

THE EFFECT OF AN ADDITION OF SODIUM CHLORIDE AND SODIUM TRIPHOSPHATE ON FAT OXIDATION PRODUCTS IN COLD STORED BEEF*

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ABSTRACT

Introduction. Meat and processed meats, depending on the animal species and anatomical element from which they were obtained, exhibit a varied fat content (most typically from 10% to 80% dry matter). Fats are relatively unstable food components. The aim of this study was to determine the effect of an addition of model brines on lipid oxidation rate in the selected beef element stored under aerobic conditions and in vacuum at a temperature of 5°C.

Material and methods. Material for analyses comprised beef: rump cut (R) and the heel of round (L). Meat was cured (at 20% in relation to raw material weight) with brine A, containing 1% NaCl in total weight and brine B, containing 1% NaCl and 0.3% sodium tripolyphosphate E 451i (including 56% P₂O₅). Meat after being massaged was stored under aerobic conditions (T) and in vacuum (P) at a temperature of 5°C for 15 days. During storage of samples changes were determined in peroxide value (PV), contents of secondary fat decomposition products using the TBARS test as well as changes in pH value.

Results. It was observed that with an extension of sample storage time peroxide value was growing gradually, but the dynamics of this growth varied. Samples coming from the rump cut muscle, stored in the atmosphere with unlimited access of oxygen, were characterised by slightly, but statistically significantly higher peroxide values in comparison to the other tested samples. The highest increase in the TBARS test value was observed in samples stored under aerobic conditions and coming from the heel of round muscle, irrespective of the type of applied brine. Conducted analyses showed that vacuum packaging of meat, in comparison to the storage of samples at unlimited access of oxygen, effectively slowed down the increase in the content of secondary oxidation products determined by the TBARS test. The greatest effect of vacuum packaging was observed for the heel of round in brine A.

Conclusions. Vacuum packaging, in comparison to storage of experimental samples under aerobic conditions, delayed the increase in peroxide value and effectively slowed down the increase in contents of secondary lipid oxidation products. Statistically significant changes in pH values were observed in the heel of round, irrespective of the type of applied brine, stored under aerobic conditions.

Key words: beef, vacuum packaging, peroxide value, TBARS

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INTRODUCTION

Trimming, comminution, mechanical deboning, emulsification, restructuring and heating cause damage to cell membranes. These processes result in phospholipids being uncovered and exposed to the action of atmospheric oxygen, enzymes, haem pigments and ions of metals. This results in rapid fat metabolism even in raw (unheated) meat. Temperature and oxygen and used packaging system have a significant effect on the course of lipid oxidation. Even a slight aeration of comminuted raw meat results within a short time in autooxidation and formation of free radicals. Storage of fat and meat raw materials at low temperatures close to zero and temperatures below zero makes it possible to extend the induction period, which does not mean that such changes do not occur [Jakobsen and Bertelsen 2000, Heś and Korczak 2007, Krysztofiak and Bilska 2008, Flaczyk et al. 2009, Bilska 2011, Domiszewski et al. 2011, Kandeepan et al. 2011].

Sodium chloride used in the production of processed meats enhances water binding capacity of proteins, reduces water activity (a_w), improves texture of the final product and improves flavour [Rhee and Ziprin 2001, Tan and Shelef 2002, Cheng et al. 2007]. Many authors are of an opinion that sodium chloride acts a pro-oxidant in meat and meat products. However, the mechanism of its action has not been fully clarified. One of the potential explanations for this phenomenon is connected with contamination of table salt with traces of metals, particularly bivalent, which act as catalysts in relation to lipids [Rhee and Ziprin 2001, Tan and Shelef 2002, Cheng et al. 2007].

The application of phosphates in meat industry results in improved juiciness, tenderness and microbiological quality of meat and extends its shelf life. Addition of phosphates to meat delays lipid oxidation processes in heated meat by forming complexes of metals, particularly iron. Moreover, they protect myoglobin against oxidation, thus facilitating a proper course of meat colouring, and later preserve the red colour of cured products. Apart from iron, pyrophosphates effectively form complexes with copper, while polyphosphates form magnesium and calcium complexes [Cheng and Ockerman 2003, Heś and Korczak 2007, Krysztofiak and Uchman 2008].

