Review on Anthocyanin Extraction from Different Natural Sources and TheirFortification in Non Alcoholic Beverages

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Abstract: Anthocyanins possess vast range of possible applications and so they have gathered the attention of the scientific community. Being the center point of the research in many different fields, especially food development, their innate coloring, biological potential and antioxidant capacity open interesting venues to the development of new food additives and functional foodstuffs. Since they are naturally occurring, the most common way to obtain anthocyanins is to extract them from different natural sources, such as fruits and flowers. In the European Union, Australia, and New Zealand, having colorant code E163 approved anthocyanin for use as food colorants [1] [2] . A panel of scientific experts for the European FoodSafety Authority in 2013 concluded that various fruit and vegetable anthocyanins have been insufficiently characterized by safety and toxicology studies for giving them approval as food additives [3]. This review aims to compile the information regarding extraction of anthocyanin from different natural sources and their fortification in non alcoholic beverages to increase the stability and neutraceutical properties.

Keywords: Anthocyanin, Antioxidant, Extraction, Fortification

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INTRODUCTION

Nowadays due to safety issues the use of synthetic dyes has been replaced by the use of natural colorants. The European Union (EU) legislation listed Anthocyanins (any anthocyanin-derived colorant) as product E163 (Markakis, 1982) according to the numbering system used by the Codex Alimentarius Commissio[4]. According to Atindehou (2002) alkaloids, flavonoids, tannins and phenolic compounds are the important bioactive components[5]. Saeed (2005) reported about the presence of more than 8000 phenolics, 25000 terpenoids and 12000 alkaloids[5]. Anthocyanins are water-soluble and have high colour intensities and it is one of the main sources for the attractive blue-violet-red-orange colour of flowers and fruits.

ANTHOCYANIN

Anthocyanin is rich in antioxidants, antiviral, anticancer properties etc. Anthocyanin is responsible for attractive colour like violet, orange, blue and red. The pH implies a significant effect on the anthocyanin molecules. Anthocyanins are more stable in acidic media at low pH than the alkaline media with high pH values[6].

EFFECT OF pH

pH	Color
3	Crimson
7	Purple
8	Grayish purple
10	Grey
12	Greenish red
14	Bright green

(Table-1)[6]

EFFECT OF HEAT

The heat stability of the anthocyanin during processing is well known. Spray drying of anthocyanin at more than 100°c temperature cause intensive degradation of the pigment. But the temperature below 90°c cause minimum degradation of the pigment. Stability towards thermal degradation will be increased at low pH. The expulsion of the oxygen from the anthocyanin pigment is very important for its stability. There are two possible mechanisms for thermal degradation of the anthocyanin.

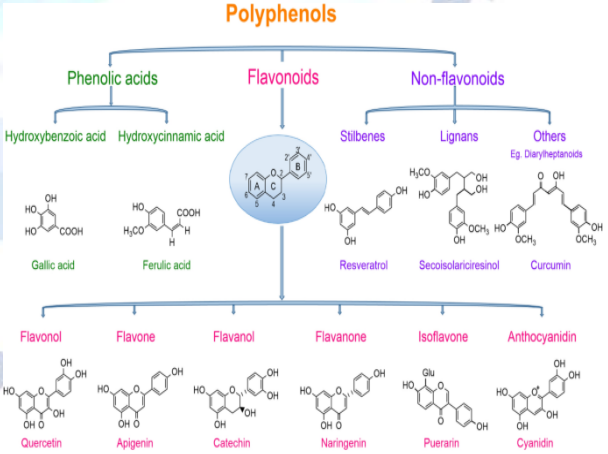
- The hydrolysis of glycosidic linkages.
- Formation of brown insoluble compound consisting of polyphenolic structure.

POLYPHENOL CONTENT

Due to the roles of the polyphenols in human health dietary polyphenols have become so much popular among nutritionists, food scientists and consumers. According to the research in recent years polyphenols possess an important role for the prevention of degenerative diseases, particularly cancers, cardiovascular diseases and neurodegenerative diseases[7][8]. Polyphenols are strong antioxidants that accelerate the functions of antioxidant, vitamins and enzymes to defense against oxidative stress caused by excess reactive oxygen species (ROS)[9].

