

Preservation of the portuguese "chouriço". Chemical and microbiological evolution related to packaging and storage time and temperature.

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ABSTRACT

The portuguese "chouriço" is a meat product, manufactured with pork meat and fat. His source comes from traditional country style food. Traditionally it is a product that is smoked during a period from 15 days to one month, at low temperatures. The industrial processing ensures that the temperatures utilized are above 60°C (quick process in a smoking house). The industrial processing consists on two steps: the first one, during 4-5 hours at temperatures above 60°C; the second one, during 12-18 hours with temperatures between 40-50°C, in traditional smoking houses.

The preservation of this product, so that the exportation can be possible is usually made by canning the product with vegetable oil. It can be made in two different ways: Can filled with vegetable oil; Can filled till 1/3 with vegetable oil. The cost of this preservation technique (packaging and oil cost), not mentioning the transportation expenses (volume and weight of the packages) increases the price of the product we intend to export in about 20%. In order to find another less expensive preservation method a study had been made concerning the evolution of microbiological, chemical and sensorial characteristics of three samples of the portuguese "chouriço". These samples had identical composition and the technology utilized was the same. The study took six months, although several samples were observed at the 18th month.

The parameters studied were the following ones: water content, protein, fat, acidity, total volatils basic nitrogen tiobarbituric acid index (Chemical parameters); Mesophiles, Sulfitoreducers Clostridia, Staphylococcus aureus, Escherichia coli, Salmonella, Enterococcus (Microbiological parameters); colour firmness, package damages, general appearance (Sensorial parameters). Experiments were repeated 3 times, according to the following scheme: Several cans were filled with vegetable oil and observed at room temperature, 5-10°C and 30°C so that we could easily reproduce the storage and transportation temperatures. Equal number of cans were filled till 1/3 with vegetable oil at the same temperatures. Finally we packed the product in a retortable pouch and the temperatures we have already mentioned were respected.

According to the results obtained, we may conclude (concerning to the essay which took 6 months under the storage conditions mentioned above) that the usual packaging system showed problems connected with can internal corrosion and changes in the firmness of the product. On the other hand the retortable system showed products with good commercial characteristics. Chemical and Microbiological results were fairly constants in the three essays.

The essay that took 18 months showed low commercial quality, when compared to the results obtained after 6 months, when the product was canned in vegetable oil, while the product packed in retortable pouches showed good commercial conditions. We may now conclude that the retortable pouch packaging system is not only less expensive but it can also offer better preserving conditions to this specific meat product.

OBJECTIFS

The aim of this work is the study of the commercial, chemical and microbiological characteristics of the "portuguese chouriço" after being packaged in a retortable pouch (made of plastic and aluminium) closed under vacuum conditions and to compare these values with those obtained in our experiments, using the usual packaging systems utilized for exportation (can filled with vegetable oil).

MATERIALS and METHODS

The samples of "chouriço", used in this study, were made through the technology of "Probar" factory, as they work with products for exportation. The highest temperature reached in the interior of "chouriço" was 65°C.

1 - Lot of "chouriço"

All samples came from the same lot. A mass module of 180 Kg, submitted to the same thermal and smoking treatment.

2 - Types of package

Type A - Retortable pouch made of aluminium and plastic closed under vacuum conditions

Type B - Cylindrical can filled with 700 g of "chouriço" and vegetable oil

Type C - Idem, but filled with vegetable oil till 1/3 of the internal capacity

3 - Samples preparation

From package:

Type A - 2 package for each analysis chemical or microbiological

Type B and C - 1 can for each analysis chemical or microbiological

Samples from all over the product being studied were picked up according to the usual laboratory techniques. For the chemical analysis the product was ground and then a cutter with horizontal blades was utilized so that a homogeneous paste was obtained.

4 - Parameters

4.1 - Commercial characteristics (direct examination)

4.2 - Colour, binding of the paste, firmness, modifications concerning the kind of package and general aspect

4.3 - Chemical characteristics (according to the usual laboratory techniques)

Water content, fat content, tiobarbituric acid index, acidity (oleic), T.V.B.N., protein

4.4 - Microbiological characteristics (according to the usual laboratory techniques)

Total plate count of mesophilic, detection of coliforms, Enterococcus, sulfitoreducers Clostridium (spores)

E. coli, Salmonella and Staphylococcus aureus

5 - Work programme

Three different lots of "chouriço" were studied, each one packaged under the techniques already referred. Afterwards they were stored under the conditions expressed in our tables. Those lots were observed at the 6th month and one of them was also analysed at the 18th month.

