TÍTULO : Evolución de los compuestos extraídos por SDE a lo largo de la maduración del chorizo de Pamplona elaborado con *Lactobacillus plantarum* y *Staphylococcus carnosus.*

TITLE : Changes in volatile compounds during ripening of Chorizo de Pamplona elaborated with *Lactobacillus plantarum* and *Staphylococcus carnosus*.

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SUMMARY

The purpose of this paper was to follow the ripening of Chorizo de Pamplona through the analysis of the evolution of the compounds extracted by SDE with dichloromethane. An increase of the number and concentration of compounds was detected during the maturation, ranging from 63 compounds (10.26mg dodecane/g dry matter) to 98 substances (223.16mg of dodecane/g dry matter) identified in mixing and final product, respectively. Acids showed the highest increase during the ripening, reaching the 90% of the total amount of compounds at the end of the process, followed by esters and aldehydes. Short chain fatty acids, that contribute to the typical organoleptic charateristics of dry fermented sausages, became apparent from the 21st day and accounted for only 1.3mg of the total of acids in final product (202mg dodecane/g dry matter). Sulphur compounds decreased sligtly during the ripening, due basically to the decrease in the content of the disulphyde di-2-propenyl, compound originated from garlic.

KEYWORDS: dry fermented sausage, ripening, SDE (Likens-Nickerson), compounds evolution.

RESUMEN

En este trabajo se efectuó un seguimiento de la evolución de los compuestos extraídos por SDE con diclorometano a lo largo de distintas fases de la maduración de Chorizo de Pamplona. Se puso de manifiesto un incremento en el número y cantidad total de compuestos aislados a lo largo del proceso, oscilando entre 63 y 98 las sustancias identificadas en amasado y producto final, respectivamente, así como un incremento en la cantidad de dichos compuestos (entre 10.26mg y 223.16mg). La modificación más importante fue el incremento en el contenido de ácidos grasos, fundamentalmente de cadena larga, hasta constituir aproximadamente un 90% del total en producto final. En esta fase, del total de ácidos aislados (202mg dodecano/g sustancia seca), únicamente 1.3mg fueron procedentes de ácidos grasos de cadena corta, que contribuyen de modo importante al flavor de los embutidos crudos curados. El contenido en compuestos azufrados disminuyó a lo largo de la maduración, debido principalmente al descenso sufrido por el disulfide di-2-propenil, compuesto procedente del ajo.

PALABRAS CLAVE: embutido, maduración, SDE (Likens-Nickerson), evolución de compuestos.

INTRODUCTION

The “Chorizo de Pamplona” is a typical Spanish dry fermented sausage whose microbial and physicochemical properties have been studied during the last years (Gorospe et al., 1989; Sarasíbar et al., 1989; Astiasarán et al., 1990; Santamaría et al., 1992; 1994). However, it seems to be necessary to extend this knowledge with instrumental measures of its sensorial properties.

In general, flavour of dry fermented sausages is consequence of chemical, biochemical and microbiological reactions that take place along the ripening process and in which a number of compounds are synthesized that contribute with their characteristic odour and taste. A particular feature that distinguish these products from other meat derivatives is that they include spices in their composition, of a great importance from a sensorial point of view (Berdagué et al., 1993; Schmidt and Berger, 1998a; Meynier et al., 1999). Furthermore, compounds from smoking should be also taken into account in those products submitted to this process (Hollenbeck, 1994; Mateo y Zumalacárregui, 1996).

Different analytical methods have been widely used by many authors to describe the profile of volatile compounds of dry fermented sausages from several areas, studying the influence of the ingredients and starter cultures used and technology of elaboration applied. These analysis have been always done in final product (Berdagué et al., 1993; Stahnke, 1994; 1995; Johansson et al., 1994; Hagen et al., 1996). Buscaihlon et al. (1993) investigated the aroma genesis of dry-cured hams following the changes in volatile compounds during the ripening, as a way of optimise the duration of processing. However, the changes that take place in the profiles during the ripening time in any kind of dry fermented sausages, have only been studied in three papers found in the literature: saucisson (Croizet et al., 1992), traditional chorizo (Mateo and Zumalacárregui, 1996) and salami (Schmidt and Berger, 1998b).

The objective of this work was to follow the evolution during the ripening of chorizo de Pamplona of the compounds extracted with dichloromethane, using the simultaneous destilation-extraction method (SDE). Furthermore, samples of red pepper, garlic and a mixture of raw pork meat and fat were also analyzed using the same method, as the main ingredients used in the manufacture of this product, in order to determine the origin of some of the aroma components.

MATERIALS AND METHODS

Sausage elaboration

A batch of Chorizo de Pamplona was elaborated in a pilot plant, using the following standard formulation of lean pork meat 75%, pork back fat 25%, red pepper 30g/Kg, NaCl 28g/Kg, dextrin 15g/Kg, powdered milk 12g/Kg, lactose 10g/Kg, sodium caseinate 10g/Kg, dextrose 5g/Kg, garlic 3g/Kg, polyphosphates 2g/Kg, Curavi (mixture of nitrates and nitrites) 0.3g/Kg, Ponceau 4R (E124) 0.3g/Kg and sodium ascorbate 0.5 g/Kg. A mixture of *Lactobacillus plantarum* L115 (10%) and *Staphylococcus carnosus* M72 (90%) from Lacto-Labo (TEXEL) was used as a starter and supplied at 10^6-10^7 ufc/g.

Lean pork meat and fat back pork were minced in a cutter with a particle size reduction to about 3mm (this little particle size is a technological characteristic of Chorizo de Pamplona, a Spanish kind of dry fermented sausage). Subsequently all ingredients and the starter culture were added and mixed in a vacuum kneading machine. After the initial fermentation phase that took place in a laboratory ripening cabinet [24 h at 24ºC and saturation relative humidity (RH), 24 h at 22ºC and 85% RH, 24 h at 20ºC and 80% RH], sausages were transferred into a drying chamber to complete 35 days of ripening [14ºC and 77% RH].

Analyzed Samples

Four different samples of sausage (25g each) were taken at every phase of analysis: 0,3,9,15,21 and 35 days of ripening. Also samples of garlic (2g), red pepper (25g) and a mixture of meat and fat (25g) were analyzed.

Likens-Nickerson extraction

Samples were ground and placed in a 250 ml flask with 100 ml of water. A second flask with 5 ml of dichloromethane and 150μg of dodecane (internal standard) was also attached to a modified Likens-Nickerson apparatus. A total of 5 ml of dichloromethane was also added to fill the apparatus solvent return loop. Sample mixture and solvent were heated to 70ºC and boiling Tª respectively, mantaining these conditions during 2h. After cooling to ambient temperature, the extract of dichloromethane was collected and dried over anhydrous Na_2SO_4.

Analysis of volatile compounds

The volatile compounds were analyzed in a HP 6890 GC System (Hewlett-Packard) coupled to a 5973 Mass Selective Detector (Hewlett-Packard). A total of 1 μl of the extracts were injected into the GC, equipped with a capillary column (30 m x 250 μm i.d. x 0.25 μm film thickness HP-5MS). Carrier gas was He (1ml/min) and the chromatographic conditions were as follows: initial oven temperature was maintained during 10 min. at 40ºC, and subsequently programmed from 40ºC to 120ºC at a rate of 3ºC/min and at a rate of 10ºC/min from 120ºC to 250ºC where it was held for another 5min. Injector Tª: 250ºC ; Mass range: 33-350 amu; Solvent Delay: 4 min.; Electron impact at 70 eV.

Identification of the peaks was based on comparison of their mass spectra with the spectra of the WILEY library and in addition, in some cases, by comparison of their retention time with those of standard compounds. The Kovats index were also calculated according to Tranchant (1982) and were compared with available literature data (Kondjoyan and Berdagué, 1996). Peaks obtained are shown in Table 1. Semiquantitative determination of the volatile compounds was based on the ratio of their peak areas obtained from the total ion chromatogram, to that of dodecane (i.s.), and the results were expresed as ng dodecane /g dry matter.

Data analysis

Data analysis was carried out with SPSS program. Means and standard deviations of eigth determinations are shown (four destilations of sausage per phase of analysis and two injections per destilation were carried out).

