

## PRELIMINARY STUDY REGARDING POSSIBILITY TO USE UV-C RADIATION ON MEAT PRODUCTS

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*Keywords: radiation, treatment, thermic.*

### ABSTRACT

*In a world where food safety not only can no longer be ignored but new rules appear, experts in the field are looking for new and new solutions. Sometimes we return to the ideas that were abandoned in the past due to the economic efficiency. Given that the production of electricity is becoming cheaper due to renewable resources, the pasteurization of meat products through UV-C radiation can be one of the solutions.*

### INTRODUCTION

Food safety challenges are present in many ways. Possibilities for contamination occur throughout the entire supply chain, including harvesting, processing, storage, and transport to consumers. Contamination causes significant food loss and waste. (Verma, 2019) To reduce the content in contamination microorganisms, including pathogen bacteria there are a lot of alternative methods for decontamination such as high hydrostatic pressure, gamma irradiation (US FDA, 2011), pasteurization steam and thermic pasteurization ((Wani, Jagpreet, Joseph, Jeremy, & Ian, 2015), meat sterilization etc. These processes have a negative effect over the physico-chemical and sensorial meat properties. Nowadays there are a real interest regarding nonthermal treatments of food products. (APHIS, 2012). Meat is usually marketed as raw material; thermic treatments are not preferred due the negative effect over the quality. Chemical methods, especially chlorine treatments to clean meat surface has been used in technological practice to decontaminate meat surface for food borne. Anyway, recent studies show that this methods leave a high concentration in chlorine products on the meat surface.

On the other hand, researchers has evaluate non thermal technologies to decontaminate foods at the room temperature, keep in integrity meat chemical composition, without any residual substances. Ultraviolet-light (UV-light) is one such non-thermal technology that is approved for surface treatment of food (Guan, Fan, & Yan, 2012; US-FDA, 2011). The germicidal effect of UV-light (UV-C) is between 245 and 285 nm (Yaun, Sumner, Eifert, & Marcy, 2003), thus it may be an alternative surface decontaminant to be used for inactivating bacteria and viruses. However, the inactivation of microorganisms by UV-light depends on the UV dose (EPA, 1999). Therefore, researchers currently are focusing on finding potential antimicrobial blends that can enhance food preservation and at the same time satisfy green consumerism (Hyldgaard et al., 2012).

### MATERIALS AND METHODS

Pork sausages in frozen form are considered belong to category "ready to eat-ready to heat". Meat products – pork sausages- has a special advantage for

the consumers and producers. For human body frozen pork sausages are considered as friendly products due the tradition recipes used in preparation and high content in proteins, lipids, and mineral substances Fe, Ca, K, S, Mg. No preservatives, colorants, taste potentiators or other chemical components were added to the recipe.

Pork sausages were obtained in laboratory, based on receipt used in meat factory. All the machine from meat factory were used in a small laboratory scale. The technological flow, the order of operations, the manufacturing recipe, the working time for UV-C radiation were

respected and could be translated to the industrial level.

#### *Sausages production*

The laboratory production recipe and method are presented in table 1. Raw and auxiliary materials were provided by local suppliers. Brat preparation consists by mixing 1.2 kg of minced meat with 30 g of salt. When the mixing process is ended the brat has been left to maturation for 2 hours. Water from brat composition was added to permit mixing of all the components. Pork fat after cutting into cubes was added to permit brat emulsification.

*Table 1.*

**Raw material and auxiliary materials used in meat sausages laboratory production**

RAW MATERIALS		AUXILIAR MATERIALS	
TYPE	MASS (kg)	TYPE	MASS (g)
Brat	1,4	Peper	1
		Nutmeg	0,6
Pork solid fat	0,6	Paprika	1
		Garlic	1



**Figure 1. Blending process**



**Figure 2. Filling process and presentation of the natural sausages**



a.



b.

**Figure 3. UV-C treatment for pork sausages: a. in natural membranes; b. in artificial membranes.**

The filling was performed using the filling machine and is shown in Figure 2

Filling the composition regardless of the recipe was performed both in natural sheep membranes with a diameter of about 2 cm and in artificial membranes with a similar diameter.

