Use of reduced amounts of nitrite in the production of Italian typical salami

P.BALDINI, G.FARINA, F.PALMIA, G.PAROLARI and R.RACZYNSKY.

A preparation technique has been studied for Italian typical salami, which allows to reduce the amount of nitrite normally used to prevent the growth of Clostridia and Enterobacteria. Inhibiting effects other than nitrite are used , thus avoiding the formation of nitrosocompounds, which may have well know effects on human organism. Dehydrating slightly the meat at a refrigeration temperature and keeping, the mince or the raw sausage for a few days at a temperature of 0°, $-4^{\circ}C$, a certain inactivation of the Clostridia is obtained, also in the presence of only 50 ppm of nitrite / I,2 decimal reductions/. The addition of small amounts of acetic acid, which do not modify the pH of the mince, determines a reduction in the number of Enterobacteria in Salami containing low quantity of chloride /2,5%/ and fat /20-23%/; this fact is enhancied at holding temperatures and lower pH values / $T=4^{\circ}$, pH=5,5/.
During the drying and the seasoning the acetic acid prevents, some times only partially, from the multiplication of Enterobacteria in salami in which sugar has not been used to lower pH; the growth in number or Clostridia has never been noted /Max.9g/g/.
At drying and seasoning temperatures below $20^{\circ}C$, no increase in the number of pathogenic Staphylococci inoculated in mince at the level of 10^4/g is observed.

Anwendung von beschränkten nitritsmengen bei zubereitung ausgetrockneter salami würste.

P.BALDINI, G.FARINA, F.PALMIA, G.PAROLARI und R.RACZYNSKY.

Um die zur Vermeidung dei Vermehrung von Clostridien und Darmbakterien normalerweise gebrauchte Nitritsmenge einzusschranken, wurde eine Zubereitungstechnik für ausgetrocknete italienische Salamiwürste erforscht, welche verbietende Wirkungen ausbeutet die verschieden sind als die Nitrits, und die Anwendung von Salpeterderivaten fordernden Substanzen nicht verlangt deren Wirkung auf Mehschensorganismus noch unvollständig bekannt ist. Bei leichtem Austrocknen des Fleisches bei Abkühlungstemperatur und Ausruhen des Wurstfleisch-gemisches, bzw. der bereits eingehüllten Wurstware während ein paar Tage bei 0°-$4^{\circ}C$ - Temperaturen, erhält man, auch in Gegenwart von nur 50 ppm Nitrit, eine gewisse Unaktivierung der Clostridien / I,2 Dezimalminderungen/; der Zusatz von Essigsäure, wenn auch unter solchen Konzetrierungen, die den pH des Fleischgemisches nicht verändern, erzeugt eine Mengeverminderung der Darmbakterien bei weniger Quantität Chlorid /2,5%/ und Fett/20-23%/ enthaltenden Salami-Würsten: diese Wirkung wird bei Ausruhetemperaturen und niedrigeren pH-Werten deutlicher /$T=-4^{\circ}C$; pH -5,5/.
Während des Austrocknens und Ablagerns verhindert Essigsäure, manchmal teilhaft, die Vermehrung der Darmbakterien in Salamiwürsten, wo, um den pH nicht herabzulassen, kein Zucker gebraucht wurde: in keinem Fall merkt man eine Zunahme in der Anzahl der Clostridien /Max 9g/g/. Bei Temperaturen unter $20^{\circ}C$ während des Austrocknens und Ablagerns werden keine Zunahmen an ins Fleischgemisch eingeimpfte Staphylokokken nach dem Masse von ca. 10^4/g festgestellt.

I2.3

Emploi de quantités limitees de nitrite dans la preparation de saucissons mûris

P.BALDINI, G.FARINA, F.PALMIA, G.PAROLARI et R.RACZYNSKY.

Afin de réduire les quantités de nitrite employées normalement pour empêcher la multiplication des clostrides et des entérobactéries on a étudié une technique de préparation des saucissons mûris italiens qui exploite des effets inhibiteurs différents de ceux du nitrite et qui n'exige pas l'emploi de substances pouvant former des dérivés nitreux dont l'action sur l'organisme humain n'est pas entièrement connu. En déshydratant la chair des saucissons à des températures de réfrigération et en faisant se reposer la mêlée du saucisson déjà dans son boyau, pendant quelques jours à une température de $0^{o}C$-$4^{o}C$ on obtient, même en présence de seulement 50 ppm de nitrite une certaine inactivation des clostrides I,2 réductions décimales: l adjonction d'acide acétique, même en concentrations telles qu'elles ne modifient pas le pH de l'amalgame,détermine une réduction dans le nombre d'entérobactéries dans des saucissons contenant de basses quantités de chlorure /2,5%/ et de gras /20.23%/: cette action est plus évidente pour des températures de repos et des valeurs de pH plus basses /$T=-4^{o}C$; pH=5,5/. Pendant le séchage et le mûrissage l'acide acétique empêche, parfois seulement partiellement, la multiplication des entérobactéries dans les saucissons où, pour ne pas abaisser le pH on n'a pas employé de sucre: en aucun cas on ne remarquera une augmentation du nombre des clostrides /max 9g/g/. En adoptant des températures de séchage et mûrissage inférieures a $20^{o}C$ on n'observe pas d'augmentation dans le nombre de staphylocoques pathogènes inoculés dans la mesure d'environ IO^{4}/g.