DISCUSSION

Table 1 shows, grouped in different chemical families, the compounds isolated with dichloromethane by SDE from Chorizo de Pamplona. Samples were taken in different phases along the ripening process and a progressive increase in the number and concentration of substances was observed.

Expressed in mg of dodecane/g dry matter, the total amount of the 63 compounds extracted in the initial phase of ripening was 10.26mg, increasing during the maturation to reach in the final product 98 isolated compounds, that accounted for 223.16mg dodecane.

Acids was the most affected group by the ripening process. Only two of them were detected in the initial phase, accounting for the 44.5% of the total area in this phase (Fig 1). They decreased their concentration, reaching a minimum in the 9th day, contributing with a 12% of the total area. As a consequence of the hydrolysis of triglycerides by both microbial and endogenous lipases, amino acid catabolism and other chemical pathways, concentration and number of this type of compounds started increasing by the 15th day. From this stage, a significant decrease of the relative contribution of the rest of the groups to the total of isolated substances was found. The most abundant ones were the long chain fatty acids (C16 and C18) that do not contribute directly to an improvement of the sensorial properties, but could act as precursors of compounds of influence on taste and odour (Arbolés and Juliá, 1992; Fernández et al., 1995). They come basically from lipolytic activity, being involved bacteria from micrococci, which attack long chain fatty acids, that are the most abundant ones in meat products (Selgas et al., 1986). Short chain fatty acids (C<6) were detected by the 21st day of ripening and they are directly implicated in the flavour of dry fermented sausages. At the end of the process they accounted for only 1.3mg dodecane/dry matter of the total 202mg dodecane/g dry matter isolated of acids. They are not usually present in the triglycerides of the raw matter, but they can be originated from microbial activity. 2-methylbutanoic acid and 3-methylbutanoic acid are originated from microbial degradation of Ile and Leu, respectively, and they are characterized by their sweatty odour (Schmidt and Berger, 1998a). Everyone of the 13 acids detected were present in the final product and their amount was much higher than in previous phases, as observed in other products, reaching a 90% of the total area. Schmidt and Berger (1998b) using a molecular destillation technique for isolation of volatiles from salami found an increase in acids from 2.7% in the initial product to a 35% at the end of the ripening, being the tetradecanoic the highest molecular weight acid detected. Acetic acid was the most abundant one in every step of the analysis. In the profile of acids in traditional chorizo detected by Mateo and Zumalacárregui (1996) using a Likens-Nickerson apparatus with diethyl ether, should be also mentioned the abundance of acetic acid, accounting for the 27% of the total area in the final product.

Aldehydes were the most abundant compounds in two of the analyzed phases (3rd and 9th days) contributing with, roughly, a 45% of the total area. Despite that their concentration was increasing progresively along the ripening, their relative contribution to the total area decreased to a 5.8% because of the strong increment of the acids. Some of the most abundant ones were detected either in red pepper (2,4-decadienal and pentadecanal) or in the raw mixture of meat and pork fat (tetradecanal, pentadecanal, hexadecanal and 9-octadecenal). These long chain aldehydes were also isolated in raw meat by Dirinck and De Wine (1994). Evolution of hexanal, taken as reference of the oxidation process (Ajuyah et al., 1993) was found to be fluctuating, in agreement with other reports (Croizet et al., 1992; Mateo and Zumalacárregui, 1996). It is of interest that its amount at 35 days is similar than that at the third day. Other detected compound from microbial degradation was benzeneacetaldehyde -from phenyalanine (Berdagué et al., 1993)-, whose concentration was 10 times higher in the final product with regard to the mixing phase. This increment could be related to the proteolytic phenomena suffered by the dry fermented sausages during their ripening, and the further transformation process of the phenylalanine.

Esters increased their concentration from 201ng of dodecane/g dry matter in the initial phase where only 4 of these compounds were isolated, to 2328ng at the end of the process where 14 esters were identified. Esters of short chain fatty acids constitute an important group from a sensorial point of view, due to their low odour threshold value and because they could add a fruitty note to the aroma and mask rancid odours (Stahnke, 1994). This group had a very good correlation with the evolution, increasing progresively from the initial phase until the end of the ripening. Montel et al. (1996) analyzing the influence of Micrococcaceae on the aroma of dry sausages found that the ethyl 3-methylbutanoate was found only in samples with *S. carnosus*. This compound appeared also in the chorizo from the 21st day of ripening.

The presence of terpenes and sulphur compounds in dry fermented sausages has been associated to addition of spices (pepper and garlic, respectively) showing high proportions of these chemical structures (Berger et al., 1990; Johansson et al., 1994; Mateo and Zumalacárregui, 1996; Meynier et al., 1999). In saucisson, this type of compunds do not seem to be so relevant (Croizet et al., 1992). Three of the 5 sulphur compounds identified in Chorizo de Pamplona (methyl allyl disulphyde, disulphyde di-2-propenyl and trisulphyde di-2-propenyl) were also found in the garlic samples showing a decrease in the total amount in the final product with regard to the initial phase. This decrease was due specially to the decrease in the content of the disulphyde, di-2-propenyl. This compound was the most abundant one originated from garlic, despite that in the analyzed sample of this spice was the trisulphyde, di-2-propenyl the most relevant one (data not shown). Mateo and Zumalacárregui (1996) pointed out that reactions that yields organic sulphur compounds from garlic starts inmediately after damage to the parenchyma of the garlic and presumably continues in the sausage during processing and storage. This fact could explain the different distribution of the sulphur compounds in the sausage with that of garlic.

The low odour thresholds of phenols let them contributing considerably to the flavour of dry fermented sausages. Those of guaiacol, 2-methoxy-4-methylphenol and 2,6-dimethoxyphenol are between 0.02 and 1.85 ppm (Wasserman, 1966). The last two were of the most abundant isolated in the final product. Everyone of the phenols detected in the sausage were also present in the red pepper, and guaiacol was also present in garlic.

The presence of BHT, detected in the raw mixture of meat pork and fat, was shown in every phase of analysis, and could be related to its addition as antioxidant to the pork fat. Aromatic hydrocarbons, alkanes, alcohols, terpenes and nitrogen compounds were the groups isolated in the lowest amounts.

In summary, 35 different compounds were detected at the end of the ripening in relation to the initial mixture, due to reactions that had been taken place along the process. The evolution of the different chemical families of compounds isolated from Chorizo de Pamplona resulted in a strong increment of acids, a relevant increment of esters and aldehydes, comparing the final product with regard to the initial stage of analysis. Content of sulphur compounds suffered a slight decrease during ripening.

Table1. Results of compounds isolated from Chorizo de Pamplona by SDE (ng dodecane/g dry matter).
Tabla 1. Resultados de los compuestos aislados de Chorizo de Pamplona mediante SDE. (ng dodecano/ g materia seca).

