CHANGES OF POULTRY VOLATILE COMPOUNDS AND MICROBIOLOGICAL CHARACTERISTICS DURING STORAGE

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Background

The concentration of volatile aroma components in meat is very small. However, the odour of some volatile substances is very strong and specific. Therefore, even the smallest change in their concentration, ratio and/or structure can result in serious changes of the sensory characteristics. Most of the substances responsible for taste and aroma are reactive and sensitive to chemical changes compounds, e. g. they easily oxidise and are thermally unstable. The major components of meat aroma are sulphur and nitrogen containing compounds, carbonyls being also important. The precursors of volatile compounds are formed during various processes taking place during meat storage and processing. For instance, amino acids and their amides accumulate during meat autolysis, free fatty acids are released during enzymatic lipid degradation. Microbiological processes also are of great importance. Meat off-flavours can be produced during these processes as well, therefore the changes in the concentration and composition of volatile compounds can provide important information on meat spoilage processes [1].

Objective

The objective of the present study was to determine the changes of free volatile acids (FVA), tiobarbituric acid (TBA) reactive substances and microbiological characteristics of poultry breasts (fresh and stored for 3, 6, 9, and 12 months at -18°C) during their storage at +4°C temperature.

Methods

FVA were extracted from the meat with water, steam-distilled and determined by the titration with 0.1 M potassium hydroxide [2]. Oxidation of meat lipids was assessed my measuring TBA value. TBA reactive species were distilled from the samples and after the reaction the amount of red-coloured complex was determined spectrophotometrically [2, 3]. Microbiological tests were performed by the standard methods: TVC by LST ISO 4833 [4], coliforming bacteria by LST ISO 4832 [5], salmonella by LST 1432 [6].

Results and discussion

The changes of FVA (in mg of 0.1 M KOH/25 g) in fresh meat during 7 days of storage were insignificant (Fig. 1); only after 9 days of storage its value exceeded 3. It is proposed [2], that the amount of FVA in the fresh meat should not exceed 4; when it increases to 4-9 the meat is considered of doubtful freshness; the value higher than 9 indicates that the meat is not fresh. However, in our study sensory characteristics (off-flavour, sticky surface) of the 7 days stored meat indicated that it was of a doubtful freshness, although FVA value was less than 2. Similar changes of FVA where determined in the meat which was stored at -18°C for 3 and 6 months prior to the thawing to +4 °C and consequent analysis at the timed periods.

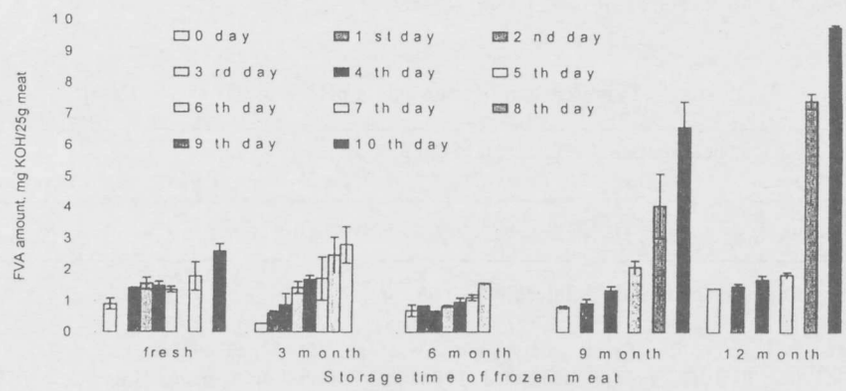

Fig. 1. Changes of the FVA amount in meat during storage at +4°C: fresh and defrosted samples after 3, 6, 9 and 12 months of storage at -18°C (n=3)

Therefore, it was decided to prolong storage experiments to 8 and 10 days with meat samples, which were freeze-stored for 9 and 12 months. It was found that the amount of FVA starts to increase intensively exactly after 8 days of storage at +4°C. Some effect of storage at -18°C can also be noticed. The amount of FVA in the fresh meat after 9 days of storage was lower than that in freeze-stored meat (9 and 12 months) after 8 days of storage. Most likely, during prolonged storage some FVA precursors are formed in the freezed meat.

The changes of TBA-value during storage were more complex when compared with FVA. TBA-value of the fresh meat practically did not change during the first three days of storage (Fig. 2); intensive increase of this characteristic was determined

after fifth day. TBA-value in 9 days stored meat was 6-8 times higher, than that in the fresh one. The changes of TBA-value during storage of defrosted meat samples were also not considerable during the first four days of storage, although slight reduction can be seen after 3 days. The amount of TBA-reactive compounds begins steadily increase after 4-5 days of storage. The pattern of TBA-value changes in the meat analysed after 12 months of storage, was different; it started intensively grow after thawing. For instance, TBA-value after 4 days of storage in defrosted meat (12 months) was higher than that in the fresh meat after 9 days.

