ALGINIC ACID AND HYALURONIC ACID, EFFECTIVE STABILIZERS OF CARTHAMIN RED COLOUR IN AQUEOUS SOLUTIONS

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ABSTRACT

Sodium salts and free forms of two heterosaccharides, alginic and hyaluronic acids were mixed with carthamin in a buffer at pH 5.5 and their preservation effects of carthamin red colour were screened after incubation for 24 h at 3-5°C in the dark. The effects observed were (alginic acid/hyaluronic acid, % on average): 69.3/60.3, for which the values are higher by 40.9 and 29.1%, respectively, compared with those of the control which was conducted with no addition of heterosaccharides. Alginic acid is a more promising stabilizer than haluronic acid, indicating that active groups such as hydroxyls, carboxyls and amino groups on the building units of the macromolecules are associated closely with the carthamin red colour preservation. The empirical outcomes are referred to the practical application of carthamin as a colourant of food products.

KEY WORDS: carthamin preservation, alginic acid, hyaluronic acid, food colourant.

INTRODUCTION

Coloured additives are indispensable for food processing to maintain attractive tincture and/or to increase economical values. For dyeing food products effectively, a vast variety of natural and synthetic colourants have now been used in practice.

Carthamin, a *Asteraceae* plant pigment, is applicable as a colourant for foods. However, its inherent lability has restricted the general application: sooner or later, carthamin dyed products are bleached to an economically useless low level. To restrict the fading of colour, various stabilizers are admixed externally, some of which are useful and some are not so effective (Saito and Fukushima 1986, 1987). In one of our previous papers, we reported that certain sugar alcohols and gelatine are efficacious to reduce the serious denaturation (Saito et al. 1993). Polyethylene glycol retained the red colour most efficiently with a preservation rate of 91.3% after incubation for 24 h at 5 °C in the dark. The efficacy of glycerine should be ranked next to this (83.8%). Gelatine was also found to be a promising stabilizer, although its effect dropped further (91.3%).

From viewpoints of sensory touch, appearance or others, any stabilizers which are to be mixed during food processing could give users favourable impression as much as possible mainly in the following respects: colour, smell, taste, softness, smoothness etc. Attending these in mind, further studies seem to be necessarily requisite for specifying additional colour stabilizers which are more suitable to the processed foods, including drinks, cakes, candies, preserves and tabloids.

The report written below is the result of observing the effect of two heterosaccharides on the stability of carthamin in a bufferized solution.

MATERIAL AND METHODS

Material

Carthamin used here was prepared from the processed and packed florets of dyer's saffron through the methods of Saito and Katsukura (1992), and Saito et al. (1992). Sodium salts or free types of alginic and hyaluronic acids were gifts from Kibun Food Chemiha (Sayama, Japan). Other chemicals and reagents were obtained from commercial suppliers. Some of the solvents used were glass distilled prior to the experimental application.

Preparation of carthamin-heterosaccharide mixtures

A weighed amount of carthamin ($4.4 \text{ nmol}\cdot\text{cm}^{-3}$) was suspended in 50 mM citrate buffer at pH 5.5, in which heterosaccharides ($10 \text{ }\mu\text{g}\cdot\text{cm}^{-3}$) had been dissolved previously. The suspension was stirred on a magnetic stirrer for about 60 min at room temperature to make clear carthamin-heterosaccharide mixtures.

Pre-setting of carthamin-heterosaccharide mixtures

The mixtures were transferred to disposable polystyrene cuvettes (dispolab Kartell), whose tops were sealed tightly with and over which enveloped further with aluminium foils, then they were placed at 3-5°C for 24 h in the dark just before the experimental use.

TABLE 1. Effect of heterosaccharides on carthamin red colour preservation

Heterosaccharide	Carthamin content nmol·cm ⁻³	Colour preservation rate, % of control*
Sodium alginate	3.5 ± 0.14	78.5
Alginic acid	3.1 ± 0.11	69.3
Sodium hyaluronate		
MW** 3 · 10 ⁵	2.8 ± 0.09	63.9
MW 1 · 10 ⁶	2.8 ± 0.11	64.0
MW 2 · 10 ⁶	2.7 ± 0.07	61.9
Hyaluronic acid		
HA-A-465-1	2.7 ± 0.11	60.9
H-HT-1	2.6 ± 0.10	59.6

* Carthamin content was 4.4 nmol·cm⁻³

** MW = molecular weight

Heterosaccharides used were 10 µg·cm⁻³

The averaged data from three separate repetitions.

