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Microbiological quality and physicochemical parameters of two types of fermented salami during ripening

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Abstract

The dry-fermented sausages that have always been imported in Albania have recently become the most consumed products. Today they are produced by some local factories. A large amount of the most representative raw fermented sausages, as "Hungary salami", "Cacciatore", and Milano", are manufactured at Albanian meat processing factories. There is little information about the survival of food pathogens in different ripening stages of these new products. We controlled some lots of production to see aspects of quality. Therefore, the microbiological quality (*Salmonella spp.***,** *Escherichia-coli.*), nitrite, water activity (a_w), NaCl content and pH were determined in two types of fermented sausages during the ripening time from days 0 to 60. The temperature in ripening camera was 23°C for the first days of maturation and 14±1 °C during all days left. As a result *Salmonella* spp. and *Escherichia-coli* were not detected at any time. The mean value of pH decreased from 5.86 to 4.81 in the first days and stabilized at 5.48. Nitrite levels were found decreased in slightly small residual levels. Water activity (aw) decreased slowly and generally correlated with air humidity in the ripening camera and the mean value changed from 0.96 to 0.85 aw. A significantly different correlation between the bacterial count and a_w values was found. The results indicate that the microbiological safety of fermented salami depend on the initial contamination level with food pathogens. The analysis was done at the ISUV and at the sausage manufacturer's laboratory. The differences in composition, size and fermentation/ripening process were determined among the two kind of produced fermented salami. The physicochemical changes that occurred were summarized in terms of decrease of pH-value, nitrite level, decrease of aw and increase of NaCl content. From the hygienic standpoint, it is important that *Escherichia-coli, Salmonella spp.* were not found in finished products.

Keywords: food pathogens, fermented salami, nitrite, water activity, pH, NaCl *c*ontent.

1. Introduction

In the last decade, products like raw fermentation sausages in our country have become very popular in difference from the tradition for cooked products. Today is growing consumer interest to foodstuffs of high nutritional value that guarantee health from food pathogens and proper hygienic products [1], because the processes used in their production, and specification of content inhibit many pathogenic bacteria. However, when fermentation process is not adequate, there is a potential microbiological risk – some food pathogens may survive and proliferate during ripening (fermentation) [2].

Fermentation and drying of meat products are the most ancient ways of preservation. Reduction of water activity (ripening/drying at low temperature) and of pH (e.g., by using starter cultures) are generally sufficient for that purpose. However, in the last decades, some pathogens have been isolated in raw fermented meat products, for example *Listeria monocytogenes* and *Escherichia coli O157:H7*. These pathogens were identified, being resistant to low pH, low aw and other environmental factors. They can induce serious human health risks [3].

Among the most representative raw fermented sausages, produced in Albania, are "Milano", "Hungarian", "Cacciatorino" and some others, manufactured at EHW meat factory. These products due to specific recipes of production, very long shelf-life, special storage conditions, and sometimes inappropriate management at meat warehouses or shops might be unsafe for consumption. Theoretically most of relevant food pathogen bacteria can be found

in raw fermented sausages [1]. The most common pathogens which are present in fermented sausages and therefore keep a health risk are *Salmonella, E. coli*, and *Staphylococcus aureus*.

In E. Drosinos study [4] it was shown that *L. monocytogenes* can also survive fermentation. For that reason, bacteria mentioned higher, has been examined and enumerated. *Salmonella* spp. is accounted for the most reported food-borne outbreaks in European Union. Eggs, egg-products and meat are the main sources of outbreaks. Positive to salmonella spp. have occasionally been found up to 5% ready-to-eat meat products [5].

The pathogenic *Escherichia coli*, including the following sub-species, as entero-pathogenic, entero-invasive, entero-toxigenic, and entero-haemorrhagic *E. coli* are most significant for food-borne outbreaks. Entero-haemorrhagic *E. coli* has produced vero-toxins or shiga-toxins and is the most common serotype isolated from the reported cases [5].

According to literature data, many recent studies in food safety have investigated non-thermal processing of food products, but there is little information about survival of food pathogens found in different ripening stages of raw fermented sausages when water activity and pH value changes affect bacterial growth.

Therefore, the aim of the study was to determine the survival limits of most popular food pathogens in manufactured raw fermented products depending on water activity (aw) and pH values.

2. Materials and methods

Sausage preparation: Sausages were manufactured according to standard practice. Three batches of each type of sausages "Milano" and Cacciatorino" were taken for the experiments.