KI	RI	Compound		Mixing	3 Days Mean ; SD	9 Days Mean ; SD	15 Days Mean ; SD	21 Days Mean ; SD	35 Days Mean ; SD
		Acids							
796	*c*	Butanoic acid		0	0 ; 0	0 ; 0	0 ; 0	8,45 ; 5,06	72,26 ; 30,56
840	*b*	3-Methylbutanoic acid		0	0 ; 0	0 ; 0	0 ; 0	360,01 ; 21,16	1053,78 ; 101,60
850	*b*	2-Methylbutanoic acid		0	0 ; 0	0 ; 0	0 ; 0	78,83 ; 3,56	232,40 ; 37,82
991	*a*	Hexanoic acid		0	0 ; 0	0 ; 0	0 ; 0	228,58 ; 46,36	690,29 ; 126,82
1183	*a*	Octanoic acid		0	0 ; 0	0 ; 0	0 ; 0	453,10 ; 86,64	1199,84 ; 224,85
1377	*a*	Decanoic acid		0	0 ; 0	0 ; 0	0 ; 0	1786,27 ; 172,25	4396,05 ; 205,71
1566	*a*	Dodecanoic acid	P	0	0 ; 0	0 ; 0	115,36 ; 25,25	806,95 ; 2,51	2005,02 ; 120,82
1762	*a*	Tetradecanoic acid	P	0	0 ; 0	52,78 ; 17,44	397,36 ; 53,93	1830,25 ; 18,45	5087,68 ; 287,49
1945	*a*	9-Hexadecenoic acid	P	0	0 ; 0	0 ; 0	227,25 ; 54,99	870,81 ; 5,78	2652,37 ; 220,10
1963	*a*	Hexadecanoic acid		3285.94	1689,76 ; 85,86	1008,63 ; 97,52	14922,62 ; 439,64	25174,56 ; 438,23	68899,91 ; 3534,36
2160	*a*	Oleic acid		1286.23	567,85 ; 27,66	325,07 ; 52,50	5572,71 ; 280,16	12584,12 ; 769,67	34032,41 ; 2893,86
2158	*a*	Linoleic acid		0	0 ; 0	0 ; 0	14629,44 ; 3638,17	20417,36 ; 976,11	80388,98 ; 2568,98
		Stearic acid		0	0 ; 0	0 ; 0	0 ; 0	0 ; 0	1244,88 ; 210,71
		Subtotal		4572.17	2257,61	1386,47	35864,75	64599,28	201955,87
		Aldehydes							
		2-Pentenal		0	0 ; 0	0 ; 0	0 ; 0	0 ; 0	48,28 ; 0,05
803	*a*	Hexanal		38.10	211,69 ; 50,49	103,35 ; 1,60	177,16 ; 30,50	76,71 ; 0,47	226,86 ; 14,52
827	*b*	2-Furanocarboxaldehyde		27.77	40,62 ; 7,86	93,68 ; 17,48	106,01 ; 28,01	105,55 ; 20,57	161,91 ; 3,48
900	*a*	Heptanal		24.02	36,71 ; 2,38	31,26 ; 0,05	51,50 ; 6,08	17,56 ; 0,16	48,70 ; 2,26
957	*b*	Benzaldehyde	P	48.04	99,02 ; 1,94	33,95 ; 18,21	60,17 ; 11,35	53,71 ; 9,24	94,90 ; 13,46
1009	*b*	2,4-Heptadienal		0	0 ; 0	0 ; 0	0 ; 0	0 ; 0	134,04 ; 4,31
1039	*b*	Benzeneacetaldehyde	P	118.57	455,54 ; 17,68	552,62 ; 30,75	533,42 ; 6,93	783,06 ; 26,39	1163,46 ; 25,97
1102	*a*	Nonanal	MT	291.29	545,36 ; 4,21	301,46 ; 10,91	436,32 ; 24,70	163,81 ; 7,51	298,30 ; 19,62
1152	*c*	2,6-Nonadienal		0	0 ; 0	0 ; 0	0 ; 0	0 ; 0	87,66 ; 7,68
1196	*c*	Safranal	P	50.96	47,50 ; 4,07	40,59 ; 2,21	55,22 ; 9,15	63,68 ; 13,26	172,01 ; 0,83
1262	*b*	2-Decenal (E)		0	0 ; 0	0 ; 0	0 ; 0	0 ; 0	89,06 ; 7,06

1293	*b*	2,4-Decadienal (E,Z)		23.63	23,21 ; 1,81	0 ; 0	0 ; 0	0 ; 0	92,43 ; 2,08
1317	*b*	2,4-Decadienal	P	7.69	23,30 ; 5,26	6,42 ; 0,23	16,23 ; 2,21	0 ; 0	154,22 ; 1,49
1368	*b*	2-Undecenal(E)		0	0 ; 0	0 ; 0	30,64 ; 1,36	0 ; 0	74,45 ; 6,13
1614	*b*	Tetradecanal+167/196	MT	39.99	49,39 ; 0,76	28,81 ; 3,41	39,36 ; 12,89	65,22 ; 8,33	116,90 ; 1,22
1711	*b*	Pentadecanal?	MT, P	0	138,84 ; 0,12	107,95 ; 15,62	86,34 ; 21,59	104,36 ; 15,72	161,15 ; 12,82
1819	*b*	Hexadecanal	MT	378.76	3777,87 ; 69,98	2807,18 ; 118,03	4313,92 ; 3,14	4753,80 ; 53,13	7045,65 ; 44,83
1999	*c*	9-Octadecenal	MT	83.03	624,78 ; 3,05	473,48 ; 21,56	916,86 ; 22,81	1046,29 ; 4,46	1428,94 ; 25,59
2037	*c*	Octadecanal		58.04	679,33 ; 15,71	511,19 ; 29,65	867,66 ; 121,90	994,52 ; 25,46	1313,27 ; 33,92
		Subtotal		1189.89	6753,18	5091,93	7690,80	8228,25	12912,17
		Esters							
846	*c*	Butanoic acid, 3-methyl, ethyl ester		0	0 ; 0	0 ; 0	0 ; 0	46,76 ; 2,83	50,27 ; 3,73
999	*b*	Hexanoic acid, ethyl ester		0	0 ; 0	0 ; 0	12,46 ; 1,43	28,54 ; 0,51	48,50 ; 3,78
1125	*b*	Decanoic acid, methyl ester		0	0 ; 0	0 ; 0	0 ; 0	0 ; 0	21,93 ; 0,50
1328	*b*	Octanoic acid, methyl ester		0	0 ; 0	0 ; 0	16,33 ; 1,49	29,91 ; 6,09	99,02 ; 8,13
1353	*d*	Propanoic acid , 2-methyl-, 2,2-dimethyl 1-(2-hidroxy-1-methylethyl) propyl ester		0	73,09 ; 5,19	45,44 ; 6,36	60,60 ; 2,09	34,12 ; 3,62	41,97 ; 2,61
1376	*d*	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester		35.40	117,70 ; 1,14	83,19 ; 9,69	206,39 ; 19,69	0 ; 0	0 ; 0
1398	*b*	Decanoic acid, ethyl ester		0	0 ; 0	0 ; 0	38,28 ; 0,18	73,08 ; 4,89	213,98 ; 4,01
1528	*a*	Dodecanoic acid, methyl ester		0	0 ; 0	0 ; 0	0 ; 0	19,63 ; 1,58	41,20 ; 5,62
1596	*b*	Dodecanoic acid, ethyl ester		0	0 ; 0	0 ; 0	0 ; 0	29,37 ; 4,72	88,52 ; 2,81
1722	*a*	Octadecanoic acid, methyl ester		17.08	25,14 ; 2,11	24,25 ; 3,33	35,14 ; 9,33	26,12 ; 5,85	75,87 ; 6,65
1795	*b*	Tetradecanoic acid, ethyl ester		0	0 ; 0	0 ; 0	49,09 ; 18,47	55,28 ; 6,05	162,48 ; 3,17
1827	*c*	Isopropyl myristate		0	33,48 ; 4,44	99,91 ; 8,02	0 ; 0	0 ; 0	0 ; 0
1928	*a*	Hexadecanoic acid, methyl ester	P	117.26	183,68 ; 2,67	164,30 ; 8,70	183,68 ; 0,39	160,73 ; 12,36	313,95 ; 4,50
1994	*a*	Hexadecanoic acid, ethyl ester	P	31.66	50,53 ; 12,46	49,04 ; 10,12	198,55 ; 39,98	249,31 ; 16,43	495,11 ; 5,10
2126	*a*	Octadecadienoic acid, methyl ester	P	0	201,23 ; 13,26	150,51 ; 9,31	281,09 ; 70,37	231,99 ; 7,50	416,69 ; 23,12
2131	*a*	Octadecenoic acid, methyl ester	P	0	73,40 ; 11,69	251,02 ; 19,79	146,84 ; 58,58	137,14 ; 5,42	258,99 ; 2,72
2175	*b*	Octadecadienoic acid, ethyl ester	P	0	0 ; 0	0 ; 0	0 ; 0	544,86 ; 183,50	0 ; 0
		Subtotal		201.40	758,26	867,65	1228,46	1666,83	2328,50

