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VARIATION OF NITRITE CONTENT IN MEAT PRODUCTS DURING THE SHELF LIFE

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Abstract: *In the meat industry nitrite is used, together with the salting mixture, to maintain pink - red color of meat, for bacteriostatic effects, antioxidant effect and for amplification of products flavor. Current standards imposed the use a concentration of nitrite that would be within the limit of 7 mg/100g product without negative effects on the human body. Two meat products were analyzed, smoked chest and gypsy steak, to monitor the development of nitrite concentration. During monitoring nitrate concentrations increased with 14% when compared to the first analysis of smoked chest, and with 7.7% in the case of gypsy steak. During the ten days of analysis nitrite concentration did not exceed the maximum allowable dose.*

Key words: *nitrite, Griess method, porkloin, smoked chest*

1. Introduction

Nitrates and nitrites are commonly used in meat products because they have positive effects such as: maintaining of pink-red meat color, antioxidant effects, bacteriostatic and flavor enhancement of products. In order to a better distribution in the products nitrates and nitrites are usually added in solid form or in brine at a ratio of 1 kg nitrate or 0.5 kg nitrite per 100 kg of solid salt.

Nitrites have an effect on the meat flavor [1] and they inhibit the oxidation of lipids [2]. Thus, some substances resulting from the metabolism of lipids, valerian aldehyde and hexanol (fat rancidity specific product) are formed in small quantity and flavor of meat is more enjoyable [3]. This explains the weak antioxidant effect of nitrite, thus resulting in inhibition of formation of substances with taste and unpleasant odor. Nitrates and nitrites are used in meat preservation not only as a source of nitric oxide, also for their bacteriostatic properties, increasing the salt preservative action. They are stronger preservatives than salt destroying some groups of microorganisms against which salt has no effect.

After highlighting the cumulative effect of nitrites and the possibility of formation of carcinogenic nitrosamines [4] toxicological implications of these chemicals have become more complex [5]. Nitrites formed with amines exogenous and endogenous nitrosamines [3] highly carcinogenic compounds [6] that turns in stomach in nitrosoguanidine (this substance ranks second in terms of carcinogenic action). Nitrites reduce reserves of vitamin A in the liver and disrupt thyroid function, but they have good effects on blood pressure [7].

Deficiencies in vitamin E and B are also due to the nitrites action. Nitrites, in a normal diet, are coming from drinking water in a proportion of 21%, from fruits and vegetables [8] more than 70%, but can also come from meat products, in which nitrite is used as a preservative and improving color agent, at a rate of 6%.

Nitrite has both bacteriostatic and bactericidal effect that can be explained by the so-called Perigo, (combination of nitrite and amine groups of microorganisms citoplasma protein structure) is dependent on pH / rH, former of HNO_2 and that NO is greater at pH <5.8. The antibacterial effect is manifested in an initial concentration of 150 mg $NaNO_2$/100 g.

In the absence of nitrite, sausages after a heat treatment have a gray color, unattractive from the organoleptic point of view. Specific red color of fresh meat is determined as the ratio of meat pigments in reduced and oxidized state, myoglobin concentration in meat, and the level of residual hemoglobin influenced by the degree of bleeding [9].

2. Materials and Methods

Determination of nitrite in meat products was performed by Griess method. The method is based on the fact that nitrites at acid pH may be combined with a primary aromatic amine to form a diazonium salt. On switching to another primary amine forms a colored complex with maximum absorption at 540 nm.