Употребление ограниченных количеств нитрита в изготовлении выдержанных колбас

П.Балдини, Г.Фарина, Ф.Палмия, Г.Паролари и Р.Рачински.

Техника изготовления итальянских выдержанных колбас была рассмотрена, чтобы сократить количество нитрита обычно употреблённые, чтобы тормозить размножение клостридий и энтеробактерий. Эта техника использует тормозящие эффекты различны с нитрата и она не употребляет вещества, которые могут создать нитрозосоединения, действие которых на человеческий организм не вполне известен.

Если мы немного сушим мясо в температуре замораживания и мы держим фарш колбасы / или выдержанную колбасу/ на некоторые дни в температуре 0^{o}, $-4^{o}C$ мы можем частично делать клостридия бездеятельными и в присутствии только 50 ppm нитрата.

/ I,2 десятичных уменьшений: добавка уксусной кислоты, также в сосредоточениях, которые не изменяет pH фарша уменьшит количество кишечных бактерий (энтеробактерий) в колбасах с низкими количествами хлорида (2,5%) и жира (20-23%).

Это действие более очевидное для температур остановки и ниже ценностей pH ($T=4^{o}C$; pH = 5,5)/.

В продолжении сушки и выдерживания уксусная кислота мешает, иногда только частично, размножение энтеробактерий в колбасах, без добавки сахара, чтобы не уменьшить pH: мы никогда не отметим увеличение клостридий (Макс. 9г/г).

В температурах сушки и выдерживания ниже $20^{o}C$ мы не отметим увеличения патогенных стафилококков, привитых в фарш в меру около IO^{4} /г.

12.3

Use of reduced amounts of nitrite in the production of italian typical salami

P.BALDINI G.FARINA G.PAROLARI F.PALMIA and R.RACZYNSKI

Stazione Sperimentale per l'Industria delle Conserve Alimentari - Parma

Microbial changes of meat in raw sausages may be responsible for the development of typical tastes and even for the spoilage of the product, depending on the microbial strains present (1). Different kinds of salami may this be obtained by a proper microbial selection.

In particular, the acidification that some types of salami undergo during the first days of ripening causes the inactivation of some harmful strains and the formation of the organoleptic properties of the product, and allows lean and fat particles to bind quickly (2).

On the contrary, a fall in the pH value must be avoided in many italian-style salami, where the addition of sugar and the subsequent multiplication of Lactobacilli result in undesired acid tastes.

The addition of nitrite and nitrate to non-acidified salami plays an important role in preventing the growth of dangerous bacteria.

When reduced amounts of these additives are added, careful attention should be paid to the other preserving factors (A_w, pH), to the preparation technique and to the characteristics of the mince (3).

In order to study the possibility of obtaining non-acidified salami, containing not more than 2,5% sodium chloride and 50 ppm of added nitrite, the following preparation technique has been employed:

1) The meat is slightly dehydrated, to lower the moisture of the mince.

2) Acetic acid is added, in some cases in amounts that do not modify the pH value, then the salami are allowed to rest at low temperature to control the number of Clostridia and Enterobacteria.

Preparation of salami

The meat used for the preparation of salami (table 1) was slightly dehydrated for a few days at chilling temperatures (0°, 3°C), thus obtaining a weight loss of about 9%. The minces were prepared by grinding and mixing the ingredients in a cutter; during the mixing, before the addition of ingredients other than meat (tabs.1 and 2), the minces were inoculated with freshly prepared (one day old) cultures of Cl.Sporogenes 3679 and Staphylococcus Aureus ATCC 6538 (10^2 and 10^4 n°/g, respectively).

The minces thus obtained, or the salami immediately after casing, were stored for three days at low temperature (0° and -4° for minces A and B, respectively).

Chemical and microbiological analyses were carried out on salami prepared with natural pork casings: on the same day of preparation; at the beginning of drying; four days later; seven days later; at the end of ripening.