#### **UV-light production and treatment**

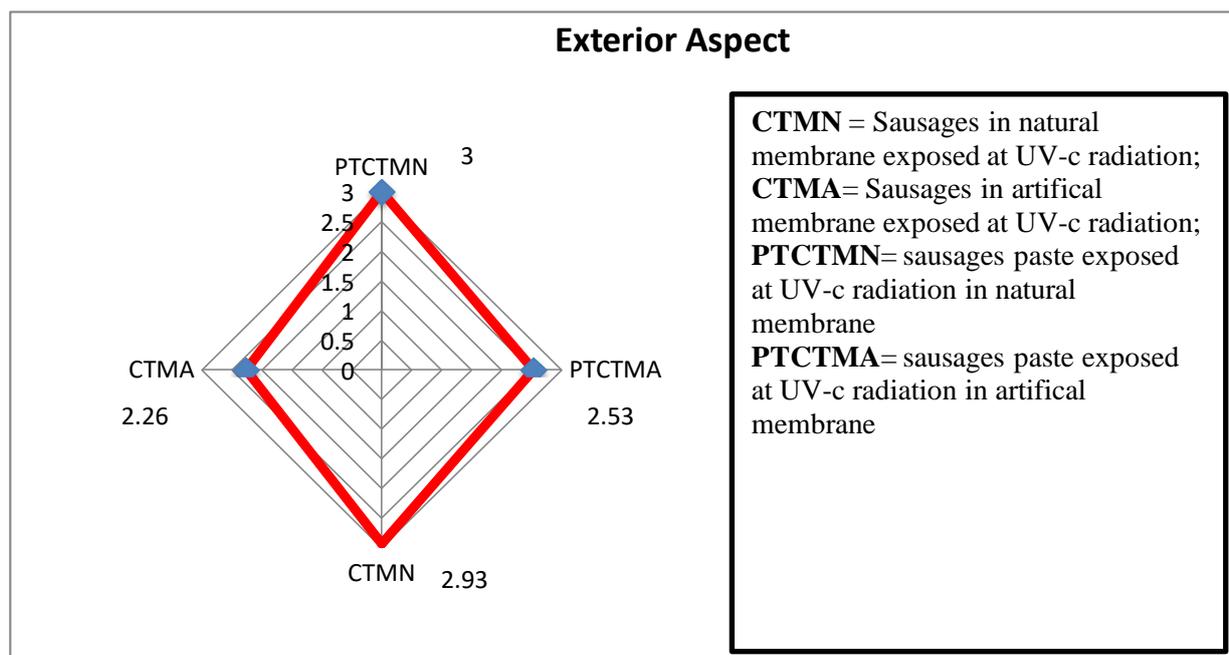
Ultraviolet light was provided by using a Spectrolinker, XL-1500 Series (Spectronics Corporation, Westbury, NY). The unit was factory calibrated at 5 cm. Energy dosage used for each treatment was calculated based on intensities and treatment time used. The set energy dosage was applied by setting intensity and time.

