

Presence of N-Nitrosamines in Canned Liver Patty

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ABSTRACT

The presence of N-nitrosamines was determined in samples of industrially manufactured liver patty stored at different temperatures for a variable period of time. Sample preparation included steam distillation and extraction of redistilled samples with dichloromethane. The extracts were analyzed by a gas chromatography – mass spectrometry system (GC-MS-SIM). Study results expressed as total N-nitrosamines, including methylethyl-, diethyl- and dibutyl-N-nitrosamines, ranged from 0.0008 to 2.997 mg/kg, which significantly exceeded the recommended value of 0.002 mg/kg. The increase in the formation of N-nitrosamines was directly dependent on the length and temperature of product storage.

Key words: N-nitrosamines, liver patty, storage.

Introduction

Nitrite salts have been used as meat preservatives. They are added to meat products for fixation of the desired red color as well as for their capacity to inhibit the growth of some microorganisms^{1,2}. However, their interaction with secondary amines from the meat may produce, *via* the process of nitrosation, a highly carcinogenic group of compounds named N-nitrosamines^{3,4}. Apart from the

meat and meat products, N-nitrosamines can be found in other foodstuffs, e.g., beer, vegetable oil, fish, tobacco products, etc.^{5–9}.

In the Republic of Croatia, the control of foodstuffs for the presence of N-nitrosamines has not been regulated by the existing by-laws^{1,2,10,11}. As meat products are widely used by the population at

large, the control of the presence of these carcinogenic compounds in meat products should be routinely and systematically performed.

The aim of the study was to determine the amounts of the N-nitrosamines formed in canned patty stored at three temperature levels for varying period of time, and to assess the possible effect of storage length and temperature on the formation of nitrosamines.

Material and Methods

Twenty-one samples of canned liver patty collected randomly in three Zagreb grocery stores were examined. All samples were of the same product label manufacturer (Croatian) and net weight. At the laboratory, the samples were divided into three groups. Group 1 samples (n = 6) were analyzed immediately. Group 2 samples (n = 9) were analyzed after 5-day storage: one third of these samples were kept at +4 °C, one third at +22 °C, and one third at +37 °C. Group 3 samples (n = 6) were analyzed after 10-day storage at the same three temperature levels.

Upon homogenization, 200 g of a sample were submitted to steam distillation, followed by redistillation of the collected distillate with the addition of sulfuric acid and dehydrated sodium sulfate. N-nitrosamines were isolated by extraction with an optimal organic solvent, and quantified by a combined system of gas chromatography and mass spectrometry (GC-MS-SIM-Perkin-Elmer Q-mass 910 benchtop mass spectrometer, Norwalk, USA). Detection limit of the method was 0.4 µg/kg^{12–14}.

Results

Study results expressed as total N-nitrosamines including methylethyl-, diethyl- and dibutyl-N-nitrosamine, ranged from 0.0008 to 2.997 mg/kg (Maximal

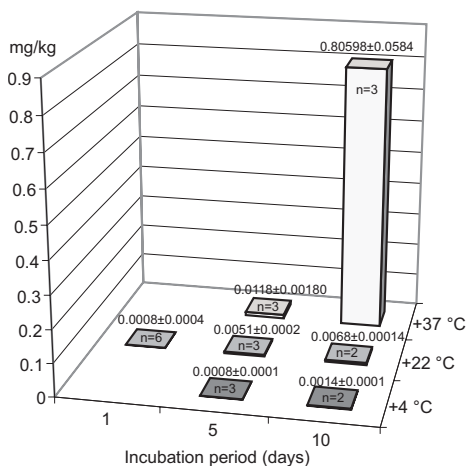


Fig. 1. Mean values of N-nitrosamines according to storage duration and temperature.

Allowed Concentration (MAC) = 0.002 mg/kg)¹⁵. As shown in Figure 1, mean levels of N-nitrosamines lower than MAC of 0.002 mg/kg were present in the samples analyzed immediately upon their transfer to the laboratory as well as in those stored at +4 °C for 5 and 10 days.

An increase in the mean levels of N-nitrosamines, dependent on the storage length and temperature, was recorded in all other study samples. The mean levels of N-nitrosamines in the samples stored at 22 °C increased from 0.0051 ± 0.0002 on day 5 to 0.068 ± 0.001 on day 10. In the samples stored at 37 °C, the mean levels of N-nitrosamines were 0.0118 ± 0.0018 on day 5 and 0.8059 ± 0.0584 on day 10.

Discussion

Previous laboratory studies showed N-nitrosamines to be a carcinogenic, mutagenic and teratogenic group of compounds. Their noxious effect resulted in lethal embryonic outcome in experimental animals⁴.

In humans, meat products are the most common potential source of N-nitrosamines. The factors associated with the formation of N-nitrosamines include the amount of nitrites used as preservatives (exceeding the allowed level of 0.2%), anaerobic conditions, and storage length and temperature (\geq room temperature). The mechanism of action and role of each individual factor as well as their possible interaction are as yet unknown^{16–18}.

Although the present study results should be interpreted with some reserve due to the small number of study samples, they provide evidence for the association between the amounts of N-nitro-

samines formed, and the length and temperature of the preserved meat storage. The higher the storage temperature and the longer the storage duration, the higher the amount of N-nitrosamines formed. Further studies on a large number of samples classified according to date of manufacture and storage conditions until analysis are expected to provide information on the possible need of systematic monitoring for the presence of N-nitrosamines in meat products. In the interim, we can only recommend that such products be stored at a temperature lower than room temperature, preferably at +4 °C.

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UTJECAJ ČUVANJA MESNIH KONZERV I NA NASTANAK N-NITROZAMINA

S A Ž E T A K

U Službi za zdravstvenu ekologiju Zavoda za javno zdravstvo grada Zagreba ispitivana je prisutnost N-nitrozamina u uzorcima industrijski proizvedene jetrene paštete, čuvane kod različitih temperatura. Prisutnost N-nitrozamina utvrđivana je u određenim vremenskim intervalima. Metoda pripreme uzoraka uključivala je destilaciju vodenom parom te ekstrakciju redestilata diklormetanom. Obradeni ekstrakti uzoraka analizirani su praćenjem karakterističnih iona u vezanom sustavu plinska kromatografija-spektrometrija masa (GC-MS-SIM). Rezultati ispitivanja ukupnih N-nitrozamina, izraženo prema metiletil-, dietil- i dibutil-N-nitrozaminu, kretali su se u granicama od 0.0017 do 2.997 mg/kg, što je značajno prekoračenje u odnosu na preporučenu vrijednost od 0.002 mg/kg. Iz dobivenih rezultata zaključujemo da se količine nastalih N-nitrozamina višestruko povećavaju u izravnoj zavisnosti o dužini i temperaturi skladištenja.