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INFLUENCE OF VEGETABLE OIL OBTAINED FROM ASTRAKHAN PLANTS ON THE FERMENTATION OF ANCHOVIES FROM THE CASPIAN SEA[1]

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ВЛИЯНИЕ РАСТИТЕЛЬНЫХ МАСЕЛ, СОДЕРЖАЩИХСЯ В АСТРАХАНСКИХ РАСТЕНИЯХ, НА ФЕРМЕНТАЦИЮ КИЛЬКИ КАСПИЙСКОГО МОРЯ

Model tests have been done in order to appreciate the capacity of some vegetable oil to diffuse in water and in the solution obtained by mixing fermented mince Caspian Sea anchovy with water. The mixture is in the proportion of 1:1. Minced fish without viscera is marked FMWV and with viscera is marked FMwV. The influence of vegetables on the enzymatic system of the fish muscles was determined by measuring pH, the refractive index and the conductivity.

Key words: Caspian Sea anchovy, fermented mince fish, plants, pH, refractive index, conductivity.

Проведены модельные испытания, чтобы оценить способность экстрактивных веществ растений диффундировать в воду и в раствор, полученный путем смешения фарша каспийской кильки с водой. Смесь находится в пропорции 1 : 1. Фарши рыбы без внутренностей были обозначены FMWV, с внутренностями – FMwV. Влияние растений на ферментную систему мышцы рыб определяли путем измерения pH, показателя преломления и проводимости.

Ключевые слова: каспийская килька, фарш рыбы, растения, pH, показатель преломления, проводимость.

Introduction

Plants have important complex substances that block radical process and have influence on microorganisms [1–3].

The best food preservatives must possess a strong bactericidal effect, rapid action to lower concentration that inhibits the more resistant microorganisms in record time. But at the same time, they need to be harmless to humans and to be removed easily from the product before its ingestion [4].

Antioxidants extracted from vegetable plants are sufficiently active and not harmful to humans. And when they are ingested together with the food, they improve the stability of its defense system against adverse factors of the immediate environment [5, 6] of the individual. Therefore the particularity of the use of plant leaves must depend on their accessibility.

Recent years, researchers are interested more and more in the use of the plant leaves as an antioxidant in the production of protein hydrolyse [5].

Considering photosynthetic productivity of plants, and the possibility to harvest several times per season, the use of plants was suggested as an industrial raw material for pharmaceutical and food industry [1]. The process of fermentation of the minced Caspian Sea anchovy had been studied by [7, 8]. They assessed the variation of the quantity of products from proteolysis. But it had been proved that during the process of fermentation, not only proteolysis takes place but other processes of fermentation catalyzed by the oxydoreductase, the transferase, the hydrolase, the lipase, the isomerase, ligase, etc. also take place. In addition to this, the hydrolase catalyzes not only protein, but also complex carbohydrate and complex lipid into simple bindings [9].

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But research of proteolysis products by the usual methods can be tedious and time-consuming.

That is why a task was set to find a system of methods to fully characterize the fermentation process, not only the proteolysis and to become at the same time an express method of appreciation the fermentation. For the assessment of fermentation it was resolved to define the refractive index (n) of solution formed during fermentation; pH and conductivity in milliSiemens/cm (mS/cm) of the mince subjected to fermentation.

This study was designed to measure the degree of diffusion of plants substances of estragon, black elder, apricot and *ounabi*, cultivated in the Astrakhan region for the improvement of the mince Caspian Sea anchovy fermentation.

Materials and methods

Area of the study

Astrakhan region is in Russia, located above the Caspian Sea. Its capital is Astrakhan. The Largest and Longest River in Europe, the Volga, passes through it and empties into the sea. The population of Astrakhan mainly engages in fishing and trade with neighbouring countries such as Kazakhstan, Azerbaijan, Georgia, Armenia and Iran. Fishermen practice mainly fishing of sturgeons which serves as a source of foreign currency. But the anchovies are small fish caught in large quantities to improve the sources of proteins for the inhabitants. It was also observed that plants account for a larger part of the feeding ration of the inhabitants of Astrakhan. And we know that plants are full of essential substances useful to human life.

Raw materials and methods

Anchovies from the Caspian Sea were used. Anchovies are of small fishes of length from 15–20 cm of the engraulideae family. Relative to the whole fish the minced fish is often the seat of more intense diffusion processes.