### **RESULTS AND DISCUSSIONS**

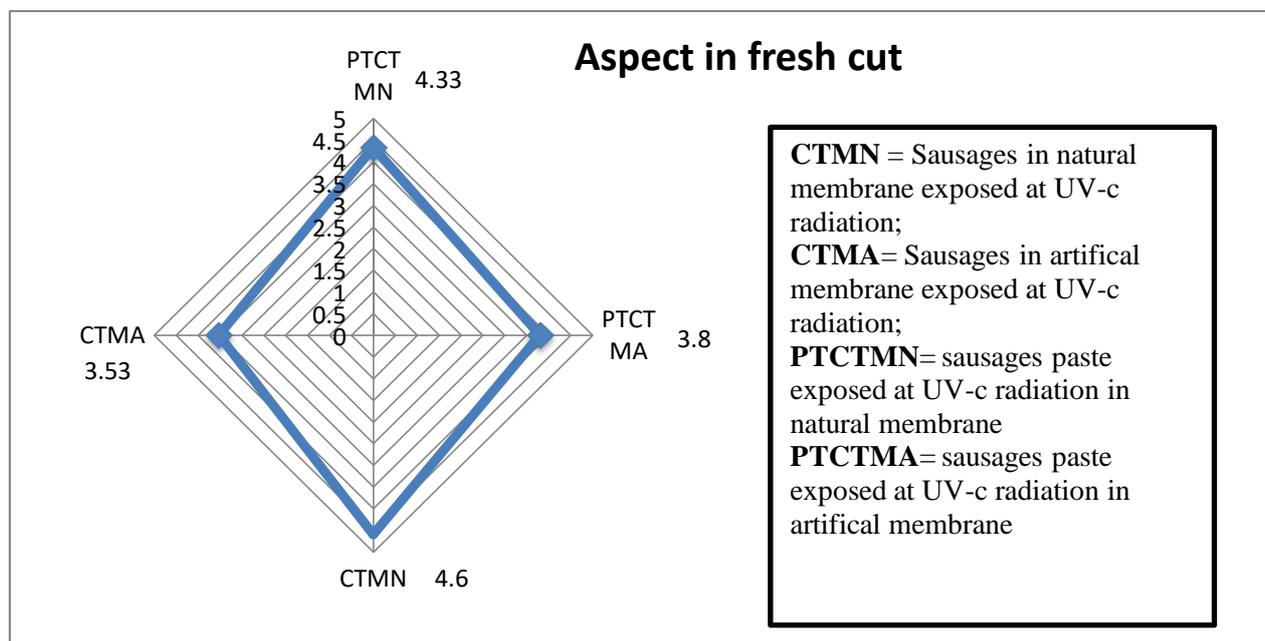
*Sensorial analyses.* Eleven examiners were involved in sensorial analyses. Each person pointed exterior texture, section texture, consistence, taste and smell. For each characteristic evaluator give points from 0 to 3 for exterior texture; 0 to 5 for interior texture; 0 to 5 for taste and 0 to 4 for smell (odor). Figures 4, 5, 6, 7 present the results obtained after sensorial test for sausages prepared in natural membrane and treated with UV-C radiation.



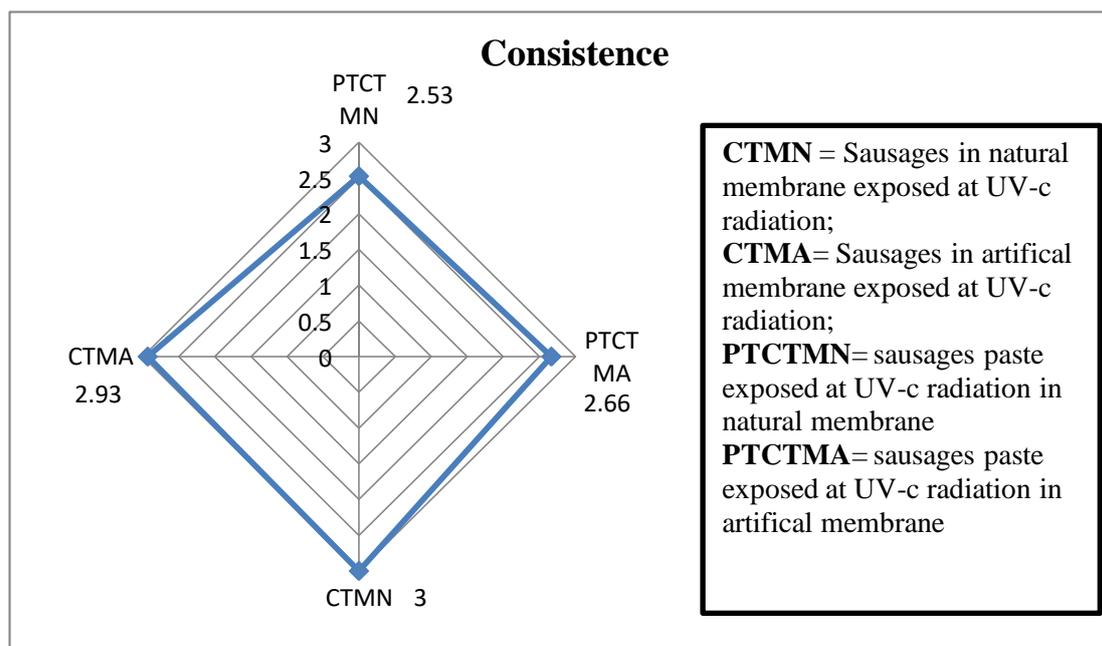
**Figure 4. Samples before sensorial exam.**



**Figure 5. Exterior aspect sensorial analyses**  
**CTMN – sausages UV-C treatment in natural membrane**  
**CTMA - sausages UV-C treatment in artificial membrane**  
**PTCTMN-Paste from sausages UV-C treatment in natural membrane**  
**PTCTMA - Paste from sausages UV-C treatment in artificial membrane**



