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Extraction of anthocyanin from pomegranate and strawberry and it's application in food.

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Abstract

Many food, medication, and cosmetic items use natural color additives. Compounds that add color to a range of food sector items are responsible for up to 85% of consumer shopping decisions, which are undoubtedly impacted by color. First and foremost, this study sought to extract natural color from foods like strawberries and pomegranates. Second, the study of various hues under basic and acidic circumstances is the main goal of this effort. The impact of color on meals was investigated.

Key Words: extraction of natural color, pomegranate, strawberry, anthocyanin , acidic media, basic media.

1-Introduction

Food coloring compounds have been divided into two categories over the past century: natural and synthetic (Downham & Collins, 2000). Today, synthetic colorants are more commonly used in food than natural ones (Ferreira et al., 2015). Synthetic colorants are not only more affordable, but they also enhance the appearance of food, are more stable under sunlight, and have a longer shelf life (Scotter, 2009). Hundreds of artificial food colorings have been developed using naphthalene, a chemical derived from petroleum (Patel & Naik, 2024). Historically, natural colorants obtained from plants and minerals were widely used to color foods, medicines, and cosmetics (Hendrix & Houghton, 1996). It is believed that as early as 1500 BC, candy manufacturers in Egyptian cities used wine and natural substances to enhance the appearance of their confections (Burrows, 2009).Recently, there has been a growing interest in extracting natural colorants from alternative plant-based sources that are safe and may even offer health benefits. This shift is largely driven by consumers' increased awareness of the importance of a balanced diet (Das & Mishra, 2023). Natural colorants have become essential in industries such as food, cosmetics, and fashion due to their non

-toxicity, biodegradability, and typically gentler impact on both the environment and human health (Shishir & Chen, 2023). Whether used as fabric dyes or as substitutes for artificial food colorings, natural dyes represent a conscious return to our roots and a renewed connection with nature (Mapari et al., 2005). Given the growing importance of natura colorants, the current study focuses on obtaining natural colors from less hazardous plants and exploring their various applications (Future Market Insights, 2024).

2. The Theoretical Framework

According to their chemical structure, natural food coloring can be classified as *flavonoid*

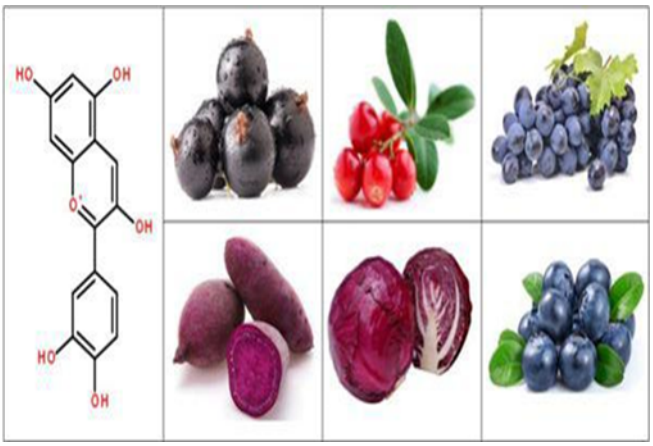


Figure 1. Some sources of anthocyanin and its structrure.

