TITLE: INSTRUMENTAL MEASURES OF SENSORY ATTRIBUTES FOR THE CHARACTERIZATION OF CHORIZO DE PAMPLONA.

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INTRODUCTION

Chorizo de Pamplona is a traditional type of dry fermented sausages that present some peculiarities as a consequence of its formulation and technological process. It has a "Norma de calidad" in which general parameters as moisture, fat, protein, carbohydrates and hidroxyproline are limited. Some previous works have also try to define aspects related with sensorial and some physico-chemical analysis (Santamaría et al., 1992; 1994).

OBJECTIVE

The aim of this paper was to obtain instrumental measures of aroma, texture and colour for commercial samples of Chorizo de Pamplona in order to contribute to its characterization.

MATERIAL AND METHODS: A total of 12 samples from differents commercial branches of Chorizo de Pamplona were analysed. **Objective colour measurement:**Reflectance spectra were determined with a UV/VS Perkin Elmer Lambda 5 spectrophotometer from 400 to 700 nm using an integrating sphere with the conditions established by Ansorena et al. (1997). The samples were measured on the surface of the dry fermented sausages. **Texture profile analysis (TPA):**An universal TA-XT2i texture analyser was used to conduct texture profile analysis (Bourne, 1978). A square samples of 1 x 1 x 1cm were compressed twice to 60% of their original height with a crosshead speed of 5 mm/sg and recording speed of 5 mm/sg. The parameters were obtained using the available computer software. **Analysis of volatile compounds:**25 g of frozen sausage 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 (i.s) was also attached to a modified Likens-Nickerson apparatus. 5 ml of dichloromethane were also added to fill the apparatus solvent return loop. Both solvent and sample mixture were heated to 70ºC and boiling Tª respectively, maintaining these conditions during 2h. The volatile compounds were analysed in a HP 6890 GC System (Hewlett-Packard) coupled to a 5973 Mass Selective Detector (Hewlett-Packard). 1 µl of the extract was injected into the GC, equipped with a capillary column (30 m x 250 µm i.d. x 0.25 µm film thickness HP-5MS). 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 hold during 5min. more. Inyector Tª: 250ºC ; Mass range: 30-350 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, also by comparison of the Kovats index, and in addition, in some cases, by comparison of their retention time with those of standard compounds. Semiquantitative determination of the volatile compounds was based on the ratio of their peak areas to the peak of dodecane (internal standard), and the results were expressed as ng dodecane /g dry matter.

DISCUSSION

Measures of colour (Table 1) showed the lower coefficient of variation (C.V.) for L* value (lightness) which is the most informative parameter to show color changes (Oellingrath and Slinde, 1985). The highest variability was found for b* values (yellowness) according with the results obtained by Ansorena et al. (1997) in Chorizo de Pamplona with the same illuminant.

Table 2 shows the results of TPA. Hardness, gumminess and chewiness were the parameters which showed the highest variability. These parameters are greatly influence by some compositional parameters as moisture and fat. Dellaglio et al. (1996) in Felino salami samples with C.V. of 14´3% for moisture and 11´8% for fat found very high C.V. (>30%) for rheological parameters. Chorizo de Pamplona analysed samples showed C.V. of 4´54% for moisture and 2´64% for fat. The C.V. of the analysed rheological parameters was between 4 and 15% which could not be considered too high.

In relation to the volatile compounds (Table 3), the highest concentration was obtained for the acids (62.68%), followed in order by the aldehydes, terpenes, phenols, esters, alcohols, ketones, sulphur compounds, aromatic hydrocarbons and alkanes.Aldehydes is the second group, from a quantitative point of view, with 7.91% of the total area. Most of them are formed by autooxidation of unsaturated fatty acids (hexanal, heptanal, 2-heptenal, 2-octenal, nonanal, 2-nonenal, 2-decenal and 2,4-decadienal) and undesirable odours have been associated to some of them (Berdagué et al., 1991). High molecular weight aldehydes were also found (tetradecanal, pentadecanal, hexadecanal, 9-octadecenal, octadecanal), and they could act as precursors for the volatile alkanals and alkenals (Dirinck et al., 1997). Other found compounds related to the oxidation of lipids were some 2-methylketones, to which a role in the flavour of cheeses has been atributed (De Frutos et al., 1991), and the 1-octen-3-ol, with a marked odour of mushroom. A great amount of terpenes, as a consequence of the use of spices were isolated. Also, the presence of eugenole, isosafrole and myristicine has been associated to the use of pepper. The presence of sulphur compounds has been associated to the use of garlic (Johansson et al., 1994). As observed by Mateo et al. (1996) in chorizo, numerous phenolic compounds were detected due to the process of smoking, being the phenol,4-ethyl 2-methoxy and the 4-methylphenol the two most abundant ones. Smoke also contributes to the presence of aromatic hydrocarbons, some of which have been found as well in raw matter (e.g. toluene, xylene, styrene) (Rembold et al., 1989). Special mention can also be made for the BHT, which is added as a preservative and it is even more abundant than the sum of aldehydes.

