

# EVALUATION OF THE TRANDAFIR SAUSAGES QUALITY DURING DISTRIBUTION ROUTE TO THE FINAL CONSUMER

ADELA DOINA MODORAN<sup>1</sup>, PETRU ALEXE<sup>1\*</sup>

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**Abstract.** *The integrity of cold chain is vital to preserve the quality of refrigerated meat products, the inadequate storage and distribution route temperatures being able to lead to irreversible consequences on the overall sausages quality. The reception in the wholesale stores, storage in refrigerators, labeling, storage in retail markets, and presentation for sale (as links of the cold chain) is well-known problem areas. The present study was designed to evaluate the quality of Trandafir sausages during distribution route to the final consumer, by hydrogen sulphide identification, easily hydrolysable nitrogen determination, and pH determination. The results reveal that the initial properties of Trandafir sausages were retained during distribution route to the final consumer. The study clearly shows a good integrity of refrigeration chain for Trandafir sausages marketing.*

**Keywords:** *Cold chain, sausages quality, hydrogen sulphide, easily hydrolysable nitrogen, pH.*

## 1. INTRODUCTION

Meat is an excellent nutritious food rich in protein with high digestibility score, essential amino acids, fatty acids, vitamins and minerals [1-5]. Meat represents the main ingredient for most meat products, the processing of meat into products being one of the most economically significant food industries due to the consumer's preference for ready-to-eat foods [6, 7]. The cooked and smoked sausages are widely consumed worldwide meat products, for convenience, high nutritive value, and high economical and commercial significance [8]. However, as the most of meat products, sausages are highly perishable products with a short shelf life and short selling time [9, 10]. From this reason, the sausages must be maintained always at low temperatures (generally, between 0°C and 5°C) that do not result in a risk to consumer's health. The cold chain of sausages consists of maintaining the cold refrigeration throughout the entire process through which the sausages passes such as manufacturing, distribution, storage, and retail display. The integrity of cold chain is vital to preserve the quality of refrigerated sausages, inadequate storage and distribution route temperatures being able to lead to irreversible consequences on the overall sausages quality [10, 11]. The receiving in the wholesale cold shops, the storage in retail markets and consumers' refrigerators, as rings of the cold chain in meat products distribution, are well-known matter areas.

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<sup>1</sup> Dunarea de Jos University of Galati, Faculty of Food Science and Engineering, 800001 Galati, Romania.  
E-mail: [adelamodoran@gmail.com](mailto:adelamodoran@gmail.com). \*Corresponding author e-mail: [Petru.Alexe@ugal.ro](mailto:Petru.Alexe@ugal.ro).

The quality of sausages during distribution route to the final consumer (in the cold chain links), can be evaluated through some physico-chemical analyzes such as the H<sub>2</sub>S (hydrogen sulphide) identification, determination of the easily hydrolyzable nitrogen (as important indicators of meat products quality), and pH measurement [12]. The objective of this study was to evaluate the quality of Trandafir sausages (cooked and smoked sausages) during distribution route to the final consumer (in the cold chain links), by conducting a series of physico-chemical assays on the product such as H<sub>2</sub>S identification, the easily hydrolysable nitrogen determination, and the determination of pH.

## 2. MATERIALS AND METHODS

### 2.1. MATERIALS

Study on Trandafir sausages quality distribution route to the final consumer (reception in the wholesale cold stores, storage in refrigerators, labeling, storage in retail markets, presentation for sale - consumers' refrigerators) was conducted on samples taken (in sterile plastic bags) from the same store, being manufactured by the same company. Trandafir sausages samples were taken according to the sampling standard, representing 2% of the lot received. The cold chain was monitored, the temperature being constant on each of the links of the refrigeration chain for marketing such as 3.2°C at reception in the wholesale cold stores; 2.3°C at storage in refrigerators; 3.6°C at labeling; 3.8°C at storage in retail markets; 3.7°C consumers' refrigerators. The sausages samples were subjected to physico-chemical analysis in order to identification of H<sub>2</sub>S, determination of easily hydrolysable nitrogen, and pH measurement, the study being conducted at the laboratory of Integrated Center for Research, Expertise and Technological Transfer for the Food Industry from Dunarea de Jos University of Galati.