The aim of this study was to verify the effect of an addition of brine containing 1% NaCl, and 1% NaCl and 0.3% sodium tripolyphosphate E 451i on lipid oxidation rate in the lumbar section of the longissimus dorse muscle – rump cut (*longissimus dorsi*) and in the semimembranous muscle – the heel of round (*semimembranosus dorsi*), stored under aerobic conditions and in vacuum at a temperature of 5°C.

MATERIAL AND METHODS

Material for analyses comprised beef: rump cut (R) and heel of round (L). Meat was cured (at 20% in relation to raw material weight) with brine A, containing 1% NaCl in total weight, or brine B, containing 1% NaCl and 0.3% sodium tripolyphosphate E 451i (including 56% P_2O_5). Prepared sample of meat were tumbled with typical programme. Process lasted 4 h and comprised several cycles of 10 min of tumbling and 20 min of relaxation time. Quantity of turns – 8/min. Laboratory tumbler (Nowicki Machinery, Poland) was used.

Meat after being massaged was stored under aerobic conditions (T) and in vacuum (P) at a temperature of 5°C for 15 days. The following sample variants were obtained:

- LAT: heel of round with brine A, stored under aerobic conditions
- LAP: heel of round with brine A, stored in vacuum
- LBT: heel of round with brine B, stored under aerobic conditions
- LBP: heel of round with brine B, stored in vacuum
- RAT: rump cut with brine A, stored under aerobic conditions
- RAP: rump cut with brine A, stored in vacuum
- RBT: rump cut with brine B, stored under aerobic conditions
- RBP: rump cut with brine B, stored in vacuum.

During sample storage the following parameters were determined:

- changes in peroxide value (PV) according to PN-EN ISO 3960:2005
- changes in contents of secondary lipid decomposition products determined using the TBARS test according to the modified method described by Pikul et al.
- changes in pH values.

Simultaneously to the analyses determining the effect of an addition of sodium chloride and sodium triphosphate on lipid oxidation products in beef, the following parameters were determined: total count of mesophilic aerobic bacteria, count of lactic acid bacteria, count of bacteria from the family *Enterobacteriaceae*, including coliform bacteria and *E. coli*. Results of these analyses were published in an earlier paper [Danyluk et al. 2011].

All analyses were performed in triplicate. Recorded results were subjected to statistical analysis using the STATISTICA 9 and Excel 2007 software. Results were interpreted at the significance level $\alpha = 0.05$.

RESULTS AND DISCUSSION

Intramuscular fat is highly desirable in beef. Its presence is manifested in the so-called marbling. There is an opinion that fat content in meat and its distribution in the muscle tissue determine such sensory attributes of meat as its taste, juiciness and texture. In the presented study analyses were conducted on two

22.42% protein, 2.86% fat and 74.23% water, while rump cut (*m. longissimus dorsi*) contained 19.73% protein, 7.46% fat and 72.71% water.

Recorded results of analyses were subjected to a three-variate analysis of variance, where sources of variation included storage time (a), type of sample – muscle (b) and storage method (aerobic conditions and vacuum) (c). Table 1 presents coefficients of significance for the analysed dependencies.

The conducted analysis of variance showed a highly significant effect of the type of sample as well as the time and method of storage, and the interactions between these factors on changes in contents of secondary lipid decomposition products as determined by the TBARS test. The type of sample (b), the time (a) and method of storage (c) as well as the (a)*(c) interaction had a statistically significant effect on changes in peroxide value. In turn, the type of sample, storage time as well as the interactions between the time and method of storage, and the type of sample and the method of storage had a statistically significant effect on changes in pH value.

Table 1. A list of F-values ($\alpha \leq 0.05$)

Source of variation	Parameters					
	peroxide value		TBA		pH	
	F _{obs.}	F _{req.}	F _{obs.}	F _{req.}	F _{obs.}	F _{req.}
Time of storage	44.31	2.90	265.41	2.90	8.77	2.61
Type of sample	2.94	2.90	54.01	2.90	10.45	2.84
Storage method	32.86	4.15	1 596.60	4.15	2.85	4.08
Time of storage × type of sample	0.35	2.19	15.66	2.19	0.66	2.00
Time of storage × storage method	3.13	2.90	156.90	2.90	5.26	2.61
Type of sample × storage method	1.79	2.90	20.74	2.90	3.07	2.84
Time of storage × type of sample × storage method	0.53	2.19	12.92	2.19	0.23	2.00

types of muscle obtained from beef carcasses and used for culinary purposes. The muscles differed in their location in the carcass, the function they serve in the musculature and their chemical composition. The heel of round (*m. semimembranosus dorsi*) contained