2.1 **Reagents**

The solution to precipitate proteins: I - Potassium ferrocyanide solution, 10.6%: in a 1000 ml flask is placed 106 g crystallized potassium ferrocyanide [K4Fe (CN) 6 • 3H2O] weighed to the nearest 0.01 g dissolved in water; II - Zinc acetate solution 22%: in a 1000 ml flask is placed 220 g crystallized zinc acetate [Zn (CH3COO) • 2H2O] weighed to the nearest 0.01 g and 30 ml glacial acetic acid, dissolved in 300-400 ml of water and dilute to the mark with water. III - Saturated sodium borate solution: 50 g sodium tetraborate crystallized placed in a 1000 ml volumetric flask, dissolve in warm water (40 - 50 ° C), cooled at room temperature and dilute to the mark with water. Griess reagent: mixture of equal volumes of solution I and solution II. The mixture was prepared immediately before use. Solution I is dissolved by heating on a water bath, 6 g sulfanilic acid, accurately weighed of 0,001 g, in 200 ml glacial acetic acid and 400 ml water. After cooling is added 200 ml of 10% sodium chloride and diluted to 1000 ml with water. Solution II is dissolved by heating in a water bath, 0.3 g of alpha-naphthylamine in 100 ml of water is filtered - if necessary - is cooled and added to 200 ml of glacial acetic acid and diluted with water in a volumetric flask of 1000 ml.

Solutions I and II shall be kept in brown bottles, sealed one week. Note: Solution II is handled carefully avoiding contact with skin.

Solution of sodium nitrite standard prepared at the time of use. Measurement equipment and materials: UV-VIS spectrophotometer, analytical balance, tubes, 100 ml cylindrical glass.

2.2 **Procedure.**

Preparing filtrate for analysis.

The sample for testing weighs about 10 g, with an accuracy of 0,001 g, is passed quantitatively into a 200 ml flask with about 100 ml of warm water (70 - 80^{o}C), and 5 ml of saturated sodium borate solution is added and the flask, is heated for 15 minutes in boiling water bath, stirring from time to time. The sample is cooled at to room temperature and subsequent is added 2 ml of

potassium ferrocyanide and 2 ml of zinc acetate, stirring after each addition. The sample stands 20 to 30 minutes and then is made up to volume. Contents of the flask are stirred and filtered off a filter paper with a high porosity. The filtrate should be clear.

The extinction of the standard sample is measured by the spectrophotometer at a wavelength of 520 nm and the calibration curve is plotted.

2.3. Samples analyzed were smoked chest and gypsy steak. The products were monitored for 10 days, and analyzed every two days.

3. Results and Discussion

In the analyzes conducted during the ten days has been found that the product has undergone some changes monitored in terms of the amount of nitrite, figure 1.

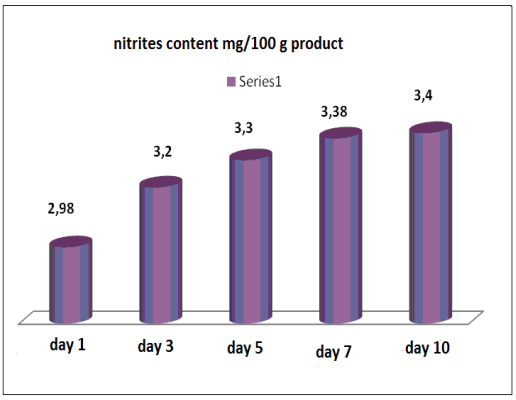

Figure 1. Variation of nitrate in smoked chest

If in the first day it was an amount of 2.98 mg $NaNO_2$/100g product on the last day the nitrite concentration reached to 3.4 mg/100 product. This increase is due to the decrease in the water content of the product during the ten days of storage. A greater increase in nitrite can be seen following the results of the fifth days, registering an increase of 10.7%

During the first days of processing, product humidity drops significantly, and the concentration of other ingredients contained in the product increases. Five days after the product has stability in the variation of nitrite and the increase was 3%. Following quantitative analysis that were made in the ten days it was recorded a maximum of 3.4 mg/100g nitrite, dosage compliance with current standards of maximum dose of 7mg/100g product.

The other product analyzed was gypsy steak., which was determined also the variation of nitrite. The results are presented in Figure 2.