Plant pigments, such as anthocyanins and chlorophyll, are typically responsible for these hues. Fruits like blueberries, pomegranates, and strawberries contain pigments called anthocyanins that give them their red, purple, or blue hues. (Krebs & Heimer 2007). Anthocyanins could be a fascinating class of chemicals in light of this. Since they are present in a variety of fruits and vegetables, including pomegranates, red cabbage, black carrots, berries, beets, and grapes, they are safe to eat (Jimenez et al, 2020). Anthocyanin turns red in acidic. environments and blue in alkaline ones. Despite possessing a positive charge at the oxygen atom of the C-ring of the basic flavonoid structure, anthocyanin is one of the flavonoids. It is also known as the flavylium (2-phenylchromenylium) ion. Anthocyanins are potent antioxidants that help lower inflammation and guard against certain illnesses. (Laleh et al., 2006).The natural anthocyanin pigment was found in strawberries and pomegranates, which were selected as examples for complete our study.For multiple scientifically substantiated reasons, pomegranates and strawberries were chosen as prime examples of anthocyanin pigments: 1. A high level of anthocyanins Due to their high natural anthocyanin content, both fruits' vivid coloring is simple to see and evaluate. The qualities of the pigment can be effectively demonstrated because to its richness. 2. Color Vibrance and pH Sensitivit .New research has shown that the anthocyanin concentration of strawberry and pomegranate fruit, peel, and seeds vary. Pomegranate Seeds: In comparison to other fruit sections, the seeds have a comparatively modest anthocyanin content of 0.5–1.0%. While Pomegranate contains 1.0–2.5% of its dry weight in anthocyanins, which is a higher concentration by comparison with seeds. On thre other hand, Strawberries contain 2.0–3.5% of their dry weight, strawberries are rich in anthocyanins. citations ,. Anthocyanin Pigment was affected by many factors such as sun and conventional heat which causes oxidization and degrade to anothacyanin more quickly. This is because high temperatures weaken the pigment's stability, lowering its color and nutritional qualities (Opara, 2013)

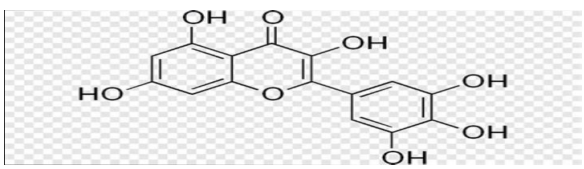


figure 2. Anthocyanin structure.

The primary drawback of anthocyanins Is

their incredibly low stability, which is readily affected by a number of factors, including sugars, vitamin C, oxygen levels, sulfur dioxide or sulfites, temperature, light, pH, relative humidity, co-pigments, enzymes (Chou ,2015). Anthocyanin is work as a potent antioxidant that shields cells from harm brought on by free radicals, it lowers the likelihood of developing chronic illnesses like cancer and heart disease. Additionally, because of its vivid hues, it serves as a defense signal against herbivores, helps shield plants from ultraviolet (UV) radiation, and draws pollinators. Consuming anthocyanins is linked to better vascular health and vision in people (Giust, 2020).

3.Methods of Research and the tools use.

Materials:

pomegranate peel, pomegranate seeds and strawberry as color extract. Water, Sodium hydroxide, ammonium hydroxide, sodium carbonate, hydrochloric acid, acetic acid and ferric chloride.
Yougurt, Muhalabi, Macroni, Flour and Rice as food.

Tools:

Burretes, hot plates, Test tubes , conical , filter paper , beakers , blender and center fusion.

Method:

Firstly, extraction of colour from pomegranate

a. Color extraction from pomegranate peel

The pomegranate peel was roasted in two different ways.
First way:
The pomegranate peel was roasted in the oven for an hour and ground, then water was added to it at room temperature for 12 hours to extract the color Then we lined it up using a piece of cloth.Prepared 4 test tubes and put extract color to examine different solutions as AcOH, HCl , NaOH , $FeCl_3$, NH_4OH and Na_2CO_3.
Second way :
The pomegranate peel was roasted in the sun for four days and ground then water was added to it at room temperature for 12 hours to extract the color Then we lined it up using a piece of cloth. Prepared 4 test tubes and put extract color to examine different solutions as AcOH, HCl , NaOH , $FeCl_3$, NH_4OH and Na_2CO_3.
b. Extracting color from pomegranate seeds
First, the seeds were ground using a blender without water and filtered by using a piece of cloth. Prepared 4 test tubes and put extract color to examine different solutions as AcOH, HCl , NaOH , $FeCl_3$, NH_4OH and Na_2CO_3 and The center fusion experiment was conducted and the color change was observed.
Secondly, Extracting color from strawberries
The strawberries were cut into small pieces and blended by blender without water. Prepared 4 test tubes and put extract color to examine different solutions as AcOH, HCl , NaOH , $FeCl_3$, NH_4OH and Na_2CO_3.

