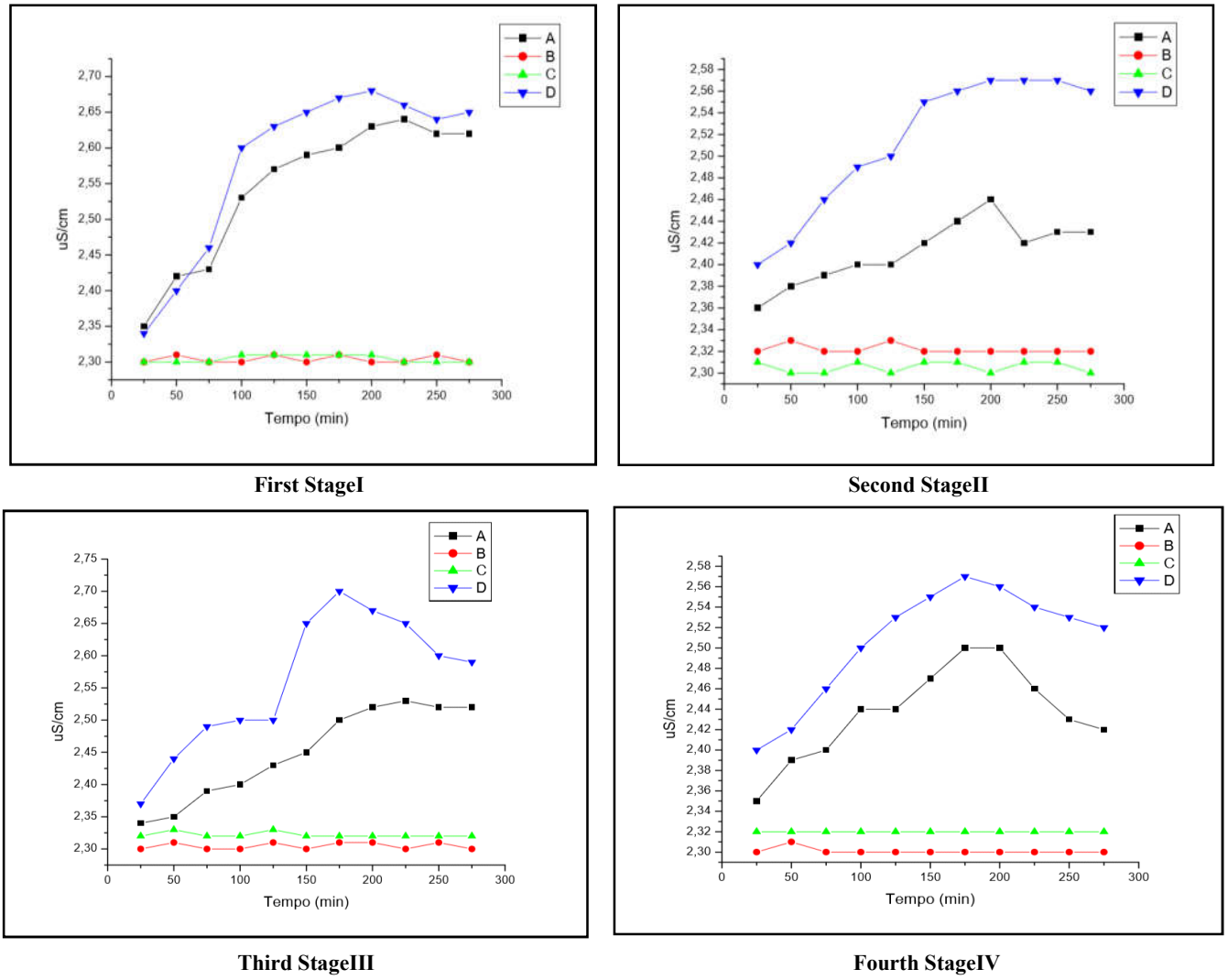

Figure 4. Detection and monitoring of microorganisms in tomato samples, evaluation of the reuse of the sanitizing solution, in the preparation of 4 samples for consumption

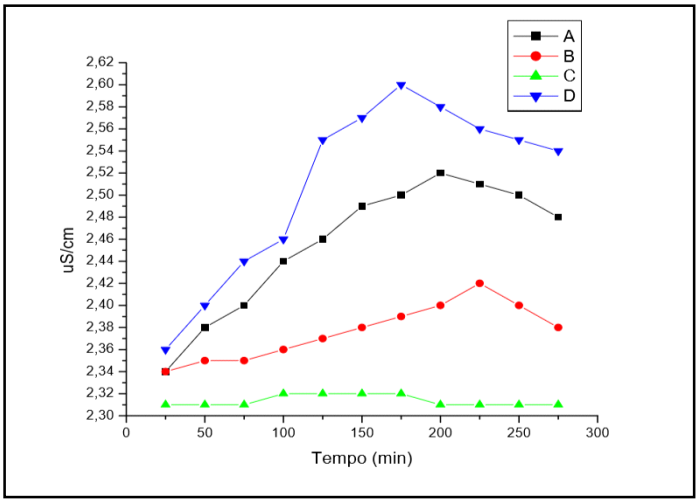

Figure 5. Detection and monitoring of microorganisms in tomato samples. Evaluation of the reuse of the sanitizing solution in the preparation of the 5th sample for consumption

