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Physicochemical and microbiological research on characteristics of meat products during storage in the membrane depending on the quality of raw materials

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Abstract. In our research we followed changes in the organoleptic, physicochemical and microbiological characteristics of meat products within the warranty period depending on the quality of raw materials and storage conditions. In processed meat products from lower quality raw materials (beef meat II) as sausages Muntenia and Bicaz consider it appropriate to reduce the warranty period from six days to 3-4 days.
Key words: raw material, membrane, storage, quality of meat products, microbiological, physicochemical.

Introduction. The increasing demand for high quality animal products in the developing world is expected to be one of the most important trends in the future of animal science and production (Bud & Mireșan 2008; Pentelescu 2009; Dărăban et al 2009; Carșai 2009; Pricop 2009; Petrescu-Mag 2009). During storage, processed meat undergoes a series of physicochemical and bacteriological changes depending on their content in water, hygienic quality of raw and auxiliary materials used in technology, hygiene and storage conditions on the technological flow (especially temperature and humidity).

An important role in the development of impaired organoleptic changes in meat preparations is attributed to the presence of germs of the genus *Proteus, Clostridium, Bacillus, Escherichia, Pseudomonas, Micrococcus* etc. Under the influence of these germs, proteins are hydrolyzed to polypeptides, then the action dipeptidase and carboxypeptidase lead to the formation of aminoacids. They continue by decarboxylation and desamination and decompose in amines and CO_2, mercaptans, indole, phenol, skatole, organic acids, hydrogen sulfide, ammonia, methane etc.

Lipids under the action of lipases secreted by germs such as *Pseudomonas* and *Bacillus*, yeasts and molds and tissue are hydrolyzed by lipases to fatty acids and glycerol. Under the action of oxydase, oxygen and light, fatty acid oxidation occurs. Peroxydes and the resulting fatty acids inhibit the development of many bacterial species.

Paper Aim. In our research we followed changes in the organoleptic, physicochemical and microbiological characteristics of meat products within the warranty period depending on the quality of raw materials and storage conditions.

Material and Method. Were examined at obtaining and during storage (10-12°C for sausage) at intervals of 2, 4, 6 days, 50 samples of finished products, from a sensory, physical, chemical and microbiological test, classified into two types, depending on quality of raw material. The version I have been assigned beef products from I, and II in alternative beef products II.

In terms of appearance and from organoleptic point of view, we appreciated the section, consistency, smell, taste and color. Physicochemically were determined pH, total

nitrogen, the content of proteic substances, amino nitrogen, ammonia nitrogen, split protein indices, sodium chloride, nitrites and water:protein ratio.

Bacteriologically were determined the total plate count, coliform number and the number of coagulase-positive staphylococci, using the techniques provided by the official rules in force (Motoc & Banu 1966; Stănescu et al 1971-1978; Stănescu et al 1974ab; Eddy 1975; Moldovanu & Laslo 2010; Filimon et al 2010 and the national legislation cited therein; The European Food Safety Authority 2006).

Results and Discussion. Finished products, to obtain, present different organoleptic characters depending on variety and quality of materials placed in technology. At sorts where was introduced in technology beef II shows the occurrence of defects in texture, or binding composition. In cases of introduction of soft fat into the technological recipe, when the emulsifying fat is inadequate, fat separation phenomenon occurs under the membrane. Of particular importance in terms of sanitation of such products is the appearance of defects due to non-microbiological hygiene on the technological flow and inadequate heat treatment.

Physicochemical (Tables 1-3), variations depending on variety and quality of components falling in composition of products were observed. In Bicaz sausage made from beef chilled and frozen II (Table 1), compared to sausage made from beef II, frozen until the limit of storage, is highlighted higher values of water content, total nitrogen, ammonia and lower bacterial load. Muntenia sausage, made from chilled beef II (Table 2), compared to sausage produced from frozen beef II, registered lower values of water content, total nitrogen, ammonia and bacterial load.

Comparative results of physicochemical and microbiological examination of Cabanos sausage, depending on the raw material used (Table 3) shows the product obtained from frozen meat registered lower values of water content, pH, amino nitrogen and total germs.

