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A Review on Anthocyanin and it's Benefits as Biocolour

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Abstract : Food colouring is an important part of our lives from many the decades because it not only makes the appearance of food looks attractive but it also increases the nutritional value of the food. Because of the various evidences related to synthetic colours harmful effects over the years now the need of consumers is shifting towards bioclours. But, biocolours also got certain limitations like sensitive to low pH and heat sensitive, etc.. so there is a need emerging to use biocolours anthocyanine not only because of its good stability at low pH and high temperature but also of its some other good properties.

Interest in anthocyanins has increased immensely during the past decade because of its unique properties like its saturated absorption and properties like acylation of anthocyanins which lowers their apparent absorption.,etc…Some studies also show that anthocyanins may play an important role in health promotion in terms of obesity prevention,cardiovascular health,anti-inflammatory and anti-cancer effects.

The present review article will enable to understand that what is anthocyanin, origin and applications of anthocyanin, applications of anthocyanin, benefits of anthocyanin, extraction of anthocyanines, future of anthocyanins and purification of anthocyanins.

INTRODUCTION

Colouring of food is an old age practice and it is basically done in order to make food more attractive . Most of the consumers of food judge food on the basis of it's colour and appearance. Food colouring is basically done in order to correct natural variations in colour and to make up the colour loss due to light, air, temperature and moisture.

In the decade of sixty, synthetic colours such as azo dyes became highly popular owing to their low cost and easy availability. However subsequent toxicological evidences and adverse physiological effects of many such synthetic food colours such as allura red, erythrosine, tartrazine, sunset yellow, brilliant blue, indigo carmine, fast green which are the cause of actions like hyperactivity, lymphomas, chromosomal damage, thyroid tumors, brain tumors, allergies, aggression, eczema, bladder tumors and other adverse behaviourial effects. So, all these are the cause of the removal of these synthetic colours and also to be more likely banned in the near future also.

So because of these reasons, now the concentration is shifted towards additives(biocolours) which enjoys of being safe but it also have certain drawbacks like-

1. Biocolours do not have concentrated colours.
2. Biocolours are very much sensitive to heat.
3. Biocolours are basically unstable at low pH .
4. Biocolours have very short shelf life.
5. Biocolours using in large quantity may affect taste also.

So for countering these problems, additives has been made having anthocyanin because of its stability at low pH and high temperatures and also because of its antioxidant agent property which will improve the appearance as well as nutritional quality of the food.

WHAT IS ANTHOCYANIN?

Chemically, anthocyanins has originated from the greek anthos, a flower, and kyanos (dark blue).“ANTHOCYANIN” is basically the water soluble plant pigment or polyphenolic compound which is used as natural food colour in shades ranging from orange, red, pink, and purple to blue in most of the international food and beverage industries.

Anthocyanin is basically used as a food colorant in most of the beverages and food industries and also used in confectionaries and for fruit preparations. Depending on pH anthocyanins can be red, violet or blue. Many anthocyanins are red at acidic conditions and turn blue at less acid conditions.These pigments can be found in fruits,stems and leaves,and their levels may fluctuate. In plants one of the keyrole of anthocyanins is a form of sunblock. These dark pigments protect plant from sun damage and decrease the risk that a plant will be burned by hot sun.

Anthocyanins also act to attract pollinators by acting as bright flags which will be easy for birds, bees and other organisms to see,which is why many flowers are bright red in colour.

Origin and History of Anthocyanin

The first production of anthocyanins are took place in early 1970s in Chr. Hansen unit located on the outskirts of Montpellier right in the heart of the southern French vineyard.

Anthocyanin is a natural pigment found widely in nature from edible fruits and vegetables such as grapes, elderberry, red raddish, red cabbage, black currant and black carrot. Some other sources of anthocyanins are as follows-blackberry, blueberry, cherry, chokeberry, cranberry, orange, raspberry, redwine, red onions, strawberry, etc…..

These compounds are among a large family of compounds known as flavonoids. Anthocyanins are very complex and their activities in the body and in plants may be the result of interactions between several different chemicals, which makes it difficult to isolate specific compounds for study.