		Alcohols								
848	*c*	2-Furanmethanol		0	0 ; 0	144,34 ; 19,84	66,71 ; 17,03	87,25 ; 1,06	147,05 ; 12,78
1097	*a*	Linalool	P	37.07	38,38 ; 2,22	33,43 ; 4,20	67,55 ; 1,00	61,46 ; 4,07	86,55 ; 0,02
1108	*c*	Phenylethylalcohol	P	0	0 ; 0	30,06 ; 7,29	30,57 ; 13,86	65,95 ; 18,09	20,73 ; 4,36
		Subtotal		37.07	38,38	207,83	164,83	214,67	254,32
		Terpenes							
930	*b*	a-Pinene	P	30.41	20,35 ; 2,60	22,18 ; 4,45	21,55 ; 0,10	29,67 ; 4,76	27,39 ; 1,72
968	*d*	Terpene		19.85	22,58 ; 1,02	0 ; 0	30,39 ; 2,99	23,92 ; 0,01	26,09 ; 4,03
1022	*a*	Limonene	P	16.38	27,36 ; 3,99	16,70 ; 0,46	16,58 ; 0,07	27,11 ; 0,04	34,06 ; 7,80
1392	*c*	Elemene	P	26.38	29,15 ; 1,47	24,62 ; 2,51	44,10 ; 9,98	55,14 ; 13,14	146,36 ; 4,37
		Subtotal		93.02	99,44	63,50	112,63	135,84	233,91
		Sulphur compounds							
845	*b*	1-Propene,3,3´-thiobis		85.11	92,13 ; 8,21	39,30 ; 7,42	59,11 ; 14,73	111,01 ; 21,90	125,19 ; 11,08
905	*b*	3-Methyltiopropanal		0	0 ; 0	40,77 ; 5,88	50,48 ; 9,23	75,56 ; 19,08	135,86 ; 29,71
910	*c*	Methyl allyl disulphyde	G	77.47	143,37 ; 16,62	97,03 ; 11,49	66,79 ; 8,06	79,02 ; 4,10	71,17 ; 17,85
1072	*c*	Disulphyde, di-2-propenyl	G	630.90	630,09 ; 19,71	516,09 ; 6,49	502,16 ; 5,10	378,49 ; 9,02	382,11 ; 0,29
1295	*c*	Trisulphyde, di-2-propenyl	G	55.06	90,43 ; 9,03	33,95 ; 1,74	48,61 ; 6,55	51,86 ; 5,70	65,58 ; 4,20
2097	*d*	Non identified		0	167,97 ; 10,40	138,79 ; 7,82	0 ; 0	0 ; 0	0 ; 0
		Subtotal		848.54	1124,00	865,93	727,14	695,94	779,90
		Ketones							
809	*c*	2(3H)-Furanone, dihidro, 2-methyl		0	0 ; 0	30,80 ; 1,41	23,70 ; 1,65	30,63 ; 3,76	30,88 ; 5,07
1090	*b*	2-Nonanone		0	0 ; 0	0 ; 0	0 ; 0	30,21 ; 1,19	76,89 ; 4,54
1458	*b*	Geranilacetona	P	132.18	148,50 ; 12,51	121,03 ; 0,73	125,24 ; 1,66	110,33 ; 0,36	184,36 ; 9,05
1488	*b*	b-Ionone+?	P	208.40	183,55 ; 6,56	158,00 ; 5,64	145,97 ; 9,98	128,53 ; 1,65	211,87 ; 9,19
1497	*c*	d-undecalactona?		30.53	36,34 ; 1,04	32,22 ; 0,72	34,88 ; 5,81	40,94 ; 8,64	51,17 ; 2,01
1497	*b*	2-Tridecanone	P	41.37	53,19 ; 4,71	47,06 ; 0,37	30,71 ; 0,51	20,07 ; 1,10	43,17 ; 5,02
1679	*c*	g-Dodecalactone	MT	70.39	106,68 ; 5,43	131,63 ; 9,81	103,66 ; 18,49	90,98 ; 2,13	122,61 ; 2,59
1695	*b*	2-Pentadecanone	MT	309.20	510,98 ; 2,06	415,79 ; 11,04	272,11 ; 30,69	163,92 ; 4,91	364,34 ; 7,14
1706	*c*	d-Dodecalactone		47.62	41,72 ; 0,94	47,42 ; 2,94	44,86 ; 9,48	52,92 ; 17,66	63,16 ; 1,88

1905	*b*	2-Heptadecanone	MT	75.39	125,12 ; 21,41	115,20 ; 8,37	160,83 ; 130,32	86,99 ; 16,36	124,80 ; 2,87
		Subtotal		915.08	1206,07	1099,14	941,96	755,52	1273,23
		Phenols							
986	*b*	Phenol	P	0	0 ; 0	0 ; 0	43,11 ; 9,81	42,44 ; 2,95	70,57 ; 22,58
1057	*b*	Phenol,2-methyl	P	34.29	0 ; 0	0 ; 0	47,67 ; 7,86	50,78 ; 0,81	90,38 ; 4,09
1079	*b*	Phenol,4-methyl	P	98.72	81,41 ; 12,92	109,52 ; 13,39	126,25 ; 22,47	143,51 ; 13,23	205,77 ; 2,99
1085	*b*	Guaiacol+?	P,G	291.29	107,34 ; 10,15	52,55 ; 5,38	93,63 ; 2,31	119,40 ; 6,10	89,39 ; 2,52
1191	*c*	2-Methoxy-4-methylphenol	P	71.09	78,76 ; 5,69	33,74 ; 4,37	95,74 ; 17,08	134,45 ; 10,40	328,73 ; 4,23
1278	*c*	2-Metoxy-4-ethylphenol+?	P	62.89	62,33 ; 1,17	33,53 ; 7,30	60,24 ; 2,35	69,78 ; 5,70	91,76 ; 2,18
1313	*b*	4-Vinyl-2-methoxyphenol	P	58.87	92,56 ; 0,29	64,29 ; 6,92	158,86 ; 8,22	195,29 ; 20,20	257,63 ; 16,62
1356	*c*	2,6-Dimethoxyphenol	P	110.92	72,64 ; 2,97	0 ; 0	95,44 ; 2,79	113,71 ; 9,93	183,39 ; 5,95
1454	*b*	Eugenol or isomer	P	74.56	56,51 ; 3,88	26,10 ; 4,33	39,59 ; 0,04	29,64 ; 2,56	78,57 ; 2,83
		Subtotal		802.63	551,54	319,72	760,54	898,99	1396,19
		Aromatic hydrocarbons							
	c	Toluene		157.03	924,63 ; 68,53	135,00 ; 21,30	67,11 ; 7,02	153,66 ; 30,65	55,50 ; 0,91
856	*b*	Xylene		56.23	82,54 ; 3,79	53,09 ; 4,34	47,07 ; 1,22	64,36 ; 12,30	76,51 ; 8,11
1445	*c*	Biphenilo		14.02	13,23 ; 2,31	10,98 ; 1,98	10,42 ; 1,05	0 ; 0	0 ; 0
1563	*d*	Trimethylnaphtalene	P	31.10	26,91 ; 4,62	23,26 ; 3,99	19,75 ; 0,95	16,91 ; 1,68	33,32 ; 2,28
1588	*d*	Trimethylnaphtalene	P	33.04	26,69 ; 3,05	30,50 ; 3,83	29,32 ; 10,29	40,04 ; 6,36	122,15 ; 4,18
1788	*d*	Phenantrene		49.15	50,51 ; 2,39	45,45 ; 1,96	70,63 ; 8,96	59,65 ; 0,27	150,94 ; 20,34
		Subtotal		340.57	1124,53	298,28	244,30	334,62	438,42
		Nitrogen compounds							
1083	*c*	Tetramethylpirazyne	P	96.63	136,74 ; 5,07	75,17 ; 22,92	83,82 ; 4,77	82,84 ; 2,81	99,10 ; 2,46
1291	*b*	Indol	P	0	0 ; 0	0 ; 0	0 ; 0	0 ; 0	29,59 ; 3,33
1506	*d*	1-Dodecanamine, dimethyl		81.23	49,39 ; 2,13	114,79 ; 15,11	48,14 ; 5,80	80,25 ; 2,52	48,41 ; 1,56
		Subtotal		177.86	186,12	189,96	131,96	163,08	177,09