Comparative analysis of exam results after physicochemical and microbiological testing of meat products of different raw materials quality shows significant differences in particular regarding the bacterial load, meaning that products made from beef II have constantly a total number of germs, staphylococci and coliform bacteria greater than the products made from beef quality I. Also most products made from beef II compared with those obtained from beef I have water, pH, amino nitrogen, ammonia and split protein indices at higher values. Mentioned differences are statistically assured. These values still favor inside of finished products proteolytic changes, greater than inside of those obtained from high quality raw materials. Our values, obtained for physicochemical and microbiological indicators of finished products, fall in the limits of the official regulations in force (Mihai & Curcă 1978; Banu et al 1985; Popa et al 1985; Popescu et al 1986).

Products during storage at 10-12°C (for 6 days if semi-smocked) were analyzed in the period of warranty, aiming to identify the appearance of physicochemical and microbiological changes. Results indicated a decrease in the quantity of water and total nitrogen and an increase in amino nitrogen content, ammonia nitrogen and split protein indices in most products examined. Under the microbiological aspect is highlighted in all cases growth of total germs, coliforms and staphylococci per gram of product.

In Bicaz sausage made from beef chilled and frozen II (Table 2) is highlighted, after six days of storage at 10-12°C, high values of pH, amino nitrogen, ammonia nitrogen, split protein indices, load of bacterial protein, both in products made from frozen and chilled meat.

Altered organoleptic changes occur after 3-4 days. Other products such as sausage Muntenia and Cabanos, obtained from frozen meat at the limit of storage period, during storage at 10-12°C for six days, present a decresed water content and total nitrogen, while the amino nitrogen, ammonia nitrogen, split protein indices and bacterial load are higher than in products produced from chilled meat. Changes in organoleptic characteristics and alteration/deterioration of quality in some products such as sausage Muntenia appear after 2-3 days of storage when a frozen raw material is used and after 4-5 days when the raw material is chilled.

Table 1

Comparative results of physicochemical and microbiological examination in sausage Bicaz finished product, depending on the quality of raw materials (chilled beef II and frozen beef II)

Specification			*Water g%*	*pH*	*Total nitro-gen g%*	*Prote-ical soub-stances g%*	*Amino nitrogen mg%*	*$\underline{N\text{-}NH_2 x100}$ N total*	*Ammonia nitrogen mg%*	*$\underline{N\text{-}NH_3 x100}$ N total*	*NaCl g%*	*$NaNO_2$ mg%*	*Water protein*	*Total no germs/g*	*Coliform bacteria /g*	*No of staphy-lococci/g*
Finished product at obtaining		A	63.66	6.11	2.80	17.46	320.00	11.36	23.44	0.83	2.80	5.00	3.63	1200	10	10
		B	64.49	5.48	2.92	18.46	212.60	7.30	24.59	0.83	2.07	4.06	3.54	625	5	5.1
		T	0.757^{ns}	7.813^{xxx}	1.167^{ns}	1.138^{ns}	10.862^{xxx}	5.305^{xxx}	1.146^{ns}	0.019^{ns}	7.338^{xxx}	5.764^{xxx}	0.864^{ns}	5.823^{xxx}	5.774^{xxx}	4.816^{xx}
Finished product after storage at 10-12ºC	2 days	A	60.58	6.30	2.70	16.59	408.00	13.65	29.00	1.04	3.00	4.00	3.55	125000	45	30
		B	57.34	5.64	2.85	17.61	282.40	9.91	32.51	1.13	2.18	4.20	3.25	25300	15	10
		T	3.196^{x}	7.571^{xxx}	1.407^{ns}	1.017^{ns}	2.561^{x}	5.251^{xxx}	3.689^{xx}	0.098^{ns}	8.766^{xxx}	1.155^{ns}	3.182^{x}	54.429^{xxx}	8.915^{xxx}	5.384^{xxx}
	4 days	A	58.60	6.40	2.50	15.52	480.00	19.37	30.00	1.24	3.20	3.00	3.76	250000	110	45
		B	52.63	5.94	2.84	17.66	334.60	12.00	35.43	1.25	3.03	4.54	2.99	42340	25	20
		T	6.253^{xx}	5.662^{xxx}	3.244^{x}	2.210^{ns}	13.532^{xxx}	10.193^{xxx}	5.708^{xxx}	0.084^{ns}	1.721^{ns}	9.270^{xxx}	9.199^{xxx}	5.872^{xxx}	19.007^{xx}	5.976^{xxx}
	6 days	A	55.70	6.50	2.40	15.33	600.00	25.74	36.00	1.50	3.82	2.00	3.72	360000	240	60
		B	50.50	6.20	2.74	16.54	475.20	17.64	34.56	1.25	3.15	4.70	3.08	80700	40	35
		T	4.063^{xx}	3.873^{xx}	2.296^{ns}	1.068^{ns}	13.220^{xxx}	10.183^{xxx}	1.536^{ns}	2.965^{x}	2.697^{x}	15.588^{xx}	6.772^{xxx}	39.292^{xxx}	10.363^{xx}	5.000^{xx}