Changes in peroxide value

Oxidation is the primary cause of deterioration of fat quality. It leads to losses of nutritive value and the occurrence of unpleasant taste and aroma in food products. The rate of the oxidation process depends

on many factors, e.g. the presence of pro-oxidants and antioxidants, the composition of fatty acids and storage conditions (such as e.g. access of light, access of oxygen, temperature) [Hęś and Korczak 2007, Krysztofiak and Bilska 2008, Flaczyk et al. 2009, Hać-Szymańczuk et al. 2011, Domiszewski et al. 2011 b].

Analytical results showed that immediately after the completion of massaging peroxide value in the analysed samples stored in the atmosphere of unlimited access of oxygen ranged from 0.113 to 0.150 milliequivalents of O₂/kg sample. It was observed that with the extension of storage time peroxide value was growing gradually, but the dynamics of this growth varied (Table 2).

significantly higher peroxide values in comparison to samples packaged in vacuum or samples coming from the heel of round muscle, irrespective of the method of storage. Sasaki et al. [2001] reported that a 10-day storage of beef steaks at 4°C does not influence changes in peroxide value. In a study by Konieczny et al. [2005] it was stated that peroxide value of cold stored beef was on average 0.090 mg O₂/kg fat and during storage it was gradually increasing, receiving on day 30 the value of 0.149 mg O₂/kg fat.

In vacuum packaged samples, irrespective of the applied brine, during the first 7 days after massaging no statistically significant changes were found in peroxide value. A statistically significant effect of brine and storage time on changes in peroxide value was

Table 2. Changes in value of peroxide number (milliequivalents O₂/kg of sample) in beef stored at 5°C (x ±s), N = 3

Time of storage days	Brine containing 1% NaCl				Brine containing 1% NaCl and 0.3% pentasodium triphosphate E 451i			
	T		P		T		P	
	L	R	L	R	L	R	L	R
1	0.13 ^{abc} ±0.03	0.15 ^{abcd} ±0.00	0.11 ^a ±0.02	0.13 ^{abc} ±0.03	0.11 ^{ab} ±0.02	0.13 ^{abc} ±0.03	0.11 ^a ±0.01	0.13 ^{abc} ±0.03
7	0.21 ^{cdefg} ±0.02	0.23 ^{defgh} ±0.03	0.11 ^{ab} ±0.01	0.18 ^{abcdef} ±0.03	0.16 ^{abcde} ±0.02	0.28 ^{ghi} ±0.11	0.11 ^{ab} ±0.05	0.15 ^{abcd} ±0.00
11	0.24 ^{defghi} ±0.02	0.25 ^{efghi} ±0.07	0.16 ^{abcde} ±0.02	0.20 ^{bcdefg} ±0.00	0.21 ^{cdefg} ±0.01	0.28 ^{ghi} ±0.11	0.21 ^{cdefg} ±0.02	0.16 ^{abcde} ±0.02
15	0.33 ^{ij} ±0.03	0.38 ^j ±0.01	0.26 ^{fghi} ±0.12	0.28 ^{ghi} ±0.03	0.31 ^{hij} ±0.01	0.40 ^j ±0.03	0.23 ^{defgh} ±0.06	0.22 ^{defgh} ±0.01

Explanations: L – heel of round, R – rump cut, T – sample stored in aerobic conditions, P – sample stored in vacuum conditions, x – mean value from three replicates, s – standard deviation, a-j – the same letter symbols indicate no significant differences according to Fisher's test (p = 0.05).

On the last day of the analyses the highest value of this parameter was found for rump cut in brine with 1% NaCl and 0.3% sodium tripolyphosphate. In that sample the highest, statistically significant, increase in peroxide value was recorded (from 0.125 to 0.400 milliequivalents of O₂/kg sample). Moreover, it was observed that samples coming from the rump cut muscle, stored in the atmosphere with unlimited access of oxygen, were characterised by slightly, but statistically

observed only at determinations performed between day 7 and day 15. The smallest increase was recorded in case of rump cut in brine B (from 0.125 to 0.220 milliequivalents O₂/kg sample). In turn, the greatest increase in the value of the analysed parameter was observed in heel of round in brine A (from 0.108 to 0.263 milliequivalents O₂/kg of sample).