### 2.2. METHODS

#### 2.2.1. Identification of H<sub>2</sub>S

The presence of H<sub>2</sub>S was identified as a qualitative response by the test with sensitive lead acetate paper. The presence of H<sub>2</sub>S leads to the blackening of the lead acetate paper due to the black lead sulphide formation, the blackening intensity depending on the degree of sausages alteration [13].

#### 2.2.2. Determination of easily hydrolysable nitrogen

Determination of easily hydrolysable nitrogen, in the form of NH<sub>3</sub> (which can be formed in the sausages after degradation of protein by the spoilage microbial action) was made according to SR 9065-7:2007 [14]. The easily hydrolysable nitrogen content calculation, expressed as mg NH<sub>3</sub>/100g sausages, is shown in Equation 1:

$$\text{Easily hydrolysable nitrogen} = \frac{0.0017 \cdot V \cdot 1000}{m} \cdot 100 \text{ [mg/100g]} \quad (1)$$

The 0.0017 number means the ammonia quantity (g) that corresponding to 1 cm<sup>3</sup> of HCl 0.1 N, V designates the volume of 0.1 N HCl used for titration of distillate (cm<sup>3</sup>), and m is the mass of the sample taken for determination (g).

### 2.2.3. pH measurement

The pH measurements were made using a standardized method [15] with a Orion 320 PerpHec Basic Benchtop pH-meter.

### 2.2.4. Statistical analysis

Results of each analysis were recorded as the mean of three replicates  $\pm$  standard deviation. Statistical analysis data were analyzed using ANOVA analysis, considering significant differences ( $p \leq 0.05$ ).

## 3. RESULTS AND DISCUSSION

### 3.1. RESULTS

The results of this study are shown in Table 1, and in Figs. 1-2. Table 1 data reveal the evolution of H<sub>2</sub>S of Trandafir sausages during refrigerating chain of the marketing stage.

**Table 1. Evolution of H<sub>2</sub>S in Trandafir sausages during distribution route to the final consumer (in the refrigeration chain links).**

Refrigeration chain links	H <sub>2</sub> S
Reception in the wholesale cold stores	Negative
Storage in refrigerators	Negative
Labeling	Negative
Storage in retail markets	Negative
Presentation for sale (consumers' refrigerators)	Negative

Fig. 1 shows the easily hydrolysable nitrogen values of Trandafir sausages in refrigerating chain links, during distribution route to the final consumer.

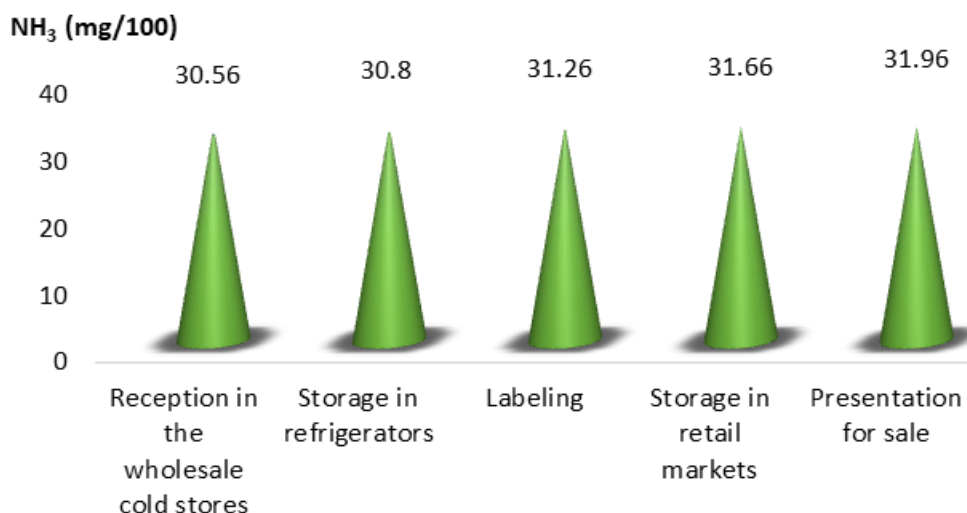


Figure 1. Values of easily hydrolysable nitrogen for the Trandafir sausages during distribution route to the final consumer (in the refrigeration chain links).

Fig. 2 presents the pH values of Trandafir sausages in refrigerating chain links, during distribution route to the final consumer.

