PHYSICAL – CHEMICAL AND MICROBIOLOGICAL ASPECTS OF RAW-DRY SAUSAGES

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Summary: The use of selected starter cultures contributes to control the fermentation during the production of raw-dry meat products as sausages. At the analysis of the influence of three industrial starter cultures on physical-chemical and microbiological changes during the obtaining of raw-dry sausages, it was observed that the use of starter cultures has a major role in decreasing pH and in modifying the sausages composition in fats, proteins and nitrogen and contributes to the reduction of residual nitrite content The presence of lactic bacteria determines the reduction of coliformi and to the improvement of the microbiological safety of the final products.

INTRODUCTION

Dry sausages are obtained by mixing first quality meat (pork, beef) and lard with starter cultures and various spice combinations like salt, sugar, additives. Lately, the fermentation process takes place under controlled conditions in acclimatised spaces. This procedure allows the obtaining of final products with controlled quality.
The starter cultures that are presently sold by different specialized firms guarantee the adding of quality microorganisms in sufficient quantity in order to achieve the wanted fermentation degree. During the fermentation process the pH drops as a consequence of the sugar transformation into lactic acid. Thus, a gradual degradation of pathogens is ensued. The acid medium contributes to the fast reduction of the nitrite added to give a red colour to the finite product (Cassens, 1995).
The lactic acid, which is obtained during the fermentation process, contributes also to the formation of the final product flavour.

The present study is concerned with the physical-chemical and microbiological variation in three raw-dry Romanian sausages obtained in

the region of Brasov, Romania, during the technological process. Three selected industrial starter cultures of bacteria are used for fermentation.

MATERIALS AND METHODS

For the fermentation process of raw-dry sausages, three types of starter cultures where used, which are listed in Table 1. Three charges of raw-dry sausages were made in the same technological conditions.

Table 1. Starter cultures used for obtaining the raw-dry sausages

Nr. crt.	Specialised firm	Name culture	Abbreviation of the culture	Existent microorganisms	Quan-tity
1	Nubassa	Baktoferment 61	**S1**	*Staphylococcus carnosus*	25g/ 50kg
2	Indasia	Rowu-Ferm	**S2**	*Staphylococcus carnosus Lactobacillus plantarum*	30g/ 50Kg
3	Darimex	Biobak Sal Plus	**S3**	*Lactobacillus plantarum Pediococcus acidilactici*	50g/ 100 Kg

The main stages, after mixing and filling, are displayed in Table 2.

Table 2. Technological stages and the conditions applied to produce raw-dry sausages

Technological stages	Technological parameters		
	Temperature(°C)	Relative air humidity (%)	Duration(day)
Leaking-calming	20-24	92-94	1
Fermentation	20-21	90- 92	1-2
Airing	14-16	88 -90	3
Smoking	14-16	86 -88	2-3
Drying	14-15	86……..76	20-35

To test the quality, physical-chemical and bacteriological analyses for every charge were made by using the standard method.

A) The physical-chemical determinations were:
- pH : the electrometrical method
- non-protein nitrogen by using the indirect method of titration with NaOH 0.1n
- nitrite content: Griess method
- salt content: Mohr method
- humidity: drying and gravimetric determination
- fat content: Soxhlet method
- protein content: Kjeldahl method

B) The microbiological determinations were (Savu, 2002):
- the Number of Total Germs (NTG): agar-agar medium, incubated at 30°C for 72 h
- the number of coliform bacteria: doubly concentrated selected medium with triptose and lauryl sodium sulfate, incubated at 37°C for 48 h and then, for the positive test, tubes with VRBL substrate, incubated at 37°C for 48 h.
- *Escherichia coli*: from the positive test tubes with coliform bacteria, *E. coli* is sown in a doubly concentrated selected medium, incubated at 45°C for 48 h and then sown in tryptonite water incubated at 45°C for 48 h and testing the indole production (with Kovacs reagent)
- *Salmonella* : the sample is sown in peptone-water incubated at 37°C for 20 h , then in malachite with magnesium chlorite medium (RV medium) incubated at 42°C for 24 h and in selenite-cystine medium incubated at 37°C for 24-48h, followed by isolation in the selected medium: with agar phenol-red and a brilliant green agar; and MacConkey agar, incubated at 37°C for 20-24h , eventually sown in nutritive agar and the biochemical reactions are tested.

RESULTS AND DISCUSSIONS:

The physical-chemical features of the analysed charges are presented in Table 3 and the microbiological characteristics are described in Table 4.