The minced fish was prepared from anchovy fillet and mixed with the viscera of same anchovy fillet. This minced fish was obtained after pounding fish muscle in laboratory mortar. Leaves of dried estragon, black elder, apricot and *ounabi* were sprayed and added to the anchovy mince.

Therefore, the conductivity of the fermented mince was measured with the apparatus CONMET-2, the refractive index – with refractometer IRF-454 and hydrogen potential – with the apparatus ANION-410 K. The kinetic variation of the indices of the mince containing different herbal substances was established (in a ratio of 1 : 1).

Results of the research and discussions

Fig. 1, *a* shows pH curves trend after adding leaves to distilled water. It was noticed that leaves of estragon, *ounabi* and black elder secrete important quantity of protons in the first four hours. The trends of curves are virtually the same. From Apricot leaves the same quantity of proton is extracted in 5.5 hours. Then, there is predominance of the alkalinity that gives rise to the pH of the solution to 7.0 in 8 hours.

In minced anchovy without viscera (FMWV) (fig. 1, *b*), reduction of the pH is observed in the solution of mince without herbal substances in 5 hours to 3.5. The same pH value was attained within 4 hours after the addition of estragon and black elder leaves, same as with water. It is likely that the extracted substances from leaves block the hydrolysis process in the minced anchovy. Under the action of substances contained in the *ounabi*, a sudden decrease in the pH from 5.5 to 3.5 was observed compared to the system made up of water. Substances from Apricot leaves also reduced the pH of 5.5 to 4.0. Then under the influence of substances of *ounabi* and Apricot leaves, there is a slight increase in the pH in 4 hours. Fermentation of anchovy mince by muscle enzymes containing added plant substances gives increase in the pH up to 8.5 under the influence of *ounabi*, and under the influence of estragon and black elder up to 6.5 pH. The rise of pH is observed during 1.5 hours and later proton predominates again in the solution, and pH reaches 4.5. This phenomenon demonstrates that herbal substances during 8 hours can protect the mince against putrefying effect of microorganisms. Indeed, substances containing free acid groups are formed in the mixture of the fermentation substances of the mince and the leaves. The kinetic variation of pH in the presence of leaves of Apricot shows that the quantity of protons remains at the same level (4–5) for 8 hours.

In the presence of enzymes of the viscera of anchovy (FMwV) (fig. 1, *c*), Apricot leaves substances form a buffer for 8 hours (pH = 4.5÷5.1).