4.Results of Research

Table 1. Studying the effect of ferric chloride on extracted color from strawberry and Pomegranate.

Source of Extracted color	$Fecl_3$
Strawberry	Reddish brown
Pomegranate peel in the oven	Black red
Pomegranate peel in the sun	Black red
Pomegranate seeds	Rich red

Table 2. Studying the effect of different medium on extracted color from strawberry and Pomegranate

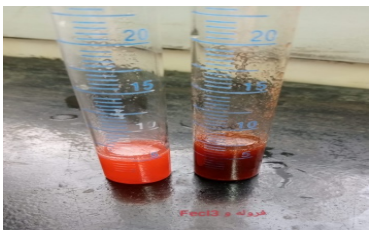


Figure 3.Strawberry colour with $Fecl_3$

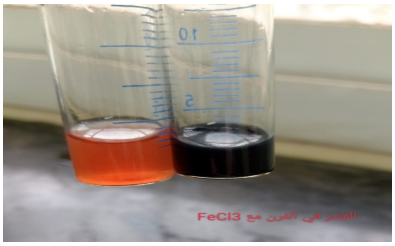


Figure 4. Pomegranate peel in the oven with $Fecl_3$

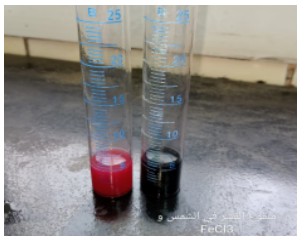


Figure 5.Pomegranate peel in the sun withFecl₃

Figure 6. Pomegranate seeds with Fecl₃

Source of Extracted color	Neutral (water)	Acid (AcOH)	Acid (Hcl)	Base (Na_2CO_3)	Base (NH_4OH)	Base (NaOH)
Strawberry	Red	light red	Orange	Deep red	Blood red	Yellow
Pomegranate peel in the oven	Light red	Red	Reddish orange	Black	Reddish orange	Rich red
Pomegranate peel in the sun	Red	light red	Light red	Reddish brown	Reddish brown	Reddish brown
Pomegranate seeds	Rosy	Red	red	Reddish Brown	Orange	Reddish orange