The microbiological tests were done in ISUV of Albania Institute and physicochemical tests were performed in sausage manufacturer laboratory of a real company in Albania. For detection and enumeration of bacterial cultures standard microbiology of food and animal feeding stuffs ISO methods, adapted in Albania were used: ISO 6887-2:2004. Preparation of test samples, initial suspension and decimal dilutions for microbiological examination; ISO 4833:2003. Horizontal method for the enumeration of microorganisms - Colony-count technique at 30; ISO 6579:2003 Method for the detection of *Salmonella* spp.; ISO 7251:2006 Horizontal method for the detection and enumeration of presumptive *Escherichia coli*. The three series of raw fermented sausages were investigated (total 50 samples). Samples were taken from each batch for chemical and microbiological (*Enterobacteriaceae, Salmonella* spp.,) and physicochemical (pH and a_w, nitrite and nitrate, NaCl content) analysis on days 0, 15, 30 and 60 after formulation. The specifications applied in the preparation stage (final size of meat and fat pieces and used casings) as well as the critical technological parameters (i.e. temperature, relative humidity and duration) in the subsequent stages of technological production (curing of stuffed sausages, fermentation, ripening and drying) are presented in table 1.

pH was measured on 1st, 15th, 30th, 60th days of maturation. Three individual pieces of sausages were measured each time, and then mean pH value was calculated. The pH-meter Testo 205 (Testo AG Germany), with automatic temperature compensation, was applied. Calibration was done by means of 2 point method with pH standard solutions 4.01 and 7.00. Water activity was measured with PawKit (Decagon) simultaneously with pH measuring. Calibration of devices was done with saturated NaCl (sodium chloride) 6.0 mole standard solution (0.760 a_w at 20 °C). Samples for water activity measuring were collected in original polyethylene vessels with caps and measured immediately after collecting.

Determination of nitrite was determined according to the method of AOAC [6]. Determination of NaCl content was determined according to the method of AOAC [6].

Statistical analysis. All measurements were reiterated three times, and tests were triplicate. The results represent the mean ± standard deviations. Tables and chart figures were done by means MS Excel 2007 software.

3. Results and discussion

The microbiological test is focused only to the pathogenic counts. The count *E. coli* and *Salmonella* spp. was not detected at any time, during the all time of ripening.

The samples of Milano sausages had a mean initial pH value of 5.86±0.04, which agrees with the results found in the study [7]. A rapid decrease in pH was observed during the first three days of fermentation for Milano sausage to 4.86±0.04 mean value and to 4.76±0.04 mean value for the Cacciatorino. The final pH of the fermented sausages

had a mean value of 5.48±0.05 for both types; this drop in pH was due to lactic acid production by the starter culture used for fermentation [8]. Lactobacilli are the major producers of lactic acid responsible for the decrease in pH and the increase in acidity during fermentation [9]. Lactic and acetic acids are often suggested to be major contributors to the acid aromas and tastes and the development of the texture of fermented sausage [10]. The mean value of initial water activity in Milano sausage and Cacciatorino was 0.96 and 0.98 respectively, which decreased in the product from 0.963±0.004 to 0.851±0.006 and from 0.98±0.04 to 0.86±0.05 during ripening. Decreasing trends of aw and pH are shown in Figure 1.

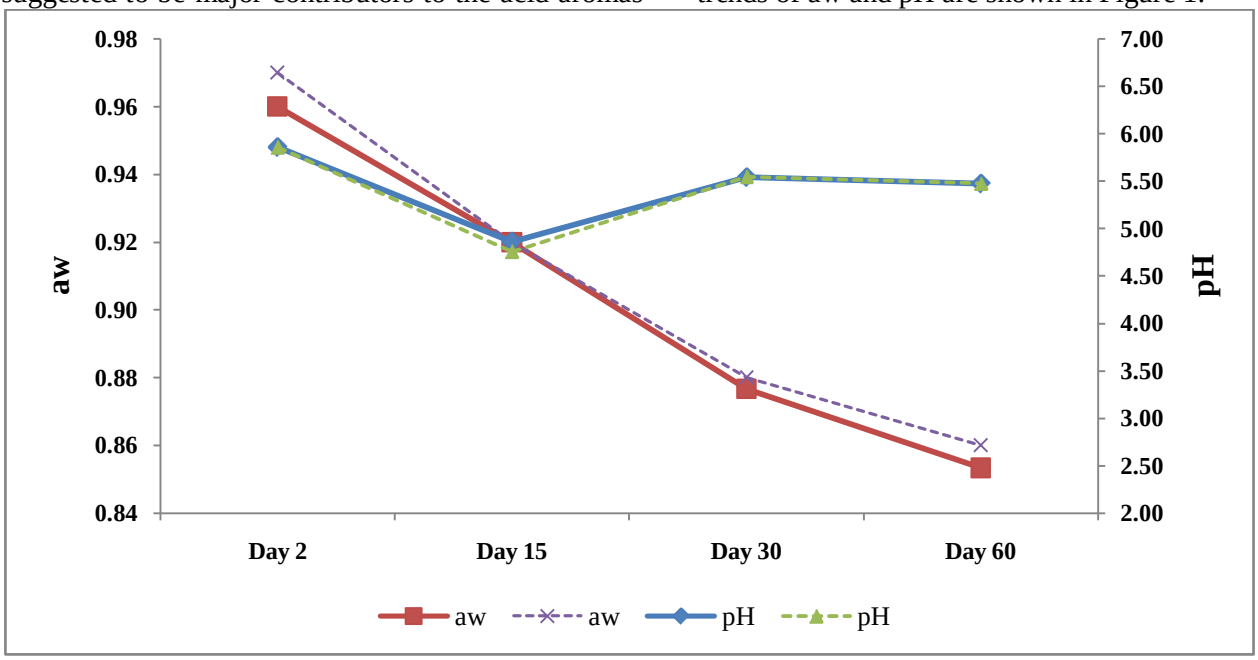

Figure 1: Decreasing trends of aw and pH mean values during ripening time.

