

FORMATION OF HISTAMINE IN VACUUM PACKED FERMENTED SAUSAGES

P. PIPEK*, F. BAUER and G. SEIWALD

Institute of Meat Hygiene, Meat Technology and Food Science, University of Veterinary Medicine,
Linke Bahngasse 11, A-1030 Vienna, Austria

* Present address: Institute of Conserve Technology, Chemical-Technological University Prague, Suchbátarova 3, 166 28 Prague 6,
Czechoslovakia

SUMMARY: To investigate the possible excessive formation of histamine during storage in vacuum package raw sausages were stored under different conditions sliced and unsliced and examined in respect to the content of histamine, the total count of microorganisms and the number of different bacteria. The result show, that the formation of undesired high amounts of histamine only depends on the water/protein ratio and the producer of the raw sausages. Differences between vacuum packed and non vacuum packed samples could not be obtained.

INTRODUCTION: During the fermentation of raw sausages amounts of histamine between 1 and over 600 mg/kg dry matter are formed (BAUER et al., 1989; DIERICK et al. 1974; PECHANEK et al., 1980, 1983; RICE et al. 1975; TAYLOR et al., 1978; VANDEKERKHOVE, 1977) depending on the age of the raw material and the presence of histidine decarboxylating microorganisms (BAUER et al. 1990; TSCHABRUN et al. 1990; KRANNER et al. 1991). An additional formation of histamine during storage of ready-to-sell raw sausages could not be observed (RAMANTANIS et al. 1985; TSCHABRUN 1988), if the sausages were stored in whole pieces (not sliced and vacuum packed). But the increasing number of self service shops and a changed consumer behaviour require sliced and vacuum packed fermented sausages.

So, the objective of this study was to investigate, whether histamine will be formed during storage in vacuum package und the causes of its formation.

MATERIAL AND METHODS:

Materials under investigation: Raw sausages fermented under different conditions were stored up to 8 weeks in vacuum package - sliced and unsliced - at 5° to 10°C and/or room temperature.

Determination of Histamine: Histamine was measured fluorimetrically as o-phthalaldehyde-derivative (LERKE and BELL, 1976)

Bacteriological investigations: The bacteriological status was investigated by determination of the total count of aerobic microorganisms, Lactobacillae, Micrococcae, Enterococcae, Pseudomonadae, Enterobacteriaceae and yeasts. The ability of microorganism for producing histamine was tested by determination of histamine formed in a specific decarboxylase nutrient broth containing histidine (KRANNER et al., 1991).

RESULTS AND DISCUSSION: Raw fermented sausages should be stored at about 15°C, usually near or at room temperature (e.g. in a supermarket). The optimal storing conditions for sliced and vacuum packed raw sausages are 10°C and below, usually in a refrigerator (PRÄNDL et al., 1988). In order to stimulate the formation of histamine the storage of vacuum packed and sliced products were also carried out at room temperature in a few experiments.

The examinations of raw sausages of two different producers show that the contents of histamine of raw sausages from producer A were approx. 100 mg/ kg dry matter and below, the histamine concentration of products of enterprise B were between 200 and over 300 mg/kg with exception of two short ripened sausages (Grosso Salami and Blockwurst). The content of histamine of sliced vacuum packed fermented sausages increases during storage more than sixfold, if the water/protein ratio exceeded 1.8 (fermented

sausages ripened for a shorter period; raw sausage Type I). If the water/protein ratio was below 1.3 (raw sausage Type II) the histamine concentration did not reach the double of the initial values regardless of the initial amount of histamine (Fig.1).