		Alkanes							
	a	Octane		0	82,33 ; 0,33	38,52 ; 12,03	0 ; 0	0 ; 0	61,77 ; 16,65
1300	*a*	Tridecane	MT	36.24	0 ; 0	16,38 ; 2,69	28,42 ; 6,22	34,37 ; 0,59	43,73 ; 7,74
1400	*a*	Tetradecane	MT,P	48.32	48,06 ; 2,97	41,54 ; 1,56	41,12 ; 0,41	68,25 ; 0,08	127,06 ; 5,91
1500	*a*	Pentadecane	MT	35.54	54,40 ; 2,16	40,32 ; 0,48	33,43 ; 0,88	31,36 ; 0,86	74,99 ; 1,49
1600	*a*	Hexadecane	MT,P	58.17	69,74 ; 10,60	53,12 ; 11,30	52,49 ; 17,08	47,61 ; 1,80	121,18 ; 12,08
1700	*a*	Heptadecane	MT,P	0	0 ; 0	0 ; 0	0 ; 0	12,27 ; 0,03	60,83 ; 3,98
1800	*a*	Octadecane	P	13.33	39,93 ; 2,84	39,50 ; 7,66	0 ; 0	0 ; 0	0 ; 0
		Subtotal		191.60	294,45	229,37	155,46	193,86	489,56
		Others							
989	*c*	Furane,2-pentil	MT,P	0	46,48 ; 10,53	50,31 ; 4,11	45,00 ; 12,48	62,28 ; 7,40	136,12 ; 1,18
1366		95/125		36.52	40,61 ; 0,01	35,23 ; 1,36	52,53 ; 3,34	45,82 ; 3,40	71,59 ; 3,94
1512	*d*	Dibenzofuran(168)	P	34.79	40,03 ; 0,70	39,26 ; 1,06	26,95 ; 0,55	23,07 ; 1,19	34,11 ; 0,95
1524		Main ion 99		353.21	71,76 ; 0,52	272,31 ; 24,60	146,87 ; 13,85	280,12 ; 6,88	199,52 ; 0,86
1532		2(4H)-Benzofuranona, 5,6,7,7a tetrahidro-4-4-7a-trimethy +?..		243.67	223,60 ; 7,99	156,89 ; 0,29	208,98 ; 17,75	163,36 ; 5,13	225,31 ; 7,37
1876		Main ion 149		158.97	132,06 ; 0,30	123,49 ; 4,48	138,21 ; 33,78	117,11 ; 3,63	171,27 ; 2,38
		Subtotal		827.16	554,53	677,47	618,54	691,78	837,92
1516		**BHT**	MT	66.09	93,00 ; 5,32	84,53 ; 9,96	60,85 ; 2,91	50,62 ; 7,13	87,47 ; 4,07
		Total		**10263.08**	**15041,11**	**11381,78**	**48702,20**	**78629,30**	**223164.57**

KI: Kovats Indices for the DB5 column. **RI**: Reliability of identification, indicated by the following symbols: *a*, mass spectrum and retention time identical with those of an autentic sample; *b*, mass spectrum and Kovats index in agreement with the corresponding literature data; *c*, mass spectrum consistent with spectra reported in the Wiley library data; *d*, tentative identification by mass spectrum. **O:** Compounds detected in P (red pepper), G (garlic) and MT (mixture of raw meat and fat).

KI: Indices de Kovats para la columna DB5. **RI**: Calidad de la identificación segú;n los siguientes símbolos: *a*,espectro de masas e índice de retención idénticos a patrones comerciales; *b*, espectro de masas e éindice de Kovats de acuerdo a datos recogidos de la bibliografía; *c*, espectro de masas semejante al contenido en el banco Wiley; *d*, tentetiva de identificación según el espectro de masas. **O:** Compuestos detectados en P (pimentón), G (ajo) y MT (mezcla de magro y tocino).

Table1. Results of compounds isolated from Chorizo de Pamplona by SDE (ng dodecane/g dry matter).
Tabla 1. Resultados de los compuestos aislados de Chorizo de Pamplona mediante SDE. (ng dodecano/ g materia seca).

				Mixing	3 Days		9 Days		15 Days		21 Days		35 Days	
KI	**RI**	**Compound**			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
		Acids												
796	*c*	Butanoic acid		0	0	0	0	0	0	0	8,45	5,06	72,26	30,56
840	*b*	3-Methylbutanoic acid		0	0	0	0	0	0	0	360,01	21,16	1053,78	101,60
850	*b*	2-Methylbutanoic acid		0	0	0	0	0	0	0	78,83	3,56	232,40	37,82
991	*a*	Hexanoic acid		0	0	0	0	0	0	0	228,58	46,36	690,29	126,82
1183	*a*	Octanoic acid		0	0	0	0	0	0	0	453,10	86,64	1199,84	224,85
1377	*a*	Decanoic acid		0	0	0	0	0	0	0	1786,27	172,25	4396,05	205,71
1566	*a*	Dodecanoic acid	P	0	0	0	0	0	115,36	25,25	806,95	2,51	2005,02	120,82
1762	*a*	Tetradecanoic acid	P	0	0	0	52,78	17,44	397,36	53,93	1830,25	18,45	5087,68	287,49
1945	*a*	9-Hexadecenoic acid	P	0	0	0	0	0	227,25	54,99	870,81	5,78	2652,37	220,10
1963	*a*	Hexadecanoic acid		3285.94	1689,76	85,86	1008,63	97,52	14922,62	439,64	25174,56	438,23	68899,91	3534,36
2160	*a*	Oleic acid		1286.23	567,85	27,66	325,07	52,50	5572,71	280,16	12584,12	769,67	34032,41	2893,86
2158	*a*	Linoleic acid		0	0	0	0	0	14629,44	3638,17	20417,36	976,11	80388,98	2568,98
		Stearic acid		0	0	0	0	0	0	0	0	0	1244,88	210,71
		Subtotal		4572.17	2257,61		1386,47		35864,75		64599,28		201955,87	
		Aldehydes												
		2-Pentenal		0	0	0	0	0	0	0	0	0	48,28	0,05
803	*a*	Hexanal		38.10	211,69	50,49	103,35	1,60	177,16	30,50	76,71	0,47	226,86	14,52
827	*b*	2-Furanocarboxaldehyde		27.77	40,62	7,86	93,68	17,48	106,01	28,01	105,55	20,57	161,91	3,48
900	*a*	Heptanal		24.02	36,71	2,38	31,26	0,05	51,50	6,08	17,56	0,16	48,70	2,26
957	*b*	Benzaldehyde	P	48.04	99,02	1,94	33,95	18,21	60,17	11,35	53,71	9,24	94,90	13,46
1009	*b*	2,4-Heptadienal		0	0	0	0	0	0	0	0	0	134,04	4,31
1039	*b*	Benzeneacetaldehyde	P	118.57	455,54	17,68	552,62	30,75	533,42	6,93	783,06	26,39	1163,46	25,97
1102	*a*	Nonanal	MT	291.29	545,36	4,21	301,46	10,91	436,32	24,70	163,81	7,51	298,30	19,62
1152	*c*	2,6-Nonadienal		0	0	0	0	0	0	0	0	0	87,66	7,68
1196	*c*	Safranal	P	50.96	47,50	4,07	40,59	2,21	55,22	9,15	63,68	13,26	172,01	0,83
1262	*b*	2-Decenal (E)		0	0	0	0	0	0	0	0	0	89,06	7,06