The first anthocyanins which were extracted came from grape skins, black currant skins and elderberry. Nature, primitive agriculture, and plant breeding have produced various uncommon crops containing anthocyanins including blue or red fleshed potatoes and purple or red broccoli, cabbage, cauliflower, carrots and corn. Tomatoes have been bred conventionally for high anthocyanin content by crossing wild relatives with the common tomato to transfer a gene called the anthocyanin fruit tomato gene into a larger and more palatable fruit. . Anthocyanins can also be found in naturally ripened olives, and are partly responsible for the red andpurple colours of some olives.

Common anthocyanin

some of the most common anthocyanins are as follows:

1. Delphinidin
2. Cyanidin
3. Petunidin
4. Pelargonidin
5. Peonidin
6. Malvidin

Sources of anthocyanin

Some of the major sources of anthocyanins are as follows:

1. Hibiscus
2. Roselle
3. Red radish
4. Grape skin
5. Purple potatoes
6. Purple carrots
7. Red cabbage
8. Elder berry

Stability of Anthocyanins

Anthocyanins are soluble in water and appropriate for coloring low pH systems. Capable of indicating pH by their shade in solution, anthocyanins exhibit various shades of yelloe-red to magenta below a pH of 3.8.For most anthocyanins, the lower the pH, the more intense and stable is the color. As the pH increases, the anthocyanins lose intensity and become bluer, at the expense of stability.

Each anthocyanin exhibits a different stability profile predominantly determined by the following factors:

1. The chemical structure of the anthocyanin
2. Other extracted compounds in the color product
3. The ingredients and processing used in the finished product
4. The finished product packaging and storage conditions.

As soluble colors, the strength of anthocyanins is characterized by absorbance. An E value is the absorbance value at the wavelength of maximum absorbance at pH=3, standardized to solution concentration of 1%.

Extraction of Anthocyanin

Anthocyanin, like flavonoids in general, have aromatic rings containing polar substituent groups (hydroxyl, carboxyl and methoxyl) and glycosyl residues that altogether produce a polar molecule. consequently they are more soluble in water than in non-polar solvents, but depending on the media conditions anthocyanins could be soluble in etherat a pH value where the molecule was unionized. These characteristics aid in the extraction and separation of anthocyanin compounds. Conventional methods of pigment extraction usually employ dilute hydrochloric acid in methanol. Methanol containing 0.001% HCl was the most effective, but HCl is corrosive, and methanol produces toxic effects after human exposition; consequently, food scientists frequently prefer the use of other extraction systems. Among other solvents, one finds ethanol and water, 80 and 27% effective as methanol, respectively. Additionally, it must be taken into account that aromatic acyl acid linkages are relatively stable in dilute dilute HCl/MeOH mixtures, but aliphatic dicarboxyl acyl groups (malonic, malic, oxalic) are susceptible to diluted acids, and different methodologies must be considered. It is recommended to use weaker acids (acetic,

formic, perchloric) during extraction and to monitor the acidity during the process. With methanol, citric acid is the most effective organic acid followed by tartaric, formic, acetic, and propionic; with water,the best acids are acetic acid, citric, tartaric, and hydrochloric. Recently, an aqueous extraction process for anthocyanins from sunflowers hulls was evaluated. It was shown that extraction with sulfurous water (1000 ppm SO2) was better than the traditional extraction with ethanol:acetic acid:water system. Also, it was mentioned that 1h of extraction was enough to reach a complete extraction of pigments. It was suggested that possible reasons for the improved extraction with SO2 are the interaction of anthocyanins with HSO3 ions, which improve the anthocyanin solubility and the diffusion through cell walls.

Applications of anthocyanin

There is a great application of anthocyanins in various food and beverages industries such as -

1. In soft drinks
2. In instant drinks
3. In fruit drinks
4. In liquors
5. In confectionary
6. In fruit jellies
7. In jams etc…

Separation of anthocyanins

The initial attempts for the separation of anthocyanins were based on the adsorption in paperchromatography or in other suitable adsorbents. Nowadays, thin layer chromatography (TLC) is widely used, because this technique has shown continuous innovations and still keeps its advantages (practical and very cheap). For preparative work, droplet counter current chromatography has been applied to separate the anthocyanins of blackcurrant. On the other hand, a general patent for the purification of anthocyanins involves selective absorption on a finely divided oxide such assilicic acid, titanium oxide, or alumina, which is coated with a styrene polymer.However, undoubtedly,the main developments of recent years in the research of anthocyanins is the introduction of HPLC for their separation and quantitation. Interestingly, it is possible to distinguish zwitter ionic anthocyanins by their HPLC chromatographic separation.