**Figure 6. Aspect in fresh cut**  
**CTMN – sausages UV-C treatment in natural membrane**  
**CTMA - sausages UV-C treatment in artificial membrane**  
**PTCTMN-Paste from sausages UV-C treatment in natural membrane**  
**PTCTMA - Paste from sausages UV-C treatment in artificial membrane**



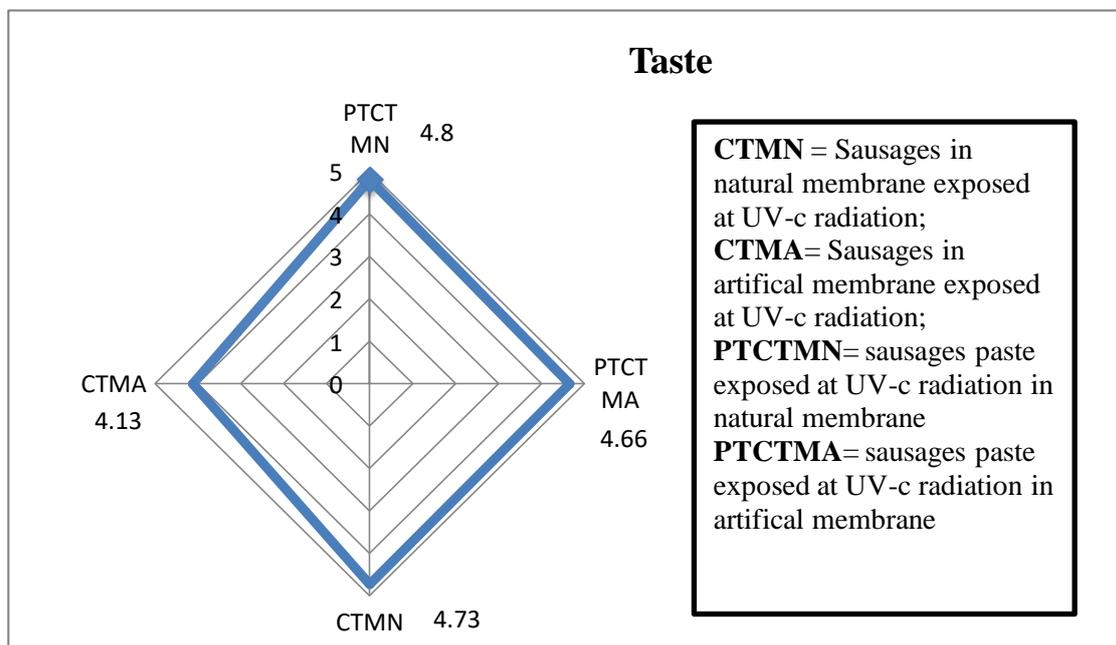
**Figure 7. Consistence**

**CTMN – sausages UV-C treatment in natural membrane**

**CTMA - sausages UV-C treatment in artificial membrane**

**PTCTMN-Paste from sausages UV-C treatment in natural membrane**

**PTCTMA - Paste from sausages UV-C treatment in artificial membrane**



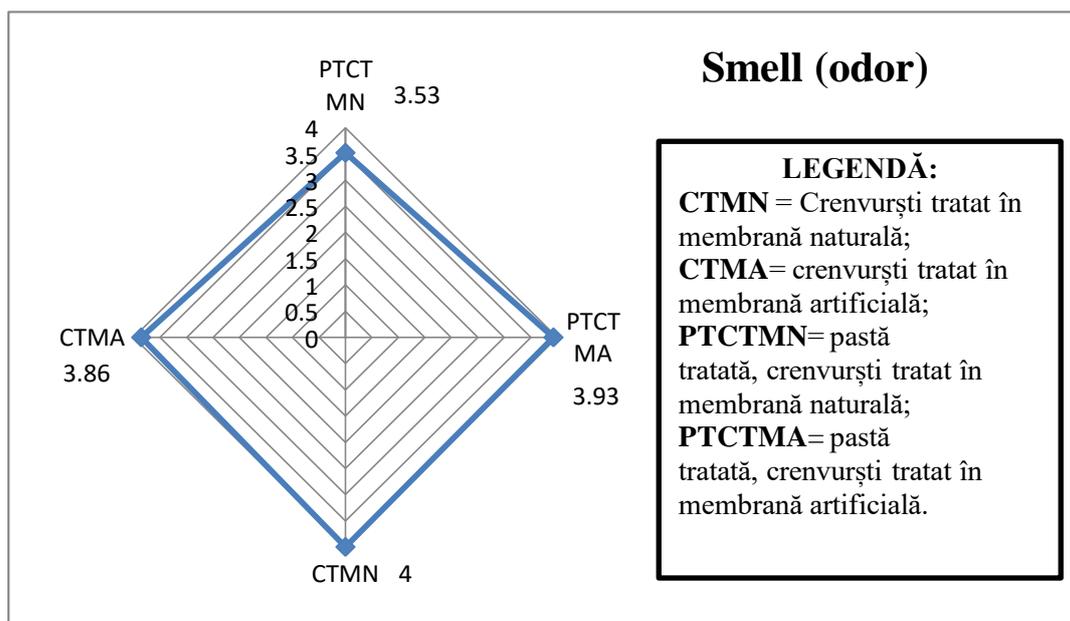
**Figure 8. Taste**

**CTMN – sausages UV-C treatment in natural membrane**

**CTMA - sausages UV-C treatment in artificial membrane**

**PTCTMN-Paste from sausages UV-C treatment in natural membrane**

**PTCTMA - Paste from sausages UV-C treatment in artificial membrane**



**Figure 9. Smell (odor)**

**CTMN – sausages UV-C treatment in natural membrane**

**CTMA - sausages UV-C treatment in artificial membrane**

**PTCTMN-Paste