Equations presenting the rate of changes in peroxide value in the tested samples are given below.

1. $y_{LAT} = 0.0136x + 0.1100$ $R^2 = 0.9680$
2. $y_{LAP} = 0.0107x + 0.0703$ $R^2 = 0.7705$
3. $y_{LBT} = 0.0134x + 0.0837$ $R^2 = 0.9152$
4. $y_{LBP} = 0.0101x + 0.0797$ $R^2 = 0.8379$
5. $y_{RAT} = 0.0150x + 0.1229$ $R^2 = 0.9114$
6. $y_{RAP} = 0.0102x + 0.1074$ $R^2 = 0.9432$
7. $y_{RBT} = 0.0181x + 0.1148$ $R^2 = 0.9240$
8. $y_{RBP} = 0.0063x + 0.1109$ $R^2 = 0.8774$

Legend: y – peroxide value, x – storage time, L – heel of round, R – rump cut, A – brine containing 1% NaCl, B – brine containing 1% NaCl and 0.3% sodium triphosphate E 451i, T – sample stored under aerobic conditions, P – sample stored in vacuum.

When analysing the obtained equations we may observe that vacuum storage, in comparison to storage in the atmosphere of unlimited access of oxygen, effectively delayed the increase in peroxide value in the analysed experimental samples. The greatest slowing down of the peroxide value increase was observed in case of rump cut with brine B.

In order to provide a more reliable interpretation the results of analyses were converted as a ratio of peroxide value at the analysed dates (N_t) to peroxide value immediately after the completion of the massaging process (N_0 ; $y = N_t/N_0$) and presented in Figure 1.

When analysing slopes of equations it may be stated that changes in peroxide values in samples from the heel of round muscle were influenced first of all by the method of storage (Fig. 1 a and 1 b). In contrast,