1293	*b*	2,4-Decadienal (E,Z)		23.63	23,21 ; 1,81	0 ; 0	0 ; 0	0 ; 0	92,43 ; 2,08
1317	*b*	2,4-Decadienal	P	7.69	23,30 ; 5,26	6,42 ; 0,23	16,23 ; 2,21	0 ; 0	154,22 ; 1,49
1368	*b*	2-Undecenal(E)		0	0 ; 0	0 ; 0	30,64 ; 1,36	0 ; 0	74,45 ; 6,13
1614	*b*	Tetradecanal+167/196	MT	39.99	49,39 ; 0,76	28,81 ; 3,41	39,36 ; 12,89	65,22 ; 8,33	116,90 ; 1,22
1711	*b*	Pentadecanal?	MT, P	0	138,84 ; 0,12	107,95 ; 15,62	86,34 ; 21,59	104,36 ; 15,72	161,15 ; 12,82
1819	*b*	Hexadecanal	MT	378.76	3777,87 ; 69,98	2807,18 ; 118,03	4313,92 ; 3,14	4753,80 ; 53,13	7045,65 ; 44,83
1999	*c*	9-Octadecenal	MT	83.03	624,78 ; 3,05	473,48 ; 21,56	916,86 ; 22,81	1046,29 ; 4,46	1428,94 ; 25,59
2037	*c*	Octadecanal		58.04	679,33 ; 15,71	511,19 ; 29,65	867,66 ; 121,90	994,52 ; 25,46	1313,27 ; 33,92
		Subtotal		1189.89	6753,18	5091,93	7690,80	8228,25	12912,17
		Esters							
846	*c*	Butanoic acid, 3-methyl, ethyl ester		0	0 ; 0	0 ; 0	0 ; 0	46,76 ; 2,83	50,27 ; 3,73
999	*b*	Hexanoic acid, ethyl ester		0	0 ; 0	0 ; 0	12,46 ; 1,43	28,54 ; 0,51	48,50 ; 3,78
1125	*b*	Decanoic acid, methyl ester		0	0 ; 0	0 ; 0	0 ; 0	0 ; 0	21,93 ; 0,50
1328	*b*	Octanoic acid, methyl ester		0	0 ; 0	0 ; 0	16,33 ; 1,49	29,91 ; 6,09	99,02 ; 8,13
1353	*d*	Propanoic acid , 2-methyl-, 2,2-dimethyl 1-(2-hidroxy-1-methylethyl) propyl ester		0	73,09 ; 5,19	45,44 ; 6,36	60,60 ; 2,09	34,12 ; 3,62	41,97 ; 2,61
1376	*d*	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester		35.40	117,70 ; 1,14	83,19 ; 9,69	206,39 ; 19,69	0 ; 0	0 ; 0
1398	*b*	Decanoic acid, ethyl ester		0	0 ; 0	0 ; 0	38,28 ; 0,18	73,08 ; 4,89	213,98 ; 4,01
1528	*a*	Dodecanoic acid, methyl ester		0	0 ; 0	0 ; 0	0 ; 0	19,63 ; 1,58	41,20 ; 5,62
1596	*b*	Dodecanoic acid, ethyl ester		0	0 ; 0	0 ; 0	0 ; 0	29,37 ; 4,72	88,52 ; 2,81
1722	*a*	Octadecanoic acid, methyl ester		17.08	25,14 ; 2,11	24,25 ; 3,33	35,14 ; 9,33	26,12 ; 5,85	75,87 ; 6,65
1795	*b*	Tetradecanoic acid, ethyl ester		0	0 ; 0	0 ; 0	49,09 ; 18,47	55,28 ; 6,05	162,48 ; 3,17
1827	*c*	Isopropyl myristate		0	33,48 ; 4,44	99,91 ; 8,02	0 ; 0	0 ; 0	0 ; 0
1928	*a*	Hexadecanoic acid, methyl ester	P	117.26	183,68 ; 2,67	164,30 ; 8,70	183,68 ; 0,39	160,73 ; 12,36	313,95 ; 4,50
1994	*a*	Hexadecanoic acid, ethyl ester	P	31.66	50,53 ; 12,46	49,04 ; 10,12	198,55 ; 39,98	249,31 ; 16,43	495,11 ; 5,10
2126	*a*	Octadecadienoic acid, methyl ester	P	0	201,23 ; 13,26	150,51 ; 9,31	281,09 ; 70,37	231,99 ; 7,50	416,69 ; 23,12
2131	*a*	Octadecenoic acid, methyl ester	P	0	73,40 ; 11,69	251,02 ; 19,79	146,84 ; 58,58	137,14 ; 5,42	258,99 ; 2,72
2175	*b*	Octadecadienoic acid, ethyl ester	P	0	0 ; 0	0 ; 0	0 ; 0	544,86 ; 183,50	0 ; 0
		Subtotal		201.40	758,26	867,65	1228,46	1666,83	2328,50

		Alcohols								
848	*c*	2-Furanmethanol		0	0 ; 0	144,34 ; 19,84	66,71 ; 17,03	87,25 ; 1,06	147,05 ; 12,78
1097	*a*	Linalool	P	37.07	38,38 ; 2,22	33,43 ; 4,20	67,55 ; 1,00	61,46 ; 4,07	86,55 ; 0,02
1108	*c*	Phenylethylalcohol	P	0	0 ; 0	30,06 ; 7,29	30,57 ; 13,86	65,95 ; 18,09	20,73 ; 4,36
		Subtotal		37.07	38,38	207,83	164,83	214,67	254,32
		Terpenes							
930	*b*	a-Pinene	P	30.41	20,35 ; 2,60	22,18 ; 4,45	21,55 ; 0,10	29,67 ; 4,76	27,39 ; 1,72
968	*d*	Terpene		19.85	22,58 ; 1,02	0 ; 0	30,39 ; 2,99	23,92 ; 0,01	26,09 ; 4,03
1022	*a*	Limonene	P	16.38	27,36 ; 3,99	16,70 ; 0,46	16,58 ; 0,07	27,11 ; 0,04	34,06 ; 7,80
1392	*c*	Elemene	P	26.38	29,15 ; 1,47	24,62 ; 2,51	44,10 ; 9,98	55,14 ; 13,14	146,36 ; 4,37
		Subtotal		93.02	99,44	63,50	112,63	135,84	233,91
		Sulphur compounds							
845	*b*	1-Propene,3,3´-thiobis		85.11	92,13 ; 8,21	39,30 ; 7,42	59,11 ; 14,73	111,01 ; 21,90	125,19 ; 11,08
905	*b*	3-Methyltiopropanal		0	0 ; 0	40,77 ; 5,88	50,48 ; 9,23	75,56 ; 19,08	135,86 ; 29,71
910	*c*	Methyl allyl disulphyde	G	77.47	143,37 ; 16,62	97,03 ; 11,49	66,79 ; 8,06	79,02 ; 4,10	71,17 ; 17,85
1072	*c*	Disulphyde, di-2-propenyl	G	630.90	630,09 ; 19,71	516,09 ; 6,49	502,16 ; 5,10	378,49 ; 9,02	382,11 ; 0,29
1295	*c*	Trisulphyde, di-2-propenyl	G	55.06	90,43 ; 9,03	33,95 ; 1,74	48,61 ; 6,55	51,86 ; 5,70	65,58 ; 4,20
		Subtotal		848.54	956.03	727.14	727,14	695,94	779,90
		Ketones							
809	*c*	2(3H)-Furanone, dihidro, 2-methyl		0	0 ; 0	30,80 ; 1,41	23,70 ; 1,65	30,63 ; 3,76	30,88 ; 5,07
1090	*b*	2-Nonanone		0	0 ; 0	0 ; 0	0 ; 0	30,21 ; 1,19	76,89 ; 4,54
1458	*b*	Geranilacetona	P	132.18	148,50 ; 12,51	121,03 ; 0,73	125,24 ; 1,66	110,33 ; 0,36	184,36 ; 9,05
1488	*b*	b-Ionone+?	P	208.40	183,55 ; 6,56	158,00 ; 5,64	145,97 ; 9,98	128,53 ; 1,65	211,87 ; 9,19
1497	*c*	d-undecalactona?		30.53	36,34 ; 1,04	32,22 ; 0,72	34,88 ; 5,81	40,94 ; 8,64	51,17 ; 2,01
1497	*b*	2-Tridecanone	P	41.37	53,19 ; 4,71	47,06 ; 0,37	30,71 ; 0,51	20,07 ; 1,10	43,17 ; 5,02
1679	*c*	g-Dodecalactone	MT	70.39	106,68 ; 5,43	131,63 ; 9,81	103,66 ; 18,49	90,98 ; 2,13	122,61 ; 2,59
1695	*b*	2-Pentadecanone	MT	309.20	510,98 ; 2,06	415,79 ; 11,04	272,11 ; 30,69	163,92 ; 4,91	364,34 ; 7,14
1706	*c*	d-Dodecalactone		47.62	41,72 ; 0,94	47,42 ; 2,94	44,86 ; 9,48	52,92 ; 17,66	63,16 ; 1,88
1905	*b*	2-Heptadecanone	MT	75.39	125,12 ; 21,41	115,20 ; 8,37	160,83 ; 130,32	86,99 ; 16,36	124,80 ; 2,87

