DEVELOPMENT OF A NATURAL PH INDICATOR BASED ON ANTHOCYANIN-CONTAINING LOCAL RAW MATERIALS AND VISUAL ASSESSMENT OF FOOD PRODUCT FRESHNESS

S.N.Obloberdiyev[1], G.Sh.Korabekova[2], F.Sh.G'ulomova[3], M.J.Bekmurodova[3], Sh.E.Ulashova[3], Z.A.Madusmonova[3]

[1]Acting Associate Professor, Tashkent Institute of Chemical Technology, Yangiyer Branch, Yangiyer, Uzbekistan

[2]Master's student, Tashkent Institute of Chemical Technology, Yangiyer Branch, Yangiyer, Uzbekistan

[3]Bachelor's student, Tashkent Institute of Chemical Technology, Yangiyer Branch, Yangiyer, Uzbekistan

Abstract. This study focuses on the development of a natural pH indicator based on anthocyanin-containing local raw materials for the visual assessment of food product freshness. Anthocyanins are natural pigments that change color depending on the acidity of the medium. The prepared indicator was used to monitor pH changes in food products during storage. The results showed that the natural indicator can visually reflect freshness loss through clear color changes. This approach is eco-friendly, simple, and suitable for preliminary quality control of food products.

Keywords: natural pH indicator, anthocyanins, local raw materials, food freshness, visual assessment, food quality, color change.

Annotatsiya. Ushbu tadqiqot antosianin saqlovchi mahalliy xomashyolar asosida tabiiy pH-indikator ishlab chiqish va oziq-ovqat mahsulotlari yangiligini vizual baholashga qaratilgan. Antosianinlar muhit kislotaliligiga qarab rangini o'zgartiruvchi tabiiy pigmentlar hisoblanadi. Tayyorlangan indikator oziq-ovqat mahsulotlarini saqlash jarayonida pH o'zgarishini kuzatishda qo'llanildi. Natijalar tabiiy indikator mahsulot yangiligining pasayishini rang o'zgarishi orqali aniq ko'rsatishi mumkinligini tasdiqladi.

Kalit so'zlar: tabiiy pH-indikator, antosianinlar, mahalliy xomashyo, oziq-ovqat yangiligi, vizual baholash, rang o'zgarishi.

Аннотация. Данное исследование направлено на разработку природного pH-индикатора на основе местного сырья, содержащего антоцианы, и визуальную оценку свежести пищевых продуктов. Антоцианы являются природными пигментами, изменяющими цвет в зависимости от кислотности среды. Полученный индикатор был использован для наблюдения за изменением pH пищевых продуктов в процессе хранения. Результаты показали, что природный индикатор позволяет наглядно определять снижение свежести продукта по изменению цвета.

Ключевые слова: природный pH-индикатор, антоцианы, местное сырьё, свежесть пищевых продуктов, визуальная оценка, изменение цвета.

INTRODUCTION

Food freshness is one of the most important indicators of food quality and safety. During storage, many food products undergo physicochemical changes, especially changes in pH, which may indicate spoilage. Therefore, simple, safe, and eco-friendly methods for freshness assessment are needed.

Anthocyanins are natural pigments found in local plant raw materials such as red cabbage, berries, and colored fruits. Previous studies have shown that anthocyanins can change color depending on the acidity of the medium. However, the use of locally available anthocyanin-rich raw materials for visual food freshness assessment has not been sufficiently studied.

The aim of this study is to develop a natural pH indicator based on anthocyanin-containing local raw materials and to evaluate its ability to visually assess the freshness of food products. The novelty of the research is the use of local raw materials to create an environmentally friendly, simple, and visually effective natural indicator for food quality control.

MATERIALS AND METHODS

The research object was a natural pH indicator obtained from anthocyanin-containing local raw materials. Red cabbage was used as the main raw material because it contains a high amount of anthocyanin pigments. Drinking water, ethanol solution, filter paper, and food samples were used as additional materials.

The raw material was washed, cut into small pieces, and extracted with water or ethanol solution at 40–50 °C for 30–40 minutes. The obtained extract was filtered and used as a natural indicator solution. In addition, filter paper was immersed in the extract and dried at room temperature to prepare indicator strips.