CONCLUSIONS

Not too much variability was found for parameters related to texture and colour, showing an uniformity for these properties in the commercial products. Among volatile compounds, the groups of acids is the most abundant one (62.68%). Due to the extraction method, most of the compounds are those of high molecular weight, with a not very high relevance in odour. BHT has been found in some of the samples.

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RESULTS

Table 1. Colour parameters

	L*	a*	b*
Mean	50.91	24.31	14.95
C.V.	6.05	9.75	18.86

Table 2. Texture parameters

	Hardness (g)	Springiness	Cohesiveness	Gumminess	Chewiness
Mean	5900.65	0.57	0.49	2941.92	1743.86
C.V.	13.75	7.02	4.08	15.11	13.83

Table 3. Profile of volatile compounds. Mean expressed as ng dodecane/ g dry matter.

KI	RI	Compound	Mean	CV
		Acids		
	C	Butanoic acid	80.80	44.58
845	B	Butanoic acid, 3-methyl	4469.46	165.95
1001	A	Hexanoic acid	890.31	39.60
1190	A	Octanoic acid	1798.91	68.91
1386	A	Decanoic acid	8212.99	73.54
1573	A	Dodecanoic acid	3329.92	110.53
1768	A	Tetradecanoic acid	7113.66	63.20
	A	9-Hexadecenoic acid	3480.08	69.87
	A	Hexadecanoic acid	57817.29	62.53
	A	9,12-Octadecadienoic acid	25832.57	48.79
	A	9-Octadecenoic acid	64519.89	41.94
			177545.88	(62.68% of T.)
		Aldehydes		
802	A	Hexanal	276.83	35.13
827	B	2-Furanocarboxaldehyde	400.09	71.02
904	A	Heptanal	172.49	126.98
959	B	Benzaldehyde	183.33	43.42
960	B	2-Heptenal	60.58	30.93
1043	B	Benzeneacetaldehyde	790.00	28.89
1060	B	2-Octenal	96.00	32.84
1105	B	Nonanal	440.71	28.54
1161	B	2-Nonenal (E)	149.40	39.49
1263	B	2-Decenal	106.57	22.92
1318	B	2,4-Decadienal	67.83	72.05
1615	B	Tetradecanal	265.00	117.95
1712	B	Pentadecanal	575.49	65.52
1819	B	Hexadecanal	15681.44	42.38
	C	9-Octadecenal	1081.56	26.31
	C	Octadecanal	2059.86	38.32
			22407.169	(7.91% of T.)
		Esters		
813	B	Propanoic acid, 2-OH, ethyl ester	610.91	129.95
1003	B	Hexanoic acid, ethyl ester	43.64	3.58
1127	A	Octanoic acid, methyl ester	50.09	62.69
1191	C	Methyl salicilate	49.98	29.44
1285	C	Bornyl acetate	107.64	39.32
1329	A	Decanoic acid, methyl ester	151.48	43.05
1398	B	Decanoic acid, ethyl ester	959.10	186.61
1723	A	Tetradecanoic acid, methyl ester	211.33	84.97
1795	B	Tetradecanoic acid, ethyl ester	816.57	162.86
	A	Hexadecanoic acid, methyl ester	668.87	64.00
	C	Hexadecanoic acid, ethyl ester	691.78	186.09
	A	9,12-Octadecadienoic acid, methyl ester	193.50	31.19
	A	9-Octadecenoic acid, methyl ester	75.74	62.63
			4630.6205	(1.63% of T.)