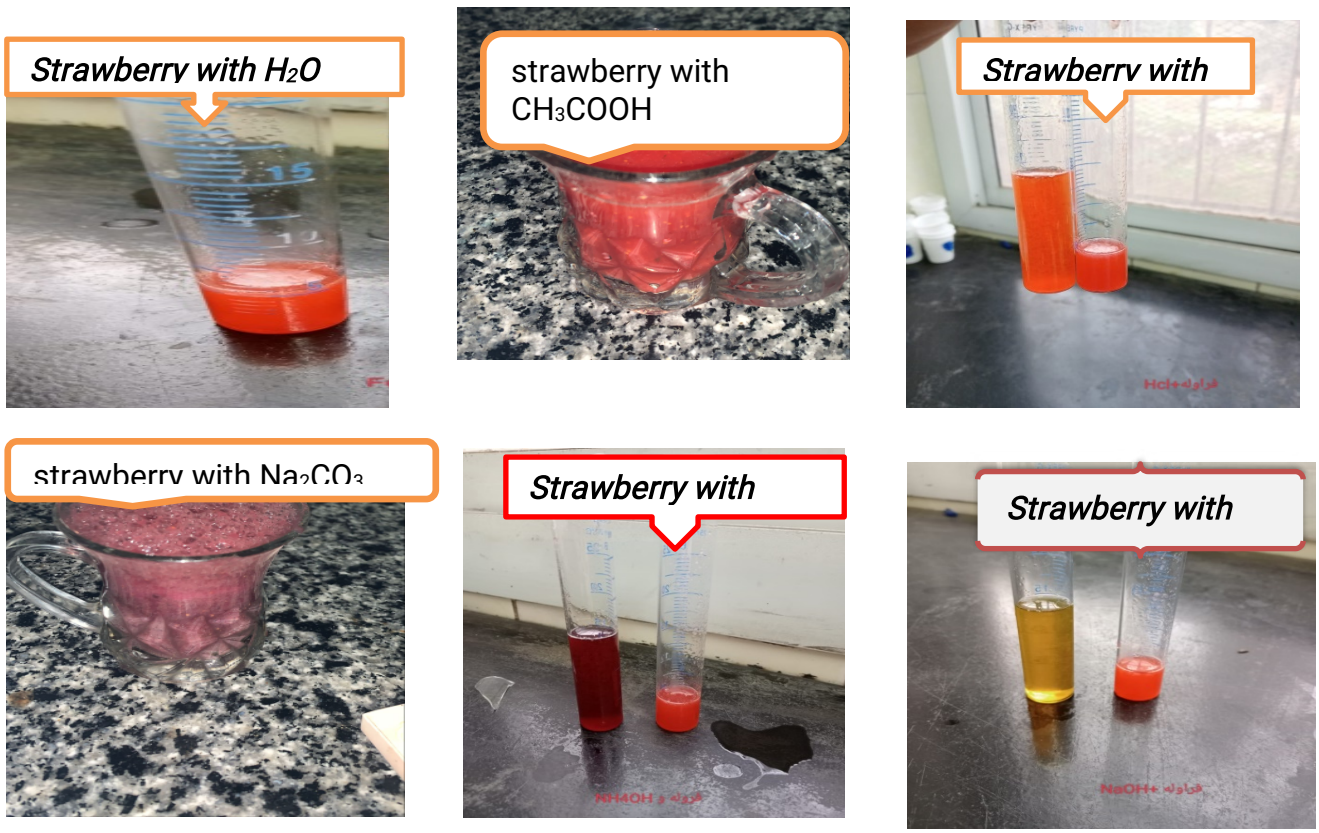


Figure 7. The effect of acidic and basic media in anthocyanin color of strawbarry