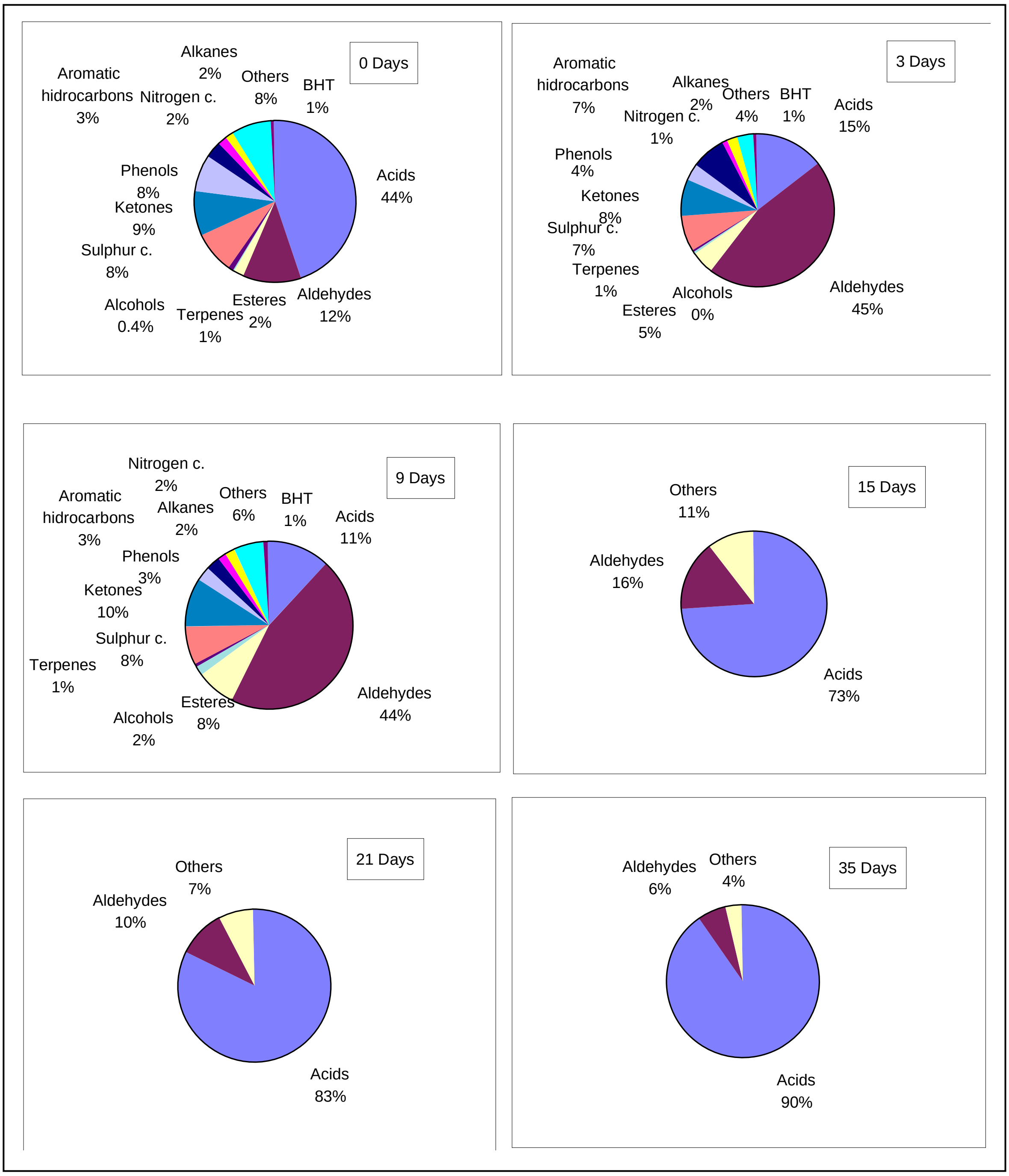
		Subtotal		915.08	1206,07	1099,14	941,96	755,52	1273,23
		Phenols							
986	*b*	Phenol	P	0	0 ; 0	0 ; 0	43,11 ; 9,81	42,44 ; 2,95	70,57 ; 22,58
1057	*b*	Phenol,2-methyl	P	34.29	0 ; 0	0 ; 0	47,67 ; 7,86	50,78 ; 0,81	90,38 ; 4,09
1079	*b*	Phenol,4-methyl	P	98.72	81,41 ; 12,92	109,52 ; 13,39	126,25 ; 22,47	143,51 ; 13,23	205,77 ; 2,99
1085	*b*	Guaiacol+?	P,G	291.29	107,34 ; 10,15	52,55 ; 5,38	93,63 ; 2,31	119,40 ; 6,10	89,39 ; 2,52
1191	*c*	2-Methoxy-4-methylphenol	P	71.09	78,76 ; 5,69	33,74 ; 4,37	95,74 ; 17,08	134,45 ; 10,40	328,73 ; 4,23
1278	*c*	2-Metoxy-4-ethylphenol+?	P	62.89	62,33 ; 1,17	33,53 ; 7,30	60,24 ; 2,35	69,78 ; 5,70	91,76 ; 2,18
1313	*b*	4-Vinyl-2-methoxyphenol	P	58.87	92,56 ; 0,29	64,29 ; 6,92	158,86 ; 8,22	195,29 ; 20,20	257,63 ; 16,62
1356	*c*	2,6-Dimethoxyphenol	P	110.92	72,64 ; 2,97	0 ; 0	95,44 ; 2,79	113,71 ; 9,93	183,39 ; 5,95
1454	*b*	Eugenol or isomer	P	74.56	56,51 ; 3,88	26,10 ; 4,33	39,59 ; 0,04	29,64 ; 2,56	78,57 ; 2,83
		Subtotal		802.63	551,54	319,72	760,54	898,99	1396,19
		Aromatic hydrocarbons							
	c	Toluene		157.03	924,63 ; 68,53	135,00 ; 21,30	67,11 ; 7,02	153,66 ; 30,65	55,50 ; 0,91
856	*b*	Xylene		56.23	82,54 ; 3,79	53,09 ; 4,34	47,07 ; 1,22	64,36 ; 12,30	76,51 ; 8,11
1445	*c*	Biphenilo		14.02	13,23 ; 2,31	10,98 ; 1,98	10,42 ; 1,05	0 ; 0	0 ; 0
1563	*d*	Trimethylnaphtalene	P	31.10	26,91 ; 4,62	23,26 ; 3,99	19,75 ; 0,95	16,91 ; 1,68	33,32 ; 2,28
1588	*d*	Trimethylnaphtalene	P	33.04	26,69 ; 3,05	30,50 ; 3,83	29,32 ; 10,29	40,04 ; 6,36	122,15 ; 4,18
1788	*d*	Phenantrene		49.15	50,51 ; 2,39	45,45 ; 1,96	70,63 ; 8,96	59,65 ; 0,27	150,94 ; 20,34
		Subtotal		340.57	1124,53	298,28	244,30	334,62	438,42
		Nitrogen compounds							
1083	*c*	Tetramethylpirazyne	P	96.63	136,74 ; 5,07	75,17 ; 22,92	83,82 ; 4,77	82,84 ; 2,81	99,10 ; 2,46
1291	*b*	Indol	P	0	0 ; 0	0 ; 0	0 ; 0	0 ; 0	29,59 ; 3,33
1506	*d*	1-Dodecanamine, dimethyl		81.23	49,39 ; 2,13	114,79 ; 15,11	48,14 ; 5,80	80,25 ; 2,52	48,41 ; 1,56
		Subtotal		177.86	186,12	189,96	131,96	163,08	177,09