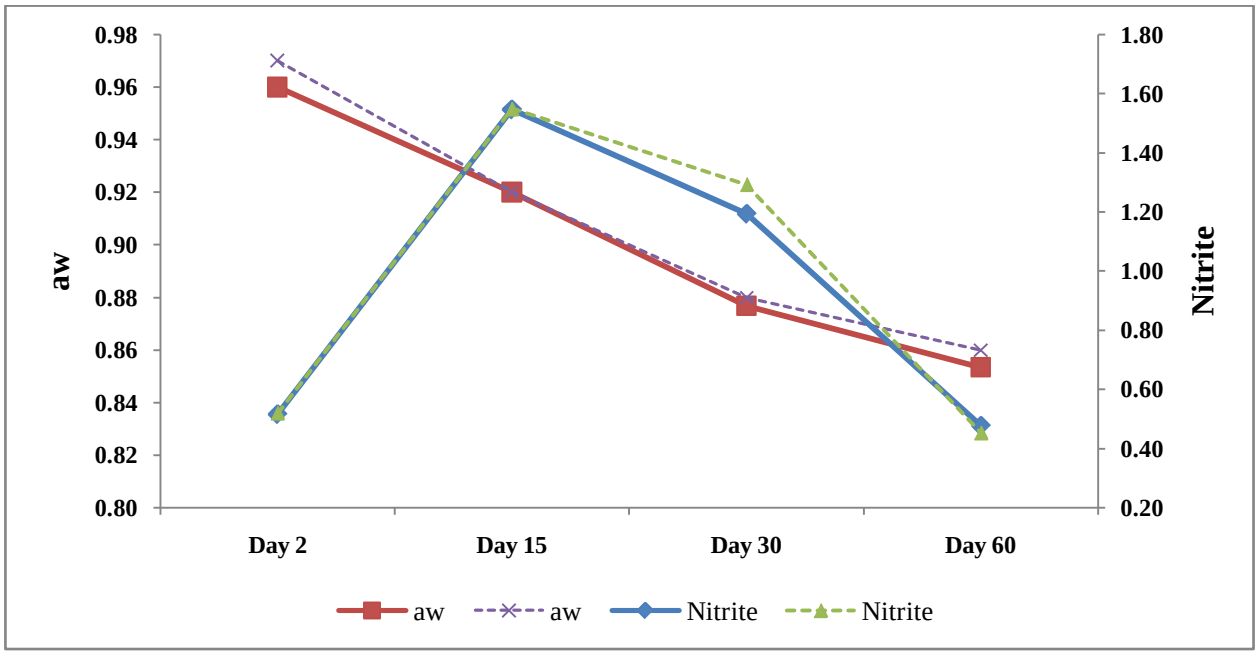

Figure 2: Decreasing trends of aw and nitrite mean values during ripening time

Fermentation/ripening processes varied among the different types of sausages. These types of sausages are produced from pork meat, only. Other ingredients are sugars, salt, fat and spices (it might be simply black pepper. The size of sausages is 50 mm and 32 mm in diameter respectively for the Milano and Cacciatorino sausages. Ripening of the sausages was carried out under controlled conditions of temperature and relative humidity. In general, temperature was between 12ºC and 14ºC and relative

humidity 70–85%. Sausages are considered ready to be consumed after 60 days of maturation. The most intensive decrease of pH was measured to the small diameter products during fermentation and ripening (from 5.86 to 4.8).

Salt content at Milano sausage, just after the preparation (day 0) was 2.39 mean value and at the moment to be ready reach 3.46 value. Proportionally to starting content and degree of moisture losses, an increase of NaCl content was observed, also. We also observed the variability of nitrite content in sausages, due to the time needed for nitrate to convert in nitrite. The variability level of nitrite is the same in both products and in correlation with the pH values. We fixed lower final values in Cacciatorino sausages 0.42±0.004 compared with Milano product with 0.48±0.04. The decrease of nitrite level is correlated with a_w values decrease. Decreasing trends of aw and nitrite mean values during ripening time are shown in the Figure 2.

4. Conclusions

The continual decreased changes of water activity and partly pH diminished possible initial count of some bacterial species, such as *Salmonella* and *E. coli* that allows considering raw fermented sausages being relatively safe and healthy meat product. From the hygienic standpoint, it is important that, *Salmonella spp.* and *E.coli* were not found in finished products. The size of sausages seems to have not significant effect in microbiological quality and physicochemical parameters between two types of products. The number of other pathogens, if they were present in the raw material or sausage batter, decreased or became non-detectable.

5. References

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