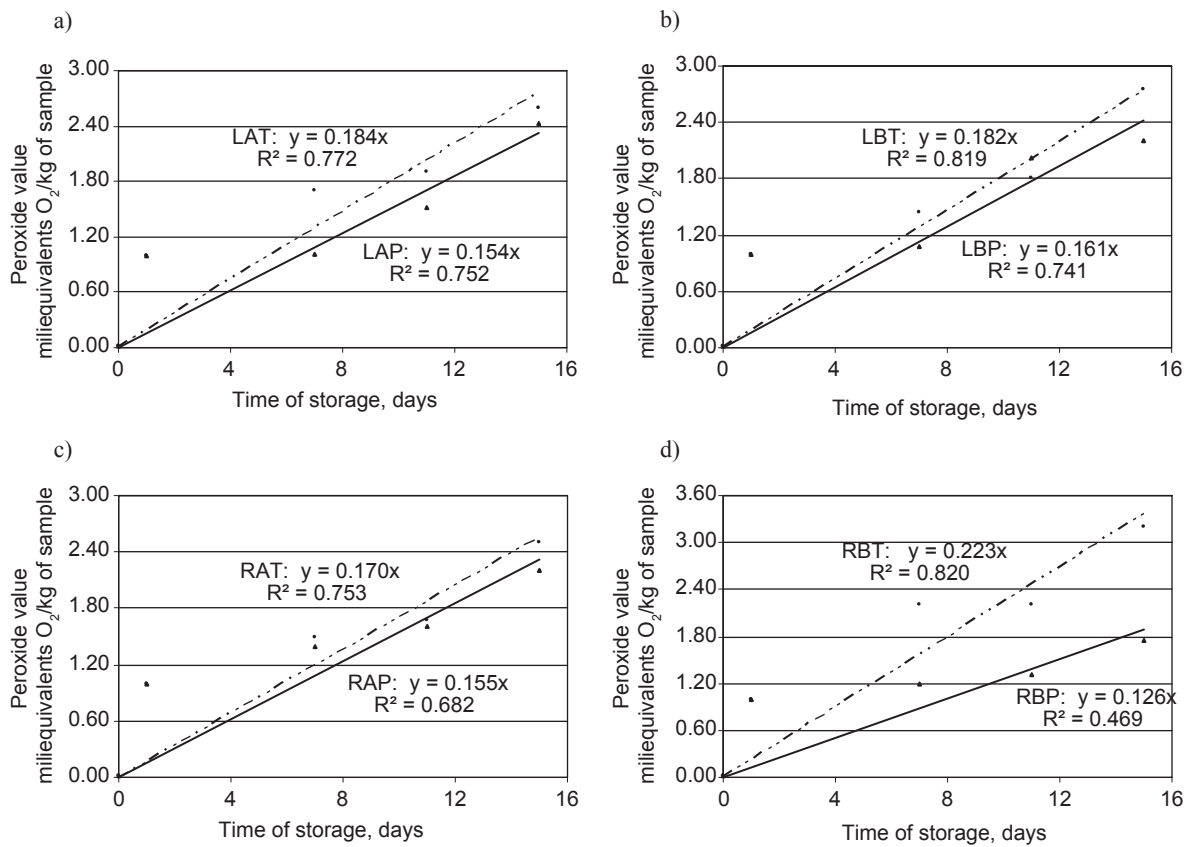


Fig. 1. The effect of storage time on changes in value of peroxide number (converted into relative values)

in rump cut, which contained 2.6 times more fat, apart from the method of storage, also the type of used brine had a statistically significant effect on changes in this parameter (Fig. 1 c and 1 d).

Changes in contents of secondary lipid decomposition products determined by the TBARS test

The TBARS test is a standard indicator test in the evaluation of undesirable oxidation changes occurring in fat. Malonic aldehyde detected with the use of this test is a secondary autooxidation product [Konieczny et al. 2005, Sun et al. 2001].

In the conducted analyses it was observed that the mean amount of malonic aldehyde in the tested samples ranged from 0.174 (for the RBP sample on the first day of analyses) to 1.584 mg malonic aldehyde/kg of sample (for sample of LBT on the last day of analyses). Similar TBARS values, depending on the method of meat preparation and the type of added salt, were reported in their studies by Konieczny et al. [2005].

When analysing changes in secondary lipid decomposition products with the use of the TBARS test (Table 3) a statistically highly significant increase was found in the amount of malonic aldehyde in samples stored in the atmosphere with unlimited access of oxygen. The greatest increase in the TBARS value was

recorded in samples coming from the heel of round muscle, irrespective of the applied brine. Immediately after the completion of massaging only rump cut in brine B was characterised by a statistically significantly lower value of this index in comparison to the other samples stored under aerobic conditions. Sasaki et al. [2001] in their study (on beef steaks) observed similar dependencies. They stated that the TBARS value for the analysed samples increased statistically significantly during the 10-day cold storage. Cheng and Ockerman [2003] observed that roast beef with no phosphates added was characterised by a statistically significantly higher value of the TBARS test in comparison to samples with a 0.4 and 0.5% addition of sodium polyphosphate. Ke et al. [2009] stated that an addition of citric acid inhibits lipid oxidation more effectively in boiled beef than sodium triphosphate.

In the heel of round (in brine A and B) stored in vacuum a statistically significant increase was observed in the TBARS values during the 15-day storage. However, the sample in brine B was characterised by a much slower increase in the content of secondary oxidation products (equations 13 and 14). In turn, rump cut in brine A and in brine B was characterised by a slow, statistically significant increase in the amount of malonic aldehyde during the 15-day storage under anaerobic conditions (equations 15 and 16).

Table 3. Changes in contents of secondary lipid decomposition products determined using the TBARS (mg malonic aldehyde/kg of sample) in beef stored at 5°C (x ±s), N = 3

Time of storage days	Brine containing 1% NaCl				Brine containing 1% NaCl and 0.3% pentasodium triphosphate E 451i			
	T		P		T		P	
	L	R	L	R	L	R	L	R
1	0.37 ^{efgh} ±0.04	0.36 ^{defgh} ±0.04	0.27 ^{abcdef} ±0.02	0.20 ^{abc} ±0.10	0.37 ^{fgh} ±0.01	0.28 ^{abcdef} ±0.00	0.22 ^{abc} ±0.03	0.17 ^a ±0.00
7	0.46 ^{hij} ±0.02	0.97 ^l ±0.01	0.32 ^{cdefg} ±0.01	0.25 ^{abcdef} ±0.07	1.03 ^{ll} ±0.12	0.54 ^j ±0.00	0.24 ^{abcde} ±0.11	0.19 ^{ab} ±0.11
11	1.58 ^o ±0.02	1.16 ^m ±0.02	0.41 ^{ghi} ±0.06	0.28 ^{abcdef} ±0.07	1.12 ^{lm} ±0.01	0.81 ^k ±0.01	0.25 ^{abcdef} ±0.01	0.24 ^{abcd} ±0.01
15	1.51 ^{no} ±0.02	1.41 ⁿ ±0.08	0.51 ^{ij} ±0.20	0.31 ^{bcdefg} ±0.01	1.58 ^o ±0.04	0.84 ^k ±0.00	0.31 ^{bcdefg} ±0.05	0.32 ^{bcdefg} ±0.01

