About the redox potential of meat cans

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Abstract – **Currently, the redox potential value (Eh) as an indicator of canned food quality is used in a limited number of scientific publications, while Eh measurement have not yet become usual practice of research.**

The purpose of this research was to determine the dynamics of Eh value in meat and canned meat products after heat treatment and during storage.

The assessment of Eh values of used raw meat material was conducted depending on its thermal state. It was established that Eh values of chilled lamb meat was 1.5 times lower than the redox potential values of pork and beef. It was shown that freezing and subsequent thawing of raw meat leads to decrease in redox potential of meat by 18-35% depending on its type.

Comparative analysis of Eh value dynamics in canned products made from thawed raw materials showed a general tendency for decrease in values of this indicator compared to canned products made from chilled meat. For canned pork Eh value decreased by 29%, for canned beef - by 9.5% and for canned lamb meat - by 20.6%, respectively. Analysis of the effect of sterilization conditions on the redox potential showed that more severe conditions of sterilization lead to lower redox potential value of the final product.

Study of Eh value dynamics of canned meat in pieces during storage showed the presence of three periods characterized by different degree of redox potential decrease and transformation of protein and fat.

Keywords – **meat, canned food products, redox potential**

I. INTRODUCTION

To predict the behaviour of raw meat during processing a set of indicators objectively reflecting its quality is used. It is known that the value of the redox potential is the measure of microorganism capacity for survival, growth and catabolism and may indicate degradation processes in food products during storage. Thus, it is an indicator of the stability of meat products during storage. Currently, some data are gathered on the dynamics of this indicator in relation to the storage of chilled meat, cooked and smoked sausages [1-2]. It should be noted that these products generally tend to have contact with oxygen from air, which is originally contaminated with vegetative forms of microorganisms. Water activity plays an important role in description of microbiological processes during storage of food products. As for canned foods, in this case we are dealing with a closed system containing no vegetative forms of microorganisms after sterilization. This fact indicates that water activity is not significant. There is also no inflow of oxygen into the product. For such systems, redox potential value could be an indicator determining the intensity of biochemical transformations in the product during production and storage.

Currently, the redox potential value (Eh) as an indicator of canned food quality is used in a limited number of scientific publications, while Eh measurement have not yet become usual practice of research.

The purpose of this work was to study the dynamics of Eh depending on raw meat type, its thermal state, sterilization conditions and storage time of canned meat products.

II. MATERIALS AND METHODS

The targets of this research was raw meat (pork, beef, lamb) derived from one corresponding carcass in chilled and thawed form, as well as canned meat in pieces produced from these raw meat materials.

Measurements of Eh values were performed using the Five Easy FE20 instrument (Mettler Toledo, Switzerland)

III. RESULTS AND DISCUSSION

The results of Eh measurement in used raw meat material depending on its thermal state are shown in Table 1.

Table 1 Eh values in meat depending on its thermal state, mV

Meat type	Thermal state	
	chilled	thawed
Beef	60	49
Pork	63	49
Lamb	43	28

As can be seen from Table 1, the average redox potential values in meat regardless its thermal state are in close range. At the same time, Eh values of chilled and thawed lamb are, respectively, 1.4-1.5 and 1.8 times lower than the corresponding values of pork and beef. It was established that freezing and subsequent thawing of raw meat lead to decrease in redox potential values in pork by 22%, in beef - by 18% and in lamb - by 35%.

Table 2 shows the values of Eh in canned products made from chilled and thawed raw meat material.

Table 2 Eh values in canned meat products depending on thermal state of raw materials, mV

Canned meat type	Thermal state	
	chilled	thawed
Braised beef	52	47
Braised pork	45	32
Braised lamb	34	27

Data in Table 2 show a general tendency to reduce the level of Eh value in canned products from thawed meat compared to products made from chilled raw materials. This decrease for canned products from pork, beef and lamb was 28.9%, 9.6% and 20.6%, respectively.

Tracing the dynamics for the redox potential values of different types of meat depending on the type of technological treatment, it should be noted that the greatest decrease in Eh values for beef and pork (23.3-28.6%) occurred during sterilization, and for lamb meat - during freezing and thawing of raw material while the value of Eh decreased by 34.9%.

