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Encompass Traditional Evolutionary History of Plant Life

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Introduction

Betalains can be regenerated after thermal processing via the use of acids. Various organic acids have been proposed to aid regeneration and retain stability during processing and storage of betalains. Bilyk noted that addition of isoascorbic acid into a betacyanins solution either before or after heating helped to regenerate betacyanins. The regenerated betacyanins were restored almost completely after storage. On the other hand, the degraded betaxanthins could not be regenerated by the use of isoascorbic acid due to its instability in acidic condition. Then organic acid is a suitable pre-treatment for enhancing the stability of red colorant from betacyanin but not for yellow colorant from betaxanthins. The quantity of regenerated betacyanin is affected by pH, storage temperature, type of additives, and the presence or absence of oxygen. Han studied the regeneration of degraded red beet betacyanins in the presence of different types of acid-based additives, which were antioxidants, organic acids, and inorganic acids. Acid-based additives helped to regenerate red beet pigments that were degraded by heating for few minutes [1]. The degraded pigments were restored. The effect of pH on pigment regeneration was also evaluated, and it was found that the addition of ascorbic acid and iso-ascorbic acid resulted in the highest retention of pigments for the sample controlled at pH of gluconic acid and meta-phosphoric acid also resulted in the higher retention of pigments, with the retention respectively for the sample controlled at pH. Besides the ability to regenerate the pigment after heating, ascorbic acid and iso-ascorbic acid could also help stabilize beta-cyanins during food processing and storage. Reynoso reported that garambullo juice that was added with ascorbic acid exhibited higher redness than the untreated sample after sterilization [2]. The presence of the acid in red beet juice and garambullo juice also resulted in an increase in the stability of betalains during storage at 25 C for five days. Moreover, ascorbic acid could improve the stability of betalains when metal ions are present, since the acid could act as a chelating agent.

Discussion

Anthocyanins are highly sensitive to change in pH, which results in shift of color. Using anthocyanins as a natural colorant is suggested at low pH. At pH below 4, antho-cyanins primarily are in the form of flavylium cation, which is more stable than other structures. Cevallos reported that at a pH, the colorant samples from red sweet potato and purple carrot showed high stability during storage at storage for days, hue angle of the red sweet potato colorant at pH still exhibited red violet color after storage [3]. In contrast, the color of the samples that were controlled at pH above shifted from purple blue to brown and yellow, and after few days the color of all the samples was predominated by the yellow colored chalcone. Besides a proper pH adjustment, the source of anthocyanins must be considered to obtain the most stable colorant. Different sources of rice plants materials contain different anthocyanin structures, which affect their stability. Anthocyanins from red cabbage, black carrot, red radish, and red sweet potato are reported to be more stable to heat and pH change than anthocyanins from other sources due to their acylation of structure. Acylation of anthocyanin molecules can enhance stability through intramolecular co-pigmentation. Higher stability of acylated anthocyanins is attributed to the stacking of acyl group with the pyrylium ring of flavalium cation, thus preventing the nucleophile attack of water and subsequent formation of chalcone. Many researchers have indeed demonstrated the stability of acylated anthocyanins in comparison with that of non-acylated anthocyanins. For example, Cevallos- Casals and Cisneros-Zevallos, who studied the stability of anthocyanins from red sweet potato, purple carrot, purple corn, and red grape, reported that anthocyanins from red sweet potato and purple carrot, which mainly consist of acylated anthocyanins, were more stable than those from purple corn and red grape, which mainly consist of non-acylated anthocyanins [4]. Anthocyanins extracted from red sweet potato exhibited longer half-life than those from purple carrot, purple corn, and red grape when heated at and controlled at pH. Intercellular co-pigmentation has been suggested to improve the stability of anthocyanins. Intercellular co-pigmentation is defined as interactions between anthocyanin molecules and other molecules, e.g., flavonoids, alkaloids, amino acids, organic acids, metals, and other anthocyanins .The basic role of intercellular co-pigmentation is the same as that of intracellular co-pigmentation, which is to protect flavalium cation from the nucleophile attack of water molecules [5]. Gauche reported that addition of organic acids into an anthocyanins solution could retard colour change when the pH of the solution increased, whereas the solution without organic acids became colourless. Moreover, the half-life of anthocyanins solutions with added organic acids was longer than that of the untreated sample during storage, addition of tannic acid resulted in the longest half-life of the sample maintained at pH. Although intercellular co-pigmentation can help increase the stability of anthocyanins, this reaction induces an increase in the absorbance and wavelength of the maximum absorbance of pigment. Bathochromic shift results in colour change from red to red orange or blue. Addition of tannic acid to an anthocyanins solution from Isabel grapes controlled at pH, for example, led to an increase in the absorbance and wavelength of the solution, resulting in bluer and brighter color of the treated sample. Betalains can be regenerated after thermal processing via the use of acids [6]. Various organic acids have been proposed to aid regeneration and retain stability during processing and storage of betalains. Bilyk noted that addition of isoascorbic acid into a betacyanins solution either before or after heating helped to regenerate betacyanins. The regenerated betacyanins were restored completely. On the other hand, the degraded betaxanthins could not be regenerated by the use of isoascorbic acid due to its instability in acidic condition. Then organic acid is a suitable pre-treatment for enhancing the stability of red colorant from betacyanins but not for yellow colorant from betaxanthins. The quantity of regenerated betacyanins is affected by pH, storage temperature, type of additives, and the presence or