Anthocyanins role of benefits in using as additives

1. Anthocyanins are absorbed intact and absorption can be saturated.
2. Because of low pH stability of anthocyanins, the best possible use of anthocyanins as a colorant in acidic foods like beverages, jam, jellies etc…
3. Since anthocyanin is water soluble, so few of the anthocyanin can be used commercially in food products where water is the main solvent.
4. According to a 2009 research: A growing body of evidence suggests that anthocyanins may possess analgesic properties in addition to neuroprotective and anti-inflammatory activities.
5. In vitro, anthocyanins possess MAO inhibitory activity for both MAO-A and MAO-B. MAO function is connected to neuro degenerative diseases, depression, and anxiety.
6. Anthocyanins are potential antioxidants agent for use in food products and helps in stoppage of food reduction with oxygen and "going bad" , due to which appearance as well as nutitional quality of the food gets improved.
7. Anthocyanins also fluoresce, combined with their antioxidant properties, this can be a powerful tool for plant cell research, allowing living cell imaging for extended periods of time without a requirement for other fluorophores.
8. Anthocyanins have been credited with the capacity to modulate cognitive and motor function,to enhance memory and to have role in preventing age related declines in neural function.
9. Many students have shown a relationship between improved visual acuity with anthocyanin consumption.Visual acuity can be defined as sharpness of vision and is generally based on the snellen chart,where normal visual acuity is 20/20.
10. In a 2008 study from the 'Journal of Agricultural and Food Chemisry'researchers are found to believe that Anthocyanin fights obesity.The experiment found that mice that were fed an anthocyanin-enriched high-fat diet for eight weeks gained less weight than mice who were fed the same diet without anthocyanin.
11. Anthocyanins inhibiting growth of new blood vessels that nourish tumours,a process called angiogenesis.
12. Anthocyanins are also ameliorating environmental stresses induced by visible and UVB, radiation, drought and cold temperatures.

Major Organizations Involved in Commercial Production of Biocolurs with Anthocyanins are as follows

1. Chr. Hansen
2. Overseal Colour Inc.
3. Overseal Foods Ltd, UK

4. Bush Boake allen Co, USA
5. Burman Laboratories Pvt. Limited, India
6. Gist Brocades, The Netherlands

Obstacles in the path of understanding the effects of anthocyanins"

In most of the interventions of anthocyanins in human health,details on the mechanism of actions for bioactivity, uptake, absorption, bioavailability, whole body distribution and tissue localization are still not fully understood.Here are a few obstacles which comes in the path of understanding the effect of anthocyanins:

1. The inability of the scientist or medical practitioner to track metabolic progress of anthocyanins after injection.
2. Anthocyanins are highly susceptible to oxidation and degradation.
3. When speaking in terms of biological activity in the human body,an anthocyanin pigment is almost never acting independently.
4. Many of the classic phytochemical methods used to extract from plant tissues and fractional components can degrade and inactive anthocyanins,making it difficult to isolate.

Future of anthocyanins

Being polyphenols, attention has gathered on the possible health benefits of the anthocyanins in recent years. This feature of the pigment is likely to be increasingly used in future, both in functional foods and health food products.
Anthocyanins may play an important role in health promotion in terms of –

- Obesity prevention
- Cardiovascular health
- Anti-inflammatory
- Anti-cancer effects
- Visual acuity
- Alzheimer's disease
- Other age-related neurodegenerative disorders
- High blood cholesterol
- Bacterial infections
- Urinary tract infections

They are used as food additive with E number E163.
Medical researchers also has been examining the potential health benefits of having anthocyanin-enriched plant foods like berries included in the regular human diet.

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