Explanations – as in Table 2.

Jakobsen and Bertelsen [2000], when analysing fresh beef (the longissimus dorsi muscle) packaged in modified atmosphere, observed that lipid oxidation rate depends on the level of oxygen in the packaging and on the temperature of storage. Also Berruga et al. [2005] stated that vacuum packaging effectively inhibits lipid oxidation in lamb meat in comparison to modified atmosphere packaging (80% CO₂/20% O₂).

Conducted analyses showed that vacuum packaging of meat, in comparison to sample storage under conditions of unlimited access of oxygen, effectively slowed down the increase in secondary oxidation products determined by the TBARS test. The greatest effect of vacuum packaging was observed for heel of round in brine A. Equations of straight lines describing the rate of changes in secondary oxidation products (equations 9-16) are given below. In turn, Figure 2

presents changes in the amounts of malonic aldehyde in the tested samples during storage, converted into relative values (as N_i/N_0).

9. $y_{LAT} = 0.0969x + 0.1564$ $R^2 = 0.7723$
10. $y_{LAP} = 0.0169x + 0.2354$ $R^2 = 0.9402$
11. $y_{LBT} = 0.0821x + 0.3258$ $R^2 = 0.9593$
12. $y_{LBP} = 0.0056x + 0.2093$ $R^2 = 0.8243$
13. $y_{RAT} = 0.0738x + 0.3488$ $R^2 = 0.9723$
14. $y_{RAP} = 0.0073x + 0.1988$ $R^2 = 0.9951$
15. $y_{RBT} = 0.0425x + 0.2564$ $R^2 = 0.9419$
16. $y_{RBP} = 0.0100x + 0.1462$ $R^2 = 0.8656$

Legend: as in equations 1-8.