from sausages UV-C treatment in natural membrane**

**PTCTMA - Paste from sausages UV-C treatment in artificial membrane**

In accordance with examiners marks it can conclude that pork sausages with UV-C treatment in natural membrane CTMN obtained high remarks in opinion off all the evaluators. In second position was situated sausages treated with UV-C radiation in artificial membranes. At the end, the evaluators choose sausages past removed from natural and artificial

membranes. Marks between samples are not significant different, but on the first position evaluators choose the sausages UV-C treated in natural membranes. Hydrolysable nitrogen is a freshness index. All the sausages samples where examine regarding low hydrolysable nitrogen. Results are presented in table 2.

*Table 2*

**Hydrolysable nitrogen**

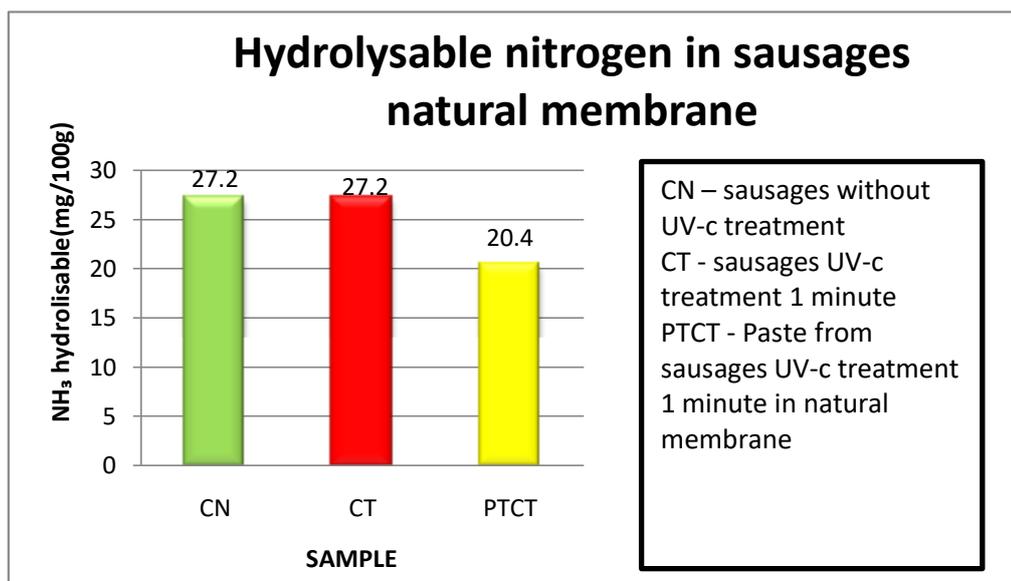
Home-made recipe		
	Natural membrane treatment with UV-c (NH <sub>3</sub> , mg/100g)	Artificial membrane treatment with UV-c (NH <sub>3</sub> , mg/100g)
CN	27,2	23,8
CT	27,2	23,8
PTCT	20,4	22,1
PTCT 2 MIN	No detectable	18,7