Table 1 - Commercial and Chemical Characteristics of "Chouriço" from 3 Different Lots Just Before Being Packaged

Lots Identification	Commercial Characteristics				Chemical Characteristics 100 g						
	Colour	Firmness	Binding of the paste	Notes	Water content	Protein	Fat content	T.V.B.N.	Acidity (oleic acid)	T.B.A	Notes
Lot 1	Redish Brown	Hard	Very good	—	25.2	19,2	49.3	—	0.5	0.6	—
Lot 2	"	"	"	—	33.1	21.8	39.5	—	1.3	0.9	—
Lot 3	"	"	"	—	33.3	21.0	39.5	—	1.2	1.1	—

Table 2 - Microbiological Characteristics of "Chouriço" Just Before Being Packaged

Lots Identification	Total plate count (Mesophilic) Col./g	Detection of Coliforms	Detection of Enterococcus	Detection of Sulfitired Clostridium (Spores)	Detection of Staph. aureus (1 g)	Detection of E. coli (1 g)	Detection of Salmonella (25 g)
Lot 1	1,28x10 ⁵	Pos. 1 g Neg. 10 ⁻¹ g	Pos. 10 ⁻³ g Neg. 10 ⁻⁴ g	Pos. 10 ⁻¹ g Neg. 10 ⁻² g	Negatif.	Negatif.	Negatif.
Lot 2	1,32x10 ⁵	Neg. 1 g	Pos. 10 ⁻⁴ g Neg. 10 ⁻⁵ g	Pos. 10 ⁻² g Neg. 10 ⁻³ g	Negatif.	Negatif.	Negatif.
Lot 3	1,71x10 ⁶	Neg. 1 g	Pos. 10 ⁻⁶ g	Pos. 1 g Neg. 10 ⁻¹ g	Negatif.	Negatif.	Negatif.

Table 3 - Evolution of the Commercial, Microbiological and Chemical Characteristics of 3 Kinds of Package under Different Storage Conditions during 6 months

Storage Conditions	Lots	Package	Commercial				Microbiological				Chemical					
			Colour	Firmness	Binding of the paste	Notes	Total plate count (Meso-ph.) col/g	Detection of Coliforms	Detection of Enterococcus	Detection of Sulfitor. Clostridium (Spores)	Water content	Protein	Fat content	T.V.B.N.	Acidity (oleic acid)	T.B.A.
3 months at 5 - 10°C plus 3 months at 30°C	1	A	Redish brown	Hard	Good		1,0x10 ⁵	Neg. 1g	Pos. 10 ⁻¹ g Neg. 10 ⁻² g	Pos. 10 ⁻¹ g Neg. 10 ⁻² g	28.9	18.4	50.0	0.03	1.1	0.5
		B	"	"	"	(2)	1,5x10 ⁵	Neg. 1g	Neg. 1g	Pos. 10 ⁻¹ g Neg. 10 ⁻² g	28.4	17.0	48.5	0.03	1.1	0.6
		C	"	"	"	(2;3)	9,8x10 ⁴	Neg. 1g	Pos. 10 ⁻¹ g Neg. 10 ⁻² g	Pos. 10 ⁻¹ g Neg. 10 ⁻² g	26.7	18.0	50.0	0.03	1.5	0.5
	2	A	"	"	"		1,1x10 ⁵	Neg. 1g	Pos. 10 ⁻⁵ g Neg. 10 ⁻⁶ g	Neg. 1g	34.8	23.4	38.5	0.05	2.5	0.3
		B	"	Medium hard	"		6,3x10 ⁵	Neg. 1g	Pos. 10 ⁻³ g Neg. 10 ⁻⁴ g	Pos. 10 ⁻¹ g Neg. 10 ⁻² g	28.7	17.9	47.3	0.03	2.9	0.2
		C	"	"	"	(3)	3,7x10 ⁵	Neg. 1g	Pos. 10 ⁻² g Neg. 10 ⁻³ g	Pos. 10 ⁻² g Neg. 10 ⁻³ g	31.7	22.0	42.5	0.05	2.5	0.4
	3	A	"	Hard	"		4,2x10 ⁸	Pos. 1g Neg. 10 ¹ g	Pos. 10 ⁻² g Neg. 10 ⁻³ g	Pos. 10 ⁻¹ g Neg. 10 ⁻² g	35.1	22.1	37.0	0.07	3.0	0.3
		B	"	Soft	Regular		3,0x10 ⁶	Neg. 1g	Pos. 10 ⁻³ g Neg. 10 ⁻⁴ g	Pos. 10 ⁻² g Neg. 10 ⁻³ g	28.6	18.1	48.0	0.05	3.3	0.2
		C	"	Hard	Good		3,0x10 ⁸	Neg. 1g	Pos. 10 ⁻⁴ g Neg. 10 ⁻⁵ g	Neg. 1g	32.6	20.4	41.0	0.06	2.4	0.3
plus 3 months	1	A	"	"		6,2x10 ⁴	Neg. 1g	Pos. 10 ⁻² g Neg. 10 ⁻³ g	Pos. 1g Neg. 10 ⁻¹ g	28.1	—	49.5	0.03	1.7	0.2	
		B	"	"	(2)	1,1x10 ⁵	Neg. 1g	Pos. 10 ⁻³ g Neg. 10 ⁻⁵ g	Pos. 10 ⁻² g Neg. 10 ⁻¹ g	28.6	—	49.5	0.03	2.0	0.2	
		C	"	"	(2;3)	6,0x10 ⁶	Neg. 1g	Pos. 10 ⁻⁵ g Neg. 10 ⁻⁶ g	Pos. 10 ⁻² g Neg. 10 ⁻¹ g	26.9	—	50.0	0.04	1.6	0.2	