Based on the results it can be stated that up to the fourth sample, the sanitizing solution proved to be effective in eliminating microorganisms present in the sample solutions, and therefore in the preparation of tomatoes for consumption. However in the fifth sample, said sanitizing solution becameinefficient regarding the elimination of microorganisms.

Thus, in these experimental conditions, it can be recommended to be reused four times, in the proper preparation of tomatoes for consumption. Its re-use culminates with advantages, both in terms of reagent economy and water, as well as benefits to the environment.

Conclusion

Firstly, the good performance of the proposed flow system in the monitoring of the CO_2 concentration produced by the microorganisms in the sample solutions is of particular importance, in order to detect the presence and the proliferation of the microorganisms in said solutions. In all analyzed samples, the presence of microorganisms was verified, thus justifying the need to sanitize these fruits in their preparation process for consumption.The sanitizing solution used showed positive results regarding the elimination of the microorganism in the solutions of the samples.Another advantage of this solution is its efficient reuse in four batches of samples, thus favoring a great saving of water and of regent.Therefore this methodology converges for a significant saving of both reagent and water, besides benefits to the environment.

REFERENCES

ALVES, A. R. F. Eating disorders of bacterial origin. 87f. Dissertation (Master in Pharmaceutical Sciences). Facultyof Health Sciences, Fernando Pessoa University, Porto, 2012.

BRITO, L.; CASTRO, S.D. Expansion in the production of industrial tomatoes in Brazil and Goiás. Conjuntura EconômicaGoiana, Bulletin Quarterly. Goiânia: Secretary of Planning and Development of the State of Goiás, p.43-52, 2010.

BRUNO, L. M.; PINTO, G. A. S. Application of chlorine in the preparation of fresh vegetables for domestic consumption. Revista Agronômica, v.35, Special Issue, p. 259-263, 2004.

CAMPOS, V. C.; BASTOS, J. L.; GAUCHE, H.; BOING, A. F.; ASSIS, M. A. A. Factors associated with adequate consumption of fruits and vegetables in adults in Florianópolis. Revista Brasileirade Epidemiologia, v.13, n.2, p.352-362, 2010.

CASTRO, F.T.; OLIVEIRA, S.P.; TABAI, K. C. Impacts on the hygienic and sanitary conditions of the fruit and vegetable retail trade in Rio de Janeiro-RJ communities. RevistaBrasileira de Economia Doméstica, Viçosa, v.28, n.1, p.201-223, 2017.

COSTA, S.B.; GUEDES, M. C. M.; PINTO, M. M. F.; EMPIS, J.; MARTINS, M. M. Alternative sanitizing methods to ensure safety and quality of fresh-cut kiwifruit. JournalofFoodProcessingandPreservation, v.38, p.1-10, 2014.

FONTES, P. C. R.; SILVA, D. J. H. Olericultura: theoryandpractice. Viçosa, MG: Federal Universityof Viçosa, 2005. 486p.

NASCIMENTO, M. S.; SILVA, N. Chemical treatments in strawberry sanitization (*Fragaria vesca* L.). BrazillianJournalFood Technology. v.13, n.1, 2010.

RISSATO, E.A.S.; BONNAS, D.S. Evaluation of the efficiency of the implantation of a standard operating procedure (POP) in an institutional nutrition and nutrition unit. In: 5th Symposium on food security Food and Health, 2015, Bento Gonçalves. Anais. Bento Gonçalves: Federal Universityof Rio Grande do Sul, 2015. v.5, p.14

SANTOS, J.S. ; OLIVEIRA, M.B.P.P. Minimally processed fresh food packaged in modified atmosphere. BrazilianJournalofFoodTechnol, Campinas, v.15, n.1, p.1-14, 2012.

SILVA, S. B .; LUVIELMO, M. M .; GEYER, M. C .; PRÁ, I. Potentialities of the use of ozone in food processing. Agrarian Sciences, v.32, p.659-682, 2011.

VILELA, N.J.; MELO, P.C.T.; BOITEUX, L.S.; CLEMENTE, F.M.V.T. Socioeconomic profile of the agroindustrial chain in Brazil. In: CLEMENTE, F.M.V.T.; BOITEU, L.S. (eds). Tomatoproduction for industrial processing. Brasília: Embrapa, 2012. p.17-22.

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