Results and discussion

When resting at low temperature, salami showed an inactivation of Clostridia which was maximal at $-4^{\circ}C$. Table 5 shows that the death of Enterobacteria depends on the storage temperature, the pH of the mince, and the amount of acetic acid added.

During drying and ripening a multiplication of Enterobacteria in salami containing less than 1 $^{ml}/kg$ of acetic acid was observed; the increase in number was greater with increasing pH values and decreasing amounts of acetic acid. A growth in number of Clostridia and Staphylococci, on the contrary, was never noted; in spite of a large initial contamination, they never reached the number of 10^{5} n./g, which is throught to be necessary for giving a toxic product.

The pH was influenced only in those minces to which $1^{ml}/kg$ of acetic acid had been added; during drying no significant pH lowering was observed, while only salami A showed, at the end of ripening, a lower pH, as compared with the initial pH of the mince (see table 4).

Nitrites and nitrates were present at low concentrations all through the preparation; no detectable amounts of nitrite were present at the end of ageing.

The results show that it is possible to prepare salami with a little amount of nitrite, where the inactivation of Clostridia and Enterobacteria is accomplished by the combined effect of low temperatures and acetic acid, which is known to be harmful to many microorganisms.

The effect of acetic acid does not appear to be due to a pH lowering and therefore to possible changes of nitrite caused by variations in the physicochemical characteristics of the medium; furthermore, it should be remarked that a direct interaction of nitrite and acetic acid resulting in the formation of dangerous products is unknown until today; then the addition of the same additives (acetic acid, nitrite), in the same amounts, to different minces does not always result in the same pH change.

Finally, no multiplication of Staphylococci was ever found; this may be due to the fact that drying and ripening temperatures were always below $20^{\circ}C$. (4)

A set of salami, prepared with 22 ppm of nitrite and 0,22 ml/kg of acetic acid only, is being studied, now; their colour is good, but no microbiological data are available, today.

References

1) G.Reuter - Die Fleischwirtschaft 52.65 (1972)

2) H.U. Liepe - Die Fleischwirtschaft 58-1781.(1978)

3) A.Mirna XXIV Eur.Meeting of Meat Res. Workers W 5 1978

4) Meat Processing 22-February 1978

Table 1. Composition, microbiological characteristics, and storage temperatures of mi...

		Salami A	Salami B
Lean pork shoulder	%	72	72
Pork fat	%	25	25
Sodium chloride	%	2,5	2,5
Wine	%	0,5	0,5
Pepper	%	0,08	0,08
Garlic	%	0,008	0,008
Resting temperature (^{o}C)		0,+2	-4, -6
Total count ($\log^{N^{o}}/g$)		5,05	4,95
Micrococci	"	4,26	4,68
Lactobacilli	"	2,32	2,08
Enterobacteria	"	2,72	2,08
Sulphite reducing Clostridia	"	2,00	2,08
Pathogenic Staphylococci		4,71	4,48

Table 2. Nitrite, nitrate and acetic acid added to the minces.

	Salami A Mince N.				Salami B Mince N.			
	1	2	3	4	1	2	3	4
$NaNO_2$ (ppm)	50	50	50	50	50	50	50	50
$NaNO_3$ (ppm)	-	-	-	100	-	-	-	100
CH_3COOH (ml/kg)	1.00	0.50	-	-	-	0,25	0,50	-

Table 3. Environment temperature and moisture during drying and ripening.

days	Moisture %		Temp. °C	
	A	B	A	B
1	60	60	19	19
2	60-90	60-90	18	18
3	"	"	17	17
4	"	"	16	16
5	"	"	14	14
6-40	85-90	85-90	12	12

Tabla 4 a. Changes of chemical and physicochemical characteristics.

Mince	days	A_w	pH	H_2O%	NaCl%	$NaNO_2$ (ppm)	$NaNO_3$ (ppm)	Proteins %	Fat %	Ash %
1A	0	0,95	5,47	57,1	2,75	24	32	19,06	20,26	3,36
2A	0	0,95	5,59	56,38	2,70	38	33			
3A	0	0,95	5,73	54,66	2,70	28	48			
4A	0	0,95	5,77	52,47	2,75	43	105			
1A	4	0,95	5,44	52,77	2,80	24	<10	18,63	24,92	3,84
2A	4	0,95	5,58	53,61	2,80	24	22			
3A	4	0,95	5,78	53,26	2,80	24	10			
4A	4	0,94	5,81	52,94	2,75	34	97			
1A	7	0,94	5,61	52,29	3,10	27	<10	20,82	23,37	3,79
2A	7	0,94	5,59	51,59	3,16	29	22			
3A	7	0,94	5,83	50,46	3,04	22	28			
4A	7	0,94	5,86	48,81	3,04	64	48			
1A	46	0,91	5,34	39,13	3,80	<10	32	24,73	29,21	4,97
2A	46	0,90	5,40	35,78	3,98	<10	14			
3A	46	0,89	5,56	33,31	3,98	<10	17			
4A	46	0,89	5,56	33,82	4,22	<10	27			

Table 4 b.