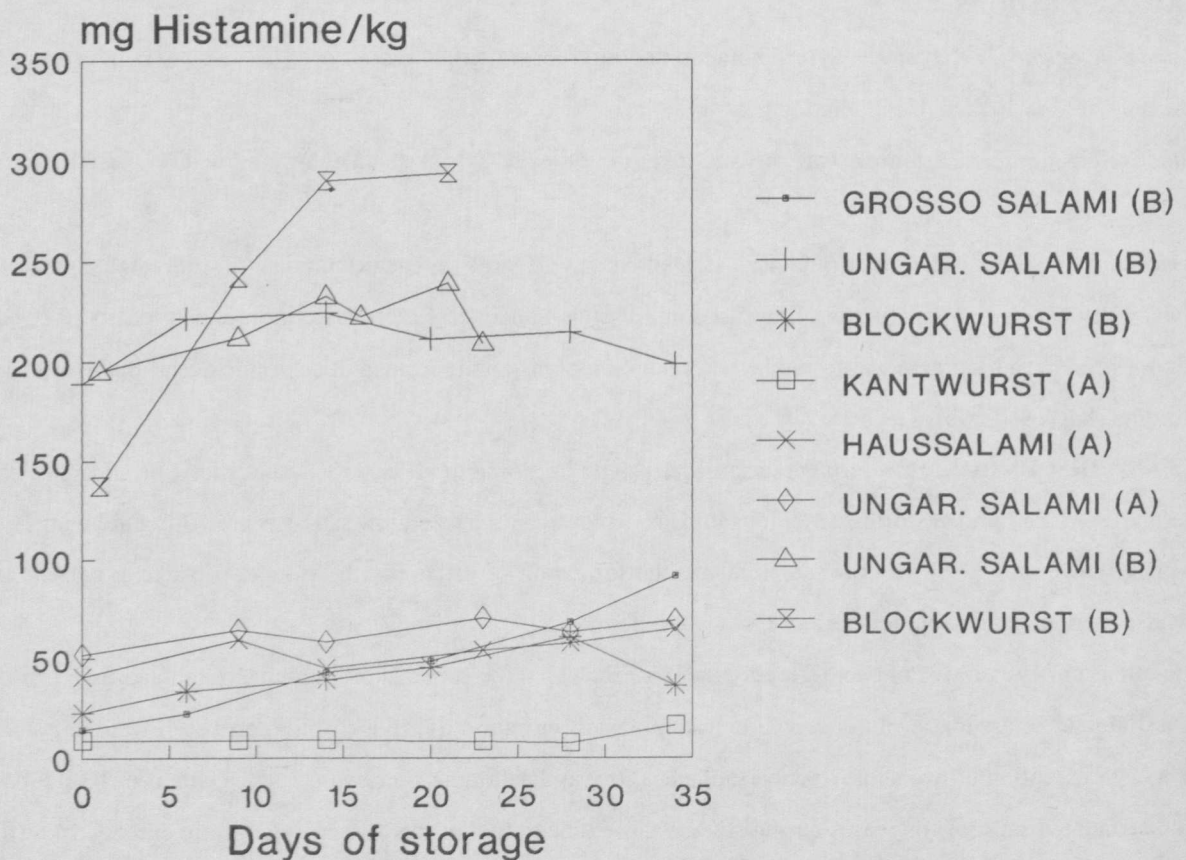
The total count of aerobic microorganisms and the count of Lactbacillae were higher in the short ripened raw sausages. The counts of Enterococcae were between 10^2 and 10^5 , no significant differences could be obtained at Micrococcae and yeast, Pseudomonadae and Enterobacteriaceae could only be detected in 1 respectively 2 samples. A change drastic of the counts could not be observed during storage (Tab.1).

Furthermore, long ripened sausages (Touring Salami; water/protein ratio 1.3) from one and the same batch was stored 8 weeks sliced and vacuum packed, unsliced and vacuum packed without cover and in a whole piece with cover at 5° C and room temperature. The results show that no histamine is formed additionally during storage independent on the package and the storing temperature (Fig.2). Differences of the count of microorganism between sliced and unsliced vacuum packed sausages and non vacuum packed samples could not be obtained. During storage the count of microorganisms changed only a little (Tab.1). Storage of fermented sausages in vacuum package also did not affect the pH-value.

The same procedure as mentioned above was carried out using a so-called "fresh raw sausage" with a protein/water ratio of 2.8, which is only ripened for 5 days. These products have to be stored cooled and in this case the results did not differ in principle compared with the result of the long ripened raw sausage. Storage at room temperature affect an increase of the histamine content from about 3 mg/kg to 30 mg/kg which are comparable with the concentration of histamine in fresh and spoiled meat respectively (ROGOWSKY and DÖHLA 1984).

The causes of the differently intense formation of histamine in comparable products can be searched in the fact that an excessive formation of histamine depends on the producer and not on the type of sausage (BAUER, 1989). So, only in products of