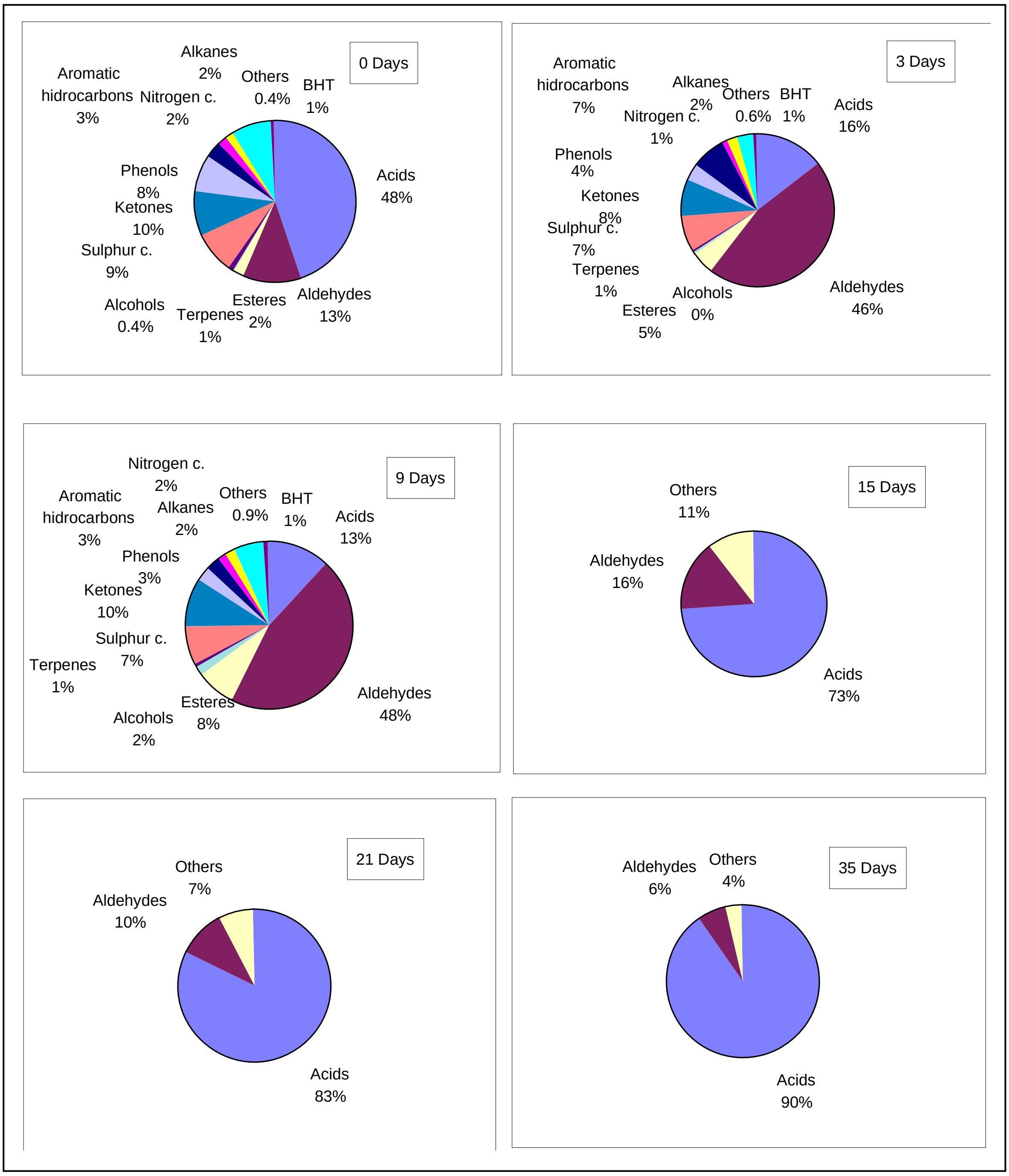
		Alkanes								
	a	Octane		0	82,33 ; 0,33	38,52 ; 12,03	0 ; 0	0 ; 0	61,77 ; 16,65
1300	*a*	Tridecane	MT	36.24	0 ; 0	16,38 ; 2,69	28,42 ; 6,22	34,37 ; 0,59	43,73 ; 7,74
1400	*a*	Tetradecane	MT,P	48.32	48,06 ; 2,97	41,54 ; 1,56	41,12 ; 0,41	68,25 ; 0,08	127,06 ; 5,91
1500	*a*	Pentadecane	MT	35.54	54,40 ; 2,16	40,32 ; 0,48	33,43 ; 0,88	31,36 ; 0,86	74,99 ; 1,49
1600	*a*	Hexadecane	MT,P	58.17	69,74 ; 10,60	53,12 ; 11,30	52,49 ; 17,08	47,61 ; 1,80	121,18 ; 12,08
1700	*a*	Heptadecane	MT,P	0	0 ; 0	0 ; 0	0 ; 0	12,27 ; 0,03	60,83 ; 3,98
1800	*a*	Octadecane	P	13.33	39,93 ; 2,84	39,50 ; 7,66	0 ; 0	0 ; 0	0 ; 0
		Subtotal		191.60	294,45	229,37	155,46	193,86	489,56
		Others							
989	*c*	Furane,2-pentil	MT,P	0	46,48 ; 10,53	50,31 ; 4,11	45,00 ; 12,48	62,28 ; 7,40	136,12 ; 1,18
1512	*d*	Dibenzofuran(168)	P	34.79	40,03 ; 0,70	39,26 ; 1,06	26,95 ; 0,55	23,07 ; 1,19	34,11 ; 0,95
		Subtotal		86.51	89.57	89.57	71.95	85.35	170.23
1516		**BHT**	MT	66.09	93,00 ; 5,32	84,53 ; 9,96	60,85 ; 2,91	50,62 ; 7,13	87,47 ; 4,07
		Total		**94707.71**	**14405.11**	**10655.07**	**48155.61**	**78022.87**	**222496.88**

KI: Kovats Indices for the DB5 column. **RI**: Reliability of identification, indicated by the following symbols: *a*, mass spectrum and retention time identical with those of an autentic sample; *b*, mass spectrum and Kovats index in agreement with the corresponding literature data; *c*, mass spectrum consistent with spectra reported in the Wiley library data; *d*, tentative identification by mass spectrum. **O:** Compounds detected in P (red pepper), G (garlic) and MT (mixture of raw meat and fat).

KI: Indices de Kovats para la columna DB5. **RI**: Calidad de la identificación segú;n los siguientes símbolos: *a*,espectro de masas e índice de retención idénticos a patrones comerciales; *b*, espectro de masas e éindice de Kovats de acuerdo a datos recogidos de la bibliografía; *c*, espectro de masas semejante al contenido en el banco Wiley; *d*, tentetiva de identificación según el espectro de masas. **O:** Compuestos detectados en P (pimentón), G (ajo) y MT (mezcla de magro y tocino).

Fig 1. Contribution of every chemical family to the total area in every phase of analysis.
Fig 1. Aporte de cada tipo de familia química al total de compuestos aislados en cada fase de análisis.


0 Days
Aromatic hidrocarbons 3%
Alkanes 2%
Nitrogen c. 2%
Others 8%
BHT 1%
Acids 44%
Phenols 8%
Ketones 9%
Sulphur c. 8%
Alcohols 0.4%
Terpenes 1%
Esteres 2%
Aldehydes 12%
3 Days
Aromatic hidrocarbons 7%
Alkanes 2%
Nitrogen c. 1%
Others 4%
BHT 1%
Acids 15%
Phenols 4%
Ketones 8%
Sulphur c. 7%
Terpenes 1%
Alcohols 0%
Esteres 5%
Aldehydes 45%
9 Days
Nitrogen c. 2%
Aromatic hidrocarbons 3%
Alkanes 2%
Others 6%
BHT 1%
Acids 11%
Phenols 3%
Ketones 10%
Sulphur c. 8%
Terpenes 1%
Alcohols 2%
Esteres 8%
Aldehydes 44%
15 Days
Others 11%
Aldehydes 16%
Acids 73%
21 Days
Others 7%
Aldehydes 10%
Acids 83%
35 Days
Aldehydes 6%
Others 4%
Acids 90%



0 Days
Alkanes 2%
Aromatic hidrocarbons 3%
Nitrogen c. 2%
Others 0.4%
BHT 1%
Phenols 8%
Acids 48%
Ketones 10%
Sulphur c. 9%
Alcohols 0.4%
Terpenes 1%
Esteres 2%
Aldehydes 13%
3 Days
Aromatic hidrocarbons 7%
Alkanes 2%
Others 0.6%
BHT 1%
Acids 16%
Nitrogen c. 1%
Phenols 4%
Ketones 8%
Sulphur c. 7%
Terpenes 1%
Alcohols 0%
Esteres 5%
Aldehydes 46%
9 Days
Nitrogen c. 2%
Aromatic hidrocarbons 3%
Alkanes 2%
Others 0.9%
BHT 1%
Acids 13%
Phenols 3%
Ketones 10%
Sulphur c. 7%
Terpenes 1%
Alcohols 2%
Esteres 8%
Aldehydes 48%
15 Days
Others 11%
Aldehydes 16%
Acids 73%
21 Days
Others 7%
Aldehydes 10%
Acids 83%
35 Days
Aldehydes 6%
Others 4%
Acids 90%

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