KI	RI	Compound	Mean	CV
		Alcohols		
833	C	1-Pentanol, 4-methyl	53.59	56.39
853	C	2-Furanmethanol	163.82	81.64
868	B	Hexanol	62.55	20.11
984	B	1-Octen-3-ol	127.24	66.00
1034	B	Hexanol, 2-ethyl	102.14	14.45
1038	C	Benzenmethanol	77.31	50.48
1101	A	Linalool	304.16	35.63
1113	C	Phenylethylalcohol	571.58	106.84
1165	B	Borneol	159.99	52.67
1176	C	4-Terpineol	2324.48	53.15
1190	D	1,6-Octadien-3-ol / a-Terpineol	176.10	78.67
			4122.96	(1.46% of T.)
		Ketones		
892	B	2-Heptanone	45.64	23.18
956	C	2(3H)-Furanone, dihydro-5-methyl	133.34	48.46
1140	B	Camphor	125.84	79.05
1205	B	Verbenone	292.26	10.55
1458	B	Geranylacetone	218.15	135.95
1489	B	b-Ionone	410.09	112.22
1538	C	2(4H)-Benzofuranone,5,6,7,7 a-tetrahydro-4-4-7a-trimethyl	504.77	83.69
1661	C	2(3H)-Furanone, dihydro-5-(2-octenyl)	514.46	52.32
1682	C	g-dodecalactone	215.00	49.80
1696	B	2-Pentadecanone	689.97	67.43
1897	B	2-Heptadecanone	266.03	64.11
			3415.545	(1.21 % of T.)
		Phenols		
995	B	Phenol	317.87	84.83
1066	B	Phenol, 2-methyl	310.51	79.15
1087	B	Phenol, 4-methyl	750.31	119.64
1089	B	Phenol, 2-methoxy (Guaiacol)	574.88	86.62
1148	B	Ethylphenol	40.10	51.45
1157	D	Phenol, 2,?-dimethyl	240.01	75.88
1245	D	Phenol, ethyl-methyl	69.05	42.42
1248	B	Dimethoxyphenol	145.40	71.62
1280	C	Phenol, 4-ethyl, 2-methoxy	911.94	127.77
1316	B	4-Vinyl, 2-methoxyphenol	227.30	70.32
1359	C	Phenol 2,6-dimethoxy	493.50	93.09
1364	B	Eugenol	109.82	43.38
1408	B	Methyl eugenol	170.15	57.41
1456	C	Eugenol o isomer	109.57	79.42
1609	C	Phenol, 2,6-dimethoxy-4-(2-propenyl)	120.46	38.48
			4590.88	(1.62% of T.)

KI	RI	Compound	Mean	CV
		Terpenes		
926	B	Thujene	325.85	25.71
931	B	a-Pinene	1070.59	53.38
945	B	Camphene	49.10	35.99
972	A	Sabinene+b-Pinene	4914.33	83.94
992	B	b-Myrcene	514.83	42.33
1000	B	a-Phellandrene	183.31	2.56
1006	B	3-Carene	1014.87	84.82
1014	B	a-Terpinene	350.35	95.34
1026	A	Limonene	1793.39	61.22
1058	B	g-Terpinene	913.33	40.53
1086	B	a-Terpinolene	526.27	44.94
1214	D	Terpene	178.42	73.49
1340	D	Terpene	119.49	52.56
1379	D	Copaene	267.54	108.34
1410	C	Cis-Cariophyllene	234.55	93.08
1422	B	b-Cariophyllene	1270.83	74.13
1440	C	a-Bergamotene	106.96	53.16
1458	C	Humulene	107.29	64.81
			13941.269	(4.92% of T.)
		Others		
1151	C	Benzene,1,2-dimethoxy	92.79	95.51
1243	C	Dimethoxytoluene	99.20	22.83
1287	B	Isosafrole	172.36	41.83
1478	C	2,6-di(t-butyl)-4-hydroxy-4-methyl 2,5-cyclohexadien-1-one	844.09	109.38
1483	C	2,6-di-t-butyl-4-methylene-2,5-cyclohexadien-1-one	1231.09	115.66
1497	C	3-tert-Butyl-4-hydroxyanisole	8579.02	143.44
1528	B	Myristicine	938.43	80.81
1562	C	Elemicine	887.16	83.11
			12844.139	(4.53% of T.)
1518	B	Bht	22574.16	(12.50% of T.)
		Sulphur compounds		
848	B	1-Propene, 3,3'-thiobis	179.02	20.52
908	B	Propanal, 3-methylthio	211.83	36.92
913	B	Methyl allyl disulphyde	229.27	32.74
1076	B	Diallyl disulphyde	1387.13	48.82
1133	C	Sulphyde allyl methyl	120.12	24.32
1296	C	Trisulphyde, di-2-propenyl	397.92	67.05
			2525.281	(0.89% of T.)

KI	RI	Compound	Mean	CV
		Alkanes		
800	B	Octane	31.61	60.11
1300	B	Tridecane	119.52	105.38
1400	B	Tetradecane	84.71	132.21
1500	B	Pentadecane	92.06	105.70
1600	B	Hexadecane	247.08	1.47
1700	B	Heptadecane	217.89	49.15
1800	B	Octadecane	traces	
			792.853	
			(0.28% of T.)	
		Aromatic Hydrocarbons		
	C	Toluene	49.08	30.03
851	B	Ethylbenzene	14.56	23.93
860	B	m-xylene	171.99	18.52
886	B	Styrene	23.69	3.08
990	B	1,2,4-Trimethyl-benzene	47.16	68.40
1023	B	m-Cymene	660.59	73.38
1288	D	Methylnaphtalene	37.76	115.17
1592	D	Trimethylnaphtalene	39.99	77.44
			1044.80	
			(0.37% of T.)	

KI=Kovats Index
RI=Reliability of identification
(Criteria as Berdagué et al., 1991)
CV=Coefficient of variation
T.=Total