Spectrophotometric estimation of carthamin stability

Each polystyrene cuvet containing given carthamin-heterosaccharide mixture was placed separately in a cuvet holder of a Hitachi double-beam UV/VIS spectrophotometer, model U-1100. The VIS absorption maximum at 521 nm was recorded manually and the data from the spectrophotometric reading were used for the determination of carthamin content, which was computed by consulting with a calibration curve. The stability of carthamin in each saccharide solution was estimated from the carthamin amount residued in the mixtures after incubation for 24 h at 3-5°C.

RESULTS AND DISCUSSION

Table 1 summarizes the data from the tests of carthamin stability in two heterosaccharide solutions, whose pH value was controlled at a constant level with 50 mM citrate buffer. At pH 5.5 and 3-5°C, carthamin is kept at a considerably high level in solution by externally fed saccharides. On the whole, the efficacy of alginic acid is higher than that of hyaluronic acid (preservation rate, 69.3 : 60.3% on average). The listed values are both superior to the rate of the control test conducted with no addition of saccharides by 40.9% in alginic acid and 29.1% in hyaluronic acid, respectively. The difference in the stabilization effect of the test saccharides perhaps comes from the molecular form and/or the distribution

pattern of the active groups on the building blocks of the macromolecules. A possible mechanism of carthamin stabilization on glucosidic polymers has already been presented in our previous papers (Saito and Fukushima 1986, 1987, Saito 1991). Sodium salts of both alginic and hyaluronic acids tend to show relatively high levels of the preservation rate of carthamin rather than those of free types (sodium/free in alginic acid: 78.5/69.3%, sodium/free in hyaluronic acid: 63.3/60.3%). At this preliminary step, the mechanism by which the salts stabilize carthamin more effectively than free acids remains obscure, though these attracting points are to be investigated more closely in these days.

The work supplied additional findings that both alginic and hyaluronic acids can serve as promising stabilizers for carthamin in aqueous solutions, though their preservation effects are obviously inferior to those of sugar alcohols and gelatine (Saito et al. 1993). However, these polysaccharides are known to have excellent viscous properties. Due to this physical characteristics, they are applied as smoothers to soft drinks, fruit jams, pectic cakes, cosmetics, and so on. The present findings will conduce carthamin users to process soft beverages, food products, cosmetic goods and related merchandise.

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KWAS ALGINOWY I HIALURONOWY JAKO STABILIZATORY
CZERWONEJ BARWY KARTAMINY W ROZTWORACH WODNYCH

STRESZCZENIE

Sole sodowe i wolne formy dwóch heterocukrów, kwasu alginowego i hialuronowego, zmieszano z kartaminą w buforze o pH 5.5. Ich wpływ na zachowanie czerwonej barwy kartaminy oceniano po 24 godzinach inkubacji przy 3-5°C w ciemności. Uzyskane wyniki (kwas alginowy / kwas hialuronowy, przeciętny %) wynosiły 69.3 / 60.3. Wartości te są wyższe odpowiednio o 40.9 i 29.1% w porównaniu z kontrolą przeprowadzoną bez dodatku heterocukrów. Kwas alginowy jest lepszym stabilizatorem w porównaniu do kwasu hialuronowego co wskazuje, że aktywne grupy, takie jak: hydroksylowe, karboksylowe i aminowe, wchodzące w skład jednostek makromolekuł, są ściśle związane z trwałością czerwonej barwy kartaminy. Uzyskane wyniki dotyczące kartaminy mogą mieć zastosowanie praktyczne w barwieniu produktów spożywczych.

SŁOWA KLUCZOWE: kartamina, kwas alginowy, kwas hialuronowy, barwniki spożywcze.