CN – sausages UV-C treatment in natural membrane

CT - sausages UV-C treatment in artificial membrane

Paste from sausages UV-C treatment in natural membrane

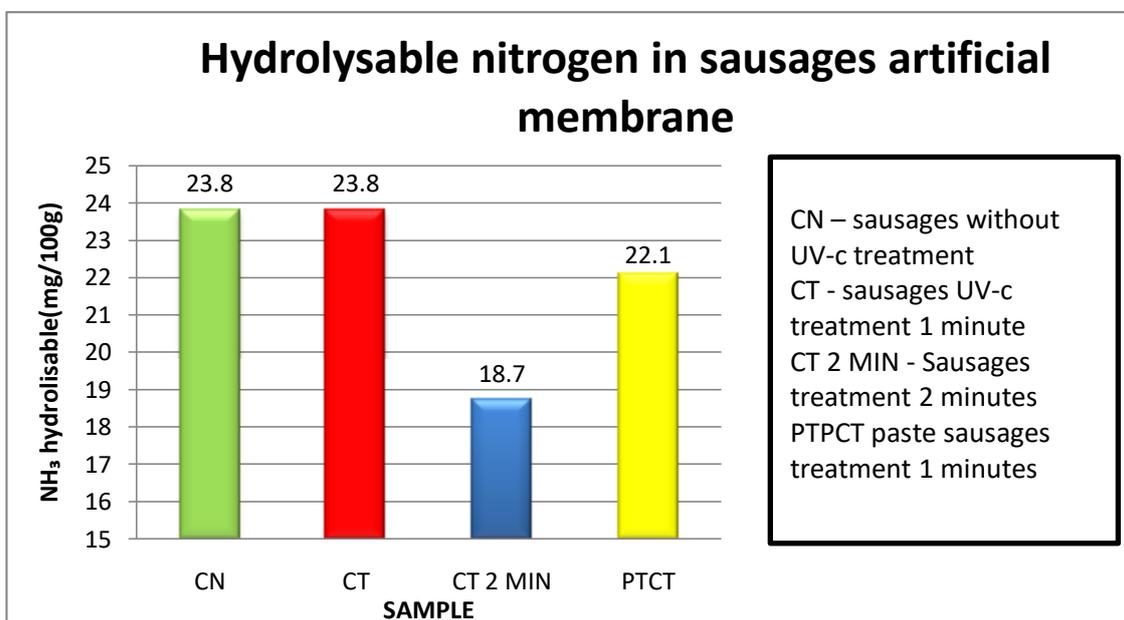
Paste from sausages UV-C treatment in artificial membrane



**Figure 10 Hydrolysable nitrogen in sausages Home-made recipe**

Sausages without UV-C treatment present high concentration in hydrolysable nitrogen. Microorganisms are not destroyed by UV-C and continue activity after sausages made it. A similar concentration in hydrolysable nitrogen

record at the sample with 1-minute UV-C treatment. The low content in NH<sub>3</sub> is recorded at the samples where the natural membrane was removed, and it used for analyses only sausages paste.



**Figure 10 Hydrolysable nitrogen in sausages artificial membrane**

Samples treated with UV-C for 1 minute or without UV-C treatment present the same concentration in hydrolysable nitrogen. If the treatment with UV-C increase at 2 minute the results improve

significant. Regarding the paste remove from sausages UV-c treatment during 1 minute in artificial membrane the concentration of NH<sub>3</sub> increase with 2 mg/100 g product.

## CONCLUSIONS

Efficacy of UV-C treatment at the sausages in artificial or natural membranes increase with time exposed. A treatment for 2 minutes is more efficient than a treatment for 1 minutes.

UV-C treatment influence the NH<sub>3</sub> (hydrolysable nitrogen) from samples due the effect regarding the total coliform bacteria. Natural and artificial membranes offer a protection barrier for the meat sausages bacteria. On the other hand, paste removed from sausages UV-c treatment in natural membranes present a low concentration in hydrolysable nitrogen due the removed of membranes during the analyses.

UV-C technique can be used to increase the sensorial properties of food where is necessary a thermic treatment. All the examiners which evaluate the sausages in sensorial test prefer the sausages obtained by home-made recipe, packed in natural membranes than the artificial membranes.

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