"MARANHOS": PRELIMINARY PHYSICOCHEMICAL AND MICROBIOLOGICAL CHARACTERIZATION.

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Background

It is important to produce low price meat products with high protein content, good gastronomic qualities, and which are easy to preserve and sanitarily safe for consumers (SOUSA & RIBEIRO, 1983). "Maranhos" is a fresh goat meat sausage traditionally home-made in Beira Baixa a region in the centre of Portugal. The existence of such an unusual and unique product, compared with other typical Portuguese meat products, is probably related to the importance of goat production in this poor Portuguese region (LOURENÇO, 1998). "Maranhos" is prepared from ground adult goat meat mixed with rice. It is sometimes enriched with dry-cured pork sausage, dry-cured ham and pork back fat. Salt, peppermint (*Mentha sp.*) and white wine are also used to season it. The ingredients are then stuffed into natural casings, small bags especially made from the goat gastric compartments. At present the product is commercialised uncooked either refrigerated or frozen, often unpacked. The final consumer has to boil it for 75-90 minutes. "Maranhos" production is still based on the experience and skill of local producers rather then being based wholly on scientific and technological know-how. Nonetheless, to our knowledge there are no published data about the physicochemical and microbiological quality of "Maranhos". Therefore it is difficult to establish the quality criteria of this product.

Objectives

This study aims to contribute to both the physicochemical and the microbiological characterization of this product. This is the first step to improve the "Maranhos" quality.

Methods

Three small traditional meat factories located in the Beira Interior region were visited. The recipes and the production technology used by each one were registered. Four "Maranhos" samples were collected in each factory at the end of the production line. The samples were immediately transported under cooling conditions to the technology laboratory of the Veterinary Medicine Faculty of Lisbon where the analyses were made.

Moisture content was determined by dissection until constant weight at 105ºC (NP-1614, 1979). Ashes were determined by weighing the mineral residue after incineration at 550-600ºC (NP-1615, 1979). Fat content was determined by the Soxhlet method (NP-1224, 1982). Protein content was determined by the Kjeldhal method (NP-1612, 1979). Carbohydrates content was estimated by exclusion of moisture, ashes, fat and protein contents. Energetic value was determined according to the classical conversion factors of Atwater (MARTINS & PATARATA, 1993). pH was measured with a pH-meter HI9023-HANNA INSTRUMENTS. a_w was measured with the ROTRONIC HYGROSKOP DT, with the measure cell WA-14TH at 25ºC of constant temperature. Salt content was determined by the current method (NP-1845, 1982). Free fatty acids were measured by extraction by chloroform and titration with 0.1N sodium hydroxide using phenolphthalein (PERSON, 1970). Peroxide value was determined by extraction by chloroform and titration with 0.01N sodium tiossulphat using starch as an indicator (HUNGARIAN STANDARDS, 1973). Tiobarbituric acid was determined by spectrophotometer UV/VISIBLE PHARMACIA BIOTEC Ultrospec→2000 with λ=538 nm (NP-3356, 1987). Total basic volatile nitrogen was determined by Conway cells method (NP-1848, 1987).

A 25 g sample of each sausage was aseptically transferred to a sterile plastic bag and beaten in a stomacher LAB BLENDER-400 with 225 ml of buffered peptone water (DIFCO). Decimal dilutions of suspension were prepared using triptone salt solution (SCHARLAU) and plated in duplicate on different growth media. The following media and incubation conditions were used: total aerobic in Plate Count agar (SHARLAU) at 30ºC for 2 days; total psicrophiles counts in Plate Count agar (SHARLAU) at 7ºC for 10 days; total termophiles counts in Plate Count agar (SHARLAU) at 42ºC for 2 days; moulds and yeasts counts in Cooke Rose Bengal agar with clorophenicol (OXOID) at 25ºC for 5 days; *Enterobacteriacea* counts in Violet Red Bile agar (OXOID) at 37ºC for 2 days; lactic acid bacteria counts on Man Rogosa Sharpe agar (OXOID) at 30ºC for 3 days; *Streptococcus* Lancefield group D in Kanamycin Aesculin agar (MERCK) at 37ºC for 2 days; total coliforms research in Briliant Green broth (SCHARLAU) at 30ºC for 2 days; *E. coli* research with Kovacs reagent in Briliant Green broth (SCHARLAU) and Peptone water (DIFCO) at 45ºC for 2 days; *Clostrdium* sulphite reducers spoors research in Sulfadyzine Polimyxine Sulphite agar (MERCK) at 45ºC for 2 days; *S. aureus* research by the cuagulase test after isolation of suspicious colonies in Baird Parker agar (OXOID) and then Brain Heart Infusion (DIFCO) at 37ºC for 1day; *Salmonella* research by biochemical test API 20E (BIOMÉRIEUX) after isolation of suspicious colonies; and *Listeria monocytogenes* research by biochemical test API Listeria (BIOMÉRIEUX) after isolation of suspicious colonies.

Results and Discussion

Tables 1, 2, 3 and 4 summarise the results as mean, minimum and maximum values, standard deviation (SD) and coefficient of percentage variation (CV%) of physicochemical and microbiological analyses.

