CHEMICAL CHANGES DURING THE AGEING PROCESS OF DRY FERMENTED SAUSAGES

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Background

The development of compounds responsible for the flavour/taste characteristics of dry fermented sausages is associated to the hydrolysis of lipids, proteins and carbohydrates, produced by microrganisms and intrinsic raw material enzymes throughout different metabolic pathways. The formation rate during the drying/ripening period is therefore time dependent.

Objective

Better comprehension of the hydrolysis dynamics in "Painho de Portalegre". If successfully achieved, it would be a very important support in trade decisions based on the final product quality profile.

Materials & Methods

Meat and fat used for "Painho de Portalegre" dry fermented sausage formulation were obtained from Alentejana breed pig carcasses, 24 hours after slaughter. The environmental temperature and relative humidity (RH) conditions observed during the fermentation and drying phases are shown in other paper submited to the present ICoMST. Formulated mixtures, before and after salt/spices addition and 3 days later just before stuffing into natural casing (6 cm diameter), as well as the product with 5, 15, 21, 30, 75 and 90 days of drying/ageing were analysed for pH, *aW*, total protein, moisture and fat contents, % NaCl, Total Volatile Basic Nitrogen (TVBN), Non Protein Nitrogen (NPN), Free Amino Acids Nitrogen (FAAN), ammonia content, organic acids and free amino acids profile.

Results & Discussion

The results concerning the evolution of physico-chemical parameters on "Painho de Portalegre" dry fermented sausage along the main processing phases are shown in Table 1. The decrease in moisture (57.6% vs 30.9%) and in *aW* values (0.96 vs 0.86) between the 5th and the 75th day of the drying/ageing period provoked the expectable increase in protein and fat contents, which attained 23.8% and 39.9%, respectively. Also due to the progressive drying of the product, the NaCl concentration increased during the same period from about 2.5% to 4%. Attending to the pH evolution this product can be classified as intermediate or even little acidified (Verplaetse, 1994) The different non protein nitrogen fractions highly increase, between the 5th and the 21st day of ripening, with values 8 times and 3 times higher for the TVBN (0.014 vs 0.073) and FAAN (0.072 vs 0.211), respectively, and almost doubling that of the NPN (2.88 vs 5.44). From this stage up to 3 months of ripening, these proteolysis indicator parameters keep increasing their concentration at a lower rate, probably due to aW and NaCl content evolution.

The changes in the concentration of free amino acids during ripening are shown in Figure 1. The concentration increased with time but more expressively after the 1st month of ageing. Taking into consideration that the end product is obtained after a ageing period of about 2.5-3 months, the final mean concentration of total free amino acids amounted to 3789 mg/100g of dry-matter, 3 times higher than the content referred by Hughes *et al.*, (2002) for a semi-dryed salami. Alanine, leucine, a lysine and valine were the most representative (>0,2mg/100g dry-matter) followed by glicine, isoleucine, fenilalanine, treonine, serine and metionine (0,1-0,2 mg/100g dry-matter) indicating a good balance between compounds associated with sweet and bitter tastes. The proline, metionine, glutamic and aspartic acids and still the histidine were detected in concentrations lower than 0.1mg/100g dry-matter, with the two last compounds showing only trace amounts. In face of this, the contribution of free amino acids to the final acid taste of the "Painho de Portalegre" seems to be irrelevant. The decrease in concentration of lysine, threonine and serine in the product aged for 3 months could represent that its metabolism by bacteria in that stage was more intense than their formation. Figure 1 also shows the variations observed in ammonia content along the same drying/ripening phases. Ammonia production speed up from the 21st day on, in total agreement with the recorded proteolytic activity. This trend may be the source of product pH increasing after 1 month of ageing. Microrganisms may be involved in this degradation activity since many native agents are often referred to possess peptidase and amino-peptidase activities (Hughes *et al.*, 2002). The increase of ammonia concentration and the modification occurred in the amino acid pattern probably play a deep influence on the sensory characteristics of "Painho de Portalegre".

The production of organic acids during the fermentation and subsequent processing stages is illustrated on Table 2. Lactic acid is, by far, the most abundant element. The concentration on product with 5 days upon the casing stuffing (1896 mg/100 g dry-matter) almost doubled the initial value of the raw material (1156 mg/100 g dry matter). Afterwards, the formation rate was slightly lower but yet relevant up to 3 months of ageing. This trend reflects the development profile found out for the lactic acid bacteria (LAB) in the product, most of them homofermentative strains (results not published). According to Ordoñez *et al.*, (1999) a typical homofermentative LAB produces about 1.8 mol of lactic acid per mole of metabolized hexose. Acetic acid is also present but in significantly lower concentrations. The highest amount (757.4 mg/100g dry matter) has been detected in raw material immediately after the seasonings addition, falling down to around 100 mg/100 g dry-matter at the end of the fermentation period (8 days) and then slightly rising again along the rest of the processing phases. These results indicate that the participation of bacteria on initial acetic acid formation is not relevant. The fresh garlic paste, a fermented product added as a condiment to the formulation was confirmed to be the main contributor to the presence of this organic acid. The increasing concentration found in the last stages of the drying/ripening process could be associated to fatty acid oxidation and alanine catabolism (Montel, Masson & Talon, 1998). Citric and pyruvic acids appeared in residual concentrations. The former is probably associated to the use of lemon for washing and deodorising the casings during its preparation. No propionic acid has been detected in this product.