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absence of oxygen. Han studied the regeneration of degraded red beet betacyanins in the presence of different types of acid-based additives, which were antioxidants, organic acids, and inorganic acids. Acid-based additives helped to regenerate red beet pigments that were degraded by heating at 100 C for five minutes. The degraded pigments were restored for few minutes. The effect of pH on pigment regeneration was also evaluated, and it was found that the addition of ascorbic acid and isoascorbic acid resulted in the highest retention of pigments for the sample controlled at pH of gluconic acid and metaphosphoric acid also resulted in the higher retention of pigments, with the retention, respectively for the sample controlled at pH.Besides the ability to regenerate the pigment after heating, ascorbic acid and isoascorbic acid could also help stabilize beta-cyanins during food processing and storage [7]. Reynoso reported that garambullo juice that was added with ascorbic acid exhibited higher redness than the untreated sample after sterilization. The presence of the acid in red beet juice and garambullo juice also resulted in an increase in the stability of betalains during storage for five days. Moreover, ascorbic acid could improve the stability of betalains when metal ions are present, since the acid could act as a chelating agent. Anthocyanins are highly sensitive to change in pH, which results in shift of colour [8]. Using anthocyanins as a natural colorant is suggested at low pH. At pH below 4, anthocyanins primarily are in the form of flavylium cation, which is more stable than other structures. Cevallos-Casals and Reported that at a pH, the colorant samples from red sweet potato and purple carrot showed high stability during storage for days, hue angle of the red sweet potato colorant at pH 4.0 still exhibited red–violet color after storage. In contrast, the color of the samples that were controlled at pH above shifted from purple–blue to brown and yellow, and after few days the colour of all the samples was predominated by the yellow-colored chalcone. Besides a proper pH adjustment, the source of anthocyanins must be considered to obtain the most stable colorant. Different sources of rice plants materials contain different anthocyanin structures, which affect their stability. Anthocyanins from red cabbage, black carrot, red radish, and red sweet potato are reported to be more stable to heat and pH change than anthocyanins from other sources due to their acylation of structure. Acylation of anthocyanin molecules can enhance stability through intramolecular co-pigmentation [9]. Higher stability of acylated anthocyanins is attributed to the stacking of acyl group with the pyrylium ring of flavalium cation, thus preventing the nucleophile attack of water and subsequent formation of chalcone. Many researchers have indeed demonstrated the stability of acylated anthocyanins in comparison with that of non-acylated anthocyanins. For example, Cevallos-Casals and Cisneros-Zevallos, who studied the stability of anthocyanins from red sweet potato, purple carrot, purple corn,and red grape, reported that anthocyanins from red sweet potato and purple carrot, which mainly consist of acylated anthocyanins, were more stable than those from purple corn and red grape, which mainly consist of non-acylated anthocyanins. Anthocyanins extracted from red sweet potato exhibited longer half-life than those from purple carrot, purple corn, and red grape when heated and controlled. Intercellular co-pigmentation has been suggested to improve the stability of anthocyanins. Intercellular co-pigmentation is defined as interactions between anthocyanin molecules and other molecules, e.g., flavonoids, alkaloids, amino acids, organic acids, metals, and other anthocyanins. The basic role of intercellular co-pigmentation is the same as that of intracellular co-pigmentation, which is to protect flavalium cation from the nucleophile attack of water molecules. Gauche reported that addition of organic acids into an anthocyanins solution could retard colour change when the pH of the solution increased, whereas the solution without organic acids became colourless. Moreover, the half-life of anthocyanins solutions with added organic acids was longer than that of the untreated sample during storage at 28 C; addition of tannic acid resulted in the longest half-life of the sample maintained at pH. Although intercellular co-pigmentation can help increase the stability of anthocyanins, this reaction induces an increase in the absorbance and wavelength of the maximum absorbance of pigment. Bathochromic shift results in color change from red to red orange or blue.

Conclusion

Addition of tannic acid to an anthocyanins solution from Isabel grapes controlled at pH, for example, led to an increase in the absorbance and wavelength of the solution, resulting in bluer and brighter colour of the treated sample.

Acknowledgement

None

Conflict of Interest

None

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