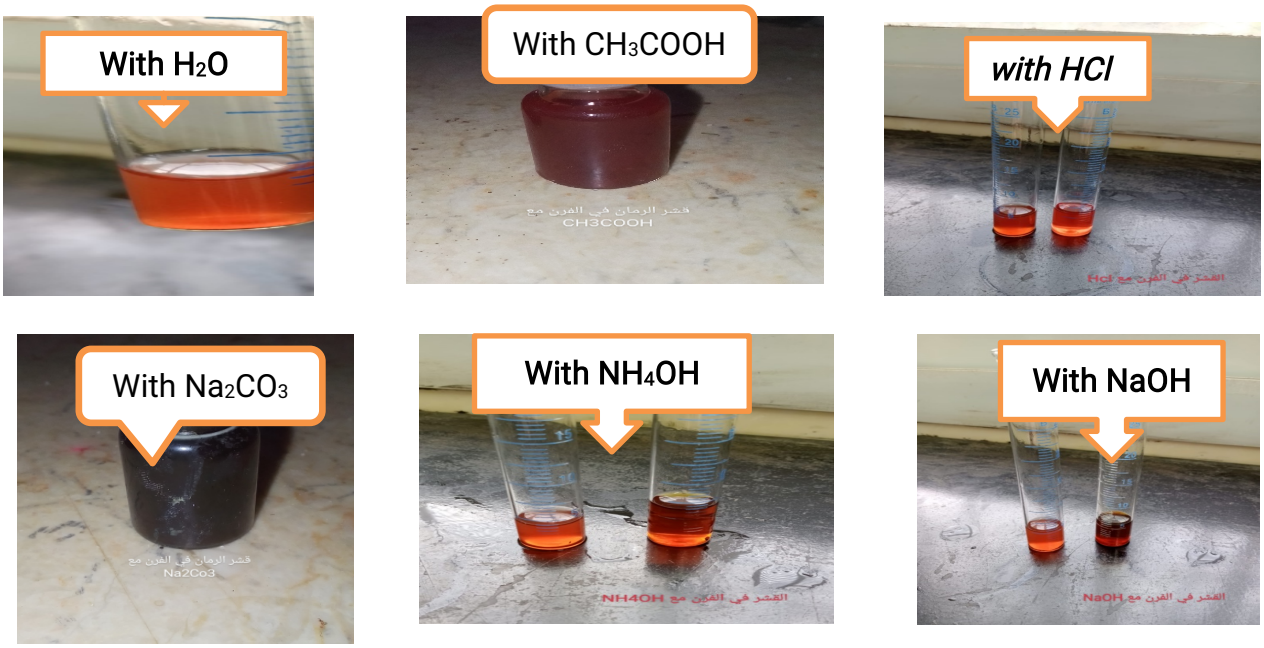


Figure 8. The effect of acidic and basic media in anthocyanin color of Pomegranate peel in the oven.

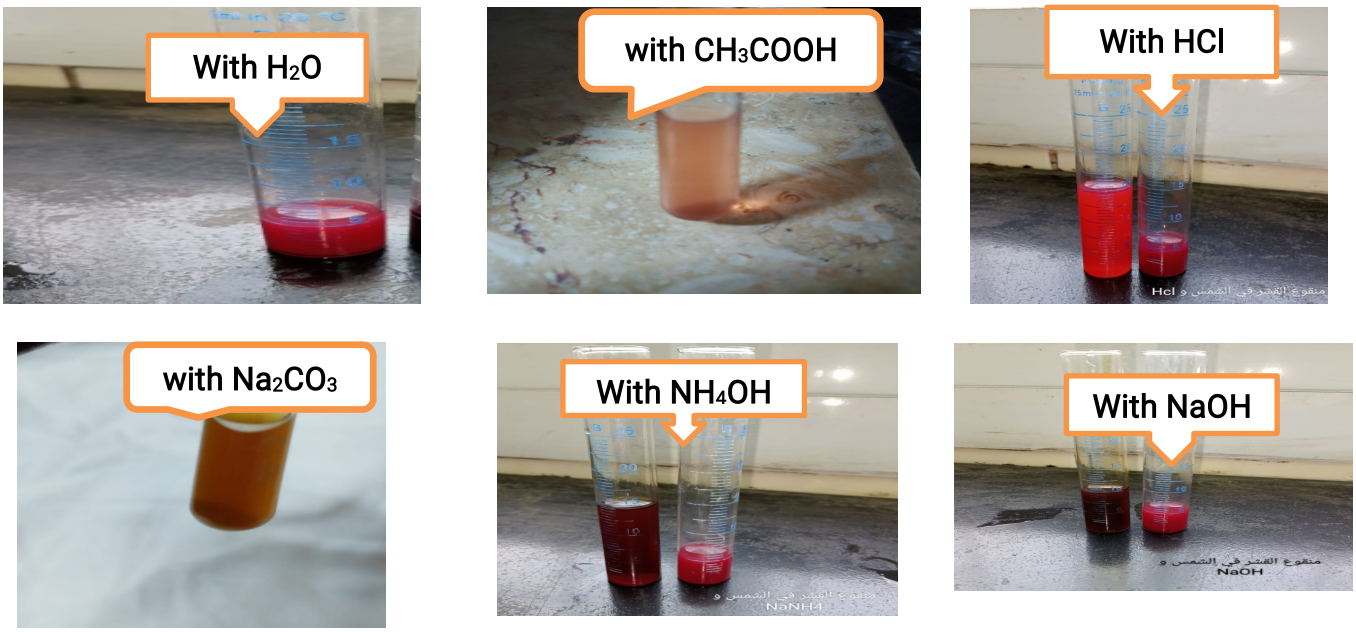
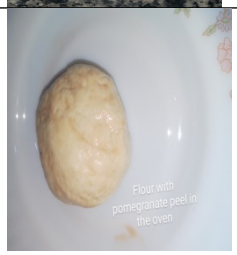
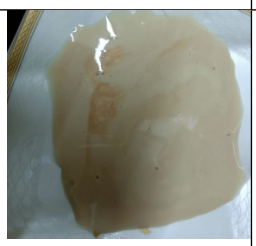
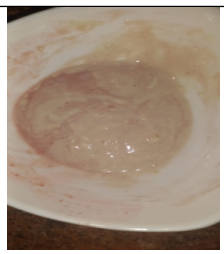