The study of the effect of sterilization conditions on Eh values in canned foods is of particular interest. The study was conducted by the example of canned beef in pieces produced using the sterilization conditions ensuring the values of achieved sterilizing effect equal to 10-11 (mode 1), 13-14 (mode 2) and 17-18 (mode 3) standard minutes, respectively.

During the use of sterilization mode 1, 2 and 3, the redox potential value of canned products decreased by 8.9%, 13.6% and 17.2%, respectively, compared to corresponding Eh values of meat prior to thermal treatment. Thus, more severe conditions of sterilization lead to lower redox potential value of the final product.

Fig. 1 shows the dynamics for Eh value of canned products during storage at 37 °C in accordance with the method of quick determination of canned products shelf life.

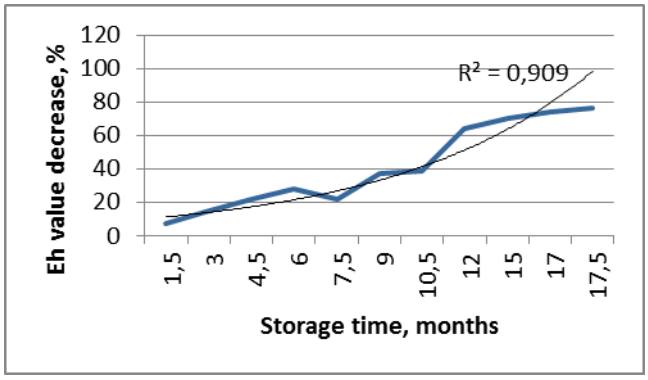

Fig. 1 Eh value dynamics in canned products during storage

Fig. 1 shows steady and gradual decrease of Eh value up to 10.5 months of canned meat storage. Further increase in storage time resulted in a dramatic decrease in redox potential values indicating intense transformation in protein and fat components of canned meat accompanied by the increase in values of the amino-ammonia nitrogen (AAN) content and peroxide numbers (PN) of fat. The results are shown in Fig. 2.

As follows from the data in Fig. 2, three periods could be distinguished during storage of canned food products. By the end of the first period, there was a slight accumulation of amino-ammonia nitrogen indicating moderate destructive changes in protein of

canned products. By the end of this period, there was no fat oxidation, as evidenced by the absence of peroxide numbers.

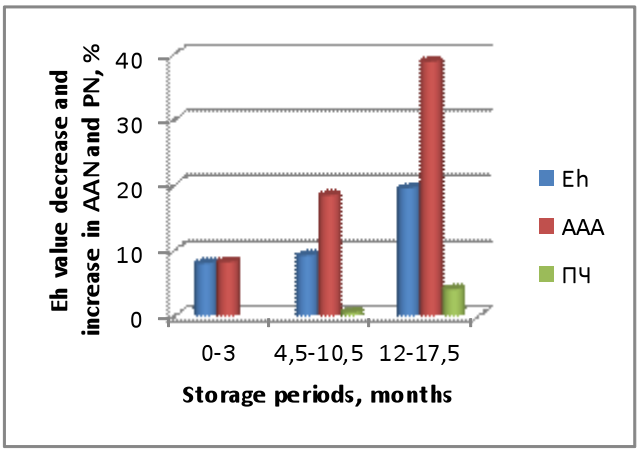

Fig. 2 Dynamics for values of redox potential, amino-ammonia nitrogen (AAN) content and peroxide numbers (PN) of fat in canned products during storage

These results indicate that by the end of the second storage period (10.5 months), regulated quality indicators did not exceed the critical values determined by establishment of guaranteed shelf life of the products. Thus, the content of amino-ammonia nitrogen was 83 mg% and peroxide number was not more than 6 mmol of active O_2/kg. Accumulation of peroxides by the end of the second storage period indicated oxidative degradation of fat activated by the free radicals formed during the transformation processes.

The third storage period was accompanied by significant decrease in redox potential values and by intense destructive processes in proteins and fats of canned products.

IV. CONCLUSION

Thus, these results strongly suggest that redox potential (Eh) is a measure of canned meat quality, while its value depends on the type and conditions of technological processing, and could be used as an indicator for establishment of guaranteed shelf life of the products.

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