

**Efeito da sanitização em couve (*Brassica oleracea* L.) minimamente processada**  
**Effect of sanitization on minimally processed cabbage (*Brassica oleracea* L.)**  
**Efecto de la desinfección sobre la col minimamente processada (*Brassica oleracea* L.)**

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## Resumo

O objetivo desse estudo foi avaliar o efeito da sanitização em couve (*Brassica oleracea L.*) minimamente processada. Trata-se de um estudo do tipo: quantitativo, descritivo e laboratorial. As amostras foram submetidas a três processos diferentes, sendo: lavagem somente em água corrente; lavagem em água corrente seguida do uso de sanitizante à base de hipoclorito de sódio e, por fim, lavagem em água corrente seguida de sanitização utilizando compostos clorados à base de dicloroisocianurato de sódio. Posteriormente, foram realizadas as análises microbiológicas de coliformes totais e *Escherichia coli* e *Salmonella ssp.* Os resultados evidenciaram que a solução à base de hipoclorito de sódio não apresentou redução na carga microbiana, enquanto aqueles à base de dicloroisocianurato de sódio permitiram a redução a níveis seguros para consumo humano. Sugere-se um controle maior nos produtos à base de hipoclorito de sódio uma vez que possivelmente esse resultado foi devido à baixa concentração de cloro ativo livre.

**Palavras-chave:** Hortaliças; Qualidade microbiológica; Compostos clorados.

## Abstract

The aim of this study was to evaluate the effect of sanitization on minimally processed cabbage (*Brassica oleracea L.*). This is a quantitative, descriptive and laboratorial study where the samples were submitted to three different processes: washing only in running water; washing in running water followed by the use of sodium hypochlorite-based sanitizer and, finally, washing in running water followed by sanitization using chlorinated compounds based on sodium dichloroisocyanurate. Subsequently, microbiological analyses of total coliforms *Escherichia coli* and *Salmonella ssp.* were performed. The results showed that the sodium hypochlorite-based solution did not present a reduction in microbial population, while those based on sodium dichloroisocyanurate allowed the reduction to safe levels for human consumption. A greater control in sodium hypochlorite-based products is suggested, since possibly this result was due to the low concentration of free active chlorine.

**Keywords:** Vegetables; Microbiological quality; Chlorinated compounds.

## Resumen

El objetivo de este estudio fue evaluar el efecto de la desinfección en el repollo procesado mínimamente (*Brassica oleracea L.*). Este es un estudio del tipo: cuantitativo, descriptivo y de laboratorio. Las muestras se sometieron a tres procesos diferentes, que son: lavar solo con agua corriente; lavado en agua corriente seguido del uso de desinfectante a base de hipoclorito

de sodio y, finalmente, lavado en agua corriente seguido de desinfección con compuestos clorados a base de dicloroisocianurato de sodio. Posteriormente, los análisis microbiológicos de coliformes totales y *Escherichia coli* y *Salmonella ssp.* Los resultados mostraron que la solución basada en hipoclorito de sodio no mostró reducción en la carga microbiana, mientras que aquellos basados en dicloroisocianurato de sodio permitieron la reducción a niveles seguros para el consumo humano. Se sugiere un mayor control en productos basados en hipoclorito de sodio ya que este resultado posiblemente se debió a la baja concentración de cloro activo libre.

**Palabras clave:** Verduras; Calidad microbiológica; Compuestos clorados.

## 1. Introduction

The consumption of vegetables, mainly in the minimally processed form, such as cabbage, has been significantly grown as a factor justified by nutritional benefits and, mainly, convenience/practicality, considering these foods are most often sold and/or ready for consumption (Santos *et al.*, 2019).

Corresponding to the accelerated growth in the consumption of minimally processed food, there is also an increase in the number of people affected by foodborne diseases, widely known as FBD's. Thus, it requires the correct application of sanitization procedures, since they present a high rate of contamination by various microorganisms, generally related to the intake of such products (Saraiva *et al.*, 2019; Santos *et al.*, 2017).

The sanitization of vegetables is essential to ensure microbiological quality, since this process aims to eliminate pathogenic microorganisms and reduce the deterioration, to levels considered as safe. These adopted processes should be, in addition to being effective, safe by the toxicological point of view (Silva, 2018).

Regarding the ability to reduce microorganism populations by the use of sanitizers, as there are variations related to the physicochemical characteristics of foods that are submitted to this process. In addition, the contact time, type of microorganism and concentration directly influence the inhibitory effect. Therefore, it is of fundamental importance the use of antimicrobials that have proven efficacy against microorganisms, such as *Escherichia coli*, in the recommended contact time and dilution (Brasil, 2016).

Among the chemical compounds used in the food sanitization process, iodinated compounds, peracetic acid, quaternary ammonium, chlorinated compounds, and others can be listed. The chlorinated compounds, which are the most used by their relative cheaper cost, act quickly and in low concentrations, easy to apply and have a wide spectrum of action. However, because of their instability, the storage should occur in dark packages, properly closed, in ventilated places and protected from light (Germano & Germano, 2015; Nunes et al., 2010).

Chlorinated compounds are classified into two categories: organic and inorganic. Inorganic chlorinated compounds are: sodium hypochlorite, calcium hypochlorite and lithium hypochlorite, chlorine gas and chlorine dioxide. Organic compounds, on the other hand, are represented by: chloramine T, dicloramine T, dichloro dimethyl hydantoin, trichloroisocyanuric acid and dichloroisocyanuric acid (Germano & Germano, 2015).

Nunes et al. (2010) ensure that chlorinated compounds in their different forms, such as sodium hypochlorite (inorganic), sodium dichloroisocyanurate (organic), are widely used in the process of sanitization of food, at the household and industrial level. These compounds act by denaturation of proteins of the microbial cellular membrane, causing their death.