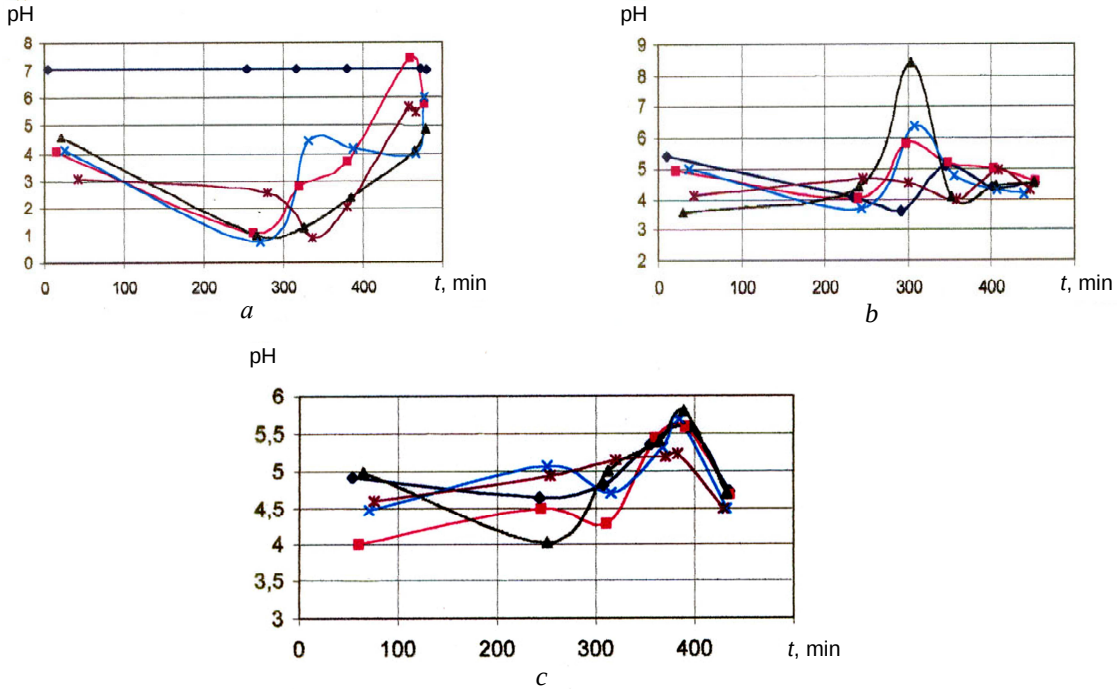

Fig. 1. Kinetic of hydrogen potential of water (*a*), of eviscerated anchovy mince of the Caspian Sea (*b*) of non-eviscerated anchovy mince of the Caspian Sea (*c*), mixed with various plants

It was noted that enzymes of the viscera of anchovy maintain pH of the mince to a higher level than with the action of muscle enzymes (4.8÷5.6 and 3.5÷5.4 respectively).

The refractive index variation (fig. 2) shows that the leaves secrete macromolecular substances after 5 hours of maceration (fig. 2, *a*) and their molecular mass is less than when they were introduced to FMWV (fig. 2, *b*), especially after their introduction to FMwV (fig. 2, *c*). It was noted that the maximum refractive index was equal to 1.337; 1.344; 1.346 respectively.

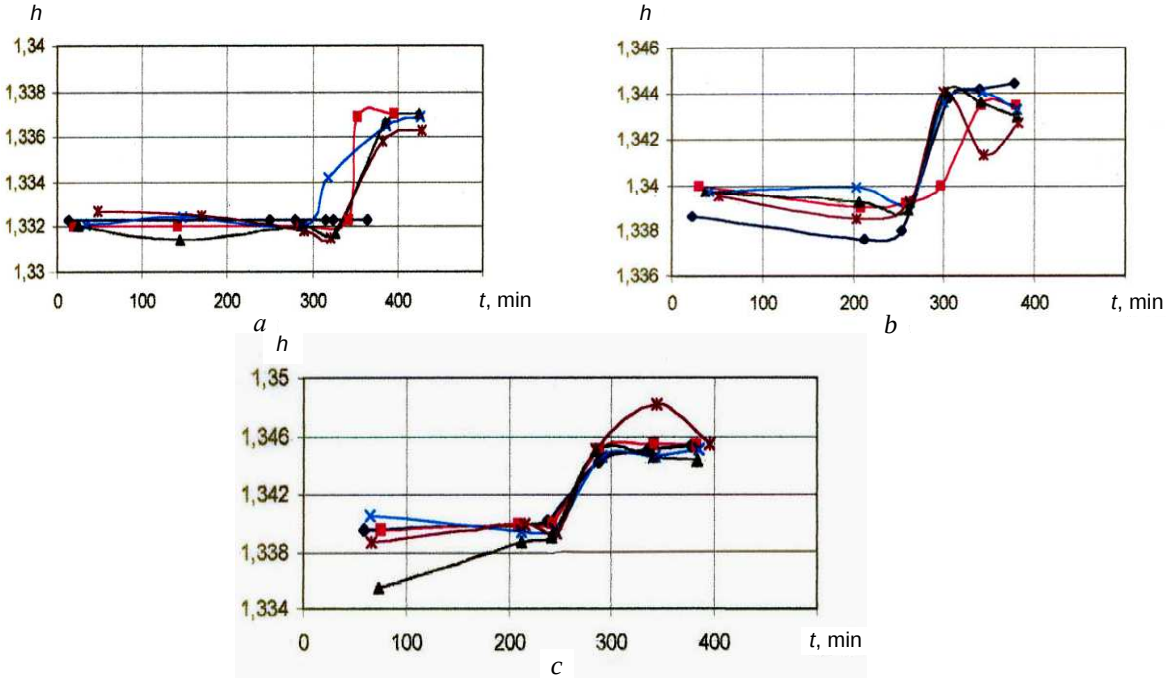

Fig. 2. Kinetic of refractive index of water (*a*) of eviscerated anchovy mince of the Caspian Sea (*b*), of non-eviscerated anchovy mince of the Caspian Sea (*c*), mixed with various plants

Thus, the use of the leaves promotes either a buffer system during the fermentation of the anchovy mince or the change of the pH. This promotes their use for the regulation of pH during the fermentation and for the application of the "barrier technology".