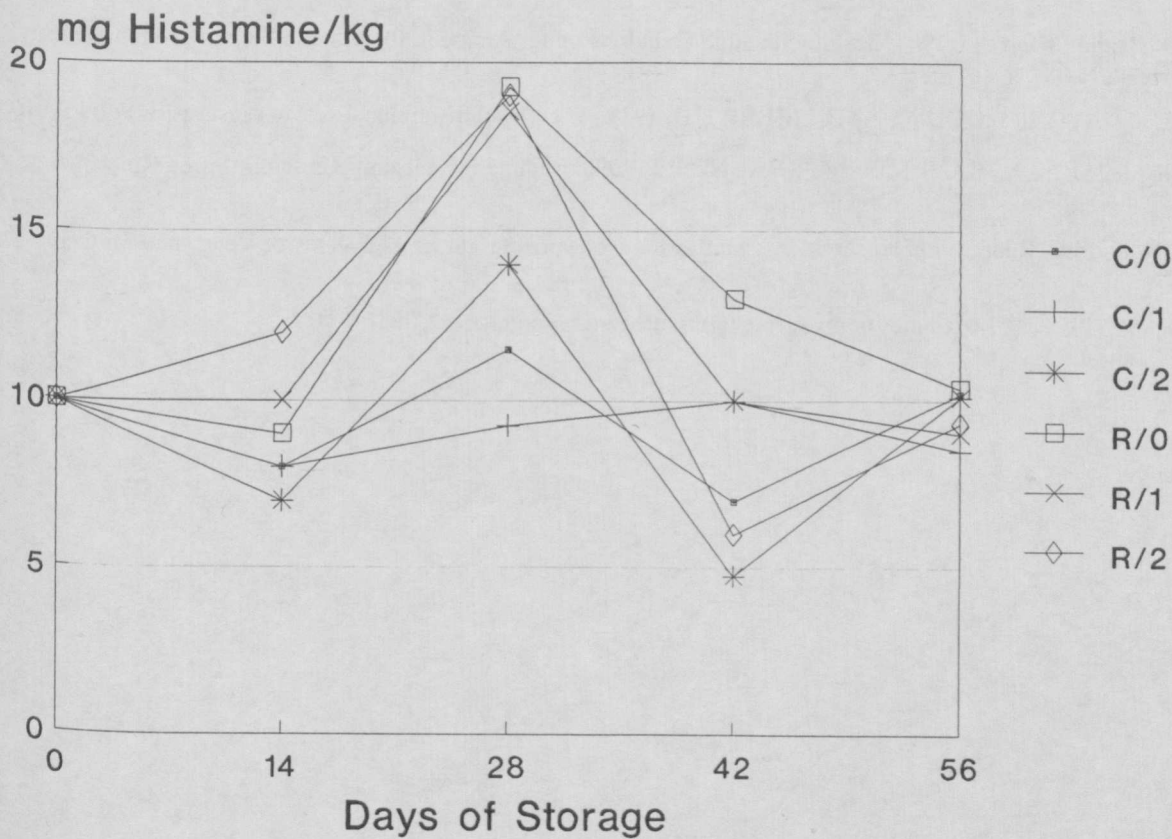
Fig.1: Formation of histamine during storage of vacuum packed, sliced raw sausages produced by two different enterprises



Tab.1: Counts of microorganisms (MO) at begin and end of storage

Storage time	Raw Sausage Type I	Raw Sausage Type II	Touring Salami		"Fresh" Raw Sausage	
			cooled	room temperature	cooled	room temperature
23 - 34 days	23 - 34 days	23 - 34 days	56 days	56 days	56 days	56 days
Total count of MO/g						
Initial	$8 \cdot 10^8 - 1 \cdot 10^9$	$1 \cdot 10^8 - 5 \cdot 10^8$	$3 \cdot 10^7$	$3 \cdot 10^7$	$2 \cdot 10^9$	$2 \cdot 10^9$
Final	$8 \cdot 10^8$	$1 \cdot 10^8 - 3 \cdot 10^8$	$7 \cdot 10^7 - 9 \cdot 10^7$	$2 \cdot 10^6$	$1 \cdot 10^9$	$1 \cdot 10^8$
Micrococcae/g						
Initial	$4 \cdot 10^6 - 7 \cdot 10^6$	$1 \cdot 10^6 - 1 \cdot 10^7$	$2 \cdot 10^6$	$2 \cdot 10^6$	$8 \cdot 10^5$	$8 \cdot 10^5$
Final	$3 \cdot 10^6 - 5 \cdot 10^6$	$5 \cdot 10^5 - 1 \cdot 10^7$	$8 \cdot 10^7 - 1 \cdot 10^8$	$1 \cdot 10^6 - 2 \cdot 10^6$	$8 \cdot 10^4 - 1 \cdot 10^6$	$1 \cdot 10^4$
Lactobacteria/g						
Initial	$4 \cdot 10^8 - 8 \cdot 10^8$	$6 \cdot 10^6 - 8 \cdot 10^7$	$1 \cdot 10^7$	$1 \cdot 10^7$	$9 \cdot 10^8$	$9 \cdot 10^8$
Final	$5 \cdot 10^8 - 8 \cdot 10^8$	$1 \cdot 10^6 - 4 \cdot 10^7$	$5 \cdot 10^6 - 8 \cdot 10^6$	$2 \cdot 10^5 - 8 \cdot 10^5$	$1 \cdot 10^9$	$1 \cdot 10^9$
Enterococcae/g						
Initial	$1 \cdot 10^3 - 1 \cdot 10^5$	$1 \cdot 10^2 - 1 \cdot 10^4$	<100	<100	100	<100
Final	$1 \cdot 10^4 - 4 \cdot 10^5$	$3 \cdot 10^2 - 5 \cdot 10^4$	500	<100	100	<100
Yeast/g						
Initial	$1 \cdot 10^2 - 3 \cdot 10^4$	$1 \cdot 10^2 - 2 \cdot 10^5$	$9 \cdot 10^3$	$9 \cdot 10^3$	<100	<100
Final	$7 \cdot 10^2 - 5 \cdot 10^3$	$1 \cdot 10^2 - 7 \cdot 10^4$	$3 \cdot 10^3 - 5 \cdot 10^4$	$2 \cdot 10^3 - 3 \cdot 10^3$	$1 \cdot 10^4 - 1 \cdot 10^5$	$1 \cdot 10^3$
Histamine producing MO/g						
Initial	not examined	not examined	<3	<3	<3	<3
Final	not examined	not examined	<3	<3	23	23