Storage Conditions	Lots	Package	Commercial				Microbiological				Chemical					
			Colour	Firmness	Binding of the paste	Notes	Total plate count (Meso ph.) col/g	Detection of Coliforms	Detection of Enterococcus	Detection of Sulfitorred. Clostridium (Spores)	Water content	Protein	Fat content	T.V.B.N.	Acidity (oleic acid)	T.B.A.
3 months at room temperature at 30°C	2	A	"	"	"		1,2x10 ⁵	Neg.1g	Pos.10 ⁻⁴ Neg.10 ⁻⁵ g	Pos.1g ⁻¹ Neg.10 ⁻¹ g	34.8	27.5	39.0	0.05	2.8	0.2
		B	"	Medium hard	"	(2)	8,0x10 ⁵	Neg.1g	Pos.10 ⁻³ Neg.10 ⁻⁴ g	Pos.10 ⁻¹ Neg.10 ⁻² g	29.1	17.6	46.5	0.04	3.3	0.2
		C	"	hard	"	(2)	1,1x10 ⁶	Neg.1g	Pos.10 ⁻⁴ Neg.10 ⁻⁵ g	Pos.10 ⁻² Neg.10 ⁻³ g	32.5	20.3	42.5	0.06	2.7	0.2
3 months at room temperature 5-10°C	3	A	"	"	"		5,0x10 ⁷	Neg.1g	Pos.10 ⁻¹ Neg.10 ⁻² g	Neg.1g	34.2	21.0	39.5	0.06	2.8	0.3
		B	"	Soft	Regular		3,0x10 ⁸	Neg.1g	Pos.10 ⁻⁵ Neg.10 ⁻⁶ g	Pos.10 ⁻¹ Neg.10 ⁻² g	29.0	17.3	49.0	0.04	3.9	1.6
		C	"	Hard	Good		4,7x10 ⁷	Neg.1g	Pos.10 ⁻⁵ Neg.10 ⁻⁶ g	Pos.10 ⁻² Neg.10 ⁻³ g	33.8	20.8	40.5	0.07	3.1	0.3
6 months at room temperature (15/26°C)	1	A	"	"	"		1,0x10 ⁵	Pos.10 ⁻¹ Neg.10 ⁻² g	Pos.10 ⁻¹ Neg.10 ⁻² g	Pos.10 ⁻¹ Neg.10 ⁻² g	27.9	17.6	49.0	0.03	0.9	0.4
		B	"	"	"	(2)	9,3x10 ⁴	Neg.1g	Pos.10 ⁻¹ Neg.10 ⁻² g	Pos.10 ⁻¹ Neg.10 ⁻² g	27.9	18.3	50.0	0.02	1.0	0.4
		C	"	"	"	(2)	6,8x10 ⁴	Neg.1g	Neg.1g	Pos.10 ⁻¹ Neg.10 ⁻² g	25.8	18.5	50.0	0.02	1.1	0.7
6 months at room temperature (15/26°C)	1	A	"	"	"		4,3x10 ⁴	Neg.1g	Pos.10 ⁻² Neg.10 ⁻³ g	Pos.1g ⁻¹ Neg.10 ⁻¹ g	28.3	16.9	49.2	0.03	1.3	0.2
		B	"	"	"	(2)	7,3x10 ⁴	Neg.1g	Pos.1g ⁻¹ Neg.10 ⁻¹ g	Pos.1g ⁻¹ Neg.10 ⁻¹ g	27.7	17.3	50.0	0.04	1.5	0.2
		C	"	"	"	(2)	9,6x10 ⁴	Neg.1g	Pos.10 ⁻¹ Neg.10 ⁻² g	Pos.1g ⁻¹ Neg.10 ⁻¹ g	26.9	17.3	50.0	0.03	2.2	0.2