A – sausage Bicaz obtained from chilled beef II
B – sausage Bicaz obtained from frozen meat II
ns – unsignificant diference
x – significant diference (p<0.05%)
xx – distinct significant diference (p<0.01%)
xxx – very significant diference (p<0.001%)

Table 2

Comparative results on physicochemical and microbiological exam at Muntenia sausage

Specification	*water g%*	*pH*	*Total nitrogen g%*	*Proteic Soub-stances g%*	*Amino nitrogen mg%*	*$\underline{N\text{-}NH_2 x10}$ N total*	*Ammonia nitrogen mg%*	*$\underline{N\text{-}NH_3 x100}$ Ntotal*	*NaCl g%*	*$NaNO_2$ mg%*	*<u>water</u> protein*	*Total no germs/g*	*Coliform bacteria /g*	*No of staphy-lococci/g*
						FROZEN BEEF I								
At obtaining (A)	64.18	5.50	3.05	18.56	194	6.32	20.42	0.65	2.91	4.10	3.45	271	10	5
After 2 days (B)	63.50	5.66	2.93	18.52	209.6	7.24	34.26	1.14	3.02	4.60	3.53	25300	25	10
t (B - A)	15.634^{xxx}	15.435^{xxx}	8.750^{xxx}	5.990^{xxx}	104.903^{xxx}	26.496^{xxx}	22.978^{xxx}	4.196^{xxx}	9.326^{xxx}	3.997^{xx}	10.870^{xxx}	1189.89^{xxx}	8.766^{xxx}	7.492^{xxx}
After 4 days (C)	63.61	6.00	2.82	17.56	306.8	11.31	47.19	1.67	3.14	4.66	3.63	35400	40	15
t (C - A)	13.714^{xxx}	18.360^{xxx}	8.612^{xxx}	4.340^{xx}	67.868^{xxx}	16.103^{xxx}	40.090^{xxx}	6.442^{xxx}	9.982^{xxx}	5.946^{xxx}	11.208^{xxx}	1618.68^{xxx}	18.758^{xxx}	15.843^{xxx}
After 6 days (D)	57.58	6.00	2.66	16.62	533.2	20.49	48.25	1.92	3.66	4.90	3.26	37301	55	20
t (D - A)	7.438^{xxx}	18.360^{xxx}	8.056^{xxx}	2.543^{ns}	11.111^{xxx}	31.734^{xxx}	44.203^{xxx}	7.245^{xxx}	12.458^{xxx}	6.254^{xxx}	6.248^{xxx}	2054.27^{xxx}	29.542^{xxx}	16.923^{xxx}
						CHILLED BEEF I								
After boiling (A)	63.80	6.10	2.80	17.50	195	6.95	19.60	0.70	2.95	4.60	3.65	150	10.40	5
At delivery (B)	63.00	6.20	2.80	17.53		7.13	2.10	0.71	3.00	3.00	3.60	250	5	1
Storage 2 days (C)	61.20	6.24	2.70	16.90	250	9.23	24.60	0.91	3.15	2.00	3.63	20000	20	15
at t (C - A)	2.590^{x}	1.692^{ns}	1.000^{ns}	0.944^{ns}	3.479^{xx}	7.764^{xxx}	3.162^{x}	6.406^{xxx}	2.530^{x}	2.582^{x}	0.218^{ns}	14.035^{xxx}	2.466^{x}	9.487^{xxx}
10-12ºC 4 days (D)	58.40	6.30	2.65	16.56	290	10.92	29.50	1.11	3.20	2.00	3.53	2800	30.00	20
t (D - A)	5.316^{xxx}	2.000^{ns}	1.519^{ns}	1.592^{ns}	6.008^{xxx}	14.283^{xxx}	4.950^{xx}	9.690^{xxx}	2.500^{x}	2.390^{x}	1.569^{ns}	19.692^{xxx}	5.034^{xx}	6.325^{xxx}
6 days (E)	57.10	6.35	2.60	16.25	332	13.44	31.60	1.22	3.50	1.50	3.52	30000	40	25
t (E - A)	6.627^{xxx}	2.500^{x}	2.000^{ns}	2.000^{ns}	9.365^{xxx}	33.549^{xxx}	7.589^{xxx}	13.937^{xxx}	5.500^{xxx}	3.450^{xx}	1.738^{ns}	8.443^{xxx}	13.712^{xxx}	10.322^{xxx}