Mince	days	A_w	pH	H_2O%	NaCl	$NaNO_2$ (ppm)	$NaNO_3$ (ppm)	Proteins %	Fat %	Ash %
1B	0	0,96	5,46	56,71	2,56	40	10	16,79	23,41	3,26
2B	0	0,95	5,41	54,80	3,04	43	26			
3B	0	0,94	5,45	55,79	3,04	54	16			
4B	0	0,96	5,67	58,52	2,80	58	81			
1B	4	0,93	5,51	49,39	3,62	18	23	20,77	25,40	4,37
2B	4	0,93	5,49	48,59	3,62	18	30			
3B	4	0,94	5,51	52,80	3,04	12	31			
4B	4	0,94	5,63	51,76	3,16	18	51			
1B	7	0,93	5,70	48,31	3,62	<10	45	19,67	27,82	4,52
2B	7	0,93	5,54	47,79	3,28	<10	37			
3B	7	0,93	5,47	48,29	3,28	<10	22			
4B	7	0,94	5,58	53,98	3,04	<10	48			
1B	31	0,90	5,48	35,94	4,90	<10	14	27,36	29,67	5,43
2B	31	0,90	5,48	38,30	3,98	<10	21			
3B	31	0,90	5,42	36,96	4,22	<10	25			
4B	31	0,90	5,63	38,49	4,10	<10	17			

Table 5. Microbial strains in salami during ripening (Log N°/g)

Salami A

Mince N.	days 0 1	2	3	4	Mince N.	days 4 1	2	3	4
Total count	5,13	5,67	5,68	5,71		5,48	4,91	5,48	6,08
Micrococci	4,38	4,26	4,32	4,68		3,48	5,08	4,08	5,26
Lactobacilli	2,18	2,80	2,73	2,56		5,95	5,72	6,43	5,91
Sulph.red.Cl.	0,48	0,78	0,78	0,95		0,78	0,78	0,48	0,48
Enterobacteria	1,48	2,56	2,48	2,32	<	1,48	2,38	3,95	2,62
Pathogenic Staphylococci	4,59	4,59	4,65	4,52		4,08	4,08	4,18	3,78

Mince N.	days 7 1	2	3	4	Mince N.	days 46 1	2	3	4
Total count	7,18	7,38	7,20	7,08		8,51	8,38	7,43	7,86
Micrococci	4,08	5,38	5,43	5,48		3,95	4,08	4,91	5,01
Lactobacilli	7,56	7,92	6,91	7,08		8,36	8,15	7,08	7,83
Sulph.red.Cl.	0,81	0,48	0,48	< 0,48	<	0,48	< 0,48	< 0,48	< 0,48
Enterobacteria	< 0,48	1,11	5,08	4,76	<	0,48	< 0,48	2,08	1,32
Pathogenic Staphylococci	4,26	4,32	4,18	3,78		3,95	3,79	3,95	3,78

Salami B

Mince n.	days 0 1	2	3	4	Mince n.	days 4 1	2	3	4
Total count	5,11	5,91	5,49	5,32		6,52	6,78	6,80	7,56
Micrococci	4,84	4,38	4,89	4,82		5,02	5,15	5,39	6,56
Lactobacilli	1,78	2,18	2,08	2,72		6,95	6,00	6,08	6,08
Sulph.red.Cl.	< 0,48	< 0,48	< 0,48	< 0,48	<	0,48	< 0,48	< 0,48	< 0,48
Enterobacteria	< 1,48	< 1,48	< 1,48	2,26	<	0,48	< 0,48	< 0,48	3,18
Pathogenic staphylococci	3,93	4,38	4,48	4,26		4,08	3,56	3,88	3,80

Mince N.	days 7 1	2	3	4	Mince n.	days 31 1	2	3	4
Total count	7,80	7,52	7,72	7,62		7,85	7,94	7,85	7,71
Micrococci	7,10	7,30	6,78	7,33		3,78	5,10	5,10	5,18
Lactobacilli	8,78	8,90	8,60	7,98		8,10	7,26	8,59	7,71
Sulph.red.Cl.	< 0,48	< 0,48	< 0,48	< 0,48	<	0,48	< 0,48	< 0,48	< 0,48
Enterobacteria	1,38	1,26	1,32	5,1		0,78	< 0,48	< 0,48	2,32
Pathogenic staphylococci	4,26	4,32	4,38	4,08		4,30	4,52	4,56	4,65