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References

Ordoñez, J.A.; Hierro, E.V.; Bruna, J.M. Changes in the components of dry-fermented sausages during ripening. Critical Reviews in Food Science and Nutrition, 39 (4):329-367, (1999).

Montel, M.C.; Masson, F.; Talon, R. Bacterial role in flavour development Meat Science, vol. 49, (1998), No. Suppl. 1, S111-S123.

Hughes, M.C.; Kerry, J.P.;Arendt, E.K.; Kenneally, P.M.; McSweeney, P.L.H.; O'Neill, E.E. Characterization of proteolysis during the ripening of semi-dry fermented sausages. Meat Science, 62 (2002), 205-216.

Verplaetse, A. Influence of raw meat properties and processing technology on aroma quality of raw fermented meat products. 40th IcoMst,1994, Session S-VIA, 45.

Table 1 – Physico-chemical characteristics of "Painho de Portalegre" dry fermented sausage along the main processing phases.

	Raw Material Spicing Period			Drying/Ripening Period (days)					
	No spicing	After spicing	3 days in spicing	5	15	21	30	75	90
pH	5.82	6.07	5.96	5.20	5.34	5.38	5.46	5.61	5.92
aW	ND	ND	ND	0.96	0.94	0.94	0.93	0.86	0.86
Protein (%)	18.20	11.80	14.20	14.50	19.70	23.10	23.50	23.80	23.20
Moisture (%)	61.34	ND	ND	57.58	52.84	53.62	46.58	30.95	33.58
Total fat (%)	ND	ND	ND	24.68	22.13	19.00	28.60	39.94	37.61
NaCl (%)	ND	2.04	ND	ND	2.86	2.78	3.36	4.18	4.06
TVBN (%)	0.006	ND	0.006	0.014	0.045	0.073	0.072	0.086	0.105
NPN (%)	2.72	ND	2.40	2.88	4.48	5.44	5.28	6.88	7.84
FAAN (%)	0.042	ND	0.038	0.072	0.163	0.211	0.243	0.295	0.358

ND – Not determined

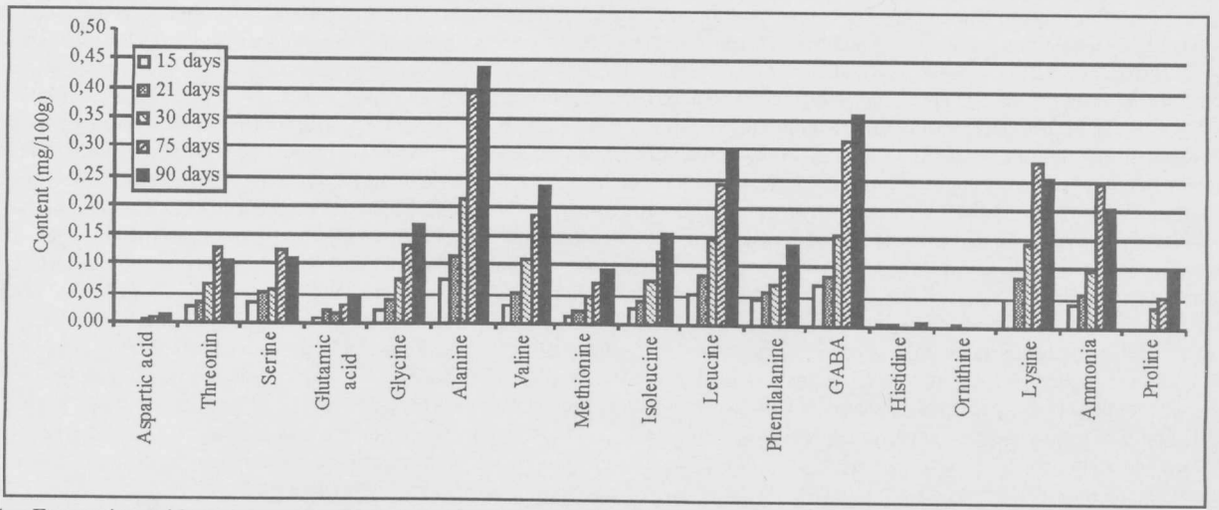

Figure 1 – Free amino acids and ammonia formation along the drying/ripening processing phase of "Painho de Portalegre" dry fermented sausage.

Table 2 – Organic acids formation over "Painho de Portalegre" processing stages.

Organic acids (mg/100g dry matter)	Raw Material Spicing Period			Drying/Ripening Period		
	No spicing	After spicing	3 days in spicing	8 days	30 days	90 days
Citric	0	0	211.52	78.13	20.16	68.62
Pyruvic	0	0	0	1.18	6.95	7.34
Acetic	0	757.35	275.49	99.16	225.77	251.44
Lactic	1155.70	782.45	1606.62	1895.69	3489.53	4631.05
Propionic	0	0	0	0	0	0