

# BIOGENIC AMINES AND GAMMA-AMINO BUTYRIC ACID CONTENT IN DRY FERMENTED SALAMIS ON THE SLOVENIAN MARKET

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## I. INTRODUCTION

Biogenic amines (BAs) are nitrogenous and organic substances of biological origin with physiological activity. In foods, BAs are formed mainly by bacterial decarboxylation of free amino acids using amino acid decarboxylase enzymes. The main interest in BAs lies in their role as indicators of food quality and their potential toxicity to human health. When consumed in large amounts, they can cause various health concern symptoms [1, 2]. High levels of BAs are found in fermented foods with high protein content, such as dry fermented salamis. Conditions during fermentation, ripening, and storage may favour bacterial decarboxylation of amino acids and accumulation of biogenic amines in varying concentrations, as a number of different factors are involved in their formation [3]. Gamma-aminobutyric acid (GABA) is a non-protein amino acid compound synthesised by glutamate decarboxylase and has numerous beneficial effects on metabolic disorders in animals and humans [4]. The aim of present study was to evaluate the formation of BAs and GABA in dry fermented salamis sold on the Slovenian market.

## II. MATERIALS AND METHODS

A total of 23 samples of traditionally and fast dry fermented salamis were randomly collected from the Slovenian market. Samples were purchased in local markets located in Ljubljana and stored at - 20 °C until analysed. Prior to analysis samples were homogenised (without casings). BAs and GABA were determined according to the EZ:faast Amino Acid Analysis Kit by Phenomenex, including extraction procedure, derivatization with propyl chloroformate and LC-MS/MS analysis. All determinations were done in duplicate. BAs investigation included PHE (phenylethylamine), TRY (tryptamine), HIS (histamine), CAD (cadaverine), PUT (putrescine), TYR (tyramine), AGM (4-aminobutyl-guanidine), SPD (spermidine) and SPE (spermine). Data were processed with SPSS Statistics programme using descriptive statistics (frequencies).

## III. RESULTS AND DISCUSSION

The levels of BAs and GABA determined in the examined samples of dry fermented salamis are summarized in Table 1.

Table 1 Biogenic amines and GABA content (mg/kg) in dry fermented salamis sold in Slovenian market

Biogenic amine	Range	Median	Mean ± SD
PHE	0 – 30.8	1.16	5.21 ± 7.79
TRY	0 – 2.26	0.52	0.63 ± 0.62
HIS	0.52 – 1495	11.1	286 ± 435
CAD	0.01 – 295	59.7	92.4 ± 88.2
PUT	0.03 – 83.9	29.6	29.7 ± 26.4
TYR	0.02 – 337	3.06	48.5 ± 85.3
AGM	0 – 1.76	0.02	0.19 ± 0.44
SPD	0.34 – 4.74	1.94	1.92 ± 1.00
SPE	0.20 – 2.69	1.12	1.19 ± 0.62
GABA	0.44 – 116	3.09	23.4 ± 35.0

PHE – phenylethylamine, TRY – tryptamine, HIS – histamine, CAD – cadaverine, PUT – putrescine, TYR – tyramine, AGM – 4-aminobutyl-guanidine, SPD – spermidine, SPE – spermine, GABA – gamma-aminobutyric acid

With the exception of AGM, TRY, and the naturally occurring polyamines SPE and SPD, a wide variation in BA concentrations was observed in the samples. The highest concentrations among BAs were found for HIS with a mean value of 286 mg/kg. In 26% of the dry fermented salami samples, the concentration exceeded 600 mg/kg. The reasons for the significant accumulation of HIS could be a high initial microbial load of the raw material due to inappropriate storage, decrease in pH at the beginning of the ripening period, and prolonged ripening [5]. The second most common BA was CAD, reaching levels above 100 mg/kg in ten samples studied, and above 200 mg/kg in one sample. In general, the highest concentrations of CAD were found in traditionally dried salamis, which may indicate either poor hygienic conditions and freshness of raw materials or the use of incorrect production processes [1, 6]. TYR concentrations were lower and exceeded 100 mg/kg in 5 of the samples studied, whereas the concentrations of PUT were lower than 100 mg/kg in all samples. PHE concentrations were comparable to those previously reported by other authors [1], and some samples did not contain this amine at all. A daily intake of 100 mg of GABA is recommended for most dietary supplement products on the market [7]. It can be concluded that most dry fermented salamis in present study contained GABA in significant amounts (mean: 23.4 mg/kg; range: 0.44-116 mg/kg), and the addition of GABA-producing lactic acid bacteria as a starter culture can even increase the formation of GABA during ripening [8].

#### IV. CONCLUSION

The content of BAs in dry fermented salamis on the Slovenian market varies widely. Some samples of dry fermented salamis are problematic due to high levels of undesirable BAs, especially histamine, cadaverine, and putrescine, although there is no limit for these biomolecules in European legislation, except for histamine in fishery products. In order to reduce the variety and ensure the safe consumption of dry fermented salamis in terms of BAs content, it is necessary to improve the production technology and hygienic quality of raw materials used in the meat industry.

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