Considering the importance of the sanitization process to ensure the distribution of a microbiologically safe food, it is necessary to maintain constant vigilance about food safety. In this sense, the study was conducted with the aim of evaluating the effect of sanitization in minimally processed cabbage (*Brassica oleracea* L.).

## **2. Material and Methods**

This is a study of the type: quantitative, descriptive and laboratorial. The procedure was performed at the Food Microbiology Laboratory of the State University of Southwest of Bahia, with samples of vegetables (minimally processed cabbage) obtained at a fair in Vitória da Conquista - Bahia, Brazil.

The samples were submitted to three different treatments: washing only in running water (Treatment A); washing in running water followed by the use of sodium hypochlorite-based household sanitizer (Treatment B) and, finally, washing in running water followed by sanitization using chlorinated compounds based on powdered sodium dichloroisocyanurate (NaDCC) (Treatment C), commonly used in institutional restaurants. The prepared solutions

and the time of contact with the sanitized food, followed the descriptions presented on the labels of the products. Subsequently, microbiological analyses of total coliforms, *E. coli* and *Salmonella ssp.* were performed, according to the parameters recommended by Normative Instruction no. 60 (Brasil, 2019).

Initially, serial dilution was performed, using 25g of the minimally processed cabbage samples in 225 ml of 0.1% peptonized water, thus the first dilution ( $10^{-1}$ ) which after homogenization, 1 ml of the first dilution was transferred to 9 ml of peptonized water, subsequently forming  $10^{-2}$  and  $10^{-3}$  dilutions by the same method.

For the analyses of total coliforms, thermotolerant coliforms (*E. coli*), and *Salmonella ssp.*, the procedures described by the American Public Health Association (2001) were adopted. To present the results, the MPN Table was used to verify the most likely number of total coliforms and *E. coli* per gram of sample. For *Salmonella ssp.*, the result was expressed in absence or presence.

### 3. Results and Discussion

The results of microbiological analyses comparing the efficacy of sanitization are presented in table 1.

**Table 1.** Microbiological standard of minimally processed cabbage with and without sanitization.

Treatments	Total coliforms MPN/g	<i>E. coli</i> MPN/g	<i>Salmonella ssp.</i>
A - Cabbage SS	1100	3,6	Abs
B - Cabbage SAS	>1100	460	Abs
C - Cabbage S	93	0	Abs

A - Cabbage SS: Washed cabbage in running water without sanitization; B - Cabbage SAS: Washed and sanitized cabbage with sodium hypochlorite solution; C - Cabbage S: Washed and sanitized cabbage with sodium dichloroisocyanurate; Abs: absence; MPN/g: Most probable number per gram.

In the analyses of the results presented in Table 1, regarding total coliforms, an important effect was observed in the reduction of such microorganism populations, when comparing Treatment C with Treatment A. This result was expected, since sodium dichloroisocyanurate is a product with a high concentration of active chlorine, which contributes to the reduction of microbial population (Germano & Germano, 2015).

Comparing the results of Treatment B with the other treatments, it was found that it had no effect, since the counting of these microorganisms were higher than those present in the samples that were only washed in running water (Treatment A).

Regarding the *E. coli* counting test, the Normative Instruction no. 60 (Brasil, 2019), which revokes the Resolution of the Collegiate Board (RDC) no. 12/2001 (Brasil, 2001), presents as reference values of 102 MPN/g for fresh vegetables, *in natura* and 10 MPN/g for foods undergoing sanitization. As presented in the previous table, it can be observed that the cabbage sanitized with sanitary water in a solution indicated by the product label for application in food, it was not efficient, and the values were higher until the cabbage was washed in running water.

The objective of sanitization is to reduce the microorganism population to safe levels, in other words, this reduction must be within the values recommended by the Normative Instruction to ensure the safety of food, however, it was observed that in treatment B (sodium hypochlorite) was not able to reduce total coliforms and neither *E. coli*.

This result can be explained by the low concentration of active chlorine in the product. In a study conducted by Souza et al. (2019) evaluating the efficiency of household sanitizers in reducing the microbial population in fresh lettuce, found that in the three evaluated sanitizers, only one presented the chlorine concentration among the values mentioned on the label and at the appropriate concentration for food sanitization (100 to 200 ppm).

Ferreira et al. (2011), evaluated the efficacy of sanitization of fresh lettuce *in natura*, commercialized in supermarkets in Campo Grande - MS, Brazil, submitted to sanitization with sodium hypochlorite at 2% for 15 min, in which they verified that there was a reduction in the population of thermotolerant coliforms in comparison with samples that were not submitted to the process. In the present study, it was not evidenced, as in the study by Souza et al. (2019).

Regarding the analysis of presence of *Salmonella spp*, it was observed that all samples were in consonance with the standards recommended by Normative Instruction no. 60 (Brasil, 2019), which recommend the absence in fresh *in natura* vegetables, as well as, for those that are submitted to a sanitization process.

Further studies are needed to analyze the efficiency of other household sanitizer brands based on sodium hypochlorite to investigate whether it is a problem in a specific brand or it occurs also in others.

#### 4. Conclusion

The chlorinated compound based on sodium hypochlorite did not presented the expected efficacy. Therefore, it is suggested that these products should be evaluated for the presence of active chlorine, to ensure, thus, the sanitizing action predicted by the product, since it is widely used for cleaning at household level.

In regard to sodium dichloroisocyanurate, it was found that it was effective in relation to microbial action, which can ensure the consumer a food free of contamination and, consequently, reducing the risk of foodborne diseases.

As a suggestion of future studies, it is indicated to evaluate the effect of other sanitizers based on sodium hypochlorite in other minimally processed vegetables. In addition, the quantification of active chlorine by different methodologies.

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