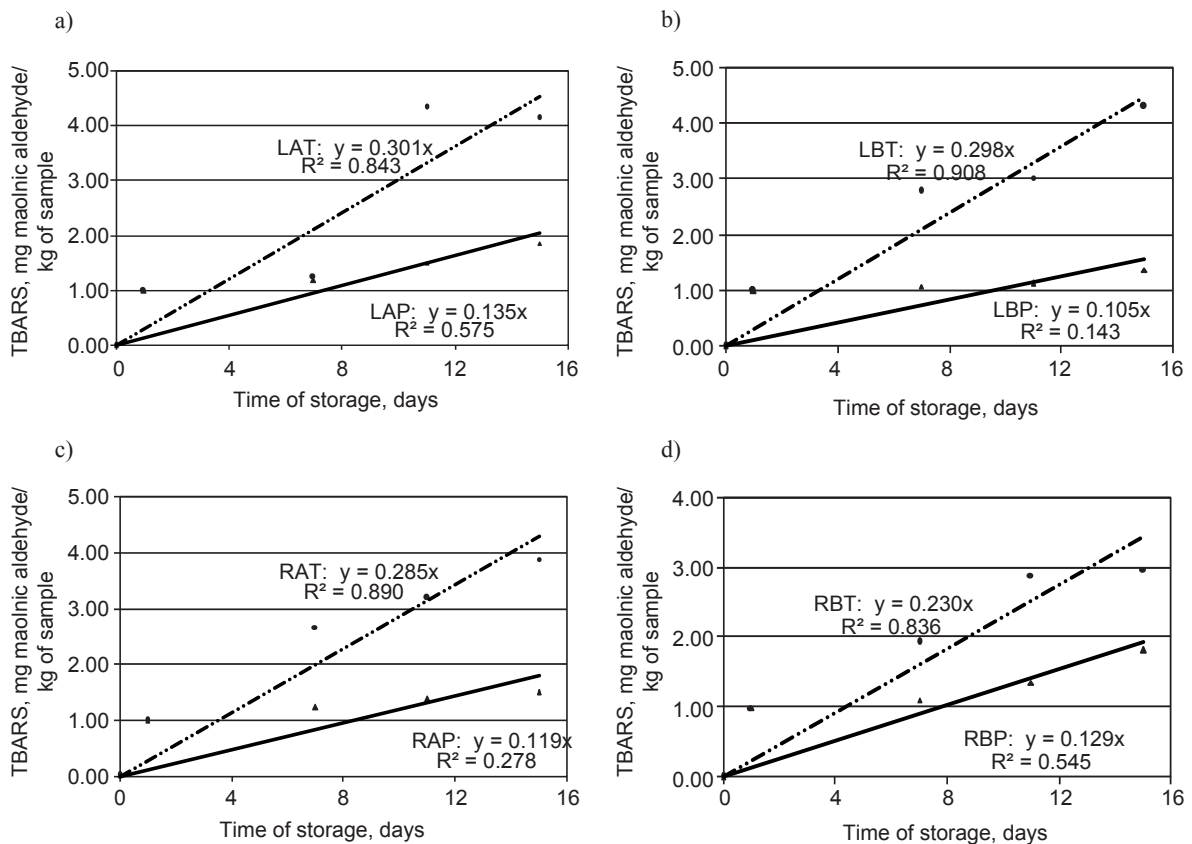


Fig. 2. The effect of storage time on changes in determined by the TBARS test (converted into relative values)

Table 4. pH value of beef stored at 5°C ($x \pm s$), N = 3

Time of storage days	Brine containing 1% NaCl				Brine containing 1% NaCl and 0.3% pentasodium triphosphate E 451i			
	T		P		T			
	L	R	L	R	L	R	L	R
1	5.97 ^{abcdef} ±0.01	5.92 ^{abcd} ±0.03	6.09 ^{abcdefghi} ±0.25	5.81 ^{ab} ±0.06	5.93 ^{abcd} ±0.00	5.93 ^{abcde} ±0.01	6.00 ^{abcdefgh} ±0.21	5.98 ^{abcdefg} ±0.23
3	6.04 ^{abcdefghi} ±0.00	5.97 ^{abcdef} ±0.00	6.34 ^{ghij} ±0.35	5.87 ^{abc} ±0.03	6.03 ^{abcdefgh} ±0.01	5.89 ^{abc} ±0.02	6.14 ^{bcdefghi} ±0.16	6.02 ^{abcdefgh} ±0.04
7	5.99 ^{abc} ±0.00	5.94 ^{abcde} ±0.03	6.16 ^{bcdefghi} ±0.53	5.77 ^{ab} ±0.23	6.06 ^{abcdefghi} ±0.01	5.97 ^{abcdef} ±0.01	6.07 ^{bcdefghi} ±0.19	5.91 ^{abcd} ±0.01
11	6.08 ^{abcdefghi} ±0.00	6.08 ^{abcdefghi} ±0.00	6.38 ^{hij} ±0.49	5.75 ^a ±0.33	6.15 ^{bcdefghi} ±0.01	5.99 ^{abcdefg} ±0.01	6.22 ^{cdefghi} ±0.33	5.83 ^{abc} ±0.03
15	6.79 ^k ±0.01	6.42 ^{ijk} ±0.00	6.36 ^{ghij} ±0.47	5.81 ^{ab} ±0.16	6.62 ^{jk} ±0.01	6.31 ^{efghij} ±0.06	6.29 ^{defghij} ±0.25	5.87 ^{abc} ±0.04

Explanations – as in Table 2.

The amount of malonic aldehyde in the tested samples depended first of all on the method of storage. However, when comparing slopes of equations it may be observed that also the type of the applied brine had a significant effect on changes in this parameter, e.g. for samples coming from the heel of round muscle stored under anaerobic conditions it amounted to 0.1359 for the sample in brine A and 0.1054 for the sample in brine B.