Fig.2: Formation of histamine during storage of raw sausages; C - cooled; R - room temperature; 0 - whole pieces; 1 - whole pieces vacuum packed; 2 - sliced and vacuum packed



enterprise B either a higher amount of histamine could be found in long ripened raw sausages or an excessive formation of histamine during storage could be observed in the case of short ripened products. If this formation is caused by a recontamination during slicing or due to unfinished fermentation could not be stated.

CONCLUSION: It can be concluded that only long ripened raw sausages are suitable for vacuum package. Regarding the formation of histamine fermented sausages with a water/protein ratio of above 1.8 cannot be recommended for this kind of storing conditions.

REFERENCES

- BAUER F., TSCHABRUN R. and SICK K. 1989. Wien. Tierärztl. Mschr. 76, 180
- BAUER, F., TSCHABRUN, R. UND SICK, K. 1989. Content and Formation of Histamine in Long Ripened Dry sausages. In: Agriculture, Food Chemistry and the Consumer (Ed.: Institut National de la Recherche Agronomique) Vol.I, p. 126
- DIERICK N., VANDEKERKHOVE P. AND DEMEYER D. 1974. Changes in non-protein nitrogen compounds during dry sausage ripening. J. Food Sci. 39, 301
- KRANNER, P. UND BAUER, F. 1991. On the Formation of Histamine in Long Ripened Dry Sausages. Proc. 37th ICOMST, Vol II, S. 889
- LERKE P.A. and BELL L.D. 1976. A rapid fluorimetric method for the determination of histamine in canned tuna. J. Food. Sci. 48, 1282
- PECHANEK U., WOJDICH H., PFANNHAUSER W. and BLAICHER G. 1980. Untersuchungen über das Vorkommen biogener Amine in Lebensmitteln. Ernährung 4, 58
- PECHANEK U., PFANNHAUSER W. and WOJDICH H. 1983. Untersuchungen über den Gehalt biogener Amine in vier Gruppen von Lebensmitteln des österreichischen Marktes. Z. Lebensm. Unters. Forsch. 176, 335
- PRÄNDL, O., FISCHER, A., SCHMIDHOFER, T. UND SINELL, H.-J. 1988. "Fleisch - Technologie und Hygiene der Gewinnung und Verarbeitung". Ulmer Verlag, Stuttgart, p. 598
- RAMANTANIS S., FASSBENDER C.P. AND WENZEL H. 1983. Untersuchungen von Histamin, Tyramin und Tryptamin in Rohwürsten. Arch. Lebensmittelhyg. 36, 9
- RICE S., EITENMILLER R.R. AND KOEHLER P.E. 1975. Histamine and tyramine contents in meat products. J. Milk Food Technol. 38, 256
- ROGOWSKY B. and DÖHLA I. 1984. Bestimmung und Gehalt biogener Amine in Fleisch und Fleischwaren. Lebensmittelchem. Gerichtl. Chem. 38, 20
- TAYLOR S.L., LEATHERWOOD M. AND LIEBER E.R. 1978. A survey of histamine levels in sausages. J. Food Protect. 41, 634
- TSCHABRUN, R., SICK, K., BAUER, F. and KRANNER, P. 1990. Bildung von Histamin in schnittfesten Rohwürsten. Fleischwirtsch. 70, 448
- TSCHABRUN, R. 1988. Bildung von Histamin in schnittfesten Rohwürsten. Thesis, University of Veterinary Medicine Vienna, p. 105
- VANDEKERKHOVE P. 1977. Amines in dry fermented sausages. J. Food Sci. 42, 283