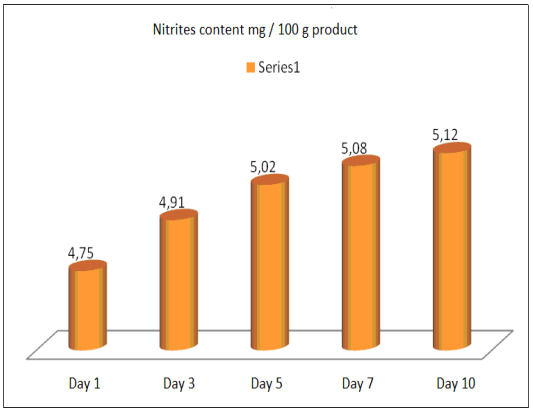

Figure 2. Variation of nitrate in gypsy steak

Following the analysis made, the variation of nitrite in gypsy steak during the ten days is 7.7%. In the first three days was the largest increase of 3.3% due to lower of humidity in the product followed by the increasing of other substances from chemical composition. In the last 5 days, variation in nitrite content was 2%. During the 10 days the concentration of nitrite was within the limit of 7 mg/100g product.

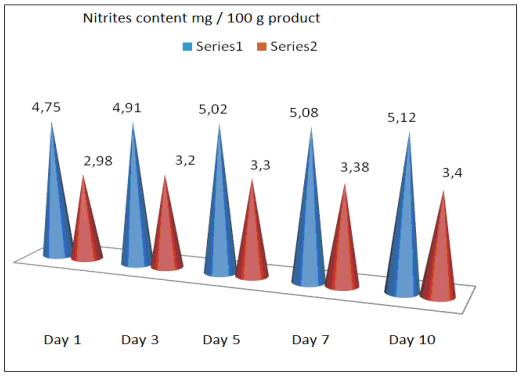

Figure 3. Comparison of nitrite content in the two products

Smoked chest and gypsy steak present different concentrations of nitrite but the variation in the ten days is similar. In the smoked chest the maximum concentration determined was 3.4mg $NaNO_2$ /100g product with a 14% increase. Gypsy steak contains 5.12 mg/100g and recorded an increase of 7.7%. The two products have different contents of nitrites due to the different production process.

The raw material for the two products is different, for getting smoked chest is using pork neck and spinal muscles, products resulting from the cutting of carcases and for gypsy steak is used boneless pork bellies.

Nitrites concentration in the product depends on nitrites and nitrates added to the salt mixture used in the meat industry and on injection mode.

The two products have a different injection efficiency given that it used the same mixed of injection**.**

Pork neck has a higher capacity of brine retention due chemical composition than pork breast. Another factor is the size of parts that are the subject to the injection process.

4. Conclusions

In this study was analyzed quantitatively the presence of nitrite by Griess method in two meat products smoked chest and gypsy steak and the variation of their concentration in a period of ten days after processing. The nitrite concentration in gypsy steak on the first day was 4.75 mg/100g product, and increased up to 5.12 mg/100g product. This increase is largely due to loss of moisture from the product and transformation reactions of nitrates. The analyzis of smoked pork chest showed a concentration of 2.98 mg / 100g of product on the first day, and an increase up to 3.4 mg/100g product. Nitrite concentrations increased in smoked chest with 14% for the entire period of study. Nitrite concentration in the two products was within the permissible limits for this additive. From a quantitative point of view, nitrite concentrations of the two samples are quite large, gypsy steak recorded a maximum of 5.12 mg/100g product because it has a higher yield of injection than the smoked chest which was 3.4 mg/100g product.

It is very important for producers to comply with limits on the use of food additives, as they can present serious risks for consumers. It is feasible to use essential oils to reduce initial nitrite levels in meat products(T.L. Coutinho de Oliveira, 2012 et al.).

Nitrate daily intake is 5 mg / kg body weight and 0.2 mg / kg body weight for nitrite. Lethal dose for children is 0.2 - 0.5 g [10].

In conclusion, it is recommended that meat products obtained with nitrates and nitrites are not used for feeding infants and for children and adults is preferable not to exceed the maximum of two classes of compounds (through moderate consumption of such foods). This goal can be achieved only by reasonable eating, balanced and varied.

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