The prepared indicator was tested on food samples during storage. Changes in color were observed depending on pH variation. The main evaluated indicators were pH value, color change, visual sensitivity, and the ability to show freshness loss. A pH meter, thermometer, laboratory glassware, filter paper, and drying equipment were used during the experiment.

RESULTS

The obtained natural pH indicator had a clear purple-blue color and showed visible color changes in different acidic and alkaline media. In acidic conditions, the indicator changed to pink or red, while in neutral medium it remained purple, and in alkaline medium it turned greenish-blue.

During the storage of food samples, a decrease in freshness was observed through gradual color change of the indicator. Fresh samples showed a purple or blue color,

while samples with increased acidity showed pink or reddish shades. This confirmed that the anthocyanin-based indicator can visually reflect pH changes related to product spoilage.

Table 1

Color change of the natural pH indicator depending on pH

Medium condition	pH value	Indicator color	Freshness assessment
Acidic	4.0–5.5	Pink / red	Spoilage signs
Slightly acidic	5.6–6.2	Light purple	Freshness decreasing
Neutral	6.3–7.0	Purple / blue	Fresh product
Alkaline	7.1–8.5	Greenish-blue	Quality change

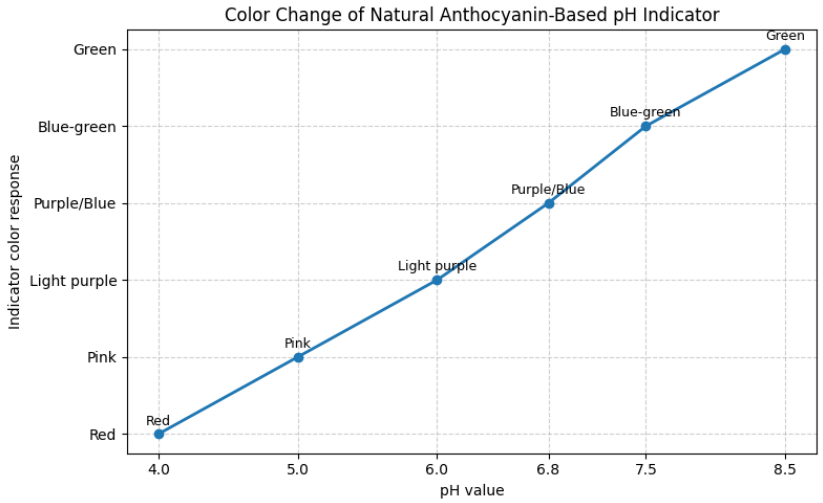

Figure 1. Color change of the natural anthocyanin-based pH indicator depending on pH value.

The graph shows that the indicator color changed from red and pink in acidic conditions to purple-blue in neutral medium and green in alkaline conditions. This confirms that the natural anthocyanin-based indicator can visually reflect pH changes related to food freshness.

The indicator strips were smooth, light, and easy to use. Among the tested variants, the extract obtained from red cabbage showed the most intense and stable color change. Therefore, this variant was selected as the optimal sample for visual food freshness assessment.

DISCUSSION

The results show that the anthocyanin-based natural indicator can effectively detect pH changes in food products. The color transition from blue-purple to pink or

red indicates an increase in acidity, which is usually related to freshness loss and spoilage during storage.

This result was obtained because anthocyanins are sensitive to changes in the hydrogen ion concentration of the medium. Red cabbage extract gave a clear color response due to its high anthocyanin content. Water or ethanol helped to extract the pigment, while filter paper served as a convenient carrier for visual assessment.

Compared with synthetic indicators, the developed indicator is safer, eco-friendly, and suitable for simple food quality control. Its main advantage is that it allows freshness to be assessed visually without complex laboratory equipment. However, its color stability may be affected by light, temperature, and long storage time.

The obtained indicator can be practically used for preliminary freshness assessment of milk, meat, fish, fruit juices, and other food products where pH changes occur during storage.

CONCLUSION

The study showed that anthocyanin-containing local raw materials can be effectively used to develop a natural pH indicator for food freshness assessment. The prepared indicator changed color depending on the pH level of the tested medium. Fresh food samples were mainly associated with purple-blue shades, while spoilage and increased acidity were reflected by pink or reddish colors. Red cabbage extract showed clear color sensitivity and was selected as a suitable raw material for indicator preparation. The developed natural indicator is simple, eco-friendly, and can be used for preliminary visual control of food product quality.

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