Table 3. The physical-chemical parameters of the raw-dry sausages after some technological stages

Stage in the technological process	Starter culture used	pH	NO_2^- mg/100g	NH_3 mg/100g	Humidity %	Fat %, reported at dry matter	Protein %, reported at dry matter
1. Leaking calming	S1	5.22	6.09	15.52	48.66	65.41	34.16
	S2	5.46	10.50	15.06	49.50	67.66	33.23
	S3	5.55	7.61	14. 78	48.68	67.46	32.19
2. Fermentation	S1	5.11	6.21	17.67	46.56	67.33	32.56
	S2	5.02	6.59	16.88	46.23	67.19	32.14
	S3	5.38	3.89	15.98	45.56	69.54	31.41
3. Airing	S1	4.87	4.30	18.44	38.87	67.77	31.95
	S2	4.93	5.37	17.52	39.27	67.45	31.98
	S3	4.99	1.72	18.10	38.12	68.23	31.29
4. Smoking	S1	4.81	0.29	19.20	28.66	72.11	27.67
	S2	4.79	0.69	17.88	34.86	68.41	31.23
	S3	4.78	0.18	20.44	34.88	65.59	34.54
5. Drying	S1	4.88	0.06	19.34	26.00	64.84	35.43
	S2	4.87	0.08	18.56	29.46	66.44	34.38
	S3	4.83	0.06	21.16	28.14	68.80	31.62

Table 4. Microbiological features of raw-dry sausage charges during certain technological stages

Stage of technological process	Starter culture used	NTG	Coliform bacteria	*E.coli*	*Salmonella*
1. Leaking calming	S1	14 000.0	100.0	1.0	abs
	S2	25 400.0	10.0	abs	abs
	S3	28 000.0	100.0	abs	abs
2. Fermentation	S1	27 000.0	>10.0	abs]	abs
	S2	38 400.0	>10.0	1.0	abs
	S3	33 800.0	< 10.0	abs	abs
3. Airing	S1	63 000.0	1.0	abs	abs
	S2	64 200.0	1.0	abs	abs
	S3	62 800.0	abs	abs	abs
4. Smoking	S1	92 000	abs	abs	abs
	S2	144 000.0	abs	abs	abs
	S3	142 700.0	abs	abs	abs
5. Drying	S1	1 000.0	abs	abs	abs
	S2	3 000.0	abs	abs	abs
	S3	1 500.0	abs	abs	abs

The analysis of data in Table 1 shows that the pH value drops considerably for all samples, especially after the fermentation stage, followed by airing for 5- 6 days. The average pH drop is up to 8.87%, the equivalent of 0.48 pH units. This decrease of pH is due to the formation of lactic acid by bacteria used as starter cultures. The final pH values are similar in the final stage for the raw-dry sausages, for all the three starter cultures used.
Also the nitrite content in products drops fast. An initial content over the admitted standard can be noticed in charges produced with the starter cultures S2 and S3, probably due to inappropriate homogenization. In the final stage, the residual nitrite is almost inexistent in all charges. The lactic acid acquired during the fermentation contributes to a considerable reduction (reaching almost nought) of the residual nitrite content.
Regarding the humidity content, a drop up to 21.08 % - the average value- can be noticed throughout the technological process.
The modification of the rapport fat-protein, with the small growth of the fat content and the small decrease of the protein quantity can be observed during the technological process. The proteins decrease is due to their partial transformation during fermentation by the microorganisms and the formation of products like nitrogen. As observed in Table 1, the non-protein nitrogen has a significant rise during the technological process, most probably because of its formation during fermentation (Kannes, 1994).
The measurements shows that the starter cultures tested in this work don't modify significantly the physical-chemical characteristics of the raw-dry sausages.

The bacteriological analyses are presented in Table 2. As observed, the initial number of total germs is different. This difference is due to the number of living microorganisms in the three tested starter cultures, the culture S1 having a much smaller quantity of lactic bacteria as the other two cultures.
NTG grow especially after fermentation as a consequence of the development of lactic bacteria. The quantity of bacteria can be well correlated with the pH value at the end of fermentation, the smaller pH being obtained at the usage of the starter culture S2, which develops better as the other two.
The coliform bacteria show a drop due to the lactic acid formed by the starter cultures in the product. In the final stage they disappear due to two technological conditions:
- a_w decreases to values too small to assure the growth of bacteria

- the pH value created by the selected lactic bacteria is small and don't stimulate the development of coliformi, which need neutral pH.

The absence of *Salmonella* and the very small number of *E. coli* (in the accepted limits) means that the process and the products had been handled in proper hygienic environment.

CONCLUSIONS

During the technological process of raw-dry sausages obtaining, the physical-chemical characteristics modifies. These modifications are due to the starter cultures used for fermentation (pH decrease, modification of the rapport between fats and proteins, formation of nitrogen). The starter cultures contribute also to the drop of residual nitrite.
The number of microorganisms in the intermediary products is represented by the lactic bacteria. The absence of *Salmonella* and the presence in very small amount of *E. coli* during the obtaining of raw-dry sausages indicates very good hygienic conditions for the fabrication of these products.
The pH drop and the reduction of the humidity content are important positive factors in the decrease of spoilage and in poisoning microorganisms existent in raw-dry sausages.

No clear differences in the physical-chemical characteristics can be made between the starter cultures used. The culture S2 seems to be more active, but also more resistant in the final product.

REFERENCES

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