The mean value for chemical composition was: for moisture 55.74%, for protein 14.93%, for fat 30.81%, for carbohydrates 49.77% and for ash 4.49%. The mean energetic value was 998.08 kj/100g. Among the components of chemical composition, fat content had the highest coefficient of variation. That is, there is a great variability in fat content among the producers as shown by the analyses of variance between producers very significant for fat content ($p<0.01$) and significant for ash and energetic values ($p<0.05$). This may be a consequence of different recipes among producers. The pH and a_w values were respectively 5.99 and 0.95. This means that "Maranhos" is an easily perishable meat product. The mean salt content is of 1.24% under the percentage recommended to assure long time conservation. The mean value for free fatty acids (FFA) was of 2.91% as oleic acid on the extracted fat, the mean peroxide value (PV) was of 7.13 mequiv/kg of extracted fat, the mean value for the tiobarbituric acid (TBA) was of 0.51 mg of malonaldehyde/kg of analysed product, the mean value for total volatile nitrogen (TVN) was of 34.53 mg/100 g of product. These values for degradation index can be considered acceptable for the product. Significant differences were detected by the analyses of variance between producers for salt content ($p<0.05$) and very significant for the peroxide value ($p<0.01$). This can be related to the use of cured meat products in the recipes, especially pork back fat, dry-cured ham and sausages.

The mean value for the aerobic plate count (*APC*) was of 7.39 log_{10} cfu/g, above the maximum limit value considered for good hygienic conditions in fresh meat products of 7 log_{10} cfu/g (MOSSEL & GARCIA, 1981). The thermophiles (*Term.*) and psicrophiles (*Psic.*) accounts were also high, 5.42 log_{10} cfu/g and 7.20 log_{10} cfu/g respectively. Very significant differences were detected by the analyses of variance between producers for the aerobic plate count ($p<0.01$) and significant for the thermophiles and psicrophiles accounts ($p<0.05$). This is probably related to differences at the hygienic level of the raw materials used and good manufacturing practices of each producer. The accounts of moulds and yeasts were respectively of 2.61 log_{10} cfu/g and 4.90 log_{10} cfu/g, slightly above the usually recommended accounts for this kind of product. The account of *Enterobacteriacea* (*Entero.*) was of 6.98 log_{10} cfu/g, above the upper recommended limit for good quality ground meat of 6 log_{10} cfu/g (MOSSEL & GARCIA, 1981). The mean lactic acid bacteria account (*LAB*) was of 5.29 log_{10} cfu/g under the usually used upper limit of 6 log_{10} cfu/g, which reinforces the idea of low hygienic quality. The mean account of *Streptococcus* Lancefield group D (*S. D*) was of 4.39 log_{10} cfu/g that is above the usually used critical value of 4 log_{10} cfu/g. The research of *Clostridium* sulphite reducers spoors was for three times positive in 1 g and absent in all the others. The results for the research for total coliforms was never better than absence in 10^{-4}g of product and for *E. coli* only one time was verified absence in 10^{-2}g of product, the high level of presence of this organism may be justified by the use of insufficiently cleaned casings. *Staphylococcus aureus* (absent in 1g), *Salmonella* and *Listeria monocytogenesin* (absent in 25g) were not detected in any of the samples tested.

Conclusions

"Maranhos" is a traditional product with low price raw materials, easily perishable, with a reasonable composition, reasonable energetic value and low salt content. Although no pathogenic flora was detected, the research and accounts of hygienic indexes are higher than it is desirable. Therefore, the microbiological quality of the product is low.

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Table 1 - Chemical composition.

	Mean	Min	Max	SD	CV%
Moisture (%)	55.74	47.69	62.53	4.53	8.13
Protein (%)	14.93	10.35	19.24	3.04	20.34
Fat (%)	30.81**	20.63	51.12	9.31	30.21
Carbohydrates (%)	49.77	26.32	60.99	9.43	18.95
Ash (%)	4.49*	3.49	5.32	0.55	12.16
Energetic value (j/100g)	998.08*	800.12	1210.68	144.31	14.46

Table 2 - Degradation indexes.

	Mean	Min	Max	SD	CV%
FFA	2.91	1.09	4.97	1.45	49.87
PV	7.13**	3.38	11.85	3.61	50.65
TBA	0.51	0.17	0.87	0.21	41.33
TVN	34.53	10.62	75.86	18.40	53.30

Table 3 - pH, a_w and salt content.

	Mean	Min	Max	SD	CV%
pH	5.99	5.67	6.48	0.21	3.45
a_w	0.95	0.94	0.95	0.00	0.45
NaCl (%)	1.24*	0.88	1.69	0.24	19.23

Table 4 - Microbiological counts (log ufc/g).

	Mean	Min	Max	SD	CV%
APC	7.39**	6.57	8.11	0.51	6.87
Term.	5.42*	3.70	7.22	1.09	20.03
Psic.	7.20*	6.32	7.95	0.50	6.99
Moulds	2.61	2.08	2.94	0.25	9.57
Yeasts	4.90	4.20	5.90	0.70	14.22
Entero.	6.98	6.26	7.63	0.47	6.70
LAB	5.29	3.63	7.54	1.15	21.65
S. D	4.39	3.55	5.93	0.82	18.78

* Significant, $p<0.05$; ** Very significant, $p<0.01$