During the fermentation process, not only hydrolysis takes place but also intense grouping of some particles after 4 hours.

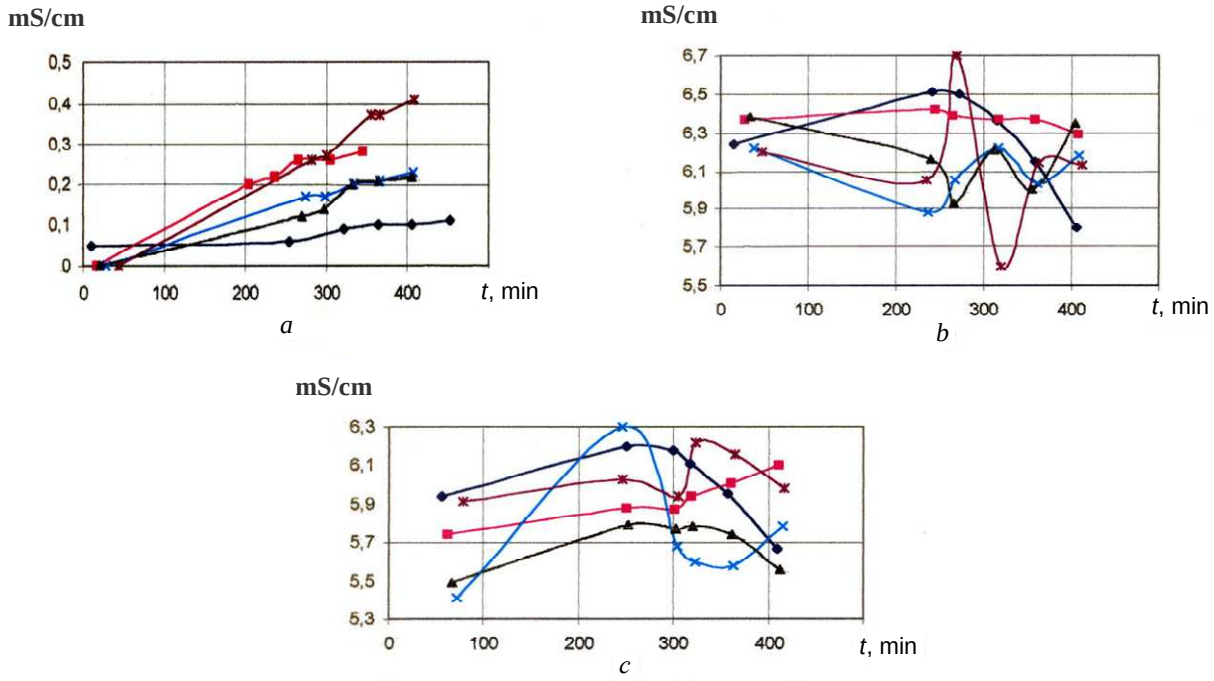

Fig. 3. Kinetic of conductivity of water (*a*) of eviscerated anchovy mince of the Caspian Sea (*b*), of non-eviscerated anchovy mince of the Caspian Sea (*c*), mixed with various plants

The conductivity of the water increases with time after adding leaves (fig. 3, *a*), and intensively produces ionized substances due to the addition of apricot leaves. With FMWV (fig. 3, b) without vegetable substances, particles that are ionized during 4 hours appear, and then they are grouped during the following four hours. The addition of estragon leaves promotes such a grouping of fermentation products in which functional groups remain constant for 8 hours.

The constancy of the conductivity variation of FMwV (fig. 3, *c*) differs from the one of FMWV by the quantity of particles ionized and grouped. The trend of the curves remains the same. The estragon allows more grouping of substances because of functional groups.

Conclusion

This survey shows that to appreciate the fermentation process by an express way, under the influence of various factors, the refractive index and the conductivity can be used simultaneously.

Also, the use of the leaves had promoted either the formation of buffer system during the fermentation of the anchovy mince, or the pH variation, and enables their use for the regulation of the pH during the fermentation and for the promotion of the barrier technology.

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