Notes

- 1) Package: A - Retortable pouch made of aluminium and plastic closed under vacuum conditions; B - Cylindrical can filled with 700 g of "chouriço" an vegetable oil; C - Idem but filled with vegetable oil till 1/3 of the internal capacity.
- 2) Food containers showed corrosion signals.
- 3) The "chouriço's" surface which was not covered with vegetable oil showed a small number of mould colonies.

Table 4. - Commercial, Microbiological and Chemical Characteristics of "Chouriço" Lot 1 after 18 Months of Storage in the 3 Kinds of Package at Different Temperatures

Storage Conditions	Lots	Package	Commercial				Microbiological				Chemical					
			Colour	Firmness	Binding of the paste	Notes	Total plate count (Meso ph.) col/g	Detection of Coliforms	Detection of Enterococcus	Detection of Sulfitorred. Clostridium (Spores)	Water content	Protein	Fat content	T.V.B.N.	Acidity (oleic acid)	T.B.A.
18 months at 5-10°C	1	A	Redish brown	Hard	Good		8,0x10 ⁶	Neg.1g	pos.10 ⁻² Neg.10 ⁻³ g	Pos.10 ⁻² Neg.10 ⁻³ g	27.3	16.9	48.5	0.02	0.9	0.3
		B	"	"	"	2	1,4x10 ⁵	Neg.1g	Pos.10 ⁻² Neg.10 ⁻³ g	Pos.10 ⁻² Neg.10 ⁻³ g	30.0	16.7	45.0	0.02	1.2	0.4
		C	"	"	"	2;3	1,5x10 ⁵	Neg.1g	Pos.1g ⁻¹ Neg.10 ⁻¹ g	Pos.10 ⁻² Neg.10 ⁻³ g	25.4	17.3	48.0	0.02	1.1	0.5
18 months at room temperature.	1	A	"	"	"		-	-	-	-	28.9	17.2	44.0	0.03	2.2	0.2
		B	"	"	"	2	1,0x10 ⁵	Neg.1g	Pos.10 ⁻¹ Neg.10 ⁻² g	Pos.10 ⁻¹ Neg.10 ⁻² g	28.1	17.7	48.0	0.03	2.6	0.2
		C	"	"	"	2;3	8,0x10 ⁴	Neg.1g	Pos.10 ⁻¹ Neg.10 ⁻² g	Pos.1g ⁻¹ Neg.10 ⁻¹ g	27.7	16.9	47.0	0.03	2.4	0.2
3 months at 5-10°C plus 15 months at 30°C	1	A	"	"	"		7,0x10 ⁴	Neg.1g	Pos.10 ⁻¹ Neg.10 ⁻² g	Neg.1g	28.7	15.9	49.3	0.03	3.1	0.2
		B	"	Medium hard	Regular	2	5,3x10 ⁴	Neg.1g	Pos.10 ⁻² Neg.10 ⁻¹ g	Pos.1g ⁻¹ Neg.10 ⁻¹ g	28.6	16.8	50.5	0.05	3.6	0.2
		C	"	Hard	Good	2	8,2x10 ⁴	Neg.1g	Pos.10 ⁻² Neg.10 ⁻² g	Pos.1g ⁻¹ Neg.10 ⁻¹ g	26.7	16.4	50.5	0.04	2.4	0.2
3 months at room temperature plus 15 months at 30°C	1	A	"	"	"		8,6x10 ⁴	Neg.1g	Pos.10 ⁻¹ Neg.10 ⁻² g	Neg.1g	28.2	16.3	45.5	0.03	2.7	0.2
		B	"	Medium hard	Regular	2	6,7x10 ⁴	Neg.1g	Pos.10 ⁻¹ Neg.10 ⁻² g	Pos.1g ⁻¹ Neg.10 ⁻¹ g	30.1	16.6	46.5	0.04	3.5	0.2
		C	"	Hard	Good	2	8,8x10 ⁴	Pos.1g ⁻¹ Neg.10 ⁰ g	Pos.10 ⁻¹ Neg.10 ⁻² g	Pos.1g ⁻¹ Neg.10 ⁻¹ g	29.4	17.4	46.8	0.06	7.1	0.2

