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Rapid assessment of canned fish quality via fast protein and metabolite liquid chromatography

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INTRODUCTION & AIM

The consumption of canned fish as an affordable food product with high nutritional value suitable for long-term-storage is steadily growing in many parts of the world. An important and often overlooked factor that influences canned fish quality is the freshness of the raw materials used in the production process.

It was shown before that the freshness of raw fish [1] and ready-to-eat fish products [2] can be rapidly and reliably assessed by the fast proteins and metabolite liquid chromatography (FPMLC) technique and very simple and affordable equipment.

The aim of our study is to evaluate the applicability of fast protein and metabolite liquid chromatography FPMLC for quality control of canned fish treated with high-temperature sterilization.

Keywords
fast protein and metabolite liquid chromatography; canned fish quality; nuclear magnetic resonance; fast protein liquid chromatography; fish freshness

METHOD

The testing method is based on FPMLC implemented in an optical chemical sensor with the PD-10 gel column for separation of proteins and ATP metabolites contained in fish muscle tissue and UV LED photometric detection in the wavelength range of 255-265 nm near the characteristic absorption peak of ATP.

Determining the degree of freshness is based on the relative content of ATP breakdown products: the longer the fish is stored before canning, the lower the content of ATP, ADP, IMP and the higher the content of hypoxanthine and inosine. On FPMLC chromatograms it is manifested as a shift of the peak responsible for ATP metabolites to the right relative to the protein peak. During sterilization enzymes are deactivated and the content of ATP related substances is fixated.

Fifteen samples of various canned fish from different manufacturers were acquired from local supermarkets for this research. For the verification of the FPMLC four samples chosen as the most representative were analyzed by HPLC and NMR spectroscopy.

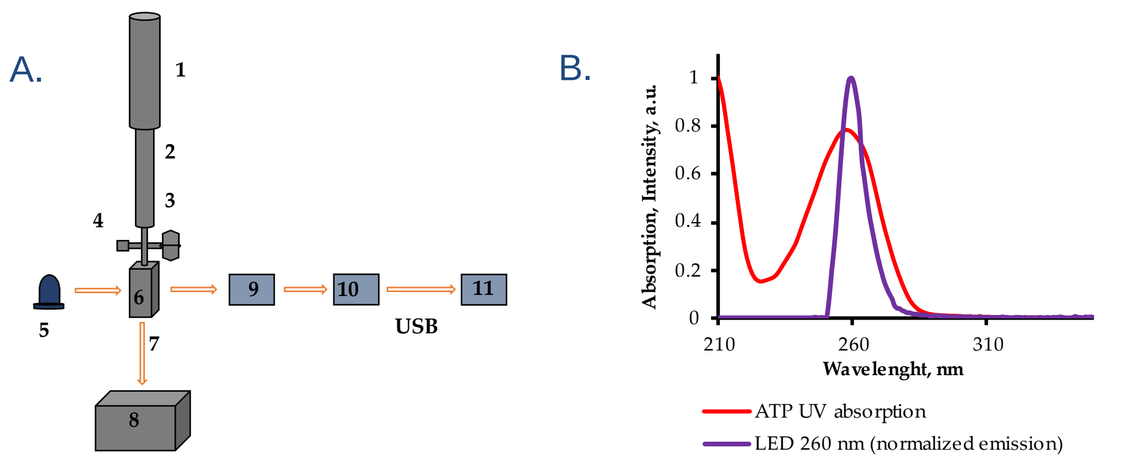

Figure 1. A) The scheme of the optical sensor: 1–LabMate buffer reservoir; 2–PD-10 column; 3–three-way valve; 4–service port; 5–UV LED (255-265 nm); 6–flow cell; 7–flow rate regulator; 8–drain vessel; 9–photodetector; 10–electronic unit, 11–laptop PC. B) ATP absorption spectrum in the UV range and LED emission spectrum

RESULTS & DISCUSSION

The delay time between peaks (the Time index) for 15 samples varied in a range from 138 s to 193 s (Figure 1). It was suggested that the higher the Time index, the less fresh raw fish was used.