ns – unsignificant difference
x – significant difference ($p<0.05\%$)
xx – distinguish significant difference ($p<0.01\%$)
xxx – very significant difference ($p<0.001\%$)

Table 3

Comparative results of laboratory exams at Cabanos saussage, finished product, under different thermal state of raw material used

Specification	*Cabanos from chilled meat*			*Cabanos from frozen meat*			*t*
	X	sx	V%	X	sx	V%	
water, g%	59.72	0.872	3.228	55.72	0.802	3.217	3.398^{xx}
pH	6.16	0.051	1.851	6.02	0.049	1.820	1.980^{ns}
Total nitrogen g%	2.23	0.073	7.330	2.64	0.065	5.548	4.136^{xx}
Proteic soubst g%	14.32	0.676	10.556	16.25	0.679	9.346	2.012^{ns}
Amino nitrogen mg%	292.8	8.096	6.182	212	7.88	8.312	7.152^{xxx}
$\frac{N\text{-}NH_2 x100}{N\ total}$	13.54	0.605	9.993	8.00	0.292	8.145	8.238
Ammonia nitrogen mg%	22.17	0.703	7.086	25.42	0.741	6.517	3.181^{x}
$\frac{N\text{-}NH_3 x100}{N\ total}$	0.97	0.069	16.044	0.96	0.081	18.909	0.113^{ns}
NaCl, g%	1.84	0.077	9.384	3.2	0.130	9.081	9.028
$NaNO_2$, mg%	7.00	0.032	1.010	4.06	0.093	5.107	30.006^{xxx}
Water/protein	4.25	0.072	3.764	3.42	0.073	4.769	7.969^{xxx}
Total no. of germs/g	156.4	41.406	59.197	53.20	6.851	28.797	2.459^{x}

ns – unsignificant difference; x – significant difference ($p<0.05\%$); xx – distinguish significant difference ($p<0.01\%$); xxx – very significant difference ($p<0.001\%$).

Correlating the organoleptic changes with the physico-chemical and microbiological ones of finished products during storage within the period of warranty we can highlight that products obtained from good quality raw materials maintain their normal characteristics within the warranty period.

Low quality meat products are sausages Bicaz and Muntenia. They are obtained usually from beef quality II. In such cases of products, sensory changes within the warranty period appear after 3-4 days of storage at 10-12 °C.

Conclusions. Membrane preparations of meat have, at obtaining, qualitative values as regards sensorial, physical-chemical and microbiological, depending on variety and quality of raw materials introduced during processing.

The products of low quality raw materials (beef meat II) present, compared to those obtained from good quality raw materials, a larger quantity of water, the pH increased further and higher bacterial load. In this case the total nitrogen content is lower, and the amino nitrogen, ammonia nitrogen and split protein ratios higher.

Products made from beef II have consistently higher numbers of germs, staphylococcus and coliform bacteria than the products obtained from beef I.

Finished products during storage show a decrease in the quantity of water and total nitrogen and an increasing amount of amino nitrogen, ammonia nitrogen, protein cleavage indices and growth in the bacteriological aspect of total plate count, coliform bacteria and staphylococci.