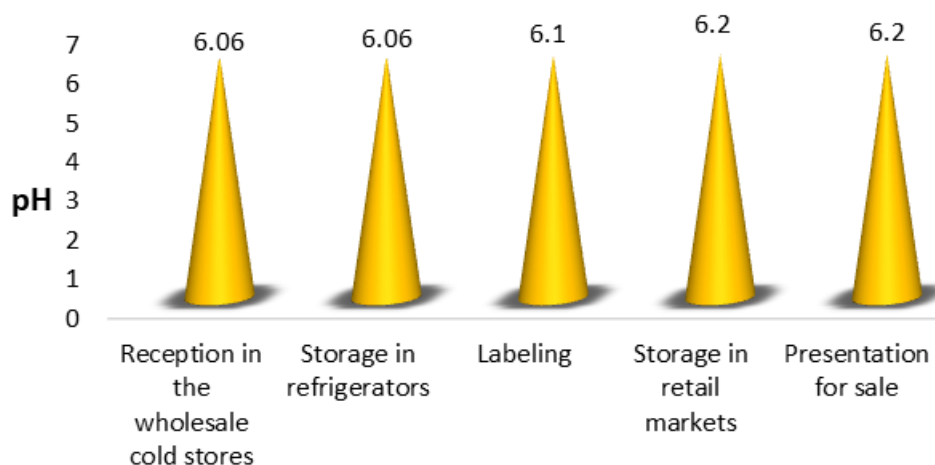


Figure 2. Values of pH for the Trandafir sausages during distribution route to the final consumer (in the refrigeration chain links).

### 3.2. DISCUSSION

The  $\text{H}_2\text{S}$  compound appears in advanced stage of degradation of proteins through the bacterial action on sulfur amino acids, representing the primary indicator of meat products quality. Assays based on the use of lead acetate are among the most sensitive methods for identification of the presence of  $\text{H}_2\text{S}$ . From the Table 1 data, it can be noticed that in any of the link refrigerating chain during distribution route to the final consumer,  $\text{H}_2\text{S}$  was not identified, indicating that the Trandafir sausages have maintained their quality due to the integrity of cold chain.

A very important marker for meat products quality is easily hydrolysable nitrogen, the quality degree of the analyzed sausages being evaluated by determining of this marker, expressed as mg  $\text{NH}_3$ /100 g sausages [16, 17] (Fig. 1). From Fig.1 it can be observed that the

obtained values for easily hydrolysable nitrogen were below the maximum admitted limit of 45 mg NH<sub>3</sub>/100 g product, according to the Romanian legislation [18], alteration sensory changes occurring at values above 45 mg % NH<sub>3</sub>.

The easily hydrolysable nitrogen ranged between 30.56 mg NH<sub>3</sub>/100 g and 31.96 mg NH<sub>3</sub>/100 g. Thereby, in all links of the refrigerating chain all sausage samples tested have met this requirement, indicating that there is no microbial alteration, and the sausages are appropriate for human consumption. As seen in the Fig. 1 the easily hydrolysable nitrogen values have increased slightly and steadily in time with about 4.5 %. This occurs as a result of the dehydration of the sausages during storage and disposal.

Another parameter that indicates the quality of meat products is the pH, the acidity representing an important factor in evaluating the initial quality of meat products and their behaviour during storage [19].

However, only the pH value as a quality indicator is controversial, pH value being could be correlated with the easily hydrolysable nitrogen. The pH values tended to increase, the initial pH value was 6.06 and, by the end of the refrigeration chain, the pH grows up to 6.2 (Fig. 2), generally the pH value of cooked sausage tending to be 6.2-6.3 [20].

The obtained value of pH fitting well in the limits, which indicates that the Trandafir sausages tested are qualitative. The pH values increased slightly at labeling and storage in refrigerator as links of the refrigerating chain. This pH growth takes place as a result of the small accumulation in time of easily hydrolysable nitrogen [20].

#### 4. CONCLUSIONS

The cold chain management in Trandafir sausages supply is very important for the overall success in delivery of these products.

This study reveals that the initial properties (H<sub>2</sub>S, NH<sub>3</sub>, pH) of Trandafir sausages were retained during distribution route to the final consumer, H<sub>2</sub>S content being negative in all refrigeration chain links, NH<sub>3</sub> content increasing with only 4.5 % (as a result of the dehydration of the sausages during storage), while the pH increasing only with 2,3 % (as a result of the small accumulation in time of NH<sub>3</sub>).

The results clearly demonstrate a good integrity of refrigeration chain for Trandafir sausages marketing. The consumer will accept the Trandafir sausages for their quality levels.

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