Changes in pH values

Table 4 presents results of measurements for pH values. It was found that samples stored at free access of oxygen directly after the completion of massaging had similar pH values (5.92-5.97 units). Storage of these samples resulted in a statistically significant increase in pH. The highest statistically significant increase in pH values (to 6.79 units) during the 15-day storage was recorded in the heel of round in brine A. However, the smallest, but statistically significant increase in pH values was observed in rump cut with an addition of 1% NaCl and 0.3% sodium triphosphate E 451i (sample RBT). Cheng and Ockerman [2003] in their studies observed that the pH value increased statistically significantly in roast beef with an addition of sodium triphosphate at 0.25-0.50% and applied

massaging. In turn, a 7-day storage of beef subjected to thermal pretreatment, irrespective of the amount of added sodium triphosphate, did not influence changes in this parameter.

In the vacuum-stored heel of round in brines A and B a slight, statistically non-significant increase in pH value was found during 15-day storage. In contrast, in rump cut, irrespective of the used brine, storage time did not have an effect on changes in pH values.

CONCLUSIONS

1. Vacuum packaging delayed an increase in peroxide value and effectively slowed down an increase in contents of secondary lipid oxidation products.

2. Statistically significant changes in pH were observed in the heel of round, stored under aerobic conditions, irrespective of the used brine.

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WPŁYW DODATKU CHLORKU SODU I TRÓJFOSFORANU SODU NA PRODUKTY UTLENIANIA TŁUSZCZU W MIĘSIE WOŁOWYM PRZECHOWYWANYM W WARUNKACH CHŁODNICZYCH

STRESZCZENIE

Wstęp. Mięso i przetwory mięsne – zależnie od gatunku zwierzęcia i elementów, z których zostały pozyskane – wykazują zróżnicowaną zawartość tłuszczu (najczęściej od 10% do 80% suchej masy). Tłuszcze są stosunkowo nietrwałymi składnikami żywności. Znaczący wpływ na przebieg oksydacji lipidów ma temperatura i tlen. Celem pracy było sprawdzenie wpływu dodatku modelowej solanki na szybkość utleniania

lipidów w mięśni najdłuższym lędźwi – rostbef (*longissimus dorsi*) oraz mięśni półbłoniastym – ligawa (*semimembranosus dorsi*) przechowywanych w warunkach tlenowych i w próżni w temperaturze 5°C.

Materiał i metody. Materiałem do badań było mięso wołowe: rostbef (R) i ligawa (L). Mięso peklowano (w ilości 20% w stosunku do masy surowca) solanką A, zawierającą 1% NaCl w masie całkowitej oraz solanką B, zawierającą 1% NaCl i 0,3% trójfosforanu pięciosodowego E 451i (w tym 56% P₂O₅). Mięso po masowaniu przechowywano w warunkach tlenowych (T) i w próżni (P) w temperaturze 5°C przez 15 dni. W czasie przechowywania prób oznaczano zmiany: liczby nadtlenkowej (LN), wtórnych produktów rozkładu tłuszczów testem TBARS oraz zmiany wartości pH.

Wyniki. Zauważono, że w miarę wydłużania czasu przechowywania prób rosła stopniowo wartość liczby nadtlenkowej, ale dynamika tego wzrostu była różna. Próby pochodzące z mięśnia rostbef, przechowywane w atmosferze nieograniczonego dostępu tlenu, charakteryzowały się nieznacznie, ale statystycznie istotnie, większymi wartościami liczby nadtlenkowej w porównaniu z pozostałymi badanymi próbkami. Największy wzrost wartości testu TBARS zauważono w próbach przechowywanych w warunkach tlenowych i pochodzących z mięśnia ligawa, niezależnie od zastosowanej solanki. Przeprowadzone badania wykazały, że pakowanie próżniowe mięsa – w porównaniu z przechowywaniem prób w warunkach nieograniczonego dostępu tlenu – skutecznie spowalniało wzrost wtórnych produktów utleniania oznaczanych testem TBARS. Największy wpływ pakowania próżniowego zaobserwowano dla ligawy w solance A.

Wnioski. Pakowanie próżniowe – w porównaniu z przechowywaniem prób doświadczalnych w warunkach tlenowych – opóźniało wzrost wartości liczby nadtlenkowej oraz skutecznie spowalniało wzrost wtórnych produktów utleniania tłuszczu. Statystycznie istotne zmiany wartości pH zaobserwowano w ligawie, niezależnie od zastosowanej solanki, przechowywanej w warunkach tlenowych.

Słowa kluczowe: mięso wołowe, pakowanie próżniowe, liczba nadtlenkowa, TBARS

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