Notes

- 1) Package: A - Retortable pouch made of aluminium and plastic closed under vacuum conditions; B - Cylindrical can filled with 700 g of "chouriço" and vegetable oil; C - Idem but filled with vegetable oil till 1/3 of the internal capacity.
- 2) Food containers showed corrosion signs.
- 3) The "chouriço's" surface which was not covered with vegetable oil showed a small number of mould colonies.

RESULTS

Microbiological, chemical and commercial characteristics of the 3 lots of "chouriço" before packaging - table 1, 2. Microbiological, chemical and commercial characteristics of the 3 lots of "chouriço", influence of time and environmental conditions of storage, as well as the kind of packaging listed. - Table 3. Microbiological, chemical and commercial characteristics of lot 1, during 18 months of storage in different types of packaging, under different environmental conditions (table 4).

DISCUSSION OF RESULTS

According to the objectives of this essay, results will only be discussed regarding differences of "chouriço" packed under 3 different techniques and kept at different temperatures.

a) Commercial characteristics (tables 1,3,4)

1 - In type A package (plastic-aluminium retortable pouch), the 3 "chouriço" lots under different storage temperatures during 6 months, showed identical commercial characteristics, to the initial product. The only lot observed after 18 months (lot 1) in this type of package showed also good characteristics.

2 - In type B package (filled with vegetable oil) the 3 "chouriço" lots, after 6 months of storage conditions, showed loss of commercial quality (table 3). Lot 1 - Signs of corrosion on the internal can surface. Lot 2 - Loss of "chouriço" firmness. Lot 3 - Loss of "chouriço" firmness and mass binding. Lot 1 observed after 18 months of storage, in type B package, presents corrosion on the internal can surface and less mass-firmness.

3 - In type C package (1/3 of vegetable oil) only the lot 3, stored 3 months at 5-10°C plus 3 months at 30°C, showed identical commercial characteristics to the initial product. All the other lots including those stored during 18 months had bad commercial characteristics, caused by corrosion of the internal can surface and presence of moulds over the "chouriço".

b) Chemical characteristics

Due to the "chouriço" technology and type of mass, it is not possible to obtain homogeneous chemical composition in the same lot of "chouriço". That fact justifies the differences in chemical composition of the "chouriços" observed. Table 3 refers the values of T.V.B.N., acidity and T.B.A., of "chouriço", from the same lots using the 3 different types of package and different storage conditions. The results didn't show substantial differences therefore they do not allow judgements about the real influence of the package.

- Comparing initial and 18 months storage results (table 1,3), we can conclude that acidity increases in

all types of packages and storage conditions, while T.B.A. decreases.

- T.V.B.N. and T.B.A. do not show substantial changes in different kinds of package. Concerning the acidity values, they increase during storage. This increase is less expressive for package type A and C. Nevertheless the package type C tested during 3 months at room temperature plus 15 months at 30°C, showed a quite high value (7.1 - oleic acid), compared with all values obtained in the essay.

c) Microbiological characteristics

In tables 3 and 4 the results referring to Staph. aureus, E. coli and Salmonella are not included because they were always negative as shown on table 2.

Comparing data from tables 3,4 with table 2, the most notifying results are referred to the total mesophiles. We observe an increase of mesophiles in all types of package of lot 3, that suffered complementary storage at 30°C, during 3 months. Comparing those results we are not able to conclude if the differences obtained are related to the different types of package. Comparing the results of the initial product (table 2), with "chouriço" after 18 months of storage in different conditions (table 4), we can see that indicators maintain or decrease in all types of package of lot 1.

CONCLUSIONS

From all the 3 types of packages experimented in this essay, the plastic aluminium retortable pouch closed under vacuum conditions, seems to offer better preservation conditions for "chouriço" to be exported, specially regarding commercial characteristics. The other two types of package (B and C) are those usually used by the portuguese meat industry.