CLASSIFICATION

In the plant kingdom dietary phenolics or polyphenols form one of the most countless and widely distributed groups of natural products. Recently more than 8000 phenolic structures are known and among them over 4000 flavonoids have been recognized[10][11][12]. These are listed below.



(FIG-1)[13]

FLAVONOIDS

Flavonoids are group of plant metabolites providing health welfare through signaling pathway and vegetables.They are found in variety of fruits and vegetables. They are polyphenolic compound containing 15 carbon atoms and they are water soluble.

They contain 2 phenyl rings and one heterocyclic ring[14].

ANTICANCER PROPERTIES OF POLYPHENOL

The most studied mechanism on anticancer effect of polyphenols are their ability to modify proliferation and apoptosis polyphenols have been shown to control the cancer growth by inhibiting the proliferation of cancer cell. The anticancer effect of polyphenols may also be partially medicated through their abilities of counteract, reduce and also repair damage resulting from oxidative stress and inflammation and involvement of regulation of carcinogen, various transcription. It is well established that free radicals reacts with all components of DNA, thus damaging its bases and deoxyribose backbone and causing mutations of genes which may lead to cancer. It contains antioxidant which is a good chemo preventive agent. They suppress the oxidative damage. It induced hepatocarcinogenenic.

ANTHOCYANIN EXTRACTION FROM DIFFERENT SOURCES AND IT'S INCORPORATION IN BEVERAGES

Anthocyanin from banana bract

In the last decade only, anthocyanin pigments in banana bracts were discovered as biological food colorants. The bracts are abundant source of anthocyanins with the presence of all six most common anthocyanidins. Acid hydrolysis of anthocyanins disclosed about the presence of six more common anthocyanidins (delphinidin, cyanidin, petunidin, pelargonidin, peonidin and malvidin)[15]. The wild banana bracts are pigmented by glycosides (probably 3-diglucosides) of four anthocyanidins combinations.

They are cyanidinpelargonidin; cyanidindelphinidin; malvidin-peonidin; delphinidin-petunidin-cyanidin-malvidin-peonidin. The proportions of this various components slightly vary as between clones of one species and even between samples, but the general pattern acts as a characteristic of a species and so it is of considerable taxonomic value. In Musa acuminata a cline in bract color is varied and depends on the variation in oxidation and methylation of the anthocyanidins. The bracts of edible bananas have, broadly, the pigments expected on taxonomic and genetic grounds but show an (unexplained) tendency towards a generally lower level of methylation of the anthocyanidins[16]. On the other hand, Leucoanthocyanins are present in most portions of the banana plant. They yield delphinidin and cyanidin in proportions that differ approximately with total intensity. The total anthocyanin the from selected banana bracts is extracted with ethanol solutions and characterized by UV-visible spectrophotometry. The content is found 224.41 ± 1.91 mg/kg. And this content is highest when the solvent concentration is at 40% solvent with pH 4[4]. Moreover, the variation of the color characteristics can be found with the variation of solvent concentration and pH. At pH 4 the value of chroma is higher in all different concentrations. The results reveal that the color of anthocyanin is decreased due to increase of pH. The value of hue angle was in the range of (73.69±0.33) to (-71.14±1.39), which indicates the color from yellow to magenta, and this is the natural color of anthocyanin[4]. So, banana bracts can be used as a possible source of extracting natural colorant as a replacement of artificial colorant in various food industries.

Fortification of rose petal's polyphenolic copigments in strawberry anthocyanin

A study was performed about the strawberry anthocyanins's heat stability on the addition of polyphenolic copigments , naturally occurring in rose(Rosa damascene Mill) petals. The degradation of anthocyanins ideally followed the first order reaction kinetics (R=0.99) and the half-value increased significantly due to the addition of the rose petal polyphenolics[17].This study suggests a nature-derived idea ragarding the improvement of the quality of colour-labile strawberry products by fortification with polyphenolic copigments extracted from rose petals(distilled). It has been observed that especially after extended heating the color stability increased as the total color difference values were smaller for anthocyanins upon copigment addition. Moreover, the stabilizing effect of rose petal polyphenols was compared with that of some well-known copigments like isolated quercetin, kaempferol, and sinapic acid. It was found that at a molar pigment/copigment ratio of 1:2, the purified rose petal extract is the most effective anthocyanin-stabilizing agent. The results obtained show that the rate of thermal degradation of strawberry anthocyanins decreases with the addition of rose petal