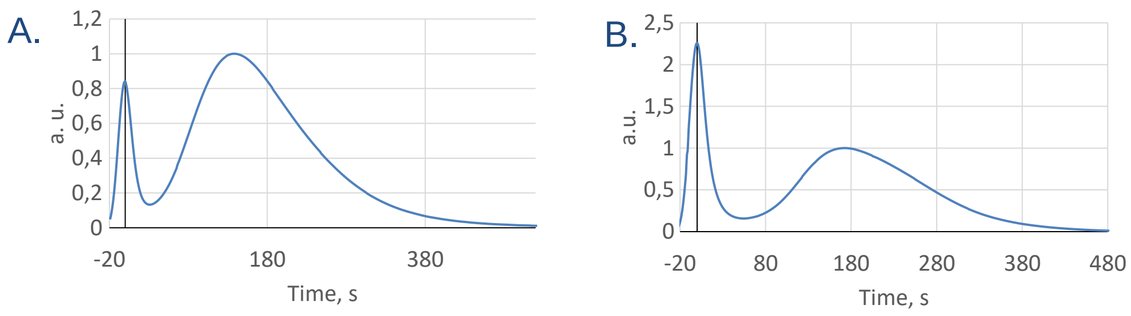

Figure 2. FPMLC chromatograms for canned sardine «Connétable» (A) and pink salmon «Moreslav» (B)

Table 1 and Figure 3 shows a comparison of the results of the FPMLC method (the Time index), NMR spectroscopy (freshness index K_I), HPLC (freshness indices K and K_I) and estimated storage time of raw fish before production, taking into account inevitable thermal degradation of nutritional nucleotides and nucleosides during high-temperature sterilization.

Table 1. Comparison of the results of the FPMLC method, NMR and HPLC

Canned fish	Time, s	K_I, % HPLC	K_I, % NMR	K, % HPLC	Estimated storage time at 2-4˚C, days
Sardine «Connétable»	138	42	37	31	0-2
Sardine «Moreslav»	154	61	57	42	3-7
Trout «Ecofood»	164	57	54	41	3-7
Pink Salmon «Moreslav»	179	89	91	64	>8

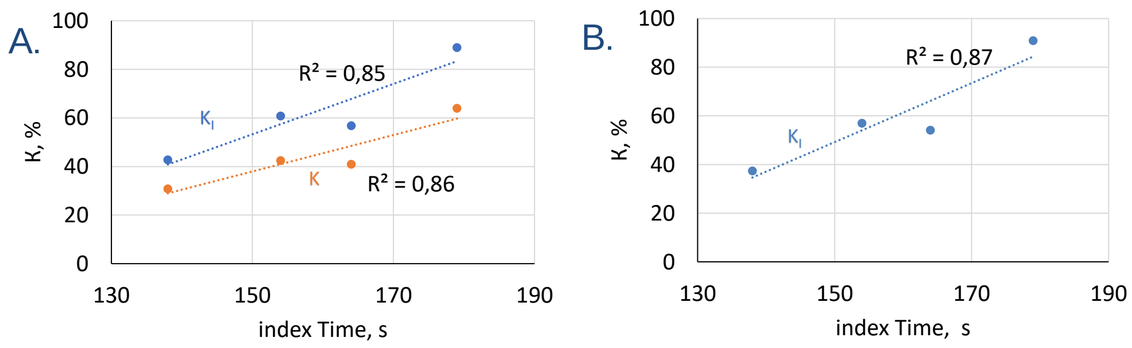

Figure 3. The correlation of the index Time and the nucleotide-based freshness indices measured by HPLC (A) and NMR spectroscopy (B) for 4 samples of canned fish

CONCLUSION

The Time index derived from the FPLMC chromatograms of canned fish showed a good correlation with well-established nucleotide-based K and K_I indices (quality factors) estimated by HPLC and NMR techniques, which confirms the fact that the FPMLC method can be used to assess the initial freshness of raw materials in processed fish products.

FUTURE WORK / REFERENCES

1. Konoplev G.A., Sünter A., et. al. // Engineering Proceedings. 2023. V.35 (3).
2. Sünter A., Kuznetsov A., et. al. // AppliedChem. 2023. V.3. P. 334-349.