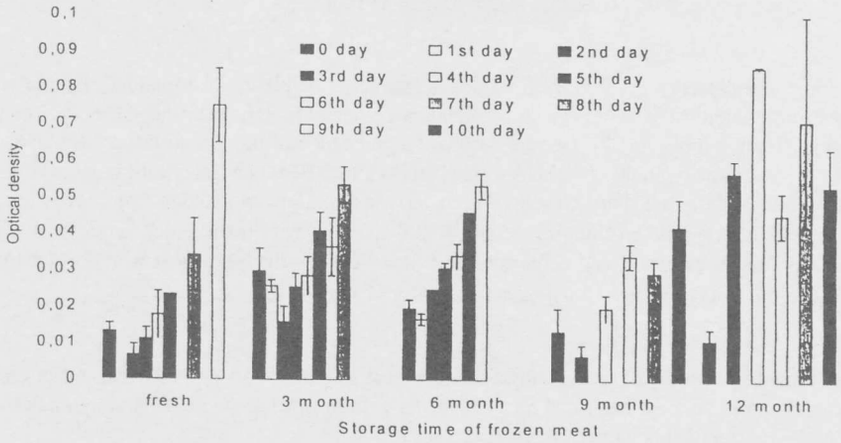

Fig. 2. Changes of the meat TBA-value during storage at +4°C: fresh and defrosted samples after 3, 6, 9 and 12 months of storage at -18°C (n=3)

Regulations establish 4 days shelf life for minced poultry. Therefore, fresh meat was stored 4 days at +4°C for microbiological contamination tests. During this period TVC did not exceed the limits established by the Lithuanian Hygienic Regulation HN 26:1998 (10^6/g), while the count of coliforming bacteria was close or even slightly higher (5×10^2/g) (Table 1). Salmonella were not found in any of the tested samples. Defrosted meat was stored up to 10 days.

In general, the TVC in the defrosted samples exceeded the limit after 6-7 days of storage except for 9 and 12 months freeze-stored meat; TVC was 3.00 and 1.4×10^6, respectively, after 4 days of storage. The count of coliforming bacteria was higher almost in the all defrosted samples and considerably increased during storage. However, it is interesting to note that the count of coliforming bacteria in 12 month stored meat after thawing was quite stable (from 1 to 7.8×10^3) during the all period.

Table 1. Microbiological tests results

Storage time, days	Fresh		Freeze-stored 3 months		Freeze-stored 6 months		Freeze-stored 9 months		Freeze-stored 12 months	
	1	2	1	2	1	2	1	2	1	2
0	1.3×10^5	8.4×10^3	-	-	2.6×10^5	3.0×10^3	1.10×10^5	6.00×10^2	1.90×10^5	1.00×10^3
1	8.3×10^4	6.0×10^3	3.0×10^5	6.0×10^3	1.9×10^4	1.0×10^3	-	-	-	-
2	1.8×10^4	5.7×10^3	1.1×10^5	7.4×10^3	2.1×10^5	1.0×10^3	6.50×10^5	5.70×10^3	9.30×10^5	1.50×10^3
3	7.7×10^4	4.6×10^3	1.3×10^5	2.0×10^3	2.0×10^5	4.7×10^3	-	-	-	-
4	8.6×10^4	6.9×10^3	3.0×10^5	5.6×10^3	6.0×10^5	6.3×10^3	3.00×10^6	6.00×10^4	1.40×10^6	7.80×10^3
5	-	-	2.1×10^5	2.6×10^3	2.7×10^7	6.4×10^3	-	-	-	-
6	-	-	1.9×10^5	1.5×10^3	1.1×10^7	7.8×10^3	$>3.00\times10^6$	1.10×10^6	1.00×10^6	1.60×10^3
7	-	-	1.8×10^5	7.0×10^4	-	-	-	-	-	-
8	-	-	-	-	-	-	$>3.00\times10^6$	$>1.50\times10^6$	1.90×10^8	1.40×10^3
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	$>3.00\times10^6$	$>1.50\times10^6$	2.60×10^8	1.60×10^3

1 – TVC in 1g of the sample; 2 – Coliforming bacteria in 1g of the sample

Conclusions

The amount of FVA and TBA-value of poultry meat stored at +4°C was quite stable during the first days of storage; intensive increase of these characteristics begins after 4-5 days of storage. TBA-value increased more rapidly in the 12 months freeze-stored meat indicating the changes of the samples during freeze-storage. The intensive increase in TVC and coliforming bacteria was observed after 4-5 days of storage, however the count of coliforming bacteria in defrosted 12-month stored meat did not change during 10 days of storage.

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