Figure 9. The effect of acidic and basic media in anthocyanin color of Pomegranate peel in the sun

Figure 10. The effect of acidic and basic media in anthocyanin color of Pomegranate Seeds

Table 3. Applications of anthocyanin in food.

Source of Extracted color	macaroni	yogurt	muhalabi	Flour	rice
Strawberry					
Pomegranate peel in the oven					
Pomegranate peel in the sun					
Pomegranate seeds					

5. Interpretation of Result

According to food industry and green chemistry, Water is used as the extraction solvent in our color extraction process, despite its low yield, but it is safe environmentally. The existence of Anthocyanin color was confirmed by using ferric chloride. From our results in table(1) and (fig3,4,5,6.)the color showed reddish brown with strawberry and black red with pomegranate. This confirms the presence of flavonoid structure due to formation of colored metal complex (fig3,5.)The Impact of pH is an important parameter that is reached, it has an impact on the color of anthocyanins because of the ionic nature of the molecular structure.

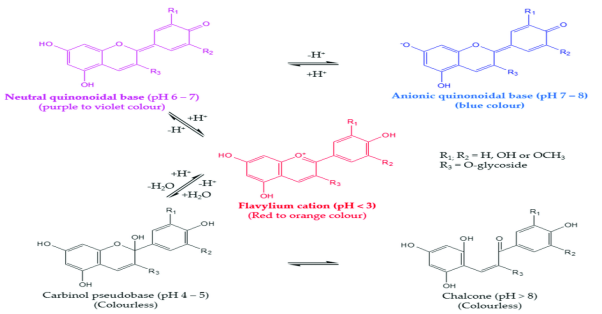


figure 11.Affect of PH on anthocyanin color.

Four distinct chemical forms of anthocyanins are known to exist, and they are contingent upon the pH of the solution. In acidic media using hydrochloricu acid and acetic acid (table 2.), anthocyanins exist in the flavylium cation form, which is highly conjugated and absorbs light in the red region in strawberry (fig 7)and Pomegranate (figure8). The structure remains stable due to the presence of positive charges (Brouillard, 1982). On the other hand, in basic media as sodium carbonate and ammonium(table2), It was observed that the intensity of red color decrease due to deprotonation of the quinonoidal base occurs, enhancing resonance structures that shift absorption(figure8) ,(Mazza, 1993). But in case of sodium hydroxide as strong base (tabl2.), anthocyanins degrade into chalcone structures, which can be colorless or yellow, depending on further breakdown(figure 9)(.Jorge, J., et al, 2019).he results from these data, strawberry and Pomegranate can use as source of anthocyanin as natural food color Impact on Anthocyanin Pigment of Sun Drying and Conventional Heat Drying on pomegranate peel in oven and sun showed that extensive exposure to sunshine and high temperatures causes anthocyanins to oxidize and degrade more quickly, which results in a considerable loss of anthocyanin This is because high temperatures weaken the pigment's stability, lowering its color and nutritional qualities.(Opara, U. L,2013). (Chou, 2015).Also,the health benefits of on human that takes our main attention to apply these natural colors on food such as yogurt, cheese, rice, starch and flour as shown in table (3)

6. conclusion

We concluded that the color of strawberry and permanganate changed in acidic and basic media due to transformation in anthocyanin structure. Also, extensive exposure to sunshine and high temperatures causes anthocyanins to oxidize and degrade . moreover, it was found that natural color affects food as yogurt, cheese, rice, starch and flour as shown in table (3).

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