Products produced from raw materials of lower quality during storage show higher values of pH, amino nitrogen, ammonia nitrogen and bacterial load than the products from raw materials of good quality.

Correlating the organoleptic changes with the physico-chemical and microbiological ones of finished products during storage within the period of warranty we can highlight that products obtained from good quality raw materials maintain their normal characteristics within the warranty period.

In processed meat products from lower quality raw materials (beef meat II) as sausages Muntenia and Bicaz consider it appropriate to reduce the warranty period from six days to 3-4 days.

References

Banu C., Oprea A., Daniel G. H., 1985 [Indrumător în tehnologia produselor din carne]. Editura Tehnică, Bucharest. [In Romanian]

Bud I., Mireșan V., 2008 Contributions concerning the quality indices' appreciation in main aquatic organisms, which fall under human consumption. AACL Bioflux **1**(1):73-83.

Carșai T.-C., 2009 Genetic markers assisted selection in cattle: leptine gene locus and its polymorphism. ABAH Bioflux **1**(1):1-19.

Dărăban S., Coroian C., Georgescu B., 2009 Cluj Merino breeds' potential for meat production. ABAH Bioflux **1**(1):57-62.

Eddy B. P., 1975 The effects of salt. Concentration and temperature on nitrite production and metabolism. The Microbiology of Fish and Meat Curing. London, Brines, p.87.

Filimon M. N., Borozan A., Bordean D., Radu F., Popescu R., 2010 Microorganisms, qualitative indicators of meat products. Scientific Papers Animal Sciences and Biotechnologies **43**(2):346-349.

Mihai M., Curcă D., 1978 [Research on changes of protein substances in frozen beef]. Lucrări Ştiinţifice, Series C, I.A.N.B., Bucharest, p.157. [In Romanian]

Moldovanu C., Laslo C., 2010 Research on raw material correlation and soy protein derivatives used for meat preparations in membrane. ABAH Bioflux **2**(2):53-57.

Motoc D., Banu C., 1966 [Biochemistry of meat and its subproducts]. Editura Tehnica, Bucharest. [In Romanian]

Pentelescu N. O., 2009 Fatty acid, retinol and carotene content of organic milk. ABAH Bioflux **1**(1):21-26.

Petrescu-Mag R. M., 2009 Promoting the slow food concept for a better Common Agriculture Policy and environmental protection. AAB Bioflux **1**(2):51-52.

Popa G., Vasilescu V., Mihai M., 1985 [Contributions to the assessment of freshness of meat preparations]. Lucrări Ştiinţifice, Series C, Vol **28**, I.A.N.B., Bucharest, p.89. [In Romanian]

Popescu N., Popa G., Stanescu V., 1986 [Physical-chemical laboratory determinations for food of animal origin]. Editura Ceres, Bucharest. [In Romanian]

Pricop F., 2009 Findings of Morgan in chicken: are they real? ABAH Bioflux **1**(2):71-83.

Stănescu V., Laslo C., 1971 [Biochemical changes in the pork process flow of meat preparations]. Lucrări Ştiinţifice ale I.A. Cluj, Series Veterinary Medicine **27**:337. [In Romanian]

Stănescu V., Laslo C., Guga C., 1974a [Amino acid content of processed meat emulsion with and without added soy flour]. Sesiunea Ştiinţifică Studenţească a I.A. Cluj, 19-20 April, 1974. [In Romanian]

Stănescu V., Laslo C., Klemm W., 1974b Influence of sterilized brine on the reduction of microorganisme in piklend and smokend meat products. I.A.N.S IX-Internazional Symposium, Kiel, F.R. Germany.

Stănescu V., Laslo C., 1977 The influence of microclimate and storage biochemical a Herations in some sorts of processed meat. IAMS X-International Symposium Szezechin, Poland.

Stănescu V., Laslo C., 1978 [Dynamics of biochemical and bacterial load in some meat products depending on temperature and shelf life]. Buletinul Institului Agronomic Cluj-Napoca, Seria Zootehnie şi Medicină Veterinară **30**:113. [In Romanian]

The European Food Safety Authority, 2006 EU Directive 2001/18/EC and according to EU Regulation 1829/2003.

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