polyphenols, which results improving the color retention without affecting the gustatory quality of the product[18]. This approach suggested appears to be easily applicable at industrial scale. On addition, the recovery of rose petal by-products rich in polyphenolics could be recommended, thus adding value to the rose processing industry.

Grape anthocyanin pigment and it's fortification

Anthocyanins are hugely distributed among several plants and have been considered as important additives to foods and other fortifications. The grape anthocyanins are transferred to the wine or juice; significant amounts of them are left in the pomace, which become a very important source for the extraction of these pigments. A powder and a solution consisting of grape anthocyanins are marketed , named as Enocianina, or Enocyanin in Italy. These products are used primarily for fortifying the red color of wines. The primary objective of this work was to extract the anthocyanins of fermented grape skins and further study the stability of these pigments in a nonalcoholic carbonated beverage by a simple method, to which they were added as natural colorants[19].

Further from another study the significant and strong negative correlations were observed between anthocyanin concentrations and the levels of polymeric, haze and brown color development during storage at higher temperatures. If grape juice was stored at lower temperature, it could reduce the continuous loss of biologically active anthocyanins and the development of haze and brown color too[20].

Anthocyanin extraction from butterfly pea flowers

Now-a-days, the acceptance of nonalcoholic drinks in market is being highly increased. Due to rise in health and wellness demand, these segment markets are growing rapidly in subsequent years. These products have the ability to create high returns due to its natural and organic contents.

In this research there was a study related to development of an acceptable mocktail drink by extracting the natural pigment of the butterfly pea flowers .The trainer of Bartending NC II noted that the flowers of the butterfly pea plant or Clitoris ternatea has been used in food-ice cream and tea further she wanted to study and record the possibility of developing mocktail drinks using the extract of the flowers with its vibrant and unique natural pigment[21]. Recent studies suggested about significant amount of some non-enzymatic antioxidants such as ascorbic acid, reduced glutathione and total carotenoids in the leaves and flowers of two varieties of *Clitoria ternatea*. Among them one has blue flowers and another has white flowers. The benefits that can be obtained from the flower are:

1. It has natural anti-oxidant property
2. Improves blood circulation
3. Prevents hair loss and graying hair.

Some studies claim about the cleanliness of the blood, improvement of night vision, revitalizing skin and hair. Another research study has demonstrated that the extract of butterfly pea flower possesses antidiabetic activity and has strong antiglycation and antioxidant properties and might have therapeutic potentials in the prevention of advanced glycation end products or age mediated diabetic complication[22].

Anthocyanin from purple cabbage

Red cabbage (RC), also known as purple cabbage has very low level of saturated fat, cholesterol. It is a source of thiamin, folate, riboflavin, K, Fe, Mg, Ca and Mn, dietary fiber, vitamins K, B, A, C, providing big amounts of anthocyanins and presenting high antioxidant properties. It may decrease the tendency of cardiovascular diseases, cancer and brain disorders. Anthocyanins are generally the largest and most important group of naturally occurring water soluble pigments . Their bioavailability and stability are based on their chemical formulation. Colour stability decreases towards neutrality but some anthocyanins showed a stability increase culminating at local maxima around 8-9[23].

CONCLUSION

It can be concluded that this study would help people to extract anthocyanin from different natural sources such as banana bract, strawberry, grape, butterfly pea flower, purple cabbage etc. Then it has been aplied for fortification in different non alcoholic beverages. And depending on the study the stability as well as the antioxidant property such as polyphenol content has been increased. The food industries can also use to avoid the carcinogenic effect of synthetic colorants. As a

result of these extraction of the color from different natural sources and its fortification into non alcoholic beverage enhance the quality of the product by increasing antioxidant activity. Giving the final product a better color improves overall appearance and makes it more appealing to the customers.

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